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PhD RESEARCH THESIS

"Socio-technical energy transitions and the tourist industry: Steering to sustainable development"

Konstantinos G. Vattes

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ΕΘΝΙΚΟ ΚΑΙ ΚΑΠΟΔΙΣΤΡΙΑΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

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ΤΜΗΜΑ ΙΣΤΟΡΙΑΣ ΚΑΙ ΦΙΛΟΣΟΦΙΑΣ ΤΗΣ ΕΠΙΣΤΗΜΗΣ

ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ

ΔΙΔΑΚΤΟΡΙΚΗ ΔΙΑΤΡΙΒΗ

«Κοινωνικο-τεχνικές ενεργειακές μεταβάσεις και η τουριστική βιομηχανία: Προς μια βιώσιμη ανάπτυξη»

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Abstract

This research thesis aims at steering an energy transition also including the tourist industry so that the latter can be directed to sustainable development. In answer to this aim, this thesis' main objectives revolve around developing a hybrid model for sustainable socio-technical transitions that integrates governance and local engagement approaches and to run five energy transition scenarios, including, in the empirical case of Chios, the tourism sector. The research is theoretically based on the deep transitions concept (Schot and Kagner, 2018; Kagner and Schot, 2019), which is perceived as parallel connected transitions of a number of socio-technical (s-t) systems in the direction of sustainable development. Based on this view, it is argued that turning tourism to sustainable development requires participating in technological transformations in a series of s-t systems such as energy, transportation, water, waste as well as other ones which are related to and are affected by tourism. Nevertheless, in this research thesis, I focus on the energy transition issue, considering that the tourism sector will be included in the core of this complicated and deep socio-technical transformation.

Relying on this analysis, this work is divided into five main chapters. The first two set the theoretical framework, establishing the hybrid model which has been used as a theoretical tool. The third chapter presents the two exemplary cases regarding nested energy transitions in North Europe, while the last two refer to the empirical case, where a deep energy transition including the tourism sector in Chios is aspired to be steered. More precisely, the first chapter's main objective is to review sustainability literature on tourism studies and social sciences, delimit the vague and ambivalent sustainable development concept (Geels et al, 2017; Newig et al, 2007; Walker and Shove, 2007) according to the needs of this research thesis and partially set the framework steering the energy transition. The second chapter’s target is to review literature and, through this, to highlight the way social sciences perceive energy transitions and how the latter are related to vital environmental issues. In doing so, a critical review of the Multi-Level Perspective (MLP) model is illustrated, while other transition approaches are depicted so that an enriched hybrid approach will be developed. The third chapter illustrates the two exemplary cases of nested transitions of North Europe, where an energy transformation has already started since the mid to late 90s, affecting tourism in a positive way. Thus, it presents the case of Samso deciding an energy transition after winning a state competition and that of Gotland embracing energy transition, following the state issuing directions to its regions to do so. These transitions will be analyzed with the help of the hybrid model established in the previous chapter. Through this analysis, the different actors, their dynamics and the users’ importance can be identified, while it will also facilitate my transition to the empirical case by inspiring me in regard to issues of the institutional framework developed, the technologies used and the actors established. The fourth chapter presents a socio-technical analysis of the national electricity regime as well as of the Chian nested energy regime. Additionally, performing a deep transition requires evaluating tourism as well as other interrelated s-t regimes like the transportation one;

hence, an analysis of those regimes in the local level in tandem with the electricity regime will take place. The fifth chapter steers an energy transition in the empirical case. The transition process follows the logic of different pathways (Foxon et al, 2013), resulting in social and technical alterations; building on this, five different scenarios of deep energy transitions including tourism will be presented, in a 30-year horizon. Consequently, the scenarios of “flourish of renewables”, the “gas emergence”, the “linkage with the neighbors”, the “continental solution to the motherland” and the “interconnection with others” are illustrated. Different scenarios declare a divergence in the transition's starting point, the local engagement level and technological decisions.

These final points are important issues also relating to what this research can contribute. Hence, local engagement in the transition process, albeit in a fully coordinated top down transition, is a central objective. Developing a local steering actor as a way to facilitate local engagement and accelerate energy transitions in frameworks with a political culture similar with the Greek one, where innovative institutional contexts and mature technologies don't seem to be adequate in achieving transforming the energy sector, is another core issue highlighted in this work. A third issue is that this research focuses on the significance of technologies in the transition pathways that will be followed. Influenced by the STS analysis, the methodological hybrid approach, which is used in this research, draws attention to the fact that different technologies involve different actors exerting other pace of power, namely changing the power relations in the process, while further, these infrastructures have divergent dynamic (agency) ultimately resulting in alternative s-t transition pathways. Finally, this research thesis also contributes to enriching relevant literature of sustainable development on tourism, by proposing a new perception in the way Tourist Studies perceive and approach sustainable development on tourism.

Subject Area: Sustainable Transitions/ Energy Policy/ Regional development

Key words: socio-technical energy transitions, governance, sustainable development, sustainable tourism development, social engagement, deep transitions, regional sustainable development, tourism governance.

Περίληψη

Σκοπός αυτής της διδακτορικής διατριβής είναι να καθοδηγήσει μία ενεργειακή μετάβαση που θα συμπεριλαμβάνει και την τουριστική βιομηχανία, έτσι ώστε η τελευταία να κατευθυνθεί προς τη βιώσιμη ανάπτυξη. Για την επίτευξη αυτού του σκοπού, οι κύριοι στόχοι της είναι η δημιουργία ενός υβριδικού μοντέλου για βιώσιμες κοινωνικό-τεχνικές μεταβάσεις, το οποίο θα ενσωματώνει προσεγγίσεις διακυβέρνησης (governance) και εμπλοκής της τοπικής κοινωνίας καθώς και η ανάπτυξη πέντε σεναρίων ενεργειακών μεταβάσεων που θα περιλαμβάνουν και τον τουρισμό στην εμπειρική περίπτωση της έρευνας, τη Χίο. Το παρόν πόνημα βασίζεται στην έννοια των βαθέων μεταβάσεων (deep transitions) (Schot and Kagner, 2018; Kagner and Schot, 2019). Η έννοια αναφέρεται σε παράλληλες αλληλοσυνδεόμενες μεταβάσεις ενός αριθμού κοινωνικο-τεχνικών (κ-τ) συστημάτων προς την κατεύθυνση της βιώσιμης ανάπτυξης. Έτσι, γίνεται κατανοητό ότι η βιώσιμη ανάπτυξη του τουριστικού τομέα απαιτεί την εμπλοκή του σε μία σειρά από τεχνολογικούς μετασχηματισμούς ενός μεγάλου αριθμού κομβικών κ-τ συστημάτων, όπως αυτά της ενέργειας, των μεταφορών, του νερού και των απορριμμάτων, καθώς και άλλων τα οποία διασυνδέονται με τον τουρισμό και επηρεάζονται από αυτόν. Σε αυτήν τη διδακτορική έρευνα έχει επιλεχθεί η εστίαση στην ενεργειακή κ-τ μετάβαση, ως η πλέον σημαντική από τους παραπάνω αναφερόμενους μετασχηματισμούς, εμπλέκοντας και τον τουρισμό σε αυτήν την πολύπλοκη κ-τ αλλαγή.

Για την υποστήριξη αυτών των στόχων, το παρόν πόνημα περιλαμβάνει πέντε κύρια κεφάλαια. Τα δύο πρώτα αναπτύσσουν το θεωρητικό πλαίσιο, δημιουργώντας το υβριδικό μοντέλο που θα χρησιμοποιηθεί σαν μεθοδολογικό και θεωρητικό εργαλείο. Το τρίτο παρουσιάζει δύο υποδειγματικές περιπτώσεις τοπικών (nested) ενεργειακών μεταβάσεων από τη Βόρεια Ευρώπη, ενώ τα δύο τελευταία αναφέρονται στην εμπειρική περίπτωση, όπου γίνεται προσπάθεια καθοδήγησης μιας βαθειάς ενεργειακής μετάβασης που θα περιλαμβάνει και τον τουριστικό κλάδο στη Χίο. Πιο συγκεκριμένα, στόχος του πρώτου κεφαλαίου είναι η επισκόπηση της βιβλιογραφίας αναφορικά με τη βιώσιμη ανάπτυξη στον τουρισμό και στις κοινωνικές επιστήμες, και μέσω αυτής, η οριοθέτηση της ασαφούς και αμφίσημης έννοιας της βιώσιμης ανάπτυξης (Geels et al, 2017; Newig et al, 2007; Walker and Shove, 2007) με βάση τις ανάγκες της παρούσας διδακτορικής διατριβής, θέτοντας επιπλέον μερικώς το θεωρητικό πλαίσιο. Αντίστοιχα, το δεύτερο κεφάλαιο έχει ως στόχο την επισκόπηση προσεγγίσεων του πεδίου των Σπουδών στις Βιώσιμες Μεταβάσεις (Sustainable Transition Studies), μέσω της οποίας επισημαίνεται ο τρόπος που οι κοινωνικές επιστήμες νοηματοδοτούν τις ενεργειακές μεταβάσεις, καθώς και η σύνδεσή τους με εξαιρετικής σημασίας περιβαλλοντικά ζητήματα. Έτσι, παρουσιάζεται μία κριτική επισκόπηση του μοντέλου των Πολύ-Επίπεδων Οπτικών (MLP) και άλλων προσεγγίσεων του πεδίου, με τη βοήθεια των οποίων δημιουργείται το υβριδικό μοντέλο. Στο τρίτο κεφάλαιο, αναλύονται οι δύο υποδειγματικές περιπτώσεις νησιωτικών περιοχών, αυτές του δανέζικου Σάμσο και του σουηδικού Γκόντλαντ, στις οποίες ενεργειακές μεταβάσεις έχουν ξεκινήσει ήδη από τη δεκαετία του 90, επηρεάζοντας παράλληλα με θετικό τρόπο και τον τουρισμό τους. Αυτές οι μελέτες περίπτωσης αναλύονται με τη βοήθεια του υβριδικού μοντέλου που δημιουργήθηκε στο προηγούμενο κεφάλαιο, έτσι ώστε να καθοριστούν οι διαφορετικοί δρώντες, η δυναμική τους και η σημαντικότητα των χρηστών, ενώ παράλληλα να διευκολυνθεί η ανάλυση στην εμπειρική περίπτωση, καταθέτοντας προτάσεις για την ανάπτυξη θεσμικών πλαισίων, τη χρήση τεχνολογιών και τη δημιουργία σημαντικών δρώντων.

Το τέταρτο κεφάλαιο παρουσιάζει μία κ-τ ανάλυση του εθνικού ηλεκτρικού καθεστώτος (national electricity regime) καθώς και του τοπικού καθεστώτος της Χίου. Επιπρόσθετα, πραγματοποιείται η αποτίμηση του τουριστικού κλάδου καθώς και άλλων αλληλοσυνδεόμενων καθεστώτων –όπως αυτού των μεταφορών εντός του νησιού– στο τοπικό επίπεδο. Το πέμπτο κεφάλαιο καθοδηγεί μία ενεργειακή μετάβαση στην περίπτωση της Χίου. Η μετάβαση ακολουθεί τη λογική των διαφορετικών μονοπατιών (pathways) (Foxon et al, 2013), παρουσιάζοντας πέντε διαφορετικά σενάρια ενεργειακών μεταβάσεων που συμπεριλαμβάνουν και τον τουρισμό, σε έναν χρονικό ορίζοντα τριάντα χρόνων. Τα διαφορετικά σενάρια είναι το «flourish of renewables», το «gas emergence», το «linkage with the neighbors», το «continental solution to the motherland» και το «interconnection with others», τα οποία υποδηλώνουν διαφορετικότητα στη στιγμή εκκίνησης της μετάβασης, στο επίπεδο τοπικής συμμετοχής σε αυτήν και τη χρήση εναλλακτικών τεχνολογιών.

Τα τελευταία αυτά χαρακτηριστικά σχετίζονται επιπλέον με την κύρια συνεισφορά της παρούσας διδακτορικής διατριβής. Έτσι, η τοπική εμπλοκή στη μετάβαση είναι κύριο ζητούμενο αυτής της έρευνας, αν και προσεγγίζεται σαν μία από τα πάνω και πλήρως συντονισμένη διαδικασία. Επιπρόσθετα, η δημιουργία ενός ενδιάμεσου δρώντα καθοδηγητή της μετάβασης, σαν ένα εργαλείο που συμβάλλει στην εμπλοκή της τοπικής κοινωνίας και την επιτάχυνση της διαδικασίας, αποτελεί ένα άλλο κρίσιμο στοιχείο που τονίζεται ως αναγκαίο σε περιβάλλοντα με μια πολιτική κουλτούρα όπως αυτή της Ελλάδας. Ένα τρίτο σημαντικό στοιχείο αποτελεί η εστίαση της έρευνας στην επιλογή της τεχνολογίας ως παράγοντα που καθορίζει το μονοπάτι μετάβασης που θα ακολουθηθεί. Λόγω της επιρροής που ασκούν οι οπτικές του πεδίου STS[1], η έμφαση δίνεται στο γεγονός ότι οι διαφορετικές τεχνολογίες περιλαμβάνουν και διαφορετικούς δρώντες, αλλάζοντας με αυτόν τον τρόπο τις σχέσεις δύναμης σε μια διαδικασία μετάβασης, ενώ επιπρόσθετα εναλλακτικές υποδομές έχουν άλλη δυναμική (agency), με τελική απόρροια την αλλαγή του μονοπατιού της μετάβασης. Τέλος, η παρούσα έρευνα συνεισφέρει στη βιβλιογραφία της βιώσιμης ανάπτυξης του τουρισμού, προτείνοντας μια νέα οπτική στον τρόπο που οι Επιστήμες του Τουρισμού τη νοηματοδοτούν και την προσεγγίζουν.

Θεματική Περιοχή: Ενεργειακές μεταβάσεις/ Ενεργειακή πολιτική/ Περιφερειακή ανάπτυξη.

Λέξεις Κλειδιά: κοινωνικο-τεχνικές ενεργειακές μεταβάσεις, διακυβέρνηση, βιώσιμη ανάπτυξη, βιώσιμη τουριστική ανάπτυξη, κοινωνική συμμετοχή, βαθειά μετάβαση, περιφερειακή βιώσιμη ανάπτυξη, τουριστική διακυβέρνηση.

[1] Το πεδίο Επιστήμη-Τεχνολογία-Κοινωνία (STS) αντιλαμβάνεται την τεχνολογία ως κοινωνικο-τεχνική, εστιάζονται μεταξύ άλλων στο ότι μέσω του σχεδιασμού της και των υποδομών της αποκτάει δυναμική και κατά μία έννοια κάνει πολιτική. Το μοντέλο MLP, που σε μεγάλο βαθμό χρησιμοποιείται σε αυτήν την έρευνα, υιοθετεί αυτήν την αντίληψη του πεδίου Επιστήμη-Τεχνολογία-Κοινωνία.

Στην Άννα, για τις θυσίες,

την φυσική και ψυχική της

υποστήριξη όλα αυτά τα

χρόνια…..

και στο γιο μου Αχιλλέα.

Ευχαριστίες

Σε μια πολύχρονη έρευνα όπως η συγκεκριμένη ο φόβος να ξεχάσεις κάποιον/ους από τους ανθρώπους που συνέβαλαν με διάφορους τρόπους στην υλοποίησή της είναι δυστυχώς αρκετά μεγάλος. Όπως και να έχει, η ολοκλήρωσή της θα ήταν αδύνατη χωρίς τη βοήθειά τους. Θα ήθελα λοιπόν αρχικά να ευχαριστήσω για τη βοήθειά τους, τους ανθρώπους και τους φορείς που δέχθηκαν να μου δώσουν συνεντεύξεις. Ιδιαίτερα θα ήθελα να ευχαριστήσω τους κυρίους Jesper Roug Kristensen και Jan Jatzen από την Ακαδημία Ενέργειας του Σάμσο (Samso Energy Academy) και την κυρία Hellena Anderson από την Περιφέρεια του Γκοτλαντ (Region of Gotland) για την καθοδήγησή τους και τις χρήσιμες πληροφορίες που μου παρείχαν, καθώς και όσους άλλους με βοήθησαν με τις πληροφορίες τους. Επίσης θα ήθελα να ευχαριστήσω τον καθηγητή του Πανεπιστημίου του Μάαστριχτ Vincent Lagendijk για τις αναλυτικές και χρήσιμες παρατηρήσεις του στα κεφάλαια που του έστειλα. Θα ήθελα επίσης να ευχαριστήσω θερμά μια σειρά συναδέλφων του τμήματος, και κυρίως αυτούς που συμμετείχαν στις ομάδες ανάγνωσης, για τις πολύ χρήσιμες παρατηρήσεις τους στις παρουσιάσεις που έκανα. Ιδιαίτερα θα ήθελα να ευχαριστήσω την κυρία Δήμητρα Μπαρκούτα και τους κυρίους Γιάννη Φωτόπουλο και Serkan Karas.

Τέλος, ιδιαίτερα θα ήθελα να ευχαριστήσω τον καθηγητή Στάθη Αραποστάθη για την υποστήριξη, την καθοδήγηση, τις εποικοδομητικές συζητήσεις και την υπομονή που επέδειξε καθόλη την περίοδο της συνεργασίας μας· ο ρόλος του ήταν καθοριστικός για τη σημερινή μου αντίληψη σε ζητήματα ενεργειακής πολιτικής και μεταβάσεων. Επιπρόσθετα, θα ήθελα να ευχαριστήσω από καρδιάς τον καθηγητή Αριστοτέλη Τύμπα, καθώς όχι μόνον υπήρξε ο εμπνευστής της αρχικής ερευνητικής ιδέας αλλά μου παρείχε αφειδώς γενικότερη ακαδημαϊκή υποστήριξη όλα αυτά τα χρόνια. Ένα ευχαριστώ οφείλω επίσης στον καθηγητή Θεόδωρο Σταυρινούδη για τις υποδείξεις του σε ζητήματα τουρισμού, καθώς και στην υπόλοιπη επταμελή εξεταστική επιτροπή για τις γόνιμες συμβουλές και επισημάνσεις τους, και ειδικότερα στους κυρίους Καλογήρου, Αραμπατζή και Σταμπουλή για την επισήμανση ανάγκης παρουσίασης της συμβολής της διατριβής μου από το εισαγωγικό της ακόμα μέρος και δημιουργίας ενότητας που να αναφέρεται στις πολιτικές επιπτώσεις (policy implications) του υβριδικού μοντέλου που χρησιμοποίησα καθώς και των σεναρίων μου, και στους κυρίους Γκότση και Σταμπουλή για την παρατήρηση σχετικά με τη

χρήση του όρου «situated rationality» αντί του όρου «bounded rationality», που είχα αρχικά χρησιμοποιήσει ως περισσότερο δόκιμο στην περίπτωση της έρευνάς μου.

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List of Publications

1. Vattes K. and Arapostathis St., (2019), "Nested transitions and the significance of localities", Environmental Innovations and Societal Transition, (work in progress).

2. Vattes K, Barkouta D and Arapostathis St, "Beyond Tensions: Governance, Local Movements and the Energy Transitions in the Greek Islands", 17th STS Conference Graz 2018.

3. Papazafeiropoulou A.S., Schipper F. and Vattes K., "Gazing at the West. The transnational orientations of Balkan mobility infrastructure during 1950 – 1960", in 8th Tensions of Europe Conference, Athens, Greece (September 7-10 of 2017).

4. Papazafeiropoulou A.S., Vattes K. and Zacharopoulou K., (2016), "Technology and the Industry of Pleasure and Experiences: Transportation and the Technical Reconstruction of Postwar Greece as a Tourist Destination" in History of Technology, Volume 33, 2017.

Συνοπτική Παρουσίαση

Στην παράδοση του πεδίου Επιστήμη-Τεχνολογία-Κοινωνία (Science, Technology and Society), καθώς και αυτού των Επιστημών των Βιώσιμων Μεταβάσεων (Sustainable Transition Studies), υπάρχουν οπτικές που κατανοούν τους τεχνολογικούς μετασχηματισμούς ως κοινωνικές και τεχνολογικές, μακροχρόνιες, εξελικτικές διαδικασίες αλλαγής ενός συστήματος ή μιας πλειάδας εμπλεκόμενων συστημάτων, γνωστές στη σχετική βιβλιογραφία ως βαθιές μεταβάσεις[2] (deep transitions) (Schot and Kagner, 2018). Τα παραπάνω πεδία, επιπρόσθετα, κατανοούν τη βιώσιμη ανάπτυξη ως μια διαδικασία τεχνολογικού μετασχηματισμού. Το παρόν πόνημα βασίζεται σε αυτές τις οπτικές, επιχειρηματολογώντας για την ανάγκη επίτευξης μιας ενεργειακής μετάβασης που να περιλαμβάνει και την τουριστική βιομηχανία –και υπό αυτήν την έννοια πρόκειται για βαθιά μετάβαση–, έτσι ώστε να κατευθύνει την τελευταία σε πιο βιώσιμα μονοπάτια.

Μεταξύ των διαφόρων τεχνολογικών συστημάτων, η ενέργεια αποτελεί μια από τις αναγκαίες προϋποθέσεις των βιομηχανικών κοινωνιών για την επίτευξη του παρόντος τρόπου ζωής (Hutton, 1998:24). Στο ίδιο μήκος κύματος, η παραγωγή και χρήση τεράστιων ποσοτήτων ενέργειας απαιτείται για την συνέχιση των σύγχρονων πρακτικών σε μεγάλο αριθμό ενεργοβόρων κλάδων. Ένα τέτοιος κλάδος με πολύ μεγάλο περιβαλλοντικό αποτύπωμα είναι και ο τουριστικός (Gossling, 2013; Scott et al, 2016). Υπό αυτήν την έννοια, η στροφή του τουριστικού κλάδου προς τη βιώσιμη ανάπτυξη απαιτεί αλλαγή στις κοινωνικές πρακτικές παραγωγής και κατανάλωσης του κλάδου πρωτίστως σε ζητήματα ενέργειας. Κάτω από αυτό το πρίσμα, η παρούσα ερευνητική διατριβή διαμορφώνει το κατάλληλο θεωρητικό και μεθοδολογικό πλαίσιο πραγματοποίησης ενεργειακών μετασχηματισμών που ενσωματώνουν και την τουριστική βιομηχανία με τη χρήση μελετών περίπτωσης σε μια ανάλυση πέντε κύριων κεφαλαίων. Ο σκοπός και οι κύριοι στόχοι της έρευνας αυτής παρουσιάζονται στη συνέχεια.

Σκοπός και Στόχοι

Ο σκοπός της έρευνας αυτής είναι η πραγματοποίηση μιας βαθιάς ενεργειακής μετάβασης που να περιλαμβάνει και τον τουρισμό, έτσι ώστε αυτός να οδηγηθεί προς τη βιώσιμη ανάπτυξη. Για την επίτευξη του παραπάνω σκοπού, δημιουργείται ένα υβριδικό μοντέλο πραγματοποίησης βιώσιμων κοινωνικο-τεχνικών μεταβάσεων, κάνοντας χρήση της σχετικής βιβλιογραφίας, ενσωματώνοντας προσεγγίσεις διακυβέρνησης (governance) και τοπικής συμμετοχής (local engagement), με τη χρήση του οποίου εκτελούνται πέντε σενάρια ενεργειακών μεταβάσεων που περιλαμβάνουν και τον τουρισμό, στην εμπειρική περίπτωση της έρευνας, αυτή της Χίου. Η Χίος, εξαιτίας διάφορων γνωρισμάτων της, μπορεί να πραγματοποιήσει

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[2] Η σχετική έννοια, η οποία έχει ξαναδημιουργηθεί πολύ πρόσφατα, αναφέρεται σε μια σειρά μετασχηματισμών κοινωνικο-τεχνικών (κ-τ) συστημάτων όπως αυτού των μεταφορών, της ενέργειας, της διατροφής, της ενδιαίτησης, των επικοινωνιών κ.ά. προς την ίδια κατεύθυνση κατά τα τελευταία 200-250 χρόνια (Schot and Kagner, 2018.). Με άλλα λόγια, η οπτική αυτή βασίζεται στη μακροχρόνια εξάρτηση πλήθους κ-τ συστημάτων που ενίσχυσαν τη βιομηχανική νεοτερικότητα (Kagner and Schot, 2019).

ευκολότερα μια βαθιά ενεργειακή μετάβαση που να επηρεάσει θετικά τον τοπικό τουριστικό κλάδο αλλά και το νησί στο σύνολό του. Βέβαια, μια ολοκληρωμένη βαθιά ενεργειακή μετάβαση θα περιλάμβανε αλλαγές σε μια σειρά άλλων κ-τ συστημάτων, πέρα από αυτού της ενέργειας, όπως σε αυτά των μεταφορών, της ύδρευσης και των απορριμμάτων που σχετίζονται και αλληλεπιδρούν με τον τουριστικό κλάδο. Παρόλα αυτά, το παρόν πόνημα εστιάζει στην ενεργειακή μετάβαση –σαν την πλέον κομβική αλλαγή προς την βιώσιμη ανάπτυξη–, εμπλέκοντας και την τουριστική βιομηχανία σε αυτήν τη βαθιά και πολύπλοκη κ-τ διαδικασία. Από την άλλη πλευρά, θεωρώ ότι οπτικές ενεργειακού μετασχηματισμού που περιλαμβάνουν μόνο τον τουριστικό κλάδο συνδέονται μόνο με την τελική χρήση των τεχνολογιών και αποτυγχάνουν να αντιληφθούν και να αποτιμήσουν αποτελέσματα αλλαγών που βλέπουν ολόκληρη την αλυσίδα της ενεργειακής παραγωγής. Κατά αυτήν την άποψη, μια ενεργειακή μετάβαση που ενσωματώνει και το τουριστικό κ-τ σύστημα, μπορεί να επηρεάσει τις κοινωνικές, τεχνολογικές και θεσμικές παραμέτρους σε μεγαλύτερο βαθμό με έναν πιο επωφελή τρόπο για την τουριστική βιομηχανία, οδηγώντας τον κλάδο προς τη βιώσιμη ανάπτυξη.

Θεωρία και Μεθοδολογία

Μεθοδολογικά, το παρόν πόνημα χρησιμοποιεί τόσο ποιοτικές όσο και ποσοτικές μεθόδους, φιλοδοξώντας να απαντήσει στο σκοπό και τους στόχους του με τον περισσότερο παραγωγικό τρόπο. Στο πλαίσιο αυτό, θα ακολουθηθούν προσεγγίσεις που κατανοούν τον κοινωνικό και τεχνολογικό χαρακτήρα των τεχνολογικών δικτύων, μέσα από τη σχετική βιβλιογραφική επισκόπηση. Το πεδίο Επιστήμη, Τεχνολογία, Κοινωνία (STS) αποτελεί ένα διεπιστημονικό τομέα που τονίζει τη σημασία των σχετικών (relevant) κοινωνικών ομάδων και προσεγγίζει συμμετρικά τις τεχνικές και κοινωνικές παραμέτρους της τεχνολογικής ανάπτυξης. Σε ζητήματα ενέργειας και ενεργειακής τεχνολογίας η πιο δημοφιλής έννοια του STS πεδίου είναι αυτή των κοινωνικο-τεχνικών συστημάτων, που πρωτοπαρουσιάστηκε από τον Hughes (1983 and 1987) μέσω του πλαισίου των μεγάλων τεχνολογικών συστημάτων (large technological systems), τα οποία δεν περιλαμβάνουν μόνο τις υλικότητες αλλά και τους οργανισμούς, το θεσμικό πλαίσιο και τις πολιτισμικές αξίες της κοινωνίας. Συμβατικές ή παράλληλες οπτικές ακολουθούν και άλλοι ακαδημαϊκοί του πεδίου σε θέματα που σχετίζονται με την ενέργεια.

Επιπρόσθετα, η επίτευξη των στόχων της έρευνας απαιτεί την προσέγγιση της έννοιας της βιώσιμης ανάπτυξης. Η έννοια αυτή χαρακτηρίζεται ως ασαφής, αμφίσημη και κανονιστική από τους ακαδημαϊκούς του STS πεδίου και των κοινωνικών επιστημών στο σύνολό τους (Geels et al, 2017; Lange et al, 2013; Walker and Shove, 2010; Vob et al, 2007). Η κυρίαρχη αντίληψη αντιλαμβάνεται τη βιώσιμη ανάπτυξη στην ενέργεια σαν ένα ζήτημα οικολογικού εκμοντερνισμού, δηλαδή σαν ένα στοιχείο βελτίωσης της ενεργειακής αποδοτικότητας ή απανθρακοποίησης[3] των ενεργειακών τεχνολογιών (Heiskanen et al, 2019; Walz and Kohler, 2014; Hajer, 1995). Άλλες,

[3] Εννοώντας τον περιορισμό του άνθρακα στον κλάδο της ηλεκτροπαραγωγής.

πιο εναλλακτικές προσεγγίσεις, κατανοούν τη βιώσιμη ανάπτυξη ως μια δυναμική διαδικασία κοινωνικών και τεχνολογικών μετασχηματισμών ενός μεγάλου αριθμού αλληλένδετων κοινωνικο-τεχνικών συστημάτων προς την ίδια κατεύθυνση (Schot και Kagner, 2018, Kagner and Schot, 2019). Επιπλέον, άλλοι ερευνητές, προσεγγίζουν την έννοια μέσω της χρήσης της έννοιας της ενεργειακής δημοκρατίας (energy democracy) (Becker και Nauman, 2017, Szulecki, 2018, Hess, 2018 και 2019) και της χρηστής διακυβέρνησης (good governance) (Stirling et al, 2018), προσπαθώντας να ενσωματώσουν τους στόχους του εκδημοκρατισμού σε αυτήν, μετατοπίζοντας έτσι τη λήψη αποφάσεων και την πολιτική εξουσία στο τοπικό επίπεδο. Περαιτέρω, η κατανόηση της βιώσιμης ανάπτυξης εξετάζεται –στο ίδιο κεφάλαιο– από την πλευρά της επιστήμης του τουρισμού. Σύμφωνα με αυτή την οπτική, η επικρατούσα άποψη στον ακαδημαϊκό λόγο αναφέρεται σε έναν αγοραία προσανατολισμένο τουρισμό, ο οποίος φροντίζει για την διατήρηση του περιβάλλοντος μέχρι του σημείου που να επιτρέπει την συνέχιση της οικονομικής ανάπτυξης στην περιοχή υποδοχής. Παρά τις εναλλακτικές απόψεις που επικρίνουν την κυρίαρχη, οι επιστήμονες που μελετούν τη βιώσιμη ανάπτυξη στον τουρισμό δεν προσεγγίζουν την ανάγκη για τεχνολογικές μεταβάσεις και τη διασύνδεσή τους με τον τουρισμό ως βασικό ζήτημα του πεδίου. Η ενσωμάτωση οπτικών του STS στο πεδίο του τουρισμού επιτρέπει την κατανόηση της βιώσιμης ανάπτυξης σαν βαθιού κοινωνικού και τεχνολογικού μετασχηματισμού. Στο ίδιο μήκος κύματος, οι ακαδημαϊκοί του πεδίου ανέπτυξαν προσεγγίσεις στην ενεργειακή πολιτική που διευκολύνουν τις μεταβάσεις σε πιο βιώσιμες κατευθύνσεις (Rip et al, 1995, Rip and Kemp, 1998, Sorensen and Williams, 2002, Hoogma κ.ά., 2002). Οι απόψεις αυτές συνδέθηκαν με πολιτικές ατζέντες που στοχεύουν στο να κατευθύνουν τους κοινωνικο-τεχνικούς μετασχηματισμούς πλησιέστερα σε μονοπάτια βιώσιμης ανάπτυξης (Hommels et al, 2007, Geels and Schot, 2007, Hommels et al, 2007b). Σε αυτό το πλαίσιο, αναδύθηκε στα τέλη της δεκαετίας του '90 το πεδίο των Επιστημών των Βιώσιμων Μεταβάσεων (Sustainable Transition Studies), το οποίο προσεγγίζει τους τεχνολογικούς μετασχηματισμούς ως κοινωνικές και τεχνολογικές οντότητες. Αναλύει θέματα όπως το κλείδωμα (lock-in) μιας τεχνολογίας σε ορισμένες καινοτομίες αντί για άλλες (Geels et al, 2018, Geels and Schot, 2007, Rip and Kemp, 1998), το ρόλο των δρώντων με το να αποσαφηνίζει ποιοι από αυτούς αποδείχθηκαν ως πιο σημαντικοί στην διαδικασία της μετάβασης (Smith et al, 2005), καθώς και τους όρους με βάση τους οποίους πραγματοποιήθηκε η μετάβαση και τα συμπεράσματα που θα μπορούσαν να αντληθούν σχετικά με τη συμμετοχή των ενδιαφερόμενων μερών στη λήψη αποφάσεων και τη δέσμευσή τους να καθορίσουν τις αποφάσεις σχετικά με τις τεχνολογικές διαδρομές (pathways) που θα ακολουθηθούν (Geels and Schot, 2007a; Foxon, 2010; Foxon et al, 2013). Έτσι, στην παρούσα διδακτορική διατριβή υιοθετούνται κάποια από τα μοντέλα του πεδίου, και κυρίως αυτό των πολυ-επίπεδων οπτικών (MLP), καθώς και άλλες προσεγγίσεις της σχετικής βιβλιογραφίας, με μία όμως κριτική ματιά, εξάγοντας μέσα από αυτήν τη διαδικασία το υβριδικό μοντέλο. Το μοντέλο των πολυ-επίπεδων οπτικών (MLP) αποτελεί την πιο «ώριμη» και γνωστή προσέγγιση στη σχετική βιβλιογραφία. Σε σύγκριση με άλλες προσεγγίσεις, είναι καλύτερα οργανωμένο, χρησιμοποιώντας έναν ευρύτερο και καλύτερα κατανοητό αριθμό παραμέτρων που σχετίζονται τόσο με την πλευρά της προσφοράς (καινοτομίες) της ανάλυσης όσο και με την πλευρά της ζήτησης (περιβάλλον χρήστη) (Rip and Kemp, 1998, Geels, 2002, 2004 2005a, b, 2006, Geels and Schot, 2007, Verbong and Geels, 2007, Schot et al, 2016). Βέβαια, οι αδυναμίες του μοντέλου είχαν σαν αποτέλεσμα το MLP να αντιμετωπίσει από την αρχή σημαντική κριτική. Στο πλαίσιο της παρούσας διδακτορικής έρευνας θα προσπαθήσω να συμπληρώσω και να εμπλουτίσω το μοντέλο έτσι ώστε να απαντά τόσο σε αυτή την κριτική όσο και να αποκτά έναν πιο κανονιστικό και βιώσιμο (sustainable) χαρακτήρα. Κατά την άποψή μου, η διακυβέρνηση, ο ρόλος των χρηστών και η συμμετοχή των τοπικών κοινωνιών αποτελούν θεμελιώδεις παραμέτρους για την ανάλυση της βιώσιμης μετάβασης και για τη διαχείριση της μετάβασης σε βιώσιμα μονοπάτια. Το υβριδικό μοντέλο που θα αναπτυχθεί ως αποτέλεσμα αυτών των αλλαγών θα χρησιμοποιηθεί ως μεθοδολογικό εργαλείο για τη διεξαγωγή μιας ενεργειακής μετάβασης στην εμπειρική περίπτωση της ανάλυσής μου, τη Χίο. Το αποτέλεσμα της μετάβασης θα παρουσιαστεί με τη μορφή διαφορετικών μονοπατιών (σενάρια).

Αναφορικά με τη μεθοδολογία που θα ακολουθηθεί, οι δύο βασικές παραδόσεις έρευνας στις κοινωνικές επιστήμες είναι ο θετικισμός και η φαινομενολογία (Saunders et al, 2000). Αυτή η ερευνητική εργασία ασχολείται με ποιοτικές προσεγγίσεις φαινομενολογικής έρευνας και βασίζεται στην ανάπτυξη και χρήση ενός υβριδικού μοντέλου που εστιάζει σε θέματα διακυβέρνησης, καθώς και σε περιπτωσιολογικές μελέτες. Οι περιπτωσιολογικές μελέτες αναφέρονται σε δύο νησιωτικές περιοχές της Βαλτικής Θάλασσας που ξεκίνησαν ενεργειακές μεταβάσεις στα τέλη της δεκαετίας του '90. Η εκ των υστέρων (ex post) ανάλυση και στα δύο νησιά εμπλουτίζει την υβριδική προσέγγιση με διάφορα στοιχεία[4]. Περαιτέρω, η ανάλυση αυτή, μολονότι ενσωματώνεται μεθοδολογικά στα διαφορετικά σενάρια που αναπτύσσονται στην περίπτωση της Χίου (en ante analysis), από την άλλη πλευρά, πρέπει να διαχωριστεί από την τελευταία, μιας και στη χιώτικη εμπειρική μελέτη αναπτύσσονται επιπρόσθετα και άλλα στοιχεία που αφορούν τη δυναμική του τοπικού καθεστώτος, τα οράματα των δρώντων για τη ενεργειακή μετάβαση του νησιού, καθώς και άλλα στοιχεία που αφορούν την τοπικότητα. Τα χαρακτηριστικά αυτά έγιναν αντιληπτά σε μένα, μέσω της μελέτης σχετικών εκθέσεων, αλλά και μέσω συνεντεύξεων με τους μηχανικούς και τους υπεύθυνους για τη χάραξη πολιτικής που θεωρούνται σημαντικοί. Τα στοιχεία αυτά ενσωματώνονται στα διαφορετικά σενάρια των δυνητικών μεταβάσεων. Σε αυτό το πλαίσιο, η πρωτογενής έρευνα της ανάλυσής μου θα χρησιμοποιήσει ημι-δομημένες συνεντεύξεις, που αναπτύσσουν μία λίστα θεμάτων και ερωτήσεων που ποικίλλουν μερικώς από συνέντευξη σε συνέντευξη. Ημι-δομημένες συνεντεύξεις λοιπόν διεξάγονται στα δύο νησιά των υποδειγματικών περιπτώσεων (συγκεκριμένα, στο Samso και στο Gotland), καθώς και στη Χίο. Ο στόχος των συνεντεύξεων στις υποδειγματικές

[4] Όπως για παράδειγμα με εργαλεία και διαδικασίες συμμετοχής των τοπικών κοινωνιών, δημιουργία ενός τοπικού δρώντα που θα κατευθύνει τη μετάβαση (local steering actor), σημασία ενδιάμεσων (entanglers) στην ενεργοποίηση των τοπικών κοινωνιών, ανάπτυξη ενεργειακών τεχνολογιών βασισμένων σε τοπικά χαρακτηριστικά.

περιπτώσεις είναι να προσδιορίσουν τη δυναμική των δρώντων και να επισημάνουν τους σημαντικότερους από αυτούς σε κάθε περίπτωση, καθώς και τους σημαντικούς χρήστες, τα καινοτόμα θεσμικά πλαίσια και τις κύριες τεχνολογίες. Από τις μελέτες στο Βορρά έτσι, αναπτύσσονται οπτικές, εργαλεία και διαδικασίες που διευκολύνουν μια βιώσιμη ενεργειακή μετάβαση στο Νότο, ενώ περαιτέρω, αυτές οι υποδειγματικές περιπτώσεις κάνουν αντιληπτό τον τρόπο με τον οποίο οι ενεργειακές μεταβάσεις επηρεάζουν την τοπική τουριστική βιομηχανία. Από την άλλη πλευρά ο στόχος της εκ των προτέρων (ex ante) ανάλυσης στην εμπειρική περίπτωση της Χίου είναι να κάνει κατανοητές τις προθέσεις, τις δυναμικές και τα πιθανά οράματα των εθνικών και τοπικών δρώντων και τη δύναμή τους στο συγκεκριμένο πλαίσιο, έτσι ώστε να διευκολυνθεί η ανάπτυξη των πέντε διαφορετικών σεναρίων. Προς αυτή την κατεύθυνση αξιολογήθηκαν θέματα όπως ο τρόπος με τον οποίο αντιλαμβάνονται οι δρώντες την έννοια της βιώσιμης ανάπτυξης καθώς και ο τρόπος που έγινε κατανοητός ο ρόλος τους σε μια ενεργειακή μετάβαση. Όσον αφορά το δείγμα των ερωτηθέντων, επιλέχθηκε η δειγματοληπτική μέθοδος μη-πιθανότητας ως πιο κατάλληλη για τις συγκεκριμένες περιπτωσιολογικές μελέτες. Οι ερωτώμενοι στις υποδειγματικές περιπτώσεις ήταν φορείς που ασχολούνταν με τη διαδικασία μετάβασης, κυρίως δρώντες χάραξης πολιτικής και μηχανικοί, αλλά και άλλες εμπλεκόμενες ομάδες, όπως οι τουριστικές επιχειρήσεις, οι αγρότες και οι τοπικοί πρωτοπόροι χρήστες. Στην εμπειρική μελέτη της Χίου οι ερωτηθέντες ήταν κυρίως εκπρόσωποι ενεργειακών δρώντων εθνικού καθεστώτος (national regime's actors delegates) που δραστηριοποιούνται στο νησί, τοπικοί και περιφερειακοί φορείς χάραξης πολιτικής αλλά και άλλα ενδιαφερόμενα μέρη, καθώς και τοπικοί τουριστικοί δρώντες. Τέλος, τα δεδομένα που προέρχονται από τις συνεντεύξεις έχουν υποβληθεί σε επεξεργασία με τη βοήθεια σύγχρονων πρακτικών διαχείρισης δεδομένων και συμφωνιών εμπιστευτικότητας. Όσον αφορά τα δευτερεύοντα δεδομένα, χρησιμοποιήθηκαν διαφορετικές πηγές, όπως βιβλία, περιοδικά, εφημερίδες, εκθέσεις, σημειώσεις συνεντεύξεων καθώς και εθνικοί νόμοι και οδηγίες της Ευρωπαϊκής Επιτροπής. Κατά κύριο λόγο τα στοιχεία αυτά προέρχονται από περιοδικά μηχανικής και τεχνικής φύσης, όπως για παράδειγμα τα περιοδικά *Energy Policy, Environmental Innovation and Societal Transition, Environmental Policy Planning* και το *Energy Research and Social Science*, καθώς επίσης και περιοδικά του πεδίου του τουρισμού, όπως το *Journal of Sustainable Tourism* και το *Tourism Management*.

Κύρια Κεφάλαια

Με βάση τα παραπάνω η διδακτορική διατριβή χωρίζεται σε πέντε κύρια κεφάλαια. Τα δύο πρώτα θέτουν το θεωρητικό πλαίσιο, κάνοντας μία κριτική επισκόπηση της σχετικής βιβλιογραφίας του τουρισμού, του STS και των Επιστημών των Βιώσιμων Μεταβάσεων, καθορίζοντας το υβριδικό μοντέλο το οποίο στη συνέχεια χρησιμοποιείται ως θεωρητικό εργαλείο. Πιο συγκεκριμένα οι κύριοι στόχοι του πρώτου κεφαλαίου είναι η απάντηση δομικών ερωτήσεων, η σύνδεση κρίσιμων εννοιών και η μερική σχηματοποίηση του πλαισίου που θα κατευθύνει την ενεργειακή μετάβαση. Προς αυτήν την κατεύθυνση το κεφάλαιο αρχικά προσδιορίζει την άρρηκτη σχέση των ενεργειακών μεταβάσεων με την αντίληψη της βιώσιμης ανάπτυξης στον διεθνή πολιτικό και ακαδημαϊκό λόγο. Ως εκ τούτου εξηγεί εν μέρει την απόφασή μου να προκρίνω μια ενεργειακή μετάβαση, σε αντίθεση με άλλους τεχνολογικούς μετασχηματισμούς, ως τη σημαντικότερη στο πλαίσιο μιας βαθιάς μετάβασης. Εξετάζει, επιπρόσθετα, τον τρόπο με τον οποίο οι επιστήμονες της Επιστήμης του Τουρισμού αντιλαμβάνονται τη βιώσιμη ανάπτυξη στον τουρισμό, ενώ παράλληλα εντοπίζει τους περιορισμούς τους στην κατανόηση της βιωσιμότητας, σαν ενός, μεταξύ άλλων, τεχνολογικού, ή καλύτερα κοινωνικο-τεχνικού μετασχηματισμού. Για την αντιμετώπιση αυτής της αδυναμίας χρησιμοποιούνται οπτικές από το πεδίο του STS, με έμφαση σε ενεργειακά ζητήματα, εστιάζοντας κυρίως σε τρεις θεματικές ενότητες, τα οποία ενδιαφέρουν πρωτίστως την έρευνά μου, δηλαδή, ζητήματα ενέργειας και διακυβέρνησης, ζητήματα ενέργειας και χρηστών ή εμπλοκής της κοινωνίας των πολιτών, καθώς και άλλα που σχετίζονται με την ενέργεια, το περιβάλλον και τη βιωσιμότητα. Συνάμα, για τις ανάγκες αυτής της διατριβής, ένας επιπρόσθετος στόχος σχετίζεται με την, κατά μία έννοια, οριοθέτηση της ασαφούς και αμφιλεγόμενης έννοιας της βιώσιμης ανάπτυξης. Για την επίτευξη του στόχου αυτού, μελετάω τη σχετική βιβλιογραφία για τη βιωσιμότητα και τη βιώσιμη ανάπτυξη στην ενέργεια έτσι όπως προσεγγίζεται από τις κοινωνικές επιστήμες.

Στο δεύτερο κεφάλαιο γίνεται επισκόπηση της βιβλιογραφίας των Βιώσιμων Μεταβάσεων και μέσω αυτής προσδιορίζεται ο τρόπος με τον οποίο οι κοινωνικές επιστήμες κατανοούν τις ενεργειακές μεταβάσεις και το πώς οι τελευταίες συνδέονται με ζωτικά περιβαλλοντικά ζητήματα. Σε αυτό το πλαίσιο πραγματοποιείται μια κριτική επισκόπηση της προσέγγισης των πολυ-επίπεδων οπτικών, καθώς και άλλων προσεγγίσεων και τυπολογιών βιώσιμων μεταβάσεων, έτσι ώστε να αναπτυχθεί ένα εμπλουτισμένο υβριδικό μοντέλο. Σύμφωνα με τη σχετική κριτική στο μοντέλο των πολυ-επίπεδων οπτικών, η προσέγγιση έχει κατηγορηθεί για έλλειψη διακυβέρνησης (lack in governance) και πολιτικής στη διαδικασία μετάβασης, καθώς και για παράβλεψη του ρόλου των χρηστών και των κοινωνιών σε αυτήν. Κατά την άποψή μου η σημασία της δύναμης (power) και της δυναμικής (agency) στις διαδικασίες μετάβασης είναι ζωτικής σημασίας για τον τρόπο που αυτή εξελίσσεται. Για το λόγο αυτό θέλω να τονίσω με πιο αποφασιστικό τρόπο αυτές τις παραμέτρους, εμπλουτίζοντας το μοντέλο με άλλες τυπολογίες και προσεγγίσεις. Επιπλέον, υποστηρίζω τη σημασία που έχει η ανάληψη από την κυβέρνηση ενός κεντρικού ρόλου στην όλη διαδικασία μετάβασης στο μοντέλο που θα χρησιμοποιηθεί, έτσι ώστε το υπόδειγμα να προσαρμοστεί σε ένα πολιτικό πλαίσιο παρόμοιο με αυτό της Ελλάδας. Τέλος, εμπλουτίζω το μοντέλο με τυπολογίες, εστιάζοντας στον ρόλο των χρηστών και τη συμμετοχής της κοινωνίας των πολιτών. Θεωρώ ότι αυτά τα δύο στοιχεία είναι καίριας σημασίας για να κατευθύνουμε τη μετάβαση σε πιο βιώσιμα μονοπάτια. Επιπλέον, αυτές οι παράμετροι θα βοηθήσουν το μοντέλο να προσαρμοστεί σε ένα περιβάλλον νησιωτικών περιπτώσεων, όπου οι τοπικότητες δημιουργούν έναν μοναδικό κατά περίπτωση «βηματισμό» και μία ιδιαίτερη δυναμική. Πιο συγκεκριμένα, θα γίνει αναφορά στο νησιωτικό περιβάλλον του

Αιγαίου, όπου κατά την τελευταία δεκαετία έχουν υπάρξει αντιθέσεις και τοπικές εντάσεις σχετικά με την εγκατάσταση ανανεώσιμων τεχνολογιών.

Το τρίτο κεφάλαιο παρουσιάζει τις δύο υποδειγματικές περιπτώσεις τοπικών νησιωτικών μεταβάσεων της Βόρειας Ευρώπης, στις οποίες μια ενεργειακή μετάβαση ξεκίνησε από τα μέσα μέχρι τα τέλη της δεκαετίας του '90, επηρεάζοντας θετικά τον τουρισμό. Η πρώτη περίπτωση, το Samso, είναι ένα δανέζικο νησί που ξεκίνησε μια προσπάθεια μετάβασης στην ενέργεια μετά την επικράτηση σε έναν κρατικό διαγωνισμό για το ενεργειακό νησί της χώρας, στα τέλη της δεκαετίας του '90. Η δεύτερη, αυτή του Gotland, αφορά ένα τουριστικό νησί το οποίο κατά τα μέσα της δεκαετίας του '90 πραγματοποίησε επίσης μια ενεργειακή μετάβαση, ακολουθώντας τις σχετικές προτάσεις του σουηδικού κράτους προς τις περιφέρειές του. Και τα δύο νησιά έχουν καθοδηγήσει μια ενεργειακή μετάβαση που εμπλέκει την τοπική κοινωνία, ενώ εξελίσσονται περαιτέρω σε τουριστικά ανεπτυγμένες περιοχές. Περαιτέρω, στην περίπτωση του Samso αναπτύχθηκε ένα θεσμικό πλαίσιο που διευκόλυνε σημαντικά τη συμμετοχή των ντόπιων, ενώ στην περίπτωση του Gotland ο τουριστικός τομέας συμπεριλήφθηκε κατά κάποιο τρόπο στη διαδικασία μετάβασης στην ενέργεια, όπως θα εξηγήσω αργότερα. Αυτές οι μεταβάσεις θα αναλυθούν με τη βοήθεια προσεγγίσεων και εργαλείων βιώσιμων μεταβάσεων. Ειδικότερα, το υβριδικό μοντέλο που καταρτίστηκε στο προηγούμενο κεφάλαιο, και βασίζεται κυρίως στην προσέγγιση MLP αλλά και σε άλλα μοντέλα καθοδήγησης μεταβάσεων, θα χρησιμοποιηθεί ώστε να εντοπιστούν οι διαφορετικοί δρώντες, η δυναμική τους και η σημασία των χρηστών κατά τη διαδικασία. Η μελέτη των περιπτώσεων αυτών κρίθηκε σκόπιμη, ώστε να διευκολύνει μια ενεργειακή μετάβαση στην εμπειρική περίπτωση της Χίου σε ζητήματα τεχνολογιών, θεσμικού πλαισίου και δρώντων που πρέπει να δημιουργηθούν.

Τέλος, τα δύο τελευταία κεφάλαια αναφέρονται στην εμπειρική περίπτωση όπου επιδιώκεται η επίτευξη μιας βαθιάς ενεργειακής μετάβασης, συμπεριλαμβανομένου του τουριστικού τομέα. Έτσι, στο τέταρτο κεφάλαιο, που αποτελεί ένα ειδικό κεφάλαιο, με την έννοια ότι ζητούμενο σε αυτό είναι να πραγματοποιήσει μια κοινωνικο-τεχνική ανάλυση του εθνικού καθεστώτος (national regime) –κυρίως αυτού που έχει εμπλακεί στις ανανεώσιμες τεχνολογίες– καθώς και μια ανάλυση του τοπικού ενεργειακού καθεστώτος (nested energy regime) της Χίου. Μια ανάλυση αυτού του τύπου είναι απαραίτητη για την αποσαφήνιση των αντιλήψεων και της δυναμικής των φορέων, καθώς επίσης και για την ανάπτυξη του πλαισίου υπό το οποίο θα πραγματοποιηθεί η μετάβαση. Επιπλέον, η πραγματοποίηση μιας βαθιάς μετάβασης απαιτεί την αποτίμηση του τοπικού τουριστικού κλάδου καθώς και άλλων αλληλοσυνδεόμενων τοπικών κ-τ καθεστώτων (nested s-t regimes), όπως οι μεταφορές. Για το λόγο αυτό, πραγματοποιείται μια ανάλυση των τοπικών καθεστώτων των μεταφορών και του τουρισμού σε συνάρτηση με το καθεστώς ηλεκτρικής ενέργειας. Επιπρόσθετα, αναφέρονται εκτενώς οι κύριοι λόγοι που οδήγησαν στην επιλογή της Χίου ως εμπειρικής υπόθεσης. Τέτοιοι παράγοντες είναι η εγκατάσταση τεχνολογιών ανανεώσιμων πηγών ενέργειας και η χρήση συνεργατικών σχημάτων που εμπλέκουν την τοπική κοινωνία στην παραγωγή ενέργειας ήδη από τη δεκαετία του 1980, το χαμηλό ενεργειακό κόστος του νησιού σε σχέση με άλλα μη διασυνδεδεμένα με το ηπειρωτικό δίκτυο ηλεκτρικά συστήματα, και βέβαια η περιορισμένη τουριστική ανάπτυξή του, ο πολιτιστικός και περιβαλλοντικός του πλούτος, καθώς και δημογραφικοί λόγοι. Κατά την άποψή μου αυτά τα χαρακτηριστικά του νησιού επιτρέπουν περισσότερα εναλλακτικά μονοπάτια μετάβασης όσον αφορά τις ενεργειακές τεχνολογίες που θα χρησιμοποιηθούν και τις μορφές τουρισμού που θα αναπτυχθούν σε σχέση με άλλα μεγάλα νησιά.

Το πέμπτο κεφάλαιο κατευθύνει μια ενεργειακή μετάβαση στην εμπειρική περίπτωση. Η διαδικασία μετάβασης ακολουθεί τη λογική των διαφορετικών μονοπατιών (Foxon et al, 2013), ως απόρροια κοινωνικών και τεχνολογικών διαφοροποιήσεων. Με βάση αυτό παρουσιάζονται πέντε διαφορετικά σενάρια βαθιών ενεργειακών μεταβάσεων, που συμπεριλαμβάνουν τον τουρισμό, που εκπονούνται σε ορίζοντα τριακονταετίας. Το πρώτο από τα σενάρια αυτά που ονομάζεται «flourish of renewables» και ακολουθεί ένα μονοπάτι που προωθεί την εκτεταμένη εγκατάσταση τεχνολογιών ανανεώσιμων πηγών ενέργειας και αποθήκευσης, καθώς και την ουσιαστική ενθάρρυνση της τοπικής συμμετοχής στη μετάβαση. Ένα δεύτερο σενάριο ονομάζεται «gas emergence» και προτείνει την ενεργειακή μετάβαση σε σταθμό χρήσης αερίου καθώς και την εγκατάσταση ανανεώσιμων τεχνολογιών. Το τρίτο μονοπάτι ονομάζεται «linkage with the neighbors» και προωθεί την ηλεκτρική διασύνδεση του νησιού με τα γειτονικά νησιά και την ταυτόχρονη μετάβασή του σε τεχνολογίες ανανεώσιμων πηγών ενέργειας. Το επόμενο σενάριο είναι το «continental solution to the motherland» και αναφέρεται στην περίπτωση της ηλεκτρικής διασύνδεσης του νησιού με την ηπειρωτική Ελλάδα και τη μετάβασή του σε τεχνολογίες ανανεώσιμων πηγών ενέργειας. Τέλος, το τελευταίο σενάριο είναι το «interconnection with others», που αναφέρεται σε ένα μονοπάτι διασύνδεσης του νησιού με το γειτονικό τουρκικό ηλεκτρικό δίκτυο. Πρέπει να σημειωθεί στο σημείο αυτό ότι τα διαφορετικά σενάρια δηλώνουν διαφορές στη στιγμή εκκίνησης της μετάβασης, στο επίπεδο συμμετοχής της τοπικής κοινωνίας και στις τεχνολογικές αποφάσεις. Επιπρόσθετα, στο ίδιο κεφάλαιο, προτείνεται μια μετάβαση τουρισμού προς τη βιωσιμότητα, ως απόρροια της ενεργειακής μετάβασης, κατά τη διαδικασία του βαθιού μετασχηματισμού. Το τελικό κεφάλαιο συνοψίζει τα αποτελέσματα και τη συμβολή αυτής της ερευνητικής εργασίας στη σχετική βιβλιογραφία. Ως εκ τούτου τονίζονται τα πλεονεκτήματα και οι ελλείψεις, καθώς και οι κύριοι στόχοι και οι περιορισμοί του υβριδικού μοντέλου που χρησιμοποιείται. Περαιτέρω παρουσιάζεται μια συστηματική σύγκριση της εμπειρικής περίπτωσης με τις υποδειγματικές, ενώ επιπρόσθετα γίνεται προσπάθεια θεωρητικοποίησες των αποτελεσμάτων της έρευνας, με βάση το ελληνικό πολιτικό και κοινωνικό πλαίσιο. Περιγράφεται επίσης ο τρόπος με τον οποίο μια μετάβαση στην ενέργεια προς τη βιωσιμότητα επηρεάζει επωφελώς τον τουρισμό και την τουριστική ανάπτυξη.

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Figure 16. Share of each technology in gross consumption in electric production in 2006 and 2016 (ΥΠ.ΠΕ.ΕΝ., 2018:10).

Figure 17. Total and based on the use power consumption and production in Chios for a two-decade period (Author data reconstruction from statistics.gr).

Figure 18. Tourist arrivals in Lesvos, Samos and Chios between 2010-2016 (Author data reconstruction from ΣΕΤΕ, 2017).

Figure 19. An enriched representation of the users' role using examples from the Chian nested energy regime (Shot et al, 2016; Van Vliet et al, 2005).

ΠΡΟΛΟΓΟΣ/ PREFACE

Έναυσμα για αυτή τη διδακτορική έρευνα υπήρξε η αίσθησή μου –ως απόρροια των προηγούμενων σπουδών μου– ότι το πεδίο των Επιστημών του Τουρισμού κατανοεί τη βιώσιμη ανάπτυξη στον τουρισμό με έναν ελλειμματικό τρόπο (αυτή εξάλλου είναι και η κριτική από ένα τμήμα των ακαδημαϊκών του πεδίου). Παράλληλα, η πρώτη επαφή μου με το πεδίο Επιστήμη, Τεχνολογία, Κοινωνία, πριν ακόμα ξεκινήσω την προσπάθεια αυτή, με έπεισε ότι οι οπτικές του πεδίου επιτρέπουν τη νοηματοδότηση της έννοιας της βιώσιμης ανάπτυξης με έναν πληρέστερο τρόπο, αναδεικνύοντας τους τεχνολογικούς μετασχηματισμούς και τον κοινωνικό παράλληλα με τον τεχνολογικό τους χαρακτήρα. Οι μετασχηματισμοί αυτοί σε ανανεώσιμες τεχνολογίες ενέργειας βρίσκονται στο κέντρο της διαδικασίας αυτής.

Οι τεχνολογίες ανανεώσιμων πηγών ενέργειας, και κυρίως οι ανεμογεννήτριες, ενισχύθηκαν σε μεγάλο βαθμό από τα μέσα της δεκαετίας του 1970, ως αποτέλεσμα μιας σειράς παραγόντων και μεταβλητών. Πλήθος χωρών στην Ευρώπη αλλά και οι ΗΠΑ στράφηκαν σε αυτές τις εναλλακτικές μορφές ενέργειας, αυξάνοντας τη διείσδυσή τους στα εγχώρια ηλεκτρικά συστήματα, κατά τις επόμενες δεκαετίες. Στην Ελλάδα, όπου ο εξηλεκτρισμός της χώρας ουσιαστικά ολοκληρώθηκε στα τέλη της δεκαετίας του 70 με τις αρχές αυτής του 80, οι προσπάθειες των δρώντων που χάραξαν πολιτική σε ζητήματα ανανεώσιμων τεχνολογιών ενέργειας, αν και υπήρξαν προοδευτικές σε πολλές περιπτώσεις, ήταν παράλληλα αποσπασματικές, με πολλές αντιφάσεις λόγω των διαφορετικών και αντιτιθέμενων συμφερόντων και των σχέσεων δύναμης των συμμετεχόντων στο τομέα. Παράλληλα, η τουριστική ανάπτυξη της χώρας, που εκτοξεύεται κατά τη δεκαετία του 1980 σε πολλές νησιωτικές χώρες, αυξάνει ραγδαία τις ενεργειακές ανάγκες των περιοχών αυτών κυρίως κατά την τουριστική περίοδο. Η ανάπτυξη αυτή δεν ακολουθείται από σχεδιασμό για στροφή στις ανανεώσιμες τεχνολογίες, οπότε και προαπαιτεί τη μεγέθυνση των υπαρχόντων πετρελαϊκών σταθμών, πρωτίστως στα νησιά που δεν συνδέονται με το ηπειρωτικό ενεργειακό σύστημα.

Επηρεασμένη από τα παραπάνω ερεθίσματα, η εργασία αυτή επιχειρηματολογεί για την ανάγκη να ακολουθηθούν εναλλακτικές-αντικομφορμιστικές διαδρομές ώστε να κατευθύνουμε πραγματικά τον τουρισμό προς τη βιώσιμη ανάπτυξη. Τονίζει επιπρόσθετα την ανάγκη αλλαγής σε επίπεδο τεχνολογιών, δικτύων, πρακτικών, θεσμικού πλαισίου σε μία σειρά τεχνολογικών συστημάτων, με πρώτο όμως απ' αυτά, ως σημαντικότερο, το ηλεκτρικό. Παράλληλα όμως η διατριβή αυτή επιχειρηματολογεί για τη σημασία αυτών καθεαυτών των ενεργειακών μετασχηματισμών για τη δημοκρατικοποίηση των εν λόγω συστημάτων σε τοπική κλίμακα, τον περιορισμό της κλιματικής αλλαγής και εν τέλει για την καθοδήγηση προς την βιώσιμη ανάπτυξη.

Η εργασία αυτή, αποτέλεσμα εξαετούς και πλέον προσπάθειας, εκπονήθηκε μεταξύ Χίου και Αθήνας, βιβλιοθηκών, αιθουσών του ΙΦΕΤ και συνεδρίων, παράλληλα με τη δουλειά μου. Επιπλέον οι περισσότερες από τις συνεντεύξεις που πήρα ήταν σε αυτές τις δύο περιοχές. Για τις ανάγκες των συνεντεύξεών μου στη Σουηδία και τη Δανία βρέθηκα για περίπου ένα μήνα κατά την άνοιξη του 2016 στις χώρες αυτές. Τέλος, θα ήθελα για άλλη μία φορά να ευχαριστήσω την οικογένειά μου που μου στάθηκε και με υποστήριξε σε αυτήν τη μακρόχρονη προσπάθειά μου.

Introduction
Aims, Objectives and Structure

In the tradition of Science, Technology and Society (STS), as well as that of Sustainable Transition Studies, there have been perspectives perceiving technological transitions as social and technological long-term evolutionary transformations of a single system or complexes of systems[5] (Schot and Kagner, 2018). Further, these fields conceive sustainable development as a process of technological transitions. This research thesis is based on these perceptions, arguing for the need to achieve an energy transition including tourist activity so that the latter can veer to more sustainable orientations.

Energy is considered one of the necessary preconditions in industrial societies enabling current life style (Hutton, 1998:24). In addition, producing major energy amounts is required so that we keep current routines in a number of energy consuming sectors. A sector of this kind, classified among the major ones, is tourism (Gossling, 2013; Scott et al, 2016). Following a sustainable development pathway requires changes in social practices and patterns in tourism as well as other raw-materials-demanding markets. In this context, in this introductory chapter, I am going to outline the aims and objectives, the theoretical and methodological framework as well as the main issues negotiated in each one of the five chapters of this research thesis.

Aims – Objectives and Research Questions

The aim of this research thesis is to steer a deep energy transition including tourism so that the latter can be led to more sustainable pathways. In doing so, I will approach ways of integrating sustainable technology transitions perspectives in directing tourism to sustainable development pathways. More specifically, a hybrid model for sustainable socio-technical transitions, that integrates approaches of governance and

[5] Transition Studies use the concept of deep transitions defining this process. As it will be argued in the second chapter more analytically, the concept refers to a series of transitions in a number of socio-technical systems for the provision of transport, energy, food, housing, healthcare, communications etc., in a similar direction over the past 200-250 years (Schot and Kagner, 2018). The notion relies upon a long term-path dependency of several s-t systems which reinforce industrial modernity (Kagner, and Schot, 2019). Examples of this concept are the linked transitions of mobility and food supply in the previous two centuries (Van der Vleuten, 2018). Similar direction of these s-t transitions were, for instance, mechanization and mass production coupled with individual consumption (Kagner and Schot, 2019). Based on these, scholars argue for the need of a similar to these past deep transitions in the future towards sustainable development.

local engagement, will be developed so that it runs different energy transition scenarios including, in the case of Chios, the tourism sector. Chios is an island with low tourist development, thus there is a window of opportunity to prompt a successful deep energy transition which will positively affect the local tourist industry as well as the whole island to a great extent. In addition, I argue that turning tourism to sustainable development requires participating in technological transformations in a series of socio-technical (s-t) systems such as energy, transportation, water, waste as well as other ones which are related to and are affected by tourism. Nevertheless, in this research thesis, I focus on the energy transition issue, considering that the tourism sector will be included in the core of this complicated and deep socio-technical transformation. As I am going to show in the next chapter, in the public discourse, transformation of the energy systems has been connected in a pivotal way with the turn to sustainable development. Further, I argue that any energy transformations pertaining solely to tourism are only linked to end-use technologies, failing however to see the whole energy production chain. Thus, I contend that an energy transition integrating the tourist s-t system as well could beneficially influence the social, technological and institutional parameters to a greater extent, ultimately leading the tourist sector to more sustainable pathways. In this context, relying on the deep transition concept (Schot and Kagner, 2018; Van der Vleuten, 2018) I argue for the need for parallel and interlinked changes of social and technical character in a number of unsustainable s-t systems in the direction of sustainable development. My approach will focus on governance and social engagement issues as well as on the users' role in the energy transition process. In order to deal with the above mentioned aims and objectives, I will set a number of research questions:

1. Could a perspective of sustainability as a deep social and technological transformation allow for a more social and environmentally oriented tourism?
2. What can we learn from case studies of the North so as to establish an approach of energy transitions for the South?
3. How can we integrate dimensions of governance in a sustainable transition approach so as to influence the users and allow the management of the demand side?
4. How can we develop a sustainable transitions model in a way that is sensitive to national and regional characteristics (political, cultural, geographical)? In

this context, a more specific question that this research would attempt to address is: How can we steer sustainable transitions so as to engage civil society in paternalistic political frameworks as that of Greece?

Theory and Methodology

In this research thesis, quantitative and qualitative methodolody will be used so that the aforementioned research questions can be answered in the most productive way possible; therefore, theories and approaches perceiving the social and technical “nature” of technological networks will be employed. STS is a similar interdisciplinary field that emphasizes on social relevant groups and symmetrically approaches technical and social aspects of technological development. Regarding energy issues, the most well known concept of STS scholars is that of the socio-technical system (Sovacool, 2014). Hughes (1983 and 1987) argues for large technological systems which not only contain materiality but also the organizations, the regulative framework as well as cultural values. On reviewing the STS literature, I will refer to essential energy-related topics, which have been stressed by the scholars of the field. Building on this, I will focus on three energy topics which interest my research the most, namely those associated with governance, users and civil society as well as with the environment and sustainability.

Another concept which is studied in the first chapter is that of sustainable development. The concept is recognized as an ambivalent but also as a normative one by the scholars of STS and social sciences in general (Geels et al, 2017; Lange et al, 2013; Walker and Shove, 2010; Vob et al, 2007). The dominant view of the field perceives sustainable development in energy as an issue of ecological modernization, thus as a matter of improving the efficiency of energy technologies, or at best, of de-carbonization, which refers to limiting the power sector's carbon intensity (Heiskanen et al, 2019; Walz and Kohler, 2014; Hajer, 1995). Other, more alternative views, regard sustainable development as a dynamic process pertaining to social and technological transformations of a large number of interrelated s-t systems in the same direction (Schot and Kagner, 2018; Kagner and Schot, 2019).

Moreover, other scholars, putting concepts as energy democracy (Becker and Nauman, 2017; Szulecki, 2018; Hess, 2018 and 2019) and good governance (Stirling et al, 2018) into use, try to integrate sights of democratization into sustainable development in energy, thus shifting decision making and political power to the local level. Further, conceptualizing sustainable development is reviewed with regard to tourism. According to this perspective, the prevailing view in the academic discourse refers to market-oriented tourism, which preserves the environment to such an extent that it allows for additional economic growth in the host area. Furthermore, despite alternative views criticizing the predominant one, tourism scholars do not approach technological networks transformation and their interconnection to tourism swerving to more sustainable pathways as a core issue. Integrating STS perspectives in tourism will promote approaching sustainability in terms of deep social and technological transformations.

Further, the field's scholars have attempted to develop approaches in energy policy facilitating transitions to more sustainable directions (Rip et al, 1995; Rip and Kemp, 1998; Sorensen and Williams, 2002; Hoogma et al, 2002). These views intertwine with political agendas aiming at directing socio-technical transformations closer to sustainable development pathways (Hommels et al, 2007; Geels and Schot, 2007; Hommels et al, 2007b); this is the context that the field of Sustainable Transition Studies emerged during the late 90s. The field approaches technological transformations as social and technical entities. It analyses issues like locking in a technology at certain innovations instead of others (Geels et al, 2018; Geels and Schot, 2007; Rip and Kemp, 1998), or the actors' role, by analyzing whose proved to be the most significant one in the changing process (Smith et al, 2005). Using Sustainable Transition Studies approaches, there will be an attempt to adopt a historically informed policy model[6] integrating social concerns, societal engagement and alternative conceptualizations of sustainability so that tourism can be steered to more environmentally and socially sensitive orientations. Hence, employing the multi-level- perspective (MLP) model as well as other parts of innovation studies literature in a critical way and establishing a hybrid approach will be a central objective.

Multi-level perspective (MLP) is the most "mature" and well-known approach in the relevant bibliography. Compared to previous attempts, it is better organized, while utilizing a broader and better conceptualized number of elements related to the supply side (innovations) of the analysis on the one hand as well as to the demand side (user

[6] Known as multi-level perspective.

environment) (Rip and Kemp, 1998; Geels, 2002, 2004 2005a, b, 2006; Geels and Schot, 2007; Verbong and Geels, 2007, Schot et al, 2016). In respect to the above mentioned shortcomings, MLP has faced considerable criticism from the very start. Subsequently, in this research, I will attempt to complement and enrich the model so that it both answers this criticism and acquires a more normative and sustainably oriented character. In my point of view, governance, users' role and public engagement are fundamental parameters in a sustainable transition's analysis and in managing transition to sustainable pathways. The hybrid model that will be developed as a result of these changes will be used as a methodological tool so as to run an energy transition in the empirical case of my analysis, Chios. The outcome of the transition will be presented in the form of different pathways (scenarios).

With reference to the methodology that will be followed, there are two main traditions of research in social sciences, positivism and phenomenology (Saunders et al, 2000). This research thesis deals with qualitative phenomenological research approaches and relies on developing and using a hybrid model shedding light on governance issues in the second chapter, as well as on case studies. Case studies refer to two insular areas of the Baltic Sea which initiated an energy transition back in the late 90s. The ex post analysis on both islands has enriched the hybrid approach with several elements (like, for instance, tools and processes of engaging locals, establishing a local steering actor, the significance of entanglers in activating locals, developing energy technologies based on local raw materials). Further, this analysis, despite being methodologically integrated into the different scenarios developed in the case of Chios (ex ante analysis), has to be distinguished from the latter in the sense that, in the Chian case, there are also other elements having to do with the nested regime's dynamic as well as with visions about the island's energy transition. All these were made clear to me through reports and interviews with engineers and policy makers. That is considered important and it is in a way integrated in the different transition pathways. In this framework, my primary research analysis will use semi-structured interviews in which a list of themes and questions varying partially from interview to interview has been covered. Thus, semi-structured interviews are conducted in the two islands of the exemplary cases (namely, Samso and Gotland) as well as in Chios. What the formers are aiming at is to address the actors' dynamics in the exemplary cases and highlight key actors and important users as well as display innovative institutional frameworks and the main technologies. Hence, sights, tools and processes will flourish in both North cases so as to facilitate a sustainable energy transition in the South, while, further, these cases will turn the attention to the way that these changes influence the local tourism industry. On the other hand, what I've been pursuing from the ex ante Chian analysis is to conceive the intentions, dynamics and probable visions of the national and local actors, as well as their power in the particular framework, so that developing the five divergent scenarios could be facilitated. Towards this direction, issues such as the way the actors perceive the sustainable development concept as well as the manner in which they understand their role in an energy transition will be evaluated. In regard to the sample of interviewees, non-probability sampling has been chosen as the most appropriate one for the particular case studies. Interviewees in the exemplary cases were actors engaged in the transition process, mainly policy makers and engineers, but also other relevant groups such as tourist enterprises, farmers and local pioneer users. In the Chian case, the interviewees were mainly representative of national regime energy actors also operating on the island, along with local and regional policy makers and other interested parties, as well as local tourist actors. Finally, the data drawn from the interviews have been processed with the help of state-of-the-art data management practices and confidentiality agreements. As far as the secondary data is concerned different sources like books, journals, newspapers, reports, notes of interviews as well as national laws and European Commission directives were used. Primarily, these data derive from engineering and technical journals, like for example the “Energy Policy”, the “Environmental Innovation and Societal Transition”, the “Environmental Policy Planning” and the “Energy Research and Social Science”, as well as from tourism journals such as the “Journal of Sustainable Tourism” and the “Tourism Management” case.

Main chapters

In this framework, this research thesis will be divided into five main chapters. The first two lay down the theoretical framework by reviewing the relative literature of tourism, STS and Transition Studies and establishing the hybrid model which has subsequently been used as a theoretical tool. More specifically, the first chapter's main objectives aim at answering structural questions, connecting critical concepts and partially setting the framework steering the energy transition, thus achieving three main objectives. Initially, it illustrates the pivotal relation of energy transitions with the perception of sustainable development in the international political and academic discourse. Hence, it partially explains my decision to single out energy transition in contrast to other technological transformations. Additionally, it reviews the way Tourist Studies scholars perceive sustainable development on tourism, while further, it identifies their limitations in conceiving sustainability as, among others, a technological, rather socio-technical, transformations. To deal with these shortcomings, STS perspectives in energy issues have been geared to focusing on three main topics which are of main interest to my research, those of governance, of users and civil society and of the environment and sustainability. For the needs of this thesis, a final objective revolves around delimiting the vague and ambivalent features of the sustainable development concept. Subsequently, I will review the related literature on sustainability and sustainable development in energy, as it is approached by social sciences.

The second chapter reviews the literature of Sustainable Transition Studies, and through this, the way social sciences conceive energy transitions, and by way of this, how the latter is related to vital environmental issues. In doing so, a critical review of MLP is illustrated, while other transition approaches are depicted so that an enriched hybrid approach will be developed. According to the relevant critique to MLP, the approach has been blamed for lacking in governance and politics in the transition process as well as for disregarding the users' and societies' role in it. I assess the significance of power and agency in transition processes as vital for its evolution, so I am going to stress these parameters more decisively by enriching the model. Further, I argue for the government to assume a central role in the whole process so that that the model will be adjusted to a political framework similar to that of Greece. Finally, I enrich the model with typologies, focusing on the users' role and social engagement. I consider these two elements crucial in terms of following more sustainable pathways. Moreover, these parameters will help the model adapt to an insular case environment, where localities retain their own pace and dynamics; more particularly, reference will be made to the Aegean Sea context, where, over the past decade, much tension has emerged in regard to installing renewable technologies.

The third chapter presents the two exemplary cases of nested transitions of North Europe, where an energy transition has started already since the mid to late 90s, affecting tourism in a positive way. The first case, Samso, is a Danish island embarked upon an energy transition endeavor after winning a state competition for the country's energy island, back in the late 90s. The second case, Gotland, is a crowded tourist island which, during the mid 90s, also embraced energy transition, following the state issuing directions to its regions to do so. Both islands have steered to energy transition engaging the local society while evolving further into touristically developed areas. Further, in Samso's case, an institutional framework substantially facilitating the engagement of locals was developed, while in Gotland's case, the tourist sector was in a sense included in the energy transition process, as I will argue later on. These transitions will be analyzed with the help of sustainable transitions approaches and tools. More particularly, the hybrid model established in the previous chapter is mainly based on the MLP approach, but also on other transition management models, which will also be used so that different actors, their dynamics and the users' importance can be identified. These cases will be essential in inspiring me in terms of the technologies, the institutional framework and the actors established so as to facilitate the Chian energy transition.

Finally, the latter two chapters refer to the empirical case where a deep energy transition[7], including the tourism sector, is aspired to be achieved in Chios. The fourth chapter is a special one: in this sense, a socio-technical analysis of the national regime mainly based on renewable technologies as well as an analysis of the Chian nested energy regime are illustrated. This analysis is essential in clarifying the actors' perceptions and dynamics over time as well as developing the scheme under which the transition will take place. Additionally, performing a deep transition requires evaluating local tourism as well as other interrelated local s-t regimes like the transportation one; hence, an analysis of those nested regimes in relation with the electricity regime will take place. Moreover, the main reasons which led to choosing Chios as the empirical case will be extensively listed; these are mainly the early acceptance of renewable energy technologies and of collaborative schemes engaging

[7] In this research thesis, the deep transition's concept is approached through connecting the contemporary energy s-t system with the tourist industry. Thus, as mentioned in the relevant articles, where only particular systems' relations have been highlighted expressing the deep transitions dynamics (Van der Vleuten, 2018; Kagner and Schot, 2019), in the specific cases, a parallel transition of the local electricity s-t system, the local land-based transportation one and the tourist sector will be navigated to sustainable development. Nevertheless, I have to clarify that it is clear to me that a deep transition to sustainable development on tourism requires the transition of other s-t systems as the water, waste and the agro- food ones. This could be a target of the future research.

locals in energy production, its low energy cost in relation to other, non-connected to the continental grid, electrical systems areas, its limited tourist development, its cultural and natural assets as well as demographic reasons. I argue that these features could allow for more transition pathways in regard to the energy technologies that will be used and the forms of tourism that will be developed in relation to other major islands.

The fifth chapter steers an energy transition in the empirical case. The transition process follows the logic of different pathways (Foxon et al, 2013), resulting in social and technical alterations; building on this, five different scenarios of deep energy transitions including tourism will be presented, in a 30-year horizon. Thus, the initial scenario is the "flourish of renewables" one, following a pathway promoting extensive installation of renewable and storage technologies, also enouraging locals to substantially engage in the transition. This pathway is based on one of the provisions laid down by the EU commission for alternative scenarios of energy transition European policy [based on E.C., 2011, "Energy Roadmap 2050", COM (2011), 885 final] as well as on delving deeper in conceptualizing sustainable development that takes into account the locals' wider engagement. An alternative scenario is the "gas emergence" one, which suggests changing to a gas power plant as well as installing renewable technologies. This pathway is driven by the intention of the state and the national energy utility company after considering the benefit and costs related to making a transition of the thermoelectric autonomous plants of several Aegean islands to natural gas technology due to European directives pressures for shutting down the current fossil fuel plants; moreover the national natural gas corporation also calls for running LNG-bunker infrastructures in several islands for the needs of the national shipping industry transition to natural gas technology, according to the new regulations. The third one, called the "linkage with the neighbors", promotes the electrical interconnection of the island with the neighboring islands and its simultaneous transition to renewable technologies. This scenario relies on views expressed by regional and national actors proposing it as a possible alternative in economic and technological terms. The "continental solution to the motherland" scenario refers to the case of an electrical interconnection of the island with the continental Greece and its transition to renewables. This pathway has been studied extensively by several institutional actors like the regulatory authority and the transmission one in the former years, while it has been proposed as a solution by the current National Energy Strategy (ΥΠ.ΠΕ.ΕΝ, 2018). The last scenario is the "interconnection with others", which refers to a pathway of interconnecting the island with the neighbor Turkish coast grid relying on past narratives set by policy makers in public discourse as well as on the fact that there is also alternative interconnection with the Turkish one in the continental network. Different scenarios declare a divergence in the starting point of the transition, the level of local engagement and technological decisions. Additionally, as part of the deep transition analysis ((van der Vleuten, 2018; Kagner and Schot, 2019), a tourism transition to sustainability is suggested, affected by the energy one, as a result of path dependences in the deep transformational process. In the end, there will be a concluding chapter summarizing the results and contribution of this research thesis to the related literature. With reference to the research's contribution, I would like to briefly stress some critical sights in this introductory chapter. Thus, a first contribution is that it develops an approach that allows a fully co-ordinated top-down transition, which nevertheless motivates locals and engages the society. A further contribution of this research thesis exists in the sense that it introduces a local steering actor as a way of facilitating energy transitions in frameworks with a political culture similar with the Greek one, where innovative institutional contexts and mature technologies do not seem to be adequate in successfully transforming the energy sector. A final contribution is related to this research focusing on the significance of technologies in terms of the transition pathways that will be followed. Influenced by the STS analysis, the methodological hybrid approach which is used in this research draws attention to the fact that different technologies involve different actors exerting different pace of power, namely changing the power relations in the process, while further, these infrastructures have divergent dynamic (agency) entailing alternative s-t transition pathways. An approach like this is unique in transition models set in the core of their analysis governance issues. Finally, this research thesis also contributes to the literature related to sustainable development on tourism by proposing a new perception in the way tourist studies perceive and approach sustainable development on tourism.

Furthermore, this chapter stresses the advantages and shortcomings, as well as the main objectives and limitations of the hybrid model that will be used. Further, a systematic comparison of the empirical case with the exemplary ones will be presented, while I will also attempt to theorize the results of my research, based on the Greek political and social framework, emphasizing on its policy implications. Ultimately, in this final chapter, I will outline the way in which an energy transition to sustainability will beneficially affect tourism and tourist development.

First Chapter

Deep Energy Transitions and Sustainable Development: Science, Technology and Society approaches

Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits - not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new era of economic growth. The Commission believes that widespread poverty is no longer inevitable. Poverty is not only an evil in itself, but sustainable development requires meeting the basic needs of all and extending to all the opportunity to fulfill their aspirations for a better life. A world in which poverty is endemic will always be prone to ecological and other catastrophes.

Brundland Commission report "Our Common Future", 1987:16

The concept of sustainable development emerged initially by intergovernmental organizations in the early and mid 80s (IUCN/UNEP/ WWF/FAO/UNESCO, 1980; World Commission on Environment and Development, 1987) as a result of conceiving environmental degradation and unlimited inequality as an outcome of human activity and "conventional" economic development. Global actors' insufficient attempts in evaluating human-made consequences to the environment during the 70s[8] led to the General Assembly of the United Nations in 1982 and its report "Our Common Future", five years later, arguing for the need of societies to turn to sustainable development. The concept had a normative status requiring new forms of social learning, involvement and co-operation. Thus, sustainable development passes into the public discourse of policy makers, researchers, business community and activists. However, the concept trying to integrate different, sometimes mutually exclusive perspectives (Redclift, 2005), resulted in its vagueness and its ambivalent character (Geels et al, 2017; Newig et al, 2007). Generally speaking, the term brings

[8] The Stockholm UN Conference (1972) results on these issues were in fact very poor.

out three pillars, an economic, a social and an environmental one. The first refers to an economic perspective of future development. Besides, the word development is mainly related to economic growth thus it has an economic view. The social perspective relies upon sustainable development's concern about inter and intra generational equity living and developing countries' need for growth so that they eliminate poverty. Brundland's (1987:15) incentives to avoid compromising "the ability of future generations to meet their own needs", as well as his exhortation for equity encouraging citizens' engagement, accurately describe and delineate the social dimension of sustainable development. First and foremost, sustainable development has an environmental perspective arguing for mitigation of resource depletion, climate change and environmental degradation. The environmental view, which advocates for an economic growth more environmentally friendly, is actually the most conventional perception of the term.

Building on these attempts, since the early 90s, intergovernmental organizations have planned a series of other international meetings in an effort to mitigate at least the environmental consequences of 'conventional' economic development, evaluate anthropogenic environmental degradation, plan and define targets and objectives to achieve sustainable development. Rio Earth Summit U.N. conference (1992) was the first of these meetings trying to specify ways of responding to Brundland's report for social and technological transformation to sustainable development.

This aforementioned conference, held in Rio, attempting to help international community deliberate and cooperate in issues related to environmental problems, adopted a new framework and sought international agreements. Main issues being addressed in the conference were a declaration of principles known as "Rio Declaration on Environment and Development", "Agenda 21' regarding desired actions, a statement of principles on forests and a number of international agreements regarding climate change, biodiversity and desertification (Parson and Haas, 1992; Kates et al, 2016). Thus, Rio Declaration was composed of 27 principles aiming at facilitating countries' turn to sustainable development; among these principles was also the "polluter pays" one. Further, Agenda 21 referred to actions needed so that we reduce our ecological footprint (Karimi, 2005). The report contains policies, actions, programmes and guidelines helping states achieve a more sustainable economic development taking into account Earth's carrying capacity (Ibid, 2005).

The most significant achievement of the Conference was an agreement on Climate Change Convention; being signed by 158 states, it led to the Kyoto Protocol (1997) and the Paris Agreement (2015) (UN Chronicle, 2007). The convention aims at stabilizing greenhouse gas (GHG) emissions in the atmosphere by recognizing the problem, while the agreements following were setting the framework for reining global warming (Falker, 2016). Thus, the Kyoto Protocol, adopted in 1997, established mechanisms such as the Clean Development Mechanism, facilitating countries to reduce greenhouse gasses, thus laying the ground for adopting the Paris Agreement (Kurihama and Abe, 2018). Kyoto was based on the principle of common responsibilities of developed and developing countries, however differentiated ones, while it advocated for the necessity that developed countries take the initial steps so as to limit their GHG emissions before developing countries would be asked to do so (Clemenson, 2016). Paris Agreement, on the other hand, was built upon different principles introducing a new phase in environmental politics (Falker, 2016). Thus, in contrast to Kyoto Protocol, the latter obliges all developed and developing countries to take actions to mitigate climate change. Further, Paris Agreement avoided establishing quantitative limits of GHG emissions' reduction by allowing states to set their own targets on the road to sustainable development (Falker, 2016).

It becomes clear from the above mentioned discourse that although other issues were also of great importance, in governance level, climate change mitigation has been acknowledged as the major issue of primary concern so that international community turns to sustainable development. More particularly, climate change was recognized in these agreements as a universal threat for societies, while it has its roots to the ways we have organized and developed our lives, particularly our highly demanding energy needs (Kirby and O' Mahony, 2018). According to the Intergovernmental Panel on Climate Change, the anthropogenic influence on the climate system is clear, while our recent emissions of GHG are the highest in history (IPCC, 2014:40). Historical emissions have driven atmospheric concentrations of several gases to unexampled levels, at least concerning the last 800,000 years (IPCC, 2014:44).

Energy is the major factor of the anthropogenic GHG emissions between 2000 and 2010 in a 47% share, being followed by the industry (30%), transport (11%) and building (3%) sectors (IPCC, 2014:46). Thus, it has been established that changes in the energy framework are the core issue when it comes to achieving sustainable development. In other words, the road to sustainable development requires social and technological changes of energy production and consumption practices and patterns. Further, energy is not a conventional commodity but is rather a precondition for

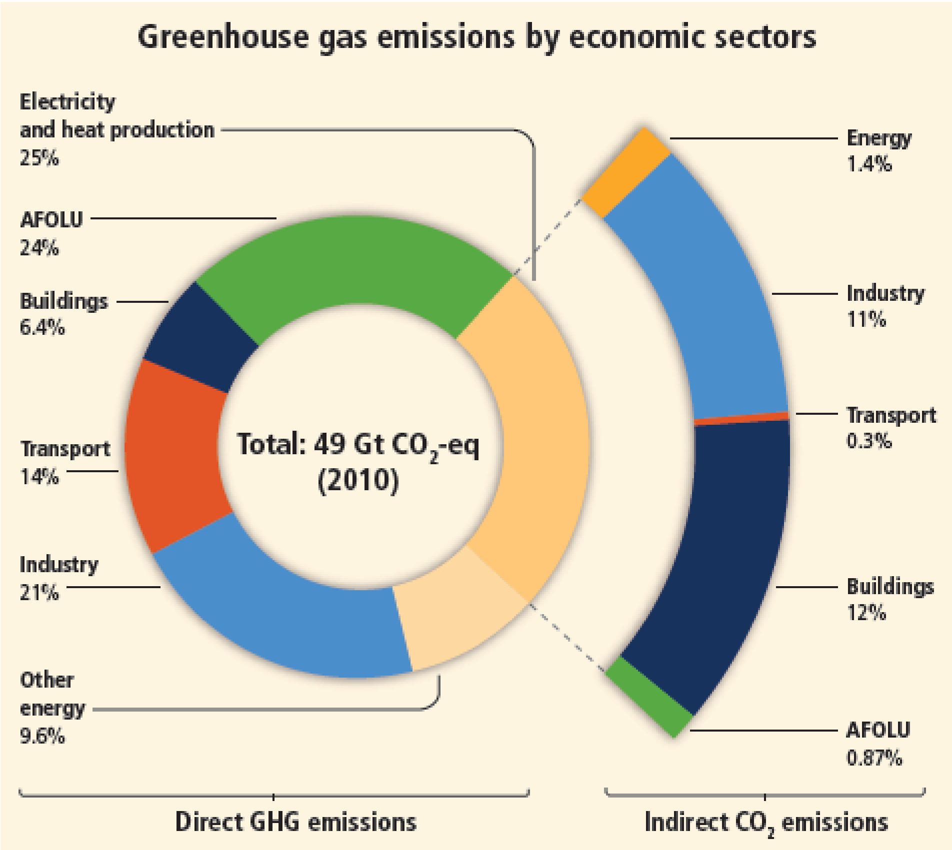

Figure 1. Greenhouse Gas Emissions by Economic Sector (IPCC, 2014:47)

recent issues of everyday life, behavior and individual choices (Van Vliet et al, 2005; Hutton, 1998). Hence, reducing energy consumption requires changes in the way we behave and act as consumers and users of several appliances. Moreover, seeing the other side of the coin, someone could argue against the massive energy amounts required by keeping current patterns and routines in a number of energy consuming sectors. Tourism, as a major international industry, is a sector of this kind. Thus, the sector accounts for 7% of the world's exports in goods and services, 10% of world's GDP and one in ten jobs worldwide (WTTC, 2015; UNWTO, 2017). In addition, tourist industry has developed rapidly and uninterruptedly since 1950. Thus, international tourist arrivals skyrocketed from 25 million in 1950 to 1.235 million in 2016 (UNWTO, 2017). This extraordinary growth of the sector brings about its vast energy consuming character. Thus, transportation, accommodation and other touristic activities absorbing energy in the host areas are responsible for about 5% of world CO_2 emissions[9] and for almost a 10% share of other global warming gasses (UNEP, 2008). Most of these emissions are related to car and airplane transportations (Respect, 2009). More specifically, tourism related to air transport has the biggest share of this energy consumption and is the fastest growing source of emissions in tourism (Respect, 2009; UNWTO, 2017).

In this context, it is argued that a turn of tourism to sustainable development also requires an energy transition including this industry due to path dependencies[10] (Rip and Kemp, 1998). Based on this, the main aim of this chapter is to highlight the significance of energy networks and energy transformations in order to direct energy consuming sectors like tourism to sustainable development orientations. In order to achieve its objective, the chapter will introduce perspectives perceiving sustainable development as deep structural and social transformation that will facilitate understanding the significance of interconnection of several sectors; therefore, it needs to be conceived that initially running an energy transition will guide tourism to more sustainable pathways. In this manner, approaches of the Science Technology and Society Field and Transition Studies will be analyzed. In this context, in the next section, Tourism Studies literature is reviewed in a critical way so that we can study the way the field conceptualizes sustainable development in tourism.

Interpreting sustainable development in tourism

Public understanding of the human made environmental changes and pressures to the international community for a sustainable future have contributed, since the late 80s, to constructing the concept of “sustainable development”. According to the report “Our Common Future” of the World Commission on Environment and Development (1987), sustainable development is “*development that meets the needs of the present without compromising the ability of future generations to meet their own needs”* (WCED, 1987). Despite being criticized from the outset for ambivalence, hypocrisy and vagueness (Cohens et al, 1998; Robinson, 2003 and 2004; Hedren and Linner,

[9] The report notes that estimated CO_2 emissions of tourism is between 3.9% to 6% of global emissions, while RF emissions including the maximum contribution of cirrus are up to 9% (UNEP, 2008:133).
[10] Rip and Kemp (1998: 354) define the concept as interrelatedness of social, technological and institutional parameters like artifacts, infrastructures and routines showing resistance in changes, namely in transformation processes.

2008), the concept started influencing many sectors. Tourism, albeit with some delay, was influenced by this notion as one of the biggest world industries. Thus, contemporary tourism, consisting of a heavy energy consuming sector due to its electricity and transportation needs, tried to adapt to these changes. The following pages contain a review of Tourism Studies literature related to alternative more sustainable tourism pathways; the significance that tourist scholars gave to issues of energy, steering tourism to sustainable development, is also evaluated. The section aims at evaluating the way that tourism scholars perceive sustainable development in tourism and whether the latter is conceived as a reason for deep structural and social transformations in several s-t systems[11] like electricity, transportation, water management and waste management, in the core of which is an energy transition.

Generally speaking, tourism scholars have been criticizing conventional tourist model even since the 70s. The consequences and characteristics of conventional tourist development have extensively concerned tourist academics. In this manner, criticism was launched regarding the industry's negative repercussions in relation to the local communities, the environment and the long-term deficiencies that such a development would result in. Moreover, the emergence of environmental and anti-nuclear movements and Green Parties in many European countries reinforced that criticism requiring a different trend for the development of tourism. In this framework, the 80s marked the appearance of alternatives to the conventional form of tourist development in the relevant literature. These forms were described as "special interest tourism", "alternative tourism" or "alternative forms of tourism", "authentic", "sensitive" and "appropriate" (Clarke, 1997; Smith and Eadington, 1992; Weiler and Hall, 1992; Butler, 1990; Krippendorf, 1989; Holden, 1984; Coccosis et al, 2011; Venetsopoulou M., 2006; Coccosis and Tsartas, 2001). In spite of this whole bulk of different names and the subplot of differences that these forms of tourism have, they share a common perception regarding a tourism that will take into account the local community and the environment, will be organized in a smaller scale and will limit mass tourism's negative ramifications (Jamal et al, 2013; Welk, 2004; Shepherd, 2002; Desforges, 1998;). Furthermore, these attempts of alternative forms of tourism that were associated with the protection of the environment, but also with the responsibility towards local community, were made known as "responsible tourism" (Jamal et al,

[11] The meaning of socio-technical (s-t) system is introduced in the second chapter of this research thesis.

2013; Haywood, 1988; Coccosis et al, 2011). The term is rather used to declare principles and guidelines instead of a particular form of tourism (Saarinen, 2014:2). Relying on the view of the directly interested parties, as for instance are the developing countries, many scholars note that the concept's key characteristics include limiting the negative the environmental, economic and social impact, facilititating the economic benefits for the local community, enhancing its well being and its working conditions, engaging communities in the decision making process, blending tourists with locals so that the formers would more properly understand and experience the latters' culture, as well as environmental and social issues in a context of respect among them, and finally enabling the access of people with disability issues (Jamal et al, 2013: 4596).

As it has been made clear, alternative tourism emerged, in the tourist literature, as the exact opposite of mass tourist development (Weaver, 1991). Undoubtedly, the distinction between mass and alternative tourism was criticized as being more confused and complicated that it was presented (Kontogeorgopoulos, 2003 and 2010; Collins-Kreiner and Israeli, 2010). Besides, among the alternative forms of tourism except from the eco-tourism, the agro-tourism, the natural tourism and the cultural tourism types, there are also the business travels, the cruise ship tourism and the conference tourism (Chen and Rahman, 2017; Datzira- Masip, 2006; Dowling, 2006; Garrod and Wilson, 2003; Johnson, 2002; Holloway, 1998). Thus, as Baysan (2001) clarifies, any form of tourism other than the 3s[12] model is considered an alternative one. Further, many scholars highlight the vagueness of the concept (Weaver, 1991) and the frequently common directions of alternatives forms of tourism with mass tourism, as in many cases, they developed as mass phenomenon (Vainikka, 2013; Aramperri, 2010; Sharpley, 2000). Based on the Tourist Studies literature so far, it can be argued that the field conceives the need of tourism transformation referring to sustainable perceptions of sustainable development in tourism even before the term was adopted, mainly through the concept of responsible tourism to which I referred earlier. Sustainable development in tourism was established in the relevant literature mainly in the early to mid 90s. Conceptualizing the term as well as related critique and shortcomings are presented in the following section.

[12] Namely, the conventional form of tourism.

Perceptions of sustainability in tourism and technology

In the academic discourse, sustainable tourism has concerned researchers extensively for a time span of more than two decades, which stretches until today (Cronin, 1990; Turner, 1991; Turner et al, 1994, Farrell, 1999; Hunter, 1999; Jafari, 2005; Higgins-Desbiolles, 2017). Therefore, a consistent conclusion concerning the literature on the mother concept of sustainable development, as well as the tourism related literature since its early stage (Wall 1993; Wheeller 1993; Farrell B.H., 1999, Butler, 1999; Smith and Sharicz, 2011; Law et al, 2016, Higgins D., 2017), is that there is considerable confusion and conflict over what sustainability on tourism is or should be. Thus, the concept faces critique as an ambiguous and vague concept that presents the principles but does not tell us anything about the practices, the strategies and the results, thus deterring policy making.

The dominant perception comprehends sustainable tourism as tourism that protects the environmental, cultural and social environment of the host destination so that the latter allows the economic development of tourism (Swarbrooke, 1999; Farrel, 1993 and 1999; Muller, 1994; Turner, 1991; Weaver, 2012 and 2011; Mac Kercher, 1993, Hunter, 1999). Thus, Farrell (1999 and 1993) argues that the sustainable tourism concept is an environmentally oriented one, which downplays the two other parameters, that is the economy and the society, while he calls for a sustainable tourist development that finds a balance between the three (also Muller, 1994). Further, Mac Kercher (1993) claims that sustainable tourism has to be conceptualized under the supervision of the tourist industry. In more recent views, Weaver (2012) presents an economy-oriented interpretation of sustainable development which is in parallel with Brutland's view, while supporting a perspective of sustainability based on ecological modernization. Other authors (Jafari, 1989, 2001 and 2005; Turner et al, 1994; Hunter, 1997 and 1999; Moscardo G. and Murphy L., 2014) use typologies of sustainability on tourism and argue for a flexible interpretation of the concept based on the local characteristics of the tourist destination. Jafari (1990) introduced a typology for analyzing and planning tourist development (2001 and 2005). His model referred to all forms of tourism including the conventional one; besides, he mentions the weakness of small scale tourism when it comes to dealing with the shortcomings of the massive model (2001).

Hunter (1997 and 1999) also claims that the notion of sustainable tourist development is a growth-oriented perspective in the literature, which is completely amputated from the parental concept of sustainable development. He criticized tourist scholars for their frequent aversion to define the sustainable tourism development when they talk about it. Its typology represents a reflexive concept, which adapts sustainable tourism based on the particular characteristics of each location and the stages of Buttler's (1980) tourist area cycle of evolution. Relying on this, he argues for different qualities of sustainable tourism, presenting a conceptual framework with four divergent types. Weaver (2012 and 2000) presents a typology of four pathways of tourist development, arguing for sustainable mass tourism. He mainly focuses on the three of these trajectories, which support an evolutionary orientation (organic, incremental and induced pathways), rather than a revolutionary one.

In a similar perspective, many scholars try to approach the concept using several management oriented quantifiable techniques like the carrying capacity, the cost-benefit analysis and several indicators (Martin, B.S. and Uysal, M, 1990; Wallace and Pierce, 1996; Ross and Wall, 1999a, b; Twining-Ward & Butler, 2002; Briassoulis, 2001, Tsaur et al, 2005; UNWTO, 2007; Michalena et al, 2009; Carrillo and Jorge, 2017; Nepala et al, 2019) like, for example, the sustainable tourism indicators. In this context, Michalena et al (2009), for instance, are using several indicators and a multiple criteria decision making approach so that they meet sustainable tourism development through renewable energy technologies (2009: 130). Other scholars promote a multi-indicators approach, evaluating the short and long-run causality of tourism and pollutant emissions for mountainous developing destinations (Nepaal et al, 2019). Carrillo and Jorge (2017), using weak and strong sustainability indicators, assess the sustainability of tourist development in 17 Spanish regions. In this manner, they determine the degree of the weak and strong sustainability of tourism to each area.

Eco tourism; conceiving sustainability in tourism?

Further, sustainable tourism was associated with forms of alternative tourism and mainly the ecotourism (Fennell, 1999; Kontogeorgopoulos, 2010; Jamal et al, 2013). In spite of the different conceptualizations, most scholars agreed on its sustainable characteristics and its opposition to the conventional paradigm (Amaro, 1999; Honey, 1999 Muller, 2007; Kontogeorgopoulos, 2010). In addition, some scholars (Blamey, 1997; Cole & Sinclair, 2002) associate it directly with sustainability and sustainable tourism. Nevertheless, it is also displayed that there can be more symbiotic relations of ecotourism and mass tourism in which these two forms could co-exist in a tourist destination as two alternatives (Van Oosterzee, 2000; Weaver, 1998, 2001, Kontogeorgopoulos, 2010; Vainikka, 2013). On the other hand, Jamal et al (2013) mention that, unlike the ecological and conservation characteristics of early ecotourism, the concept has been shaped in the opposite direction for the decades that followed; in this manner, in their view, the sustainability feature of ecotourism is under question. Furthermore, other researchers call the sustainability of the concept into question (Marzouki et al, 2012; Saarinen, 2014). Within this framework, Jamal et al (2013: 4602) propose a "decommodified" approach to ecotourism that will evaluate the local and global relation and which will approach locals and the natural environment with respect, while recognizing their cultural characteristics and relationships.

Regarding sustainable tourism, although the concept has been criticized since its existence, as of late, a new range of criticism and skepticism about it has risen. This is because of the failure of the concept to limit the negative ramifications of tourism and change its practices although the tourist industry has been consistently expanding. In this regard, many scholars criticized its tourist-centric perspective, its frequent inconsistency with the mother term of sustainable development, its focus on the local picture while ignoring the larger global one, its "sensitivity", which is usually restricted to environmental concerns while overlooking other dimensions of sustainability, its perception, guided by the academic community and inter-governmental institutions, that faces sustainability as an objective, scientific concept, and its vulnerability to integrate into other activities (Higgins-Desbiolles, 2017; Jamal, 2017; Moscardo and Murphy, 2014; Saarinen, 2014; Jamal et al, 2013; Moscardo, 2008 and 2009). Further, they suggest that the concept be integrated in and linked to that of responsible tourism, sustainable development and governance theories (Saarinen, 2014; Moscardo and Murphy, 2014; Jamal, 2017). Others call for moving beyond sustainable tourism as a concept that facilitates sustainability (Conway and Timms, 2010; Hall, 2009; Sharpley, 2009).

In this framework, Jamal et al (2013) highlight important issues and omissions of sustainable tourism discourse and try to promote conceptual frameworks of it that include the concepts of justice and care. Moscardo and Murphy (2014) criticize the failure of sustainable tourism to limit the negative repercussions of tourism and change its practices. Thus, they propose the idea of tourism as a tool that will support sustainability in different layers (2014: 2539); through the related literature, they point out that sustainable tourism concept is market oriented. Alternatively, they propose a new multi-level analysis approach that takes into account the quality of life (QoL) rather than only the economic and environmental dimensions (2014: 2543). Saarinen (2014) criticizes the current results and perceptions of sustainable tourism through the relevant literature. He mentions that the related tradition on sustainable tourism has evolved through three different perspectives which approach it with other terms concerning their focus and understanding of the concept as well as regarding the resources used in tourism (2014: 4). In spite of their differences, he argues that all three perspectives focus on the local scale, while they disregard the global. Saarinen argues that there is one last opportunity for sustainable tourism to re-form so that it overcomes its limitations. Thus, he calls for sustainable tourism to be redefined into a more critical view that links local and global scales. Regarding this, he highlights that local sustainable tourism practices as ecotourism, accompanied with the unsustainable practice of long-haul flights, could not give a sustainable tourism result; thus, in his words, “sustainability is a matter of both local and global responsibilities” (2014:10). Based on these remarks, he proposes that we move beyond a tourism led development and use tourism as a tool for sustainable development. To this objective, the necessity for the tourist industry to change is undoubted, while he advances a tourist development associated with the need of people (the workers and the local community), as well as with the quality of life and well being in the future (2014:10). Additionally, he argues that it is necessary that any such transition process be steered by the governmental and inter-governmental organizations so that sustainability in tourism in a local and a global connection is ensured. Higgins-Desbiolles (2017) criticizes the perception and guidance of the tourist policy makers regarding sustainability by arguing that contemporary tourism is more about sustaining tourism rather than sustainable development of tourism. She argues that the failure of sustainable tourism concept to lead us to more sustainable directions can be clearly seen on the “overtourism” that is the new phenomenon[13]. Finally, Jamal (2017) argues for tourism governance in the “new” world that emerges with new modes and interpretations of governance, a corporatist, market-driven perception, and finally, a weak regulatory and legislative environment at the global[14] but also at the local and business level of tourism. According to the author, tourism governance and policy making remains just a means till nowadays. By this concept, she refers to governance facilitating democracy and the host society and tourists engaging into the governance and policy issues of tourism in the local and the global level (2017:2). Decisively, she comes to the conclusion that good tourism governance presupposes justice, thus the rise of the values of democracy, diversity and equity. Finally, in sustainable tourism discourse, there are few attempts which have tried to use alternative approaches perceiving technology and technological changes as social and technological entities at the same time. These attempts comprehend the approaches only superficially. In this direction, Gössling et al (2012) try to use a transition management approach although they lose technologies from their analysis. Dedeke A. (2017) uses the Actor Network Theory framework in order to analyze sustainability issues on tourism. However, in his analysis, the author conceives networks, and subsequently its role in changing the type of tourism, only as social, disregarding the network's technological perspective.

Climate change and sustainable tourism

Another perspective of sustainability on tourism connects it with climate change concerns. In this view, the literature had been rare and possibly in a premature stage until recent years[15], while sometimes hypotheses and scenarios look like a wish list[16]. Further, only recently have scholars linked sustainable tourism to limiting tourism emission, thus de-carbonization, putting in the picture the massiveness of the phenomenon and the need for at least a stagnation of the tourist flows (Oklevik et al, 2019). The authors are primarily interested on transportation emission (mainly aviation) on tourism rather than on other energy technologies. Thus, Gössling et al (2002) use an ecological footprint analysis of tourism in their case study (Seychelles),

[13] See for example Seraphin H., 2018.
[14] Besides, she notes that the supranational institutions that compose regulations have weak regulatory power.
[15] Regarding this, see the relative new article of Fang et al, 2018.
[16] See for instance Lee and Brahmasrene's (2013) view on tourism-emission relation.

arguing that 97% of the footprint is a result of air travel. Other scholars indicate the importance of including tourism into climate policies and analyses so that emissions of the industry are reduced (Patterson and McDonald, 2004; Dwyer et al, 2010; Gössling and Hall, 2008; Scott et al, 2010). They highlight that tourist industry is a major producer of greenhouse emissions. Especially aviation is responsible for 40% of these emissions (Scott et al, 2016; Bows, 2010). Thus, many argue for the significance of governmental policies (Gössling and Hall, 2008; Scott et al, 2010), as well as policies of actors in the local scale, so that these destinations follow more sustainable tourist pathways away from over-tourism (Oklevik et al, 2019). However, there are views (Lee and Brahmasrene, 2013; Paramati et al, 2018) that questionably try to connect tourism development even with declining CO2 emissions through technological efficiency.

Gössling (2013) presents a picture of the role of tourism on the national emissions based on reports or on the rare academic articles. In a later article, Scott et al (2016) wonder whether tourist industry could follow the objective of WTTC for 50% reduction of GHG emissions until 2035 and 70% until 2050 in relation to the 2005 baseline, based on different scenarios. They note that the already presented scenarios of a “business as usual” orientation can only achieve very marginal results. In their view, achieving the targets requires further measures and coordinated policies that have to be market oriented; thus, de-carbonizing the industry is required before oil reserves are consumed. On the other hand, they mention that, although tourist industry's intergovernmental actors acknowledge the necessity to decouple the emissions of the sector, there haven't been any particular attempts to move on such transition through strategies and planning. These scholars promote pathways whose objectives will be achieved by the abatement of the tourist industry in tandem with carbon offsetting, rather than by implementing scenarios of an exclusive offsetting perception, as other scholars have recommended (Gillenwater et al, 2007). By the term “abatement”, they refer to the transition to tourist industry with more energy-efficient innovations that contribute to the sector’s energy needs declining (Scot et al, 2016b:58), whereas, by the offsetting concept, they refer to the GHG emissions of the industry declining by purchasing credible emission by other sectors rather than directly (Ibid:57). In their view, abatement scenarios are more cost-effective, while additionally, they will result in the industry becoming less dependent on other sectors and climate policies' uncertainties, avoiding a carbon cost exposure from 2050 on and reputational risks in regard to the sector (Ibid: 66). Many researchers argue also about the necessity of limiting long-haul travels. Actually, the most radical perspectives connect sustainability on tourism with calls for an urgent decrease in aviation and cruise ship travels (Scott et al, 2016b; Gössling and Peeters, 2015; Peeters and Dubois, 2010; Scott et al, 2010).

Tourism, Sustainability and the significance of energy transitions

What can be inferred from the above mentioned is that sustainable tourism, according to the dominant view of the academic discourse, refers to market-oriented tourism, which protects the environment to the extent that it allows further economic growth of tourism in the host area (Mac Kercher, 1993, Hunter, 1999; Weaver, 2012 and 2011). Thus, it is based mainly on an economic perspective of tourist industry's sustainability, counting the results through the earnings and the tourist flows, as well as on an environmental view, mainly through a technological modernization based on the efficiency of the artifacts and the technological networks. Further, as tourism scholars argue, it fails to notice the global picture, the local societies and the poor participating in tourism (Jamal et al, 2013; Jamal, 2017). In addition, sustainable development in tourism is proposed through a notion of divergent qualities advocating for more superficial (weak) or deeper (strong) types of sustainable tourist development (Carrillo and Jorge, 2017). The perspectives of tourism scholars on sustainable development in tourism will be useful in the final section of this chapter, when the vague concept of sustainable development will be delimited so that it facilitates the framework and the objectives of this thesis.

Further, in regard to sustainability on tourism, I argue that, in their analysis, all the different tourist traditions on sustainability overlook the significance of technological transformations in the transition of tourism to more sustainable pathways. However, these scholars, trying to focus on the importance of s-t networks in sustainable development in tourism, as is the case with Dedeke A. (2017), fail to notice the technological factor of the network. Further, in the rare cases that tourist scholars focus on the energy-consuming character of the industry, they zoom in on transportation. Furthermore, the different traditions do not perceive the inertia of a tourism transition to sustainability as a phenomenon deriving from, among others, technological issues like on lock-in mechanisms of the dominant actors, patterns and practices. The field of Science, Technology and Society (STS) approaches technology as a socio-technical entity. Based on that, I am going to use approaches and concepts that understand sustainability in terms of deep social and technological transformations (Schot and Kagner, 2018; Kagner and Schot, 2018) as I will show more extensively in the next chapter. Thus, I argue for sustainability on tourism through energy sustainable transitions that rely on parameters like governance and power relations, steering processes and reflexiveness, as well as on the role of the change of practices through users and local participation. What's more, although my analysis will focus on a local scale, I realize the significance of a global picture, thus I will propose certain actions or approaches in the final concluding chapter of my research thesis, inspired also by actor's decisions in the third chapter. I also advocate the importance of local engagement in the concept of sustainability. In the following sections, I will introduce notions and conceptual frameworks perceiving sustainable development as normative and deep social and technological transformation. Initially, in the section to come, I will critically review the literature on the interdisciplinary field of Science, Technology and Society, focusing on issues related to energy.

Energy and Socio-technical Transitions: Issues, Topics and Approaches

In this section, I will enrich tourism perception of sustainable development using Science, Technology and Society (STS) perspectives. More particularly, I argue that strong structural and social interlinks between different sectors, as they show considerable inertia, hinder a potential transformation to sustainable trajectories. To put it differently, activating an energy transition to sustainability will positively affect other s-t regimes[17], creating the framework that will lead the tourism s-t regime to more environmentally and socially sensitive directions. STS is an interdisciplinary field emphasizing on socially relevant groups and approaching symmetrical technological and social aspects of technological development. Thus, its views could give us new insights in energy and –finally– in tourism issues. Regarding energy issues, the most well known concept of STS scholars is that of socio-technical system (Sovacool, 2014). Hughes (1983 and 1987) argues for large technological systems

[17] This concept is defined in the second chapter of this thesis.

containing not only the materiality but also the organizations, the regulative framework, as well as cultural values. Differently, systems consist of several related parts that “become ordered, integrated and coordinated” (Sovacool and Hess, 2017: 717). Furthermore, many STS scholars (Hughes, 2001; Bijker et al, 1992; Kline & Pinch, 1999) view large technological systems as “social constructed artifacts” containing different actors which alternatively signify those artifacts. Another well known concept of STS literature relating to energy is that of “seamless web” (Hughes, 1986), used by approaches such as the social construction of technology (SCOT) and the actor network theory (ANT) (Bijker and Pinch, 2012; Sovacool, 2006).

In this section, I would discuss essential energy-related topics that have already been stressed by the researchers of the field. I will focus mainly on three energy topics which I consider of great value for my analysis. These are the issues of governance, of users and civil society and of the environment and sustainability. This is because I consider the way that these elements are perceived as essential in determining energy issues following a sustainable orientation. By this, I will argue for an STS perspective as a theoretical tool, allowing for an approach to sustainability issues in terms of deep social and technological transformations, and thus, enabling setting up a deep transition[18] to tourism.

Issues of Governance

The concept of governance was firstly brought up by political science, STS and other fields, resulting in the notion that the governments in multi-dimensional and multi-facet world are not any more the only players guiding societal issues (Kooiman, 2003; Smith and Stirling, 2006). In the current world, governance as governing has become a diffused process shared among governmental actors, the market and the society (Meadowcroft, 2007). Towards this direction, in the STS field, the concept of governance in subjects of energy was presented through different conceptualizations and conceptual frameworks. Thus, Sovacool (2010) argues for open and close research styles as ideal typologies of energy governance. He uses case studies connecting governance issues with the deployment of wind turbines, ethanol and hydrogen fuel cells. Inspired by past attempts, the author uses the term (Hughes,

[18] Regarding the deep transition concept, see See also in the second chapter of this research thesis. See also Schot and Kagner, 2018; Van Vleuten, 2018; Kagner and Schot, 2019.

1983, 1987 and 1989; Jamison, 1987) while enriching it with new characteristics. In his view, open research style is described by inclusive, participating, co-operating, decentralized and flexible characteristics of energy research (Sovacool, 2010: 907). Thus, this style engages many actors in different levels of management, diffusing the results of the research to many stakeholders and looking for evaluation from users and consumers (Ibid). Moreover, the open research style is decentralized and flexible as it permits the different groups of actors to work in their way and allowing them to adopt their own standards and processes. Generally speaking, while adopting an open research style, someone could even negotiate the size or other characteristics of the artifact. Danish development in wind technology in the decades of 70s and 80s could be characterized as such too (Heymann, 1998). In this context, having Danish engineers engage in other relevant wind actors, focusing on practice-oriented rather than ambitious technologies, learning from each other and deliberating on issues like the designs, policies, scientific knowledge (Nielsen and Heymann, 2012) contributed to country's wind technology success. The way that the Danish energy s-t regime was developed in the above mentioned period as well as governance issues will be studied in the third chapter of this research. The close research style in energy, on the other hand, is characterized by an exclusive, centralized, narrow and rigid form, also establishing strong property rights. This style permits only particular actors to participate, holding the results in check and promoting competition between the actors. Additionally, it is centralized, as a small number of actors manage the whole process, while it doesn't focus on issues of users' and markets' engagement (Ibid: 908). In this view, Winner's (1986) American nuclear reactor is a paradigm of close research style. According to his notion, nuclear reactors in the USA require an authoritarian, centralized and exclusive technological approach (Ibid). As I am going to argue subsequently, the wind energy policy of the 70s and the 80s in Sweden also moved in this direction.

Other STS scholars (Nielsen and Heymann, 2012; Brittan, 2001; Hughes, 2001; Kline & Pinch, 1999; Pinch, 1999; Hecht, 1994; Bijker, 1992 and 1995; Bijker & Law, 1992) have explained how differences in technological designs hide dissimilar political and social narratives or successes and failures of the innovations, and in this way, how governance is exerted through artifacts and groups of engineers. With respect to this, Gabliel Hecht's (1994) article on the design of two nuclear reactors in post-war France is indicative. Through this, the author argues that reactors were not just technological artifacts but political tools, as completely different narratives, visions and perceptions on the political and industrial future of the French state have been inscribed by their engineers and managers through their designs (1994: 658). Besides, the field's academics approach governance as governing emphasizing on technologies and technological systems narratives as powerful socio-technical imaginaries (Jasanoff and Kim, 2015; Jasanoff, 2009; Miller 2015; Miller and Edwards 2001, Urlike, 2015), thus as dynamic objects of governance (Hackett et al, 2007; Jasanoff, 2006). Regarding this, it is indicated, for instance, how political elites and policy makers in South Korea, through socio-technical narratives of sustainable national development, tend to downplay the high degree of risks related to the environment, health and safety (Kim, 2015).

Users and civil society engagement

Although STS scholars underline the importance of technological characteristics as tools of governance, different traditions of STS show the significance of users' role in shaping the technological configurations (Oudshoorn and Pinch, 2008). These advocates of technological studies argue on the role of users, consumers and social participation in shaping and stabilizing technologies (Nye, 2004; Morth, 2002; MacKenzie, 1998). Regarding this, scholars like David Nye (2004) showed the terms under which users and consumers of electricity, as social relevant groups, bring about energy policy and innovation. Moreover, he argues on the connection of users' practices with cultural and geographical dissimilarities affecting the penetration of electricity among the different countries and areas, as well as the relevant narratives adopted in the particular cases. Nye also explains that differences were a matter of political decisions and perceptions regarding the public or private character of electricity and the encouragement of its intensive or extensive use. I consider the role of users in energy policy and energy transitions significant, thus I will revert to it in the following chapter.

On the same wave length, Heymann (1998) uses the concept of technological style to explain regional and national developments of technological deployment. In this trend, the role of civic engagement and of social relevant groups' deliberation in avoiding tensions and installing renewable technologies are reviewed by other scholars. Thus, Jolivet and Heiskanen (2010), following insights of the Actor Network Theory (ANT), attempt to highlight local actors' resistance or acceptance on wind-turbines projects. Authors shed light on micro analysis and micro political dynamics affecting more global pathways (Ibid: 6748). Based on that, they use the concepts of framing and overflowing of different actor networks, as well as that of materialization of a narrative, through which they interpret the participatory process. Through a case study of local resistance to wind turbines being installed, they stress these perspectives arguing on the importance of analyzing the social and technical dimensions in each such project separately.

Another perspective of users rising in the field of STS argues for a more emphatic and direct use of the social engagement parameter in technological policy and in energy policy in particular (Chilvers and Evans, 2009; Brown, 2007; Levidow 1998; Rayner 2003; Irwin 2006). These views, although having limited presence in the field (Breyman et al, 2017), highlight the engagement of “pure publics” –that is, of those parts of communities that have no prior engagement in a subject– in technological policy (Soneryd, 2016). Initial attempts defined the methods, thus focusing on specifying the objectives and the techniques which can achieve deliberation, as well on guidance issues (Lezaun and Soneryd, 2007; Bogner 2012). These conformed approaches were criticized for meager participation, myopic perception of publics and its agency (Braun and Schultz 2010; Jasanoff and Kim 2009; Marres 2007; Felt and Fochler 2010 and 2011). In this framework, in more recent understandings, STS’s advocates blend and enrich these trends with insights from other fields approaching social engagement (Chilvers et al, 2018; Chilvers and Longhurst, 2016; Soneryd, 2016; Marres, 2012). I am going to present some of these perspectives widely in the next chapter.

Moreover, technological studies literature also associates social participation with the concepts of democracy, democratic governance and energy democracy (Hess, 2018; Jasanoff, 2011; Fischer, 2000; Sclove, 1995; Wynne, 1996), as well as energy justice (Jenkins et al, 2018; Jenkins, 2018; Sovacool et al, 2017; Sovacool and Dworkin, 2015 and 2014, Hall et al, 2013). Towards these concepts, energy democracy, although partially similar to energy justice, does however present clear differences; thus, the former emphasizes the most on issues of structural inequality on energy politics and the need for societal change (Hess, 2018). Besides, engaging publics is a step towards democratic participation and governance (Hess et al, 2008). On the other hand, the growing arguable issue of energy justice focuses mainly on meeting the energy needs of those with a lower income as well as of the oppressed ones; further, it highlights that power relations could actually overlook these needs by evaluating alternative interests as more significant. Applying logics of social justice, the term is influenced by environmental justice (Jenkins, 2018), a concept analyzed subsequently, blending with environmental and sustainable perspectives as well as having insights from civil society's engagement and governance in energy policy. More recent views, conceiving energy justice as an analytical tool, allow energy scholars to perceive the way values could be established or marginalized in energy systems, as well as to deal with energy issues (Sovacool et al, 2017; Sovacool and Dworkin, 2015). I will return and analyze the concept of energy democracy more extensively in a next section of this chapter.

STS's perspectives on environment and sustainability

Environment and sustainability constitute another issue of technological studies interweaving partially with matters of justice and civic participation. As Yearley (2008: 936) argues, the significance of the environment in STS is not a matter of a different perspective or a new site extending the field, but of "key insight into the status of 'the natural' in advanced modernity". Advocates of the field also present issues of environmental justice relating to energy (Kimura and Katano, 2014; Lerner, 2005; Sawyer 2004). Thus, Lerner (2005:1041), using STS tools, presents and analyzes how local residents, accusing an international company's plant of causing vast pollution and urging for its relocation, achieve their objectives with homemade samples. These scholars employ STS analysis in order to conceive the way that science and technology could provide fundamental insights indicating environmental injustice. Thus, STS discourse introduces new prospects of an environmental justice concept, perceiving the unfair way that knowledge in this particular topic is produced, thus structuring environmental injustice (Ottinger et al, 2017). Finally, the role of socio-technical systems in constructing, supporting and sometimes sabotaging environmental injustice (Ibid) is also underlined. Many scholars are studying topics like research and environmental policy nexus (Bocking, 2004; Sundqvist et al, 2002), ecosystem management practices (Helford, 1999), citizen participation in environmental understanding and decision making (Bush et al, 2001; Petts, 2001; Yearley et al, 2001) in connection with technological, and in some cases, energy policies. Further, the related literature on the field discusses this kind of topics with an inter-disciplinary view with scholars from other disciplines like Geography (Castree & Braun, 2001; Demeritt, 2002), Environmental Sociology (McCright & Dunlap, 2000, 2003), Evolutionary Economics (Rip and Kemp, 1998) and others.

Other views focus on environmental sustainability and raise issues of energy use as a factor leading to the former's failure. In this line, Nye (2004:189) compares artifacts' ecological modernization and energy efficiency race as "the mad queen in Alice Worderland, who has to run as fast as she could just to stay were she already was". Regarding this, some scholars remind us the co-evolutionary character of socio-technical systems (Callon, 1995; Akcrich, 1994; Hughes, 1988;) through approaches like ANT or concepts like seamless web. Therefore, Wong (2015), for instance, argues for use of ANT approach as a tool in energy studies steering to more sustainable pathways. Others call for further attention to the relation between social practices and materiality, proposing changes not only to the technical part but also to social practices for environmental sustainable trajectories in energy policy (Brand and Fischer, 2013). In this context, since the 90s, STS scholars have been trying to develop approaches in energy policy facilitating transitions to more sustainable directions (Rip et al, 1995; Rip and Kemp, 1998; Sorensen and Williams, 2002; Hoogma et al, 2002). Further, these views correlate with political agendas arguing for more sustainable orientation as their primary objective (Hommels et al, 2007; Geels and Schot, 2007; Hommels et al, 2007b). I am going to come back to this debate in the next chapter, where these views and approaches will be introduced in detail. Consequently, we focus on views of social science, and more particularly on STS scholars, highlighting the way these fields interpret sustainable development in relation to energy issues.

Thinking on sustainable development in energy: social science perspective

Historian Paul Warde (2011:154) argues that the concept of sustainability as a perception of conserving soil nutrients so as to prevent permanent degradation emerged in the late eighteenth and early nineteenth century. Over the past decades, sustainability has come to the fore through the concept of sustainable development. Many scholars, of course, underline that there are some distinctions between these two terms (Tijmes and Luijf 1995; Dresder, 2002). The most well known definition of sustainable development in recent history is that of the Brundtland Commission report introduced about four decades ago. However, since the 80s, endless definitions of the concept have been developed (Pearce et al, 1989; Pezzey, 1992; Mitlin 1992; Murdoch 1993; Murcott, 1997), while the concept has been used in many different ways and in different qualities (Langehelle, 2000). Thus, divergent typologies and approaches of sustainable development have been developed (Dobson, 1996 and 1999; Mac Manus, 1996). Moreover, other scholars recommended different qualities of sustainable development, from very weak to very strong (Pearce, 1993; Turner, 1993; Turner et al, 1994; Baker et al, 1997). Regarding the quality of sustainability, Norton argues that weak sustainability declares “maintaining a non-declining stock of economic capital into the indefinite future” allowing “unlimited substitution” between natural and human-made types of capital, while the strong form of the concept “specifies limits on substitution” based on the inherent importance of some natural resources (Norton, 2005, p. 307).

In this section, I am going to critically review the literature on sustainability and sustainable development in energy as it is approached by the social sciences. I am looking for the divergent ways sustainable development is perceived by social sciences scholars related to energy. Further, I am interested in alternative approaches and criticism on the dominant perceptive. My review is based mainly on literature on STS and other interdisciplinary fields of social sciences studying energy issues.

Perceiving divergently sustainable development in energy

There hasn't been a clear definition of sustainable development by the scholars of the field. Although many of them mention its vague and ambivalent features, as well as its normative nature (Geels et al, 2017; Newig et al, 2007; Walker and Shove, 2007; Vob et al, 2007), only few have tried to define the term. Lange et al (2013:405) connected the term with the concept of global justice, restricted environmental resources and fragile ecosystems. Toward this, many scholars conceive sustainable development as mainly a process of ecological efficiency of energy technologies and network, or at best, a de-carbonized one (Heiskanen et al, 2019; Walz and Kohler, 2014; Shove and Walker, 2007 and 2010; Huber, 2000; Vliet et al, 2005; Langelle, 2000; Hajer, 1995; Weale, 1992). Ecological modernization was perceived by few scholars (Weale, 1992; Hajer, 1995) as identical to sustainable development. Supporters of this notion argue that technological and managerial changes could face and persuasively answer environmental crisis (Seghezzo, 2009) or, as other scholars raise it, that the eco-efficiency argument indicates that such transformation could maintain current development patterns (Baker, 2007). Regarding this, others distinguish the concepts arguing that ecological modernization could be at best a "weak" view of sustainable development (Langelle, 2000). In addition, many researchers (Hagbert and Bradley, 2017; Huber, 2000) claim that achieving sustainable development in energy requires more than the answer that technological efficiency can come up with.

In this line, Seghezzo (2007), attempting to limit sustainable development shortcomings, proposes a five dimensional approach to interpret and comprehend the concept in a more credible way. Hagbert and Bradley (2017) advocate the need to study alternative narratives of sustainability in energy policy beyond the conventional ones focusing on issues of eco-efficiency. Thus, they present paradigms of alternative visions influencing production patterns and every-day life styles towards sustainability. Through interviews, authors introduce perceptions regarding self-sufficiency and downshifting to low-consumption lifestyles, thus differentiating from the conventional ones. Other scholars (Shove and Walker, 2007; Hubber 2000) underline that the dominant view in academic and business discourse is that of efficiency boosting. Therefore, they argue that changes towards sustainability focus on making contemporary innovations and technologies more efficient, following the usual patterns of production and consumption. Towards this direction, businesses continue investing heavily in unsustainable technologies making them more efficient rather than substituting them with other more sustainable ones; based on this, Shove and Walker (2007) criticize the idea of "sustainable" nuclear energy infrastructures. Approaching this issue in terms of proposals, Hubber (2000:281) supports the notion that turning to sustainable development calls for changes beyond efficiency and sufficiency dilemma, thus qualitative transformations of the "industrial metabolism"; this can be interpreted as a change of industrial networks, technologies and products, enabling its persistent use without degrading the environment or draining the already limited current stock of resources. Supporting his notion, he argues in favor of technologies such as hydro-solar energy.

In the way to de-carbonized societies, policy makers perceive gas along with the deployment of techniques capturing carbon emissions as reliable solutions or –even worse– they come up with narratives of nuclear energy as answers to sustainable development, as it has already been mentioned. Therefore, many researchers (Meadowcroft, 2009; Meadowcroft and Langhelle, 2009; Verbruggen et al, 2014; Diaz-Maurin and Kovacic, 2015; Gralla et al, 2016; Perlaviciute et al, 2016) approach gas and nuclear power issues in the road to sustainable development according to the aforementioned logic. Diaz-Naurin and Kovacic (2015) focus on perceptions of sustainability regarding nuclear energy production, based mainly on views of sustainable development related to intergenerational equity and subjects such as nuclear waste management in the long-run and depletion of uranium resources. Further, other researchers have used distinctive multi-criteria analysis evaluating the "volume" of sustainability on nuclear energy (IAEA, 2008; IEA, 2012; Verbruggen et al, 2014). Thus, Verbruggen et al (2014) come up with 19 criteria to assess whether nuclear fission power can be a part of sustainable development. Gralla et al (2016) portray nuclear countries' perspectives of sustainability by analyzing policy documents. More particularly, the authors analyze the energy strategies of nine nuclear countries regarding the way they define sustainability in relation to energy policy. They highlight the lack of a sustainability definition, mainly in regard to some facets of the concept such as issues within the social and risk sustainability dimensions. They argue that different countries focus mainly on economic and social dimensions, assessing sustainability through criteria as climate change, efficiency of energy supply and technologies as well as investment costs, while ignoring others like nuclear waste management problems or issues pertaining to depletion of natural resources.

Other scholars argue that nuclear as well as other questionable energy technologies become parts of the solution due to "lesser evil" comparisons in a decarbonizing world with rapidly growing energy needs (Jacobsen and Delucchi, 2009; Vanderheiden, 2011:609). Relying on these issues, it is underlined that the major issues in de-carbonizing energy socio-technical systems are political rather than technological ones (Vanderheiden, 2011). In regard to carbon capture techniques, scholars (Meadowcroft, 2009; Meadowcroft and Landhelle, 2009) question the sustainable orientation of such innovations, persevering with the use of fossil fuels and realigning unsustainable technologies, while keeping current energy social practices and patterns. The issue of how sustainable some particular technologies are will be an ongoing one in the next but also in the fifth chapter of this research thesis.

Other more social-oriented views of sustainability promote visions and perceptions of energy policies interested in bottom-up changes, engaging social movements and local societies. A concept embedding this more civil society-oriented approach is that of energy democracy (Becker and Nauman, 2017; Burke and Stephens, 2017 and 2018; Angel, 2017; Szulecki, 2018; Van Veelen and Van der Horst, 2018). Thus, Hess (2018), relates the concept of energy democracy to that of energy justice, although he mentions that the former's focus is on the effects of structural inequality on energy politics and the need for societal change. He argues that common features of both concepts are low-income citizens' access to affordable energy and good jobs, while both terms are related to issues of reforming energy governance, enabling grassroots and public perspectives to be heard (2018:179). Further, Szulecki (2018) responds to the lack of clarity which the energy democracy concept is troubled by, emphasizing on the relation between energy and democracy, arguing in favor of energy democratic governmentality, while he introduces a new type of user, the prosumer-citizen, as the one that could facilitate a more democratic energy governance. Conceptualizing energy democracy was an issue for Burke and Stephens (2017). These scholars approach the concept through the objectives of resisting, reclaiming and restructuring followed by social movements. They argue that de-carbonizing energy networks passes through divergent narratives of energy politics, some of which energy democracy advocates intend to enhance by employing their concept. They highlight that an energy democracy concept can not only induce de-carbonizing energy systems but can also facilitate shifting social and political dynamics towards more democratic and sustainable ones. Further, in their more recent work (Burke and Stephens, 2018), authors argue for the need to strengthen the conceptual framework of energy democracy. Towards this direction, Van Veelen and Van der Horst (2018: 26), after assessing the relative literature, indicate the core aspects of the term, namely its renewable, participatory equity oriented character and an intention of shifting decision making and political power towards the local level.

In addition, other scholars (Hess, 2019; Angel, 2017) approach energy democracy through paradigms of specific energy imaginaries. Thus, Hess (2019), analyzing the case of CCA in California, shows how energy utilities recover financially and politically by engaging civil society and the state in energy issues. Additionally, Angel (2017), through the Berlin case, exhibits ways under which energy democracy movements facilitated changing power relations in the European framework. I consider energy democracy a concept that confers sustainable development a quality that needs to be used in delimiting the concept. Hence, I am going to use this concept in a next section when sustainable development will be bounded.

Transformation towards sustainable development and energy governance

Transformation, of energy as well as of other systems, to sustainability is another core issue extensively analyzed by divergent fields of social sciences. This notion has been gaining more and more ground in articulating endeavors for societal and other changes in societies towards more sustainable and equitable futures (Future Earth, 2014a, b). Thus, transformation to sustainability is referred to as a deep political process where the positions of power relations and actors change due to particular decisions (Van den Bergh et al, 2011; Meadowcroft, 2011). Towards this view, many scholars perceive sustainability as deep structural, functional, relational and cognitive changes to socio-technical but also ecological systems (de Haan and Rotmans, 2011; Hackmann and Clair, 2012; O'Brien, 2012; Feola, 2014; Patterson, 2017:2; Schot and Kagner, 2018; Geels et al, 2018). Regarding this, many focus on the slow pace of this transaction underlining technological (Rip and Kemp, 1998, Geels et al, 2018) or even institutional (Unruh, 2000; Arauho, 2014; Heiskanen et al) path dependencies. Thus, Geels et al (2018) argue in favor of an evolutionary process integrating technologies, institutions, skills, knowledge and behaviors, and on the other hand, Heiskanen et al (2019) explored insights of institutional change in energy field as a way of facilitating and accelerating transition to sustainable energy contexts.

In social science literature, different inter-disciplinary fields have tried to approach the transformation to sustainability notion by constructing alternative albeit partially overlapping approaches. On that account, socio-technical transitions (Geels, 2002; Schot and Geels, 2007; Geels, 2011; Geels, 2018), transition management (Loorbach, 2007 and 2010), socio ecological transformations (Olson et al, 2006 and 2014; Westley et al 2011), transformative pathways to sustainability (Leach et al, 2012 and 2013; Stirling, 2014), transformative adaptation (Pelling, 2011; O' Brien and Selboe, 2015) as well as social practice theory (Walker and Shove, 2007; Shove, 2012; Shove and Walker, 2014) are some of the frameworks used which approach transformation to sustainable development. Those different approaches have many differences as well as similarities in the way they perceive and develop social, environmental and technological change. In the next chapter, some of these approaches, but mainly s-t transitions one, will be introduced so that they can be later used as a methodological tool in my empirical chapters. Further, it is worth noting a framework based partially on s-t transitions which interprets technological transitions as deep structural, social and institutional changes in the same direction of an s-t regimes set (Schot and Kagner, 2018; Kagner and Schot, 2018). In other words, the approach points out the interrelated dynamics of different actors, rules and socio-technical systems, conceiving transition processes as "parallel evolution of single systems, complexes of systems as well as the broader and long term transformations of industrial society" (Schot and Kagner:1046). This concept is known as deep transitions (Schot and Kagner, 2018). I consider this conceptual framework of great value for my research analysis, thus I am going to analyze it further in the next chapter.

Further, in transformation analysis, many scholars endorse the significance of governance and politics in achieving sustainability (Ayre & Callway, 2005; Smith et al, 2005; Meadowcroft, 2007 and 2011; Smith and Stirling, 2007, 2008 and 2010; Walker and Shove, 2007; O'Brien, 2012; Lagne et al, 2013; Olson et al, 2014; Scoones et al, 2015; Patterson, 2017; Stirling et al, 2018). In this view, it is argued that a weakness of several approaches steering to sustainability could be actually a lack of governance issue (Adger & Jordan, 2009; Farrell et al, 2005; Van Zeijl-Rozema et al, 2008). Further, Walker and Shove (2007) argue on re-considering sustainability in governance as the only chance of the ambivalent and normative concept of sustainable development. Towards this notion, other scholars question the interpretation of good governance, claiming that it is not about following a conventional pathway sustaining a balance between benefits and risks, but it is also about governance taking into account bottom-up collective attempts by the civil society as well as serving a fairer share of resources in support of open-source innovation (Stirling et al, 2018). In regard to issues related to innovation, Smith and Stirling (2018) underline the significance of innovation for sustainability in steering to more environmentally benign, democratic and social just pathways, arguing about its political character, namely about the fact that the way we approach issues of innovation for sustainability rises matters of governance. Regarding this, they claim that control over innovation processes by wider audiences is of substantial importance so that greater parts of civil society can be engaged, following ethic-oriented trajectories, arguing in favor of grassroots innovation and innovation democracy. Governing in such alternative directions in innovation challenges dominant narratives and values, allowing turns towards sustainable development.

Further, different scholars have proposed different governance modes in search of the one that fits the best, thus promoting sustainable development. Hence, Meadowcroft (2007) argues for the way we should direct a transformation in a world of governance with distributed power, while Smith and Stirling (2007) present divergent modes of governance based on alternative views of the roles and connections between social evaluation and social engagement in governance. On the other hand, others argue on the need to determine different modes of governance more explicitly (Hillman et al, 2011). Thus, Lagne et al (2013) tried to create a meta-framework relying on the triad of politics, polity and policy, arguing for an approach which overpasses the vagueness of previous attempts. In the same trend, Bornemann et al (2018) propose the change of individual energy consumption behavior (CIECB) as a critical tool, moving towards sustainability which facilitates future energy governance. The issue of governance is fundamental in studying issues of power and agency, that is in understanding and steering s-t transitions, therefore the next chapter will address particular conceptual frameworks of governance that are considered useful in answering aims and objectives of this research thesis. In the final section of this chapter, I will try to delimit the concept of sustainable development, relying on the concepts and perception of the literature reviewed in the former sections of this chapter. Conceptualization of the term will be based mainly on divergent social studies fields view but also on the perspectives of tourism studies.

Conceptualizing Sustainable Development

Based on the related literature, it could be argued that social sciences conceive sustainable development as deep structural and social transformations (Schot and Kagner, 2018) affecting socio-technical and ecological systems, while focusing on issues of power relations, policy and politics (de Haan and Rotmans, 2011; Hackmann and Clair, 2012; O'Brien, 2012; Feola, 2014; Patterson, 2017:2; Geels et al, 2018). The conventional view of these transformations aims at ecological efficiency of energy technologies and networks as well as at technological de-carbonization (Heiskanen et al, 2019; Hajer, 1995; Weale, 1992). These views accept or even promote nuclear power as energy paths towards sustainable development (Shove and Walker, 2007). Other scholars made reference to issues of changes on the patterns of production and everyday life (Hagbert and Bradley, 2017). Additionally, more alternative views approach sustainable development in energy, supporting participatory processes and emphasizing on perceptions and concepts such as energy democracy (Szulecki, 2018; Hess, 2018) and good governance (Stirling et al, 2018).

In this section, I am going to delimit the way sustainable development is perceived in this research thesis, so as to limit any issues of ambivalence and vagueness of the concept. These perceptions originate from social studies in general, STS and Sustainable Transition Studies (Vob et al, 2007; Newig et al, 2007; Walker and Shove, 2007; Hagbert and Bradley, 2017; Angel, 2017; Szulecki, 2018; Burke and Stephens, 2017 and 2018; Heiskanen et al, 2019), but also from the Tourist Studies literature, which was reviewed in a former section. Based on these, I argue that sustainability has many different varieties and qualities (Pearce, 1993; Turner et al, 1994; Baker et al, 1997; Norton, 2005; Carrillo and Jorge, 2017). I argue that the concept must not be just linked to the de-carbonization and technological modernization of s-t systems and the preservation of resources (Heiskanen et al, 2019; Jamal et al, 2013) but it also has to be interrelated with further environmental concerns (regarding depletion of natural resources, environmental degradation, pollution etc.), that is changes to users' practices, life-styles and dominant pathways from the incumbents, as well as with social concerns about more democratic participation in energy issues, either in regard to deliberation processes or to the share of the capital resources, namely the need for local participation and engagement in the governance process (Angel, 2017; Becker and Nauman, 2017; Jamal, 2017; Burke and

Stephens, 2017 and 2018; Szulecki, 2018; Stirling et al, 2018; Hess, 2018 and 2019). Further, sustainability has to be interconnected with governmental organizations participating in the steering process ensuring sustainability in a local and a global connection, thus making it possible for future generations to meet their own needs (Meadowcroft, 2007; Jamal, 2017). In this context, I argue that governance and social engagement are critical concepts which determine the quality of sustainability concept in a transition, and subsequently its weak or strong character. So, deep structural and social changes leading to renewable technologies and changing the patterns and the practices of consumption, but also the way local communities participate in an energy transition render a rather deep (strong) type of sustainable development. Such view has been influenced by concepts like energy democracy and good governance (Hess, 2018; Stirling et al, 2018). However, running an energy transition could lead to frameworks without particular social changes due to restricted users/consumers' participation in the deliberation process or due to their limited interest in owning the capital resources; in these cases, an objective would be to achieve at least a superficial (weak) type of sustainable development. Regarding this, I argue that eco-efficiency and de-carbonization must not be the only parameters evaluating sustainable development (Hagbert and Bradley, 2017). Thus, use of renewables and a minimum level of changing the consumption patterns has to be secured, determining the weak sustainable development. In those trends, a parameter guaranteeing a limit level of sustainability[19] of the process has to be defined. I consider technologies and management techniques as demand side management as parameters of great value, as the case study of Gotland presented in the third chapter will show us, as to facilitate achieving at least a weak type of sustainable development.

In the following chapter, I am going to present a critical review of Sustainable Transition Studies approaches, an interdisciplinary field which perceives transitions as social and technological transformations. More particularly, I will focus on the field’s most mature approach of societal and technological transformation, that of socio-technical transition, so that I establish a hybrid model which orients societies to sustainable development, positively influencing tourism as well. In this attempt, I am going to integrate conceptual frameworks and notions that could facilitate alternative perceptions of sustainable development, allowing for a more holistic view.

[19] Namely, a weak type of the concept.

Second Chapter – Sustainable Transition Studies: Between Social Studies of Technology and Evolutionary Economics

As discussed briefly in the previous chapter, in recent research on development and management of radical innovations in the STS Field, there were initiatives (Hommels et al, 2007; Geels and Schot, 2007b; Hommels et al, 2007) for conceptual connections of social constructivist approaches with others based also on other fields like evolutionary economics. Linking STS theories and concepts with evolutionary economics has been raised since the late 90s. In this context, a new interdisciplinary field, that of Sustainable Transition Studies, has flourished. The field uses the conceptual framework from Sociology of Technology and History of Technology, as well as from innovation studies and evolutionary economics (Rip and Kemp, 1998; Geels, 2002).

Further, the field perceives and analyzes technological transformations as socio-technical entities. In this manner, it comprehends systems' transformation by emphasizing on issues like technology locking in at certain innovations instead of others (Geels et al, 2018; Rip and Kemp, 1998), on the role of actors, by analyzing which affected the changing process the most (Smith et al, 2005), and finally, on the terms under which the transition was carried out and inferences which could be drawn regarding the participation of the stakeholders in decision making and their engagement in determining decisions regarding the technological pathways which will be followed (Geels and Schot, 2007a, Foxon, 2010; Foxon et al, 2013).

The concept of sustainable transitions refers to alterations that have been made in socio-technical systems, in a number of sectors that face vital environmental problems like energy, transport, water, food[20] so that they transform these sectors into more sustainable configurations facilitating sustainable development. In other words, the transition approaches are used mainly as tools interpreting and analyzing socio-technical systems as well as establishing policies steering to sustainable development pathways (Geels, 2005c and 2005b; Meadowcroft, 2007). Sustainable transitions are dynamic and long-term processes including many different actors. The socio-technical concept[21] declares that transitions do not only refer to changes in the materiality, namely the artifacts, the infrastructures and the networks, but also to changes in

[20] See, for instance, Verbong and Geels, 2007; Brown et al, 2008; Truffer et al, 2010; Hinrich C., 2014.
[21] This concept emanates from the STS theory, and more specifically, from SCOT analysis.

policies, institutional and regulatory frameworks (cognitive routines, patterns and regulative rules), users' patterns and practices, markets and cultural meanings (Geels F., 2011:25, Smith et al, 2005:1491). Rotmans et al (2001:2) define transitions as sets of interlinked changes influencing and strengthening each other, while taking place in alternative areas like technology, economy, culture, ecology, behavior, institutions and belief systems. The most used and well-known approach in the related literature on the field is a middle-range theory, known as multi-level perspective (MLP) (Rip and Kemp, 1998; Geels, 2002, 2005a,b,c, 2006; Geels and Schot, 2007; Verbong and Geels, 2007; Geels, 2010), to which I will refer later.

A multi-level perspective approach and its shortcomings

MLP is a historically informed policy model that tries to analyze the characteristics and dynamics of a socio-technical system and the changing process from one system to a more sustainable one. These shifts are large-scale and long-run ones, with a duration of 50 years or more (Schot, 2018). Despite its limitations, the approach is better organized than previous attempts, while it uses a broader and better conceptualized number of elements that have to do both with the supply side (innovations) of the analysis and with the demand side (user environment) (Geels, 2004). It has been influenced by many different disciplines and perspectives, primarily from history of technology, sociology of technology, institutional theory and STS studies, evolutionary economics and cultural studies. It is mainly based on innovation studies, and more particularly on “systems of innovation” theories such as sectoral systems of innovation, technological systems and large technological systems (LTS) theory (Geels, 2004). As many scholars argue (Arapostathis et al, 2014; Bolton and Hannon, 2016), the approach has been mostly influenced by the LTS theory of Thomas Hughes (1983; 1986) and other researchers (Mayntz and Hughes, 1988; La Porte, 1991; Summerton, 1994; Coutard, 1999). Hughes argued that technological networks are centralized infrastructures, which constitute an aligned framework of technical elements, institutions and interested companies in a “seamless web” (Hughes, 1986). The alignment process is achieved through the “system builders” concept, which addresses interactions between technical, institutional and social elements, enabling the unity of the technological system (Bolton and Hannon, 2016). When such system finds its pace and solves its technical, institutional or financial problems, that is its reverse salients (Hughes, 1983), it gains momentum and comes into view.

MLP is using the socio-technical (s-t) integration logic to the s-t system analysis that LTS uses, although it does not consider materiality as the core of the system; the social and material parameters are rather viewed as of equal importance (Geels, 2004:898). In addition, although the concept usually employs countries in the spatial level of analysis, contemporary efforts of transition research refers to nested paradigms too[22] (Coenen et al 2012; Coenen & Truffer 2012; Hansen and Coenen 2015). In the next section, the core characteristics of this approach are analyzed, as well as the main criticism exerted to it.

A co-evolutionary socio-technical analysis

The analysis that MLP follows depends on a three-level perspective of an s-t system. The three levels are constituted by the socio-technical regime that expresses the meso-level of analysis, the technological niches, which is the micro-level, and the socio-technical landscape. The three levels don't insinuate a kind of hierarchy but rather differences of the particular levels regarding their stability. Differently, as Geels (2011:37) pointed it:

> "…the levels are defined as referring to different degrees of structuration of local practices, which relate to differences in scale and the number of actors that reproduce regimes (and niches). Levels thus refer to different degrees of stability, which are not necessarily hierarchical." (Geels, 2011:37).

As it can be inferred from the above description, the model uses the concept of s-t system as the unit of analysis rather than the artifact or the innovation that is preferred

[22] The concept of nested paradigm is used frequently in the transition and MLP analysis (Geel, 2011; Geels, 2005b; Geels and Schot, 2007) referring initially to the relation of the three perspectives' analysis of the model during a transition – where the three levels were made understood as nested hierarchy (Geels, 2004). However, the concept is not used in declaring a regional or insular transition. This is because, predominantly, socio-technical transition case studies focused their analysis on a national scale (Raven et al, 2012). Over the past decade, developing related critique in regard to the treatment of space and place in the MLP and transition literature (Coenen et al, 2012; Coenen and Truffer) has led to suggestions being articulated in regard to the way the model could approach spacial scales and spacial relations between actors (Raven et al, 2012). This work has been influenced by these analyses and perceptions, perceiving nested transitions as regional or other transformations in a national context where localities and proximities matter. In this latter perception, the nested regime's concept is used with an horizontal and a vertical meaning (Ibid: 71). Therefore, a vertical nested perception refers to the national, international and regional features and specificities, while an horizontal one to differences between regimes for households, large industries and so on (Ibid: 71).

by previous theories. But what is actually an s-t system? It is the artifacts/networks and resources (social, financial and institutional) that are needed to fulfill societal functions (Geels, 2004: 900-901). They encompass the production, diffusion and use insights of technology. In these elements, the actors (human or societal groups) are integrated –since, without them, the s-t systems can not function– and so are the rules/institutions which limit and coordinate the actors. These three dimensions are interlinked and interact in a way that a totality in a dynamic process is formed. Thus, s-t systems could be defined as a complicated phenomenon including technologies/networks, recourses, institutions/rules and actors that are interlinked and interact in several ways. Subsequently, the three distinct parallel levels of analysis and their connections are about to be presented.

The socio-technical regime

This concept is of primary concern in the MLP approach, as it is on the core of the analysis of both the s-t system and transition concepts. According to this view, transitions are defined as shifts from one regime to another (Geels, 2011:26). Regime is pertained to share cognitive routines, search heuristics and other kind of rules in an engineering community, but also in other groups interested in the system, like scientists, policy makers, users and special interest groups, who participate and contribute in the patterning of technological development (Nelson and Winter, 1982; Bijker, 1995; Rip and Kemp, 1998; Geels, 2002, 2005a). In other words, an s-t regime is a set of cognitive, regulative and institutional configurations shared within particular social groups, but also among them[23]. Socio-technical regimes are in general stabilized systems in many different ways (technologically, institutionally and socially). The alignment is a result of several mechanisms, as the lock-in process and the path-dependence one (David, 1985; Geels, 2002:910; Geels et al, 2018). Lock-in concept (as well as path dependencies) refers to the notion that an s-t system, when

[23] Transition scholars have studied many regimes and their transitions such as, for instance, the water supply one (Geels, 2005; Soderholm, 2013), the energy regime transitions in different national frameworks (Verbong, Geels, 2009; Geels, 2014), the aviation regime and its transition from propeller to turbojet aircrafts (Geels, 2006), the ships regime and the transformation from sailing ships to steamships (Geels, 2002). It is also worth mentioning that MLP scholars argue that conceptualizing regimes as well as the other two model perspectives in a spatial manner (namely, the niche and landscape) can not be taken for granted, but is rather negotiable and is being developed in parallel with actors' networks (Raven et al, 2012: 71). Further, socio-technical regimes could be characterized as nested both by an horizontal and a vertical meaning (ibid). Thus, for example, in a vertical meaning, an electricity regime could have national, international and regional features and specificities, while an horizontal nested meaning is refers to differences between regimes for households, large industries and so on (ibid). For a more detailed analysis of the regime concept, see also Geels, 2004.

stabilized, is locked in a certain dimension. This is a result of the interaction and co-evolvement among institutions, social groups and the materiality.

Thus, cognitive, but also normative and regulative configurations enhance path dependences and lock-in. More specifically, the cognitive elements like the competencies, the skills, the current knowledge of the enterprises, but also the learning process which is based on current knowledge strengthen these path dependences (Geels, 2004: 910). Also, other configurations, like shared believes, expectations, organizational commitments and vested interests in the continuation of the system, relations of trust and the perceptions of users' preferences, strengthen the lock-in mechanism. Moreover, users' life styles, patterns and expectations are defined according to the incumbent system. Ultimately, regarding the materiality aspect, the firms' artifacts and technological interdependences of the networks increase the rigidity of a system through compatibility standards, networks externalities, sunk investments and economies of scale (Geels, 2004). Stability mechanisms neither transfuse inert characteristics to the s-t system nor deter innovations. Innovations occur mainly as add-ons that increase the performance and further stabilize the certain pathways and the incumbent system.

Technological Niches

Niches, in the MLP analysis, are the main reason for the emergence of radical innovations in the s-t system. They represent "protected spaces" which shield radical novelties from the mainstream markets. Niches could be either technological niches, like universities or companies' laboratories for R-D, which work mainly with public subsidies, or small markets in the mainstream market with specific characteristics, like for instance the wind turbines of the Danish case in the mid seventies, as I will argue in the next chapter. Niches are the less stabilized levels in the s-t systems, thus they could allow deviations from the paths and the trajectories of the incumbent regime. The instability of the niches permits them to follow different trajectories and paths. When a radical innovation "matures" through the successful learning process of its actors, rules and social networks, it becomes more stable. However, even if a radical novelty is stabilized, its entrance in a regime is not an easy task, as s-t regimes are stabilized frameworks. Novelties face "mis-matches" with existing regimes, making the breakthrough in the s-t system and its transition even harder. To clarify the transition process of an s-t system and the mechanism allowing it, Geels and Schot (2007) have developed a pathway typology of transition, which I will present later in this section. Tensions and mis-alignments in the system could, under certain circumstances, lead to its breakthrough, allowing the access of the radical novelties into it.

Socio-technical landscape

This level of analysis refers to the macro-level (macro-economics, deep cultural patterns, demographic trends, macro-political development). In a way, it represents the macro environment of an s-t system, that is other regimes and structural frameworks beyond the influence of the incumbent regime and the technological niches. Because of that, the other two levels of analysis are not in a position to change landscape or to affect its pressures, at least in the short run; on the contrary, it is the large technical and material structures that, through their "hardness", constrain or enable changes (Geels, 2005b). Despite the fact that changes in the macro-level occur slowly, in some cases changes could be sudden and rapid. Van Driel and Schot (2005) produced a three-type concept of the landscape changes to comprise all different cases. According to it, the first one includes static factors or factors changing slowly (like the climate). The second consists of elements that change in the long-term (for

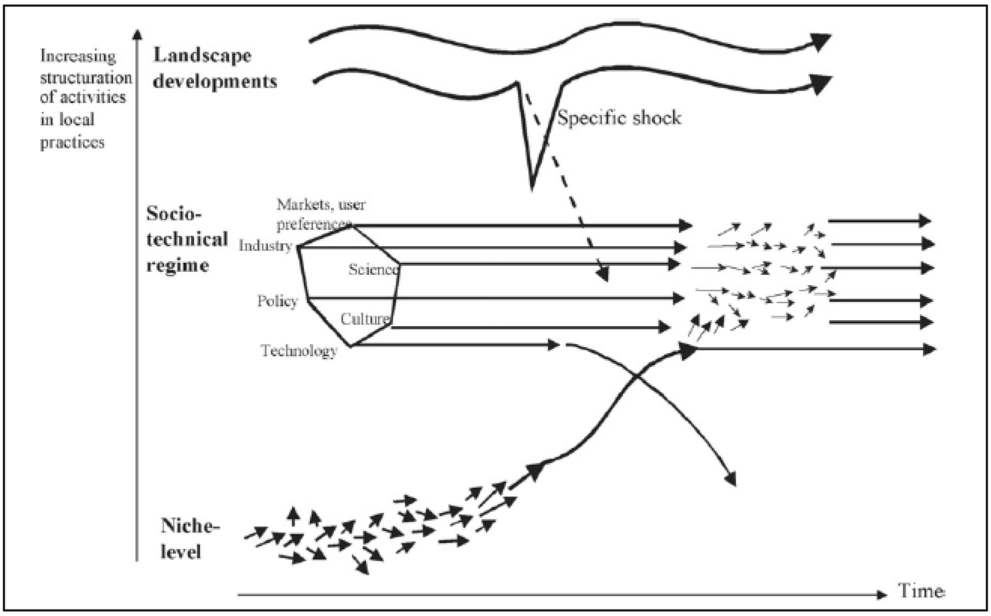

Figure 2. A representation of the multi-level perspective approach during a transition process (Geels, 2002: 1263).

example, internet results to different regimes), while the last one, which is the most dynamic, refers to rapid external shocks that change the landscape suddenly, like wars, economic crises and high immigration flows. Based on this typology, landscape does not look like a static concept unwilling to embrace alterations; in contrast, it acquires a dynamic and explosive character. Macro-level influences the local practices where actors interact through its "hardness", but not in a mechanical way (Geels and Schot, 2007); this means that changes have to be perceived and translated by actors so that these tranformations influence them.

Unlock and instability processes

As it has already been mentioned, regimes are stabilized elements that prevent the breakthrough of radical novelties and the transition of s-t system; therefore, a transition process requires the instability of the incumbent regime. According to transition scholars, this is a mechanism that requires going through procedures at all different levels. Tensions and mis-alignments of the regime are necessary for the unlock process to be initiated. A mis-alignment happens when the actions of different social groups in a regime and the paths that they follow are directed in other trends (Geels, 2004). Although the instability of a regime is a main factor contributing to its transition to a new one, the orientation and the extent of this transformation depend on the characteristics of the s-t landscape and technological niches. In an effort to answer to the related criticism presenting MLP as a bottom-up change model, but also to enrich and reinforce s-t transitions analysis, Geels and Schot (2007: 405-413) developed a typology of pathways in a transformation process. Different pathways in their evaluation are ideal. The particular typology grounds on two axes, the timing and the nature of interaction. The former refers to the moment landscape pressure takes place in relation to the development of the novelty. Landscape pressure could occur either when the niche technology is fully developed and stabilized or when this is not the case. The latter is related to the relationship (strengthening or disruptive) of the landscape pressure and the novelty with the regime. Changes in the combinations of the two axes cause six different types of transition. Thus, with respect to the “timing” and the “nature of interaction”, the pathways are the following:

1. *Reproduction process*, which refers to the case a landscape pressure does not exist. This condition reinforces the stability of the regime. Radical novelties that

struggle to enter the regime have little chance of achieving it as a mis-match emerges. Only the novelties that reinforce the s-t regime, as they increase its performance and stabilize it even more, could enter as add-ons.

2. *Transformation path*, which refers to transitions that a moderate landscape pressure exerts though the radical novelty is not well developed. The transition of this type is mild enough for the regime actors, as they respond by reorienting the trajectory that is followed by the regime. Outsiders' role in this case is of vital importance, as they draw attention to negative externalities and demand solutions; they could also propose other practices or technologies. Like the reproduction pathway, in the transformation path, novelties function only as adds-on in the s-t regime.
3. *Reconfiguration*, which describes pathway novelties that are initially adopted as add-on or they replace other components of the regime, mainly because of their superior performance; their use in the regime increases its stability. Subsequently, that leads to further adjustments and, under landscape pressures, could allow sequences of component innovations and major reconfigurations of the regime. So, in this pathway, although having been created by the old one, this new regime changes the former's basic architecture.
4. *Technological substitution*, which is the pathway that characterizes cases where large and sudden landscape shocks create major problems to the stabilized, until that time, regime and finally lead to its replacement. Radical technological niches are sufficiently developed, waiting for the opportunity to enter large markets. A sudden and large landscape shock changes the equipoise and allows radical novelties to be diffused in the main market; as they enter it, they create a competition with the incumbent. If the new technology replaces the old one, a number of other changes (knock- on effects) in the s-t regime will follow.
5. The *de-alignment and re-alignment* path, which relates to cases that the regime becomes unstable because of large and sudden landscape pressures. The niches are not well developed so the pressures are not disruptive. Subsequently, there is a prolonged period of co-existence of many novelties. During this period, innovations compete each other in terms of resources, attention and legitimacy. After some time, one or more of them, gain momentum and become dominant; this re-aligns a new regime.

6. A *sequence of transitions* path, where the continuous and disruptive landscape pressures lead initially to the transformation path, which then is followed by the reconfiguration, while finally the substitution or de-alignment and re-alignment trajectory is taking place.

Although I believe that many essential parameters a trajectory will follow are not presented in this typology, I consider it as helpful. Therefore, this contextual framework could be useful mainly in cases that we want to analyze and describe transitions that have already been adopted. Other parameters that, in my point of view, will give a more purposive character in the approach will be studied later in this chapter. Afterwards, I deal with a model of users focusing on their different roles and capabilities exercising power and agency. The model is developed by Schot et al (2016), who had set out to respond to the severe criticism against the MLP about overlooking users and the demand side in its analysis.

Role of users

Schot et al (2016) try to engage users' role in the socio-technical transition model by developing a typology regarding the types of users and their participation in the transition process. They point out that change of practices requires the initiation of an un-lock and instability process in the incumbent regime. According to this view, practices are transformed in directions that are supportive to the dominant novelties and their re-alignment. The typology includes five types of users and tools to stimulate them. These categories of users are user-producers, user-legitimators, user-intermediaries, user-citizens and user-consumers. Additionally, the tools that are proposed could be actually used by central and local governments or by other steering actors during a steering process. Authors (2016) argue that, in their typology, users participate through all stages of the transition process. Users, as other actors, could have more than a role at the same time during the transition. Next, the main characteristics of each type of user are presented, while later I shape this typology, enriching it with new qualities and elements.

User producers are innovators-practitioners constructing or modifying novelties in a local scale. These users affect the users' preferences, practices and routines, although not necessarily in a sustainable way (Schot et al, 2016). Thus, users-producers consist key actors in the emergence of niche transitions. Schot et al (2016) also propose ways to stimulate and upgrade their role and importance during the whole process. In their notion, this could happen by engaging them in the innovation policy, while they recognize the improvement of their access to finance, the use of tax credits, the easy accessibility to knowledge and relevant networks as important tools to that gentrification. I concur with Schot et al for the importance of these tools for the support of user-producers, even though, in my opinion, it had to primarily be ensured that their participation will contribute to the change of practices and patterns in a sustainable way. User-legitimators help cultivate the importance of a novelty in the society. These users try to legitimize socially the technological niche; thus, they stress its values and acceptance. Authors argue that it is important that funding be guaranteed for this kind of users so that they can be supported and encouraged. Their greater involvement in the evaluation of technology, the foresight activities and science and the society policy is also critical to that direction (2016:6). I regard this type of users as very important in achieving a sustainable transition, as they exert agency and power and could promote change of practices. However, it is important to stimulate these user-legitimators that redound to the change of life-styles in an environmentally friendly direction.

The third category of Schot et al typology is the intermediary-users. As far as these users are concerned, they are mediators that contribute to the formation of the design, the rules and regulations of use, the usage, the expectations and interpretation of the artifact. I consider this type of users of major importance. These users are the negotiators of the innovation technology. Schot et al (2016) present user clubs and associations as possible actors of this type. As I will argue in the third chapter, there are also other users belonging to this category. More specifically, in nested transitions, where localities could influence the acceptance or rejection of transition tasks, these users could, as key actors, contribute to the transformation process being activated. Furthermore, with regard to tools facilitating activating these users, Schot et al (2016:6) suggest that mediation spaces be constructed as well as certain tasks be delegated to them. It becomes clear from the above mentioned characteristics that these users also exercise power and agency. Thus, I acknowledge this type as extremely important to sustainable transformation being adopted. Further, I am going to enrich this type of user with more tools so that I activate them, in the third chapter, building around the results of the exemplary cases. I argue that the establishment of an intermediary institutional actor as an intermediary user implicating local entanglers in the transition process was decisive in the Samsian case, as the next chapter will show us.

User-citizens are activists and NGOs that share different values and practices compared to the conventional ones. So, their role could be significant in terms of practices veering towards an environmentally oriented pathway. As tools to their stimulation, Schot et al highlight their participation on a regular basis in policy making processes regarding transitions of energy or of other utilities. I also support this view and I think that the users-citizens' perspective and behavior could be even more critical in establishing local transition projects, especially if these users are well-known and dependable parts in the eyes of local communities. Finally, users-consumers are actually individual consumers or consumers' collectives that, through their purchase but also through domestication and symbolic meanings regarding the consumer's status or identity, re-shape their routines and practices. This type of users does not seem to exert power and agency in a sustainable way since, in general, they adopt conventional practices and ways of life. I argue that, under certain circumstances, user-consumers could influence and activate others in a sustainable way, changing their practices and life-styles. For this reason, later in this chapter, I am going to enrich this particular approach with a conceptual framework of different user-consumers' types. In the next section, a conceptual framework that has been developed initially as an individual model will be introduced, which, over the past two decades, has constituted an extension of the MLP framework. Strategic Niche Management (SNM), but also the approach of Transition Management, try to manage transitions while they are closely linked to the MLP tradition.

Niche Management and Management Transitions

Strategic Niche Management (SNM) and Transition Management (TM) are conceptual and methodological tools that go beyond the analytical and in a way prescriptive character of MLP, thus trying to manage transitions (Rip and Kemp, 1998; Kemp et al 1998; Weber et al, 1999; Hoogma et al, 2002; Loorbach, 2007 and 2010). Both approaches try to formulate the patterns and the processes so that they can be used for managing the transition to a sustainable pathway. According to SNM scholars (Rip and Kemp, 1998; Kemp et al 1998; Weber et al, 1999; Hoogma et al, 2002; Raven, 2005; Kemp et al, 2007; Verbong et al, 2008; Schot and Geels, 2008), the model is a way to "prepare" and protect innovations from the hostile market environment until they are ready to enter it. This was necessary because of the many sustainable innovations that failed to enter the main market (Weber et al, 1999). Further, scholars argue that the approach has also been followed, modified and validated through an extensive number of case studies (Kemp et al, 1998; Hoogma et al, 2002; Van de Laak et al, 2007).

SNM is constructed around the social constructionists' theories of sociology of technology and STS regarding the co-constructed relation of technology and society. However, STS scholars criticized the approach for lack of operationalization in learning issues as well as for its purposive character and its protected sterilized novelties that retain a tenuous grasp of the "real world" (Hommels et al, 2007). Furthermore, the approach is based on the evolutionary economics and the perception of a co-evolutionary character of the process. As I have already discussed in the MLP analysis, this evolutionary characteristic could facilitate tranforming a regime from inside. Moreover, this approach uses as a unit of analysis, the innovation artifact, rather than the s-t system.

SNM mainly focuses on the processes that make niche development well developed. The objective is for technological niches to be used as "shields" of the novelties until they are ready to join the conventional market. Thus, according to this process, it is important to adjust the on-going dynamics. The approach has the pseudo-evolutionary characteristics that MLP has, in the sense that niches are supposed to emerge in a collective, bottom-up action (Verbong et al, 2008). The approach perceives technological niches either as laboratories and protected spaces or, in a later stage, as market niches, where the innovation has already been stabilized in many ways, for example technologically and institutionally, and tries to penetrate into the mainstream market.

Scholars of the approach are interested in managing particular forms of innovations (Schot and Geels, 2008). More specifically, they fasten on two categories of innovations. These are innovations that serve long term objectives that are socially beneficial as well as radical novelties that are totally different than the conventional ones, requiring protection as they face a mismatch in the central market. Because of that, researchers of the field regard real world experimental projects as necessary tools that assess the extent to which an innovation is prepared to enter the market niche (Schot and Geels, 2008). Initially, niche management focuses only on processes that contributed to the niche innovation maturing (internal process). The idea was that, when the novelty is stabilized, it will be introduced to the technological regime. Later on, and particularly over the past twenty years, it has taken into account that there are also external processes required for a regime to be transformed. Thus, stabilization and “maturity” of a niche technology is a necessary, but not a considerable requirement for the transition. In this stage, SNM model was integrated in a sense to the MLP approach. Thus, SNM is nowadays part of the MLP approach, and in this framework, it has tried to modulate technological niches so that they enter the mainstream market. As MLP analysis explains, changes happen to multiple levels rather than only to the niches. This conceptual change of the way that a transition takes place contributes to a different view of the whole process. In this way, the relation of the novelties with the incumbent regime is not inevitably an antagonistic one, but it could also be a rather complementary one, as it has already been argued. However, the niche management analysis continued to deal with the establishment of a properly developed niche innovation. In doing so, SNM’s scholars presented three parallel processes through which they examine the successfulness and effectiveness or the unsuccessfulness of a novelty.

Table 1. Representation of the different transition management types and their focus (Loorbach, 2010: 171).

Transition Management Types and Their Focus (Loorbach 2007)

Transition Management Types	Focus	Problem Scope	Time Scale	Level of Activities
Strategic	Culture	Abstract/societal system	Long term (30 years)	System
Tactical	Structures	Institutions/regime	Mid term (5–15 years)	Subsystem
Operational	Practices	Concrete/project	Short term (0–5 years)	Concrete

These procedures have to do with the structuring of expectations and visions, the building of social networks and the learning process at different dimensions (Schot and Geels, 2008: 540-1). Based on this view, visions and expectations are necessary, since they facilitate the learning process, attract attention and legitimize protection and deployment of an innovation. Furthermore, social networks develop the essential resources (economic, human, knowledge and skills) and engage users in the whole process. Finally, it is important that the learning process follow different dimensions, concerning, for example, technical things or the choices of the market and users,

regulations and state's policies, societal and environmental effects. Additionally, other more sufficient and precise characteristics were proposed to the three processes, so that the improvement and maturation of the niche innovation could be guided and managed more effectively. The approach defined also a self-steering procedure for the transition. This was about an internal process in which stakeholders could add a new actor and learning processes or set a demonstration project on how to redirect their attempts so that they follow a desired path (ibid). Thus, based on this perception, steering is exerted by the actors that participate in the process like, for example, from the users, enterprises and other stakeholders and not from a central governmental or independent actor (Loorbach, 2007).

Since the early 2000s, another approach, that tried to manage sustainable transitions as an alternative to SNM, has been developed. Transition Management (TM) was based mainly on governance literature and has an even more operational stance (Loorbach, 2007). Advocates of this model (Rotmans, Kemp, and van Asselt, 2001; Loorbach 2007 and 2010; Kemp, Rotmans, and Loorbach, 2005 and 2007) argue that is necessary to orient mainly to the expectations and the envisioning, but without forgetting the socio-technical character of the process. Because of this, they support ex-ante envisioning practices so that they influence the whole process. The model developed four different types of governance for s-t transition (table 1.), named strategic, tactical, operational and reflexive[24] (Loorbach, 2002; 2007). Different types refer to dissimilar time horizon and scheduling of governance (Loorbach, 2010). These different types of governance are presented through a cyclical process named "transition management cycle" through which scholars try to manage transitions operationally (Loorbach, 2010). Nevertheless, the model has many commons with the SNM approach regarding the role of experiments and vision for the success of a transition. On the other end of the spectrum, an important difference of the two approaches was the envisioning of main actors before the experiments would commence, in the case of transition management. According to this, transition

[24]The meaning of reflexive governance and reflexiveness, as used in this thesis, will be analyzed later in this chapter.

managers establish transitions arenas, in other words places where regime actors, niche actors and other stakeholders were assembled, in an attempt to influence regimes' perceptions and cognitive routines before the experiments.

It is worth mentioning that both these approaches use the novelty/innovation as a unit of their analysis. This change in relation to the unit of analysis is essential when one would like to analyze energy systems and energy transition, namely large s-t systems, and that renders those approaches extremely myopic (Schot and Geels, 2008). Differently, focusing on the artifact doesn't sufficiently reflect the primary interests of analysis in system innovation (Geels, 2018). Afterwards, I will illustrate a conceptual framework partially using MLP approach in interpreting transitions as parallel transformations of s-t systems complexes. Deep transitions (Schot and Kagner, 2018) perception of the way different s-t systems are interrelated and interacted is considered fundamental for the objectives and the analysis of this research thesis.

Interrelations and parallel tractions of s-t systems

In perceiving transition, it is essential that one bear in mind the analysis (Schot, 2016; Schot and Kagner, 2018; Kagnerand Schot, 2018) regarding the concept of Deep Transitions. According to this view, a deep transition refers to a number of interrelated and sustained changes of a large number of s-t systems in the same direction (Schot and Kagner, 2018:1045). The framework is based on the interconnection of two distinctive approaches, trying to interpret the parallel evolution of s-t systems and complexes of s-t systems, as well as the role of the socio-technical regime in determining the new trajectories (2018:1046). According to the authors, the approach stresses the interrelated dynamics of different actors, rules and socio-technical systems, conceiving transition processes as "parallel evolution of single systems, complexes of systems as well as the broader and long term transformations of industrial society" (Ibid: 1046). Based on this conceptual framework, the authors argue that the target for sustainable development requires transformations in the form of a Deep Transition (Schot and Kagner, 2018, Van der Vleuten, 2018).

The concept refers to large-scale socio-technical changes made in the long-term, that is in periods of 40 or 50 years. Further, in contrast to the majority of transition literature referring to a single s-t system, the deep transitions concept is analyzed as a set of interrelated s-t systems. In this kind of analysis, despite a series of current approaches, as the Control Revolution thesis (Beniger, 1986), the Eras of Technology concept (Misa, 2004) and the Techno-economic Paradigm (TEP) framework (Freeman and Louçã, 2001; Perez, 2002), the Deep Transitions approach seeks to cover a gap regarding the way s-t systems are historically interlinked, following particular parallel trajectories and becoming dominant determinants of the social and technical networks of the "economies, polities, cultural frameworks, social interactions and everyday practices" (Schot and Kagner, 2018:1046). In doing so, the authors have embedded two distinctive approaches, the Multi-Level Perspective (MLP) and the Techno-economic Paradigm (TEP) in order to analyze the Deep Transition context. Deep Transition analysis is based on s-t elements of the MLP, that is on the co-evolution of actors, institutions and technologies (Kagner and Schot, 2018), giving equal importance to the social and the technological features (Geels, 2002; Geels and Schot, 2007; Geels, 2010; Geels, 2018). The model has been introduced extensively in the former sections of this research thesis. Besides, as I have already explained, this conceptual framework will constitute the basis of the hybrid approach that I will introduce in a next section.

The TEP model aims at interpreting long term processes of economic cycles, known as waves (Freeman and Louçã, 2001; Perez, 2002 and 2013). In this process, it tries to analyze the mechanisms related to the way a set of s-t systems is interlinked. According to this analysis, deep transition is the result of a set of distinctive historical waves-like patterns (Scot and Kagner, 2018:1046). The model's advocates support the view that these waves are the result of mechanisms like credit availability, fluctuations in the production of gold, emergence of new states and demographic changes (Papenhausen, 2008: 790–793; Köhler, 2012:3; Bernard et al, 2014: 89; Schot and Kagner, 2018:1046). In addition, driving forces of theses waves-like patterns are the various clusters of interrelated technological, organizational and institutional innovations (Ibid: 1046). Proponents of those approaches (Freeman and Louçã, 2001; Perez, 2002) claim that the creation of these clusters in the former Deep Transitions were responsible for tremendous economic and managerial changes such as productivity and product quality boost, structural changes in production and consumption, and long-term economic growth, as well as political and cultural transformations (Schot and Kagner, 2018:1046). Based on these two conceptual frameworks, deep transition context is perceived as a process in which rules emerge, are then aligned with others and finally spread to several s-t systems, accomplishing divergent levels of stability and range (Ibid: 1054). I regard this concept as critical in achieving the aims and objectives of my research thesis, hence I will make use of the way it is perceived in my analysis in the next chapters. However, I would like to clarify that I am not going to take advantage of the tools, and more particularly the TEP model that authors use in their analysis, as, in the third and the fifth chapter of this research, I develop a hybrid methodological tool based on MLP, through which s-t transition will be interpreted and steered. In enriching my perception regarding system innovation analysis, in the next section, I will introduce other transition approaches and conceptual frameworks related, more or less, to the MLP, while some of them will be analyzed more extensively on the basis of the objectives and perceptions of this research thesis.

Other sustainable transition approaches and typologies

Sustainable transitions studies, during the last two decades, have developed a large number of transition approaches and conceptual frameworks influenced by different traditions (Thomas Hughes, 1986; Rip and Kemp, 1998; Langhelle, 2000; York, Van Driel, and Rosa 2003;Jorgensen and Sorensen, 2002; Van Vliet et al, 2005; Shove and Walker, 2007 , 2010 and 2014; Meadowcroft, 2007; Hendriks, 2008; Foxon et al, 2013; Chilvers & Longhurst, 2016). Regarding this, some of these approaches try to evolve further and be interlinked with the dominant MLP approach, while others follow a completely different perspective. Thus, Rip and Kemp (1998) analyze path dependences as an interconnection of technical, institutional and social parameters in s-t systems showing resistance in changes and arguing for the need of transition pathways in order for the s-t transitions to be achieved. Foxon et al (2013) present alternative transition pathways relying on branching points analysis and different governance schemes. Smith et al (2005) regard governance, thus power relations and agency between actors, as essential factors influencing the evolution and the analysis of an s-t transition. Meadowcroft (2007) underlines the importance of the state's central role in a world of distributed governance arguing for civil society's engagement in a transition, as it has also been mentioned in the first chapter of this research thesis. Other scholars focus on the noteworthiness of public engagement in the transition analysis (Hendriks, 2008; Chilvers and Evans, 2009; Chilvers &

Longhurst, 2016), as it has already been pointed out in the first chapter. Thus, Hendriks (2008) views social engagement in a transition as a limited and technocratic process. According to his analysis, the actors promoted and assisted to participate in a transition are mainly the market-innovators, niche actors and market enterprises, while the main objective is to assure their engagement and co-operation. However, in his approach, other actors, like users, civil society and local communities, are excluded from the transition process, in contrast to the author's democratic-oriented research questions. In a more inclusive conceptual framework, more recent views (Chilvers & Longhurst, 2016) have used complementary approaches that rely on former results in transition studies but also in STS perspectives. Authors use former research results to enrich the potentiality of the analysis. Others put in the core of their analysis practices and thus schemes of production and consumption interrelation (Van Vliet et al, 2005) focusing mainly on the significance of mediating actors and issues of changing current consuming life-style (Shove and Walker, 2007, 2010 and 2014) facilitating a transition. Following a fully alternative to the MLP perspective, other scholars (Jorgensen and Sorensen, 2002) propose Arenas of Development (AoD) following flat world analysis. AoD is based on the actor network theory (ANT) and on innovation and governance studies. Its main target was initially descriptive but also supportive to actor policies and interventions in innovations and design. According to Jorgensen (2012), the flat analysis of the approach is owing to it refusing to acknowledge the prescriptive benefits of an hierarchical analysis. The concept of the arena of development is a very fluid and heterogeneous cognitive space, where a certain framework exists and in which socio-technical interactions and transformations take place (Jorgensen, Sorensen, 2010: 410). In this section, some of the transition approaches and typologies already mentioned will be analyzed further, based on issues like the perspective of sustainable development, that I have already adopted in the previous chapter, calling for social participation (Hess, 2018), and the significance of good governance practices (Stirling et al, 2018) encouraging it, as well as the extent to which they highlight the state as a central actor of the transition process, an approach that generally dovetails with the Greek political framework, within I am going to follow a steering methodology making a transition in the fifth chapter of this research thesis. Thus, the approach of Smith et al (2005) regarding power and agency, that of Meadowcroft (2007) focusing on the state, the engagement of civil society and the distribution of governance, a typology of Van Vliet et al

(2005) regarding different types of user-consumers role in relation to their providers as well as Chilvers and Longhurst's (2016) analysis regarding different categories of civil societies engagement in an s-t transition will be developed. Some of these approaches will be integrated later in my hybrid approach as a response to the MLP's critique, also focusing on the way sustainable development is conceived in this thesis and the Greek political context. Later, I will present a conceptual framework which puts in the foreground of analysis elements of power and agency, that is governance issues (Smith et al, 2005), which I consider very important when it comes to analyzing the dynamics of the incumbent regime actors.

Adaptive capacity and selection pressures as tools of agency and power

Smith et al (2005) propose a typology as a heuristic tool for governance, agency and power for sustainable transformations that could be integrated in the MLP approach. In the authors' view, transitions initiatives are the result of two elements, selection pressures and adaptive capacity. The trend of a transition is partially depending on whether or not the articulation of selection pressures is acting on behalf of the incumbent system. Actors of a regime try to adapt selection pressures or to influence the results of the pressures upon them.

More particularly, they (Smith et al, 2005: 1495-1496) note that articulation could be the result of pressures in a specific regime or of more general pressures towards certain trajectories. Anti-nuclear movements could be an example of the former type of pressures, while climate change can be an illustration of the latter. These pressures create debates in civil society that influence system's changes. On the other hand, the concept of adaptive capacity refers to the flexibility of an s-t system to adapt efficiently (as a whole or partially) to the pressures that are exerted to it. The level of adaptive capacity of incumbent members depends on their ability to adapt to changes according to their resources. In other words, adaptive capacity refers to whether or not the incumbent regime has the relevant resources which are deemed necessary for the transition, or if it has to find them externally. Further, the term also refers to the degree of co-ordination across regime members. Ultimately, it demands that at least some of the main actors survive (Ibid: 1497). Effective "use" of both elements will require collaboration by the incumbent regime members and resource flows between actors. What is also becoming clear is the perception of governance as well as that of agency and power in these two processes.

Based on this kind of analysis and interpretation of sustainable s-t transitions, authors present a typology of sustainable transition as a degree of coordination framework of selection pressures and the locus of adaptive resources. According to this, the horizontal axis (figure 3) measures the level of co-ordination and steering of the process that is related to the articulation of selection pressures. An intended transformation of a regime could be guided by influential actors within the regime or by overarching networks of governance (Smith et al, 2005:1498). It could also require a certain level of agreement regarding measures and objectives, without dealing with the desirability of them (Ibid, 2005). The vertical axis refers to the internal or external position of the resources necessary for the transition. This axis has to do mainly with the adaptive capacity of a regime element.

The typology of governance for s-t system transitions

The typology embodies a four-type pathway, bases on the axes of coordination response and resources adaptation. The different types, which are ideals, are the endogenous renewal, the reorientation of trajectories, the emergent transformation and the purposive transition. The endogenous renewal follows trajectories of internal adaptation within the incumbent regime and the high co-ordination capacity of it. It refers to changes in the s-t system that originate from within the regime, at least in cases that it considered sustainable. In other cases, as the commentators argue (2005:1503),

> *"a more interventionist approach to governance is warranted. The challenge is to identify how transformation processes can be steered in a more sustainable direction".*

The reorientation of trajectories pathway refers to changes where the resource adaption is also internal, although they are uncoordinated in terms of the articulation of selection pressures. Regarding this, authors argue that, in this type of transitions, changes are radical and are experienced as shocks in the incumbent regime. These shocks could be internal or external to the s-t system. The new pathways that could be

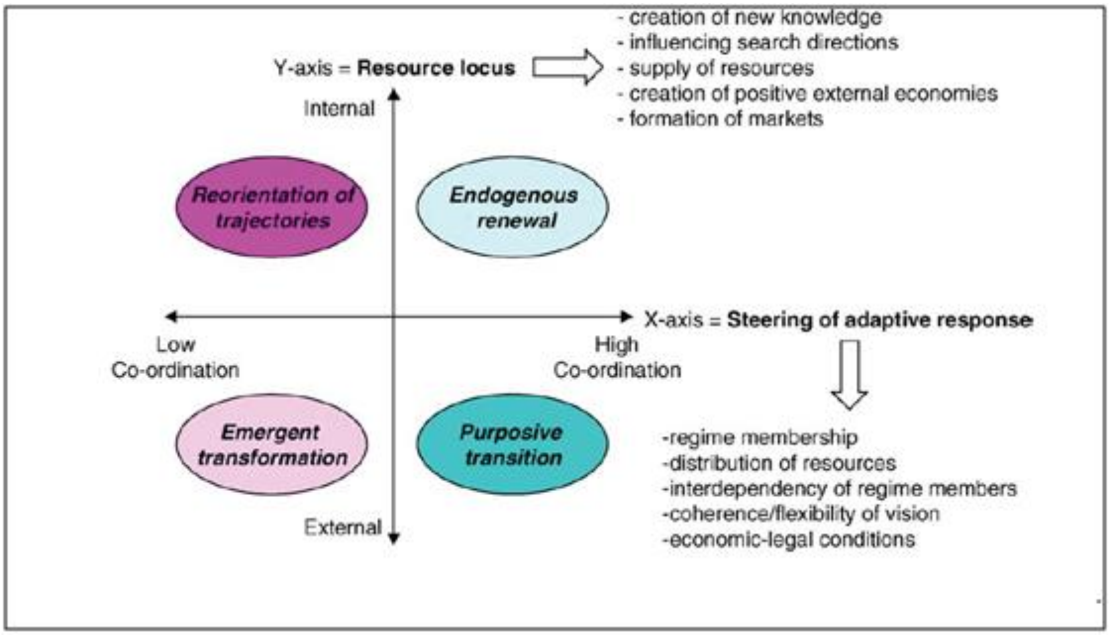

Figure 3. A representation of the transition process in relation to the degree of coordination of selection pressures and the locus of adaptive resources (Smith et al, 2005: 1499)

followed do not declare changes in the actors, networks and institutions that contribute to the incumbent regime. The emergent transformation type refers to changes that are uncoordinated too, but in which the resources, necessary for the alterations, are not capable within the incumbent regime. In this kind of trajectories, there is the possibility of major structural changes. The last type of the typology is that of the purposive transitions. It is about a high articulated selection pressures trajectory, where external actors and resources (niche actors) are promoted and which "reflect a set of societal expectations or interests" (Ibid: 1502). In my point of view, government led[25] transitions to more sustainable pathways have to be of this kind.

Governance, agency and power as tools of s-t transitions

Smith et al (2005) present the dynamic concept of "governance" as one that inferences the attempts for changes. As it has been already argued in the previous chapter, governance refers to processes activating the regime's actors in a multi-dimensional world of distributed responsibilities and power (Kooiman, 2003; Smith and Stirling, 2006). It relates to the management of pressures by the system's actors and to the deployment of resources and the allowance of system changes (Smith et al, 2005:1503). Governance encapsulates the meanings of agency and power. Authors highlight how agency intertwines with power, explaining that power facilitates and

[25] Regarding this concept, see Foxon, 2010; Foxon, 2013; Foxon et al, 2013.

delimits agency. This becomes evident when deciding over issues that will be prioritized during a change and others that will disappear from the agenda. They also mention the importance of power in configuring selection pressures and adaptive capacity, as well as in achieving s-t transitions. Agency is defined as the capacity to change or positively influence the results of selection pressures or adaptive capacity (Ibid: 1503). That ability requires exercising political, economic and institutional power.

More clearly, in their typology, governance is introduced through three core parameters that allow the discourse of incumbent regime members regarding the governance of the s-t transition. These themes are the regime membership, the distribution and interdependency of resources and the visions of transformation. Regarding the first, Smith el at focus on the way interaction and interconnection of the regime’s actors form the exercise of agency. Resource distribution and interdependency is another parameter influencing governance of sustainable transformations. In general, the resources capacity includes not only the financial ones but also a number of other assets like raw materials, infrastructure, knowledge, expertise, legitimacy. The different resources are interlinked and they are necessary for the stability of the s-t system, while they are possessed by different actors. Authors understand the interdependency of resources (financial, legitimate authority and knowledge) as a parameter affecting or determining their power relations and the distribution of power among them. This means that power is determined not as something that is possessed by the individual actors' ability but as a structure of the actors’ interaction and dependency (Ibid: 1504); thus, power relations in an s-t system enhance or limit the agents' attempts for changes. The extent to which different actors have control over the resources, as well as their agendas, affect the transition’s trend and orientation. Their distribution is uneven between the regime’s actors, and their possession or their shortage affect the power relations of them. Additionally, shifts in the selection pressures influence the value of particular resources and the power of the different agents.

Visions and expectations are important tools in delimiting s-t problems and activating actors to solve them. Smith et al (2005: 1506) mention that the role of visions in this process is:

1. To map a space of all the probable alternatives that could be developed.

2. To work as heuristics as they give answers to technical, institutional and behavioral issues.
3. To work as a "compass" for all stakeholders, which stabilizes technical and other innovative activities.
4. To act as symbols that bring together different actors.
5. To work as a narrative that attracts resources.

As I will argue in a later section, in this research thesis, this typology of governance will be integrated to the MLP model so as to highlight the significance of power and agency and enrich the multi-layer model. Afterwards, another perspective of the concept of governance will be analyzed. Governance for the sustainable development approach (Meadowcroft, 2007) focuses of issues of distributed governance, assigning a central role to the state during the steering of the s-t transition process. This view is of vital importance, mainly while studying those cases of more paternalistic political frameworks, in which the government retains a central role, like the Greek case that we will analyze in the fourth and fifth chapter.

Distributed Governance, Social Engagement and the role of the State

In his paper "Who is in charge here? Governance for Sustainable Development in a Complex World", James Meadowcroft (2007) observes that the power in modern societies is distributed and wonders if sustainable transitions in contexts like these could be achieved. He proposes an approach of techniques which, through what he calls governance for sustainable development, shifts power balances and transforms socio-technical systems to more environmental and social sustainable directions. Meadowcroft (2007), like other scholars (Geels et al, 2017; Newig et al, 2010; Walker and Shove, 2010), notices the ambiguous meaning of the term "sustainable development" and explains the normative ideas that it includes[26], as well as the significance of the environment, society and economy alignment as principal parameters of the concept. Primarily however, he focused on the approach of governance for sustainable development (s.d.), which he defines and associates with issues like:

1. The identification and management of critical threats to sustainability.

[26]As, for example, are environmental protection and concern for future generations' well-being.

2. The integration of sustainability into general practices of governance.
3. The organization of collective reflection and decision with respect to reconciling social priorities and orienting the overall development trajectory.

To interpret this new approach, he attributes two key characteristics to it, social transformation and steering logic. The social transformation concept, on one hand, has to do with a radical displacement in existing patterns and practices of production and consumption, and as a result, the sustainable transition of intensive and polluting sectors like energy, tourism and transport (Meadowcroft, 2007). Steering logic, on the other hand, is the core concept of his analysis. It refers to an attempt to shift nowadays trajectories of socio-technical systems so that they not only achieve current development objectives but also preserve the preconditions for social advance in the future (Ibid,:302). The steering process could try to orient society towards attaining desirable objectives and avoiding certain dangers, to take action so as to protect groups that are susceptible to changes and finally to re-order social institutions so that they could better cope with the needs of the new environment (Ibid: 302). According to this steering process, a sustainable orientation, even in social and environmental terms, is followed.

The author mentions that in these societal processes governments are not the only actors exerting power and participating in governance for sustainable development. He highlights that in liberal political systems power is usually distributed and diffused in several actors (Meadowcroft, 2007). The diffusion and fragmentation of power applies to both the state, with its many ministries, central and peripheral governments, and semi-autonomous agencies, with different perspectives and agendas. Thus, tensions along with co-operations between competitive players are, under certain circumstances, commonplace in this environment. Besides, the actors' efforts focus on their survival or the success of decisions according to their interests. Regarding this, the author agrees with Smith et al (2005) that the distribution of power is unequal between the different actors and that there are many different forms and resources (related, for example, to finance, influence, knowledge, laws, etc) that could determine if an actor is capable of imposing or supporting its opinions and pathways. The most powerful regime members are those that may come off worst from a transition of the current socio-technical system, thus they seem to perform more sluggishly in these kinds of transformations. With respect to governance for sustainable development, he argues that distribution of power and power relations are interested in issues of power only in those cases that the latter aspire to transform social practices in a sustainable way. Hence, sustainable steering will direct a transition to these pathways in which the power of actors that sustainably change social practices will be strengthened.

Consequently, in an attempt to clarify the governance for sustainable development in a context of distributed power, the author notes that the role of states in this new situation has to change. According to his notion, governments have to influence the orientation of societal development (Ibid: 305). The author argues that diffusion of power in modern societies is primarily an opportunity rather than an obstacle to sustainable development. He explains that governance diffusion is better than the uncontested power of a government, which could enforce its vague and ambivalent targets regarding sustainable development. Based on this logic of sustainable development, the concept of steering process could be approached; thus, it is the result of actions and mutual influence among many system's actors, including those outside the government (Ibid: 302). The process, when it turns out to be successful, appears to be very helpful in terms of progressing towards sustainable development. The extent to which civil society and local communities engage in the whole process is fundamental in terms of affecting the trajectories followed so far and determining clear objectives (Ibid: 307).

Finally, the author emphasizes the importance of government as an actor that takes much responsibility for ensuring that progress is actually being made. Steering logic implies an important role for public authorities at all levels (central and peripheral) in governance for sustainable development. The state participates both in shaping society and in the context through which society could influence the trajectories that would be followed (Ibid: 303). Thus, he recommends a turn towards an interactive/reflective mode of governance (Ibid: 309). The reflexive governance concept is a common one the theories of transitions (Hendiks and Grin, 2010; Smith and Stirling, 2007; Grin, 2006; Rip, 2006; Loorbach & Rotmans, 2006; Voß and Kemp, 2005 and 2006; Beck et al, 2003; Lynch, 2000; Schot, 1998), although it is not always approached in the same way. Reflexive governance is conceived as a process in the road to sustainable development, in which regime actors adapt their perceptions, way of operating and planning, in an effort to avoid economic consequences of current inertia, which leads to problematic development in the future (Vob and Kemp, 2005). Others (Hendiks and Grin, 2010) argue that governing for sustainable development requires repeatedly contemplating practices, structures and outcomes of governance. In this framework, reflexive governance is related to regime actors reconsidering their institutional, structural or cognitive contribution to constant problems, envisioning alternatives. The concept is also related to an innovative and strategic thinking of changing socio-technical regimes (Loorbach & Rotmans, 2006; Schot, 1998). Moreover, the concept is also perceived as endeavors of particular actors to participate in governance, de-align world patterns and thus undermine and influence themselves (Beck et al, 2003). In this particular case, reflective mode of governance is about a dynamic concept which refers to developing knowledge and constructing an understanding of the public good that extends beyond particular interests and is widely shared (Meadowcroft, 2007). The concept has many things in common with the adaptive capacity concept that Smith et al (2005) propose, despite its superior quility. However, in contrast to the concept's common use, the reflexive mode of governance here applies to acts and practices that a government follows (Meadowcroft, 2007). I am going to come back to this concept in the fifth chapter in order to explain the way it will be perceived and used in the particular research. Meadowcroft (2007) also presents a few critical typical features that such an approach could incorporate (Ibid: 308-309). These features are:

1. Actions taken by the government enabling those factors and forces –within the political/legal/administrative sphere– that tend to promote a sustainable orientation towards development.
2. Exploiting interactions of incumbent regime members so that they learn about the characteristics and opportunities for transformation.
3. Establishing long term and short term objectives and formulating such goals as crucial parameters in creating visions of how the system can be expected to evolve.
4. Governmental involvement, monitoring and support to co-governance networks where the state/business/civil society participate as well as promoting political conditions that enforce such initiatives.
5. Implementing institutions (independent, from a political and administrative view) that track social and environmental trend, analyze and assess existing

practices, the efficacy of transition results and the control over the implementation.

6. Promoting a "public sphere" that, among others, will cultivate a sustainable development ethos to the society.
7. Encouraging the logic of "ecological citizenship", as a parameter of sustainable development adoption.

The author argues that governments have to intervene following such an approach so that they shift the distribution of power and enhance sustainable development transitions (Ibid: 309-310). In his view, this intervention process will steer the process of s-t transition to pathways that are socially and environmentally concerned. That is why he introduces techniques for the change of power relations. These techniques are presented in the following table, accompanied with some necessary explanations and examples. According to these, Meadowcroft suggests that legal rights and responsibilities be adjusted (table 2). By this, he is in favor of governments getting involved in legal obligations and adjustments of regimes so that the negative effects of particular products and firms are exposed. He argues that the state needs to establish new rules or regulations exerting pressure to incumbent actors that follow unsustainable practices; by doing so, the state gives a nod of approval to actors that truly act towards sustainable development. As a paradigm, the author presents a case where the state will adopt a legislation forcing industries using hazardous substances to identify them by placing signs in the local facilities. Such a measure would have a severe impact on some companies' social response image as well as on their branding, denting their popularity, ultimately compelling them to take measures towards cutting down on those substances.

Furthermore, the author recommends another technique for establishing or supporting new institutional actors so that the latter support transitions to environmental and social aware trajectories (table 2). Regarding this, an example could involve the state establishing an institutional intermediary actor that will participate in the steering process of a local energy transition, integrating knowledge and perceptions offered by universities, local communities and movements. As I intend to show in the next chapter, an actor of this type has been established on Samso island in Denmark. A third proposition involves boosting those actors and technologies so that they can lead to more sustainable pathways. By this, the author supports the financial, regulative or other kind of facilitation so that these actors could confront unsustainable incumbent actors. Thus, subsidizing, for instance, particular institutional schemes of co-operation and local engagement, supporting certain types and sizes of renewable technologies, increasing the installed energy capacity of this technologies in the local energy mix and integrating new local providers in the process can steer pathways followed so far to a socially and environmentally more sustainable direction. Finally, the idea of the state promoting blending and interconnecting different actors that support sustainability is also recommended; that way, the actors can together address issues and problems and re-evaluate their concern for technology. These actions could result in bringing actors closer or even in integrating the way they understand and approach several issues, further strengthening and stabilizing the particular niche technologies.

Table 2. Techniques for changing power relations (Meadowcroft, 2007: 311).

Techniques	Concept	Example
Adjusting legal rights and responsibilities	*Governments' involvement in legal obligations and adjustment of regimes.*	Oblige an industry to identify hazardous substances used at local facilities. This action will render their use less convenient and less popular, while it will also tip the balance in favor of groups campaigning against toxic releases.
Creating new institutional actors	*Give support to new autonomous actors that could promote changes or assist other parties in organizing themselves.*	In a local energy project for a transition to RE, the government establishes and subsidizes a new autonomous organization that uses existing know-how (deriving from universities, local communities, activists and so on) so as to steer the project.
Establishing new centres of economic power	*Strengthen economic actors whose activities point in the direction of desired social ends. Creating economic rivals enterprises against big companies of the regime could support sustainable development.*	Supporting, legislatively (through regulations) and financially (with subsidies, lower interest rates in loans), economic actors (co-operatives or SME) and promoting particular types of RE technologies that are considered sustainable. By doing so, there is a larger likelihood of enhancing them with respect to jobs and revenues from taxation while enlarging their political power and position in favour of sustainable develoment.
Encouraging inter-organizational collaboration	*Bringing groups together to address particular problems as well as parameters which could adjust power relations and could redefine issues and interests.*	Organizing renewable energy technologies forums and exhibitions in with the participation of co-ops that are active in the renewable energy field as well as other sustainable energy producers and providers, universities, active users, activist groups and other mediators so that their interaction and collaboration is encouraged.

For instance, organizing RE technologies forums and exhibitions, encouraging interaction and collaboration, with the participation of co-ops that are active in the renewable energy field, incumbent actors displaying interest in renewable technologies and other sustainable energy producers and providers, universities, active users, activist groups and other mediators, would be a helpful way of steering to sustainable development. In relation to this, I consider Meadowcroft's (2007) approach as very useful for the needs and the objectives of this research. More specifically, the concept of steering with the state assuming a pivotal role in this endeavor, the interest for the civil society to become engaged and the perception of reflexiveness will facilitate s-t transitions in local scale to sustainable development in political frameworks, where governments retain a more central role, as is the case of a Greek island, which will be analyzed in the fourth and fifth chapter. Next, conceptual frameworks evaluating the role of consumers in an s-t system (Van Vliet et al, 2005) and that of public participation (Chilvers and Longhurst, 2016) will be examined. These perceptions put in the spotlight of analysis interpretations of sustainable development based on concepts like energy democracy (Hess, 2018) and good governance (Stirling et al, 2018).

Consumers' role and the significance of networks

As I have already mentioned, in evaluating user-consumer importance in the change of practices and s-t systems, it would be helpful to begin by presenting a typology of different consumer types and their competence to change their practices. Van Vliet et al (2005) developed a typology of consumers' role. According to this, the significance of consumers to the change of practices differentiates vis-a-vis providers. This notion presents another lens of the user-consumer's role (Shot et al, 2016) in changing practices in a sustainable way. Thus, all kinds of consumers are parts of networks of elements that affect consumer practices. Authors (2005: 46-48) argue that the change of practices and patterns depends on a number of differentiations in elements, like resource use, providers, mediating technologies and consumer roles. They support the notion that consumer roles are redefined with respect to the types of the energy system differentiation (2005:47). Based on that, they propose a four-type typology of consumers' role in parallel with the type of providers. I present these four ideal types of users-consumers and, in parallel, I argue for their capability to facilitate or not s-t transitions with respect to sustainable development. These four types are captive consumers, customer-consumers, citizen-consumers and co-providers. Captive-consumers are those consumers that are captive in a particular utility. The producer-consumer relationship in this category is the traditional one, which follows a top-down decision making. These consumers have no chance of choosing between different providers, producers or services, as there is only one provider, or there are no differences in services among them. Thus, in this case, their practices and patterns are usually unreceptive to change. These kind of consumers adopt sustainable practices obligatorily and only in the case that the provider uses sustainable technologies.

The customer-consumer type also follows the traditional top-down relationship between consumer and producer. However, in this case, consumers have some choices regarding providers and services, which depend on how they are positioned by different service providers. In s-t regimes with this category of consumers, as well as in the former type, the production narrative is based on the satisfaction of consumer-customer's needs. Thus, the user-consumer is highly unlikely to contribute to change of practices in a sustainable way. The only possibility for sustainable pathways to be followed is through demand side management (Pina et al, 2012). Citizens-consumers, on the other hand, are customers who the providers deal with so that the former are environmentally conscious citizens, whose practices and activities are affected by social or environmental objectives (2005: 48); in other words, providers are coming up with extra charges in order to support the use of green energy. Authors (2005) argue that this type of users could be either customers of energy systems or co-providers; their role depends on the local configuration of service systems.

The latter type of this typology is that of the co-provider. These are user-consumers that generate energy services on their own. They are owners of small wind-turbines, or photovoltaic panels (PV) and micro-combined head and power systems (CHP) (2005:59). Co-providers could be either individual end-users or part of local energy associations. These users participate in the provision process, something that in a way affects their practices and patterns. Building on this conceptual framework, later in this chapter, I will argue for the importance of different users-consumers' types in evaluating their role and dynamic in an s-t energy transition process. As I have already argued, matters of social engagement and users are essential in this research with regard to the way sustainable development has been perceived. Thus, I will embed this approach to the users' role model (Schot et al, 2016) already presented in a previous section. In the following section, I will present a final typology of different public participation types, which also blends the view of transitions with that of STS field.

Public engagement

As it has already been mentioned in the first chapter, these authors (Chilvers & Longhurst, 2016) build on STS views while perceiving public engagement in sustainable transitions following emergent and co-productive logics; the focus is on the public engagement creation in the making (Chilvers & Longhurst, 2016:3). The approach aims at showing the way collectives of participation in transition are orchestrated and co-produced, in respect to a number of parameters. The view revolves around the participatory process emerging and being orchestrated through mechanisms of enrolment and mediation (Chilvers & Longhurst, 2016:7). The former probably refers to a centralized process, involving a small number of actors, in which a particular form of participatory collective practices and definitions are promoted. The latter refers to the routines, skills and artifacts that are required for the participatory process to be held together (Chilvers & Longhurst, 2016). Authors argue that these processes are subjected to resistance both from the internal to the participatory collective as well as beyond it. These actions try to reject, alter or strangle moves balancing the three dimensions[27] (Chilvers and Longhurst, 2016:7). Additionally, according to their analysis, the two orchestration mechanisms (enrolment and mediation) contribute to certain actors being either included or excluded from the process. More particularly, they argue that every form of public engagement, exclude particular actors, according to its social and technological characteristics, visions and definitions of the issue.

Chilvers & Longhurst (2016) illustrate this relational co-productive perspective of public engagement through an analytical framework that they design. They exhibit the emergent participation process and the mechanisms through which public engagement process is co-produced based on a three-dimensional scheme referring to the objects, the subjects and the specific procedural dimensions of participation. Thus, in their typology the main elements are the subjects (identity of participants/publics), the

[27]Namely, the subjects, the objects and the model of participation in which I will refer to subsequently.

objects (issues) and the model of participation (political philosophies, procedural format/configuration). In contrast to former views promoting one of the three dimensions, their framework highlights how all of them are co-produced.

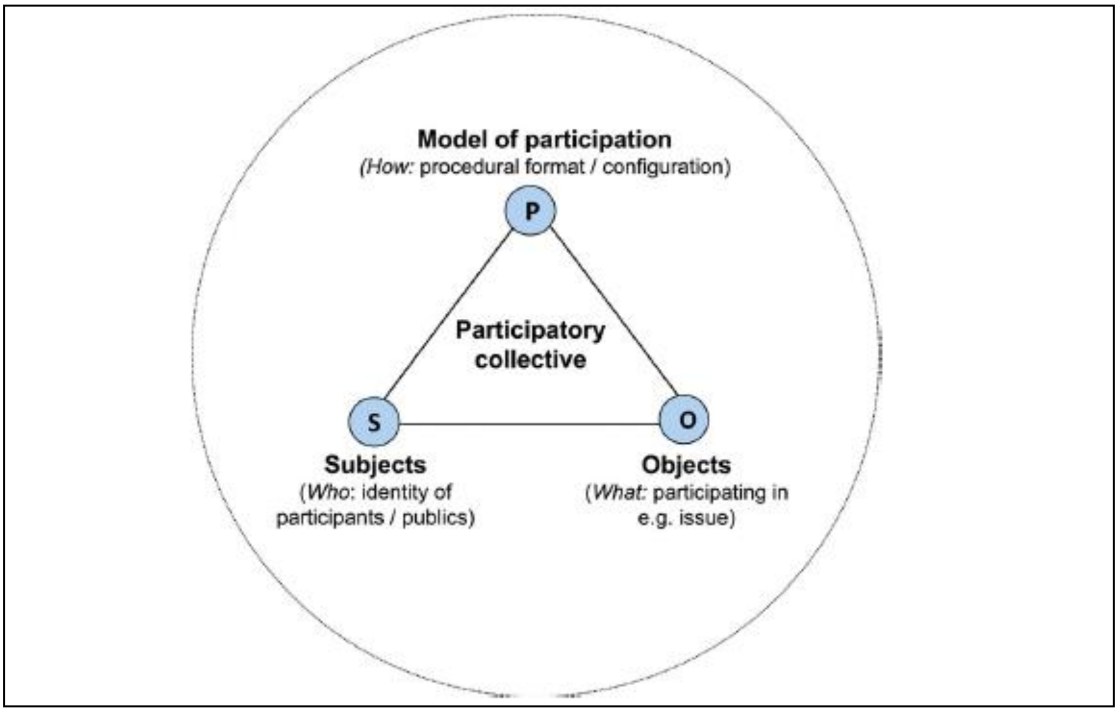

Figure 4. A participatory process emerges through the co-production of subjects (S), objects (O) and procedural formats (P) in relation to the setting and extant orders (outer circle) (Chilvers and Longhurst, 2016:6).

Further, in contrast to former perspectives delineating a governmental-led process as a pre-given one, authors (2016) highlight a typology of four different sights of public engagement. Beyond the governmental-led deliberative consultation, which represents the conventional type of participation, the other three ideal types are the technological trials linked to domestic energy practices, the environmental social movement and the grassroots innovation type of participation. In the first of the three types of public engagement, the whole process is a centralized and institutional one. The public is framed as a form of a consumer/citizen, whereby a greater degree of "consumer engagement" will shift the consumer from a passive user to an empowered and active part of the system (2016:13). The environmental social movement type of participation declares citizen-led or "bottom-up" collectives, which produces more active publics (2016:16). Finally, the grassroots innovation type is a citizen-led or "bottom-up" perspective of participation, where the public is active and technically competent. Many of the approaches presented in this section could be embedded in the multi-layer model, enriching its features and reliability. In regard to the MLP approach, although it is acknowledged as a more mature and reliable approach to sustainable transitions, a considerable amount of criticism in a number of issues has been exerted from the very beginning. Subsequently, such criticism will be presented, while I will also try to embed it in an alternative hybrid approach.

Main criticism, problems and response to the socio-technical transition analysis

The multi-level perspective has, from the very beginning, faced appreciable criticism regarding its functionality and procedures. The debate could be categorized into two main kinds of arguments: the criticism that focuses on the effort to extend the possibilities and solve particular problems and that which is sceptical on the approach and argues on its insufficient functionality. More particularly, MLP has been criticized for inaccurately specifying the extent of the s-t regime (Berkhout et al, 2004:54), putting undue emphasis on niche levels (Smith et al, 2005; Shove and Walker, 2010), creating conceptualization problems (Shove and Walker, 2007), lacking in agency, power and politics (Smith et al, 2005; Genus and Coles, 2008; Shove and Walker, 2007 and 2010) and failing to avoid ambiguity and ambivalence concerning a series of concepts (Shove and Walker, 2007 and 2010; Genus and Coles, 2008).

Deficiency in determining regime level – Emphasis on niche level

Regarding the extent of the regime level, Berkhout et al (2004:54) criticize the model for being obscure regarding the s-t regime empirical level. This kind of criticism has been answered by Geels and Schot (2007:402), who argued that, in socio-technical analysis, the researcher should initially delimit the s-t system of analysis and then operationalize the model. Other scholars criticize the major priority that the approach gave into the niche concept. Smith et al (2005) criticize the s-t transition analysis as an approach that emphasizes a lot on the niche concept. They argue that, without selection pressures, which will be either internal or external, it is impossible for a substantive change to develop. Regarding this, Shove and Walker (2010) question the characteristics, qualities and the closure mechanism that a novelty achieves, according to MLP's scholars, when it gains momentum and enters the s-t regime. They notice that, when an innovation is introduced in an s-t system, it includes two processes, the diffusion and the absorption of it and its practices (Shove and Walker, 2010). So, the stabilization of novelties can be rather put down to the practices required by the novelty being accepted and reproduced, and not to any kind of qualitative improvement or closure; as they pointed it out:

> *"Enduring and relatively stable practices (and complexes of practice) do exist but only because they are consistently and faithfully reproduced, not because they have achieved some kind of closure". (2010:471)*

The first part of this criticism was more or less answered by the pathway transition typology that Geels and Schot (2007) developed and was presented earlier in this chapter. This typology perceives transitions as the results of changes in different levels while viewing niche in the transformation of the s-t system as less important.

Lack of agency, power and politics

Many commentators refer to the lack of agency, power and politics in the approach. More specifically, in their analysis, Smith et al (2005: 1491-1510) criticize MLP as functionalist. They argue that it tries to treat a system's change as a monolithic process and that is too descriptive, while it does not refer to terms like "agency", "governance" and "power", which could transfuse a more effective character into the approach. To limit this inefficiency of the approach, they propose a typology, as a heuristic tool for governance, for s-t system transitions, which has been analyzed in the previous section. Yet, I consider their analysis useful, so, in the next section, I am going to embed it to the MLP approach in my hybrid model.

Albeit from a different perspective, Shove and Walker (2010: 471-472) also referred to the approach lacking in agency, focusing on the users' and other mediators' role and importance. They argue that the commentator is interested only on changes in the supply side of the analysis; by this, they mean that they basically care about alterations in the efficiency and the ecological modernization of artifacts and networks. They note that the approach does not analyze elements like users' patterns, practices and life styles, or the matter of mediators, features that are related to the side of demand. Additionally, they indicate that the "socio" element of the approach has to refer to changes as a consequence of social processes; besides, MLP scholars have pointed out that the "socio" and "technical" elements are of equal importance (Geels, 2004:898). Shove and Walker (2010) also observe that, in the cases that the socio element is on the scene, the interest is shifted on how this will align or de-align the s-t system in the future and not on changes of practices into a sustainable path. Based on these, they conclude that this way of proceeding reproduces current unsustainable practices and patterns while not permitting their sustainable transition. I regard this criticism as essential, thus I will try to adopt techniques and frameworks helping responding to it.

Shove and Walker (2007: 764; 2010:475) further criticized the model for neglecting politics as a basic and necessary element in transitions to more sustainable contexts. They questioned the view of transition management and that of MLP advocates (Geels, 2006a) that a transition could just be an emerging and co-evolutionary process, which (under certain circumstances) could be exercised by an external position through cultivating niche novelties and engaging different stakeholders in design processes. They point out that a sustainable transition is a political process; as such, managers could not be excluded from the analysis and have to participate with certain agendas, directions and so on, as all the other actors participating in it. Genus and Coles (2008:1441) agreed with this criticism and mentioned that an apolitical approach regarding "transition managers" in a political process like this could only end up emasculating useful actors in an attempt for a more sustainable framework. In respect of this argument, Shove and Walker (2007) also criticize the landscape as distant and external concept to the transition procedure. Instead, they suggest that emphasis be given on practitioners, users and consumers getting involved in the transition:

> *In sum, it is necessary to recognize that provisional templates for transition are political statements that can only be partially inclusive (when there are ever more actors on the social stage), contingent (when conditions are dynamic) and potentially unstable as material forms and practices evolve over time. (2007:766p)*

Lawhon and Murphy (2011) also criticize disregarding politics in s-t transitions. They argue that the core of sustainable transitions' analysis is occupied by technology and markets, while other more social oriented elements, such as users, the public and democratic engagement, are absent. Sharing the abovementioned authors' concerns that effective and feasible self-steering and management can be exerted from a neutral position –unlike what the sustainable transition management and MLP approaches claim–, I am going to enhance MLP with other conceptual frameworks highlighting transitions as highly political processes.

Lack of users' perspective and of the demand side of analysis

As many scholars have noted (Grin, Rotmans, and Schot, 2010: 331; Shove and Walker, 2007 and 2010), users' role and public engagement are parameters that are determined and examined superficially in MLP analysis. Nevertheless, many researchers (Hutton, 1998; Van Vliet et al, 2005; Shove and Walker, 2007 and 2010; Chilvers and Longhurst, 2016; Chilvers et al, 2018) argue for the importance of users and collective participation in sustainable transitions. Hutton (1998:25), for example, argues that utilities sectors that participate in transition models, like electricity and water, do not manage regular products-commodities (dresses, for example) but are rather pre-conditions for the contemporary way of life; hence, the use of these commodities is the result of social and cultural norms and conventions (Vliet et al, 2005:14). Because of that, changes to users' patterns, practices and life styles are necessary on the way to ecologically more sustainable socio-technical pathways. It has been shown in the previous chapter that sustainable development is perceived by many scholars (Heiskanen et al, 2019; Walz and Kohler, 2014; Huber, 2000; Langelle, 2000; Hajer, 1995; Weale, 1992) as a a process of ecological efficiency and de-carbonizion of s-t systems. In this trend, many scholars (Nye, 2004; Vliet et al, 2005; Shove and Walker, 2007 and 2010) emphasize this point in s-t transition approaches arguing that –regarding the change of attitudes– attention is primarily drawn on improving the efficiency of the artifacts rather than changing conventions and principles of consumption. More specifically, as I have analyzed elsewhere, Shove and Walker (2007:7) criticize the tendency of MLP and other transition approaches to become exclusively interested in issues regarding technological efficiency and environmental modernization, so that they reach the goal of sustainability. They indicate that changes in the way of living and users' patterns, and likewise their involvement in the whole transition procedure, are playing a major role in a sustainable outcome. MLP scholars (Schot et al, 2016) respond in a sense to this critique by developing a typology of users and their role during a transition, as it has been presented earlier on this chapter.

Ambiguity and ambivalence of its main concepts

Different scholars (Shove and Walker, 2007 and 2010; Genus and Cole, 2008) argue regarding the ambivalence and ambiguity of the approach over a number of choices and interpretations (sustainable concept rhetoric, path articulation as well as start and end points of analysis). Shove and Walker (2007: 765) questioned the idea of transition management considering it a partially insufficient concept. They mentioned its inadequacy to decide on picking certain trajectories instead of others, while also objecting to the use of the term “sustainable”. Regarding especially the vague and unclear concept of sustainability, they warn of the risks of the sustainable transition approach being used as Siloam font for unsustainable technologies (Shove and Walker, 2007 and 2010). They also point out that, in respect to its normative character, advocates of the model focus on presenting only the novelties that have emerged in the s-t regime and directed into more sustainable directions, while on the other hand, they fail to mention the unsustainable ones (2007: 765). Finally, they mark that the s-t transition model, as other transition approaches, revolves partially around promoting as sustainable the novelties that are more stable (in a political, institutional, technical, power relations way) but not necessarily more environmentally and socially sustainable (as technologies or as practices and images). Thus, for instance they notice that controversial or even unsustainable technologies, like nuclear power or the Carbon Capture and Storage (CCS) technology, have been considered sustainable ones (Shove and Walker, 2007:768, Meadowcroft and Langhelle, 2009).

Additionally, Genus and Coles (2008: 1440) argue regarding the establishment of a transition's start and end points. They highlight that start points could have different characteristics in different case studies, while their choice depends on the researcher's subjective view. Further, authors express their wonder about the conceptualization and trend of a transition pathway. They note that going through the literature review doesn't help one clearly understand the criteria by which a new path is determined or chosen. Relying on the already introduced criticism to the multi-layer model, I will later endeavor to embed it to the hybrid conceptual framework that I am going to develop. The hybrid approach will further take into account the way sustainable development has been delimited in this research, as well as the centralized political culture of the South so that the model fits better with the empirical case of Chios in which I am going to follow a methodological steering approach, making an energy transition, following different pathways.

Governance, users and public engagement in socio-technical transitions – A hybrid approach

In this section, I am going to present a hybrid sustainable transition approach, which I will use in the next three empirical chapters of my analysis. This approach is mainly based on the socio-technical system's transition approach but in a rather critical way. Thus, it will also use conceptual frameworks which have already been introduced in a former section. I argue that a number of parameters like governance, the state's central position in the steering process, the users' role and public engagement are fundamental parameters in a sustainable transition's analysis in an effort to respond to the critique that has been voiced against the MLP, to perceive sustainable development as it has already been delimited in the first chapter and to take into account the Greek political framework under which it would run a deep transition (Schot and Kagner, 2018) –using different scenarios in the fifth chapter of this research thesis. Based on this, MLP and its typologies, having been developed by the central scholars of the MLP so as to respond to criticism, will be used. Towards this trend, Schot et al's (2016) approach regarding users' role is regarded as significant in the sense that it highlights the particular user types and the way they could participate in the transition by bringing local society into action. However, this latter typology will be enriched by other views, allowing for a higher level of agency to be given to certain types of users.

At this point, I would like to make clear that I am not going to use transition management techniques in my analysis although they are add-ons to the MLP approach. I disagree with the view of managing transitions as a reliable tool to sustainable orientations. I comprehend transition approaches and typologies as tools that could enable us to perceive things regarding the actors participating in the process, its dynamic, as well as of its actors, the possible pathways that could be followed and expected shortcomings. Hence, I disapprove the view of s-t transition as standardized managerial processes or, differently, as “truth machines” (Geels and Schot, 2007). The alternative hybrid model that will be introduced is in a sense adapted to a local scale so that it can meet spatial differentiation and constraints following nested transition paradigms. As I have already mentioned, in more current attempts, transition and MLP scholars (Coenen et al 2012; Coenen & Truffer 2012; Raven et al, 2012; Hansen and Coenen, 2015) turn their attention to spatial differences of transition processes. Nested transitions of cities and other smaller or isolated territories have been researched over the past few years; especially urban transition's research has been increasing rapidly (Fenton, P. and Gustavson, S., 2017; Swilling, M., Robinson, B. et al, 2013; Sangawongse, S., Sengers, F., Raven, R.P.J.M., 2012; Coutard, O. and Rutherford, J., 2010). As I will subsequently argue, this research will review cases of transitions to insular areas, namely nested ones. Thus, in respect to already mentioned shortcomings of the model, as well as to the parameters that I consider of major importance to sustainable transitions, I am going to complement and enrich the model so that it answers this criticism as well as it acquires a more normative and sustainable oriented character. I could categorize the critiques that I view as essential into two main types.

The first one refers to the ambivalent and vague character of the sustainable development concept in transition analysis (Shove and Walker, 2007 and 2010). I consider this issue a very critical one, mostly in those scenarios that transition analysis is used in a purposive way –as will be the case in the fifth chapter of this thesis– so that the steering actor promotes or discourages certain technologies and managerial schemes based on the way sustainable development is perceived. Regarding this, the hybrid approach being developed in this section will conceive sustainable development relied on how the concept was bounded in the first chapter. By doing so, I shed light on participatory processes and users and their importance as actors of the transition process. Thus, as I will later show on this section, I will use an enriched approach of Schot et al’s (2016) framework by also integrating in this model sides and perceptions of Van Vliet et al’s (2005) theory that was presented in a former section. Furthermore, I consider the earlier presented conceptualization of social transformation (Meadowcroft, 2007) significant in engaging civil society and steering the s-t transition to more sustainable pathways. Regarding this, I would later present a critical enrichment of this approach too.

The second critical issue in my point of view refers to the lack of politics in the MLP approach, as many scholars argue (Smith et al, 2005; Meadowcroft, 2007; Shove and Walker, 2007 and 2010). More precisely, Walker and Shove (2007:4) point out the transition manager's neutrality during the whole transformation process, while Smith et al (2005) mention the lack of governance. This view also regards the steering process as a neutral, in a way, process. In my perspective, transitions are primarily a matter of power and power relations (Smith et al, 2005; Meadowcroft, 2007; Shove and Walker, 2007 and 2010). Because of this issue, governance has to be emphasized in the transition process, as does the state's role, which has to be central in the steering process. Besides, it is claimed (Geels, 2011:25; Foxon et al, 2013:14) that incumbent firms are reluctant to develop radical innovations that could direct to sustainable pathways, as they necessitate high risk investments with uncertain results. In this manner, I agree with Meadowcroft (2007) that the steering process has to be controlled directly or indirectly from the government, which needs to have a sustainable-oriented agenda, so I am going to integrate Smith et al’s (2005) as well as Meadowcroft’s (2007) views in my hybrid approach. Hence, only when the state has a sustainable-oriented agenda and supports local engagement will it allow small actors and users engaged in a transition process to achieve participatory energy transitions. Afterwards, I will present particular elements and tools that I am going to use or integrate in this alternative model, based on MLP approach, so that its effectiveness and its performativity can be improved.

Governance as a central parameter

As I have argued elsewhere, one of the initial critiques regarding the MLP model is its unclear reference to the governance concept. Primarily Smith et al (2005), but also other scholars (Meadowcroft, 2007; Coles and Genus, 2008; Bolton and Foxon, 2011; Arapostathis et al, 2013), have referred to the importance of governance and criticized the s-t transition model. Responding to this critique, I will accommodate Smith’s et al (2005) perspective presented earlier in this chapter, mentioning the importance of governance concept in s-t transformations, something that, in my point of view, will enrich MLP approach, ultimately making it more efficient. In my perspective, governance as an element that encapsulates agency and power is of major importance in achieving a sustainable and stabilized transition. I claim that this kind of typologies would establish clear grounds so that we can analyze and understand incumbent actors' dynamics and power relations. I would also use this analysis in evaluating the power and agency of the different incumbent actors participating in the particular cases, in the third and the fourth chapter of this research respectively. In addition, in an attempt to formulate the basic concepts of the approach even further, I develop an enriched representation of this typology, which is presented in the following figure.

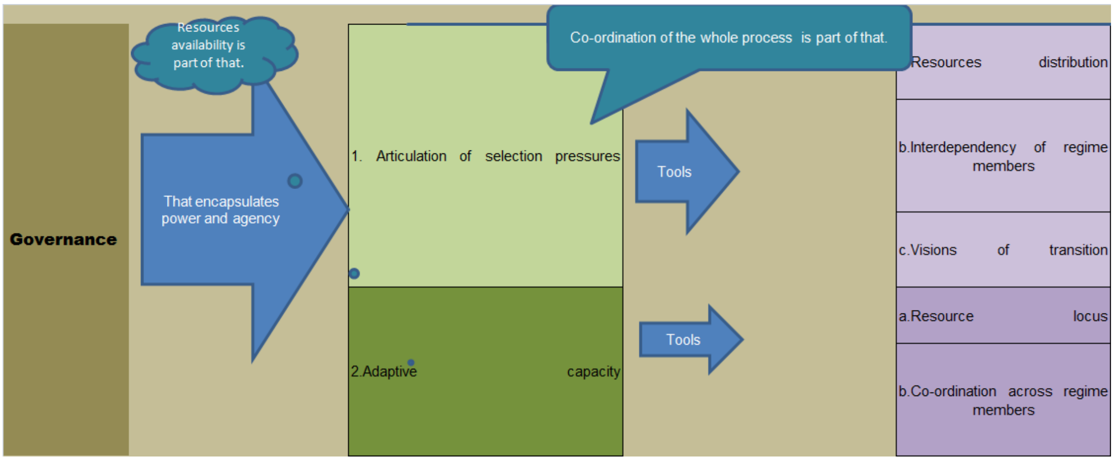

Figure 5. An enriched representation of governance concept according to Smith et al's 2005 approach.

According to this figure, governance is perceived through articulation of selection pressures and adaptive capacity. The former of these concepts is related to three tools showing each incumbent actor's power. Therefore, the amount of resources in a number of issues related to knowledge, finance, raw materials and the social level that an actor possesses, and alternatively, their distribution among different actors, signify each actor's power and dynamic in the s-t regime; however, these elements also affect the actor's agency. Furthermore, the interdependence of different actors and their importance for each others' "survival" or better operation also affects their power and the power relations among them. Finally, short term and long-term visions about an s-t transition and an actor's role determine its power but also its agency in convincing and interlinking other endeavors to its visions. On the other hand, adaptive capacity is linked to an actor's capability to co-ordinate regime members, creating imaginaries and narratives while following new pathways which serve its interests, while also being based on the needs of the transition process. The concept is also connected with the possession of different resources by the different actors. Analysis of this kind will be critical in following chapters when evaluating incumbent regime actors' power and agency.

The governance concept will provide the MLP with a more normative character, and I regard the four types of typology for governance of s-t transitions as fundamental in showing governance, agency and power parameters. Reviewing the approach critically, I would argue that it promotes transitions that reinforce and stabilize the current regime instead of prioritizing more sustainable paths, since it is interested, almost exclusively, in the way that an instable incumbent regime would be re-aligned. This perception reinforces transformations that are based on the supply side on analysis, rather than changes on demand, resulting in more environmentally and socially sustainable transitions. Regarding this, I consider that governance for sustainable development approach (Meadowcroft, 2007) would be vital in granting a different quality to the concept of governance in the hybrid model, aligning the former approach to this thesis' perception on sustainable development as well as to the Greek political context. Thus, governance concept will be perceived in this thesis through both the governance of s-t transitions typology (Smith et al, 2005) and the idea of governance for sustainable development (Meadowcroft, 2007). Although this notion has much in common with Smith et al's (2005) view, it nonetheless contains some new qualities, meanings and mechanisms, which I contemplate as useful. Besides, Meadowcroft's approach is a more prescriptive one for a transition in the making, while it places the state in the core of the transition process. As it has been discussed earlier, governance for sustainable development approach (Meadowcroft, 2007) encases the elements of social transformation and of steering logic. I believe that these two features are critical in achieving, in a sense, bottom-up energy transitions, viewing the state as a central steering actor.

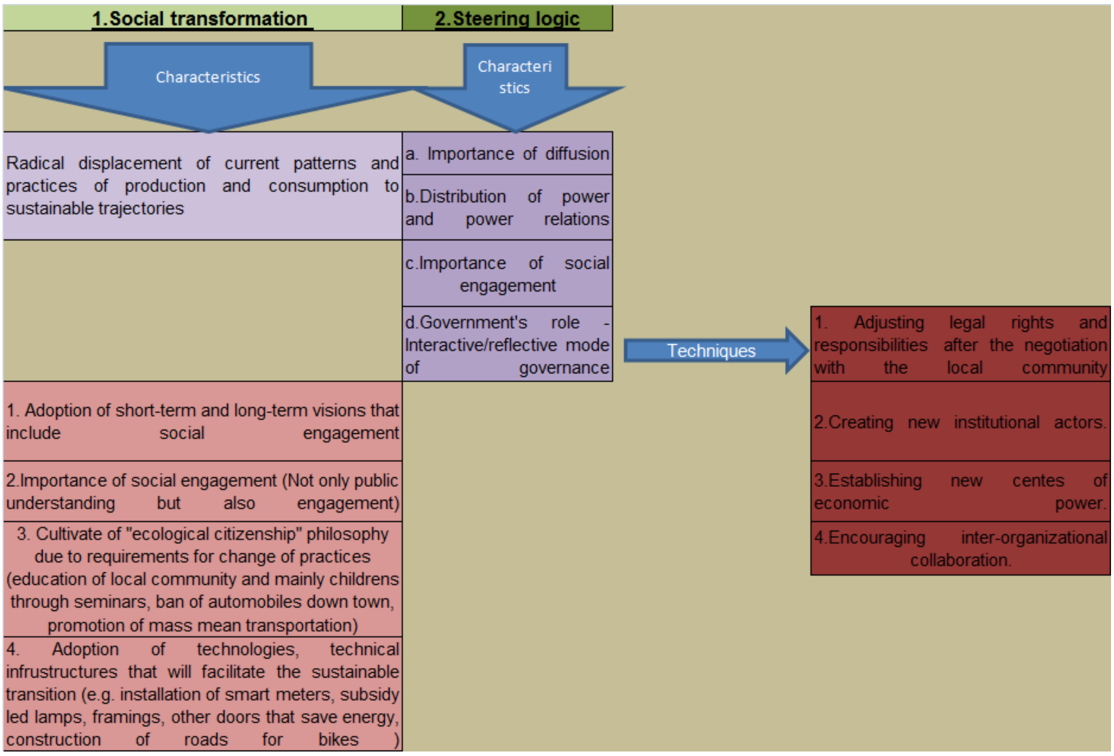

Figure 6. Enriched representation of Meadowcroft’s approach regarding the concept of governance.

The foregoing graph shows an enriched representation of Meadowcroft’s (2007) approach. Governance in this model is interpreted through social transformation and steering logic. Regarding this, social transformation is achieved through a series of measures and actions. Thus, an energy transition would adopt short-term and long-term visions after deliberating with the local community. Moreover, it is important that the civil society engage in the whole process in terms of participating in decision making as well as of owning the technologies. About this issue, I will also enhance the model later with approaches about users’ role (Shot et al, 2016; Van Vliet et al, 2005) so that it will be easier for the society to engage in the s-t transition. Meadowcroft (2007) also claims that it is necessary that societies assume a more ecological philosophy when achieving social transformation. Fostering that kind of philosophy, I believe that social, institutional and technological changes are needed, while it is also vital that the regional/local government participate in the process. For instance, promoting the local community’s education in regard to more environmentally friendly technologies as well as adopting more democratic decision making schemes could be a step in the right direction. Educating children into the new philosophy, thus establishing seminars facilitating adopting that trend, would be particularly essential. Furthermore, banning automobiles in city centers as well as promoting cycling and public means of transportation are other measures guiding to a similar pathway; needless to say, most of these actions call for cooperative and willing local authorities. Finally, I argue that installing particular technologies and technical infrastructures will be helpful in creating a social transformation during an s-t transition; constructing smart micro-grids facilitating a change of practices is an example of this kind. I am going to use this social transformation perception and the number of tools introduced in the fifth chapter in order to make it easier for the local society to engage in the energy s-t transition. In addition, I would like to argue that, in respect to the social transformation concept, I regard the reference to engagement issues –relating to the governance for sustainable development approach– as limited and superficial. This is because, although the approach refers to the need for social engagement and users' participation, it is doing so only to a small degree, without focusing on typologies, techniques, tools or processes that could be followed so that the change of patterns and practices is achieved in production and consumption. Thus, I regard my attempt to determine the concept of civil society engagement more specifically and analytically as part of my contribution to adding to governance theories related to transitions.

The second parameter of governance in this approach is the steering logic. With reference to this concept, I argue that activating the interactive/reflective mode of governance, a concept analyzed elsewhere, is a tool for balancing sustainability and stability. This element uses a number of techniques already presented in a former section of this chapter, which I however have partially enriched by having public engagement participation in mind. Based on this, I argue that, while adjusting legal rights and responsibilities, it is vital that dialogue with the civil society take place

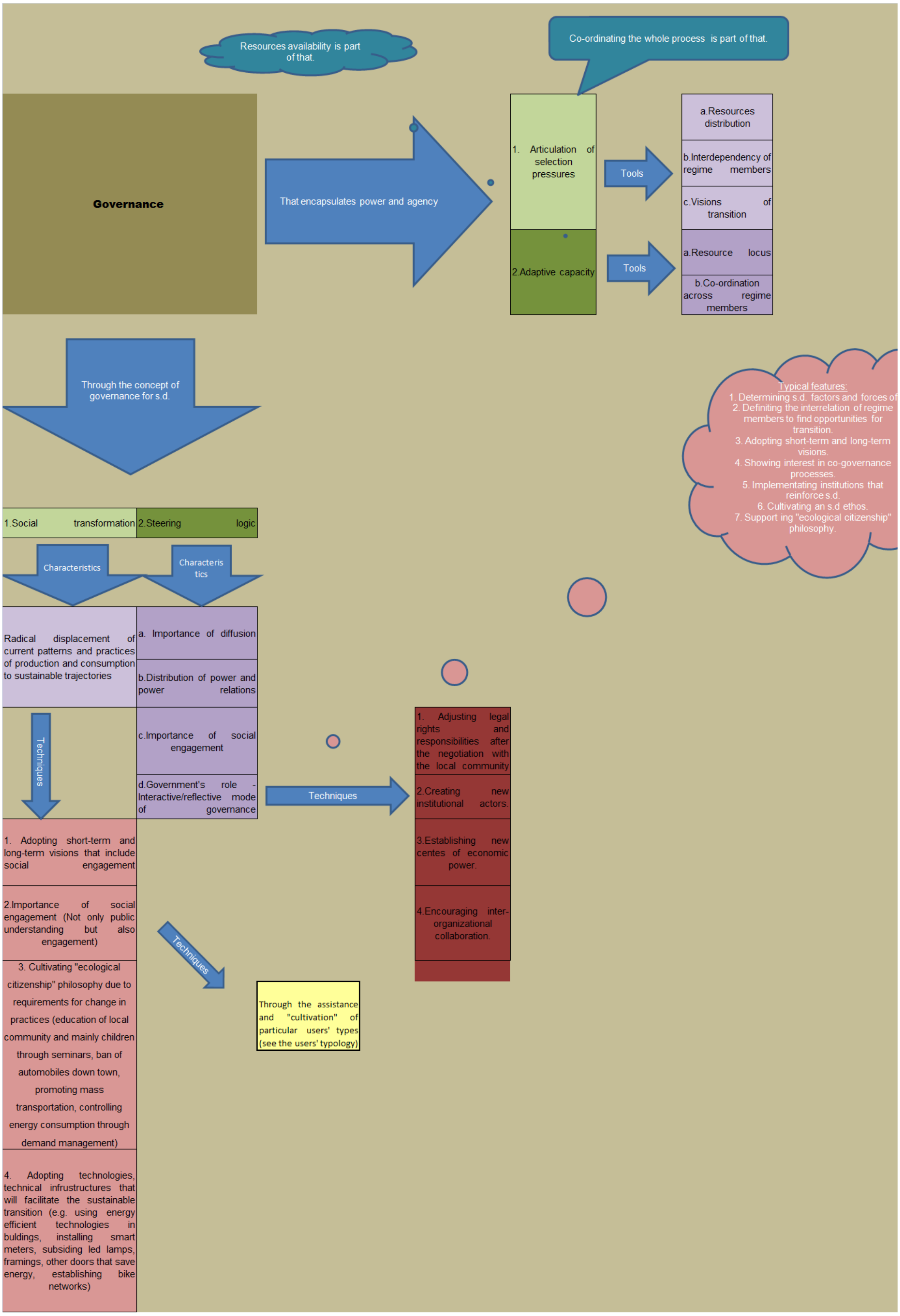

Figure 7. A hybrid approach in governance – Enriched representation of the governance concept.

beforehand; my notion is that integrating a governance perspective relying on social transformation and steering logic in MLP will reinforce its regulatory characteristics. This will prove to be crucial in the fifth chapter, where I will develop different pathways of a sustainable transition using steering tools and techniques based on the presented approach; the interactive/reflective mode of governance, utilized as a “compass” in an attempt for sustainable steering, will be particularly valuable in the policy making action. I will return to this issue in the fifth chapter of this research, where I will more precisely define the reflexive mode of governance, according to the steering process's needs.

In other words, I argue that integrating these two typologies for governance strengthens the whole process by specifying the governance parameters, by revealing the more stabilized pathways and further by giving us tools and processes so that we can follow more sustainable trajectories in a reflexive way. Based on these characteristics, above I introduce a schematic representation of how I perceive governance and its tools and techniques, as I have enriched it. Based on this view, the governance concept is interpreted through two complementary ways. The former, signifying a type of governance that encapsulates power and agency, retains a chiefly analytical character, providing us with details about the power and the agency of the incumbent regime’s actors. The latter, which can be comprehended as the governance of sustainable development, features both an analytical and a normative feature. In this manner, using this concept in an analytical way could provide us with details regarding the extent to which a society engages in a transition (as in the exemplary cases in the third chapter of this research thesis); similarly, using it in a normative way, in case of a transition in the making (as that will be presented in the fifth chapter), could give us tools and techniques steering the transition. The figure also features elements of the conceptual frameworks of the users’ role whereby I will enrich the model, as I will argue in following section. Therefore, in the next section I will present typologies and views that could enhance the concept of social transformation. In this manner, typologies of the users’ role will be merged into the approach, so that more emphasis could be given to the element that I consider fundamental in terms of adopting sustainable pathways.

Users, civil society and local communities in the core of the s-t analysis

As I have already noted, many scholars have criticized multi-layer approach for lacking in providing an analysis of the demand side, especially that regarding users. In this chapter, I have already presented Schot’s et al's (2016) typology regarding users and their role during a transition. The concept serves as a response to the criticism that has been exerted on the multi-layer model. I regard this conceptual framework as a useful tool for a demand side analysis; besides, I acknowledge users' importance in governance and in changing practices, following pathways of sustainable development during a transition. Thus, I adopt this conceptual framework using the five different types of the user's role, namely the user-producer, user-legitimator, user-intermediary, user-citizen and user-consumer (Shot et al, 2016), as they have been presented earlier. Further, in regard to user-consumer, I argue that this kind of users are in a way comprehended as captive ones, in the sense that they do not exert power and agency in a sustainable way, since they basically embrace conventional practices and ways of life. Hence, in order to grant these users a more active role, I will embed the previously presented Van Vliet's et al (2005) approach in the framework. Authors (2005: 46-48) argue that the change of practices and patterns depends on a number of differentiations in elements, like resource use, providers, mediating technologies and consumer roles. Building around this, they have come up with four different types of users-consumers, namely captive consumers, customer-consumers, citizen-consumers and co-providers. Inspired by this typology, I argue that users-consumers could promote changing practices in a sustainable way by exerting power and agency, mainly in the cases that they are able to influence or participate in the production. I argue that users-consumers can support the whole process mainly in the event of transforming into co-providers. As such, they will engage in the production process, a factor which, together with regulative and technological changes (as, for example, are the government installing smart meters and using demand side management), could affect their practices in a sustainable way. Furthermore, in my notion, captive and customer user-consumers are not actually active users, although Van Vliet et al (2005:61) are in favor of the opposite. This is because the former two consumer types have an unsustainable agency, or to put it differently, they have no agency. In this last case, it is the government and utility companies that exert power and play a role in a transition to a sustainable orientation.

Thus, these user types, in my point of view, could not influence or change the patterns and practices in a sustainable-oriented way, unless the utility company or the government has obliged them differently. Citizen-consumers, on the other hand, could contribute to a sustainable transition, as their patterns and practices have, to an extent,

Types	Characteristics	Comments-Tools	Examples
User-producer	They are innovators-practioners, who construct or modify novelties on a local scale. They act cohesively in terms of new users' preferences, practices and routines.	Universities could play, or could assist in, such a role. Additionally, users' activities of that kind could be enhanced by access to finance, tax credits, knowledge and relevant networks. This type of users could not be used in a normative way.	The small wind turbines developed as prototypes by civilians in Denmark during the mid-70s energy transition.
User-legitimator	They help cultivate the importance of a niche in the society - they try to socially legitimize the technological niche. So, they try to stress its values and acceptance. These users exert agency and power and could help achieve changes of practices.	They could be funded and encouraged through greater involvement in evaluating technology, science and society policy.	A municipality that primarily installs pvs on the roofs of the municipality's buildings and buying electric cars for its needs.
User-intermediary	They are mediators that contribute to forming the artifact's design, rules and regulations of use, usage, expectations and interpretation. They usually are the innovation technology negotiators, so they could be users' clubs and associations.	Constructing mediation spaces and delegating certain tasks to them; also, establishing new institutional actors that work as intermediaries.	In the Danish energy transition case, the Organization of Renewable Energy (OVA) and the Association of Wind Turbines Owners, back in the late 70s, are actors of this kind.
User-citizen	They are mainly activists and NGOs that share different values and practices compared to the conventional ones.	Their involvement in the policy making process.	In the Greek framework, Greenpeace could be such a user.
User-consumer	They are users that, through their purchases, but also through domestication and symbolic meanings regarding the consumers' status or identity, re-shape their routines and practices.	Providing digital and natural fora that will help them exchange experiences. Their tranformation to co-providers or to citizens-consumers.	All local residents changed their practices as a result of the nested s-t transition.

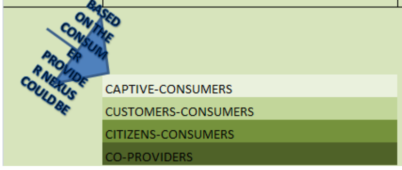

Figure 8. A hybrid representation of the users role and agency in achieving a transition

already veered to more environmentally sensitive perceptions. In addition, I argue that citizens-consumers' engagement in the civil society will, on the one hand, reinforce their practices, and on the other hand, will assist society to progress towards more sustainable practices. Thus, I argue for the need to transform users-consumers to co-providers as a way of engaging society in an energy transition, changing consumption patterns in sustainable orientation. Based on this view, in the different pathways that will be displayed in the fifth chapter, transforming user-consumers to co-providers by installing roof-pvs or participating in small wind turbines projects will be a central objective.

Building on this, the enriched representation of Schot et al's (2016) typology is presented above (figure 8). The table shows different users' types featuring their characteristics, according to Shot et al's (2016) analysis. Moreover, the third column depicts several techniques or tools enabling these users to become active. In the case of user-intermediaries, I argue that, except from mediating spaces and delegating certain tasks to them, some of these actors could steer a nested transition under certain circumstances. I will return to this view in the third and the fifth chapter of this thesis; more precisely, I am going to enrich the user-intermediary concept in the end of the next chapter transition, where I will introduce two exemplary cases of nested transition from the North.

Finally, the last column presents examples of the different users' types; it has been influenced by the cases that will be presented in the third and the fourth chapter. I am going to use this augmented representation of the users' role in the third and the fifth chapter, presenting local actors featuring the different users' roles. I will use this tool either as an analytical (in the case of the third chapter) or as a prescriptive one (in the case of the transition in the making in the fifth chapter) facilitating the steering process. To test the validity of the approach I will later analyze two cases of nested energy transition that has already started during the previous two decades. These are exemplary cases of insular isolated areas which have an impact on the tourist infrastructures, practices and habits. The energy transitions in both cases contain deep transition, also encompassing heating/cooling and transportation systems, while in the second of these cases (that of Gotland), a tourism energy transition is in "the pipeline", steering tourism to sustainable development. In both transition projects, local participation did exist at least in the primary stage of the project. I am going to analyze the s-t transition of these activities using the hybrid approach, highlighting civil society's participation and governance issues.

Chapter 3
Exemplary cases of nested energy transitions

In this chapter, two paradigms of nested energy transitions affecting their tourist sector will be introduced and analyzed. Both areas have started a transition to energy self-sufficient and CO2-neutral pathways. These paradigms will be used as exemplary cases of energy s-t transitions in isolated districts. The first case, Samso, is a Danish island which set about performing an energy transition after winning a state competition for the country's energy island, back in the late 90s (Jantzen et al, 2018). The second case is a Swedish island in the Baltic Sea. Gotland is a crowded tourist island which set off to run an energy transition after the state encouraging its regions to do so back in the 90s (Municipal Council of Gotland, Energy 2010, 2006). Engaging civil societies to the particular s-t transitions, at least in the first stage of the process, were the main reasons for choosing both areas as exemplary paradigms.

This chapter aims at presenting two case studies of the North through which sights, tools and processes are expected to emerge so as to facilitate a sustainable energy transition in the South. Another objective is to turn the attention to the way that these changes influence the local tourism industry. It is important to clarify that, in both cases, the energy transition has marked the beginning of a huge, deep transition in the making which still continues. What needs to be noted here is that I focus on the transition of the electricity s-t regime being on the core of this deep transition, although changes on both islands also include other s-t regimes like transportation, which in my point of view, was part of the wider nested energy regime, as well as water and waste s-t systems. This research is interested on energy-related issues, thus it only prioritizes this part of the transition. Besides, it has been analyzed in the first chapter of this thesis that energy is on the core of the s-t transitions (Heiskanen et al, 2019; Geels et al, 2018), while further in the global public discourse, energy s-t transition has been defined as the most critical issue for climate mitigation through which the concept of sustainable development has been perceived (IPCC, 2014).

Furthermore, the case of Samso will be presented and a social, economic as well as partially spatial analysis of the island will be introduced. I argue that geographic, economic and social parameters are significant in determining the evolution of a transition process and the s-t pathways that will be followed (Coenen et al, 2012; Hansen and Coenen, 2015). Thus, elements like mean household income, unemployment percentage, average age of residents as well as potentially flat or mountainous terrains either facilitate or hinder s-t transition, the engagement of locals but also the usage of particular technologies. Consequently, localities are essential in determining the potential alternative pathways.

A nested energy transition: The case of Samso

As I have noticed, this section will begin by briefly reviewing the social and economic condition of the island in research. This is important, as it enables social and economic features to be included and evaluated in the following s-t transition analysis. Samso is a small windy island close to Jutland peninsula. It is a 114 km^2 low lands area, with its length and width amounting to 26 km and 7 km respectively (Andersen et al, 2013), and it is composed of 22 villages. Four of them are located to the north, uncultivated areas of the island, while the rest of them are situated on the south part. Tranebjerg, which is its largest town, is located on this part of the island (Jorgensen et al, 2007). There are also approximately 4.000 residences whereas its population has been following a downswing trend since 1997. Thus, while there were 4.366 inhabitants in 1997, their number fell to 3.710, nineteen years later, in 2016[28]. The demographic reduction can be mainly put down to the absence of education after the secondary school level, which compels young people to move to the mainland for studies, with the majority of them not coming back to the island (Jorgensen et al, 2007). Additionally, limited options for occupational rehabilitation deteriorate the economic and social conditions as well as increase uncertainty (Halkier, 2007). These characteristics have led to the island’s population becoming an aging one; besides, the median age on the island is higher than the Danish average (Andersen et al, 2013). On the other hand, its residents' economic prosperity has not followed that falling trend. On the contrary, the mean income rates of the island during the last decade are on the rise[29].

Economic activity

Samso is a small insular area, with its developed economic sectors and activities being subsequently limited. The main economic activities are agriculture, tourism and the

[28] Data from https://www.statistikbanken.dk/statbank5a/default.asp?w=1366, see also Jorgensen, 2007.
[29] See https://www.statistikbanken.dk

public sector (social institutions, education and health), while the energy sector is an emerging one (Andersen et al, 2013). According to Statistic Banken DK, the primary sector, agriculture, has since 1997 been among the most important economic ones of the island, although its ratios have been declining[30].

Tourism has also grown to a substantial extent in the last twenty years. In the late 2000s, there were about 500.000 overnights annually (Jorgensen et al, 2007:30), while its number increased during the following years so that tourist arrivals reached the number of approximately 450.000 in the mid 2010s[31]. The island has been a tourist destination, owing principally to its natural environment and its beaches. Further, tourism is a seasonal activity, rising mostly during July and August[32]. The flows have consisted mainly by domestic tourists, while international flows come mainly from German, the Netherlands and other Scandinavian countries[33]; these arrivals constitute more than the 90% of the sector. Tourists are interested in beaches and the natural environment. Except for agriculture and tourism s-t regimes, manufacturing also used to be a large enough sector until 1999, at least judging by the number of workers that it employed. An international food producer actor with production and sales across the world, Danish Crown, owned a slaughter house on the island with approximately 70 employees (Halkier, 2007). In 2000, the company shut down the local manufacture, thus the unemployment rate and the economic uncertainty on the island increased. Under these conditions, in 1997, the Danish government launched a competition so as the Danish Renewable Energy Island could be chosen. The winner would be the area that would schedule the most complete sustainable transition plan to 100% RE (a neutral $CO2$ emissions) supply (Saastamoinen, 2009). The plan had to be based on mature niche technologies that had already existed in the market, such as wind turbines, photovoltaic (pv) cells, biomass, district heating**,** solar thermal heat, ground heat (Ibid). It had to achieve energy self sufficiency for a period of over a decade and phase out of fossil fuels; further, the level of local participation in the project was evaluated by the state as important before the latter could settle on a choice (Jorgensen et al, 2007). Winning the energy transition competition was viewed as an opportunity to reverse the employment and demographic ratios (Halkier, 2007). The success of such a project could provide a competitive advantage for enterprises in

[30] See https://www.statistikbanken.dk/
[31] Data from interview with a local Tourist Office delegate.
[32] Data from interview with a local Tourist Office delegate.
[33] Data from interview with a local Tourist Office delegate.

terms of energy cost reduction and technical expertise, thus potentially attracting new residents and increasing employment (Ibid). In the end, the island won the competition. Therefore, in the following pages, I will present the energy transition that took place on the island.

Socio-technical transition analysis

The main objective of this section is to illustrate a socio-technical transition analysis based on the hybrid approach presented in the second chapter. Further, the section aims at showing the way transitions in socio-technical systems can be studied as long-run co-evolutional processes, involving governance issues, changes in the markets, users' groups, infrastructures, culture and legislation, also affecting other s-t regimes (Geels, 2006, Schot and Kagner, 2018). I would also like to present the dynamic of local actors participating to the regime's transformation, focusing on the civil society’s engagement and the users' role (Meadowcroft, 2007; Schot et al, 2016). Regarding the latter, in my opinion, there are particular user categories entangling the transition process, thus activating the local community (Schot et al, 2016; Van der Vleuten, 2018; Hess, 2018). These types of users are very clearly introduced in the Samsian case.

The Samso island case consists of a nested energy transition **(**Fenton P. and Gustavson S., 2017; Hansen and Coenen 2015; Coenen et al. 2012; Raven R., Schot J. and Berkhout F., 2012; Coenen & Truffer 2012) that is part of the Danish energy transformation project. Nested transitions[34] are influenced by landscape pressures and transformations in the incumbent regimes but they have their own pace and dynamics as well as partially different actors (**(**Fenton P. and Gustavson S., 2017; Hansen and Coenen 2015). In the Samsian paradigm, a transition project was implemented in less than ten years. The energy scheme adopted engaged the domestic community to a great extent; that was crucial concerning its local acceptance. Regime actors participated in this government-led transition were several s-t regime actors, such as the Ministry of Environment, grid owners, a Danish electricity company called NRGi –which also is the electricity distributor on the island– and other state actors, but also local nested regime actors as the Municipality of Samso but also other local actors

[34] The term is used in this work in a spatial way, as it has been explained in the introduction chapter.

which had not participated in the nested energy regime before the beginning of the s-t transition process. Thus, local society and particular actors, such as farmers, energy co-ops, several mediators –including plumbers, blacksmiths and local and external businesses– participated in the s-t transition. The engagement of individual local entanglers[35] in several projects was essential (Van der Vleuten, 2018; Hess, 2018). Above all, this transition was steered in a local level and activated by the Samso Energy Academy (SEA), while the preceding institutions played a crucial role, as it will be argued in the next sections of this chapter.

Afterwards, I will present a historical analysis initially of the Danish energy s-t regime since the 50s and subsequently of the nested Samsian regime. The main objective of introducing the Danish energy transition project is to determine the features, the culture, the perception and the dynamics of the s-t nested regime. In respect to niche technologies, the analysis will be focused mainly on the evolution of the wind turbines technology. In general, the s-t transition is divided into three periods, the one spanning from the start-up of the transition in Denmark to the 90s, the second one from the early 90s to the early 00s and finally the last period from the early 00s and on. During the first period, the incumbent regime was in a way stabilized until the 70s, where landscape pressures de-aligned it and many niche technologies had been established in the Danish socio-technical system. New conditions resulted in a limited transformation to the energy mix of Samso too. During the second period, the acknowledgement of environmental problems by the international community led the Danish government to steer an energy s-t transition to sustainability while, further, changing society's attitudes in regard to the environment and increased landscape pressures to the energy s-t regime. Actually, this was the initial stage of the nested transition in the case of Samso. In this phase, Municipality's role could be characterized rather as neutral concerning the transition process. Finally, in the last period, and more particularly since installing the off-shore wind technology, Municipality's role changed and a number of new actors were established. Among them, the Samso Energy Academy, an intermediary-user (Shot et al, 2016), steered the energy transition in the local level.

[35] The term refers to actors activating others, thus facilitating the s-t transition. Transition and STS scholars have referred to these types of actors (Van der Vleuten, 2018; Hess, 2018). I am going to return to this type of actors and their features in the fifth chapter of this research thesis.

Wind turbines and district heating systems in a fossil fuel world – The Danish energy s-t transition

In the Danish case of the energy s-t transition, after WWII, the power network in the country was centralized at least in terms of productions, as ownership remained distributed in many co-operatives and other stakeholders (Nielsen, 2010:19). Additionally, fossil fuel power AC plants displaced DC powered turbines to a great extent. While developing the Danish wind turbine, the design and construction of the Gedser wind turbine were matters of primary importance (Nielsen, 2010). Without a doubt, during the 50s and 60s, the wind-energy technology had remained a very small niche market. Besides, incumbent regime actors like DEF, the lobbing actor of Danish Utility Companies, the suppliers association as well as politicians did not actively support wind innovation attempts (Nielsen, 1999:170-172). Indeed, the incumbent regime's actors had strong faith and clear ideas about the trends of future development arguing in favor of the atomic power as the only niche technology being in position to compete with fossil fuels[36].

A major landscape pressure, the oil crisis during the early 70s, affected the Danish energy regime and influenced the governmental energy policy. Thus, a de-alignment and re-alignment pathway (Geels and Schot, 2007) was in the pipeline during the following two decades. The Danish government ran the risk of its great dependency on oil acting as a handicap for its economy, expressing its will to ensure secure energy supply[37]. This new reality de-aligned the country's energy regime. The break of lock-in condition created windows of opportunities, as niche energy technologies, like wind and nuclear power, emerged. Nuclear power had been adopted by other European energy regimes already since the 1950s and 1960s. Besides, Denmark participated in the “Atoms for Peace” research programme, trying to develop a nuclear reactor (Meyer, 2017). Thus, the national energy s-t regime like the Danish Utilities Association, the Ministry of Commerce and other benefited actors supported an s-t transition pathway to an energy mix based mainly on nuclear power. According to this narrative, nuclear power was promoted as the basic power resource in the Danish energy mix, minimizing national energy dependency and maintaining future

[36] See Henrinken speech at 1957, in Nielsen, 1999:168.

[37] More than 90% of all energy supply was imported oil. (See http://www.ens.dk/sites/ens.dk/files/dokumenter/publikationer/downloads/energy_policy_in_denmark_-_web.pdf 6p)

economic development (Nielsen and Heymann, 2012:16). The plan also supported wind power[38] use in a complementary role through a large-scale wind turbines[39] governmental programme (Heymann, 1998; Nielsen and Heymann, 2012:16). In spite of the incumbent regime actors providing support towards this pathway, this narrative was finally rejected due to the huge social opposition to nuclear energy and probably due to the reluctance to absorb the political cost during the 1975 national elections (Ibid). Furthermore, the old successful tradition of wind turbines, and mostly the successful Gedser wind turbine implemented during the 60s, was an important challenging narrative which contributed to the nuclear failure.

At the other end of the spectrum, opposition to nuclear energy engaged a mosaic of different actors sharing common ideals and social values, like environmental protection, democracy and social justice (Ibid: 19). These actors shared common expectations about the efficiency and the good potential of the small scale wind turbines. They were mainly pioneer users like users-producers, users-legitimators and intermediary-users (Schot et al, 2016). These grassroots innovation movements organized meetings[40] introducing small wind turbines as relevant solutions[41], strengthening their technical knowledge and other cognitive routines. Towards this direction, small wind turbines' owners released a monthly energy magazine, sharing common technical and economic data with niche's actors (Nielsen and Heymann, 2012:20). In 1979, the establishment of a test station for small wind turbines by the Danish Government contributed significantly to bringing closer the technical and cognitive routines among niche actors (Dannemand Andersen, 1993). The station controlled and standardized the wind turbines characteristics, while tests were obligatory in turbines suitable for public subsidies (Nielsen and Heymann, 2012:21). The Test Station was very important in terms of stabilizing the niche technology.

During the 80s, terminating nuclear power transition pathway as part of the state's energy policy and establishing wind technology as the central one, as well the boom in turbines exportations in California's wind market, redounded to the wind

[38] According to this plan, the wind turbines share in the new energy mix was around of 10%.
[39] According to the R&D programme, every wind turbine has an installed capacity of 630 kW (see Nielsen and Heymann, 2012).
[40] Meetings such those had been organized by the OOA, since the late 70s. In these meetings, many small wind turbine stakeholders and enthusiasts participated and allowed for the development of a grassroots energy network (Nielsen and Heymann, 2012: 18-19).
[41] See for example NOAH's summer camps themes during the second half of the 70s. (Nielsen and Heymann, 2012)

technology entering the s-t regime, thus allowing for its wider diffusion and acceptance in the Danish community, rendering many of these strong incumbent actors of the national energy s-t regime during the 90s (Ibid:12). Since the late 80s, intergovernmental organizations and civic societies made the need for a turn to sustainability clear. Global concern and environmental sensitiveness had increased raising new landscape pressures' in the energy s-t regime. These pressures led to a technological substitution path (Schot and Geels, 2007) in the Danish energy regime which is still being followed until nowadays. During the 90s, the Danish Government's initiatives adopting Agenda 21 forced incumbent actors to try to adapt to the new conditions. In terms of governance, based on the conceptual framework of Smith et al (2005) introduced in the previous chapter, it could be argued that the incumbent regime has since then followed a purposive government-led transition. The main objective of the state's strategy was the participation of renewables in the energy mix with a percentage of 35% until 2030. The mean RE level in the country was at that time approximately 12%. Policy makers promoted wind power and bio mass as the core technologies which would support the s-t energy transition. During the 2000s, the Danish Government set an ambitious long-term target of abandoning fossil fuels by 2050. In this framework, a first step was greatly developing renewables in this decade, thus reaching an installed capacity share of the country's energy mix up to 40% in the early 2010s and a penetration in regard to final energy demand rising from 17% in 2005 to 30% in 2020 (Danish Energy Agency, 2012 and 2018; IRENA-GWEC, 2013). Subsequently, the nested transition of the island of Samso will be introduced. Thus, the transition pathways followed, the technologies used and the main actors participating in this process will be highlighted.

Niche technologies, entangling actors and social engagement in the nested regime of Samso

During the 70s, when the national energy regime de-aligned, the nested regime in Samso island could be characterized as stabilized. Samso was connected with cables with the mainland electricity network through which it covered its needs. Futhermore, there was no electricity production on the island (Saastamoinen, 2009). Concerning heating and transportation, fossil fuels were used, that were transported to the island by tankers[42] (Ibid). Heating technologies used in households were mainly individual ones, running on fossil fuels. The sole exception to this condition was a district heating plant constructed in Tranebjerg by the local community which run on oil (Samso: The renewable energy island of Denmark). That plant was abandoned a few years later as cost-inefficient.

Renewable technology was unknown to Samsings. It wasn't until 1983 that the first wind turbines were installed on the island (Jorgensen et al, 2007). The two small wind turbines were erected by “Samso Wind Energy”, a co-operative organization being the pioneer user-producer and user-legitimator of the island (Ibid). These turbines were replaced later on with larger ones. That was the only renewable project that had taken place on the island until the 90s. As environmental awareness of the Danish society grew, it has also influenced Samso’s community since the early 90s. Thus, in 1992, a group of users sharing environmental concerns got involved in re-establishing the district heating plant in Tranebjerg using renewable raw materials (Samso: The renewable energy island of Denmark). These were local entanglers (Van Vleuten, 2018; Hess, 2018) who tried to convince local residents of the need for a sustainable s-t transition in heating. Their belief and vision that such a plant could operate led them to contacting an incumbent actor, NRGi, the national energy company already operating in the electricity nested regime (Jorgensen et al, 2007). Although it had no experience in district heating plant, the company rose to the occasion (Samso: The renewable energy island of Denmark). The group of intermediary-users and the incumbent actor managed to convince the local community of the importance of a transition to biomass-fueled district heating, creating expectations and arguing in favour of the stability and efficiency of the niche technology. The new plant was a fossil-free one, as it used straw and belonged to NRGi (Ibid). District-heating technology was not new in Danish economy; in fact, the Danish Heating Association, a major incumbent actor of district-heating companies, was established in 1957. The association nowadays amounts to around 400 companies all over Denmark. The companies are mainly municipal-owned, or alternatively, they follow a co-operative scheme. The co-operative character of these enterprises can be also attributed to the

[42] Elements by data collection through interview with SEA delegate.

regulative framework, which defines district-heating organizations as non-profit ones[43]. However, conventional district-heating plants were using oil as raw material.

In this context, the Danish Ministry of Environment ran a competition in 1997 for the Danish self-sufficient island. The state wanted to create a renewable energy transition paradigm for other isolated communities (Jorgensen et al, 2007). Samso was the winner, managing to implement its plan in less than a decade, something that required a high-level of co-ordination (Jantzen et al, 2018). In 1997 the island, came up with its master plan for the transition. This was a result of the initial plan funded by the Danish Government (Jorgensen et al, 2007). The plan was designed by the Plan Energy, an individual consultancy firm and the Energy Company (SEC), one of the two new institutional actors that were established for the transition (Saastamoinen, 2009). The local society was not engaged to this process. The central government steered the whole process, initially by funding several procedures of the s-t transition and new actors like the Energy Company (Ibid). The latter was the actor which partially ran the s-t transition locally, and more specifically, the wind farms and district heating projects (Ibid). The other new actor formed by the Municipality of Samso was the Samso Energy and Environmental Office (Jorgensen et al, 2007). This actor promoted social and environmental technical solutions based on master plan's targets, consulting users that would like to establish their renewable energy project (Saastamoinen, 2009). In other words, these two actors were intermediary users, operationally steering and coordinating the transition process, creating expectations of its significance, interacting with other actors in local and national level and listening to the local community, so that they could reassess practices and adjust initiatives. Sharing a strong belief about the results of the transition plan, these two local steering actors would invite locals in meetings concerning the planning and development work while trying to engage them into the transition pathways.

The deliberation process between locals and the steering actors was able to resolve conflicts, thus establishing a framework of trust among them. The local society had the opportunity to participate in the meetings individually or through several local actors expressing their opinions (Saastamoinen, 2009). Steering actors adopted and

[43]This information has been collected by the official site of Danish District Heating Organization (for more info see https://www.danskfjernvarme.dk/english/about-us).

integrated the majority of the meeting suggestions made by the locals[44]. Meetings engaged locals in technical issues (like the position and the exact size of the wind turbines) but also in economical matters (like the cost of the project and the payback period) (Saastamoinen, 2009:11). This helped social legitimization and acceptance of the niche technologies build up within the local community. Hence, many local actors and users like businesses, farmers, business councils, blacksmiths and plumbers decided to invest in and support the whole process, so that they would have financial incentives[45]. For example, the economic benefits and financial tools[46] that could arise by installing inland wind turbines in their land were made clear to the landowners who mainly were farmers, so that many of the latter ended up investing in these projects.

Additionally, sub-projects like district heating were decided using local biofuels from local suppliers, investing in the circular economy, thus further engaging local society. Using local expertise worked in this direction too. In this trend, the two local steering actors, SEC and Samso Energy and Environmental Office, organized seminars educating and certifying local blacksmiths and plumbers according to the national scheme, so that local professionals could install renewable energy technologies and systems (like pvs) (Ibid:10). During the meetings, the steering actors started planning short-term and long-term visions based on the project plan’s guidelines as well as on locals’ decisions deriving from the meetings. Educating local community by running energy saving campaigns, briefing locals regarding particular individual electricity or heating technologies (Jorgensen et al, 2007), thus contributing to its social transformation[47]. All these processes allowed power relations of the nested regime to change and new local actors to enter, while it also contributed to distributing the necessary to s-t nested regime resources (like knowledge and land) to new actors, thus altering practices (Saastamoinen, 2009). Further, steering institutions gave locals the technical and professional knowledge, helping the latter decide the proper heating technologies or take business decisions. Besides, local steering facilitated activating local society financially too. Until 2000, most of the investments had come from local residents (Saastamoinen; 2009:8). State’s and municipal’s grants were limited, as from the €53,3 million that had been invested only 4 of them came from public

[44] This was mentioned in my interview with SEA delegates.
[45] Interviews with SEA delegates and with the farmer and wind turbine owner named Tranberg.
[46] Like a decennial fixed price agreement, low interest rates loans and so on.
[47] According to Meadowcroft’s (2007) conceptual framework presented in the previous chapter.

subsidies (Ibid). On the other hand, it needs to be noted that lack of a strong nested energy regime, with many incumbent regime actors, minimizes resistance against the local transition projects, facilitating its breakthrough, enabling niche technologies to emerge and realigning the new nested regime. In addition, a decentralized grid (with transformer stations) eventually made the energy transition to more sustainable pathways easier. Hence, although the local electricity network was not at that time considered a "smart" one, its configuration allowed for the extensive use of decentralized renewable technologies[48].

The role of individual users engaged in the project was also crucial, entangling it in its favor. Soren Hermansen, the first employee of the Samso Energy and Environmental Office (SEMK), was such an individual (Saastamoinen, 2009). Soren is a very competent and insightful man that was very well-known to the locals[49]. He believed in the project very much and participated in the meetings and other processes supporting new technologies and mainly wind-farms projects to the locals[50]. Thus, this individual became a local entangler (Van Vleuten, 2018; Hess, 2018), activating local society and subsequently facilitating s-t transition. However, in Soren's case, being part of an institutional actor like SEMK, allowed him to institutionalize in a way its perspective in the public discourse, socially legitimatizing it easier. Therefore, establishing an institutional indermediary actor, staffing it with individual entanlgers taking part in the steering process, thus contributing to engaging local society to the s-t transition easier and to a greater extent. As it will be shown afterwards, the Samso case involved many local entanglers arguing very actively in favor of particular sub-projects. Their motives were mainly environmental or economic ones. In the following section, I shall provide an analysis of the project regarding the installation of ten wind turbines on the island. The rather small wind park was designed to address the island's energy needs.

[48] Samso's electricity s-t system was not considered a smart one until mid 2010s, when an interview with SEA delegates took place (2016).
[49] This was mentioned in my interview with SEA delegates (2016).
[50] His colleagues in SEA mention that, in many cases, altough he would go to meetings with subjects other than energy, at the end of the meeting, he would ask for the participants's permission to talk about the energy project (source: interviews with SEA delegates).

The Land-based wind turbines project

The inland turbines project started in 1998; it was the first sub-project that took place. The niche technology had to cover the electricity consumption needs of the island, based on the hypothesis that its levels wouldn't fluctuate compared to those of previous years (Andersen et al, 2013). Moreover, the grid connection stabilized the local network, increasing its reliability. The initial electricity project of the transition process required installing fifteen inland wind turbines of 750 kW, so that it would cover the island's electricity needs. Instead of that, following negotiations, steering local actors suggested –and finally got– that eleven inland wind turbines of 1 MW each be installed, to ensure covering the island's average electricity consumption (Jorgensen et al, 2007:21). Further, wind farms were planned to be installed in the south-west areas, while every windmill could electrify approximately 600 households (Samso Energy Academy, 2014*:2*).

In 1998, the two local steering actors organized a few meetings inviting local actors so as to inform them on selecting wind sites and financing the project. The government was also steering the process by determining fixed prices, increasing the expectations for operational and financial success, raising local actors' interest in investing in the wind energy, mostly on the part of farmers' community (Jorgensen et al, 2007; Saastamoinen, 2009). More particularly, many farmers with potential turbines sites were convinced of this investment's financial sustainability, thus becoming keener on investing in this transition pathway (Jorgensen et al, 2007:21). Hence, determining fixed prices in the electricity production for a ten-year period and regulating them by law for the particular project rendered this a low-risk investment, allowing for a loan to be disbursed more easily[51]. Furthermore, the state's role in steering the transition was also evident in engaging other public actors that dispensed technical or financial support, as for instance was the Danish Energy Authority (Saastamoinen, 2009:7). The local steering actor's role was also vital in entangling in the particular sub-project. Except for the two local steering actors, there were also other individual users entangling in the s-t transition, enriching the local community with the values of the niche technology. Some of them contributed to legitimizing the particular niche technology or its usage and values in the eye's of the local community, while others investing in it affected and in a way re-shaped their practices

[51] Data from the interview with a farmer and wind turbine owner and a representative of the Paludans Flak wind turbines co-operative.

as well as those of other consumers. Farmers, for instance, belonged in this latter user-consumers' category, with some of them entangling the others in very actively participating in the s-t transition[52].

Additionally, user-consumers played a crucial role, following these "first-runners", getting interested in engaging and investing in the project, when it began gaining popularity. Regarding this, institutional and regulatory framework essentially facilitated the engagement of locals in the wind-project (Jorgensen et al, 2007; Saastamoinen, 2009). The energy scheme was, in my perspective, the fundamental characteristic of this transition. The local steering actors adjusted an ownership scheme allowing every simple user on the island to invest in the wind farms. Thus, a cooperative scheme was established, enabling the participatory process to evolve, thus affecting in a way the routines, the skills and the artifacts required in this transition (Ibid). The plan was based on the idea of reserving shares for every local that would like to receive them under the umbrella of a co-operative (Jorgensen et al, 2007:21). The same scheme had been followed by "Samso Wind Energy" company, which had been the first actor to install small wind turbines on the island, back in the 80s (Ibid). This actor had facilitated legitimizing the niche technology in the view of the society, thus it was decided to participate in running the new project too. The institutional framework under which this legitimator-user (Schot et al, 2016) ran was also helpful for the new project facilitating the extensive engagement of the civil society (see also figure 9.).

Based on the conceptual framework of public participation (Chilvers and Longhurst, 2016) that has been presented in the previous chapter, engagement is achieved through mechanisms of enrolment, mediation and exclusion. Thus, in the particular co-operative scheme, the enrolment mechanism mainly enclosed the two local steering actors and "Samso Wind Energy". Additionally, the mediation process was more open to the local actors. Besides, at it has already been argued, locals participating actively in meetings, thus influencing their results to a great extent. Especially with regard to the technical features of the niche technology, such as its height and capacity, altering them was actually suggested during the meetings. Concerning exclusions, the co-operative plan mainly ruled out non-residents as well

[52] Financial motives to landowners for investing in wind turbines were very strong, according to an interview with a farmer and wind turbine owner.

as those wind turbines enterprises that did not construct 1 MW turbines. With regard to locals, the whole process did not exclude any individuals or groups –at least intentionally; on the contrary, the relatively low cost of its share gave the chance to the majority of citizens to financially get engaged in the project. Accordingly, the number of users-consumers finally deciding to invest in this project amounted to approximately 450, reserving two wind turbines (Jorgensen et al, 2007); that is, 1/9 of the local residents were engaged in this co- operative, while the remaining nine

Types	Characteristics	Comments-Tools	Examples
User-producer	They are innovators-practioners, who construct or modify novelties on a local scale. They act cohesively in terms of new users' preferences, practices and routines.	Universities could play, or could assist in, such a role. Additionally, users' activities of that kind could be enhanced by access to finance, tax credits, knowledge and relevant networks. This type of users could not be used in a normative way.	The small wind turbines developed as prototypes by civilians in Denmark during the mid-70s energy transition.
User-legitimator	They help cultivate the importance of a niche in the society - they try to socially legitimize the technological niche. So, they try to stress its values and acceptance. These users exert agency and power and could help achieve changes of practices.	They could be funded and encouraged through greater involvement in evaluating technology, science and society policy.	The municipality of Samso that primarily installs pvs on the municipality building's roofs and buying electric cars for its needs. In Samso's case, the "Samso Wind Energy", namely the pioneer association, established two wind turbines in the island in 1983.
User-intermediary	They are mediators that contribute to forming the artifact's design, rules and regulations of use, usage, expectations and interpretation. They usually are the innovation technology negotiators, so they could be users' clubs and associations.	Constructing mediation spaces and delegating certain tasks to them; also, establishing new institutional actors that work as intermediaries.	The Samso Energy Academy and its predecessors are users of this type. Other local users of this type are Samso Wind Energy and Paludans Flak, the local co-operatives of in-land and off-shore wind turbines.
User-citizen	They are mainly activists and NGOs that share different values and practices compared to the conventional ones.	Their involvement in the policy making process.	-
User-consumer	They are users that, through their purchases, but also through domestication and symbolic meanings regarding the consumers' status or identity, re-shape their routines and practices.	Providing digital and natural fora that will help them exchange experiences. Their tranformation to co-providers or citizens-consumers.	All local residents changed their practices as a result of the nested s-t transition.

Figure 9. An enriched representation of Schot et al's (2016) approach on users' role in the Samsian transition.

turbines were owned by farmers (Ibid). Based on this local participation typology, the particular s-t transition could be characterized as grassroots innovation (Chilvers and Longhurst, 2016).

Following this pathway, some points regarding the users’ role in the particular s-t transition could be highlighted. The picture above (figure 9) shows elements regarding users and their role in the Samsian nested transition. A similar figure has been presented in the previous chapter, presenting the different roles users play in a transition. The figure is based on the hybrid model developed in the second chapter of this research thesis (Schot et al, 2016). Its last column shows examples of the different user types from the local case of Samso. As it has been discussed so far, the two local actors –Samso Energy Company and Samso Energy and Environmental Office

(SEMK)– steering the whole process in a local level are intermediaries-users. However, their role in the s-t transition is more critical than that of normal users of this type. This is because they are in fact the intermediary institutional actors steering the process.

Samso Wind Energy is also an intermediary-user, although this actor belongs simultaneously to other user categories (Schot et al, 2016). Nonetheless, this user does not have the extensive role that the two local steering actors have. Municipality is also an important actor of the nested s-t regime and a user-legitimator in the s-t transition process. In this initial stage, Municipality kept a relatively neutral role, albeit a rather local engagement-oriented one. It exerted power and agency by setting the regulatory context, thus, together with the County Office of Arhus participating in assessing environmental considerations, they would decide on the more appropriate turbine sites and provide the necessary permits[53]. In addition, it accepted the decision made by the meetings and the local steering actors for 11 wind turbines of 1MW, rather than 15 750 kW- wind turbines, to be installed. This allowed for an alteration to the turbines' maximum height –from 70 to 77 meters. Other nested regime's actors could also be added in this picture, like, for instance, the district heating co-operative which was established in Ballen-Brandby, as I am going to explain later. Subsequently, the heating nested transition is introduced.

Heating

Heating transition was part of the wider energy transition running on the island. Adopting the s-t transition pathway that was followed in late 90s in Samso changed the heating methods on the island –depending on fossil fuels up to that point– by using district heating systems running mainly on biomass and other individual niche technologies (Jantzen et al, 2018). More specifically, this transition pathway contained three fossil fuel-free district heating plants constructed in densely populated areas under collaborative schemes and other individual fossil fuel-free niche technologies, such as heating pumps, hot water solar collectors and biomass heating units, in the off-network areas (Ibid). Actually, district heating technology was not something new on the island. In the early 90s, one of the district heating

[53] Data deriving from a Municipality's respresentative.

networks was constructed in Tranebjerg. This initial station as well as the three new stations were running on biofuels (like straw and wood chips) or solar energy instead of oil.

District heating technology constitutes the basic source of heating supply. Approximately 43% of the needs are provided by district heating, while another 27% is supplied by other sustainable niche technologies used by individual users (Jorgensen et al, 2007:44; Saastamoinen, 2009:15). In many cases, users-consumers use a combination of more than one technology for heating and cooling. To ensure high local participation in district heating projects, steering actors, together with the Municipality of Samso, set a framework facilitating the transition pathway. Existing houses in the areas, where a station was being constructed, participated voluntarily in the transition, while new ones were obliged to connect to the network (Jorgensen et al, 2007:11). Further, the Municipality of Samso made an arrangement so that building owners could finance district heating technology by receiving mortgage loans (Jorgensen et al, 2007:11).

Social engagement was crucial in establishing the niche technology promoting the s-t transition. Active residents and local co-operatives participation affected, and in a way, co-developed, the whole process. Furthermore, local plumbers, craftsmen and blacksmiths adjusted their practices and products, contributing to individual sustainable niche technologies being installed. More specifically, a course steered by local steering actors gave local plumbers the technical knowledge and certified them to install state authorized solar heating systems and maintain them (Andersen et al, 2014; Jorgensen et al, 2007:11-17). The following paragraph presents the three district heating s-t transitions more extensively.

The district-heating plant of Nordby-Marup

In 1998, the two local steering actors, the Samso Energy and Environmental Office and the Samso Energy Company, organized a meeting concerning the plant that, according to the master plan, would be constructed in the northern part of the island. The participants –mainly individual users mediating in the process that would like to consume cheaper and more sustainable heating– assigned running the transition to a group of locals from these two villages. Some of them had a very strong faith in the necessity and importance of the transition in the two villages of the north, expressing their will to participate in the whole process (Samso: The renewable energy island of Denmark). These entanglers contributed to shaping the usage, raising expectations and interpreting the new artifact. The niche technologies that would be used were biomass (wood chips) and a solar heating system. In the same year, this group of users contacted NRGi, the incumbent actor constructing the plant in Tranebjerg, evaluating its interest in establishing a plant in their villages (Samso: The renewable energy island of Denmark). They also started informing and motivating potential users-consumers regarding the economic efficiency and environmental perspective of the transition.

In 2000, the incumbent actor negotiated with other s-t regimes and nested regime's actors, like the Danish Energy Authority, the Municipality and Samso Energy Company, submitting its revised proposal for the project. Except of its regulatory role, the Danish Energy Authority had partially sponsored the project (Jorgensen et al, 2007). The new plant was constructed five years ahead of time, owing to the very active role of this group of entanglers (Ibid). In this sub-project, the role of the local intermediary-users steering the process, but mainly that of local entanglers, were vital. These individuals shared the steering actors' vision, believing in the efficiency and trustworthiness of this transition pathway, motivating in a way the incumbent regime actor, as well as the locals. Their expectations about the transition's environmental significance and its economic benefit prompted other residents to connect with it in a percentage of 80% (Jorgensen et al, 2007:11).

Onsbjerg heating station

According to the initial plan, this transition project consisted of a biogas niche technology system being fed on heat surpluses from the docking of ferries in Kolby Kas and Saelvig, biological trash and wood chips (Jorgensen et al, 2007:12). Six more villages, except for Onsbjerg, also participated in this project. Its excessive financial cost and the huge energy losses, owing to the villages being situated far from each other, led to this transition pathway being rejected. Low faith and expectations by the related actors about the outcome of this plan contributed to it being unable to raise sufficient funding, ultimately resulting in its failure (Ibid).

Instead of proceeding with this plan, local steering actors, a group of local user-consumers from Onsbjerg and a local farmer-entrepreneur decided to construct a smaller district heating station (Ibid). Steering actors explained that a grant from the Danish Energy Authority was available, facilitating this type of projects and aspiring to activate potential investors (Samso: The renewable energy island of Denmark). The entanglers' role was also important in convincing other users-consumers about the credibility of the niche technology in achieving s-t transition. Further, straw was chosen as the technology that would fuel the plant, resulting in ensuring technical expertise helping operate the plant, as this technology was similar to Tranbjerg's station. The local investor covered the whole investment also using its own straw for heating production (Jorgensen et al, 2007:12).

Ballen-Brundby co-operative plant.

Ballen-Brundby's district heating plant belonged to the co-operative of the residents of two villages. As in the case of Onsbjerg, the master plan in this transition pathway was scheduled to supply four rather than two villages. The local steering actors called a meeting in 1998 with the locals of the villages that were interested in the project so as to designate a working group of representatives from the area (Jorgensen et al, 2007:12). This group of users got in touch with the s-t regime actor participating in the local regime, NRGi, in an effort to construct a fossil fuel-free district plan. Soon, the project's economic inacceptance became evident, because of large heat losses and users' limitation. The incumbent actor's decision reduced the working group to users only from Ballen and Brundby (Jorgensen et al, 2007:12). Steering actors, together with the local individual users-consumers and the incumbent actor, continued their delegations with respect to the economic model of the transition project. However, in 2002, a disagreement between the incumbent actor and the users-consumers resulted in the former withdrawing from the project, due to economical reasons[54].

Nonetheless, the group of local individuals entangling in the transition process showed strong faith in the efficiency and sustainability of the project while setting clear objectives about their next moves. This led to another meeting between the steering actors and the entangling group of individuals from the two villages, in which they deal with the challenge to assess the possibility of a crucial number of locals

[54] Data from an interview with a district heating co-operative's representative.

being interested in joining the plan (Ibid). Local entanglers activated the residents of the two villages deciding to establish a co-operative so as to install the plant[55]. It could be argued that the steering actor reconsidering the available transition pathway is part of a reflexive governance procedure (Meadowcroft, 2007) in order for a nested s-t transition to a biomass plant to be achieved. In terms of the final result, the role of the local steering actors, which came up with all the necessary calculations as well as the necessary economic and technical information supporting the transition (Jorgensen et al, 2007:13), was crucial. This actor consulted the locals technically and financially, contributing to an image of sustainable technology for the project being cultivated, thus reaffirming its economic and functional stability.

The public participation conceptual framework that was also used earlier in this chapter (Chilvers and Longhurst, 2016) can help interpret this co-operative-owned district heating network. With reference to this, the enrolment mechanism contained the steering actor and the local entanglers. The mediation process in this case primarily involved the local steering actor as there was no other participant possessing technical knowledge in this transition pathway. Furthermore, I argue that part of the mediation process is also Onsbjerg's local farmer-entrepreneur, as the plant would use similar technology with the one in Onsbjerg and would be operated by him. Finally, regarding exclusions, I argue that the particular task excluded not only other types of technologies but also every user far from the area due to operational reasons. This participation type could be characterized as a technological trial linked to the domestic energy practices (Chilvers and Longhurst, 2016). Afterwards, other innovation technologies used by individual households in order to achieve the s-t transition are presented. These innovation technologies, mainly photovoltaics and individual renewable technologies heating systems, refer mainly to individual users.

Individual installations and other attempts

Until 2002, several national and European grants for individual heat installations and photovoltaic cells (PVs) had been running (Jorgensen et al et al, 2007:23 & Andersen et al, 2). During these years, in order to promote Pvs, thus strengthening sustainable transition pathways, local steering actors had run renewable projects for individual

[55] According to district heating plant's representative, creating a co-operative was not an initial plan of the transition project (data by the interview with a representative of the co-operative).

households. Hence, together with tradesmen, they organized a course on the island certificating blacksmiths and plumbers to install state-authorized solar heating systems (Jorgensen et al, 2007), which were the only ones applicable for funding. Certifying local actors in the niche technologies engaged them to the s-t transition process, resulting in steering into pathways with greater social engagement level. Further, this process transformed professional groups, thus promoting and mediating in the usage of the particular innovation technologies. Additionally, steering actors arranged two energy campaigns demonstrating to local users-consumers niche technologies, like heat pumps, solar heating systems, biomass installations- employing specialists and professionals, while answering technical and financial questions (Saastamoinen, 2009:11).

In regard to individual projects, the Municipality also played a vital role from the very beginning. Thus, even from 1999, this nested regime actor had installed solar panels on its buildings, while, further, it had leased electric cars to service local pensioners (Jorgensen et al, 2007:26). Installing innovation technologies facilitated legitimizing them socially sooner or later, thus this actor was a user-legitimator even since this early stage of the s-t transition. Unfortunately, in the case of electric cars' technology, many technical issues and tradeoffs resulted in them being withdrawn from the actor's fleet, as the technology was in an immature stage (Ibid). Discontinuing of state's subsidies from 2002 onwards limited the use of particular niche technologies negatively affecting the transition process[56] (Jorgensen et al et al, 2007:23 & Andersen et al, 2). This stoppage increased the role and the significance of the local steering actors as well as of other users-legitimators and intermediaries as mediators, thus facilitating the nested s-t transition to a renewable technologies' pathway. Besides, nowadays Samso has installed the most solar panels per inhabitant in Denmark (Samso Energy Academy, 2014*:2).* The final project of this first nested-energy transition stage was the pathway of the off-shore wind turbines, which is presented in the next section. Furthermore, I will underline the most significant actors and users of this transition pathway.

[56] Particularly in regard to pvs installation which reduced resulted in subsidies stoppage together with the increased production cost per kWh (Jorgensen et al, 2007:23).

New wills and new actors

In the early 00s, the last step –and probably the most challenging one– of the s-t transition pathway began. That was the installation of ten off-land wind turbines (Jorgensen et al, 2007:22). Lack of a trustworthy transportation niche technology during the early 2000s excluded the possibility of a sustainable transition of this nested s-t system materializing at that time (Ibid). Aspiring to balance the usage of fossil fuels in transportation, a proposal concerning producing equal quantity of power by installing offshore wind turbines was made. Transportation transition as part of the island's deep transition would be an objective at a later stage. The initial plans featured ten wind turbines rated at 1.5 MW, but finally the solution of ten turbines of 2.3MW each was preferred (Jorgensen et al, 2007). The offshore wind farm was installed before 2003, on the southern edge, 3 kms far from the island.

For the needs of this sub-project, new actors were established, while the dynamic and the role of many others changed in this nested transition. Initially, a number of the nested regime's local actors[57] originated from the Samso Offshore Wind Co. This institutional actor operated as a "protective umbrella" making it safer for the local actors and users-consumers to participate in a high-risk investment. Through this framework, the local regime's actors steered the transition to pathways facilitating local engagement. Government had also regulated fixed prices in this transition process, as it did in the case of inland turbines[58]. Besides, the earlier project's economic and operational success had socially legitimized wind technology, creating expectations and showing faith in it. Therefore, the local community showed increased interest in actively taking part in the meetings and the working groups of the transition process (Jorgensen et al, 2007:21-22). Furthermore, accomplishing many other sub-projects, during previous years, had increased the locals' environmental sensitivity.

The ownership scheme was more flexible than that of the inland turbines. The increased cost of the offshore wind technology demanded that investors out of the island participate in the transition (Ibid). Therefore, one of the off-shore wind turbines belonged to an investment company from the mainland. Further, many of the nested regime's local actors, like the Municipality, farmers and other individual local users-

[57] These actors were the Samso Commercial Council, the Samso Farmer's Association, the Samso Municipality, and of course, the Samso Energy and Environmental Office .
[58] Data from interviews with Paludan Flak's representatives.

consumers, participated in the scheme. Hence, in this transition process, the local government owned half of the wind turbines (Ibid); more specifically, since this project began, this actor's role extended far beyond supervising legitimacy issues and influencing the community by enabling several niche technologies to be socially legitimized. Thus, the actor's involvement in owning and operating half of the large wind turbines project transformed it to a major actor which actively participated in the steering process[59]. The Municipality's financial participation amounted to a little over than 15 million euro[60]. Further, from 2007-2008 onwards, this actor's role became even more active and progressive since it would participate in the steering process setting short-term and long-term visions (Samso Energy Academy, 2014). Local farmers participating in the nested s-t regime already owned two more wind turbines from previous transitions. The final two turbines were financed by two co-operatives with approximately 1.500 users-consumers; one of them, Paludan Flak, has about 200 local users, while the other one featured users from all over Denmark (Ibid). Thus, local engagement was huge in this transition project too.

Further, the government's influence in fulfilling the task remained vital. In fact, this was already clear, judging by the state's decision to determine fixed prices for the project and facilitating the project's success at an economic and technical level, through many public organizations. In this direction, the Danish Energy Authority funded the preliminary sea floor studies as well as the environmental studies required (Jorgensen et al, 2007:22). Installing this innovation technology allowed local society to engage further in the s-t transition. Concerning the users-consumers' role in installing off-shore wind parks, prior projects had familiarized these users with wind technology, thus enabling them to engage in the process more comfortably, either for environmental or for economical reasons.

In 2007, this initial stage of the Samsian energy s-t transition pathway reached a landmark, as the initial objective had been accomplished. Particular actors of the nested regime participated very dynamically at the second stage, deepening the s-t transition and creating visions of turning Samso into a fossil-free island until 2030 (Samso Energy Academy, 2014). Samso Energy Academy was the one of these nested regime's actors. The Academy was established by the merge of the former two local

[59] This is also its position according to its representatives that I talked with.
[60] Data from interviews with a Municipality's representative.

steering actors, the Samso Energy and Environmental Office and the Samso Energy Agency, additionally encompassing the Energy Service Denmark. Therefore, a new steering actor, funded by the E.U., the Danish and the regional government and the Municipality emerged (Halkier, 2007). The new actor functioned as a consultation center for individual renewable technologies projects, as well as for research and education. Thus, this intermediary institutional actor, managing to adapt to the new conditions created after the first stage of the s-t transition ended, continued its steering role in the local level, simultaneously assuming new roles regading research and education issues[61]. Further, it transformed to an actor collecting the previous project's experience, co-operating with other international actors on nested transitions and educating locals and others in issues like sustainable energy, community power and sustainable development (Samso Energy Academy, 2014). These features as well as also a number of projects[62] transformed SEA to a symbol, binding together communities of interest and practice. In this framework, this actor created new narratives and visions about short-term and long-term deep transitions of the island steering its development through its vision for a fossil-free island until 2030 (Samso Energy Academy, 2014). Under its new profile, this steering actor also acted as a user, legitimizing particular technologies through its new-built sustainable house. The house used as a mediation space is a bioclimatic one featuring a solar heat plant and solar cells on its entire roof's square footage, while it uses a grey water network that makes reusing rain water possible (Samso Energy Academy, 2014); hence, it is considered an exemplary paradigm of a sustainable house. The Samso Municipality was the other critical actor at this second stage of the sustainable transition project, changing its role and perception significantly from 2007 onwards. This actor transformed into the most important one of the entire energy transition, assuming an even more active role, participating in the development and planning of the deep s-t transition.

At this second stage, short-term objective of these two key actors focused on transforming the island's transportation to a more sustainable one (Jantzen et al,

[61] Under this new role, this actor consults locals free of charge, thus helping them upgrade their energy efficiency (interview with SEA representatives).
[62] As was the SEA building and turning the Samso golf course into a sustainable one.

2018). With respect to this, it only took the Municipality eight years [63] to succeed in running a 50% civic electric car fleet, owning and operating a natural gas ferry (which was the one of the two ferries travelling daily to the island), while plans concerning switching public transportation energy technology probably to biogas until 2020 have also been drawn up (Jantzen, 2008; Jantzen, 2009; Jantzen and Hermansen, 2010;

Table 3. Size of role and power of incumbent and local actors participating in the Samso s-t regime[64]

Regime Actor	Size of role within the nested regime	Power within the nested regime	Source or data supporting the estimates
Government - Danish Ministry of Environment and other related ministries	Central	Powerful	Establishing and funding Energy Company (SEC) / Determining fixed price to several projects / Setting visions for a low carbon economy / Jorgensent, 2007
Danish Energy Agency	Important	Large	Giving technical and financial support / Funded by the Government / Jorgensen, 2007
NRGi	Central	Powerful	Participating in district heating projects without previous knowledge / Jakobsen, 2008 / Jorgensen, 2007
Municipality	Important / Central since the mid to late 2000s	Important / Increased since the mid 2000s	Creating new institutional actors / Funding particular projects / Creating visions of island's future / Interviews with actor's representatives
Samso Energy Academy and its ancestor institutions	Central	Very Large	Negotiated the different projects / Steering the transition process / Creating visions and expectations from the projects in the local community / Jorgensen, 2007 / Interviews with local actor
Farmers	As individuals low/ in the framework of the transition medium	Small	Interview with the local association's representatives
Users entangling the process	As individuals low / in the framework of the transition important	As individuals low / in the framework of the transition medium large	Interview with many of them
Wind turbines co-ops	As individuals low/ in the framework of the transition medium	Low	Interview with the local co-operative's representatives
Wind Investors	As individuals low/ in the framework of the transition medium	Small	-
District heating Investors	As individuals low/ in the framework of the transition medium	Small	Interview with the local association's representatives
District heating co-op	As individuals low/ in the framework of the transition important	Small	Interview with the local co-operative's representatives
Large Users			-
Small Users	Low	Small	-

Mathiesen et al, 2015; Jantzen et al, 2018). Moreover, the Municipality, together with the SEA, steers the construction of a biogas plant until 2020[65]. In relation to

[63] Data from interview with a Municipality's representative.

[64] The table follows Arapostathis et al's (2013) framework, referring to the nested actors' role and power. Evaluating the actors' role and power relies on primary and secondary data. Parameters are determined on rather qualitative data and elements. More specifically, evaluating each actor's power and size of role depends on the theoretical model already developed in the second chapter of this research thesis, as well as in semi-structured interviews and reviews of the related literature. Interviews assisted me in evaluating actors' visions and resource capacity and assessing their perception about others' importance.

[65] According to the Municipality's representatives , the plant will cover the ferry's energy needs, switching from

individual transportation, the municipal actor promotes narratives of transition to electric cars by 50% and endeavors of changing practices in personal transportation to car-sharing by the 2020s[66]. Relying on this, the Municipality has already constructed five public charging stations for electric cars located at key points on the island (Samso Energy Academy, 2014). Afterwards, I am going to argue about s-t regimes' and nested regimes actors' significance in facilitating this particular s-t transition. Thus, I will analyze issues of governance, power and agency in the nested regime.

Governance, power and agency in the nested energy transition

With the above mentioned in mind, I argue for a governmental intervening transition in financial, legislative and consultative terms that is fully coordinated. All sustainable steering processes require this kind of transitions (Smith et al, 2005:1500). The government, which is the central actor in the power relation, is mainly responsible for developing and extending this transition. It is clear that, without its initiative, the process would not be raised (table 3). More particularly, this central regime actor established new institutions, locally steering the transition to sustainable trends and realigning the regime by regulating fixed prices for a decade in the wind turbines' case as well as subsidizing the process either directly or through other public organizations (Jorgensen et al, 2007). Finally, it changed the norms and values by setting visions for a low-carbon economy (Samso Energy Academy, 2014). NRGi, the national energy company, was actually the only actor of the national incumbent energy regime to be involved directly in the nested energy transition. The actor achieved to participate in some of the district heating projects, although it lacked any previous knowledge on this technology (Jorgensen et al, 2007; Jacobsen, 2008). Together with other actors, it created visions and expectations and, beyond any doubt, it managed to adapt to the s-t regime’s changes and landscape pressures. This actor is considered powerful since its actions exerts power and agency.

Regarding the local actors of the nested s-t regime, the Municipality of Samso was a major one. Although it kept a low profile role at the initial stage, it did join in the steering of the process, by regulating as well as adopting new institutional actors and sometimes by subsidizing sub-projects. It also tried to facilitate installing sustainable

natural gas to bio-gas, those of heavy transportation and finally those of a local factory, making an energy transition from fossil fuels to biogas (interview with a Municipality’s representative).

[66] Data from interview with a Municipality’s representative.

technologies, for example by making arrangements with banks, so that building owners could finance district heating technology by receiving mortgage loans (Jorgensen et al, 2007:11). At the beginning, it acted principally as a regulator which, however, was in favor of the s-t transition's success. Furthermore, in my point of view, the actor also exerts power by creating new institutional actors, like the Samso Energy and Environmental Office did by reinforcing and facilitating the sustainable transition's success. Not to mention that the Municipality was, as early as this initial phase, a user-legitimator, installing and using many new technologies (electric cars, solar panels), presenting its values and characteristics to the local community (Samso Energy Academy, 2014). This kind of users exerts agency and power assisting change of practices by legitimizing innovation technologies. Relying on this, its role is considered pivotal in the evolution of the s-t transition (Samso Energy Academy, 2014). Subsequently, its role changed since its involvement in the off-land wind turbines project. In this project, the Municipality was transformed to the most important investor, thus to a very active actor. The particular project would probably have failed in case this player had not participated so actively economically. Since 2007, this local actor has assumed the role of the major steering actor, determining the s-t transition's pace, thus deepening the process. Together with SEA, this actor has created short-term as well as long-term visions and expectations to the local community, generating narratives concerning phasing out fossils until 2030, financing a number of big sub-projects and demonstrating new technologies that would contribute to their interpretation (Ibid).

During the first years of the transition, the local steering actors' role, namely the Samso Energy and Environmental Office as well as the Samso Energy Agency, was also critical in activating locals and succeeding in following a sustainable s-t transition pathway, while SEA’s role was upgraded even more from 2007 onwards. This local steering actor was supported, technologically and financially, by the central and local government, while firm footholds were established in local society too (Halkier, 2007; Jorgensen et al, 2007; Saastamoinen, 2009; Samso Energy Academy, 2014). Further, it could be considered an intermediary-user institution, featuring entanglers and strengthening their voices and arguments (Saastamoinen, 2009). More particularly, these actors acted as the entanglers’ supportive umbrella, institutionalizing and asserting their voice in the public discourse. Further, these actors coordinated the processes, making them more appealing to the local community through their visions and expectations, while, in several cases, they established new actors or re-established old ones[67]. Additionally, in many cases, they steered s-t transition following a reflexive mode of governance (Meadowcroft, 2007). Hence, in those cases that the initial plan would grind to a halt, they took over a more active role, coming up with adjustments in the process and the actors participating in materializing the project (Saastamoinen, 2009:13). Besides, these institutional actors actively engaged into the formation of the master-plan. Since SEA was established, this new intermediary actor created visions aiming initially at the next steps of the transition process, in an effort to engage society. The construction of an SEA building contributed to create a mediation space, reinforcing the actor even more (Samso Energy Academy, 2014).

Further, according to Smith et al (2005), as the conceptual framework presented in the second chapter indicates, resources capacity also expresses the power relation of an actor. Thus, in Samso's case, the local steering actor’s impact on the local society, its technical expertise, its participation in international organizations and its understanding in successfully securing EU programmes indicates a high level of resources capacity. SEA participated in the governing process through meeting with locals organizing campaigns and exhibitions as well as intervening in various ways . SEA and the preceding actors were probably the main institutions steering the sustainable s-t transition. Since 2007, these actors transformed to a new one with other functions and objectives, a change showing adaptive capacity. The new actor had developed technical knowledge from the previous projects, thus it was regarded as a trustworthy actor both by the governmental and intergovernmental organizations that funded it as well as by the local community. Erecting a sustainable building further contributed to granting SEA the role of a user mediating particular technologies and practices.

The users' role was also fundamental in this transition. Those that exerted power were notably users-legitimators like the Municipality and users-intermediaries, such as the local institution steering the transition, while, at a lower level, important users also were the Samso Wind Energy (see figure 9 regarding users' role) and the other local co-operatives. Also significant was the role of individual entanglers participating in

[67] As, for instance, happened in the cases of Samso Wind Energy and Samso Offshore Wind Co.

the negotiations and the workshops of particular sub-projects. These users engaged in adopting niche technologies, creating expectations and visions for them. On the other hand, their role was not fundamental in changing energy consumption practices and habits. Regarding this, I have already stressed in the previous chapter that limiting the energy consumption could primarily be achieved by transforming users-consumers to co-producers. Thus, as particular users settled on better insulating their houses, installing solar pvs in their roofs, or using CHP systems and –through this– cutting down on their energy consumption, they arguably changed their practices in a sustainable way. However, based on SEA's reports (Jorgensen et al, 2007:23), electricity consumption has not decreased despite using more sustainable technologies and launching energy-saving campaigns on a local level. Relying on this, it could be assumed that the change of energy practices could be facilitated by managing demand through technological and institutional alterations (Van Vliet, 2005; Pina et al, 2012). Further, I argue that local steering actors could steer s-t transition to more sustainable pathways leading to changing practices by inspiring local society in sharing fitting visions. Thus, I consider this transition sustainable mainly due to shifting decision making to the civil society and installing sustainable niche technologies. On the other hand, it contributed to the social transformation, namely the change of practices, only to a limited extent. In this context, I call for demand side management, ensuring energy consumption is restricted or retained.

Energy transition and tourism transformation to more sustainable pathways

In this section, it is evaluated the changes and opportunities that the deep energy transition has provided to the nested tourism regime. As it has already been discussed, in the case of Samso a socio-technical energy transition has been already achieved while local steering has in a way deepening it in other s-t systems. However, the central tourism nested regime's actors making policy have not included strategically tourism to the deep transition in the making so far. On the other hand, the energy transition has influenced in a way, at least superficially tourism s-t regime. Towards this direction, the transition pathway being followed influenced gradually the attitudes and practices of locals, in regard to energy efficiency in building issues. Thus in the tourism regime, many cottages on the island installed pv cells, hot water solar collectors or insulated their buildings in a better way[68]. Further, transportation transition in the making influences in a positive way and is going to do it to a greater extent in the future tourism s-t regime to sustainability.

In a different perspective, additionally, transition influenced the branding of the island, while it attracted special categories of visitors interested in the transition process. Thus, the island was made known in an international level[69] improving positively the branding of the island as a tourist destination, raising the arrivals. Further, running an energy transition attracted professionals, politicians and the academic community interested in them, thus creating new forms of tourism and increasing tourism arrivals, although to a very small extent (Jorgensen et al, 2007: 30). In regard to this, the renewable energy transition project attracts approximately 5.000 tourists annually that would like to see and study the way that it has been organized (Ibid:30). On the other hand the transition didn't affect the way policy makers and other nested tourism regime actors think on tourism or formers will, including tourism regime in the deep s-t transition. Besides, energy consumption patterns of locals haven't changed either (Jorgensen et al, 2007). In respect to this, I argue that a deep transition including tourism requires corresponding actions and visions of the nested tourism s-t regime. This means that what is required is to develop visions of limiting energy consumption in tourism and schedule the way policy makers will support tourist actors, and by doing so, engage them in a transition.

Still, a tourist transition demands changes in a technological, institutional, regulatory and social level. Tourist flows development during the last twenty years increases energy needs on the island thus making an s-t transition of the tourism regime necessary.

Issues of governance in nested energy transitions: The case of Gotland

This section presents a different nested energy transition case. Although Gotland, the Swedish island, is also a paradigm from the North, its demographic, geographic and economic characteristics render it a completely dissimilar case compared to that of

[68] Results from interview with regime's representatives.

[69] Many popular international newspapers and magazines such as *The Guardian*, *The New Yorker* and *The New York Times* hosted articles in regard to Samso energy transition (see related articles and interviews in www.energiakademiet.dk). Further, SEA's co-operation with actors from all over Europe, Japan, Africa and the U.S. also contributed to that direction (Samso Energy Academy, 2014).

Samso. In the same direction, localities in social, political and cultural characteristics, as well as in technical, technological and institutional choices allowed for following an alternative transition pathway. Above all, the core actors' power relations and their narratives advocated for different dynamics and balances in this nested transition. Still, Gotland's transition to 100% fossil fuel-free electricity is currently in the making, while expected to be completed during the next decade (Action plan in Energy 2020, 2013). Deepening the transition in other s-t regimes has already been scheduled, however, such transition is a harder and more complicated one (Ibid). Finally, in the Gotland case, a main feature of this nested deep transition which differentiates it is the steering actor's attempt for a future energy transition in tourism[70]. Subsequently, I will present a general overview of the island as well as main economic activities data. These facts will help observe the overall island's activities as well as the energy transition that took place there more comprehensively.

A few words about Gotland

Gotland is the biggest island of the Baltic Sea. The territory of the island covers a flat area of 3.140 km^2, which is rugged in the north area and wooded in the south one (Holm, 2017: 11). In the early 1970s, Gotland was upgraded to a Municipality. Since 1997, the Municipality has been responsible for the regional development on Gotland area. More than a decade later, in 2011, the Municipality became a separate region with more extensive jurisdictions, while at the same time it was renamed to Region of Gotland[71] (Holm, 2011: 4). Gotland Region also contains a number of other smaller islands. Many of these areas are characterized by special fragility and major ecological significance (Ibid). The region also has a large cultural heritage. More particularly, Visby, the island's capital and the most populated city, is included in the World Heritage List of Unesco. The medieval town of Visby boasts the best-preserved curtain wall in the whole Northern Europe (Holm, 2011: 7) as well as a number of other cultural monuments in the region. These characteristics of the island, as well as its beaches and climate have allowed a massive tourist sector to be developed. Regarding demographics, the island has approximately 58.000 inhabitants

[70] Interviews with tourism's representatives.

[71] In this analysis, I will be alternatively referring to Gotland's local government as Municipality or Region of Gotland, pertaining to the same actor.

living on it all year around, with a further upward trend expected to occur within the following years (Holm, 2017). The median age is nowadays 44,6 years (Ibid).

Economic activity

In the Region of Gotland both the industrial and the service sector have been developed. Most of the companies are small enterprises[72]. Thus, the total of companies amounts to slightly less than 10.000, currently employing approximately 27.000 employees (Holm, 2017). Tourist industry, together with the agriculture and food sector, as well as the cement and limestone industry are the main and most prosperous economic activities; particularly agriculture and the food sector are probably the most dynamic and rapidly developing of the aforementioned sectors (Ibid). The majority of foods produced on the island are being exported to the continental country. Many farms operating in agriculture also alternate between producing energy, engaging in tourism or selling (retailing) local products. Over the past decade, new economic activities have emerged, as is, for instance, furniture manufacturing (Ibid). Below, the basic characteristics of the island’s tourist sector will be presented so that the size of the nested tourist regime will be evaluated.

Tourist sector

Tourism development is of major significance for the local economy; tourists' arrivals continue to rise, boosting the tourism sector (table 4.). Further, more than 15% of jobs are related directly or indirectly to tourism[73]. Many sectors like services, retail and

Table 4. Tourist arrivals and overnights in Gotland (Source: Holm, 2011, 2015 and 2017).

Tourist arrivals and overnights				
Year	**2010**	**2012**	**2014**	**2016**
Arrivals	1.960.932	1.945.000	2.036.906	2.236.589
% of Arrivals (in an annual bases)	-	-0,41%	2,36%	4,90%
Overnights	927.000	855.000	888.000	1.029.000
% of Overnights (in an annual bases)	-	-3,88%	1,93%	7,94%

72 Suggesting that fewer than five employees are working in each of them (Holm, 2017).
73 This is inferred by overviewing “Gotland in figures 2017”, 2017:17.

food as well as transportation, housing and other ones have been positively influenced by tourism growth. Over the past years, the arrivals have skyrocketed to more than two million hosts (figure 10), while the guest overnights exceeded one million in 2016 (Holm, 2017). Tourism is actually internally oriented, as many inlanders either rent or buy holiday homes in Gotland. Internal tourism amounts to 90% of all visitors, while the remaining10% relates to international ones (Holm, 2011). Foreign tourists

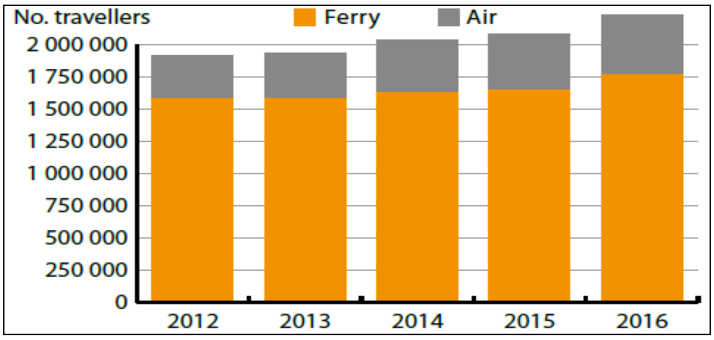

Figure 10. Tourist arrivals on Gotland for the 2012-2016 period (Holm, 2017:25).

visiting Gotland mainly come from neighboring countries such as Germany, Norway and Finland (Ibid). Tourism is also characterized by seasonality, reaching its peak for eight to ten weeks during summer. Tourists usually stay in hotels, although there are also many who opt for other types of accommodations (Holm, 2017). Thus, there are roughly 8.000 holiday homes in Gotland, many of which are inhabited only during summer (Action plan in Energy 2020, 2013). These cottages are not connected to any district heating network, while many of them do not use any type of heating. Moreover, over the past fifteen years, almost two thousand new houses and flats have been erected, many of which are used as holiday homes (Action plan in Energy 2020, 2013). Preferred means of transportation for someone to access the island are ship and airplane. Regarding this, the majority of the visitors opt to travel by ferry, although a the number of visitors who flew to Gotland in 2016 slightly exceeded the four hundred fifty thousand mark (Holm U.,2017: 15).

Steering, power and agency in a nested transition: A socio-technical analysis

In this section, Gotland’s nested transition to renewables is outlined, focusing on s-t transitions models and typologies, while highlighting governance and participatory frameworks issues. To illuminate this issue, I will briefly sketch a few perspectives and features pertaining to the Swedish socio-technical energy regime, as well as its transition, in the postwar era. This is vital in determining the state energy policies as well as the technological pathways and the institutional frameworks that promoted and allowed the local s-t transition. The incumbent energy regime of Sweden was an oil-dependent one until the 70s. The first oil crisis outburst in the early 70s de-aligned it, exerting landscape pressures leading to its transition. These changes have also affected Gotland's local regime from the early 80s onwards, promoting the nested transition of bio-energy and wind power since the 90s (Municipal Council of Gotland, Energy 2010, 2006). In the Swedish case, the s-t transition is divided into three main periods. In the first, immature period, the oil crisis occurring in the early 70s was the initial driving force for a transition to niche technologies, preferably renewable ones. However, nuclear power, as a mature technological niche, also entered the country's s-t regime (Nilson et al, 2014:72). During this period, changes in the local regime were limited. The second phase of the transition marked significant climate change laws and liberalization of the energy sector, adding to previous landscape pressures. In Gotland's case, local steering actors created short-term and long-term visions and expectations, following a sustainable transition pathway until 2010 (Municipal Council of Gotland, Energy 2010, 2006). Finally, in the mid 2000s, the state's visions for de-carbonizing Swedish economy summed up the third period of the transition process. This period is characterized by governmental and other state's actors exhibiting great will in achieving a transition to renewable technologies by 2020 (Cruciani, 2016). In the nested regime, this stage of transition is in the making.

Essential actors of this process in the national s-t regime are the government and other state actors, while in the local nested s-t regime, the Municipality of Gotland –after being transformed to Region of Gotland in the early 2010s–, Gotland Energy AB (GEAB) –the local energy distributor and provider–, the municipal property company of Gotland, GotlandHem, co-ops which were transformed to a wind power investors' association and several local investors, as well as users, such as, for instance, the farmers association, are some of them. More particularly, the regional government played a critical role by envisioning a sustainable transition, legitimizing it socially and activating local actors and users (Municipal Council of Gotland, Energy 2010, 2006). Lastly, in Gotland's case, a main issue is to analyze the tourist energy transition that is currently scheduled. Thus, the basic processes, tools and actors are activated by the regime's actor so that they achieve a tourist regime's transition to more sustainable pathways.

Socio-technical changes and renewable energy policy in Sweden

In regard to their Danish neighbors, the Swedish policy makers have just recently become interested in the renewable technologies(Meyer, 2007). Further, they followed an alternative transition pathway regarding the way they tried to develop wind power. This framework could be described based on typologies reviewed in the first chapter of this thesis as a close type of research (Sovacool, 2010), engaging only pivotal s-t regime's actors such as large utilities, few other regime's actors following narratives of large-size turbine plants (Astrand and Neij, 2006: 279). In the Swedish case, low oil prices had allowed for its extensive use for the country's industrial and economic development, since the 50s. Moreover, large amounts of water stocks from rivers facilitated utilizing them extensively, thus producing cheap hydropower (Nilson et al, 2004:67). Besides, incumbent energy regime actors started to experiment in nuclear power even since 1947 (Jonter T. and Rosengren E, 2015), while a few years later, the first pilot nuclear reactor was constructed. In general, until the early 70s, incumbent regime actors used oil technology for electricity, heating and transportation while opting for hydropower for electricity.

The oil crisis, in the early 70s, was actually the first landscape pressure which led policy makers to thinking of renewable technologies pathways as part of potential energy solutions. After that, a de-alignment and re-alignment transition pathway was followed by the country's s-t regime (Geels and Schot, 2007). At that time, the Swedish economy's dependence on oil was huge. Thus, almost 80% of the country's primary energy needs were covered by oil in the early 70s (Nilson et al, 2004: 72). As oil prices suddenly sore, the energy s-t regime was de-aligned, creating a window of opportunity to niche technologies such as wind, biomass and nuclear power. In this framework, in the mid 70s, the state first embarked on its R&D programmes, developing wind energy and mainly engaging large incumbent actors in this s-t transition pathway (Nilson et al, 2004). Energy incumbent actors created a narrative of efficient technologies development, taking into account their cost and performance (Moberg, 1979). Such actors were several state actors like the Aeronautical Research Institute of Sweden (FFA), the Department of Meteorology at the University of

Uppsala, various departments at Chalmers University of Technology and the Swedish University of Agricultural Sciences in Alnarp, but also utility companies and companies from established automobile, manufacturing and shipbuilding industries (Astrand and Neij, 2006: 284). The core actors engaged in the initial R&D niche technology programmes during the 70s and the 80s were mainly the large utility companies (Ibid).

Towards this direction, two large-scale wind turbines were constructed in the early 80s; Maglarp (3MW) and Nasudden I (2MW) (Astrand K. and Neij L., 2006: 283). The latter of these projects was installed to the south of Gotland. The projects succeeded in installing the prototypes but they failed to churn out wind turbines (Soderholm and Pettersson, 2007). These state's research and development programmes also engaged other smaller regime actors, such as individual user-producers, small energy companies, wind turbine manufacturers and other small investors, albeit only to a small extent[74]. In respect to nuclear power, the fact it was both supported by major regime actors[75] and it had already been adequately developed rendered installing and integrating it in a country's energy regime remarkably easier. In respect to these, the Swedish government promoted nuclear power, so a series of nuclear reactors were constructed between the mid 70s to mid 80s (Nilson et al, 2004: 72). However, the large societal oppositions to nuclear energy and the Harrisburg accident in the late 70s discredited this niche technology in the eyes of the society, preventing the country's energy regime from re-aligning and leading to a referendum in the early 80s, which decided on phasing out nuclear energy in the long-run (Jacobsson and Bergek, 2004; Astrand K. and Neij L., 2006; Meyer, 2007). Tensions and the so-called nuclear trauma contributed, to a large extent, to renewables and mainly wind power gradually developing in Sweden's energy mix until the 90s (Jacobsson and Bergek, 2004: 827). On the other hand, public opposition against nuclear energy at least prevented it from evolving further, thus creating a new window of opportunity for wind power.

On the other hand, although bio-energy was not regarded as a viable energy source initially, its significance in the energy mix changed following the second oil crisis in

[74] This accounted for the very small development of wind turbine manufacturers in Sweden. For instance, wind turbine manufacturers between 1975 and 2000 did not exceed ten (Astrand and Neij, 2006).

[75] These s-t regime actors, such as the General Swedish Electric Company (ASEA), which designed nine of the country's twelve nuclear reactors, possessed the technological experience and financial benefit to exert pressure on policy actors to advocate for its boosting (Astrand K. and Neij L., 2006)

the late 70s (Nilson et al, 2004). Since then, state has been encompassing bio-energy to its energy policy, financing its R&D initially through biomass use for heat and electricity (Ibid:73). However, alternative uses of biomass in fields other than energy, delayed its penetration to the energy mix, which only came into existence in the early 80s (Ibid). Further, in this period, the state diffused the use of this innovation technology by adopting energy taxes, thus rendering it, together with coal, cheaper than oil (Ibid:74). In the early 1990s, the state's decision to establish a carbon tax made biomass the least expensive energy fuel, steering an energy transition to biomass (Nilson et al, 2004; Astrand and Neij, 2006). However, biomass mainly penetrated in heating. The spread of biomass in heating rather than in electricity was attributed to imposing these taxes solely to heating (Helby, 1998). This exclusive use of carbon taxes can be put down to selection pressures (Smith et al, 2005) by the electricity regime actors, excluding electricity from the law, as well as of low-price hydro and nuclear power in electricity (Nilson et al, 2004). Further, the tax was imposed on mainly non-energy tension sectors (NETS) concerning heating production, as the industry production was paying a small or no environmental tax whatsoever (Ibid).

In the late 80s, a second R&D wind power programme was co-financed by large utilities and other incumbent actors. In this programme, the state subsidized and supported exclusively large incumbent actors, although these had very poor results in installing the niche technology. Regarding this, it is argued that about 100 million euros were invested in developing projects between the 70s and 80s by the policy maker, supporting almost exclusively incumbent regime actors (Astrand and Neij, 2006: 281). On the other hand, large regime actors such as utilities did not seem to share the visions, perceptions and commitment of the policy makers. Regarding this, it is claimed that these actors have relatively different visions by both supporting nuclear power and by partially perceiving wind installation as an anti-nuclear stance[76] (Jacobsson and Bergek, 2004: 827).

[76] Regarding this, large utility actors participated in the incumbent regime's alliance, opposing the phase-out of nuclear power (Jacobsson and Bergek, 2004: 827). Towards this direction, during the 70s, in the public debate, Vattenfall doubted of the possibilities and the dynamic of wind power (Moberg, 1979). For more information, see also the "nuclear trauma" (Jacobsson and Jonhson, 2000; Jonhson and Jacobsson, 2001; Bergek and Jacobsson, 2003).

Since the early 90s, a series of landscape pressures changed the government's energy policy by choosing alternative transition pathways. Acknowledging the need for climate change mitigation and adopting Agenda 21, the Swedish government steered to pathways facilitating a transition to wind energy. Further, de-regulation of the energy market, in the early 1990s, following international market changes, as well as EU directions, led to the liberalization of the energy regime, establishing new institutional actors (Nilson et al, 2004:72). Towards this direction, policy actors shifted governmental financial support from energy development to energy production (Astrand, Neij, 2006; Soderholm, 2007). A first step to this pathway was the multi-party agreement that was reached in 1991, marking Sweden's energy policy transition to sustainable technologies (Nilson et al, 2004:72). The agreement was a direct outcome of the compelling need to phase out nuclear power regarding the Swedish energy mix, from 2000 onwards (Jacobsson and Bergek, 2004: 827). In this framework, policy makers agreed to promote wind power and bio-energy as pivotal niche technologies for the country's s-t energy transition (Nilson et al, 2004:72).

Through the new energy policy, the state tried to steer s-t transition through alternative regime actors such as regional utilities, small businesses, wind energy co-ops, thus raising wind energy production. Further, in the mid 90s, obliging power distributors to buy electricity from small producers, mainly wind technology-related ones, reversed in a way the balances of the s-t regime in relation to wind power (Astrand, Neij, 2006). Regional authorities also played a vital role as nested actors which participated in the steering of an energy transition to wind technology. Swedish law allowed these actors to control the number and the areas of wind installation on the local scale (Meyer, 2007). Hence, the wind energy production boosted from 5,6GWh in 1990 to 447GWh after a decade (Swedish Energy Agency, 2003). Nonetheless, the raise in the installed capacity didn't radically change wind power's share in the energy mix; even in the mid 2000s, wind production was a slight share of the country's power production (Meyer, 2007). During the 1990s, biomass fueled electricity plants were supported financially by the state. In this manner, approximately 25 CHP plants were constructed. Their number was relatively high considering the large pressures of incumbent actors like Vattenfall which discouraged this kind of investments (Kaijser, 2001); besides, the profitability of these investments was limited at that time. Thus, their installation would derive from their increasing commitment by the regional authorities to bio-energy and to sustainable development (Nielson et al, 2004: 74-75).

As wind technology was gradually developing, it enabled policy makers to assume in the early 2000s a more active role, facilitating transition to renewables (Meyer, 2007). Thus, they constructed pilot projects regarding planning tools and permitted granting processes in regions with different characteristics (Ibid). Further, the new instrument tool that had been promoted since 2003, the trading of green certificates, remarkably contributed to renewable energy, mainly wind power, hugely developing during the next decades (Meyer, 2007). This enhancing mechanism of the transition process meant that cheaper sources of renewable energy could be developed, namely biomass and inland wind turbines (Cruciani, 2016). Until the mid 2010s, the fossil fuels' share in the primary energy supply had been reduced to only 30%, while renewables participated in final energy consumption with more than 50%, resulting in Sweden, which had achieved its energy EU Directive 2009 objectives for 2020 several years in advance, leading EU renewable energy penetration in the energy mix (Ibid). Further, in the mid 2010s, the country’s main political parties came to an agreement to achieve an energy policy target of 100% transition to renewables until 2045. Subsequently, the local s-t transition of Gotland is presented. This analysis will stress the major actors and the technological pathways which promote this s-t transition.

Envisioning a local energy transition to sustainability

During the start-up phase of the transition in Sweden, Gotland had achieved only partial small changes in the nested s-t system. A grid connection of the local electricity s-t system with that of continental country had been installed already since the mid 50s[77]. In respect to niche technologies and specifically to the wind installation, the early 80s marked the construction of one of the first wind turbines in the country in Nassuden, to the south of the island (The power of the everlasting breeze). The project, run by a major incumbent actor, Vattenfall, constructed the first large scale (2MW) wind turbine in the country, named Nassuden I. The turbine operated until the late 80s, when it was replaced by a new one, Nassuden II (Ibid). District heating networks were also installed in several towns of the island at that period. In Visby, district heating had been running since the 80s (Biofuel in Visby's

[77] The first grid interconnector that joined the island with the inland went into service in 1954, featuring a 20MW capacity. Source: https://en.wikipedia.org/wiki/HVDC_Gotland .

district heating). Although transitions to bio-mass had already started in the continental country at that time, these networks were fueled mainly by oil (Ibid).

Influenced by climate change mitigation as well as by sustainable development narratives rising in the early 90s, the Municipality of Gotland embarked on an s-t transition, creating narratives of achieving a sustainable society by 2025 (International Study of Renewable Energy Regions). In respect to this, the local actor published an "Eco-Program" creating visions for a sustainable energy s-t transition within a generation (Municipal Council of Gotland, Energy 2010, 2006). The deep transition narrative, despite having the energy transition in its core, also included a number of other s-t systems and regimes, like water and waste, as well as agriculture (Action plan in Energy 2020, 2013: 5). In this direction, this local actor steered the nested transition by setting short-term and long-term[78] objectives, activating a number of local public actors, which could be influenced, directly or indirectly, as well as local enterprises and users-consumers (Municipal Council of Gotland, Energy 2010, 2006). The energy transition pathway proposed installing niche technologies, focusing mainly on wind power and bio-energy, being in harmony with the national trajectories.

In steering the s-t transition, the Municipality established, in 1996, the Gotland Energy Agency[79], a consulting local actor which tried to sensitize users-consumers and other local nested regime actors to energy issues (International Study of Renewable Energy Regions). Further, the local government used local meetings and information campaigns so as to influence social transformation and steer the transition process. The actor also created narratives of massive, locally owned wind power installation and energy saving in buildings (International Study of Renewable Energy Regions). Still, following the national directions for district heating networks, it scheduled and envisioned a transition of local heating to renewable sources within a decade, while it legitimized and supported the initial steps of a public transportation transition to bio-energy (Municipal Council of Gotland, Energy 2010, 2006).

More particularly, in the early 90s, the Municipality determined alternative plans allowing the investors to install inland and off-land wind parks (Municipality of Gotland, 2009). Further, this nested regime actor ran local meetings, facilitating the

[78] The Energy plan 2010 was a long-term vision of this type.
[79] The new local actor was funded by the National Energy Agency (International Study of Renewable Energy Regions).

establishment of energy co-operatives, thus engaging local community to an s-t transition pathway to wind energy. Many local actors attended those meetings. The local farmers' association but also other local actors, such as companies and users-consumers, were interested in participating in the s-t transition (The power of the everlasting breeze; International Study of Renewable Energy). Besides, niche technology and energy production collaborative schemes were known to the local society. Regarding this, a few small wind turbines had been installed, even since the late 80s, by environmentally sensitive local users through cooperative frameworks (International Study of Renewable Energy). Thus, in regard to the current wind energy transition, more than 2,000 individual users participated in these wind projects through cooperative schemes. In many cases, local enterprises and farms were transformed to co-providers users-consumers (Van Vliet et al, 2005; Shot et al, 2016) by building their own wind turbines (see figure 10), covering their energy needs and promoting environmentally friendly profiles (Environmental Programme for Eco-municipality Gotland 2008-2012, 2008). These wind co-operatives, simultaneously acting as indermediaries-users (Schot et al, 2016), mediated the usage and the expectations of the niche technology (see figure 11 below).

As renewable technologies' penetration in the local s-t system escalated, it necessitated improving the “smartness” of the network[80]. To facilitate the s-t transition process, the local energy distributor, Gotland Energy AB[81] (GEAB), engaged in the wind project. Thus, this actor, together with other incumbent regime actors, took particular measures so as to transform the local grid into a smart one, ensuring its reliability (Smart Grid Gotland, 2013). In this framework, the transition process raised the wind power's penetration to the local energy mix to 15% of the annual consumption. Local cooperative schemes constructed more than 130 wind turbines on the island, until the beginning of 2000s, while they boosted wind installation to 200 until the late 2000s (International Study of Renewable Energy Regions).

As in the case of electricity, once again, it was the local Municipality that steered the nested transition in heating too. In respect to this, the local actor supported and

[80] Upgrading the network projects was successfully undertaken by Gotlands Energi AB (GEAB), thus integrating a large amount of locally produced wind power into the local power distribution grid.
[81] This actor also owns the majority of the district heating systems on the island, as well as the grid connection. GEAB is a very important local energy actor owned by Vattenfall (owning a 75% share) and by the Municipality (owning a 25% share).

envisioned networks' fueling by bio-energy until 2010 (Municipal Council of Gotland, Energy 2010, 2006). To achieve its objective, the steering local actor set short-term goals, handing out obligations and responsibilities to other local actors that were participating in the projects, as well as demanding that the public actors in charge implement and report measures (Municipal Council of Gotland, Energy 2010, 2006:30). In this trend, the national energy policy regarding environmental taxes facilitated the nested actor's attempts for a transition to bio-energy. Besides, the actor owned a minority share in the local electricity producer, GEAB, which ran the majority of these networks (Biofuel in Visby's district heating). Under these conditions, until the mid 2000s, this actor had managed to carry out a transition to biomass in several villages district heating network's (Ibid). Hence, the annual biomass consumption increased from 18GWh in 1990 to 100GWh in 2005 and more than 210GWh in 2010 (Action plan in Energy 2020, 2013:17). In this manner, 95% of island's district heating had been supplied by renewable energy, even since the early 2000s. Nowadays, the annual district heating production exceeds 500GWh (Holm U., 2017:17). Moreover, in regard to individual niche technologies,[82] information meetings and advice provided by the local consulting actor, the Energy Agency of Gotland, to local user-consumers regarding their efficiency and features increased their share during that period (Municipal Council of Gotland, Energy 2010, 2006).

Reducing heating needs through energy efficiency and savings in buildings was also another issue set by the municipal actor, developing visions about saving in public buildings; besides, many of the island's apartments and buildings are owned by the Municipality. The actor steered this transition mainly through a public local actor which manages municipal buildings, GotlandHem[83], requiring that it improved buildings' energy efficiency and use renewable fuels for their heating (The Landlord that cares for the environment). In respect to this, it took GotlandHem slightly more

[82] Individual niche technologies like geothermal heating and heatpumps installed in smaller buildings eliminated oil and electricity consumption for heating in the areas away from the district heating networks (at least for the inhabitants that live in Gotland all year around) (Municipal Council of Gotland, Energy 2010, 2006:30-32). Nowadays, less than 10% of households use fossil fuels to heat their homes, while this percentage is declining even more in the case of apartments. Fossil CO2 emissions from heating homes has dropped by over 95% since 1990 (Action plan in Energy 2020, 2013:7), Further, in regard to the electricity transition, except for wind energy, solar power has also been implemented on the island, while, over the past years, its use has risen rapidly (Holm U., 2017)

[83] GotlandsHem, the region's property actor, owns and manages 5,350 apartment all over the island. The actor engaged in the transformation projects by adopting several measures, increasing the energy efficiency of its buildings and shifting their fueling to biofuel. Then, it went on to constructmore energy-efficient buildings. Thus, since 2010, almost all of GotlandsHem's properties have been fueled by bio-energy, while the new apartments are supplied by heating monitoring consumption systems (The Landlord that cares for the environment).

than a decade to reduce its heating needs by 30%, while the great majority of its properties were bio-fueled (Ibid). Serving its electricity needs, this nested regime's actor buys eco-labelled electricity, that is electricity produced from renewable energy sources. Furthermore, in order to diminish its electricity needs, this actor changed many of the artifacts it used with more efficient ones[84] (Ibid). GotlandHem also operated as a user-legitimator, fostering energy efficiency and energy savings issues in the local society, thus facilitating the transition (figure 11). The Municipality's role was also critical in steering a transition to a sustainable transport s-t system. An s-t transition of transport required coming up with solutions to two different issues, in both an institutional and a technological level, in reference to the road transport system as well as to the use of environmentally compatible fuels (Municipal Council of Gotland, 2008:15-20). Concerning the former of these issues, the local steering actor adopted several measures so as to accelerate the change of social practices, while legitimizing particular technologies. Towards this direction, the actor facilitated biking, therefore improving civilians' access to public transport services (Action plan in Energy 2020,2013). In respect to renewable fuels' issue, the different types developed on the island were, and actually still remain, immature technological niches operating in a niche market[85]. The scant financial results that these projects rendered have raised skepticism by nested regime's actors in new types of biofuels. However, in regard to biogas, several small scale biogas plants have been constructed since the mid 90s, producing nowadays approximately 22GWh per year, bringing about new hopes in facilitating a transition to biofuels (Action plan in Energy 2020,2013). In this framework, the Municipality steered a transition to biogas by supporting, as early as the mid 2000s, a transition to biogas-fueled cars, acquiring 500[86] of them (International Study of Renewable Energy Regions), as well as by recruiting city buses[87] running on biodiesel (from mid 2000s on) and by planning a similar transition to a rural busses s-t system (Action plan in Energy 2020, 2013). In addition, other

[84] Therefore, it replaced, for instance, the laundry equipment, switched from light bulbs technology to led type and adjusted ventilation systems (The Landlord that cares for the environment).

[85] Several types of bio-fuel have been examined and cultivated in this field the last twenty years. During the 90s, local farmers and investors tried to produce biodiesel by rapeseed oil. A decade later, ethanol, a type of biodiesel, has been produced by other local stakeholders . These attempts allowed RME and E85 to be used of in the local energy fuel market, at least in a limited extent. Thus, in the mid 2000s, there were on the island two filling stations selling RME and another one selling E 85 (Municipal Council of Gotland, 2008).

[86] Nowadays, a small number of electrical vehicles are also operated on the island (source: interview with Municipality's representative).

[87] The island has an extensive and frequent public busses service. In this view, the busses network operates 240 daily journeys all over the island. the municipality has drawn up a plan for switching from rural buses transportation to biodiesel within the next decade (Holm, 2017).

nested regime's actors, like private investors, farmers and the Municipality, have participated in the niche market, facilitating the adoption of this transition pathway.

Use of biogas on a local scale had been introduced even since a very early stage of this transition, albeit only as a heating fuel on a very small scale (International Study of Renewable Energy Regions). In respect to this, in the mid 90s, a small biogas plant was constructed by the island's Agriculture College using cow manure for fuel and producing biogas for heating the college (Ibid). Since the 2000s, a few other biogas plants have been operating (International Study of Renewable Energy Regions; Action plan in Energy 2020, 2013). In the biogas project, as well as in other transition

Types	Characteristics	Comments- Tools	Examples
User-producer	They are innovators-practioners, who construct or modify novelties on a local scale. They act cohesively in terms of new users' preferences, practices and routines.	Universities could play, or could assist in, such a role. Additionally, users' activities of that kind could be enhanced by access to finance, tax credits, knowledge and relevant networks. This type of users could not be used in a normative way.	Probably, the wind turbines co-operative sheme established back in the 80s.
User-legitimator	They help cultivate the importance of a niche in the society - they try to socially legitimize the technological niche. So, they try to stress its values and acceptance. These users exert agency and power and could help achieve changes of practices.	They could be funded and encouraged through greater involvement in evaluating technology, science and society policy.	The Region of Gotland is such a user in regard to bio-fuel cars' use; GotlandHem in regard to energy efficiency in buildings.
User-intermediary	They are mediators that contribute to forming the artifact's design, rules and regulations of use, usage, expectations and interpretation. They usually are the innovation technology negotiators, so they could be users' clubs and associations.	Constructing mediation spaces and delegating certain tasks to them; also, establishing new institutional actors that work as intermediaries.	Region of Gotland is such a user in regard to biogass production and bio-fuel cars use; the wind co-ops established in the early 90s in Gotland.
User-citizen	They are mainly activists and NGOs that share different values and practices compared to the conventional ones.	Their involvement in the policy making process.	The Region of Gotland is such a user in regard to bio-fuel cars' use; GotlandHem in regard to energy efficiency in buildings.
User-consumer	They are users that, through their purchases, but also through domestication and symbolic meanings regarding the consumers' status or identity, re-shape their routines and practices.	Providing digital and natural fora that will help them exchange experiences. Their tranformation to co-providers or citizens-consumers.	Individual users, farms and enterprises.

Figure 11. An enriched representation of Schot et al's (2016) approach regarding users' role in the transition in Gotland.

projects, it is worth noting the role that the Region of Gotland played as a user-legitimator and intermediary (figure 11). More specifically, it had tried to socially legitimize several niche technologies, like cars running on biofuels as well as bio-fueled busses, by promoting and using them. Further, as an intermediary user, the actor mediates particular technologies through their usage (this is the case regarding about 500 biogas cars that the actor's fleet boasts) but also through the expectations created for niche technologies like biogas[88].

[88] Many of these cars would have being sailed as second-hand ones in the insular market promoting the use of

By mid 2000s, the first stage of the nested energy s-t transition had reached its end. During this period, wind technology capacity on the island had increased from 5MW to almost 90MW. In this framework, the local steering actor envisioned re-powering the 200 wind turbines, replacing those to the south side of the island with new ones of bigger capacity (Holm, 2015: 32). The size of this investment required switching from wind-cooperatives schemes to share-holding companies. This fundamental change

Table 5. Wind power production in Gotland (source: Action plan in Energy 2020, 2013:19).

Wind power production					
Year	**1990**	**2005**	**2010**	**2015**	**2020- Possible Outcome**
Installed Capacity (MW)	5	90	112	186	700
Annual Output (GWh/ year)	10	173	230	380	1850

in the ownership scheme was primarily dictated when the local steering actor considered making full use of the extraordinary wind potential on the island, thus advocating for large scale wind installation[89]. In addition, this transition further boosted the wind installed capacity to almost 190MW in less than a decade (Action plan in Energy 2020, 2013); this was almost the maximum production that the local electricity s-t system could accept. Increasing locally installed capacity requires interconnecting the island's network with the Swedish mainland using a new cable. Installing a third interconnection cable will lead the nested s-t regime to a further transition. In this stage, raising the wind power capacity for a further 1,000 MW is scheduled (The power of the everlasting breeze).

The second phase of the nested energy s-t transition is currently in the making. Envisioning in a series of issues related to installing new wind power plants, constructing additional grid connection, producing biogas, using biogas to public transportation, diffusing further renewable heating, as well as changing infrastructures, energy patterns and practices will deepen the s-t transition in the following decade[90] (Action plan in Energy 2020, 2013). Regarding these changes, the

biogas as a car fuel.

[89] Data from interviews with Region's of Gotland representatives.

[90] Some of these information are part of interview with Region's of Gotland representatives.

Municipality is a core actor in steering but also legitimizing particular niche technologies. Further, the active cooperation among other nested regime's actors, as are the GEAB, biogas investors, wind power local stakeholders, local companies and individual users-consumers, could permit extensive social participation and diffusion of power in the local level.

Governance, power and the role of local actors in the nested regime

Following that, the actors participating in the local regime during the transition process will be portrayed[91]. The main objective of this analysis is to evaluate the power and the role of the various actors in the nested regime. Based on this, I argue that the government played a central role both in the country's energy transition as well as on the local level. This actor created the national visions for an energy transition to renewables, subsidizing certain technologies and determining national energy policy. Further, while interviewed, several actors referred to its importance in promoting a nested transition. The National Energy Agency is a public institutional actor funding local advisory institutions, thus facilitating diffusion of renewable technologies. Hence, its power during the transition within the nested regime is important. However, the actor is funded by the government[92].

The region of Gotland is probably the most important local actor in steering the island's s-t transition. Thus, its role in the whole process is central. The actor had come up with the local short-term and long-term visions for a nested energy transition even since the mid 1990s. Attempting to achieve these visions, it set objectives and prompted a large number of local public actors to participate in the transition process. Further, it motivated local actors, such as the farmers, to engage in the projects. Because of these data, the region of Gotland is considered a powerful actor for the nested energy transition. Vattenfall and Gotland Energy AB (GEAB) are also requirements for other users steering the project. Besides, it directly or indirectly regarded as very important actors. GEAB owns the distribution network, the majority

[91] As in the case of Samso the table follows Arapostathis et al (2013) framework.

[92] Statistics from the site of the Swedish Energy Agency (http://www.energimyndigheten.se).

of the district heating systems on the island, while its updating projects in the

Table 6. Size of role and power of incumbent and local actors participating in the Gotland s-t regime.

Regime Actor	Purpose – Role	Size of role within the nested regime	Power within the nested regime	Source or data supporting the estimates
Government	Executive and legislative role	Central	Powerful	Creating visions / Subsidizing certain technologies / Determining the national energy policy / Steering regional governments facilitating the transition / Interviews with other actors
National Energy Agency	An institutional actor trying to diffuse knowledge in energy effeciency and finance sustainable niche technologies .	Important	Very Large	Funding the local advicory institutions and facilitating the diffusion of renewable technologies / http://www.energimyndigheten.se/en/about-us/
Vattenfall	Sweden's national company and one of the biggest energy companies worldwide.	Very Important	Powerful	It is the owner of the grid connection / It is the majority shareholder of GEAB
Region of Gotland/ Municipal of Gotland	-	Central	Powerful	Creating the local short-term and long-term visions / Setting objectives and requirements to other users / Influencing, directly or inderictly, a large number of local public actors / Region Gotland, "The Sustainable Energy Action plan in Energy 2020", 2013; Municipality of Gotland, "Energy 2010: Energy Plan for the Municipality of Gotland 2007-2010", 2006; Region of Gotland, "Vision Gotland 2025" (in Swedish), 2013.
Gotland Energy AB (GEAB)	The local energy company, which operates the local grid, while it also owns district heating network on the island	Very Important	Very Large	Interviews with the company and other stakeholders / Smart Grid Gotland: Briefing Document CIRED 2013 Smart Grid Gotland Project, 2013.
GotlandHem	The actor manages the municipality's buildings and property.	Important	Medium to Large	It owns a large percentage of buildings and apartments in Gotland/ http://gotland.se/59010
Wind co-ops	It has engaged in more than 2,000 local households in the wind energy project	Low to Medium	Low as individuals, though increasing as an aggregate	
Gotland windpower producers association	The association of the windpower investors.	Low	Small	
Gotland Energy Agency	Its role was to raise the consiouness of the local authorities and citizens in terms of energy issues - After the first	Low	Small	
Visby Energy	Local provider in Visby's distict heating network	Low	Small	
Gotlandsflis	Local provider in local distict heating networks	Low	Small	
Investors in biogass plants	Mainly private investors. Some farmers participate in these projects.	Medium	Medium / Goes Increasing in case of a transportaiton transition to biogas	
Wind Power Department/ Upsala University Campus Gotland			Low	
Farmers Association		Low to Medium		
Larger Users (energy tension sectors, tourist industry, agriculture industry)	Energy tension sectors like cement industry but also tourism and the agriculture industry belong to energy intensive users	Medium	Medium to Large	
Small Users		Low	Individually low, though increasing as an aggregate	

electricity network allow for the variable electricity production and thus the transition of the local s-t system. Vattenfall is a key player of the national energy regime, while it is the majority shareholder of GEAB.

Wind co-ops that had been running until 2010 played a significant role in developing the wind projects. So, their power within the nested regime is considered important in case of operating as an aggregate. On the contrary, switching from co-ops to share-holding companies decreased local participants' power. Moreover, there are also a few other actors whose power could be viewed as low. It is worth highlighting the significance of the investors in biogas plants for a transportation transition to biogas technology, as well as that of large users. By this, I refer to energy tension sectors like cement industry as well as tourism and agriculture industry. Regarding tourism, local policy makers envisioned a deep transition including local tourism regime in the future. Besides, tourism is one of the major sectors on the island yielding high returns to the local economy. Afterwards, Gotland's attempt to further deepen the transition running a tourism energy one will be presented.

Deep transition including tourism – To a sustainable development on tourism pathway

Tourism has been largely affected by the energy transition. Thus, nowadays, there are many local tourist regime's actors on the island promoting energy sustainable tourist experiences[93] (Holm, 2017). Many hotels, usually the larger ones, have adopted a number of efficient niche technologies, like solar thermal, solar pvs or even recharging energy points. Further, the more environmentally aware hotels have established eco-labeling diminishing their environmental footprint and improving their sustainable characteristics[94]. However, sustainable energy patterns and practices are not the conventional type of tourism on the island but rather a limited one.

In respect to this, over the past few years, the state, together with several regional institutional actors participating in the nested tourism regime, have started steering a deep transition including tourism. This procedure is trying to engage local tourism's actors, mainly hotels and other guesthouses, in changing their energy habits as well as replacing their technologies with more efficient ones in order to become more sustainable as enterprises[95]. More particularly, the state has established a tourism county to be in control of a tourism energy transition. This actor works together with the Region of Gotland and other local tourism regime actors, so that it supports them in achieving an s-t transition. Moreover, the actor aims primarily at engaging small tourism companies, which are barely interested in sustainability issues[96]. Differences in positioning small and large nested tourism regime actors in sustainability issues are

[93] These are data from the interviews with a representative of the region's tourist development department and with a county's representative.
[94] Interviews with representatives from hotels of this type.
[95] Data from interviews with the county's representatives.
[96] According to county's representatives, these businesses, being predominantly family ones, struggle to keep up with changes regarding subsidies for tourist actors in environmental issues or the EU programmes because of their size and limited staff (source from interviews).

vital[97]. Apart from that, 70 to 80% of small businesses on the island are totally unaware of sustainability issues, while the large majority of the sector consist of small companies[98]. In this regard, the actor runs seminars about energy issues, assisting tourist enterprises in them reducing their cost and improving their environmental footprint, thus steering the nested tourism regime to a more sustainable pathway. Besides, harnessing the economic impact is of primary concern for the majority of these local actors[99]. Thus, the tourism county's role is to pursue eco-effiecient technological mature niches that can have a direct economic impact on the local actors, informing the latters about state's financial support, promoting particular niche technologies –based on the state's and region's objectives– like pvs and electric cars as well as explaining their financial benefits[100].

Furthermore, together with the Region of Gotland, they attempted to establish a sustainable brand for the island by creating a particular narrative, thus promoting certain vacation or transportation means types, by promoting tourist products relying on transportation featuring bikes and electric cars as well as by offering accommodation in hotels using solar panels and bio-energy for hot water. In this framework, these two institutional actors, together with other nested tourism regime actors, have created tourist products offering driving experience using an electric car, encouraging tourists to visit particular sights where the car can re-charge. Additionally, nowadays, there are more than one thousand bikes for rent in Visby and other towns on the island, while a number of hotels and accommodations either offer or rent bikes to their customers so that they can bike around the town[101].

In conclusion, local actors' attempt to deepen the energy s-t transition using mature niche technologies has also affected the local tourist regime. The sustainable visitor prototype envisioned by institutional actors participating in the local tourist regime will probably take decades becoming a dominant one. However, the island is already undergoing an s-t transition, offering the aforementioned particular tourist "products", while a few of its visitors are interested in them. Besides, the deep transition procedure encompassing tourism is still in the making. If it comes into fruition, it can activate parts of the local society, having a substantial impact on its energy, water and

[97] Data from interviews with the county's representatives.
[98] Data from interviews with the county's representatives.
[99] Data from interviews with the county's representatives.
[100] Data from interviews with the county's representatives.
[101] Data from interviews with the Region's Tourist Development's representatives.

waste s-t nested regimes, as well as its practices and habits. Consequently, it can work towards accomplishing a tourism energy transition to sustainability.

Some final thoughts on the different, nested s-t transitions

In this section, I would like to focus on the features regarding the two exemplary cases that can pave the way for the local civil society to become actively engaged, permitting, in a sense, a bottom-up energy s-t transition. Additionally, changes enhancing a deep transition, which includes tourism, to more sustainable pathways, in regard to energy, thus a tourism energy transition, are highlighted. These changes could be vital in the next chapters where a deep transition including tourism on the island of Chios, Greece will be steered, namely an energy transition of the nested regime which can affect the local tourist regime. Therefore, I will focus on analyzing the characteristics of the two cases.

Based on this, I argue that in the case of Samso, a government-led transition debating oriented pathways with the civil society took place. This nested s-t transition is characterized by the users' active role, the local society engaging in decision making and in financing the projects, as well as by local institutional actors steering the transition in the local level. Transition studies scholars elsewhere (Foxon, 2013; Foxon et al 2013, Foxon et al, 2010) have presented three different pathways based on key actors governance logics. These pathways are a market-led[102], a government-led and a civil society-led[103] one. A government-led energy pathway has been described as an energy transformation in which the state retains a dominant role aiming at achieving a certain objective (such as securing energy supply) or responding to landscape pressures (such as climate change and European legislation regarding thermo-electrical power plants) (Foxon, 2013). In these cases, the state assumes the initiative, establishing institutional actors, establishing fiscal incentives for incumbent or new actors, developing “technology push” programmes (Ibid) so as to succeeding in its strategic targets. Moreover, in this pathway, end users are perceived in conceptual frameworks as “capture” ones, as they keep a passive role regarding

[102] According to the researchers, this pathway’s narrative supports a logic that incumbent energy utilities should dominate, while the government rather stands on the sidelines regarding setting the framework (Foxon, 2013).
[103] Civil society-led pathway is referred to as a narrative of civil society’s dominance to the energy socio-technical system, scheduling bottom-up logics, decentralized grids and energy efficiency options (Foxon, 2010; Foxon, 2013).

changing their energy patterns and practices or participating in energy production, covering part or all of their energy needs.

In contrast to conceptualizing a government-led pathway in this light, although in the Samsian case it was the state actor which came up with initial visions, subsidizing the transition and having several state actors provide the project with technical expertise , many decisions were made by the locals. On the other hand, such transition could not be deemed as a civil society-led, since it was not based on boosting social movements efforts to figure out bottom-up solutions to energy-related environmental and social problems (Foxon, 2013) but it rather relied on the state predominantly coordinating planning so as to actively engage civil society. By establishing an intermediary institutional actor, as were the Samso Energy Academy and its preceding organizations, so as to steer the local transition, the state managed to ensure that a locally engaged transition pathway would be followed (Jorgensen et al, 2007). This local actor engaged local community, showing reflexivity in the way it steered the transition (Ibid). Further, it set an open deliberation process, deciding on several characteristics and on carrying out the transition, while engaging a large percentage of local actors and users-consumers so as to financially participate in it. In this direction, it was essential that the local steering actor achieve to adopt the vast majority deriving from local society’s proposals following discussions during the local meetings[104]. Moreover, engaging entanglers in the institutional actor as well as in the separated sub-projects, allowed locals to rapidly activate and participate in the projects (Jorgensen et al, 2007). The entanglers’ participation in the intermediary institutional actor further legitimized their perception and view in the public discourse. In addition, engaging mediating actors such as plumbers, craftsmen and blacksmiths helped establish local interest in the success of the transition process. All these, brought about more collective visions regarding the significance of an energy transition. On top of that, changes in the regulatory framework promoted the locals’ participation. Creating energy co-ops or establishing “umbrella” actors, like the Samso Offshore Wind Co, suitably illustrate these changes.

Taking all these facts into account, I maintain that this is a government-led transition which debates with the civil society, thus its perception can be regarded as alternative compared to current approaches (Foxon, 2013; Foxon et al, 2013; Foxon et al, 2010).

[104] Data from interviews with SEA’s representatives.

According to this view, governance and steering could be outlined as a process exerted in parallel, both on a national and a local scale. Hence, although it is the state that initially sets up the transition framework establishing the local actor, it is the latter that engages the locals in steering the process. I will use this interpretation of government-led transition in different levels during the next chapters, where I will set my empirical case. I will argue that a communication channel between the state and the local steering actor is necessary in a nested transition, especially in Greece, where it is a centralized and bureaucratic political framework that calls the shots.

On the other hand, in Gotland's case, despite the local community widely participating of , I regard the nested transition as a more intervening one, in the sense that Municipality did engage local society but it did so in a more framed procedure, keeping a more decisive role for itself. Thus, although several meetings with the locals were indeed scheduled in this case, it was this actor that envisioned the project from the very beginning, steering it to desirable transition pathways (Municipal Council of Gotland, Energy 2010, 2006). In other words, the actor envisioned short-term and long-term changes, applying direct or indirect pressure to local actors so that they would be activated and participate in the project, affecting local practices, at least in regard to their habits in energy efficiency concerning buildings issues (Action plan in Energy 2020, 2013). However, reducing energy needs as a result of changes in building's energy efficiency, also had to be an objective in sustainable energy transitions.

Furthermore, disparities in technologies used affected the locals' energy practices. More particularly, in the case of Gotland, constructing a smart grid network allowed demand side management to develop while engaging users in energy management issues, altering their energy practices. In the Samsian case, employing a decentralized grid with transformers stations allowed diffusing renewables installation but without engaging local users in energy management through the network's "smartness". Based on this, I regard a smart grid network that would allow demand side management thus affecting users' energy practices as essential; therefore, I am going to integrate it in my conceptual framework presented in the fifth chapter of this research thesis as well as in the concluding chapter, as a parameter influencing social transformation. Nonetheless, it could be argued that the different transition pathways followed in the two cases are also related to the different political, cultural and social frameworks in which the national s-t regimes and the different societies operate.

In respect to a deep transition including tourism on both islands, I claim that a change of energy efficiency in buildings practices is the minor outcome of an energy transition process in tourism sector. Hence, in both cases, many local tourist regime's actors got engaged in the s-t energy transition, installing individual niche technologies, thusly managing to downsize their cost as well as their energy needs. In the case of Gotland, however, local institutional tourism actors' attempts deepened the energy transition by integrating tourism nested regime, thus facilitating creating sustainable tourist products, promoting a sustainable branding for the destination. Further, in the Swedish island case, adopting a state actor that would consult local tourist regime's actors, engaging them to an s-t transition including tourism, deepened the transition process even further, raising the likelihood of a future energy transition of the island's tourist regime being driven towards a more sustainable pathway. Therefore, it could be argued that adopting a local actor facilitating engaging a nested tourism regime's actors in the tourism transition could direct to a deep tourism-related transition to more sustainable pathways. I am going to use this framework in the case of Chios in the fifth chapter of this research thesis.

To sum up, I argue that steering a sustainable transition by following pathways engaging local society requires a rather open process. My conviction is that the Samsian case does represent such a transition. Based on this, I claim that establishing intermediary institutional actors steering the transition locally, including local entanglers, so that they prompt the local community to participate in the transition, and engage mediators, constitute vital tools in ensuring an s-t energy transition which engages local society. Additionally, other actions facilitating local engagement will followed based on the two exemplary cases. Regional governments, and especially municipalities, need to assume an active role envisioning the transition and legitimizing its technologies. Finally, I argue that intermediary institutional actors like the SEA are considered intermediary users (Schot et al), mediating the usage, expectations and interpretation of the niche technology in the local society. Consequently, I will enrich Schot et al's (2016) conceptual framework with this type of actors as intermediary users. In the next chapter, I will firstly outline the Greek energy regime putting emphasis on the integration processes of the renewables, while, secondly, I will present the nested regime of Chios island.

Fourth Chapter
A socio-technical transition in the making

In this chapter I will introduce and analyze a case of a nested energy transition in the making regarding an insular area in Greece, Chios. It aims at portraying the main actors, the nested regime's dynamics as well as, the technologies and other features facilitating a deep transition regarding tourism. In addition, this is vital so that the transition pathways that will be analyzed and ensued in the next chapter have the situated rationality[105] of the national and local framework. In doing so, the socio-economic characteristics pertaining to Chios will be presented in the next section. As I have already argued in the third chapter, the geographic, economic and social parameters are considerable in determining a transition process's evolution as well as the s-t pathways that will be followed (Coenen et al, 2012; Hansen and Coenen,2015). Following that, an analysis of the national energy s-t regime will be illustrated so as to determine the incumbent actors and outline those participating in the local regime. Based on that, the nested regime in Chios will be defined at a later stage. Further, as it has been argued as early as from the introduction, this chapter mainly aims at analyzing why Chios island was selected in this research thesis for steering an s-t transition in the making. Regarding this latter target, I will subsequently present the main reasons for choosing an island, and more particularly, Chios, so that this target is accomplished.

S-t energy transitions, tourism and the choice of Chios island

Islands will be more prone to experiencing the harmful effects that climate change brings about, in comparison with the continental areas (Michalena et al, 2009). This derives from a series of features that these areas display, such as their isolated

[105] The concept of situated rationality is opted for in the particular context in contrast to the more popular –mainly in the fields of economics and psychology– concept of bounded rationality. Situated rationality is related to individuals' choices of actions associated with the situated options which they conceive, "but also the individuals themselves, their expressions of their needs and motives, the manner in which their capacities and capabilities have been molded, their values and interests are conditioned by the context of their birth and development" (Lawson, 1997:121). In other words, the concept is more associated with an individual's position to the society, rather than with the outcome (Karnoe and Nygaard, 1999). Towards this perception, an outcome could be interpreted as "good" or "bad" based on the evolution of the ongoing systems of social relations in which the individual has been situated (Ibid:84). On the other hand, the notion of bounded rationality (Simon, 1990, 1997; Secchi, 2017; Zhao, 2018) is related to the idea that, when individuals make decisions, they do so based on the cognitive limitations posed by their minds, their capacities and the time available to make the decision. The notion of situated rationality was considered a more adequate concept in terms of describing the embedded rationality in the decision making process of the local, national actors relying on the situated context.

character, their ecological fragility, their size and limitation of resources (Kaldelis et al, 2004). Because of this, these areas have to pave the way in regard to sustainable development issues. Above all, Greek insular areas are sources of natural wealth and cultural heritage (Margaras, 2016). Natural and cultural characteristics render tourism a dominant activity for the majority of the Greek islands. Further, in many cases, tourism is a monoculture, resulting, on the one hand, on the islands achieving economic development but contributing, on the other hand, substantially to their resources degrading and their energy needs soaring[106]. Hence, as it has already been argued, a deep energy transition including tourism will be an initial and important step, facilitating the latter's turn to more sustainable pathways. Chios has been chosen to steer such an energy transition that would affect tourism.

Table 7.Tourist arrivals, overnights and occupancy in Lesvos, Samos and Chios between 2010-2016 (Author data reconstruction from Sete, 2017).

Regional areas		2010	2011	2012	2013	2014	2015	2016
Lesvos	Arrivals	103325	109310	95625	110510	122508	131633	91883
	Overnights	487418	508832	394727	458918	563283	584023	465863
	Occupancy	37,00%	37,10%	28,10%	32,40%	39,10%	39,80%	31,00%
Samos	Arrivals	110293	111401	99561	113745	118606	124530	109373
	Overnights	704788	725322	656947	773643	809466	797400	691533
	Occupancy	46,80%	45,90%	37,80%	39,00%	40,60%	44,30%	38,80%
Chios	Arrivals	53728	55428	46757	55818	58419	62563	52036
	Overnights	205811	190596	144799	169882	177390	196374	200862
	Occupancy	32,20%	28,10%	21,30%	24,80%	25,60%	28,20%	28,10%

Source: ELSTAT - Data is based on part of the total available beds - it is not extrapolated to derive an estimate for the whole market as there is no information about the months during which each hotel operates

Chios is located in the North-East Aegean. The island displays limited tourist development (table 7). The table above shows the arrivals concerning the major islands of the North-East Aegean. Those pertaining to Chios island are almost half the number regarding the other two areas. Moreover, there is a relatively small number of hotel units for the island's size as opposed to the other Greek islands[107]. At the same time, Chios has among the lowest average energy cost in comparison with the other autonomous electrical systems of the region and the Greek archipelagos[108]. This is illustrated in the table below (table 8.) showing data from the energy production in the

[106]As I am going to show in a later section, there is a strong positive correlation of these two systems in many insular areas.
[107]For more about this issues, see the data in a following section regarding the nested tourist regime.
[108]See the related figures of ΔΕΔΔΗΕ, «Πληροφοριακό Δελτίο Παραγωγής στα Μη Διασυνδεδεμένα Νησιά για το έτος 2012», 2018.

largest autonomous electrical systems in the Greek archipelagos. In the highlighted column, one can see the average variable cost per island. It can be clearly inferred from the table that Chios has the lowest average variable cost. Restrained tourist development and limited average cost are considered important parameters which can stimulate an s-t transition including tourism. I argue that in places with limited tourist activity and relatively low average cost, the alternative transition pathways which could be followed, in regard to the technologies that will be used and the forms

Table 8. Data regarding electricity production in the autonomous electrical systems of the islands (Author data reconstruction from ΔΕΔΔΗΕ, 2018)

Electricity production in islands' autonomous electrical systems - January 2018						
Autonomous Systems	Intalled capacity of power palnts 2016 (MW)	Demand Peak 2016 (MW)*	RES Production (MWh)***	Power Plant's Production (MWh)	Average Variable Cost (€/MWh)	Share of RES in electricity production
ΚΡΗΤΗ	813,02	627,30	55.453,32	184.008,75	140,50	23,16%
ΡΟΔΟΣ	232,93	200,00	8.264,55	44.721,65	105,85	15,60%
ΛΕΣΒΟΣ	84,41	67,42	3.695,74	25.835,02	102,20	12,51%
ΚΩΣ-ΚΑΛΥΜΝΟΣ	124,45	94,50	5.051,30	19.767,08	85,77	20,35%
ΛΗΜΝΟΣ	21,58	14,70	841,87	4.387,31	97,70	16,10%
ΜΗΛΟΣ	20,60	12,28	472,51	3.227,23	85,73	12,77%
ΠΑΡΟΣ	91,18	68,20	2.922,88	12.139,48	88,77	19,41%
ΧΙΟΣ	69,93	46,80	2.024,15	18.814,31	79,45	9,71%
ΣΥΡΟΣ	35,20	23,70	327,97	7.956,30	89,91	3,96%
ΣΑΜΟΣ	47,75	29,60	1.840,44	11.031,72	82,05	14,30%
ΚΑΡΠΑΘΟΣ	17,30	11,30	300,85	2.208,04	101,94	11,99%
ΜΥΚΟΝΟΣ	62,16	41,30	309,45	6.095,68	240,48	4,83%
ΥΠΟΛΟΙΠΑ ΗΣ**	139,95		782,48	19.409,69		3,88%

of tourism that will be developed[109] are several more compared to those in other cases. Further, the island's cultural heritage and the natural wealth as well as the relatively low pace at which its natural environment deteriorates will facilitate a potential development of sustainable forms of tourism.

Another characteristic which played a role in choosing Chios so as to steer an s-t transition is its background in energy schemes promoting local participation in the sense that it was a pioneer, as wind turbines, engaging locals, had been installed as early as the late 80s. The main shareholders of the institutional actor which built the first wind park were a local municipality and some island's inhabitants. The

[109] Particular tourism forms which can lead to this sector to developing in a more sustainable direction have been outlined in the first chapter of this thesis.

downward trend concerning its population is another important reason. Of course, this has been a characteristic for the majority of Greek cities and regions over the past years of crisis. Yet, as far as the islands belonging to the Prefecture of North-East Aegean are concerned, their population has been severely shrinking over the past decades, while the live births and deaths index has been the worst in the country for the past 40 years (Κίζος κ.ά., 2013). Moreover, as it will be underlined in the next sections, social and economic parameters are also important reasons for choosing this island to steer an s-t transition. Relying on these, the next chapter will illustrate possible pathways of Chios energy transition, according to the hybrid model that has already been presented in the second chapter, as well as the findings of the two exemplary cases covered in the third chapter. Subsequently, the current condition regarding the island's social-economic environment, as well other spatial characteristics, will be introduced.

Socio-economic and geographical features of Chios – A brief presentation

Chios is the second largest island in the North-East Aegean Sea and one of the five largest, among dozens, in the Greek archipelagos. Chios borders on Lesvos and Samos, which are the nearest islands, while it is only a few nautical miles away from the Asia Minor coast (Σαραντάκου κ.ά., 2005). The island occupies 807 km^2, of mainly mountainous area. The mountainous morphology is higher in the island's north side, while it becomes shorter in the south regions. The regional unity of Chios also encompasses two more inhabited islands (Innouses and Psara) as well as other smaller ones. According to the latest census, the regional unity's population exceeds 53,000 inhabitants, with the great majority of them (more than 52,000) living on Chios island[110]. Administratively, Chios belongs to the Prefecture of North-East Aegean, which is both an island region and a border region, including five large and five small islands. Its population is approximately 200,000 inhabitants. Judging from these, in population and size terms, Chios is classified as an important island. Indeed, according to the EU, Chios is among the most important European islands, based on size and population (Rokas Renewables, 2012:62).

[110] Data from statistics.gr.

Demographic and social characteristics

From a social perspective, Chios, as well as the whole region, differs from the continental country. Being remote from in-land Greece, as well as isolated, the island differs socially and economically. As a consequence, Chios ‘population has decreased enormously since the 1950s, although, from the 80s onwards, economic and infrastructural development cut down population drain. However, since the capital as well as the villages of the south have been getting the lion's share in terms of development, inhabitants have mainly moved to Chora. Hence, nowadays, many villages, mostly in the northern part of Chios, gives off a sensation of abandonment, as most of the inhabitants have flocked to Chora and the towns close to it. Subsequently, the capital is also the largest town, with approximately 29,000 inhabitants (chios.gr).

Live births and deaths index is negative for Chios[111]; consequently the island’s community is deemed an elderly one. Furthermore, the island's median age is higher than the Greek average (Κίζος κ.ά., 2013:9). Simultaneously, since many young people usually move to other places for studies, they end up, in several cases, residing permanently away from the island (Ibid). Therefore, the educational level of the island’s citizens is relatively low (Ibid).The level of secondary and higher education stands 5% lower than the country’s average (Περιφέρεια Βορείου Αιγαίου, 2012:3). On the other hand, the unemployment percentage on the island is lower than that of Greece.

Important economic sectors

In financial terms, Chios is predominantly based on the tertiary sector, while the primary sector participation in the island's total production has decreased, at least over the last twenty years[112]. The main economic activities are the public sector as well as trade, transport and accommodation services –which are actually related to the tourist sector– and the real estate management activities (figure 12). According to the diagram above, more than 50% of the island's Added Value is based on these three

[111] Data from statistics.gr.
[112] Data from statistics.gr.

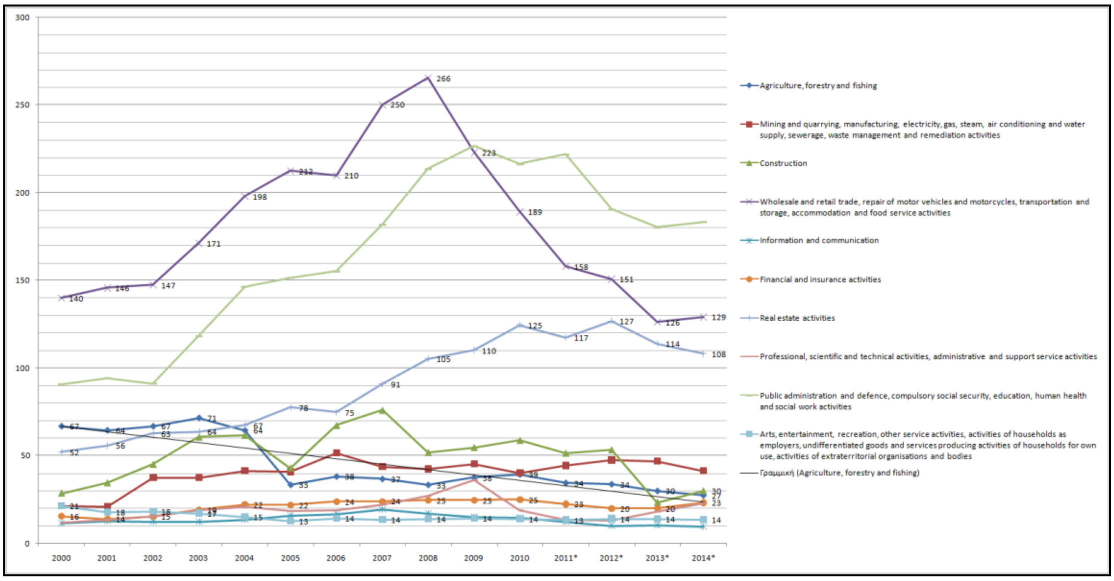

Figure 12. Gross Value Added by industry in Chios (source: statistics.gr)

sectors[113]. The primary sector, and more specifically agriculture and fishing, have downsized more than 50% since 2000. This fall can be mainly put down to the rapid and extensive fall of fish farming –an outgoing activity– since the beginning of the economic crisis in 2008; agriculture however has remained almost steady during this period. Agricultural activity is carried out in the south region of the island where the mastic tree is cultivated (Σαραντάκου κ.ά., 2005). Chios mastic is a unique product that is produced exclusively on Chios, and more particularly in the south region of the island. The cultivation of other products like citrus fruits, which used to be important, has been rendered finite over the past decades, merely covering a part of domestic consumption. Finally, the importance of merchant navy sector in the local economy is fundamental. Many locals work in merchant ships, while a Merchant Marine Academy has been established, featuring faculties for deck-officers and marine engineers. In the next section, a socio-technical analysis of the Greek energy regime and the nested one in Chios will be presented.

A socio-technical transition in the making: The case of Chios

As it has already been mentioned, in this section I will outline Chios nested energy regime so that a deep energy transition including tourism could be steered in the next chapter of this thesis, following different pathways. The following section introduces the basic features, dynamics and aspects of the Greek energy s-t regime, as well as its

[113] Data from Hellenic Statistics Authority, 2017 (see statistics.gr).

transition, mainly since the 50s, chiefly focusing on the transition towards renewable technologies. The analysis will highlight the different energy technologies used and the pathways followed. Additionally, governance and power issues pertaining to the incumbent actors and landscape pressures that has tremendously altered the national regime will be also underlined. Thus, the major national actors' dynamic and perception in regard to s-t transition are evaluated, mainly in regard to renewable technologies. This will be essential in making the transition in the nested regime. In the Greek case, the s-t transition could be divided into four different periods. Initially in the 1950s, the establishment of PPC, the national utility company, unified the fragmented s-t system, creating visions regarding the country's electrification and energy independence. In this period, lignite technology was consolidated as a significant one in electricity production, at least in regard to the interconnected to the continental grid system. In the autonomous electrical systems of the islands, fuel oil is the only technology available for electricity production. Moving on, from the 70s onwards, the two oil crises brought about landscape pressures in the s-t regime, leading to a lignite technology dominance pathway during the following decades as well as to initial attempts to create a niche renewable technologies market. During this period, the nested regime of Chios witnessed the initial, embryonic attempts aiming at a transition to a renewables pathway. Since the late 90s, landscape pressures by the EU towards liberalizing the energy regime and supporting a transition to renewable technologies have dealigned it, creating many new important actors. In this period, many regime actors seemed willing to achieve the European targets, following a transition to renewables pathway. In Chios' case, during this era, the majority of renewable technologies were installed. Finally, in the late 2000s, the Greek economic crisis created new landscape pressures, pushing for further liberalization of the energy regime, thus de-aligning it further.

The Greek electricity regime in the postwar era: Dominant sources and the struggle for the renewables deployment

The Greek electricity s-t regime was dominated by attempts to electrify the country discriminating the price policy between different producers and places as well as by the emergence of private initiative, during the first half of the 20th century (Michalena, Angeon: 2009). Until 1929, 250 towns, with more than 5,000 users each, had been electrified[114]. Multinational actors looked unwilling to invest in remote, rural and under-populated areas, deeming it financially unprofitable. Hence, nested regime actors, mainly small private investors or local authorities, ended up filling the gap in those areas (Παπαδόπουλος, 2018). The national energy s-t regime remained the same during the first postwar era years. Distributed and partial energy production, mainly local-range power companies,[115] and limited mining activity typified this sector, until 1950 (Τσοτσορός S., 1995:57).

At that time, the Public Power Corporation (PPC) was established, a national actor aiming at nationalizing distribution and production of power, determining the same electricity prices in the Greek territory and subsequently playing a primary role in the national electricity regime (Ibid). Creating a national power utility was not a priority for the Greek policy makers, however establishing a public monopoly was a one-way street. The inability of the fragmented s-t regime to develop a reliable and high-tech power network forced the right-wing governments to establish a national power actor (Ibid:88). For this reason, the state decided the takeover of the private and municipal power actors from the PPC within the following years. This process had been completed for the most part by the mid 60s (Ibid), succeeding in re-aligning the national electricity s-t regime. Through the first energy program (1951-55), the s-t regime aimed at following a pathway of domestic technologies for electricity production, thus using lignite and hydroelectric projects (Ibid: 61). The program was financed by the Greek Rehabilitation Program, the public budget and the Italian compensations (Σταθάκης, 2004). The scale, the technical knowledge required and the technologies of these projects were however unfamiliar to Greek construction companies and PPC. Besides, main financing deriving from the Marshal Plan meant that the U.S. side demanded that assignment and supervision of the projects be carried out by American actors (Τσοτσορός, 1995:87). Hence, American Ebasko Services Inc. was the enterprise in charge of running management, production and transmission projects of the program, while Pierce Management Inc. was involved in the lignite production issues (Ibid). A transition to domestic raw materials technologies brought about a reduction in the cost of electricity, rendering it affordable to wider social groups, while it was connected with the state's narrative for energy independence

[114] Information taken from the official site of the Regulatory Authority for Energy (rae.gr).
[115] According to Tsotsoros, the only exception was the Power Company of Athens and Piraeus, whose total installed capacity amounted to 52% of the country's total capacity.

(Ibid). This change, together with raising installed capacity and deploying the electricity network tremendously increased the diffusion of electricity for domestic use during the next two to three decades (Ibid). In this framework, lignite was introduced as the main raw material, contributing to national growth and development (Kavouridis, 2008: 1265).

Projects of the first electricity program included the lignite technology power station of Aliveri (1953) and the hydroelectric power plants of Luru (1954), Agra (1954) and Ladona (1955), as well as the power transmission for interconnecting the three first plants, having a length of 1.125 km. The power plant of Aliveri ran exclusively on lignite technology (Kavouridis, 2008: 1264). Lignite production mounted during the following years (Ibid). Further, in the late 50s, PPC bought the 90% of the shares previously belonging to LIPTOL Ltd., the biggest actor operating in the lignite production in the country (Τσοτσορός, 1995:90). Since then, the major incumbent actor's energy production was associated directly with lignite technology, although oil was a large share of its energy mix until the 90s. Constructing the hydroelectric plant of Luru in 1954 marked PPC's first attempt to follow a renewable transition pathway[116]. Later endeavors in this pathway were the survey projects for water potentials in 1958 and the surveys for geothermal sources in several islands and continental areas[117]conducted by the Institute of Geology and Mineral Exploration (IGME) together with the Utility in 1973.

During the 60s, country's electrification by PPC made further headway, reaching 69% of country's population, although still mainly urban areas had been the ones being electrified (Τσοτσορός, 1995:92). In regard to the insular areas of the Greek archipelagos, during this period, the incumbent actor installed 32 autonomous electrical s-t systems on the non-connected to the continental grid islands. These systems used diesel and fuel oil-powered technology to produce electricity. The use of imported oil for this purpose turned out to be expensive for the actor which was nevertheless obliged to offer a common price to all the country. During the Junta period, PPC's dependence on imported oil escalated further due to the former's decision to run the two new thermoelectric plants on oil rather than on lignite technology (Τσοτσορός, 1995: 95-96). Thus, in 1973, the actor's use of liquid fuel

[116] This information is from the official site of PPCR (ppcr.gr).
[117] Until 1973, they had carried out surveys in the islands of Milos, Nisiros, Lesvos, Santorini, Kos and a number of areas in the inland Greece featuring high temperature geothermal fields (for more information, see ppcr.gr).

technologies rose to 47.3% from 26.8% that was six years earlier (Ibid). The oil crisis which emerged during the 70s brought about landscape pressures, thus changing the state's energy policy and PPC's attempts to cut down on its dependence on oil. Hence, since the mid 70s, a transition to lignite serving as the main technology used for electricity production had materialized. During the next decades, its production for electricity use soared, covering the larger part of country's energy needs[118] (Kavouridis, 2008:1265). On the other hand, hydroelectric power technology hadn't been utilized, despite PPC's efforts to follow such pathway. Nonetheless, the state regarding this technology chiefly as a back-up one, due to deficiencies in interconnections with other countries' electrical systems until the 70s and poor water potentials, thwarted such transition pathway (Τσοτσορός, 1995: 99). According to Geels and Schot's (2007) conceptual framework that was analyzed in the second chapter of this thesis, this pathway could be characterized as a reconfiguration one.

In regard to the autonomous electrical systems of the islands using oil technology for power production, in the late 70s, the actor tentatively embarked on renewable programmes in an effort to utilize high wind and solar potential of the insular areas so as to achieve a sustainable transition. European Union subsidies in renewable technologies, during the following decades, fostered such a pathway. Thus, since the late 70s, the incumbent actor, together with other public regime's actors[119], began examining the islands' wind and sun potential and participating in pilot programs for a transition to niche technologies (Αγγελοπούλου, 2014:19). Of course, these niche projects didn't yield commercial results. However, it needs to be mentioned that these attempts preceded the establishment of a regulative context for renewables by the Greek state. Additionally, these kinds of projects boosted the actor's skills and knowledge concerning these niche technologies. More particularly, in 1982, in Kithnos island, the actor, together with the German enterprise M.A.N., constructed the first wind park. This demo programme was the first wind park installation project to be carried out internationally (Ibid:20). Further, the actor also installed other hybrid niche technology systems, like a wind turbine and photovoltaic park and accumulators that have been successfully functioning (Ibid). The solar technology farm's capacity

[118] According to the author, lignite production increased ten times between 1970 and 2005 (Kavouridis, 2008).
[119] During the early 80s, many regime actors such as the National Technical University of Athens (NTUA), the Laboratory of Meteorology of the University of Athens and the National Meteorology Service were some of them (Αγγελοπούλου, 2014:19).

was 100 kW[120], while the wind park included five wind turbines of 20 kW each. During next years, other hybrid electricity systems were also tested on the island of Kithnos.

Few years later, in 1985, the government adopted the first regulative framework regarding renewable technologies development and installation (Ibid:26). The new context was considered very innovative at that time, as it made Greece the second country in the world to adopt a special framework for renewable technologies (Ibid). The legislation (law 1559/85) gave the opportunity to small actors like municipalities and other public organizations to install renewables, thus engaging in the energy transition. Making use of this legislation, the Hellenic Organization of Telecommunication (HOT) as well as several Municipalities constructed wind farms, creating a niche market (Ibid). These projects were carried out with the technical support of the National Technical University of Athens (NTUA). One of these projects took place in Chios.

In 1987, the Centre for Renewable Energy Sources and Savings (CRES) was established, which was a new regime actor created so as to facilitate transition to renewable technologies (Αγγελοπούλου, 2014:27). This actor is the Greek institution related to renewables promotion and development, the rational use of energy and energy savings. Since the mid 90s[121], the actor has been nominated as the national coordinator in the above fields[122], while it has also served as the government's consultant in energy policy issues. During the following years, CRES participated in many pilot projects. This consulting actor's initial establishment and its new position were dictated by the state's ambitious plans for an intensive and rapid transition to renewables, even since the late 80s (Hajilambrinos, 1996). These plans aimed at achieving a transition to renewables so that the country could meet 10% of its energy demand by the year 2000 (Ibid:3). Those plans, that have become known as the "1988 Renewable Energy Plans", had been proposed by the socialist PASOK government, which however was succeeded in power by the right-wing New Democracy government (Ibid:3). Ultimately, the plan did not achieve its transition target, thus it had to be revised in the late 90s (Αγγελοπούλου, 2014: 38).

[120] This info is taken from the official site of Public Power Company Renewables (see ppcr.gr).
[121] The laws 2244/94 and 2702/99.
[122] Information taken from the actor's official site(cres.gr).

One of the above mentioned plan's objectives was the use of geothermal technology for electricity production. After the initial surveys conducted by IGME during the early 70s, several high and low enthalpy resources were found scattered in the country. PPC participated in the whole process carrying out drillings, since it was interested in utilizing the high enthalpy fields for electricity use (Ibid:17-18). A trial program aiming at this transition pathway was the project pertaining to the high enthalpy geothermal field on Milos Island (Hadjilambrinos, 1996). According to the initial project, the regime actor erected a 2 MW electric plant which ran on the niche technology[123]. This transition pathway had also included the construction of a larger geothermal plant of 30 MW (Ibid). However, tensions that ensued with the local society prevented its implementation, while inducing a negative impact all over the country concerning sustainable transition to this pathway. Hence, at that time, this niche technology failed to enter the Greek s-t regime. Consequently, utilizing geothermal technology for electricity production has remained a table-top exercise until nowadays.

During the 80s and the early 90s, the actor was also able to carry out two demo projects so as to test the efficiency and the design of domestic construction wind technologies. These projects were financed both by the PPC (51%) and the European Union (49%). In both cases, other public regime's actors also participated, such as the NTUA, other Europeans and Greek Universities[124] and the CRES. As far as the second project was concerned, other regime actors, namely Pirkal Ltd and Geoviologiki Ltd, which were private construction companies, participated supplementarily (Αγγελοπούλου, 2014:21). Pirkal was also involved in another innovation project with the PPC. In this project, this actor constructed a wind turbine of 500kW and another one of 600kW, installing them in the wind park that CRES had established in Lavreotiki (Ibid: 22). These two wind turbines featured high quality and were promoted for commercial use (Αθανασιάδης, 2001). PPC participation in several projects with other Greek owned companies was not haphazard; it was dictated by the state's energy policy objectives in regard to accumulating and deploying wind turbines as a national niche technology (Τσοτσορός, 1995). However, this transition pathway concerning the national energy regime did not come to fruition. All these projects run by the national power company and other regime actors, from the 80s

[123] The project ran until 1993 (Hadjilambrinos, 1996:567).
[124] University of Patra participated in the second of these projects too.

onwards, are based on a narrative for a transition pathway to domestic construction renewables as well as on the perception that renewable niche technologies could reduce the oil powered technology consumption of non-connected islands, or they could even be used as a substitute technology, taking into account the annual increase in energy demand in the insular areas and the fluctuation in electricity consumption during the year because of tourism (Αγγελοπούλου, 2014:33-37). They argued that the wider contribution of RES technologies to the energy mix could assist in following this transition pathway (Ibid). Meanwhile, in the early 90s, PPC ran a transition to wind technology on several Greek islands, making use of EU subsidies and using wind turbines constructed in Denmark. The project implemented wind turbines ranging from 55kW to 500kW, featuring a total capacity of more than 25MW (Ibid:29). Under this programme three wind farms with a total capacity of 5.5 MW were installed on Chios. During the mid to early 90s, PPC did not materialize other RES projects. According to Αγγελοπούλου (2014:29), the actor's inertia can be attributed to the island communities lukewarmly embracing the former projects , as well as to the immature development of storage technologies at that time.

In this context, in 1994, abiding by the "1988 Renewable Energy Plans" perception the state adopted a legislation (law 2244/94) obliging the incumbent regime actor to purchase part of the energy that was produced by other small actors, like regional governments or private investors, in case they use renewable technologies (Ibid: 27). Through this regulative framework, the state was very generous to the small individual actors, subsidizing 30% of their investment, anticipating an accelerated transition to renewable technologies in the autonomous electrical systems on the islands[125], that however never materialized. Since the mid 90s, landscape pressures emerged as a result of changes in the way the global community perceived climate as well as a result of adopting European legislations and directives for deregulation[126]. These pressures de-aligned the national s-t regime, leading to alternative transition pathways. Consequently, the end of the 90s is considered by many scholars (Papadopoulos and Karteris, 2009; Michalena, Angeon: 2009; Lazarou et al, 2007) as a period illustrating extreme changes in the national s-t regime, ending PPC's

[125] The objective set by the Ministry of Energy and Environment in 1995 had to do with installing 350MW of wind farms until 2005 (for more information see Αγγελοπούλου V., 2013:23, in Greek).

[126] The first of these directives was Directive 96/92/EC regarding common rules for internal market in electricity.

dominance in renewable technologies'[127]installation as well as limiting other regime actors' participation (Lazarou et al, 2007). Until the late 90s, the initiatives taken by private actors were marginal, as they have only installed a few hundred kilowatts up to that point (Fragoulis, 1996). By comparison, PPC had installed a capacity of approximately 30 MW by the mid 90s (Zorlos et al, 1994), which however changed during the next decade. Based on the conceptual framework established by Geels and Schot (2007), landscape pressures redirected transition's pathway to technological substitution one. This transition pathway has been followed until nowadays.

In general, until the late 90s, the transition to renewables pathway had been following a very slow pace. Niche technologies, mainly wind turbines, were usually installed in insular areas, while their total installed capacity would slightly exceed 170MW, with the vast majority of them owned by the incumbent actor (Αγγελοπούλου, 2014:29). Looking at the pig picture, in a national level, in the late 90s, it was lignite technology that mainly produced electricity (Dagoumas et al, 2007:1554). Thus, in 2000, lignite technology had a 62% share of the total electricity production, while the share of niche renewable technologies was only 1% (figure 13). Hydroelectric technology produced 8% of the electricity needs, while their installed capacity was 26% of the total installed power, being at that time 11,403 MW (Dagoumas et al, 2007:1554). Further back, in the late 80s, natural gas was introduced in the national regime, a new technology which has been influencing electricity transition pathway to a great extent until nowadays. Its entrance can be attributed to the government's will in the early 80s to approach the USSR (Arapostathis,

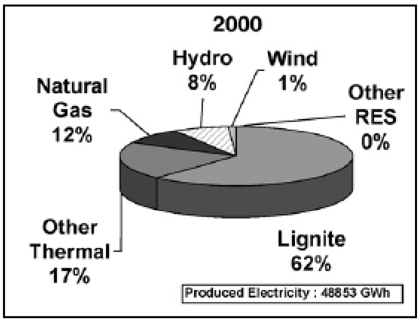

Figure 13. Produced electricity per technology in 2000 (Dagoumas et al, 2007:1554).

Fotopoulos, 2019: 46). Further, it was accompanied by narratives of the electricity regime incumbent actors for replacing lignite and diesel technologies in the power production (Ibid). As a result of the new technology, a new actor was established in the late 80s, the Public Gas Corporation (DEPA), which initially was in charge of trading and distributing natural gas[128]. Thus, natural gas technology use in energy

[127] The main technology installed involved wind turbines, while solar energy installation was meager. Hadjilambrinos (1996) argues that only solar energy technologies for water heating installations had a significant share in covering the citizens' energy needs.
[128] This information comes from the actor's official site (depa.gr).

production started gradually developing from the late 90s[129]onwards, partially substituting oil. In this trend, by 2000, natural gas technology's share had reached 12% of the energy mix (Dagoumas et al, 2007:1554). Another issue that light needs to be shed on regards introducing interconnections of the national electricity system with those of neighboring countries during the 70s and the 80s, through interconnectors (Arapostathis, Fotopoulos, 2019:46). Their number went on to increase during the 90s and 2000s, while their importance in terms of the national system's stability and reliability became a major one, increasing its dependencies (Ibid).

In regard to the transition to renewable technologies, from the mid 90s onwards, the EU directives (1996/92) have created landscape pressures ending up in the national regulative framework being modified in 1999. These changes swang the pendulum in the national regime in favor of private companies, at least regarding the renewable niche market. The new laws were utilized mainly by the wind power actors, thus leading to a significant growth over the following years (Papadopoulos et al, 2008;

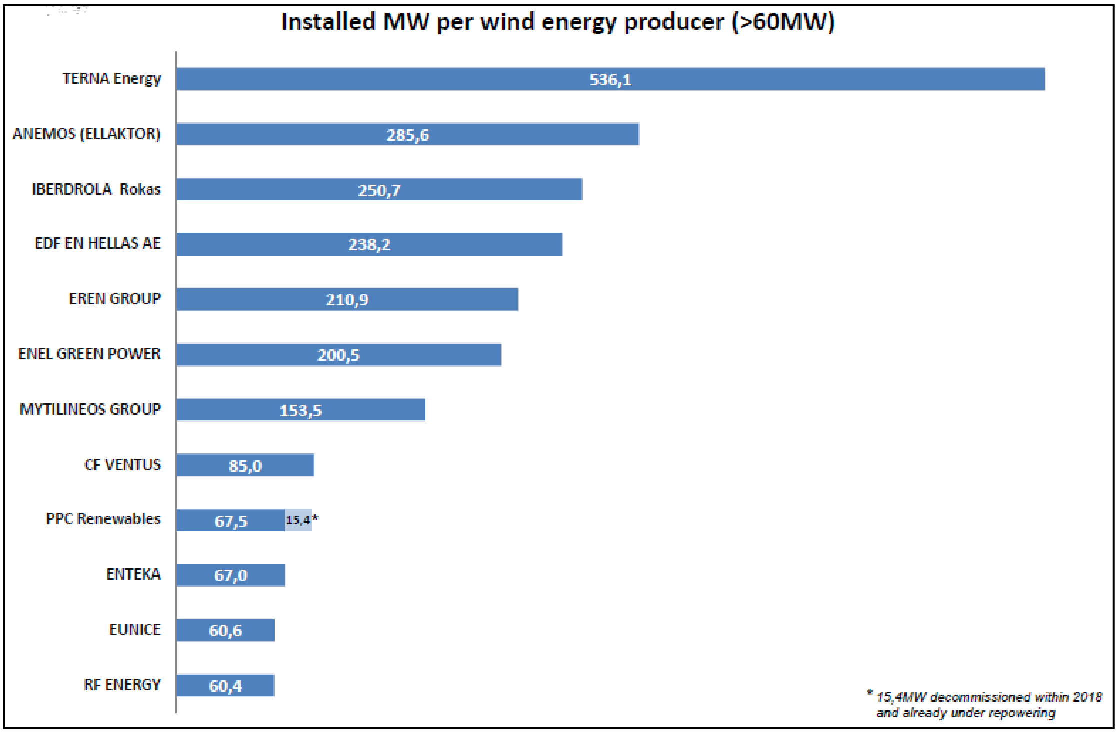

Figure 14. Country's installed capacity per wind energy producer (Source: elenaen,2018)

Tsoutsos et al, 2008; Papadopoulos and Karteris, 2009). This transition pathway was enforced by the national and European narrative and by the relevant changes in the institutional framework aiming at liberalizing the energy sector and interconnecting

129 PPC, which was the major consumer of DEPA, constructed its first power plant in the late 90s, running it on natural gas (source: depa.gr).

the islands initially with the continental network while even following with the electricity networks of central Europe, exporting renewable energy (Αγγελοπούλου, 2014: 39). During the next decades, despite remaining the electricity regime's main actor, at the same time, PPC lost its dominant position in the niche renewable market. Especially in the inland Greece, its percentage in the wind energy production shrunk, while other private regime actors flourished (figure 14), mainly constructing large-scale wind parks. Some of these actors include TERNA Energy, operating in the renewable niche market since 2000 and having a current wind installed capacity surpassing 500MW[130], ELLACTOR, which run exclusively wind parks and is now the second largest actor in the wind-powered technology market[131], Iberdrola-Rokas Inc., participating in the Iberdola Renewables multinational energy group ,operating wind and solar technology farms of total capacity 264MW[132], and MYTILINEOS GROUP, which is the major private incumbent actor in the national regime running a natural gas technology power plant while also operating in the renewable niche market[133]. Moreover, an actor expressing wind private actors' interests, Hellenic Wind Energy Association (ELLETAEN), has assumed an active role in the energy regime.

As the energy regime was being deregulated, the state was forced to demand that regulating the regime and carrying out the transmission be allocated to different actors. The new Law 2773/99 established the Regulatory Authority for Energy (RAE), an independent authority actor being in charge of monitoring the energy regime, either the conventional or the renewable energy sources and the natural gas[134] one. This authoritative actor's jurisdictions were enhanced following 2011 (law 4001/11), when the state adopted the 2009 EU directions. Additionaly, the Presidential Decree 382/2000 founded the Hellenic Transmission System Operator S.A.[135] (HTSO), a new regime actor, whose role is to maintain and develop the electricity network all over the country, as well as its interconnections with other countries. Further, the operation of HTSO was monitored by RAE.

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130 A company which deals with constructing and operating RES installations; the actor is involved in renewable technologies in Europe and America (see http://www.terna-energy.com/el/)
131 The company merged and absorbed other companies operating wind farms since the late 90s, settling in its current structure from 2008 onwards (for more info see https://www.eltechanemos.gr/homepage/eltex-anemos/).
132 For more about this actor, see https://www.iberdrola.com/press-room/news/detail/iberdrola-renews-commitment-greece-with-award-pyrgari-wind-farm
133 For more information, see https://www.mytilineos.gr/el-gr/power/and-natural-gas.
134 The information is taken by the actor's official site (rae.gr).
135 The electricity network belonged to PPC, with the HTSO just utilizing the electricity system.

The landscape pressures also affected the framework which the national utility actor, PPC, operated in. Thus, during the early 00s, the state converted the actor to a limited company in harmony with the liberalization and privatization trend that EU directions promoted (Kavouridis, 2008). Additionally, the state founded PPC Renewables (PPCR), a subsidiary company operating in the renewables niche market. This disjuncture was imposed by European pressures advocating for subsidies being granted only to renewable energy companies. The new actor inherited all renewable technologies-related activities (wind, small hydroelectric, solar and geothermal) by PPC[136] in 2006.

Deregulation of the energy market also brought about changes concerning the natural gas regime being integrated in the electricity one. Mostly from mid 2000s onwards, when the European Directives (98/30) were implemented, the context of the natural gas market changed dramatically, allowing for natural gas diffusion for domestic use, on a later stage. The new framework separated DESFA, a new natural gas regime's actor, which became the technology's grid operator[137], from DEPA, the public gas company[138]. Until that time, it was the latter that had the exclusive rights of importing, transmissing, distributing and trading natural gas. Until the mid 2000s, DEPA aimed at wholesaling to several industrial actors, but mainly to PPC, so that the latter could meet its natural gas needs for electricity production. Following this paradigm, in the mid 2000s, other private actors like HRON, Elpedison and Allouminion steel company began using natural gas technology for power production (Arapostathis, Fotopoulos, 2019: 47). Because of the market having been deregulated, natural gas domestic integration initially struggled to catch on (Fotopoulos, 2016). However, since the mid 2000s, natural gas penetration deployment has been picking up (Arapostathis, Fotopoulos, 2019). Since the early to mid 2010s, natural gas penetration to the electricity mix has been growing rapidly, becoming competitive to electricity in domestic use, at least in large urban areas.

In addition, liberalization of the energy market boosted renewable technologies production, and more particularly, the projects' wind capacity and the scale. Therefore, from an installed wind capacity reaching 106,8 MW in 1999, the sector

[136] This information is taken by the official site of PPCR (ppcr.gr).
[137] The new actor assumed the rights of the natural gas network transmission and distribution (source desfa.gr).
[138] For more information, see http://www.depa.gr/uploads/files/apologismos_2017.pdf

escalated to 237,1 MW in 2000 and 293 MW (see figure 15) two years later[139]. The average annual growth of the sector during this period exceeded 30%. Furthermore, the rapid development was facilitated by the Law 3010/02, which, being flexible with large investments, allowed them to draw up plans on a high level between the companies and the planning administrative actors without local communities and authorities actually participating. (Αγγελοπούλου, 2014:41).

Nevertheless, solar technology for electricity production, was having difficulty delivering the expected results, with their installed capacity at that time inevitably remaining meager. Niche technology picked up a few years later, in 2006, with the state the adopted a feed in tariff scheme. Indeed, in 2006, the state harmonized the national regulative framework with the EU directions, voting for the Law 3468/06, supporting niche technologies investments endorsing tools like feed in tariffs payments, thus facilitating the transition. According to Papadopoulos and Karteris (2009), the law generated legislative stability and licensing procedures. In fact, in the niche market of solar technology, where the tariff was set relatively high, the actors seized initiative very rapidly (Tsantopoulos et al, 2014). However, this speedy deployment was accompanied by an unhealthy niche market with many speculators (Karteris, Papadopoulos; 2013:297). On the other hand, solar technology in electricity production development remained limited in regard to wind technology due to high sunk cost (Chadjivassiliadis and Stambolis, 2012). Hence, in this period, large-scale investments boosted wind technology, which in turn caused the total wind capacity to skyrocket to 1323.8 MW in 2010 (figure 15). On the other hand, these changes failed to reach the regime's actors objectives for installing more than 3.300 MW in the early 2010s (Αγγελοπούλου, 2014:45).

[139] Regarding installed wind capacity rising during the years, see eletaen.gr

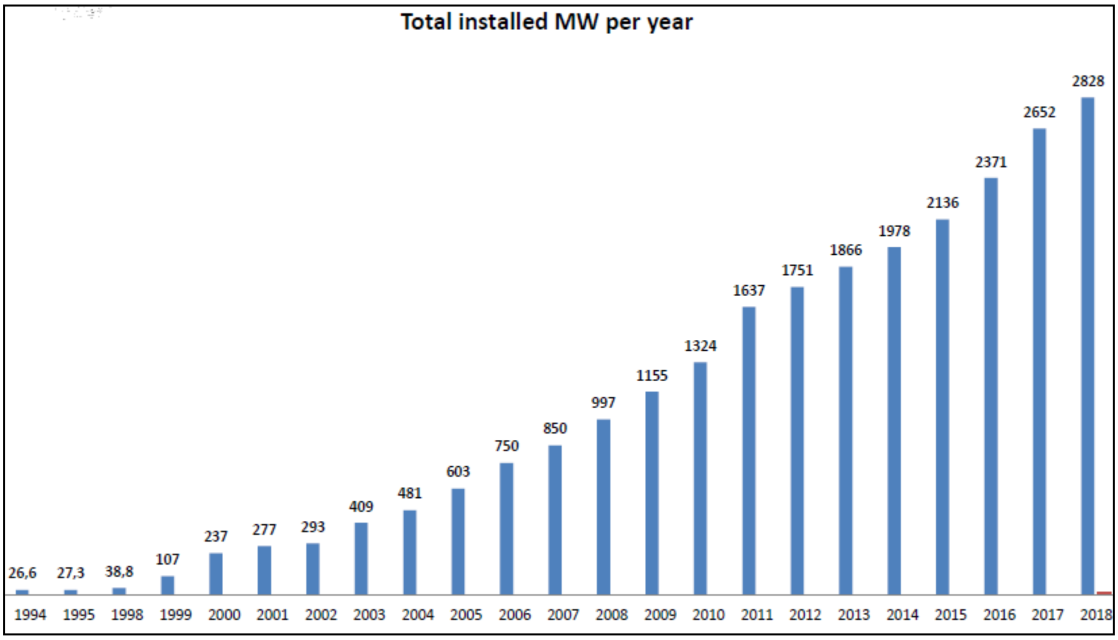

Figure 15. National installed capacity of wind turbines in a thirty year period (Source:Eletaen, 2018).

In this era, a number of heavy landscape pressures influenced the s-t energy regime to a great extent, bringing about significant changes. Thus, on the one hand, the economic crisis which struck the country in 2009 has resulted in an economic adjustment programme, which was imposed by the EU and the IMF (known as Troika) and led to pressures for the energy regime's further liberalization (IEA, 2017). During the next decade, this rapid pressure brought about a major transition in the s-t regime as well as in incumbent's actor position. According to the liberalization requirements, PPC was obliged to decrease its share up to 50% until the end of 2019 as part of the country's obligation to Troika[140]. Further, a number of economic "tools" were used in increasing the actor's cost, rendering the other regime's actors more competitive[141]. However, the actors' share still stands at approximately 80% (as for year 2018), rendering the negotiations with Troika a Gordian knot. Additionally, the crisis brought about a reduction in energy production and consumption. Thus, total energy consumption has decreased in 2013 by 30% in regard to the peak level recorded in 2007 (Ibid:22).

Another landscape pressure was driven by the 2009 EU Directive (2009/28), which argued for an energy transition to renewables until 2020 so that it could reach 18% of

[140] Regarding PPC's obligations and its divergence from Troika's targets, see http://www.bankingnews.gr/index.php?id=401868 and https://www.energia.gr/article/124932/h-deh-paramenei-kyriarhh-sthn-promhtheia-hlektrismoy-para-thn-apeleytherosh-ths-agoras-kai-ta-nome
[141] The most important of these tools was known as invitation to tender NOME. Regarding this mechanism, see https://energypress.gr/news/oi-dimoprasies-nome-os-mihanismos-enishysis-toy-antagonismoy-stin-elliniki-agora-ilektrikis

the national electricity gross consumption[142]. Following this directive, the Greek state adopted a series of laws (3851/10 and 4014/11) facilitating an accelerated and, in a way, unconditional transition to renewables so that the EU target could be achieved (Αγγελοπούλου, 2014:330). More specifically, the former of these legislations (law 3851/10) acknowledged the transition to renewables as a "national priority", allowing renewable infrastructures to be constructed in areas where this was prohibited until that time, such as for instance, in Natura 2000 site, bringing about conflicts with the local societies in many cases (Ibid: 331). The latter of these regulative changes (4014/11) aimed at simplifying the environmental licensing process. The Law limited the renewable technologies projects requiring an Environmental Impact Assessemnt (EIA). Further, although it required that the local society be informed in advance, it failed to develop any further mechanisms and tools so as to ensure it (Ibid: 343-345). Thus, in many cases, the local societies objected to them being consulted either inadequately or completely about the planned transitions. These laws, dictated by the state's energy policy to abide by EU directions, resulted in efforts for huge wind parks investments in the Aegean islands during the early to mid 2010s[143]. This pathway, in many cases, raised conflicts with the local actors, many of which had to be resolved in the Council of State[144]. One of these projects was proposed to be installed in the North-East Aegean[145].

The regulative changes which were imposed by EU Directives (2009/72) and adopted by the Greek state in 2011 (Law 4001/11), thus establishing three new administrative actors in the energy sector, were also of great significance. This law established new actors in relation to the electricity production distribution and transmission as well as to the electricity market operation. In fact, the aforementioned HTSO actor that had been established in 2000, was replaced by two new actors (IPTO and OEM). The Independent Power Transmition Operator SA (IPTO) took over the operation, maintenance and development of the transmission network[146]while the Operator of the Electicity Market (OEM) aimed at monitoring the operation of the power energy

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[142] See the directive in https://eur-lex.europa.eu/eli/dir/2009/28/oj

[143] It is worth noting that, according to the country's Specific Plan for Spatial Planning and Sustainable Development for Renewable Energy for insular areas (Law 2464/08), the maximum installed space could occupy up to 4% of the island's space, which however does not determine the installed capacity in any way.

[144] See for instance the tensions ensuing in Crete against large-scale wind investments http://bankingnews.gr/index.php?id=216993

[145] This is the project of Iberdola-Rokas "Aegean Links", to which I will refer in the next section (see Rokas Renewables, 2012).

[146] This information is taken from the actor's official site (admie.gr)

market[147]. Further, the network's distribution –that until that time belonged to the PPC –was passed on to a new actor, the Hellenic Electricity Distribution Network Operator S.A. (HEDNO S.A.). This new actor was formed after the Distribution Department was detached from PPC, and despite being a subsidiary of the latter, it is fully independent in regard to operation and management, undertaking the distribution network's operation, maintenance and development[148]. The new transmission operator actor acts as a wholly independent one, complying with the EU Directives. The above mentioned actors are controlled by RAE. These changes were vital in terms of distributing governance and employing the European strategy for a common European energy market.

The state's energy policy until the mid 2010s had mainly revolved around attaining the national target dictated by European Directives smoothly and rapidly, thus chiefly facilitating the operation and engagement by the incumbent regime actors. However, the state's approach has been partially altered since 2015. Thus, a series of new laws implemented in 2016 and 2017 aimed at engaging small actor as co-operatives, regional governments and individual users-consumers in electricity production. These laws adopted net-metering and virtual net-metering (law 4414/16) initially regarding specific actors (municipalities, farmers and non-profit foundations)[149], while, from 2018 onwards, these frameworks were made available for other consumers by decree of the Law for Energy Communities (4513/18). In respect to this institutional framework I consider engaging local society of vital importance for sustainable energy transitions, thus I will analyze it further. The scheme refers to local urban cooperatives through which local actors could engaged in the energy sector. The new institutional framework ensures favourable terms pertaining to forming and operating energy communities, aiming at the reinforcing not only family incomes, but also local businesses' initiative as well as promoting energy democracy (Hess, 2018, 2019) as well. Nevertheless, there are restrictions in order for local engagement to be ensured. As a result, at least 51% of the members should be directly related to the region which the energy community is situated in (namely, they should be a resident or a landlord), while the minimum members number should be five, since no member can possess

[147] This information is taken from the actor's official site (lagie.gr)
[148] This information is taken from the actor's official site (deddie.gr)
[149] Regarding these frameworks, see an article by Greenpease Hellas https://energypress.gr/news/greenpeace-thetiki-i-apofasi-gia-net-metering-na-dieyrynthei-perissotero

more than 20% of the partnership allowance (there are, however, exceptions concerning peripheral and local governments and its organizations), while irrespective of the percentage, everybody is entitled to having just one vote in the general assembly.

One of the most important provisions set by the new Law is that of virtual net-metering framework (Law 4416/16) for individual users and small or medium private actors. Through this framework one could produce energy for self-consumption using renewable technologies, even in cases where installing one at home is subjected to space limitations; in other words, the renewable technology can be situated far away from the consuming point. The energy produced by the system will be offset by the electricity account. According to the Law 4416/2016, Greece has become the only European country that allowed virtual net-metering primarily to specific actors (municipalities, farmers and non-profit foundations), while the framework regarding energy communities extends this possibility to all users-consumers. In general, the energy communities framework can prove to be an exceptional institutional tool which can facilitate sustainable energy transitions engaging local societies. The Energy Communities framework was followed by a narrative of democratizing the energy sector[150]. Nevertheless, it also facilitated the central political will expressed by the left-wing government to ensure that PPC remains solid under public control, in contrast to Troika's requirements[151]. On the other hand, over the past years, big investments in renewable technologies have already been approved as well as new projects are already under way[152]. Big investments were also dictated by energy planning and interconnecting several insular areas with continental Greece[153].

One way or another, over the past decade, the state has, in a sense, steered a transition pathway to renewable technologies after radical transformations in the s-t regime occurred. In a contradictory way, on the other hand, over the past few years, attempts to carry out research aiming at extracting and utilizing hydrocarbon reserves have also

[150] See, for instance, the statement made by the Minister of Environment and Energy https://energypress.gr/news/stathakis-simeio-anaforas-oi-energeiakes-koinotites-gia-tin-metavasi-se-kathares-morfes

[151] See, for instance, the statement made by the Deputy Minister of Environment and Energy https://energypress.gr/news/famellos-aspida-gia-ti-dei-ta-aytonoma-nisia-kai-oi-energeiakoi-synetairismoi-erhetai-net

[152] A few of these large investments are described in the following article:https://www.ypodomes.com/index.php/all-news/item/50706-i-anaskopisi-tou-2018-ta-megala-erga-pou-allaksan-ton-energeiako-xarti-ti-xronia-pou-perase

[153] This is the case of Crete and Cyclades islands. For more info, see IPTO's ten-year work programme 2018-27 (in Greek).

risen[154]. Still, this pathway is part of the state's, as well as other regime actors', energy policy to come up with narratives regarding an upgraded geopolitical role (ΥΠ.ΠΕ.ΕΝ., 2018:29,47), as I am going to argue again later. Besides, lignite continues to be the dominant fuel technology for electricity production, although its share has shrunk by 22% from 2006 to 2016 (table 9). According to the 2018 National Energy Plan and the state's energy policy, lignite technology will remain an important technology during the next decade, or more (ΥΠ.ΠΕ.ΕΝ.,2018:47). It is important to note, that in 2015, Greece ranked seventh in the world's lignite producers and third in EU terms, behind Germany and Poland (IEA, 2015). In regard to other technologies which participate in the national energy mix, natural gas has joined the most dominant fuels in the energy regime, during the last decade, occupying a 23% share in the electricity production (figure 16). Its supply peaked in 2011, reaching 4.0Mtoe, falling at 3.5 Mtoe in 2016 (IEA, 2017). Further, its role in the national regime is expected to be consolidated within the following decade (ΥΠ.ΠΕ.ΕΝ., 2018:51). The electricity transition that has been followed had also diminished oil technology share in the electricity production (table 9), participating only in this of the autonomous electrical systems in the insular country nevertheless, it remains the dominant fuel in the energy regime, mainly owing to its dominance in the transport s-t

Table 9. Installed capacity of each technology in the national electricity system (ΥΠ.ΠΕ.ΕΝ., 2018:8)

Technology	Interconnected Power System	Not Interconnected Power System
Lignite technology	3903,9	-
Natural Gas technology	4900,3	-
Fuel Oil technology	-	1808,3
Hydroelectric technology	3170,7	0,3
Renewable technology	5343,8	406,7
Total	17318,7	2269,3

[154] The following article by Naftemporiki is indicative of the new situation https://www.naftemporiki.gr/finance/story/1267299/energeiakoi-kolossoi-stinoun-baseis-stin-ellada

regime (IEA, 2017:22). The country imports the majority of this supply; the only exception pertains to the reserves in South Kavala, which reaching approximately 24 million barrels (ΔΕΣΦΑ, 2016).

As the table above illustrates (table 9), the significance of hydro power is also major. Water potential is used in 16 large hydroelectric technology power plants, with the total capacity of the river's reservoirs reaching 5,8 billion m^3 and an installed capacity of 3,173 MW (Γιαννακόπουλος κ.ά., 2018,:25). All large hydroelectric plants have, until nowadays belonged to the regime's main utility producer, PPC. Further, as part of the renewable transition pathway, there are 108 small hydroelectric technology power plants with an installed capacity of 223 MW (Ibid,:25). In the same pathway, wind has been the dominant technology in the niche market, as it has been already been presented (table 9), with an installed capacity of about 2,3 GW in 2018. In addition, current solar technology electricity production is 2,2 GW, while there are also 0,37 GW of roof pvs (Ibid:25). Finally, in regard to geothermal technology for electricity production, several scholars (Koutroupis, 1992; Andritsos et al, 2015; Τσετσέρης, 2016) argue that there are at least two high enthalpy fields, that of Nisyros, with a potential of installed capacity approaching 50MW, and that of Mylos, with a potential of 120MW. Additionally, the new regulative framework revolves around facilitating expanding the geothermic field up to 90^{o}C, which is used to cover energy needs for heating[155]. Further, over the past years, PPC, together with other regime actors, has drawn up schedules regarding constructing power plants employing geothermal technology in four Aegean islands[156].

In addition, over the past years, the state has been trying to transform the country into a peripheral energy hub[157]. The construction of the Trans Adriatic Pipeline (TAP), a transnational natural gas network transferring Azerbaijani natural gas to Italy, has been enforcing this narrative. Besides, in the 2018 National Energy Plan, policy

[155] See http://worldenergynews.gr/index.php?id=30705 and https://www.newmoney.gr/palmos-oikonomias/energeia/364240-ipen-anoigei-o-dromos-gia-tin-anaptiksi-tis-geothermias-se-30-perioxes-tis-xoras
[156] Regarding this, seehttps://energypress.gr/news/apo-lesvo-kai-methana-xekina-tin-axiopoiisi-ton-geothermikon-pedion-i-dei-ananeosimes
[157] See, for instance, the statements made by foreign and national officials:https://energypress.gr/news/skoyrletis-i-ellada-os-energeiakos-komvos-mporei-na-kalypsei-tis-ayxanomenes-anagkes-tis and http://www.capital.gr/oikonomia/3319224/sefkobits-i-ellada-mporei-na-ginei-energeiakos-kombos-tis-na-europis and https://www.liberal.gr/arthro/226914/oikonomia/2018/taiped-i-ellada-prepei-na-katastei-energeiakos-kombos-fusikou-aeriou-stin-europi.html

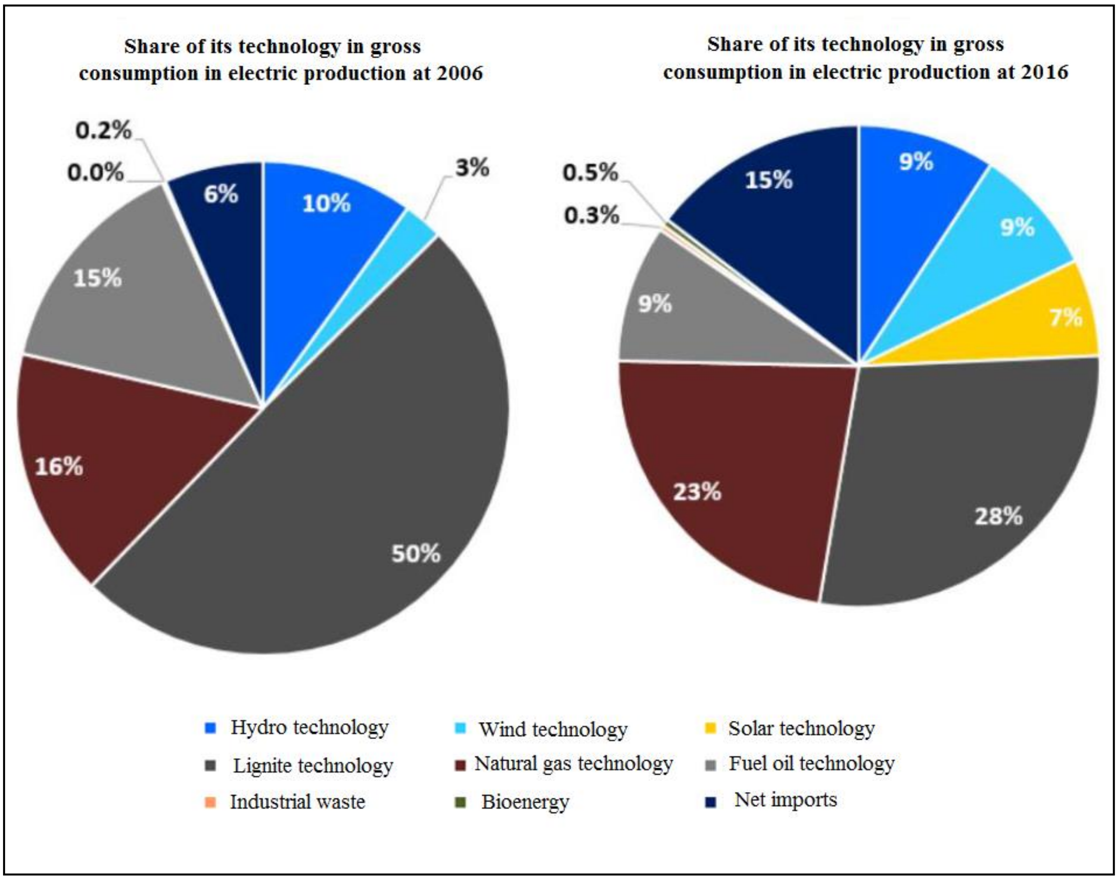

Figure 16. Share of each technology in gross consumption in electric production in 2006 and 2016 (ΥΠ.ΠΕ.ΕΝ., 2018:10).

makers viewed implementing this, as well as other similar energy projects, as critical for the country's geopolitical role (ΥΠ.ΠΕ.ΕΝ., 2018:48). Endeavors made by the energy regime to construct other international connectors[158]and off-shore floating LNG terminals[159] in North Greece, or to extract hydrocarbons, cement this pathway. Subsequently, the nested energy regime of Chios is introduced so that all the actors that participated in it are brought to the fore.

[158] As, for instance, are the attempts to construct Poseidon pipeline, stretching from the Turkish-Greek border to Italy,as well as the attempts for the EuroAsia Interconnector, connecting Israel and Cyprus with Greece and then with the continental Euro. For more information, see www.igi-poseidon.com and https://www.energia.gr/article/97069/h-syndesh-elladas-kyproy-israhl-stohos-ths-ellhnika-kalodia
[159] Regarding this issue, see https://www.ypodomes.com/index.php/all-news/item/50706-i-anaskopisi-tou-2018-ta-megala-erga-pou-allaksan-ton-energeiako-xarti-ti-xronia-pou-perase and www.gastrade.gr

Renewable technologies pathways, local engagement, tensions and obstacles in the nested energy regime

In the early 60s, PPC embarked on electrifying the islands. In Chios, it was only 1963 that such a project began[160]. Until that time, only the capital and a few villages were electrified, partly by private actors or the local authorities[161]. The incumbent actor initiated the transition by constructing the distribution network all over the island, from Chora. Within the 70s, a large number of villages had already been electrified, thus upgrading the power plant was necessary. The initial capacity was relatively small[162], as the use of electricity by the users-consumers was limited, while the need for large users on the island was scant. Besides, electrifying the island was still in progress in 1978. Completing the nested regime's electrification contributed to the diesel technology engines being upgraded initially to 6 MW[163] and later to 17 MW, until the late 80s.

The 80s also marked the first embryonic steps towards a renewable technology pathway, after the state adopted a new regulative framework. A local municipal along with several users-consumers interested in investing in wind technology established a new actor, named Promitheftiki Inc. This actor was a popular basis company, engaging the Municipality of Vrontados and users-consumers either living on or originating from the island. In this context, the actor installed, in 1989, two wind turbines of 150kW each in the central part of the island[164]. These two artifacts are still in operation today (2018), while the actor has scheduled their reconstruction. The next niche technology project in the region of Chios was ventured by PPC. The incumbent actor installed a number of wind parks in the northern part of the island, as well as on the island of Psara, during the early 90s. So, in 1992, the actor installed a wind park of 11 wind turbines of 225 KW each and another one of ten wind turbines and total capacity 1 MW. The third park on the island of Psara has a total capacity 2,025 KW. During the last decade, PPC Renewables, the subsidiary of PPC, operating in the renewables niche market, removed the wind park in Melanios, repowering the rest of the wind turbines in the other areas[165]. Since the mid 90s, the state's attempts for a

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[160] Information taken from an interview to aplotaria.gr by the first local manager of the actor in Chios (source: https://www.aplotaria.gr/dei-tzevelekos-chios/).
[161] Information taken from the same interview: https://www.aplotaria.gr/dei-tzevelekos-chios/
[162] The total capacity of the electricity engines on the island did not exceed 3 MW in 1967 (source: interviews with the actor's representatives)
[163] Information taken from interviews with PPCR's representatives.
[164] Information taken from interviews with the actor's representatives.
[165] Information taken from interviews with PPCR's representatives (see also ppcr.gr).

transition to renewable technologies ended up in an institutional framework (Law 2244/94) facilitating small actors. This context allowed nested regime actors to install a number of small wind technology projects, until the early 2000s, with a total capacity exceeding 1 MW. Promitheftiki, the oft-quoted popular basis actor, and a private actor, Aigaioelectriki Milou Co, participated in this transition by installing a wind park of a total capacity reaching 880 KW[166]. These actors repowered five of the seven wind turbines of the park over the past years.

In the mid 2000s, the state veered towards the feed in tariffs scheme in solar technology for electricity production, which contributed in a few pvs farms being installed in the nested regime by small local actors a few years later. Thus, during 2010-2011, approximately 3 MW of this niche technology was installed[167]. Further, these small actors joined the Producers of Energy for Photovoltaics Association, an actor supporting, promoting and protecting the interests related to the niche technology[168], while many of them have assumed an active role concerning association's issues in the East Aegean[169]. A different transition pathway followed by nested regime's actors refers the attempts to utilize geothermal technology for electricity production. In Chios, there are low-enthalpy geothermic fields in areas situated in the northern and the south-eastern region. A survey conducted by IGME during the mid 2000s decided on two of these fields[170]being characterized as interesting for utilizing them (ΙΓΜΕ, 2007). Normally, low-enthalpy fields are not considered appropriate for extensive electricity production, however new geothermal technologies have allowed for a limited use of these fields for electricity. In this context, within the early 2010s, the state launched an international competition for this geothermic field, which ultimately was won by Aigaioelectriki Milou Co[171]. The actor showed interest in making the transition using, among others, geothermic technology for producing electricity approaching 1MW. However, owing to the bureaucratic Greek institutional framework, the transition process remains stuck until nowadays.

[166] Information taken from interviews with an Aigaioelectriki's representative.
[167] Information taken from HEDNO (see https://www.deddie.gr/el/stoixeia-ekkathariseon-kai-minaion-deltion-mdn/2012 and https://www.deddie.gr/Images/APE%20PLIR.%20DELTIO%20JANUARY%20-%2026042010.pdf)
[168] Information taken from the actor's official site (spef.gr).
[169] Information taken from an interview with a local actor, association's representative in the East Aegean.
[170] They are placed in the area of Nenita and Thimiana in South eastern Chios (ΙΓΜΕ, 2007).
[171] Information taken from the interview with the actor.

Simultaneously, since the early 80s and during the following decades, electricity production and consumption has increased enormously. The raise of the electricity consumption has probably been driven by the change of individual users-consumers' practices and life styles, but also by nested actors emerging, as did, for instance, the Public Corporation of Water Supply and Sewage (PCWSS), which is the larger user-consumer[172] on the island, as well as other actors operating in the service sector[173]. Despite the limited tourist activity, tourist development has significantly instigated electricity demand[174]. Commercial usage of electricity ranks second after household use in the nested regime (figure 17). Commercial usage is associated, to a great extend, with tourism, as it contains accommodation, transportation and other related to tourism services. In general, the annual consumption mounted from 91,5 GWh in 1992 to 140.9 GWh eight years later, while in 2010 it has risen further, reaching 208.1 GWh (figure 17). This change in electricity production and consumption was not followed by a nested transition to renewable technologies, thus it required the incumbent actor to upgrade the diesel technology power plant to 31 MW in the 90s and to 70 MW in the 2000s[175]. Failing to follow a transition pathway to renewable technologies in the nested regime was attributed to lack of reliable electricity storage

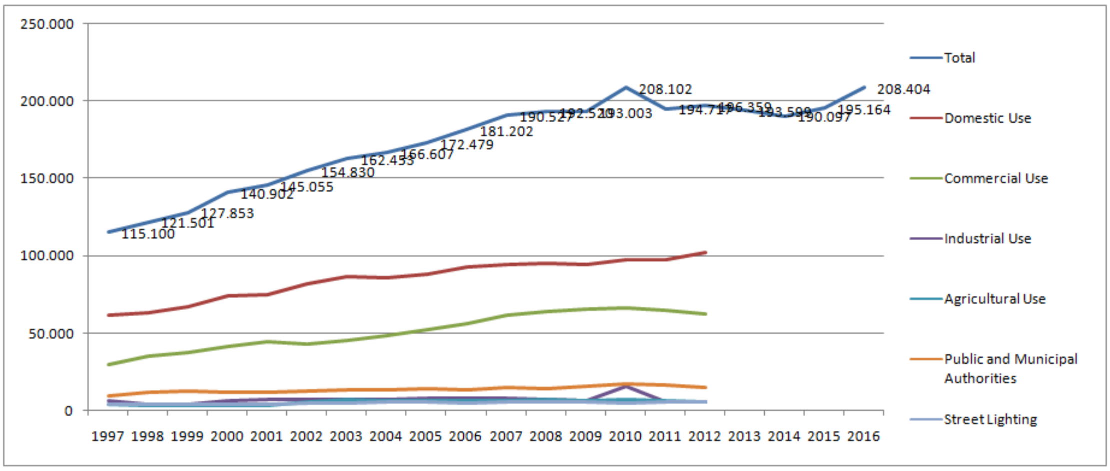

Figure 17. Total and based on the use power consumption and production in Chios for a two-decade period (Author data reconstruction from statistics.gr[176])

[172] The actor was established during the mid 1980s (source: interview with the representative of the actor).
[173] According to reconstructed data from statistics.gr.
[174] Tourism holds the lion's share of the overall commercial activity on the island. Transportation, accommodation and a series of other services are also related to tourism.
[175] Information taken from the interview with the actor's representatives.
[176] Data of the Hellenic Statistical Authority concerning electric energy consumption by great geographic area, region and department and by category of use, from 1997 to 2016.

technologies –vital for an autonomous electrical system[177]–, the sizeable investment cost at that time, the inertia on the incumbent actor's behalf[178] as well as to the local governments' inability to plan, promote and develop such an s-t transition pathway. Under these circumstances, the renewable technologies installed capacity has, since the early 2010s, remained almost steady until nowadays, stretching to 9,08 MW for wind power projects and to 5,17 MW for photovoltaic projects[179](ΔΕΔΔΗΕ, 2018).

In regard to large-scale renewable technologies investments on the island, the state's aspiration to reach the energy targets in an easy and rapid way supporting a transition to renewables contributed, as it has already been mentioned, to a friendly to large incumbent actors institutional framework being formed from the mid 2000s onwards. Hence, during this period many wind incumbent actors applied for large-scale wind technology transition in the insular areas. The excellent wind potential that the Greek islands display seemed attractive for such projects. These attempts for large-scale wind transitions in many cases sparked off conflicts with the local communities[180]. That being the case, in 2006, a wind incumbent actor, ROKAS Inc., being one of the biggest actors in the niche market, applied for installing 44 wind farms of total capacity exceeding 1,600MW on three islands of the North-East Aegean. According to the initial propositions, wind farms of total installed capacity overstepping 370MW were scheduled to be built in Chios.[181].

The acquisition of wind actor by a multinational energy actor, Iberdrola Renewables, delayed the whole process of the project. In 2010, the new company, Iberdrola-Rokas Inc., revised the project suggesting constructing a smaller one of approximately half the installed capacity, namely 706MW (Rokas Renewables, 2012). In accordance with this plan, 75 wind turbines of 2,0 MW each were supposed to be installed in Chios. Following that, an Environmental Impact Assessment was composed providing local public actors with information. The regulative framework (Law 4014/11) allowed

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[177] The electricity network distributor in an autonomous electrical system permits an upper limit of renewable technologies penetrating in the system. To catch this limit, a transition requires the using storage technology so that this pathway is followed further.

[178] According to the results derivng from interviews with local actors, there was a unwillness and an inertia on behalf of the incumbent actor to facilitate transition processes.

[179] Information taken from the official site of HEDNO https://www.deddie.gr/ This is almost the maximum installed capacity for renewable technologies permitted (only a few roof-pvs and small wind turbines installations were permitted by HEDNO at that time) on the island due to it being an autonomous electrical system (only the use of hybrid systems which contain renewables, together with storage technologies, or the use of an interconnection with the continental grid could authorize increasing the installed capacity) (source: interviews with the actor).

[180] Except for the North-East Aegean case, Crete, Skyros are other examples where tensions ensued.

[181] Source: https://olsy-gr.blogspot.gr/2011/03/blog-post.html

only a superficial deliberation with local community and NGOs, downgrading decisions made by the municipality to advisory ones. Further, the state's energy policy to acknowledge transitions to renewable technologies as "national priority" promoted this kind of projects; only the peripheral government retains a more commanding role[182]. Thus, this local actor had either to approve or refuse the transition pathway based on the company's Environmental Impact Assessment (EIA). Besides, it's RAE and the ministry responsible which make the final call. Although the local government's opinion on the project was rather positive, as early as 2011, oppositions and concerns were raised by a number of users-consumers, which went on to intensify during next years. The group consisted of academics, environmentalists, ecologists, some well-known Chiots as well as other civilians. The movement, albeit inhomogeneous in general, supported a renewable technology transition on the island. Regarding the particular project, however, these users complained for partial and improper consultation, its large scale, the insufficient compensatory measures and the negative consequences to vulnerable bird species and to Natura 2000 areas[183]. Subsequently, they demanded the project be rejected based on the particular EIA and deliberated for a sustainable transition. These actors initially tried to inform NGOs and locals through articles and the social media. In 2012, they organized a public discourse, where they presented to the local society their concerns about the project. Similar discourses came about by locals on the other two islands that had been nominated to participate in the project, Lesvos and Limnos. In the Chian case, the discourse took place in the full glare of publicity, while many local actors and users-consumers attended and, to a degree, were influenced by it[184]. Further, the group went on to run a petition against the project and inform civilians. In a sense, these efforts paid off, since many local actors, associations and professional groups, as well as users-consumers, signed against the transition project. Hence, more than twelve local actors in Chios, many of which had large influence on the island –as for instance the Chamber of Commerce– signed against it (Παυλής, 2012). Further, two Greek NGOs, the Elliniki Etairia (ELLET) – Society for the Environment and Cultural Heritage, and the Hellenic Ornithological Society submitted their own petitions (Ibid). The number

[182] Although, according to the regulative framework, the peripheral government's role is secondary, practically, there has not been any case in which, despite this actor refusing to adopt a transition project, the state or RAE decided to license the process.
[183] See Παυλής (2015 study) about this.
[184] It is worth noting that the discourse was also attended by a company's member, who, at the end of the discourse, took the floor, failing however to address several questions raised by the movement.

of institutional actors in the three islands extended thirty. Additionally, the region's academic community drew up academic reports regarding the project's sustainability (Ibid). Therefore, this actor, expressing its opinion regarding the EIA, took a negative stance. In particular, all local actors, such as scientific and institutional ones, but also collegialities were against this transition. The only exception came from the three local governments' services and the Municipality of Chios, which held a rather positive perception, as well as the CRES, which had a clear positive view as a governmental actor (Ibid). To clarify how significant the group's participation was for the process, it is underlined that, despite the Municipality having initially a very clear and positive stance on the project it ended up deciding finally not to vote in favor or against it, asserting that its opinion had an optional character (Παυλής, 2012).Further, the protesters managed to fundraise in case the conflict had to be resolved before a court[185].

As far as the movement is concerned, from the outset, its members advocated for a distinct narrative of a smaller, rather local-scale transition. In this manner, this actor proposed installing pvs on the roofs of buildings and small wind turbines, using the small geothermic field for electricity and heating/cooling and developing of storage techniques. They also argued against the need for a grid connection with continental Greece, as the company's project required. Although such a narrative was supported by the majority of the group, it was also constructed and promoted firmly by members possessing relevant academic expertise, while in some cases it was accompanied by proposals for other projects (in other fields), within the bounds of sustainable development[186]. The narrative was advocated in the public discourse, in articles in newspapers and local sites. However, it needs to be acknowledged that the movement's plan was just an outline, meaning that it included neither calculations concerning each technology's number and capacity nor cost estimates.

Moreover, in the Chian case, the 2015 regional and municipal elections, resulted in another mayor and political party coming to power. The new municipal actor looks to have a different view on sustainable transitions, as well as on cultural heritage and environmental issues. In this context, this actor participated in EU projects, together with CRES, running a pilot project for a zero-emissions energy building. The building adopted energy-saving techniques, installing it better framings and using led lamps,

[185] Information taken from interviews with the movement members.
[186] Information taken from statements from public discourses and interviews with the actor's members.

while managing to cover its electricity needs through roof solar technology panels. Additionally, the lamps on the municipal's road network were replaced by led-technology ones. The actor has been also carrying out a number of energy-saving projects in many municipal buildings by replacing the building framings and switching to led-technology lamps. Further, it re-established its membership to the Dafni network of Sustainable Greek islands[187], a non-profit peripheral actor whose members are insular regions and municipalities, trying to promote sustainable development on Aegean and Ionian islands with respect to natural and cultural environment[188]. In this framework, it could be argued that, during this period, the Municipality of Chios was transformed to a user-legitimator (Schot et al, 2016).

Afterwards, I will present the island's nested transportation and tourism regime. I have already highlighted that this research thesis aims primarily at steering a deep energy transition that would include tourism so that the latter can follow more sustainable pathways. I argue that nested transportation transition to electricity is vital for this purpose. Thus, I will demonstrate the large consumption volume of energy related to transportation, in comparison to the overall energy consumption, thus the need for the transportation's nested regime to follow the electricity transition. Concerning this, I argue that the local regime's energy needs nowadays amount to about 20,097 metric tones of oil[189]. Capacity of that scale is equivalent to annual electricity needs of 233,728[190] MWh, requiring about 27 MW of installed capacity. As the maximum annual peak of energy demand for electricity during the last decade has been about 52 MW (ΔΕΔΔΗΕ, 2012), the transportation energy share in the local energy need is considered large. In addition, electric cars technology has matured over the past decade, thus a transition pathway to this direction has already been scheduled on an international[191] and a national[192] level, for the following decades. Based on these, proceeding with a deep energy transition including tourism and following sustainable pathways also calls for changes in the nested mobility sector towards a more sustainable context, in the sense that it needs to be integrated in the local electricity

[187] In the mid 2000s, the network had established a membership with the municipality of Kardamila, which was one of the island's municipalities before the new , one-municipal, framework was adopted in the mid 2010s.
[188] Information taken from the actor's official site.
[189] See Hellenic Statistics, 2017, https://www.statistics.gr/en/statistics/-/publication/SDE15/-
[190] I used the https://www.iea.org/statistics/resources/unitconverter/ to convert TOE to MWh.
[191] See, for instance,Παπαθανασίου, Σχινά, 2019, and Graabak et al, 2016.
[192] See, for instance, the statements and the plans of the state through the National Energy Plan (2018:67, 74).

transition. Therefore, later, I will present the main local actors participating in the nested transportation regime.

A sustainable energy transition regarding the island's transportation

Cars are the main transportation technology on the island, which predominantly run on diesel or unleaded petrol. The majority of these are private ones, however business actors having a more central role in the nested regime do also exist. Public transportation includes buses and taxis. The following pages illustrate the nested regime's main actors, namely the city bus company, the taxis association and the rental car private companies. “City buses” in Chios is a private multi-share company. The actor’s fleet exhibits 19 buses, four of which are mini-buses[193]. Buses companies in Chios were established back in the 1930s. In those days, there were three different businesses on the island, serving different villages needs. During the 50s, these companies established a joint venture with a 20-bus fleet. The size of the fleet has remained more or less stable over time. Nonetheless, the fleet has been modernized, although at a relatively slow pace, resulting in the contemporary fleet's average age reaching approximately twenty years. The high average age can be mainly put down to the regulatory framework, allowing buses to operate until their 27th year as well as to the fact that such businesses financially struggle to keep the average age at a lower level. In the case of the particular actor, the youngest buses are between 12 and 15 years old.

Taxis are also part of Chios' public transportation network. In 2018, there were 112 taxis on the island, running on diesel technology[194]. Their number has, more or less, remained unvarying over the past decades. Taxis in Chios were established back in the late 40s. At those days, only two taxis existed, while their number remained limited until the late 60s. The Junta regime issued many licenses resulting in them booming to more than 70. The fleet's average age nowadays is about 16 years old. Finally, rental car companies is also a large actor of the nested regime, while also being the one affecting tourism’s sustainability and tourists’ transport practices, as tourist mobility out of the city is considered rather impossible by public transport. Based on this, nowadays, slightly more than twenty enterprises engage in the rental

[193] Information taken from the interview with an actor’s representative.
[194] Information taken from the interview with an actor’s representative.

cars sector, while their fleet boasts more than 900 cars[195]. The motor-bike fleet is of equivalent capacity. Rental cars businesses started operating in Chios back in the mid 60s. Initially, there were only two companies, while their number did not exceed forty. Its number started picking up from the end of the 80s onwards. Over the past decade its fleet has remained almost steady[196]. The fleet is mainly of small engine capacity, while they are fueled chiefly by petrol and sometimes by diesel technology. The fleet's average age used to be less than seven years old, however, the economic crisis but mainly changes in the regulatory framework had a notable impact on this characteristic. Thus, as the legislation was altered three years ago so that the accepted maximum age level rose from 7-9 years to twelve years, a gradual rise of the fleet's average age ensued, which is bound to continue in the years to come. Following, the nested tourism regime of Chios will be portrayed, so that it participates in the deep energy transition. This is vital so that it will be assessed the related infrastructures and nested regime's dynamic in regard to tourist flows. Further, this section would also like to illustrate once again how the relatively low tourist regime development favors a sustainable energy transition including tourism.

The nested tourism regime in Chios: Actors, infrastructures and tourist arrivals

The nested tourist regime in Chios was in an embryonic condition during the 70s. In the period of Junta, the island's public airport was constructed in Chios, at Chora. Tourism activity, though, was very poor due to the limited island's facilities and infrastructures. Thus, in the late 70s, there were about 700 hotel beds[197] on the island (ΕΛΛ.ΣΤΑΤ, 1983:23). During the 80s, the country's deindustrialization contributed to the central political scene establishing the national tourist regime as the country's heavy industry (Komilis, 1987; Leontidou, 1991; Papadopoulos, 1989: 297-300). Back in the days, tourism was used as the basic tool for regional development, mainly in islands with agricultural populations. In the case of Chios, as Chians made a high income–basically because of their employment into the Merchant Navy sector–, local requirements for intensive tourism development have been set aside. Besides, nested

[195] Information taken from the interview with an actor's representative.
[196] Information taken from the interview with an actor's representative.
[197] Among hotel infrastructures no A-class facilities were included (Hell. Stat, 1983).

tourist regime's development was limited, more or less, in the other neighboring North-East Aegean islands too during the 80s[198] .

Under these conditions, arrivals reached 23,034 in 1980, while they were stabilized to more than 20,000 during the 80s (ΕΛΛ.ΣΤΑΤ, 1983,1987,1990,1993). Overnights would fluctuate from close to 80,000 up to 100,000 per annum over the same period (Ibid). The nested regime's slow pace continued during the 90s too. This was driven also by the local actors' trends to follow a mild tourism development. According to a late 90s GNTO report[199], in Chios case, there was a consensus among tourist regime actors on the need for cultivating a viable tourist development (EOT, 2002). More particularly, it was also defined as a tourist development that would not act competitively to other productive activities, while it would also support the area's cultural characteristics –and, more specifically, what is called the "Chian way of life"–as well as finally promote growth that would adapt to the specific characteristics that each island's region displayed (Ibid:63).

Therefore, this nested regime's view contributed to the relatively slow rise concerning accommodation beds in Chios during the 80s and the 90s. These infrastructures increased from 1,033 in 1980 to 3,015 ten years later, in 1990 (ΕΛΛ.ΣΤΑΤ, 1983,1987,1990, 1993). The sudden development in hotel beds was a result of the rise in rented rooms, ending up in the latter superseding the number of hotel beds, within a decade (Ibid). Their number continued to expand at a low rate in comparison

Table 10. Hotel capacity in 2016 in Lesvos, Samos and Chios (ΣΕΤΕ,2017)

ΠΕΡΙΦΕΡΕΙΑ ΒΟΡΕΙΟΥ ΑΙΓΑΙΟΥ / NORTH AEGEAN REGION Ξενοδοχειακό δυναμικό 2016 / Hotel capacity 2016 Regional Area			5*	4*	3*	2*	1*	Total
Lesvos	Μονάδες	Units	0	11	43	45	9	**108**
	Δωμάτια	Rooms	0	501	1.792	1.038	145	**3.476**
	Κλίνες	Guest beds	0	976	3.365	2.016	280	**6.637**
Samos	Μονάδες	Units	2	5	35	98	17	**157**
	Δωμάτια	Rooms	402	332	1.594	2.438	225	**4.991**
	Κλίνες	Guest beds	845	609	3.022	4.575	433	**9.484**
Chios	Μονάδες	Units	2	15	32	10	6	**65**
	Δωμάτια	Rooms	76	697	528	292	86	**1.679**
	Κλίνες	Guest beds	119	1.197	970	512	150	**2.948**
Πηγή: *Ξενοδοχειακό Επιμελητήριο Ελλάδας/* ***Source:*** *Hellenic Chamber of Hotels*								

[198] Conditions were, however, marginally better in the case of Samos in the mid 80s (source ΕΛΛ.ΣΤΑΤ, 1987).
[199] See phase B of the "Tourist Development in the Region of North Aegean" study, which was edited by the GNTO,2002.

with the other islands of the region. Thus, in 2016, the hotel capacity in the nested regime was less than half of that regarding Lesvos, and only the one third of that regarding Samos (table 10). In general, there are 65 hotels, 1,679 rooms and 2,948 guest beds in the nested regime. The largest nested regime actors are Fegoudakis Group, boasting six hotels on the island, and the Chandris Hotel chain, having one hotel in Chora of Chios. Hence, one can observe a diffusion of that capacity to many small actors. Further, among them there are a few actors having a more local, and probably environmentally, oriented perception for tourism, by developing alternative tourist activities.

Contrary to major local tourist regimes such as those of Rhodes, Crete or Santorini, but also to the neighboring islands, Samos[200] and Lesvos[201], Chios tourist regime was based mainly on internal tourism. National arrivals, in relation to the foreign ones, continued escalating until the end of 2000s (ΣΕΤΕ, 2017). As the 2000s began, tourists and excursionists from the nearby Turkish coastline turned into a landmark for the tourist actors, presenting new opportunities to local tourism and having a significant impact on local political plans. The new condition brought about structural changes to the nested tourist regime's characteristics. The number of excursionists from the Turkish coasts who visited the island has soared rapidly over the years. The flows boomed, from approximately 33,000 in 2004, to more than 56,000 in 2010,

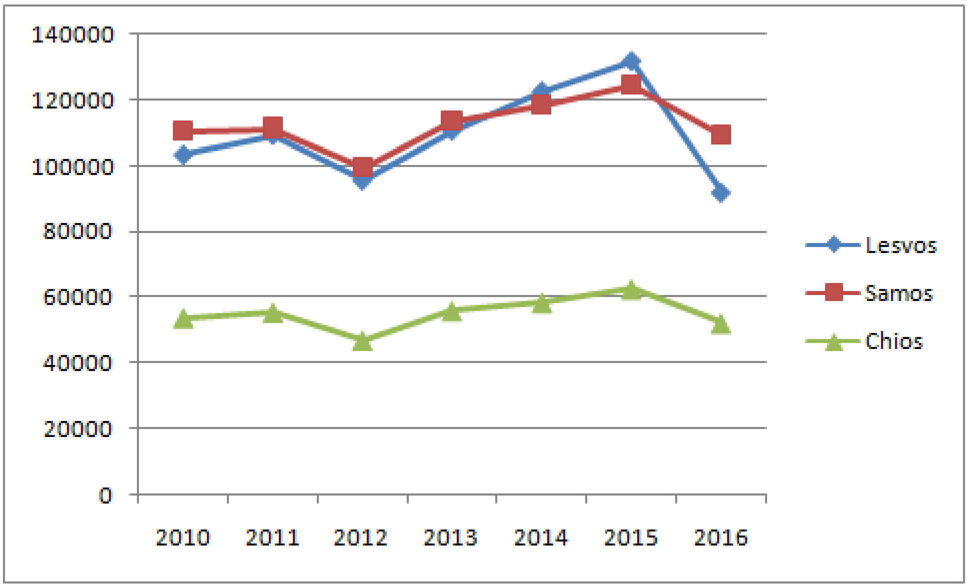

Figure 18. Tourist arrivals in Lesvos, Samos and Chios between 2010-2016 (Author data reconstruction from ΣΕΤΕ, 2017)

200 Even from the mid 80s onwards.
201 Since the mid90s.

while, in 2017, they spiraled to 130,000[202]. Even so, most of these visits regard daily trips. Likewise, European tourist flows that used to visit Chios by charter flights has gradually declined from the late 00s onwards. Consequently, from 21,000 arrivals in 2007, they ended up barely reaching 10,000 four years later, settling for just 2.234 in 2016.

Tourist regime's arrivals over the past years have been fluctuating close to 55,000 (figure 18), still considerably lower than those of the neighboring islands, which exceed in average 100,000 during this period. In 2016, tourist arrivals were 52,036 (ΣΕΤΕ, 2017). These features of Chian tourist regime make it difficult to evaluate its interrelation and path-dependences with electricity production in figures. For this reason, I will later present other massive tourism oriented insular areas reflecting this interdependence.

Tourism as a large energy consumer

The main objective of this section is to illustrate interrelation and path dependence of the tourism regime with the electricity sector, mostly in tourist insular areas, by employing quantitative data. As it has been mentioned elsewhere, this is an extra factor reinforcing the decision of choosing Chios as a sustainable transition paradigm: Chios tourism regime is immature and limited, as it has been thoroughly explained in the previous section. Mass tourism development is a core factor which accounts for large fluctuations of electricity throughout the year. More specifically, in insular areas, where their population multiplies during summer to an exponential degree, a large tourist regime is the reason for the unsustainable electricity networks.

To stress this notion more clearly, below I present aspects pertaining to the electricity needs of Rhodes, one of the major Greek tourist destinations. The Rhodian tourist regime has been regarded as a well-established sector, even since the 1950s, also paving the way for many changes to the national regime and securing its spot between the two most popular Greek tourists destinations. Rhodian case is not an ordinary tale of Greek island tourism. Tourist flows on the island were always among the biggest in the national tourist regime. Thus, even since the early 50s, approximately 42,000 people would arrive on the island every year accounting for one fourth of national

[202] Data taken from the North Aegean Region – Tourism Office.

visitors (Λογοθέτης, 1961). Tourist arrivals were raised during the next decades, but, from the 80s onwards, their number skyrocketed. Thus, they soared from approximately 778,000 in 1987 to 1,033,026 a decade later, and went on to reach 1,393,405 in 2007, while approaching the two million mark during mid 2010s. This tremendous increase of Rhodian tourism applied immense pressure to the island's nested electricity s-t system, in an attempt to determine its electricity needs. The table below presents the electricity consumption regarding different usages on the island. It is clear that the commercial sector has been holding the reins in electricity consumption even since the 1980's, while it has been continuously rising. Further, although at a first glance once can notice an increase in different uses of electricity, a second glance can reveal that the consumption percentage for commercial use has risen. More specifically, in determining the annual percentage for each use in relation to the total annual electricity consumption, one can observe that there has been a steady increase, particularly regarding the commercial demand's share in relation to the total annual electricity needs of the island. This rise in percentage the commercial

Table 11. Electricity consumption concerning Rhodes as a total and per usage, from 1980 to 2018 (author data reconstruction from statistics.gr and Λογοθέτης, 1989 and 1990).

Dodecanese	Σύνολο	Domestic Use	Commercial use (1)	Industrial use	Agricultural use	Public and Municipal Authorities	Street Lighting	Annual % change of domestic electricity consumption in relation to the total	Annual % change of commersial electricity consumption in	Annual % change of industrial electricity consumption in relation to the total	Annual % change of agricultural electricity consumption in relation to the total	Annual % change of public and municipal	Annual % change of street lighting
1980	169.770	66.184	74.668	14.694	1.846	9.407	2.971	38,98%	43,98%	8,66%	1,09%	5,54%	1,75%
1983	211.022	83.634	87.396	19.547	2.826	11.493	5.126	39,63%	41,42%	9,26%	1,34%	5,45%	2,43%
1985	250.148	96.694	108.651	19.652	3.068	14.937	7.156	38,65%	43,43%	7,86%	1,23%	5,97%	2,86%
1993	489.309	169.585	239.873	25.282	8.981	33.019	12.569	34,66%	49,02%	5,17%	1,84%	6,75%	2,57%
1998	666.345	206.867	348.641	30.322	9.189	51.996	19.330	31,05%	52,32%	4,55%	1,38%	7,80%	2,90%
2003	888.481	286.909	486.619	25.202	9.902	56.115	23.734	32,29%	54,77%	2,84%	1,11%	6,32%	2,67%
2008	1.055.617	325.683	610.574	24.272	8.137	59.702	27.248	30,85%	57,84%	2,30%	0,77%	5,66%	2,58%
2012	1.099.786	340.893	640.080	21.726	8.198	61.059	27.830	31,00%	58,20%	1,98%	0,75%	5,55%	2,53%
(1) It includes and the consumption of hotels													

use could be only justified by the increase in the tourist activity. Tourism is classified in electricity's commercial use, which contains both electricity consumption regarding hotels as well as other tourism-related business activities. Therefore, 2012's electricity consumption pertaining to this sector is almost double the consumption for domestic use, although in 1980 they were almost balanced.

Based on that, I argue for the tourist regime's energy consuming and unsustainable character, which should be attributed not only to transportation but also to its electricity needs mainly in relation to insular touristic areas. Further, I will underline that, in order to render tourist industry more sustainable, it is vital, among others, that the nested tourist regime engages into a deep energy transition. Moreover, islands receiving low tourism flows –like Chios– could steer a deep energy transition while having more choices at their disposal in regard to the technological pathway they could follow. Such transition could act as a window of opportunity for a future tourist development towards more sustainable pathways.

Configuring the nested regime actors power and agency

So, far, the previous sections have covered the national and the nested electricity regime in the case of Chios. This section aims at evaluating each actor's dynamic and role in participating in the nested s-t regime. Subsequently, the power and role of incumbent regime actors but also local ones will be delineated. To facilitate this process, a table (table 12) following the analysis will be used. As it has already been argued in the previous chapter, evaluating the actors' role and power relies on primary and secondary data[203]. This kind of analysis is vital so that we could form an overall and coherent view of the nested energy s-t regime's incumbent actors, its contemporary power and agency, as well as its expected role in the nested energy transition that will be steered in the fifth chapter. Additionally, this table shows, the anticipated size of the actors' role in case a local transition takes place. Such view would be essential in facilitating the reader to conceive the current status but also to understand probable decisions made by the steering actor so as to engage or encourage particular actors to participate in the different scenarios. The following subsection showcases the aforementioned table presenting the nested regime's local actors and the incumbent ones already participating, as well as others that are considered likely to be engaged in a potential future energy transition.

Local s-t regime’s actors' power, size of role and agency

In this section, the nested regime's various actors are presented in the table below, which aims at providing the figures regarding the actor’s role and power in the local framework, as well as their agency in case of an s-t energy transition. Further, the table evaluates the incumbent actors' current power in regard to the national electricity regime. To have an holistic view like this, it is essential that one analyze and evaluate the steering actor's decisions and agendas during the different transition process scenarios. In this context, power columns are referred either to the actors’ governance

[203] The table follows Arapostathis et al's (2013) framework, referring to the nested actors' role and power,the evaluation of which relies on primary and secondary data. Parameters are determined on rather qualitative data and figures. More specifically, evaluating each actor's power and size is based on the theoretical model already developed in the second chapter of this research thesis, as well as in semi-structured interviews and reviews of the related literature. Interviews assisted me to evaluate actors’ visions and resource capacity and assess their perception on others’ importance.

of the nested regime's transition, or to their governance within the incumbent one. In addition, the column regarding the role's current size is related to the actors' role in governance in the nested regime. Finally, the column referring to the role's expected size partially signifies agency, thus an actor's capability to activate and engage others during the transition. Evaluating these elements relies on the s-t analysis already presented in relation to the electricity regime's development, as well as on concepts like adaptive capacity and articulation of selection pressures (Smith et al, 2005), already presented in the second chapter as part of the hybrid approach. Power relations are also evaluated through semi-structured interviews; by this, the way actors perceive others' importance is assessed.

In regard to the national regime, the table presents the incumbent actors already participated in the nested one, as well as those whose power or engagement would be useful in terms of completing the transition process. Detailed presentation regarding all national incumbent institutional players, but also private and public companies, as well as local actors is considered of low value for the analysis and the steering process. Besides, focusing on local engagement will affect the artifacts and the regulative framework promoted rendering the transition process to several of these players indifferent. On the other hand, incumbent actors viewed as essential for local engagement or for particular scenarios are included in the table, even though some of them are not yet active in the local regime. These actors are mainly institutional ones.

Based on these, PPC[204] is considered a powerful actor in the nested regime (table 12). Several decisions made by this actor in a national level, owing to the extreme pressures this actor is being subjected to, like its turn to public transportation-related services [205] and its purpose to enter the natural gas market[206], are aspects showing the actor's adaptive capacity. Further, the actor aims at participating in new 2 GW renewable projects by 2030. Additionally, its decision, in the end of 2018, to absorb its subsidiary company, PPCR, and plan major investments in the renewable niche market also moves in the same direction[207]. Moreover, the fact that the state concurs

[204] In this actor, I chose to include both the company's management and its workers' union.
[205] See https://www.athenstransport.com/2018/04/ilektrika-leoforeia-dei/
[206] See https://energypress.gr/news/sto-aerio-i-megali-mpizna-tis-dei-gia-na-anaplirosei-tis-ypohreotikes-apoleies-sto-reyma
[207] See for instance the following article in the energy site worldenergynews.gr http://worldenergynews.gr/index.php?id=28276. In the light of the development of the absorption of PPCR by PPC, in the mid of April of 2019, it seems that the process has frozen due to the requirements of the banks lending PPC, as they evaluate PPCR an important asset, so that they continue lending the mother company (for more

with its visions is a factor showing its articulation of selection pressures[208]. The government's role is also pivotal in the incumbent regime, as it sets up the regulatory framework and promotes or diminishes certain tasks or regulations. Additionally, the Ministry of Environment and Energy is the central actor deciding on the national long-term energy planning for the country; thus, this actor is deemed powerful in regard to power relations. Finally, this actor's co-ordination with PPC, promoting a different alternative than that of the European narrative regarding the future of lignite and RES targets[209], as well as these actors' interdependency in articulating landscape pressures, shows their agency, which is regarded as high. The Parliament participates in the energy regime mainly through its Production and Commerce Committee[210]. This is a standing committee interested in establishing new rules and regulations; in this manner, the actor's role is mainly a regulative one. However, this actor has to comply with the majority power, namely with the governmental party's or alliance's will[211]. Based on this, its role and power is considered as medium.

CRES is also an important actor in the country's energy regime. Administratively, and in a way financially, speaking, it falls within the remit of the Ministry of Energy. On the other hand, CRES is the ministry's official energy consultant, while it possesses technological knowledge in RES projects and experience in European energy programmes due to participating in many of them[212]. These characteristics, as well as the reliability it has displayed since it was established, have led to CRES being assessed as a trustworthy partner for businesses and regional governments. In respect to this, its role and power are considered medium. The Regulatory Authority of Energy (RAE) is another core actor in the incumbent s-t regime. The actor has been regarded as powerful, at least since the early 2010s, when the regulatory framework was altered in its favor according to the EU directives. RAE is financially and administratively independent. Further, it is responsible for monitoring the energy market and issuing RES licenses, while it very actively participates in shaping the

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information about the new conditions see https://energypress.gr/news/oi-trapezes-mplokaroyn-tin-aporrofisi-tis-dei-ananeosimes-apo-ti-mitriki-kinitopoiiseis). In the case that PPC remains a separate actor, it is expected to have a very important role in the transition process and it will be among the initial national actors that will be invited to participate in it.

[208] See http://www.wwf.gr/news/2176-lefta-yparxoun-gia-ton-ligniti-me-ta-lefta-ton-ellinon-politon

[209] See, for instance, the statement made by the actor's vice president in https://energypress.gr/news/panagiotakis-epilegei-coal-exit-ston-ethniko-shediasmo-tote-den-ehei-noima-i-apoependysi

[210] https://www.hellenicparliament.gr/Koinovouleftikes-Epitropes/Katigories

[211] https://www.hellenicparliament.gr/Koinovouleftikes-Epitropes/CommiteeDetailView?CommitteeId=fd28d780-fc9a-44f8-af41-06a4503111ea&period=14816703-4628-4f22-8678-a96c009f2be6

[212] See www.cres.gr

Table 12. Nested regime actors' power and agency.

Regime Actor	Purpose-Role	Year of Establishment	Current size of role within the nested regime	Expected size of role during a transition in the nested regime	Power within the nested regime	Power within the incumbent regime
Public Power Corporation (PPC)	The country's public power corporation.	1950	Very Important	Very Important to Central	Powerful	Powerful
Government – Ministry of Environment and Energy	Executive and legislative role		Central	Central	Powerful	Powerful
The Parliament – Production and Commerce Committee	Legislative role		Medium	Medium	Medium	Medium
Center of Renewable Energy Sources (CRES)	An institution related to promoting and developing renewable technologies, the rational use of energy and energy savings. The actor was nominated as the national coordinator in the above fields.	1987	Medium – It is an actor influenced and controlled by the government. Thus, its role alters depending on the particular government in office.	Medium to Large	Medium – It possesses the technological expertise on wind and pvs technologies	Medium
Regulatory Authority for Energy (RAE)	An independent administrative authority which aims at monitoring the energy market, regarding all energy sources.	1999	Central	Central – It sets the framework regarding the transition to RES	Powerful	Powerful - Constantly increasing
Hellenic Electricity Distribution Network Operator S.A. (HEDNO S.A.)	The actor is in charge of operating, maintaining and developing the distribution network.	2011	Important	Very Important - It will install and organize the smart grid - it will participate in the DSM.	Large – Interconnections with the continental grid diminish its power in the islands	
Independent Power Transmission Operator (IPTO)	The actor is in charge of operating, maintaining and developing the transition network.	2011 - Since 2000, these jurisdictions have been passed on to HTSO..	Medium - But not in the non-connected electricity systems	Medium - In case of interconnection, it will increase to large	Large – Increasing in case of interconnection with the grid	Large to very large as a result of several islands interconnecting with the grid – Participation in its capital share by international actors
Operator of Electricity Market (OEM)	Its role will be significant in a natural gas transition to renewables through TGC and Gas Emmission Market (Scenario 2 & 3), as well as, in the case of DEPA, in participating in the local regime.	2011 - Since 2000, these jurisdictions have been passed on to HTSO..	Low	Important	Medium to Large	Medium
DEPA	It will engage in a nested transition if it decides to build a LNG bunker infrastructure on Chios or on another neighboring island (like Lesvos or Samos).	1988	Low	Important to very important depending on the scenario	Large to Very Large depending on the scenario	Large
Hellenic Wind Energy Association (ELLETAEN)	It aims at promoting scientific research, technology and wind energy applications, while trying, at the same time, to effectively express the industry's and market' well-meant interests, by acting as a think-tank and a dialogue forum with scientific documentation and competence.	1990	Low	Low	Medium to Small in the nested regime	Large
Iberdrola-Rokas Inc	A private company operating in the renewable energy production field.	Affiliated company of Iberdrola since 2004	Low	Low	Medium	Large - One of the biggest companies in the RES in Greece with a 261,47 MW installed capacity - Subsidiary of the multinational company Iberdrola Inc. - Limited position in insular Greece
Greek Association of Investors of Small Wind Turbines (GAIS)		2014	Low	Medium	Medium	Low
Prefecture of North-East Aegean	A regulator (issuing permits) and an energy user too.	-	Medium	Medium	Medium	Local actor
Municipality of Chios	A producer, a regulator (issuing permits) and the island's energy user.	-	Medium to Large	Medium to Large - Continuously increasing	Large	Local actor
Dafni - Network of Sustainable Greek islands	A non-profit organization whose members are insular regions and municipalities, aiming at promoting sustainable development on Aegean and Ionian islands with respect to natural and cultural environment.	2006	Medium	Medium to Large	Medium to Large	Regional actor
Association of Producers of Energy from Photovoltaics of East Aegean (APEPEA)	Local investors that have installed photovoltaics with production surpassing 10kW.	2006	Low to Medium	Medium	Medium	Regional actor
Promitheftiki Inc	A semi-municipal, semi-popular basis company participating in the local energy field.	1989 (as an electricity producer)	Low to Medium	Medium	Medium to small	Local actor
Aigaioelectriki Milou Co.	A privately owned company operating in the electricity production by employing renewable technologies on Chios and in continental Greece.	1995	Medium	Medium - Continuously increasing	Medium	Low
Other local wind investors	Local investors employing a 300-500 kW wind turbine.	-	Low	Low	Small	Local actor
Public Corporation of Water Supply and Sewage (PCWSS)	Major electricity user consuming approximately 7.5 GWh of energy.	-	Low	Continuously increasing	Medium - mainly if they decide to participate in the electricity production	Local actor
Large hotels - the Hospitality industry	Hospitality industry consumes the vast majority of the approximately 63 GWh consumed by the local commercial sector, in a total consumption amounting to 196GWh (source: statitics.gr, 2012).	-	Low	Continuously increasing	Medium- Mainly if they decide to participate in the electricity production	Local actor
Small users (users-consumers)	-	-	Low	Low as individuals / Continuously increasing in case of engagement through cooperatives	Small as individuals	-
Civil society group – Movement (users)	The movement complained for being consulted improperly and superficially. They articulated clear reasons for rejecting the Iberdrola-Rokas large-scale investment..	-	Low	Low as individuals / Continuously increasing in case of engagement through cooperatives	Small - In case of a local transition, some of its members could exert power	Local actor

national energy strategy. Its future role will depend on EU directives and objectives, while contemporary conditions show a central role[213].

The electricity distribution network's operator (HEDNO) is another important actor, enjoying increased jurisdictions and role, mainly concerning the insular country's autonomous electrical systems. Further, it being sufficient in technological resources, planning to construct smart grids[214] and having visions for constructing smart islands[215]illustrate this actor's adaptive capacity and power. In addition, in case of an energy transition in Chios, its role will be considered very important, due to installing and operating the smart grid network participating in managing demand. On the other hand, promoting pathways that support interconnecting autonomous electrical systems with the continental one diminishes its role and power within the transition.

IPTO is in charge of the transition network's operation, maintenance and development. Its role is significant, albeit mainly in regard to continental Greece, as regarding the islands' autonomous electrical systems, it is HEDNO which takes over, in jurisdiction terms. The transmission operator is independent administratively and financially. Further, its power seems to have increased over the past years through scheduling strategic investments,[216] participating in the State Grid Corporation of China as the company's strategic partner [217] and interconnecting autonomous islands to the continental network. Another public actor participating in the energy sector's regime is the Operator of the Electricity Market (OEM), which aims at operating and settling the energy market, scheduling every-day energy activities[218]. This actor's role will be important in the nested transition, mostly in the event of natural gas infrastructures being installed on the island, which would require a transition to renewable technologies in the long-run. In this case, pushing through mechanisms

[213] See http://www.rae.gr/site/categories_new/about_rae/intro.csp , https://energypress.gr/news/symi-kastelorizo-astypalaia-sta-hnaria-tis-tiloy-diagonismoys-gia-ta-nea-exypna-nisia-etoimazei , https://energypress.gr/news/aystira-kai-desmeytika-hronodiagrammata-gia-tis-diasyndeseis-kritis-kai-kykladon-zita-i-rae-apo.

[214] Μάργαρης, «Το νέο τοπίο στην αγορά ηλεκτρικής ενέργειας και ο ρόλος του Διαχειριστή Δικτύου Διανομής (ΔΕΔΔΗΕ)».

[215] Χατζηαργυρίου Ν, 2016, «Διαχείρηση Μη Διασυνδεδεμένων Νησιών (ΜΔΝ) με υψηλή διείσδυση ΑΠΕ».

[216] https://www.naftemporiki.gr/finance/story/1370767/admie-ependuseis-ano-ton-21-dis-euro-gia-tin-ilektriki-diasundesi-kukladon-kai-kritis

[217] http://www.capital.gr/epixeiriseis/3221130/admie-apofasistikos-o-rolos-ton-kinezon-sti-dioikisi

[218] For more information, see lagie.gr

such as green certificates[219] and Gas Emission Market[220], which are managed by OEM, will substantially contribute to steering the transition.

DEPA is the gas public corporation. As natural gas has penetrated electricity and heating/cooling at an increasing rate during the last decade, while also participating in other schemes, the actor's position in the incumbent regime has improved. Regarding the isolated islands of Aegean, the actor, together with the government, has intending on constructing LNG bunker infrastructures[221]. Thus, its role is considered crucial in case that bunker facilities are built on Chios or on a neighboring island. Moving on, the Hellenic Wind Energy Association (ELLETAEN) has expressed its interest in joining the wind power industry. This actor's vision in regard to the national energy transition process is a clear one, while it perceives every issue related to its members' interests in an official and scientific way. Moreover, it is a member of Wind Europe and of Global Wind Energy Council. All the aforementioned point to its role and power being evaluated as considerable within the incumbent regime. However, regarding the nested transition in Chios, its power is regarded as insignificant, since the actor seems to be more interested in promoting visions and policies on a national level rather than in influencing local transitions' frameworks.

Iberdrola-Rokas Inc. is an international player participating in the nested regime. This actor attempted to construct a large-scale wind project on Chios in the early 2010s, while it is still holding RAE-issued production licenses on the island[222]. As it has already been mentioned, the company is one of the biggest actors in the renewable niche market in Greece. On the other hand, its possession to insular Greece is limited[223]. Its interest in investing in North-East Aegean does remain[224], but a bad precedent has been set in its relations with the local community, while the proceeding with a project like this is also depending on others' decisions. The Greek Association of Investors of Small Wind Turbines (GAIS) is the last national actor participating in

[219] About this tool see an article about the suggestion of the OEM for such a mechanism https://energypress.gr/news/stin-protasi-lagie-gia-prasina-pistopoiitika-i-vasi-gia-tin-antikatastasi-tis-hreosis
[220] About this see for instance https://energypress.gr/news/i-agora-rypon-se-ahartografita-nera-logo-brexit-foyrtoynes-prominyontai-gia-dei-kai-eghoria
[221] About this see http://www.kathimerini.gr/974179/article/oikonomia/ellhnikh-oikonomia/depa-ta-sxedia-gia-ygropoihmeno-fysiko-aerio-sta-nhsia
[222] The national register containing production licenses from RES is kept by RAE. According to this register, the company has reserved its right of RES production in the North-East Aegean. For more info see http://www.rae.gr/site/system/docs/registry/ape_registry.csp?viewMode=normal (in Greek)
[223] https://www.e-mc2.gr/news/i-iberdrola-ananeonei-ti-desmeysi-tis-stin-ellada-me-aioliko-sto-pyrgari-poy-kerdise-ston
[224] According to the results deriving from the interviews with company's representatives.

the local s-t transition. This actor was established in 2015, representing small investors engaging in small wind turbines, thus turbines with an installed capacity not exceeding 50KW[225]. Although small wind turbines will be a prioritized technology during the steering process–as it will be argued in the next chapter–, the actor is considered of medium role and power within the transition, which can be mostly put down to this transition primarily needing to engage the locals in this kind of projects.

Following, there is a number of local actors participating in the nested energy regime. Their role could turn out to be vital in a local transformation of the energy sector to RES. The North-East Aegean prefecture is a significant local actor. Through several interviews with political and administrative directors, its role and power has been considered medium. The Municipality of Chios could be among the most important actors in case of a future energy transition. I argue that its role and power in the nested regime is considered more significant in relation to other peripheral actors. This is because of the different responsibilities and jurisdictions, as well as of its interest and willingness in participating in a transition process, mostly in regard to energy efficiency projects, based on the interviews with political directors. Dafni – Network of Sustainable Greek islands is a peripheral actor that could mediate the energy transformation process. This player is a party to European and Global networks of islands, sharing the same interests and objectives ,thus possessing the knowledge about European financial and funding tools, which have been developed for the insular areas. Further, the actor owns the technological expertise so as to support energy transitions in insular areas. These features render its role as medium to large, in the making of a transition[226].

The Association of Production of Energy from Photovoltaics of East Aegean (APEPEA) is also a regional actor with many investors on the island. The companies participating in the association have installed photovoltaics of more than 10kW each, while the biggest of these companies have a 200-300 kW installed capacity. This actor's total installed capacity approaches 5MW. The actor has shown big interest in a local transition, having recognized its financial and environmental benefits for the island. Furthermore, it possesses a clear vision regarding such a transition, which tries to communicate to the stakeholders. It is an active local actor that seems to be

[225] Regarding this actor, see https://energypress.gr/news/idrythike-o-ellinikos-syndesmos-ependyton-mikron-anemogennitrion
[226] http://www.dafni.net.gr/gr/

comprehending its role in a project like this. Eventually, it will be important if such an actor partakes in the local transition, as its members are interested in new investments in renewable technologies, while further, it could motivate groups of local investors. On the other hand, the role and power that Promitheftiki Inc is entrusted with is considered small. The company has not settled on a clear vision, while the actor is considered financially uncertain and dependent on others' decisions. Still, the actor is a user-legitimator, thus, under certain circumstances –as it will be argued later on–, its role can increase. Aigeoelectriki Mylou Co. looks to have more clear visions and targets. This actor seems to be interested in investing on RES, under certain circumstances; more specifically, it relates its decisions to changes in the regulative framework and the state's decisions, thus demonstrating some dependence on others' conclusions.

Large local users could have a significant role in an energy transition. Their current role and power in the nested regime could be considered low. This is because of their captive role, in the sense that, even though they are large users, they haven't assumed a certain role in the nested regime. However, installing renewable technologies and producing their energy could transform these actors, thus increasing their agency and power. The Public Corporation of Water Supply and Sewage are the ones that mainly have already been activated, being prepared to install renewable projects[227]. In the case of the local tourist regime, and mainly hotels and other guest houses, further motivation tools are required. The rest of the local actors seem to be having a trivial role and power in the nested energy regime. Nonetheless, in case of a transition, many of these stakeholders could significantly influence its success and the final pathway that will be followed. In this regard, this section has illustrated the nested regime's major actors. Afterwards, in the next chapter, an s-t energy transition including tourism will be scheduled for the nested energy regime of Chios. Thus, different pathways concerning the whole process will be identified in the form of divergent scenarios. Primarily however, a series of other issues related to the transition process, which need to be defined in advance, are determined, in order for the relative framework to be set.

[227] This is information from an interview with an actor's representative.

Chapter 5

Steering an energy transition

Governing Technological Pathways and Social Engagement

In the final main chapter of this research thesis, an energy transition will be steered in the nested Chian regime. The steering process will be based on the hybrid model, which has been established in the second chapter, as well as on the feedback deriving from the two exemplary cases of the North, presented in the third chapter of this research thesis. Further, the governance dynamics concerning the nested regime's actors, as they have been outlined in the final section of the fourth chapter, will be also taken into account in the transition process.

At this point, before illustrating the five different sustainable transition pathways and the way they will be steered in order for local engagement to be achieved, I believe it is worth further delimiting the framework by determining necessary actions, criteria and processes that have to be followed. At the same time, I will indicate local actors and users, whose role could turn out to be basic in terms of the transition's evolution. Thus, primarily in the next section, I will present a new institutional actor that, in my view, needs to be established so that it steers the local transition.

From governance to steering – Institutions and new actors

Steering a nested transition to sustainability requires a coordinated process in an institutional, financial and social way. In addition, in such process, the government's role has to be pivotal. More specifically, as we have seen in the second and third chapter of this research thesis, many scholars argue for the government's importance in the transition process (Smith et al, 2005; Meadowcroft, 2007; Foxon, 2013). Thus, Foxon (2013) presents the government-led pathway as an energy transformation in which the state assumes a dominant role, aiming at achieving certain objectives or responding to landscape pressures. Further, Meadowcroft (2007) argues about how significant the government is in an energy transition, being the central actor which will steer the whole process to more sustainable pathways. Towards this direction, Smith et al (2005:1499) propose a highly coordinated process in case that sustainable transition has been approached in terms of environmental and social sustainability. In the particular nested transition of Chios, I recognized the principal role that the government needs to have, based on the Greek political framework. In this context, I will establish a new institutional intermediary actor that will steer the local transition. As it has been made clear from the case of Samso in the third chapter, Samso Energy Academy and the preceding institutions were pivotal local actors in terms of steering the local transition so as to activate and entangle local society in the transition process. Besides, establishing new institutional actors is a technique already put forward in the hybrid approach that I have developed in the second chapter. More specifically, the conceptual framework that I have adopted in regard to the steering methodology (Meadowcroft, 2007) propounds creating new institutional actors as a technique for steering a transition to sustainable development (see below in figure 6).

Thus, in the Chian case, I will establish a similar actor, whose role will be to operate as the mediator between the different national and local actors as well as between society and incumbent regime actors, with a central objective of engaging local society in the transition as well as minimizing possible tensions, following reflexive ways so as to achieve the transition, contributing to democratizing the energy regime and ensuring a certain sustainable development perception. Besides, the steering actor will direct the transition process perceiving sustainability in the way this research has done. More specifically, as it has already been argued, de-carbonizing the energy sector in the long run, as well as achieving technological modernization and efficiency, are just a part, and not the full story, of a sustainable transition. Changes also to users' practices, life-styles and dominant pathways by the incumbents need to be included in conceptualizing the term. In this context, engaging local community and activating local users are included in this actor's critical objectives. Additionally, as it has been made clear by the analysis of the nested regime back in the fourth chapter, many local actors have conceived sustainable energy transition as a process completely divergent from a large-scale installation, similar to that the one which has been proposed for the North Aegean a decade ago. In this context, the steering actor has to take into account their perception in the way that it conceives sustainability. Further, following the hybrid model that I have developed in the second chapter, the steering actor will take decisions based on a reflexive process (see below figure 6). As it has been illustrated in the chapter, many scholars (Hendriks and Grin, 2007; Smith and Stirling, 2007; Vob and Kemp, 2006; Rip, 2006; Kemp and Loorbach, 2006; Vob, Truffer and Konrad, 2006; Meadowcroft, 2007) argue for the need for the actors to display reflexiveness in a transition towards sustainability, envisaging, however, the concept differently. In this discourse, Meadowcroft (2007) argues for a reflexive mode of governance, as a process exercised by the state, so that it steers an energy transformation to sustainable pathways. Based on this analysis, I maintain that the local steering actor will try to activate those players which could enhance a socially and environmentally sustainable transformation. The actor also receives the "vibrations" that the process generates, thus it responds accordingly. Further, when a transition is in deadlock, this actor steers the process, adapting it and achieving its viability. In this sense, when engaging locals in a particular project fails, this actor steers to more superficial (weak) forms of sustainability, as I will argue later on. In addition, the actor will steer the process mainly on a local scale, linking different governing state's levels; regarding this, in case of its inability to steer a transition in a sustainable way due to power relations issues with incumbent actors, it will be the state that in a way will steer the transition towards a national level by employing institutional and financial tools.

The actor will be governed by a Management Board consisting of seven members. The whole framework under which the actor operates has been influenced by a similar Greek regulative framework being adopted in regard to the protection and development of "Protected natural areas" (Law 4519/18)[228]. Relying of this context, the local steering actor will be formed by a representative of the Ministry of Environment and Energy, a representative of the Municipality, a representative of the Region, two representatives of the academic and scientific community[229], an NGO, which according to its role, is interested on energy transitions and environmental issues, and finally a representative of the production agencies, along with their deputy members. Establishing a framework like this, it carves the actor into the Greek

[228] The institutional framework of the "Protected Natural Areas" (Law 4519/18) includes the Natura 2000 network, while being an innovative context established in 2018. The framework establishes a managing body protecting the natural areas, which is a private legal entity aiming at administrating and managing these areas. The actor exhibits a non-profit, public interest nature, while it is monitored by the relevant ministry, namely the Ministry of Environment and Energy. Among the actor's responsibilities is to provide data and reasoned opinions in regard to submitting management plans, as well as their continued application, monitoring, evaluation and updating of the particular plans. In addition, other responsibilities include establishing an annual report about the Natura 2000 area, as well as drafting an Impact Assessment every three years. It is worth noting that among its duties is to deliberate with local society, production agencies and other interested parties about the areas of their responsibility in regard to issues related to managing, effectively protecting and integrating the environmental parameter in the local development model. The actor is governed by a Management Board consisting of seven members and their replacement ones. The regulatory framework also defines several other issues about the actor, like the way it is financed or how it is assessed by the ministry.

[229] These two participants will be individuals, thus, in contrast to the other ones, they will not be representing an institution or a body in charge.

institutional framework and thus in the Greek political reality. The new actor will be monitored by the Ministry of Environment and Energy. Further, the actor will be advised by a committee containing the CRES[230], the Network for Sustainable Greek islands-Dafni[231] and a Technical University[232] with experience in renewable energy technologies and transitions.

I also argue that some of the members involved in this actor have to be local entanglers. As the case of Samso in the third chapter made plain, entanglers' engagement in several sub-projects was vital for their success. Further, since the beginning, SEA had included individuals who activated and entangled the local society. Besides, STS and Transition Studies scholars (Van der Vleuten, 2018, Hess, 2018) recognized these actors' significance, as I have noted in the third chapter. Thus, Van den Vleuten (2018) highlights the importance of "system entanglers" in the s-t transformations. Further, Hess (2018: 179) argues for the need for "bridge brokers", namely individuals or institutions, to bring dissimilar groups together and adjust goals and frames in the process. This scholar also recognizes to these actors specific characteristics as a biographical background and split habitus[233], that permits them to become mediators among the different groups participating in the process (Ibid). These local entanglers, in local steering actor's framework, could mainly be the NGO so that a perception of environmentally and socially-oriented sustainability is ensured. This is because this actor is more likely to form a perception of local engagement and small-scale technologies for transitions. In general, it is vital that the alternative socio-technical perceptions and logics be represented in the particular steering actor. Towards this direction, in the nested transition of Chios, I maintain that the participation of the political activists that had engaged in the movements against the large-scale project back in the early 2010s is important. These individuals could also participate through other institutional roles, bringing in an alternative s-t logic in the transition. However, I have to note here that although this alternative socio-technical

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230 According to its objectives and role as a Ministry's consultant, this actor diffuses and shares its knowledge with the local actors, however it does not get involved in steering local transitions. On the other hand, it prefers having a more advisory role in these process.

231 This actor is not interested in steering the transition in a local level (source: interview with the representative).

232 The university will assume a technical advisor's role. The steering actor is in charge of choosing the appropriate Technical University and department; they also carry out a programme contract as set out by the relevant laws regarding this kind of agreements between public and quasi-public entities (Law 3852/10 article 100).

233 Namely a divided habitus. A habitus is the way that group culture and personal history form an individual's body and mind , thus influencing its current social actions. In this framework, in regard to the entangler, this actor will be familiar with more than one "micro-environments", therefore being in a position to mediate between them.

perception of a transition –which opens new, probably more sustainable pathways– is necessary so that pathways to sustainability can be followed, a critical view to a socio-technical transition logic is not enough, but has to be transformed into a cooperation and convergence spirit, which is necessary in making a s-t transition. In this context, in the next section, I will refer to institutional and technological aspects that need to be determined while setting the transition framework.

Preparing the transition

In this section, based on the conceptual framework of the hybrid approach illustrated back in the second chapter, I will try to further specify the necessary institutional, technological and other tools required in order to achieve attainable pathways for a sustainable nested transition. The hybrid approach that has been developed in the second chapter includes concepts and techniques that will accompany such a transformation. As it has been mentioned in this chapter, governance in the hybrid model (figure 6) is perceived among others through the social transformation concept (Meadowcroft, 2007), which employs a series of tools so as to ensure that the local society changes its practices and life styles. Engaging the locals in the energy transition process helps transform societies in a sustainable way. As we have seen in the first and the second chapter, many scholars (Jolivet and Heiskanen, 1998; Nye, 2004; Van Vliet et al, 2005; Chilvers and Longhurst, 2016; Schot et al, 2016) argue about the significance of social engagement in the way a technology will be interpreted and a transition will be steered towards more sustainable pathways. Concerning this notion, Van Vliet et al (2005) support that engaging locals creates users-consumers that are co-providers, thus users developing in a way more sustainable practices and energy consumption patterns. This perception, which has been integrated in my hybrid model, influences the steering methodology in the nested regime so that the steering actor will try to engage particular types of users and actors in order to achieve social engagement.

In this framework, in the national regime, the Energy Communities framework is a vital institutional tool that was adopted a year ago making it easier for local communities to participate, as it has already been discussed in detail in the fourth chapter. As it has been analyzed in the previous chapter, it is about a cooperative scheme which allows individuals and other local actors to produce energy which either covers their energy needs or can be sold. Using the Energy Communities framework on the island will be an initial step in engaging locals in the procedure. The framework (Law 4513/18) further favors local actors by mandating local participation exceeding 50% of the co-operatives' members. On the other hand, this framework does not allow the co-operatives to become involved in joint ventures with other management schemes, thus it excludes, in a sense, at least partially, other actors from the beginning of the transition process[234]. In regard to how important local engagement is in terms changing energy practices, it has been made evident in the third chapter regarding Samso nested regime that local engagement is not a panacea that would guarantee the change of practices. Hence, in case of limited local engagement or inability on behalf of the users to change their practices positively, other measures have to be taken so as to ensure a minimum level of sustainability. Towards this direction, in the other exemplary case that was studied in the third chapter, Gotland, it was demonstrated that the nested regime managed to cut down on its electricity consumption by installing smart grids and smart meters as well as by managing the energy demand. Besides, in harmony with that, the hybrid model that has been developed in the second chapter submits similar measures/tools towards achieving social transformation (see figure 6 in the second chapter). As it can be clearly inferred by the above scheme (figure 6), among the tools used to develop social transformation, technical and managerial recommendations are also included. Thus, the model, through certain examples, suggests that micro-grid networks and techniques managing the demand be adopted in the third and the fourth tools (as these are illustrated in figure 6, in the second chapter) so as to facilitate social transformation. Installing smart grids[235] and using managerial tools like demand side management[236] (DSM) and demand response[237] (DR) will work as an "emergency valve", ensuring the change of energy practices. Further, a smart grid will promote the

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[234] More particularly, in a way, collaborative schemes of the co-operatives with the large incumbent actors are excluded. However, although this could be characterized as a barrier or a shortcoming regarding the particular regulatory framework, it is not this legislation's main issue.

[235] According to the European Technology Platform, a smart grid is "an electricity network that can intelligently integrate the actions of all users connected to it –generators, consumers and those that do both in order to efficiently deliver sustainable, economic and secure electricity supplies." (European Commission, 2006).

[236] It refers actions modifying user-consumer energy demand through various methods, such as the financial incentives and behavioral transformation through education. It aims at encouraging consumers to use less energy during peak hours or use it during off-peak hours (https://en.m.wikipedia.org/wiki/Energy_demand_management).

[237]Any reactive or preventative method to reduce, flatten or shift demand. Historically, demand response programs have focused on peak reduction so as to diminish the high cost related to constructing generation capacity. However, demand response programs are now being employed to assist in changing the net load shape as well load minus solar and wind generation, and help with integrating variable renewable energy (https://en.m.wikipedia.org/wiki/Energy_demand_management).

energy network's efficiency and reliability, thus it is considered of major importance for distributed renewable energy technologies' s-t systems (L. Gelazanskas, K.A.A. Gamage, 2014). It is argued further that the grid's "smartness" will allow for production diffusion, that is a network that has been adjusted to renewable technologies' fluctuating production facilitates a sustainable transition (Strbac, 2008). Besides, DSM and DR use are also target for the central government, according to the current energy policy (ΥΠ.ΠΕ.ΕΝ., 2018). In this framework, in the nested transition, several DSM and DR methods, based on either incentive programmes or on dynamic pricing ones, will be developed[238]. It is worth noting that the networks' distributor, HEDNO, has announced that it is interested in running a project[239] concerning installing a large amount of smart meters in several areas of the country so as to promote wind and solar technologies for energy production and the s-t system's smartness. This project has been already planned, being distinct compared to the local electricity transition steering, presented in this research thesis. Based on the above discussion, local participation is what this steering process should by primarily aiming at, however in case it fails, technical and managerial ways will secure a limited change of energy patterns and practices. Besides, relying on the way sustainable development has been defined in the first chapter, there are divergent types and qualities regarding the concept. Hence, engaging locals will allow a rather "deep" (strong) type of sustainability in an energy transition, while, on the other hand, DSM and DR will ensure at least a weak type. Afterwards, the nested regime's different user types will be identified so that the steering actor can produce the necessary actions and use the appropriate tools to activate them.

Local users' role in activating a transition

The role of users and the society is essential in diffusing power and rendering a successful energy transition, as it has been made understood from the second chapter of this research thesis. In that chapter, it has been approached typologies realizes the users' and local society's importance (Van Vliet et al, 2005; Meadowcroft, 2007; Schot et al, 2016). Further, the critical role that local entanglers play in activating society and accelerating the transitional process is exemplified by the case of Samso

[238] For more information about the different methods and programmes of DSM and DR, see Strbac (2008) and Albadi and El-Saadany (2007).

[239] See, for instance, https://energypress.gr/news/pos-tha-egkatastisei-o-deddie-75-ekat-exypnoys-metrites-synenteyxi-me-ton-ceo-ath-misdaniti

in the third chapter. Based on that, in my point of view, when mediating institutions and actors, which act as entanglers in the making of a transition to sustainable pathways, participate in the process, their role is fundamental. Mostly in the local scale, these actors could have an essential role. The section aims at clarifying the types, features and roles of the users who need to participate in the local electricity transition. Stimulating locals to be engaged in it and aspiring for change of the users' practices requires particular user types getting involved. Thus, I will track the essential users exerting power and agency, encouraging them come up with alternative narratives. Moreover, I will highlight other actors that promote public engagement. Relying on these elements, I claim that, in the Chian case, there are three user categories exerting power and agency (see figure 19). In my notion, their contribution can maximize the likelihood of a transition with local participants becoming successful. These users are legitimators, intermediaries and users-citizens. In my perspective, no user category is similar to users-producers in the nested regime[240]. On the other hand, there are users-consumers but also other actors which have to be activated, contributing also to the local society getting engaged.

Regarding the three user categories I consider of vital significance, legitimators are those that can acclimatize society with the importance of the innovations (Schot et al, 2016). In the particular case, Promitheftiki Inc., the semi-municipal and semi-popular basis company that had been established in the mid 80s, is such a user (see figure 19). The company is the first actor that installed wind turbines on the island. It has been participating till nowadays in two wind farms of total capacity exceeding 1 MW, contributing to the technology being socially legitimized, thus highlighting its values and acceptance[241]. Additionally, as a popular basis company, it is in favor of the idea of locals engaging in installing the technology. Hence, re-establishing this user could be helpful for the local engagement and participation to an energy transition. Another user of this type is the Municipality of Chios (figure 19). Local governments are extremely important actors in the nested transitions, facilitating local engagement, as the two exemplary cases in the third chapter have shown us. In regard to the particular actors, their importance as a promoter for sustainable energy technologies being more easily accepted has been mentioned in the previous chapter. Energy savings in

[240] As it has been explained in the second chapter, these are innovators, practitioners which change and restructure renewable technologies for local use.
[241] Although its political and economic position has been degraded during the last few years.

buildings, road networks lighting switching to led[242] light bulbs technology, but primarily the zero emissions buildings pilot project could inspire the locals's practices and lifestyle. As several social relevant groups argue[243], energy savings is considered the first and most important factor assisting an energy transition. What is more, the North-East Aegean Region is a user also falling in this category. However, its role as an actor motivating the transition by participating in different projects is regarded as secondary[244].

Another user type in the nested regime are the intermediary ones (figure 19). Local actors of the Association of Producers of Energy from Photovoltaics of East Aegean, as well as other renewable technologies investors belong to this category of users. Hence, mainly APEPEA could play an important role as a mediator regarding the expectations that the local society will have from the particular technology, activating locals and promoting the transition. I also maintain that the local steering actor that will be established will be also an intermediary user. Through its role, the actor could promote the project's vision, by deliberating particular terms and sub-projects along with the local community and acting so that these projects that seem dynamic and are clearly participated by the local community can be installed. In order to succeed in this role, I have already argued, in a previous section, for the need for local individual entanglers to participate in this actor.

Users-citizens is another key category (figure 19). Firstly, these could be NGOs participating in the electricity transition. In the Greek case, Greenpeace is such an actor. Over the past years, Greenpeace has been involved in many electricity projects all over Greece, nurturing energy democracy and an alternative energy transition pathways perspective, engaging local societies and regional governments[245]. Therefore, although this user-citizen has not been co-operating in energy issues with the local governments until now, the steering actor has to involve it in the process. I argue that it participating in the transition and local meetings will affect the transition

[242] This technology is more efficient, having a long lifecycle reducing companies and households' energy consumption and economic cost. About this, see Nardelli et al, 2017.

[243]https://www.liberal.gr/arthro/20453/epikairotita/2015/Greenpeace-parousiasi-dekaetous-programmatos-exoikonomisis-energeias.html ; https://www.greenpeace.org/greece/issues/klima/2547/exoikonomhsh-energeias-oxi-allh-yp/

[244] Judging by interviews with the actor's political representatives, it seems to be interested in a more neutral role in regard to participating in energy projects.

[245] See, for instance, the case when the actor cooperated with the Municipality of Larissa so as to suppor energy democracy as well as a few of the poorest households in the city: https://www.greenpeace.org/greece/issues/klima/2454/larisa-kai-greenpeace/

pathway. Other users belonging to this category could be the two NGOs that joined the locals in taking a stand against the large-scale wind technology project, showcasing the weaknesses and the limitations associated with the EIS back in the early 2010s, as it has already been discussed in the previous chapter. Especially ELLET, which had already funded and supported cultural projects on the island since

Types	Characteristics	Comments- Tools	Examples of users in the nested Chian regime
User-producer	They are innovators-practioners, who construct or modify novelties on a local scale. They act cohesively in terms of new users' preferences, practices and routines.	Universities could play or could assist in such a role. Additionally, users' activities of that kind could be enhanced by access to finance, tax credits, knowledge and relevant networks. This type of users could not be used in a normative way.	
User-legitimator	They help cultivate the importance of a niche in the society - they try to socially legitimize the technological niche. So, they try to stress its values and acceptance. These users exert agency and power and could help achieve changes of practices.	They could be funded and encouraged through greater involvement in evaluating technology, science and society policy.	1. The municipality and popular basis company that was established in mid 1980s (Promitheftiki Inc.) 2.The municipality of Chios since 2015. 3. The photovoltaics club's local delegates. 4.The North-East Aegean Region.
User-intermediary	They are mediators that contribute to forming the artifact's design, rules and regulations of use, usage, expectations and interpretation. They usually are the innovation technology negotiators, so they could be users' clubs and associations.	Constructing mediation spaces and delegating certain tasks to them; also, **establishing new institutional actors that work as intermediaries.**	1. The photovoltaics club's local delegates. 2.(Potentially) The local institutional steering actor mediating the transition.
User-citizens	They are mainly activists and NGOs that share different values and practices compared to the conventional ones.	Their involvement in the policy making process.	1. Greenpeace, which participates and promotes energy communities projects in many Greek municipalities, is such a user. 2. ELLET and HOL, that protect the cultural and natural environment and also participated in the oppositions, are users-citizens too. 3.Local NGOs interested in installing RES belong to this users' category.
User-consumers	They are users that, through their purchases, but also through domestication and symbolic meanings regarding the consumers' status or identity, re-shape their routines and practices.	Providing digital and natural fora that will help them exchange experiences. **Their tranformation to co-providers or to citizens-consumers.**	Individuals participating in one or several of the projects.

BASED ON THE CONSUMER PROVIDER NEXUS COULD BE

CAPTIVE -CONSUMERS
CUSTOMERS -CONSUMERS
CITIZENS -CONSUMERS
CO- PROVIDERS

Figure 19. An enriched representation of the users' role using examples from the Chian nested energy regime (Shot et al, 2016; Van Vliet et al, 2005).

late 70s, has been regarded very highly in the local community. The three NGOs will be invited as soon as the deliberation process gets underway. Their involvement will influence and in a way guide the process to more sustainable orientations. Still, it is worth noting that these actors approach environmental subjects and the sustainability concept differently. Local NGOs with environmental concerns will also be invited. ELIKAS is the main illustration of these actors. Their support to transition pathways could activate groups of locals. On top of that, participating will make it possible for these users to share and shape their opinion with others, while augmenting their experience in energy transitions. This will be vital in terms of deepening the transition in the long run.

Users-consumers is also the last user category that I will refer to. In my view, their role is fundamental regarding a transition encompassing local participation and the change of energy-electricity practices. Hence, based on typologies presented in the second chapter (Van Vliet et al, 2005), I support the notion that only citizens-consumers or co-providers could adopt a sustainable ethos and enable the change of practices. This change of users-consumers practices would lead to a higher quality of sustainable development, thus a deeper perception of the sustainability concept, which is what the current research is aiming at. In this context, the local steering actor will try to activate users-consumers. Important users-consumers are also the large energy users of the nested regime. If these users achieve a transition to renewable technologies, their energy efficiency will be amended, while smart technologies could affect their energy practices, ultimately reducing their energy consumption. Secondarily, these users' energy transition could influence and push other actors or users to follow their steps. The Public Corporation of Water Supply and Sewage (PCWSS) ranks first among these actors. PCWSS is the major energy consumer on the island, together with the Municipality of Chios. It consumes approximately 7,5 GWh of energy on an annual basis, which cost about 1,5 million euro. Therefore, if this actor fully transitions to renewables, the energy needs supplied by the conventional power plant could diminish. The actor seems to be interested in a turn to renewable technologies and it has already started considering alternative pathways.

Hotels and traditional accommodations (guesthouses) are other large energy consumers on the island. Although the Chian tourist sector has a minor share in the local production, it still is an energy-consuming one. As it has been discussed in the previous chapter, in the nested regime of Chios, almost 32% of energy consumption is related to commercial use, while in the lion's share of it goes to tourism[246]. In addition, energy cost is one of the biggest costs that a hotel or accommodation space has to encounter[247]. Subsequently, hotel and accommodation owners manifested an interest in renewable technologies in case that they are supported financially and

[246] Source: Hellenic Statistical Authority (statistics.gr).
[247] Information from interviews with tourist nested regime's actors.

technically, as well as with proper financial tools[248]. Energy communities and regulative tools as net-metering or virtual net-metering could assist in activating these actors. Moreover, an objective of this thesis is a deep energy transition including also the nested tourist regime, thus it aims at engaging tourist actors and businesses. In this regard, energy transition in tourism will constitute a point of analysis in the last section of this chapter too.

Except for the particular user types, other local actors could participate in the transition process as well as enhance local engagement; for example, the academic community and the University of Aegean would engage in this process. This is significant as it will contribute to diffusing jurisdictions and power to local actors, following the direction designated by the hybrid conceptual framework (see above, in figure 6). The departments of Geography and of Environment, that mainly expressed their opinion and issued statements concerning the large-scale wind power installation project by Iberdrola-Rokas, back in the early 2010s, could have an advisory role in respect to environmental and social issues. Finally, the University's Tourist department could be conducive in supporting a future, further deepening the energy transition to the tourist regime. Other important local actors and investors will be engaged and encouraged to participate in the process too. Such actors could be, for instance, the local Chamber of Commerce as well as mediating groups, like engineers, electricians and other associations, as I am going to underline in the next section. Later, I will clarify the way the steering process will take place in the initial stage, while, subsequently, I will refer to tools and techniques that the steering actor could use so that it activates these particular users.

The steering process

In this section, I am going to map out the initial actions that the local steering actor and the state have to follow, as well as the tools and techniques it will develop so that it facilitates a pathway engaging the locals to ensue. In this framework, it initially needs to activate the transition through an envisioning and enrollment process. In this initial stage, the ministry's more active role is probably crucial in supporting the narratives and long-term visions that the local steering actor promotes. Therefore, it's the ministry that will primarily promote a general “green” transition vision. The

[248] Results of interviews with tourist nested regime's actors.

envisioned action will be followed by an open deliberation process with the local community. Hence, local meetings will be organized by the intermediary institutional actor running the whole process. During the meetings, the local steering actor will suggest and pre-schedule a number of sub-projects in the road to the s-t transition. Based on these, perceptions, objections, short-term and long-term visions of local actors will be put on paper and several aspects and issues (like the technologies that will be used, the size of the wind turbines, the places they will be installed) will be negotiated. This will be important in terms of determining the possible renewable technologies installation pathways as well as short-term visions . At this point, financial support from the government as probably small but sufficient subsidy or/and feed-in-tariffs payments, as well as financial tools facilitating local engagement have to be proposed to the local community. Similarly, pre-announcing particular projects and their installed capacity as well as the steering actor promoting particular narratives and visions are parts of an enrollment process, including and engaging particular actors, thus mainly local society. At the same time, these actions exclude specific projects and, probably, some actor types. Further, they can stimulate local frameworks and steer to pathways requiring the change of energy practices.

Incumbent regime actors will not participate in the initial attempts that would establish the local vision. These actors, and particularly PPC, will be invited at a later stage when the local society will have already formed their visions and interest. As we have seen from the relevant literature back in the second chapter, many scholars (Smith et al, 2005; Shove and Walker, 2007) maintain that power relations between divergent actors in a transition process and the incumbents' dynamic steer the process based on their narratives. Further, in the third chapter, we showed that the local actor that steered the transition in the Samso nested energy regime, initially invited the local community to the process, while negotiating with other actors at a later stage. Hence, in the nested Chian transition, I argue that the incumbent actors engaging from the very initial stage will direct the whole transition process differently due to these actors power and agency. In that case, a diffused governance transition pathway with extensive local engagement would be rather utopian, as power relations will not allow this pathway, thus leading to the steering actor being compelled to initially invite just the local society. Besides, regarding PPC, which is already an actor participating in the nested energy regime of Chios, several discussions and meetings so as to gauge its intentions and interests in a local level will be organized.

With reference to the users and their role in the transition, the local steering actor needs to activate them as it has already been discussed in the previous section. Furthermore, as it has been analyzed in the second chapter, Shot et al (2016) have put forward several tools, so as to activate these users, engaging them in the whole process. Based on that, users-legitimators will be funded and encouraged through greater involvement in evaluating technology and society policy (see figure 19). In this direction, Municipality's energy saving projects as well as installing pvs panels in municipal buildings will receive additional funding[249]; moreover, zero energy emissions buildings projects in other public spaces will be also supported. The Region needs to be similarly assisted financially by the state. Determining and fulfilling the necessary energy saving actions in erecting buildings has to be part of this transition. Further, it is necessary that such action take place before, or at least in parallel with, evaluating society’s energy needs. In this regard, zero emissions building projects could be brilliant paradigms of the way that the public and private corporations of tertiary sector must act, namely serve as demonstration projects for the local large energy-user companies.

Further, projects regarding energy efficiency in buildings aiming at reducing their emissions could even increase their effectiveness by connecting it with narratives concerning reducing consumption, by adopting local legislation requiring high energy standards in new buildings and by acting in a direction towards change of practices, as well as by installing new technological artifacts improving the effectiveness of user and the management of electricity, like the smart meters. On the subject regarding amending local legislation, this could be a decisive measure that could facilitate the change of the local society's future practices. Nonetheless, in accomplishing this, it is vital that local governments are willing to follow a sustainable transition vision. Such legislation could, for example, determine which materials should be used to all new buildings constructions or determine the insulation level that doors and windows should have[250]. Still, at a later stage of the transition, it could coerce house owners to include provision for a garage and an electric car plug-in installation in every newly

[249] In this issue, several programmes are in the making, while new ones have been announced by the government, through the National Energy Planning (ΥΠ.ΠΕ.ΕΝ., 2018:167).
[250] These are measures which have been taken in the exemplary cases.

constructed house, facilitating the deepening of the energy transition to transportation. In the event that the national legislation does not abide by such restricted requirements, the Region and the Municipality, together with the steering actor, could press and ultimately convince the central government about the need for an alteration at the local level. Besides, in respect to private buildings, current national energy plan (ΥΠ.ΠΕ.ΕΝ., 2018:57) has scheduled to upgrade a relatively large number of households on an annual basis all over the country, within the years to come. The Chian nested transition could be benefited from the national planning, improving the efficiency of local buildings and households. In addition, regarding deepening the energy transition process so as to include local transportation that will be promoted at a second stage, technical support and funding tools need to be guaranteed by the state so as for the electric storage network to be developed and cyclist path and bicycles' parking areas downtown to be constructed. With regard to the other local user-legitimator (Promitheftiki Inc), its role will be redefined by the probable changes in its institutional framework as well as guaranteeing funding tools and subsidies for renewable projects that will engage local community; validating a new regulative framework regarding energy co-ops will be helpful in this direction. These activities will also strengthen local actors. Concerning intermediary users, and more specifically the local photovoltaic association (APEPEA), the actor could be charged with a certain role in the deliberation process during the meetings, supporting establishing pvs projects of the transition pathway. Additionally, the steering actor will seek to activate users-consumers, transforming them to co-providers, mainly by participating to energy co-ops and installing roof-pvs or small wind turbines. In my point of view, diffusion regarding roof pvs and small wind turbines technologies is vital in engaging locals and enhancing their understanding on energy and environmental issues, while it prompts them to conceptualize sustainability more deeply.

Furthermore, as it has been commented upon in the case of Samso, mediating actors such as the local blacksmiths, plumbers and other associations assisted the process of the nested transition. Thus, engaging renewable technologies mediators is, in my view, essential in following more sustainable pathways. In this direction, the local steering actor could encourage engineers, electricians and other professionals that could prove to be useful in installing or maintaining renewable technologies to participate into the process. These mediating actors could argue in favor of a technology and allow its easier diffusion. Further, they could contribute in users-consumers participating in particular sub-projects. In respect to mediators' engagement, an institutional framework needs to be established that obliges energy investors that want to be subsidized by the state to install and maintain their renewable technologies only by employing state-certified technicians[251]. Running courses aiming at certifying local engineers and technicians, allowing them to install and maintain state-authorized pvs panels, heating pumps and small wind turbines, will facilitate their engagement in the transition, supporting particular technologies. The courses could be run by CRES and a University possessing the necessary know-how. Only projects processed by certified technicians will be subsidized. These actions are bound to blend local society with the renewable technology transition, while creating new actors and poles of economic interest in the local society.

Another issue that has to be clarified, is related to smart meters and smart grids as technologies that will oil the wheel of the transition leading it to more sustainable pathways, making managing demand possible, thus ensuring the change of practices. As it was discussed in a former section, HEDNO has already scheduled to install smart meters on insular Greece in an effort to bring a smart grid into existence[252]. Regarding this, the actor has announced this transition in a decade programme. More specifically, it has actually already planned one of its pilot projects, according to which the actor will install 80,000 smart meters in North-East Aegean, within the years to come[253]. An energy transition project on Chios will require these plans to speed up, while further, the nested regime will need to be included in the initial plan, something that is not actually the case at this time. Thus, the steering actor, together with the local government, have to convince the ministry and the actor to guarantee that the island isn't left out. The network's “smartness” will make production diffusion more efficient and easy, ultimately enabling the transition to sustainable trajectories. Besides, installing a smart grid is necessary for achieving high renewable technology penetration and managing the energy demand, thus it is a sine qua non condition in following sustainable pathways (Saadatmandi et al, 2018; Chaudhary and Rizwan,

[251] This framework is part of the way state approaches, in the case of Samso nested transition, the engagement of mediating actors as several professions. A similar law cannot be found in the Greek institutional context, however I regard this as very helpful in facilitating local engagement, thus I decided to use it in my approach.

[252] Smart meters is just a part of the technologies needed for installing a smart grid.

[253] See the statement of the actor regarding smart meters' importance in constructing smart grids and its planning about their installation https://energypress.gr/news/den-nooyntai-exypna-diktya-horis-exypnoys-metrites-systatiko-stoiheio-tis-neas-energeiakis and https://energypress.gr/news/pos-tha-egkatastisei-o-deddie-75-ekat-exypnoys-metrites-synenteyxi-me-ton-ceo-ath-misdaniti

2018). In respect to the issue of demand management, a number of measures and actions have to be taken so that nested regime actors facilitate the change of energy consumption practices and ensure the electricity system's reliability. Initially, the whole process has to be analyzed partially to the local residents in an effort to activate them and affect their practices. In this direction, the network's distributor actor (HEDNO) will be invited in the process, analyzing issues of DSM, creating a narrative of network's efficiency and reliability and forwarding voluntary smart-meter installation. At that time, the steering actor needs to support and strengthen this view, raising local awareness in regard to climate change issues for islands and promoting visions of local sustainability. In addition, at this point, it has to be clarified that the different projects that will be suggested by the steering actor in the local meetings will display a total capacity similar to the island's current upper consumption needs , while further, a number of storage technologies will be installed [254] so that the energy s-t system's sustainability and reliability will be assured. Towards this view, the steering actor will suggest that the total install capacity on the island reach 52MW, namely the maximum peak energy demand for the past decade[255]. Further, deepening the electricity transition to transportation requires adding further renewable technologies to the above capacity, according to nested transportation regime needs. Hence, as it has been calculated in the previous chapter, the installed capacity will equal 27MW. In other words, this installed capacity will be assumed as the necessary one in all the different scenarios that will be presented afterwards. Regarding these limits, DSM as well as other measures, like energy efficiency in buildings and installing storage stations could, in a way, corroborate that current energy needs will not be exceeded. Besides, securing the network's trustworthy operation is also part of HEDNO's jurisdictions. In this trend, this actor will very actively participate in determining the minimum installed capacity on the island. In deciding on the minimum installed capacity level, the steering actor will involve several actors such as the energy distributor, the CRES (as local actor's technical advisor), PPC and the regional governments. However, HEDNO's opinion will be of primary importance in order to ensure the network's security .

More than that, during the steering process, the intermediary actor will tackle probable deadlocks by following a reflexive mode of governance. Therefore, new

[254] This assumption derives from interviews with HEDNO's representatives.
[255] This assumption derives from interviews with HEDNO's representatives.

actors could be invited in the individual projects in case the initial local society struggles to come up with adequate interest or financial resources. These actors could be either other local and regional players that would make the decision to participate or regime actors, as, for instance, are PPC, ELLETAEN and other private national or international investors. In case the project hits a standstill and completely fails, a deliberation process for a new project will take place so as to secure the necessary power production for the network's stability and the success of the transition. Hence, in the new projects, stakeholders could negotiate several technical and other characteristics from scratch, with this process being an on-going one. On the other hand, constructing projects of a total capacity much higher than the necessary nested regime's energy needs will not be under negotiation. This restriction derives from the way that sustainable development has been perceived in this thesis in the previous chapters, while it will be ensured by pre-announcing particular projects before the negotiations with the incumbents by the steering actor, which will set obstacles to its higher deployment. In this manner, failure of the process will result in the steering actor trying to steer the transition in another pathway (scenario). More than that, in the cases that the cooperative schemes fail to come up with the planned installed capacity, the additional projects required will create other forms of participatory schemes, allowing local actors to engage. Subsequently, joint ventures among the participants in these projects will be established as managerial umbrellas, securing and increasing local participation. This kind of context allows limiting the economic risk the investors have to undertake, mainly benefiting the minor ones, like the small enterprises and other actors. Further, it could help keep the projects and the particular technologies' average cost within the bounds thanks to negotiations, purchases and agreements in a large scale. Finally, joint ventures could ensure that other necessary actions, like environmental impact assessment and technological surveys, being otherwise relatively difficult processes to be managed and controlled by small stakeholders, are rendered more affordable in financial terms.

The nested transportation regime’s transition, owing to the deep electricity transition, is another issue which needs to be determined. Influenced by the exemplary paradigms in the third chapter, I argue that deepening the energy transition that way will be planned in the long run. Further, such a transition would target at the actor steering a transition of the sector to electricity technology; however, I have to note that this will depend on the particular transition pathway and governance dynamics. More specifically, as it has been discussed earlier in this research thesis, this transition will be part of a wider electricity transition. Hence, the trajectories that will be followed in the mobility sector will be affected by the overall energy transition. For instance, following a transition pathway in terms of promoting natural gas and bio gas technologies for the electricity system (Scenario 2), then a transition regarding a large majority of heavy cars, public transport and a number of private cars will be expected to employ these technologies. The results in the mobility sector will be similar if DEPA, the national incumbent actor trading natural gas, decides to construct an LNG bunker infrastructure to Chios or another island close to it[256]. In any case, nested transport regime transformation will use technologies easily accessible, as part of the extensive electricity transition that will take place on the island. In the long run, steering the nested transport regime to sustainable pathways will unavoidably influence its local actors, such as city buses[257], taxis[258] and rental cars’ enterprises, while finally leading to alterations in the technologies and the practices pertaining to use of cars by users-consumers.

On the subject regarding steering a sustainable nested transport transition, local actor’s actions and proposals will be based on the relevant literature and the pathways that have been suggested in the exemplary cases presented in the third chapter. During the last decade, literature on sustainable transport issues has proliferated. Scholars focus on issues concerning the need and the trend that many urban areas bring down the share of trips by car and amplify the share of other ways regarding mobility, like walking, bicycle and public transport in relation to twenty years ago (Newman & Kenworthy, 2015; UN Habitat, 2013). Further, other scholars argue for extreme

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[256] This is a possible scenario, as I will argue later on.

[257] I have interviewed this actor, which, in general, is interested in a nested transportation transition where the city buses would have assumed a more important role. However, the company raised several issues into question. Thus, smaller or more frequent buses in the morning hours isn’t what the company considers a sustainable scenario.

[258] I have interviewed this actor's association, which is highly interested in a transition to more sustainable technologies. On the other hand, the actor declares that the sector supporting such transition is financially inadequate. Hence, taxis’ actors are waiting for a state subsidy to support this transformation. The last extensive change that the fleet underwent happened back in 2004. At that time, the state woud partially subsidize purchasing a taxi. In order for a sustainable transformation in this sector to be accomplished, hybrid technology is recommended. Electric cars' technology is being currently rejected because of their recharging need. Taxies operate all day around, thus recharging renders their use limited. In addition, hybrid technology has been already used into too many professional cars all over Greece for more than a decade; therefore, this technology is considered a reliable one. On the contrary, the association shows low interest in technologies like natural gas and biogas. Use of petroleum gas in cars on the island brought about many damages in cars, tarnishing liquid gas technologies' reputation. The current legislation defines the twenty-year milestone as the maximum age for a taxi. However, without a financial support by the state, professionals would rather change their car with out-of-date second-hand ones.

changes and similarities shared by many Western Europe cities in adopting a series of measures in urban transport and land policies, like diminishing car parking supply downtown and enhancing parking fees, amending public transport services, turning large city center areas into pedestrian zones, expanding bicycle networks and many more (Buehler et al, 2016 and Buehler et al, 2017). Others argue for the effectiveness of alternative sustainable transportation practices, such as car-pooling, in economic and environmental terms (Nurhadi et al, 2017). Furthermore, in regard to both exemplary cases, several measures were taken in terms of facilitating a sustainable nested transportation transition. Mainly in the case of Gotland, as it has been discussed in the third chapter, the local government established a series of measures, like improving its public transport services and cycle paths or running local buses on bio-gas technology (Action plan in Energy 2020, 2013:23). What's more, over the past few years, the Greek state has established the Sustainable Urban Mobility Plans adopting a call by the E.C[259] for the European states assuming initiatives for sustainable mobility practices (Urban Mobility Package, 2013)[260]. The plan in actually a long-term strategy processed by the local governments on issues related to mobility and the city's infrastructures[261]. The plan needs to develop short-term and a long-term visions in order to improve access in urban areas, giving priority to a series of issues like public transport, walking and cycling in the city, urban roads security and others. This sustainable transportation transition trend has influenced, over the past two years, a few Greek municipalities so as to envision and plan more sustainable pathways[262]. Based on this framework, the local steering actor has to promote a series of measures and actions forwarding the transition. More particularly, primarily the steering actor needs to ensure that the local government actors will closely co-operate and demonstrate the needed amount of willingness, particularly the Municipality, participating in this long-term transition plan in the nested energy regime; that is to say that changes in the regulative framework and the technical infrastructures as well as a potential shifting of mobility live style have to be promoted in order to facilitate the sustainable transition of the transportation nested regime. Relying on this,

[259] European Commission supports attempts for sustainable transitions in urban mobility through funding and other measures (see https://ec.europa.eu/transport/themes/urban/urban_mobility/urban_mobility_actions/sump_en)

[260] Regarding this, see the “Urban Mobiligy Package” in https://ec.europa.eu/transport/sites/transport/files/themes/urban/doc/ump/com%282013%29913_en.pdf

[261] Regarding the plan, see more in www.svak.gr .

[262] A Greek exemplary case in the town of Igoumenitsa, which, in the 2017 European Week of Mobility, won the award in the category of towns under 50,000 inhabitants (for more information see the Sustainable Urban Mobility Plan of the city in https://igoumenitsa.gr/images/gia-ton-dimoti/%CE%A013_TELIKI_EKDOSI_SVAK.pdf

diminishing traffic downtown would be an initial objective. This could be achieved by converting city center areas into pedestrian zones, banning parking in several downtown areas, designating short-stay paid parking zones and mandating that only taxis featuring sustainable technologies use the taxi zone in the city center. In addition, operating big parking areas already constructed at the edge of the city and organizing frequent transportation downtown by buses will conduce to the same result. Establishing municipal police and convincing state police to come down harder on offenders by imposing fines could be necessary[263], judging by the calls made by local actors in the interviews[264].

Further, the use of bicycles has to be diffused. Establishing a bike network with cycle paths and bike parking places all around the city has to be put forward. For the cycle paths to include the city and the suburbs, a network on a radius of approximately 6-8 kilometers from the city center is necessary to be constructed. Additionally, city buses trips' potential destinations as well as their frequency must increase too. The steering actor has to convince the public transportation company for this need, while the Municipality has to apply institutional pressure in this direction if necessary[265]. On top of this, the local steering actor will promote changes affecting users' practices and the way they perceive individual transportation. This could include changes like car pooling and car sharing. More particularly, in order to propound car pooling, trying to engage local society, the steering actor has to arrange meetings presenting and analyzing such attempts. In addition, it is vital that actors such as the Municipality be engaged in supporting such project. The active participation of the Municipality could help change of the way public views private transportation. For instance, actions such as suggesting that employees carpool to work could contribute to this direction. Furthermore, motivating rental car owner as mediating actors so as to participate in the project will forward the new pattern. In this direction, the steering actor has to promote a vision of car pooling as a solution regarding down town area residents

[263] This was also a suggestion made by the public buses' representative in our interview.

[264] In our interview, the the city buses' representative raised issues of institutional and operational changes that must be pre-negotiated and predetermined before such a transition takes place. Such subjects are, for instance, the Municipality's inability to crack down on illegal parking in the city center and move parking areas to the edges of the city.

[265] The city buses' representative, during the interview, appeared to be unwilling to come up with a number of actions necessary to increase demand for its services. Running more buses in morning peak hours and massively transitioning from city buses to mini ones are two of these actions. However, exactly because transporting school students has been determined as its major economic activity, such a perception can be easily justified; in other words, one third of the company's turnover is associated with school transportations. On the other hand, the local Municipality has to press and support this actor; European funding for sustainable urban mobility is a way to do so. See also the footnote below referring to the state's plans supporting renewable public transportation.

avoiding parking charges. Higher parking charges imposed by the Municipality could be required so as to promote change of practices. In regard to this, regulatory changes by the Municipality with the intention of facilitating the project are also required.

Regarding a transportation transition to electricity, constructing a network featuring charging stations for electric vehicles all over the island by the regional government would be critical[266]. This will forward diffusion of the electric cars in the enterprises and the households too. Further, any solutions allowing charging of electric taxis during their operation will be studied[267]. In the event that a hybrid solution prevails, decarbonizing the sector in the long run would be ensured. Furthermore, the transition of public means of transportation to de-carbonized technologies has to be promoted too. However, this is a matter of the energy pathway that will be finally supported. Irrespective of the pathway being promoted, a transition to electric buses cannot be an offset, unless their cost reduces dramatically in the future. In this regard, the city buses' actor, despite showing interest in a transition to de-carbonized transportation, also expressed its weakness to support it financially without receiving extensive financial support[268]. Therefore, although electricity buses technology has matured, this transition pathway could not be followed based on the current conditions. In this context, following this transition pathway requires financial support by the state[269] and/or the local government. Moreover, the city buses actor needs to effective collaborate with the steering actor and the Municipality, which need to support the former institutionally and financially[270] if necessary. In this trend, the Municipality participating in the formers’ equity capital, or establishing a new company, in which the city buses and the Municipality, as a shareholder, will participate, have to be examined. Alternatively, a dominant pathway will be a transition solely to mini buses, until electric buses technology manages to come into view as an economic sustainable solution. In case that the dominant scenario allows biogas to be used in the long run, transitioning buses to this technology will be promoted. In the next section, the five different sustainable transition pathways are presented.

[266] These kinds of changes have been also scheduled and are bound to be financed by the government (ΥΠ.ΠΕ.ΕΝ., 2018: 66-80, 162-174).
[267] Particular solutions have already existed in a national (see for instance https://www.fortizo.gr/fortisi-syskevwn) and an international level (Gnann et al, 2018; Serradilla et al, 2017).
[268] Data from interview with the actor's representative.
[269] In this trend, fleet renewal in public transportation is forwarded by the country's long-term energy planning (ΥΠ.ΠΕ.ΕΝ., 2018: 79-80), while a central policy for an public transportation transition expecting a 20% penetration of renewables until 2030 has been planned (see http://nationaltransportplan.gr/el/).
[270] The steering actor needs to motivate the Municipality so that funding through European programmes for this reason can be secured. Dafni network, as the steering actor’s advisor, could facilitate such an attempt.

Steering to the alternative pathways

Afterwards, I am going to present five scenarios of the energy transition. Thus, the pathways of “flourish of renewables” (Scenario 1), the “gas emergence” (Scenario 2), the “linkage with the neighbors” (Scenario 3), the “continental solution to the motherland” (Scenario 4) and the “interconnection with others” (Scenario 5) are illustrated. Each of these pathways initially refers to a deep electricity transition including tourism. In each pathway, a transition of the nested transportation regime will follow in the long run as part of deepening the process. All five pathways have a time limit reaching the 2050s. Divergent pathways correspond to using alternative technologies or interconnecting with the continental grid, differences regarding the time the transition process begins as well as regarding their scale. In addition, alternative scenarios sometimes declare, as I will argue, differences in the level of local participation and, to a degree, of change of consumers’ energy practices, thus in the governance distribution . This is also associated with its scenario's technological dimensions and features. Further, I have to note that the five different pathways are ideal in the sense that a transition could actually follow an intermediate pathway.

Further, it is worth noting that what these different scenarios are primarily aiming at is the need for the steering actor to interpret the local nested regime's different technologies in such a way that it will secure their sustainable orientation. In other words, as technologies have agency and could create unsustainable s-t entities, determining constraints that ensure their sustainable orientation is considered important. Hence, in each pathway, these regulative restraints will be defined so that sustainable transformations will be achieved.

Scenario 1 – The Flourish of Renewables

In 2011, the EU commission edited possible energy transformation scenarios until 2050[271]. The “Flourish of Renewables” pathway is based partially on one of these provisions regarding producing electricity by almost exclusively utilizing renewable technologies. Further, it has been influenced by a deeper conceptualization of sustainability, as it has been adopted by this research as well as by the EU commission preference and promotion of energy storage technologies[272]. Relying on

[271] E.C., 2011, “Energy Roadmap 2050”, COM(2011), 885 final.

[272] An efficient and clear national regulatory framework for storage technologies is required this scenario to be

the above, this pathway prioritizes a nested s-t system's transition to renewable technologies the extensive use of storage stations and the cold standby of the conventional electricity system until 2040 (see below in table 13). Further, particular renewable technologies for energy production, as the roof-pvs and the small wind turbines will be prioritized. Finally, as it has been discussed in a previous section, smart grid technology is regarded as vital for this transition pathway. The whole project's time horizon for it to reach the nested transportation transition is 2050. Furthermore, the scenario requires that the local community participate in it at an extremely level, at least during its initial plan. For this reason, the local steering actor's role is extremely important in this pathway, in terms of activating and engaging locals.

Other key actors will be the HEDNO, the energy communities, the Municipality and the APEPEA (see below in table 14). Further, other actors’ participation, as are the Chamber of Commerce and large users –like PCWSS and local hotels, especially the bigger ones–, are important for the success of the transition. The primary stage has a timescale of approximately twenty years, projecting to 2040. Initially, just before 2030, renewable and hybrid projects[273] will have to have penetrated the electricity mix in excess of 90% of the island’s energy needs; this is important so that the local power plant will be operating in compliance with the EU (2015/2193) requirements at that time[274]. Based on these, a maximum 500 hours per year operation of the plant has to be secured as a result of the transition. As the renewable technologies' installed capacity in the nested energy regime is currently reaching about 15MW, while the energy demand peak is 52 MW[275], an extra of 30MW renewables installation [276] is demanded until 2030. On top on that, the project envisages installing an extra7MW until 2040. Because of these changes, the power plant's condition could be altered after that time to a hot/cold standby. In respect to transportation, an energy transition from fuel and diesel to electricity will be promoted and supported until 2050. This project will constitute the second stage of this scenario. This second phase is expected

adopted.

273 Namely projects employing RES and storage technologies (probably batteries) in parallel.

274 About this, see the E.C. Directive in https://eur-lex.europa.eu/legal-content/EL/TXT/PDF/?uri=CELEX:32015L2193&from=EL

275 See «ΔΕΔΔΗΕ, Πληροφοριακό Δελτίο Παραγωγής στα Μη Διασυνδεδεμένα Νησιά για τον Ιανουάριο 2018, 2018».

276 The scenario requires a 90% penetration until 2030, as the peak of demand is 52MW, thus requirimg approximately 45MW until that time. As the current renewable technology installed capacity does not exceed 15MW, an extra 30MW installation needs to be scheduled.

to start in the mid 2030s. To be accomplished, an extra power capacity of 27MW is anticipated to be installed on the island, as it has been explained in the previous chapter[277]. With reference to renewable projects, mainly wind and solar technologies for electricity production will be constructed to fulfill this demand. Based on these calculations, the estimated installed capacity of renewable technologies would be 79MW. Limits in power production and consumption will be supported through envisioning energy self sufficiency. Besides, a series of measures and techniques, like DSM, will be promoted for this reason too.

Storage technologies will be of vital significance in these projects. Storage will work as base stations that will power the system when consumption may need to exceed production[278]. So, all new projects, at least within the first stage of the process (until 2030), will be hybrid ones, requiring their connection with a storage system. Thus, the storage technology capacity on the island will be at minimum 30MW. Further, plug-in electric cars could also work as storage systems in an energy demand peak. The whole process necessitates HEDNO constructing a "smart" electrical system; hence, it is critical that smart meters be instantly installed. This kind of technology will enable diffused production to match consumption.

The sub-projects

The transition pathway will contain a number of sub-projects that will be promoted by the steering actor. These sub-projects permit different engagement levels by the local community in the sense that the different technologies' technical, financial and other characteristics allow for a divergent scale of the participatory process; thus, as I have already discussed, sub-projects with potentially "stronger" engagement will be prioritized. Based on this, roof-pvs and small wind turbines projects will be scheduled and proposed by the steering actor as the initial ones. Besides, the way sustainable

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[277] The additional RES installation has been calculated based on the island's oil needs for transportation, its equivalent in MWh per annum and its transformation to MW. For more info, see www.iea.org/statistics/resources/unitconverter/ and http://www.statistics.gr/el/statistics/-/publication/SDE15/-

[278] Battery electricity storage for stationary applications is expected to be promoted based on the current efficiency results (Schimpe et al 2018; Hesse et al, 2017; IRENA, 2017). It is the various lithium battery technologies that mainly seem to have upgraded their efficiency (in respect to energy density and self discharge) and life cycle, while diminishing their cost. Cost in these technologies is expected to be reduced from 54% to 61% until 2030 in comparison with 2016 price (IRENA, 2017), thus costing between 245$/kWh to 620$/kWh (Schmidt *et al.*, 2017; Feldman *et al.*,2016; Darling *et al.*, 2014). Based on these expectations, the cost of installing a large 20MW project will probably not surpass ten million euros. Current installation cost of 20MW large wind turbines (1MW each) is close to 35 to 40 million euros. So, it could be argued, that the battery cost related to such a project will be about 25% to 50% of its total value, until the 2030s.

development is conceived in this research contributes to promoting these technologies. The locals extensively engaging in such projects could transform them in co-providers, thus possibly contributing to change of their practices as users-consumers, as it has been argued by different scholars (Van Vliet et al, 2005) in the second chapter of this research. Besides, it has been mentioned in the previous chapter that the new legislation for the energy communities can guide towards this direction, aiming at increasing individual consumers' production and boosting energy democracy. Undoubtedly, particular projects receiving priority at the expense of others could change in case of low interest in the formers.

Pvs on roofs technology

An initial sub-project being promoted is about establishing energy co-ops so as to install pvs on roofs. In the nested energy regime, HEDNO prioritizes this kind of technologies in case they are not connected with a battery storage system[279]. However, storage stations will be a primary prerequisite for this project so as to ensure the energy network' reliability and stability . The new established co-op actor will produce electricity mainly for its members' needs , who would be able to cut down on their electricity cost through net-metering and virtual net-metering. Furthermore, using storage technology will give the opportunity to the co-op to sell its electricity surplus to the network, ending up in the actor potentially operating as a provider too. The steering actor will present such a project during the deliberation process as the initial one. Funding tools and subsidies has to be ensured so that more stakeholders are attracted. Besides, the project will take place in the energy communities' context, therefore EU programmes could subsidize it[280]. The main objective will be installing at least 10 MW of electricity. The project will initially cover the capital and its suburbs.

The participants could take shares as roof owners or as investors. Therefore, users-consumers that cannot afford investing on pvs on their houses' roofs, although they own one, could join the project. Moreover, someone could participate in the co-op even by buying just one share. Furthermore, large users, such as hotels but also private investors and the Municipality, will be encouraged to partake. Private

[279] The actor's management informed us during the interview that they prioritize roof pvs and small wind turbines projects in a small scale due to their small capacity.
[280] Further, a partnership with Dafni network will facilitate pursuing additional EU programmes and funding tools.

investors, as it has been explained in a former section, could be for instance the wind-farm owners, the pvs-owner and the Chamber of Commerce, while especially APEPEA is expected to assume a very active role in this transition pathway.

From the very beginning, the project will be associated with an energy saving narrative regarding constructions in buildings; this is necessary, as energy savings will decrease households' energy requirements. Thus, a parallel energy savings project will be promoted. As far as many mediating actors are concerned, they have to be invited and motivated by the steering actor. The engineers, electricians and the civil engineers' associations will be encouraged to also have a voice in the matter[281]. Furthermore, the institutional intermediary actor, together with other stakeholders has to carry out seminars about installing pvs on roofs, with the technicians attending them becoming certified in their respective fields, as I have already analyzed.

The Municipality will also be supported to run its own energy co-op programme, together with other key public actors. As it owns many buildings, this kind of projects could be suitable for reducing its electricity expenses. Additionally, public organizations have more convenient and more efficient funding tools at their disposal, thus their engagement is considered easier[282]. Large public users as the "Public Corporation of Water Supply and Sewage" (PCWSS) will be activated in participating in the energy co-op or establishing another one together with public or municipal actors too. This actor has already been pondering on installing renewable technologies so as to curtail its energy cost[283]. In this direction, it is interested in co-operations in energy projects. Hotels, as large users, could also be urged to take part in these tasks or to establish their own co-ops, if necessary. Further, apartment complex owners as well as small societies will be supported in establishing their own co-ops so that they produce electricity on buildings roofs and reduce their electricity cost through virtual net-metering framework. Hence, many Energy Communities will be established in case that extensive interest for the project arises.

[281] The Technical Chamber of Greece has shown great interest in this kind of projects, while the association's president characterizes the transition to renewables "the engine in the Greek economy train". About this, see http://www.enikonomia.gr/economy/122663,tee-atmomichani-gia-tin-epanekkinisi-tis-oikonomias-i-energeiaki-.html

[282] This is information taken from the interviews with the public local actors.

[283] These are data taken from the interview with the actor's representative.

Small wind turbines project

Another sub-project that priority should be assigned to by the steering actor will be that of small wind turbines[284]. Small-scale artifacts are of lower cost, a fact that makes running them more effortless for individuals or local actors. In addition, their technology means that they can be installed and maintained by local technicians, thus potentially reinforcing circular economy. In reference to this issue, this technology, in economic terms, will be more profitable for the local society, as it supports circular economy and local jobs[285]. Besides, in the nested regime, HEDNO has prioritized this type of projects, because of their small installed capacity[286]. In this framework, I regard this technology as more sustainable –from an environmental, economic and a societal perspective– for the local society. Moreover, this project is also scheduled in association with storage systems too.

Initially, an energy community will be established, in case interest for such a type of project is raised by locals. The introductory target will be an installed capacity of 7MW, which translates to approximately 120 small wind turbines. A project of this capacity is considered tolerable from an economic point of view[287], while at the same time, these wind turbines' number and size are consistent with the perception of sustainable development laid down in this thesis; still, the number of the turbines will depend on the participation and could exceed the upper limit. In case of lack of financial resources, foreign actors will be invited, such as the Greek Association of Investors of Small wind turbines (GAIS) and the PPC, as the current energy provider in the nested regime, as well as private actors from other region's islands. Besides, PPC, as a powerful incumbent regime actor, will be approached so that it participates in several projects and in different ways. It is vital to note that, according to the Greek legislation regarding energy co-ops, local participants have to exceed 50% of its members. Thus, incumbent actors could participate in the project if they are interested in it under this framework.

[284] Small wind turbines are restricted, according to the Greek regulative framework, to those whose power capacity does not exceed 60 kW.
[285] On the other hand, small-scale artifacts exhibit a larger average cost, namely they are less competitive in contrast to larger-scale ones. However, nowadays, these two categories of projects are paid in a different price, while energy communities projects will compete only among themselves and not against large-scale projects.
[286] The actor's management informed me during the interview that they prioritize roof pvs and small wind turbines projects, owing to their small capacity.
[287] The cost of a project like this will not exceed 18 million euros.

Further, if the local association of engineers, blacksmiths and electronic engineers[288] participates in the deliberation process, a significant step would have been made. Their engagement could strengthen small-scale wind projects as it will institutionalize the technology into the local energy regime. Such participation will also develop circular economy. In this direction, the steering actor together with CRES and a university possessing the know-how in the technology could organize certified seminars. This process could be also joined by Eurice Wind, the Greek company which has been involved in constructing small wind turbines over the past years[289]. Regarding their positioning, the turbines could be installed at the edge of some villages, in mountainous areas with short or no vegetation, at the edge of the road networks, in areas that this is feasible, or in case of small private projects, in cottages or guesthouses in rural areas. Certainly, the actual places that will be chosen will be negotiated with the local community during the deliberation process. More particularly, when suggested places will be defined, further negotiations will follow with the residents of the villages or other interested parties, and efforts will be made so as to engage them in the projects and deal with the problem.

Large wind turbines projects

Larger wind technologies transition will succeed the two former projects. Thus, its construction will be planned from 2025 onwards. This is because its actual installed capacity will depend on that of the two previous projects. Relying on this, solar and wind technologies farms will be installed, with a total capacity that will not exceed 20MW. In regard to the wind technology projects, the steering actor will be in favor of their size not exceeding 1MW each[290]. Hence, 13MW of large wind turbines and pvs projects have to be constructed until 2030. In case that all the sub-projects will have turned out to be successful by that time, this will be the last of the projects until 2030. The rest of them will follow between 2030 and 2050.

In the particular sub-project of the large wind farm, except for the energy community, other regional and national actors will also join in. This is because this project's high

[288] Few of the local electronic engineers maintain nowadays the nested regime actors' wind turbines. These mediators will be interested in partaking in such a process.

[289] Such an actor could be interested in maintaining this technology. Further, its participation could compel the local association to become more competitive in regard to this.

[290] In case constructing 1MW wind turbines on the island gets under way, these will be the biggest wind power infrastructures ever built on it. Further, wind turbines larger than these require more extensive infrastructures, while the fact that they have faced extensive oppositions in the past should not be overlooked.

cost poses hurdles to the local society exclusively funding it. In regard to this, national incumbent actors like PPC and ELLETAEN will be invited to participate in the process. Further, in case the Municipality is interested in this project, a public-private partnership involving small regional investors and the regional public actor will be established. Alternatively, the steering actor could activate regional investors[291], like actors from the regional photovoltaic producers' association (APEPEA) and the Chamber of Commerce or Chians of diaspora, founding a limited company participating in the project, establishing a joint venture with the incumbent actors that will secure the whole project's economic sustainability.

Other Projects

Starting from 2030, a new series of sub-projects will take place. The projects will aim at completing the first phase of the process, moving on to the second one expected to last until 2050. Projects of wind turbines and photovoltaics, as well as attempts for erecting a biogas power plant will be negotiated. Further, there is a small geothermic field, which is expected to be utilized in covering heating/cooling requirements as well as some electricity needs. All these projects' capacity will be an additional 34MW[292], most of which will cover the nested energy regime's transportation needs. The share of each technology in this latter stage will depend on the renewables' energy mix at that time, each technology's dynamic as well as sustainability issues. Except for that, these projects will be also part of a deliberation process with the local community and other stakeholders.

As far as the small biogas power plant is concerned, PPC will be invited to participate in it and run it. The power plant will be of 10 to 15MW installed capacity, while being accompanied by a biogas plant producing part of the power locally. In case the incumbent actor expresses interest, other local or regional actors, such as the Municipality, the PCWSS, local investors, local farmers and livestock owners will be activated by the steering actor so that they join in the project[293]. A biogas power plant,

[291] Like associations related to renewable energy, members of the Chamber of Commerce, farmers of the island or Chians of diaspora that are interested in the project.
[292] These are 7MW projects for the remainder of the electricity needs that will be covered from 2030 onwards, and 27MW for transportation needs.
[293] In the cases of Samso and Gotland, the local community tried to be engaged in biogas production in a similar way, which has already been mentioned (see, for instance, Action plan in Energy 2020: Energy plan for Region Gotland, http://gotland.se/54546, https://energiakademiet.dk/en/samsoe-2/island-3-0/). For more information, see also in the next scenario.

producing its energy locally and assisting circular economy, will direct the nested transition to sustainable pathways. Additionally, it could promote biogas as a fuel in local transportation. Apart from the technologies categories already presented, pvs projects in mountainous areas will be intended in this latter stage.

Further, in case the projects that will be promoted hit a deadlock, the steering actor has to be reflexive. To achieve this, the actor will trace the interest of local and national/multinational actors participating in a floating wind farm project of the required capacity. Floating wind turbines technology is a niche market that has been developing over the past years[294] (Bento et al, 2019). However, their capacity is expected to rise during the next decade. In this trend, the European Wind Energy Association suggests that offshore wind technology installed capacity could reach 150GW by 2030, a large majority of which will be floating ones (Ibid:71). In terms of developing this technology in the rest of the world, the prospects are similar, with Japan having already installed more than 4GW of floating wind turbines (Ibid). On the other hand, their high cost is an important obstacle that can prevent this niche technology from evolving (Castro-Santos et al, 2014). According to researches, their cost is similar to the grounded offshore wind technology (Castro-Santos et al, 2014; Myhr et al, 2014). In any case, their cost has been dropping over the past years, while it is expected to be decreased even more in the years to come (Bento et al, 2019). Besides, in the nested energy regime, this project will run only as part of the steering actor's reflexiveness after the rest of the projects will potentially have failed, thus in 2040s. In this context, PPC and ELLETAEN will be among the first investors that will be called to participate. This is because of the former’s operation on the island and its reliable relation with the locals. Besides, ELLETAEN is the large wind turbines' association, thus its members could probably be interested in transition pathways like this.

With reference to the possible deadlocks, those could, for instance, derive from the local society displaying low interest in the transition projects from 2030 onwards or extensively installing large wind-land turbines and ground mounted photovoltaics, owing to the other projects until 2030 potentially failing. Floating wind parks projects are quite expensive, although this depends on the wind turbines' size and the project's

[294] The state has been investigating the possibility of installing this kind of projects in the Greek archipelagos; for more info see: https://energypress.gr/news/ypen-kai-rae-diereynoyn-tis-dynatotites-anaptyxis-thalassion-aiolikon-parkon-sta-ellinika-nera.

capacity. Because of its high cost, it can restrict, or even prohibit, local society's participation; for this reason, large investors from the national regime are required to investments. Finally, as far as geothermic technology is concerned, it could be used for heating cooling and, to a smaller extent, for electrifying small communities and villages on the island. As it has already been mentioned, there are low-enthalpy geothermic fields in particular areas of the island. In this direction, establishing a new legislative framework on geothermal energy (currently being at a draft stage) will be a critical change to the direction of its use. On Chios, the fields in Nenita and Thimiana could exhibit financial interest. In this direction, Aigaioelectriki Mylou Co has already tabled a proposal.

Table 13. Main technologies that will be used in the different pathways.

Divergent Pathways	Flourish of Renewables	Gas Emergence	Linkage with the Neighbors	Continental Solution to the Motherland	Interconnection with Others
Requirements for civil society's engagement	Very high	Medium to high	High	Medium to high	High
Main technologies	1.Micro-grids_technologies 2.Storage_technologies. 3.Exclusive use of RES projects. 4.All new projects will be hybrid_ones. 5.Roof pvs and small wind turbines projects will be prioritized. 6.Large wind projects and other renewable technologies will be negotiated. 7. Public means of transport, electric and hybrid technology in individual vehicles and public transport.	1.Natural gas technology converted to a biogas one 2.Micro-grids_technologies 3.Roof-pvs and small wind turbines technologies. 4.Storage-technologies. 5.Other solar and wind technologies projects. 6.Public means of transport, natural gas and biogas (in the long-run) technologies in heavy vehicles and public transport.	1.Interconnection_technology. 2.Micro-grids_technologies 3.Exclusive use of RES projects. 4.Storage_technology 5.Roof pvs and small wind turbines projects will be prioritized. 6.Large wind projects and other renewable technologies will be negotiated. 7. Public means of transport, electric and hybrid technology in individual vehicles and public transport.	1.Interconnection_technology. 2.Micro-grids_technologies 3.Exclusive use of RES projects. 4.Roof pvs and small wind turbines projects will be prioritized. 5.Other_renewable technologies_will_be negotiated. 6. Public means of transport, electric and hybrid technology in individual vehicles and public transport.	1.Interconnection_technology. 2.Micro-grids_technologies 3.Storage_technology. 4.Exclusive use of RES projects. 5.Roof pvs and small wind turbines projects will be prioritized. 6.Other_renewable technologies_will_be negotiated. 7. Public means of transport, electric and hybrid technology in individual vehicles and public transport.

Scenario 2 – The Gas Emergence

This scenario is relying on an initially passive attitude by the public and private stakeholders until the mid 2020s, in regard to island’s electricity transition. As it has been mentioned in a former section, different pathways declare, among others, alterations regarding the time the energy transition will begin. Under this condition, a nested s-t system's transition to one running on exclusively renewable technologies, as in the case described in the first scenario, is considered unfeasible before a decade goes by; thus, the island’s fossil fuel power plant has to remain in operation. However, EU Commission directive[295] (2015/2193) regarding the emission limits pertaining to medium combustion plants until 2030 will develop landscape pressures,

[295] See https://eur-lex.europa.eu/legal-content/EL/TXT/PDF/?uri=CELEX:32015L2193&from=EL

forcing in the direction of shutting down the fossil fuel plant. Based on these directives, when a system exceeds an emissions limit, restrictions in its operation are ordained, otherwise the possibility of high penalties being imposed looms; that being said, a transition until 2030 will be required so that it can comply with the particular regulation. In that case, a solution promoted by the state and the PPC revolves around transforming the diesel thermoelectric plants to natural gas technology ones[296]. As it has already been explained from the previous chapter, Chios is one of the autonomous electrical systems that faces such an issue, therefore such a scenario is possible[297]. Subsequently, as key power technology, this transition pathway uses natural gas as a mediating technology on the road to renewable ones (see above in table 13). Roof-pvs and small wind technology will also be prioritized, while the natural gas plant's transition to a biogas one in the long run is important, as I am going to explain later.

The first stage of this project has to be materialized in a time period that will slightly exceed five years. The project will contain transforming the island’s electricity plant to a natural gas technology as a base station and installing a small amount of renewable energy technologies such as wind turbines and photovoltaics. The initial plan requires a medium to high participation on behalf of the local society. A transition of the local oil powered plant to a natural gas one by the PPC could be part of the LNG-bunker infrastructure initiative, that it has already been taking place by the state and DEPA, the public natural gas actor, over the past years[298]. This transition has been scheduled as a result of the national shipping industry transition to natural gas technology, according to the new regulations. The national shipping regime's transition to natural gas will result in many LNG-bunker infrastructures being constructed in a lot of the Greek ports, both in continental and insular country. DEPA, the public gas corporation, is responsible for these projects, and Chios is among the possible areas in which a project like this could be constructed[299]. In the event that DEPA constructs such an infrastructure on Chios, then it could participate in the local transition, producing electricity and building a heating/cooling network in the city of Chios. Further, it could build natural gas fuel stations, diffusing natural gas to fuel

[296] This data is taken from an interview with PPC’s representatives.
[297] According to the interview with PPC, power plants on Chios as well as on other North-East Aegean islands exceed the set emissions limits.
[298] For more information, see https://www.shortsea.gr/poseidon-med-ii-ports-simulate-lng-operations/
[299] See, for instance, the article in “Kathimerini” newspaper http://www.kathimerini.gr/974179/article/oikonomia/ellhnikh-oikonomia/depa-ta-sxedia-gia-ygropoihmeno-fysiko-aerio-sta-nhsia

transportation[300]. In addition, a partnership with PPC will be promoted so that DEPA can sell natural gas to PPC, covering its needs. In that case, constructing larger natural gas storage infrastructures will be necessary in serving the incumbent actors' needs.

In regard to transportation, the result for the nested regime will be the same[301], if a project like this takes place in a neighboring island, like Lesvos or Samos. In this case, establishing natural gas stations for fueling cars is considered given. It is important to note that constructing LNG bunker port's infrastructures is a project which could be established in each of the scenarios, if DEPA evaluated such a project as profitable. Alternatively, a divergent pathway, in case that DEPA does not run such a project on Chios, transforming PPC's power plant to a natural gas one, could be the latter's individual project[302]. Except for the two incumbent actors, the steering actor, the Municipality, the energy communities and the large local users will be key actors in this nested transition pathway (see below in table 14). Further, the government's and OEM's roles are vital for the biogas transition in the long run. The scenario defines that RES could reach an up to 60%-70% penetration into the electricity mix until the mid 2040s[303]. Besides, in smart grids, HEDNO deems penetrations of this level reliable and cost-efficient (Hatziargiriou, 2016). Using battery storage stations will be necessary in order for the s-t system to be properly balanced so that a higher renewable technologies penetration can be achieved (Ibid). Storage is also a technology that is promoted as an ingredient of future's s-t system by the current energy planning (ΥΠ.ΠΕ.ΕΝ., 2018). Finally, storage stations will be necessary so that the island moves onto the third phase of transition by 2050 or 2060, as I am going to argue later on.

Total electricity needs will be evaluated as similar to the former project (Scenario 1). So, this scenario has been also scheduled on condition that 52MW and 27MW will be needed for electricity and for transportation respectively. In the initial stage, priority will be given to the converting the thermal plant into natural gas technology and installing renewable technologies to a limited degree. Hence, as the current installed

[300] See, for instance, the company's annual reports showing its interest in entering the fuel station market: http://www.depa.gr/content/article/002001018/1941.html

[301] There is a little doubt about the company's interest in entering the local transportation sector in case of constructing infrastructures on a neighboring island. LNG fuels do not require any further treatment. On the other hand, establishing a heating/cooling local network requires a gasification process to the LNG, thus it being accomplished depends on the economic results anticipated from such project.

[302] According to its delegates, this scenario had been considered by PPC

[303] According to the interview with a HEDNO's representative, renewable technologies' penetration into the energy mix is relatively easily achievable and reliable.

capacity from renewables is approximately 15MW, a 30MW natural gas plant will be constructed[304] and a 7MW production[305] from new renewable projects will be required until 2030 so that current energy needs will be covered. The initial sub-project supported will be the roof pvs one. Further, energy storage technology will be constructed so as to ensure the system's stability and reliability in case of energy demand exceeding 30MW. Besides, managing energy demand as well as a series of other measures already presented will ensure the network's efficiency and stability.

From 2030s onwards, the second stage of the process will be initiated. Thus, new renewable technology projects will be installed so that they contribute to a higher renewable energy penetration into the energy mix reaching up to 70%. These new projects will support a gradual transportation turn to electricity, although a large percentage of the nested transportation regime could turn to natural gas due to the latter being technically compatible with conventional cars and exhibiting lower cost. For this reason, new 15MW renewable technologies projects[306] will be scheduled. More particularly, in this stage, the steering actor will prioritize installing the same categories of renewable technologies as in the "flourish of renewable" pathway. Based on this, a pvs on roofs project will be planned, if the initial one before the 2030s turns out to be successful, together with a small-scale wind turbines one. Each project's energy capacity will depend on the needs set out by the scenario. However, initially, priority will be given to installing an additional 7MW photovoltaics[307] on roofs and 8MW small wind turbines. If these sub-projects prove to be successful, a large wind turbines project could be avoided at that time.

Commencing in the late 2030s, the third stage of the energy transition will begin. At that stage, the target will be to install the rest of RES required, as well as a turn from natural gas to more sustainable technologies. This final project will have a timetable varying between ten and twenty years, with its duration eventually depending on the EU pressures and objectives for the 2050. Independent of the pressures, the scenario

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[304] According to HEDNO's engineers, minimum technical standards required for natural gas power technology are lower than those for diesel technology, thus reducing the thermoelectric plant's installed capacity is justified, if simultaneously the renewable technology's installed capacity increases together with storage technology.

[305] As it has already been mentioned, the peak demand in the nested regime reaches 52MW; as there is already a 15MW installed capacity from renewables and –according to the scenario– the new natural gas technology will have a 30MW capacity, an additional 7MW from renewables is required.

[306] As the total installed capacity on the island is 52MW, a share of the renewable technologies in the energy mix to a 70% requires 35MW from renewables. As the installed capacity of renewables –according to the scenario– until 2030 is 22MW, a further 15MW of wind and solar technology is required.

[307] The aggregate installed capacity of the new projects solar technology, since the beginning of the transition, will be 7+7=14MW at that time.

schedules a 100% penetration into fossil-free technologies until that time. Natural gas is considered a sustainable energy technology only for a mediating period[308]. Further, the current Greek long-term energy plan (2018) argues for a strategy reducing natural gas penetration in the energy mix from 2040 onwards. In this framework, in the nested regime, the essential actions ensuring the transition from natural gas to other technologies or even limiting its amounts to minimum will be planned. EU has laid down suggestions about replacing natural gas by other renewable energy technologies until the 2050s or it coexisting with carbon capture and storage (CCS) technology (EC, COM2011/885:12). This latter technology, although initially presented as a promising one by intergovernmental and governmental actors, contributing to climate change mitigation (IPCC, 2005; IEA, 2010), it has however been developing very slowly due to technical issues[309], challenges regarding social and political character and lack of financing[310]. More particularly, it is been claimed that the shortage of large-scale pilot projects is attributed to its high risks on investments as well as reputation risks for the companies and the governments (Kern F., et al, 2015; Markusson et al., 2012; Meadocroft and Landhelle, 2009; Meadowcroft, 2009). Further, issues regarding the regulatory framework, liability regimes and long-term monitoring (Meadowcroft, 2009) as well as objections raised by social relevant groups[311] have delegitimized CCS, rendering its development in the decades to come rather unlikely and in a way problematic. In addition, as it has already been argued in the first chapter of this research thesis, the sustainable orientation of such an innovation is questionable, as it perpetuates the use of fossil fuels and realigns unsustainable technologies, while failing to abandon current energy social practices and patterns (Meadowcroft, 2009; Von Goerne and Lundberg, 2008; Kemp and Rotmans, 2005). That being said, I maintain that CCS is unlikely to offer a future solution in the nested energy regime; therefore, the natural gas remaining in the future energy mix is deemed problematic.

Another technology that has been proposed in the country's current long-term energy plan is producing hydrogen by employing renewable technologies and then injecting

[308] The E.C., in its "Energy Roadmap 2050" report (COM 2011/885), regards natural gas as a transition fuel to a decarbonized economy from 2050s onwards.
[309] See, for instance, Markusson et al., 2012 arguments about this.
[310] About this, read Kern, F., et al.,2015; Foxon et al, 2013.
[311] See, for instance, the arguments voiced by large NGOs such as Greenpeace and WWF.

it to the natural gas pipeline network[312], creating an enriched natural gas form (ΥΠ.ΠΕ.ΕΝ., 2018:58). The particular niche technology is still an immature one. This thesis is in favor of already mature niche technologies, thus such a scenario will not be advocated. Besides, according to the national plan, such a possibility will be looked into but will not necessarily be adopted. As far as this transition is concerned, a pathway leading to natural gas technology transformation to biogas and/or other mature renewable technologies will be preferred by the local steering actor. What's more, I claim that biogas, wind turbines and pvs technologies could contribute to engaging locals to a greater extent than complicated and high-tech niches like hydrogen could.

In respect of this, PPC's initial intention to transform its power plant to a biogas one or to invest in large wind turbines of equal energy capacity, shutting down the natural gas station after 2050, will be examined by the steering actor. Besides, capital investments in natural gas have an average life time between 25 to 35 years[313]. Depreciating the sunk costs of the initial investment is a factor affecting PPC's decision in changing its fuel technology. Moreover, injecting biogas into a power plant's natural gas grid is becoming a common practice[314]of relatively low cost for the investors. In any event, if the national actor doesn't seem to be interested in such a perspective, the steering actor will try to achieve adopting renewable projects, ensuring a nested regime's sustainable transition though a reflexive mode of governance (Meadowcroft, 2007). In this context, other incumbent actors interested in investing in a biogas power plant on the island will be invited by the steering actor. There will also be plans about a large wind turbines project, in which local and national actors will be invited to participate, in order for renewable technology penetration to the local network to grow.

Large technological systems, like the utility's network and the natural gas power plant, create their own pace and dynamic, which could allow its long-term operation. However, natural gas is considered a mediated fuel, thus an energy solution only in the short-run, until the 2050s or 60s. In order to secure a transition from natural gas technology from that time onwards a number of institutional tools have to be activated

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[312] For more information about the particular technology, see Walker et al, 2016.
[313]About this, see the article by "Capital" in the following link http://www.capital.gr/epixeiriseis/3313012/egkrithike-i-adeia-gia-ti-nea-megali-ependusi-tis-mutilinaios
[314] See, for instance, Sahota et al, 2018; Scalrat et al, 2018.

even from the 2030s onwards by the state. Subsequently, it is important that the central government and other governmental actors facilitate the transition to more sustainable pathways by activating tools like fiscal incentives, tradable green certificates (TGC) and gas emissions market. As far as tax reductions pertaining to renewable construction are concerned, these could be set only to a local/regional scale[315] by the government, even from the early 2030s on, supporting local engagement and a transition to renewables. The measure could continue for more than a decade, allowing PPC to utilize it in case it decides a transition to fossil-free technologies. Further, fiscal incentives will facilitate renewables to penetrate into the local network. On the other hand, the lack of an interconnection with the continental grid renders the incentive less attractive to incumbent regime actors. As far as the green certificates are concerned, they will be combined with quota obligations and non-compliance heavy fines, thus generating obstacles to natural gas penetration from the mid 2040s onwards, compelling non-renewable producers to invest in renewable technologies[316]. Tradable green certificates indirectly subsidize renewable technologies producers, decreasing their cost, thus contributing to their development (Hustveit et al, 2017; Pineda and Bock, 2016; Pavaloaia et al, 2015). Thus, even from the starting phase of the transition process, the government, together with OEM, the institutional actor operating the electricity market, will set and announce a framework requiring from electricity and heating cooling networks' providers to buy green certificates in a relatively high percentage of their sales. The framework will drive PPC to fuel its power plants using sustainable fuels. In the same direction, the institutional steering actor will try to create a 100% renewable energy island vision from the 2050s forth, supporting green certificates and reinforcing their position. From the mid 2030s onwards, this actor will start envisioning constructing a biogas plant, motivating local interested parties, engaging farmers of the region and local authorities and debating with the PPC and other biogas actors so that the third stage of the electricity transition takes place.

The last tool that will be used is related to the Emissions Trading System (ETS). This mechanism has been adopted by the EU since 2005 (E.C., 2003/87). Over the past

[315] In Greece, taxation culture allows differences in taxation between insular isolated areas and the rest of the country. The Value Added Tax on the islands as well as different financial incentives in two demonstration energy projects according to the Law 4414/16 are examples of the alternative frameworks. See also http://www.capital.gr/epixeiriseis/3248083/ubridikoi-stathmoi-me-eidika-pronomia-se-nisia

[316] Regarding TGC and quota obligations, see Pineda and Bock, 2015; Pavaloaia L., et al, 2015 and Hustveit et al, 2017.

years, the framework has been tightened up so as to call for a 43% reduction (by 2030, in relation to their 2005 capacity) in emissions regarding to the sectors included in the system[317]. The national energy regime is obliged to follow this framework in the years to come. This will exert pressure to non- renewable electricity and heating/cooling actors for a transition to sustainable energy technologies. In this context, it is presumed that a biogas plant with similar or smaller (compared to a natural gas one) installed capacity is very likely to follow this pathway. For the needs of the biogas production, a plant will be constructed, which will convert animal manure and other organic materials, as, for instance, are municipal organic waste, into energy. In this case, a part of the energy consumption needs from biogas will be locally produced. This will contribute to boosting circular economy, the financial efficiency of the project and its sustainable orientation. Besides, in energy research several scholars (Sovacool, 2010; Ruggiero et al, 2015; Hewitt et al, 2017) have presented projects or attempts of participatory pathways in a local level which facilitate their development.

In this respect, the steering actor will try to activate PPC, as well as local investors, the Municipality, the PCWSS[318], the farmers and livestock owners[319] and other interested parties so that they participate in setting up such project. PPC is considered as a crucial actor because of its know-how and its interest in such projects. In case of low engagement on behalf of local farmers, the farmers of the neighboring island will be approached. As I have already claimed, using natural gas technology for electricity could facilitate amplifying its use in other fields, such as in transportation and cooling/heating. If PPC or DEPA construct infrastructures for storing LNG, that will give the potential for it to be used in other domestic uses. Hence, other actors could be engaged in the gas technology by taking advantage of its deployment on the island and developing alternative usage. A final issue of this scenario has to do with

[317]More analytical objectives laid down by this mechanism, as it has been revised, you can see in https://ec.europa.eu/clima/sites/clima/files/docs/ets_handbook_en.pdf

[318] Sewage sludge is part of the raw materials used in biogas production.

[319] The local community went through a similar way in trying to engage in biogas production in the cases of Samso and Gotland, which have already been mentioned (see, for instance, Action plan in Energy 2020: Energy plan for Region Gotland, http://gotland.se/54546, https://energiakademiet.dk/en/samsoe-2/island-3-0/). Animal manure, energy crops and crop residues are agricultural raw materials used in biogas production. Thus, farmers, livestock owners as well as the small local poultry farms could increase their incomes by collecting the residues of their activities. In this manner, it is significant that the steering actor explain and convince these actors about their financial interest deriving from participating in the biogas project. It is worth noting that the current Greek framework allows biogas plants to work under similar collaborative schemes. That is the case, for instance, of Lagkada biogas plant, which features four livestock farms and individuals from an agriculture consulting company (for more info, see http://www.biogaslagada.gr/)

transportation. Based on that, heavy cars and public transportation transition to biogas until 2050 will be supported. Furthermore, biogas could be upgraded to bio-methane and used as a transport fuel in natural gas vehicles' engines (Scarlet et al, 2018:459). However, using biogas in individual transportation could significantly increase the need for raw materials, rendering producing the required amount locally impossible. In this regard, these needs will be covered by imports[320]. In reference to private cars, the steering actor's objective will be to promote their transition to electric cars and motor bikes technology. Proceeding with or turning down the natural gas power plant transition to biogas, along with its capacity, will affect the number and installed capacity of the other renewable technologies, which are necessary for the transition to materialize. Thus, if a 10 to 20 MW biogas plant operates on the island, additional 20 to 30 MW renewable projects, together with storage stations for this capacity, will be promoted.

Table 14. Main actors participating in the different pathways.

Divergent Pathways	Flourish of Renewables	Gas Emergence	Linkage with the Neighbors	Continental Solution to the Motherland	Interconnection with Others
Requirements for civil society's engagement	Very high	Medium to high	High	Medium to high	High
Key actors	1.Local steering actor. 2.HEDNO 3.Energy_communities 4.APEPEA. 5.User-consumers as co--providers 6.Municipality 7.Large Users - Hotels, PCWSS 8.Mediators - Engineers, Electricians 9.Chamber of Commerce. 10.Incumbent actors - PPC, ELLETAEN	1.PPC. 2.Local_steering_actor. 3.Government. 4.OEM. 5.Energy Communities 6.PCWSS 7.Other users - Hotels, APEPEA. 8.Municipality 9.Farmers and sheep farmers 10.Mediators - Engineers, Electricians 11.Chamber of Commerce. 12.DEPA (probably)	1.Local_steering_actor. 2.HEDNO 3.Energy communities. 4.PPC. 5.DEPA 6.APEPEA 7.Municipality 8.Large Users - Hotels, PCWSS 9.User-consumers as co-providers 10.Mediators - Engineers, Electricians 11.Chamber of Commerce. 12.Other incumbent actors - ELLETAEN	1.IPTO. 2.Local_steering_actor. 3.APEPEA 4.HEDNO 5.Energy_communities. 6.Municipality 7.Large_Users-Hotels,PCWSS 8.User-consumers as co-providers 9.Chamber of Commerce. 10.Mediators-Engineers, Electricians 12.Incumbent_actors-PPC, ELLETAEN	1.Local_steering_actor. 2.Energy_communities. 3.IPTO. 4.HEDNO 5.Municipality 6.Large_Users-Hotels,PCWSS 7.User-consumers as co-providers 8.Chamber of Commerce. 9.Mediators-Engineers, Electricians 10.Incumbent_actors-PPC, ELLETAEN

The type of projects will depend on the dynamic of the projects constructed during the 2030s. In any event, engaging local community will be a central target set by the steering actor.

Scenario 3 – Linkage with the Neighbors

According to this pathway, the largest islands of the region will be interconnected through grids so that they better stabilize their electrical systems and minimize

[320] Regarding the supply chain management of biomaterials producing bio-energy, see Shabani and Sowlati, 2013; Marufuzzaman et al, 2014.

average electricity cost[321]. As it has been argued in the previous section, average production cost for the islands is higher than that for continental Greece (ΔΕΔΔΗΕ, 2018). Subsequently, electrically connecting the region's five major islands and shutting down three power plants will create economies of scale for the new natural gas technology plants, thus reducing the s-t system's average cost. In this context, Limnos, Lesvos, Chios, Samos and Ikaria will be interconnected. In that case, three of the five thermo-electric plants will shut down (that of Chios, Limnos and Ikaria), while the other two (those of Lesvos and Samos) will make a transition to new, natural gas powered technology. This pathway's main technologies, except for the natural gas one, are the various renewable technologies that will be installed. In the nested Chian regime, roof pvs and small wind turbines projects will be prioritized (see table 13).

The hybrid power plant of Ikaria, that produces approximately 9.8 GWh per annum, will remain, further stabilizing the system. This pathway employs using battery storage technology in connection with installing renewable technologies on all five islands. Moreover, converting the natural gas plants to biogas ones, corresponding with the aforementioned pathway (Scenario 2), will be required after the 2050s. This means that similar policies, like those in the previous pathway, obliging in a way the incumbent actors to make a transition to biogas in the long-term have to be ensued. Nevertheless, steering the transition in a regional level is beyond the local steering actor's jurisdictions and of the need for the nested regime to transition to renewables pathway. On the islands, that the thermo-electrical plants will have totally shut down, the whole consumption will be made possible by renewables, even from an initial stage. Therefore, in the nested regime of Chios, a similar to “Flourish of Renewables” pathway will be followed, albeit moving at a more gradual pace. Relying on this, the steering process that the intermediary institutional actor will follow, the total capacity and the sub-projects types promoted will be similar to the previous scenario. Storage technology will also be promoted, however a smaller installed capacity regarding this technology is anticipated, due to grid connections. The role of the steering actor, as well as that of other local actors, will be significant, although this pathway calls for incumbent actors like PPC and DEPA assuming a more pivotal position in relation to the first scenario (figure 13).

[321] This pathway was brought up to me in an interview by a nested regime actor as a cost-efficient and reliable one.

Regarding the nested transportation transition and the heating/cooling network, things could be partially different. Regionally transitioning to natural gas and potentially establishing an LNG bunker port infrastructure, at least on one of the region's bigger islands, could therefore guarantee the transportation transition to natural gas to a great extent. DEPA or other peripheral actors will utilize LNG infrastructures on the islands so as to run natural gas fueling stations on Chios. Thus, transportation will follow the former scenario (Scenario 2) on Chios, adopting biogas technology as a renewable one, in the 2050s or 2060s. In this context, biogas will be used as a transport fuel in natural gas vehicles engines (Scarlet et al, 2018). Subsequently, heavy cars and a number of individual cars could operate on biogas on Chios as well as on the other islands of the region.

Scenario 4 – Continental solution to the Motherland

This pathway is based on previous plans drawn up by the Greek state, and particularly by IPTO, aiming at interconnecting the North Aegean Region with the main grid (ΑΔΜΗΕ, 2014:129-130). The plan included provisions about dually connecting the island with continental Greece. On the one side, the connection would link Chios island, through Limnos and Lesvos, with Northern Greece, while on the other side, the island will be connected with the Sterea Ellada Region[322]. Further, it is worth noting, that during the last decade, the Greek state has introduced a narrative regarding interconnecting all the autonomous s-t systems with the main grid[323]. Matters related to reliability, stability and security of the islands' electricity network strengthen this perspective. Moreover, this plan is part of a wider EU narrative for a pan-European interconnection. In this context, nowadays a few of the Cyclades islands have already been interconnected, while plans have been drawn up regarding interconnecting all Cyclades islands with that of Crete for the years to come. On top of that, in the long run, the South-Aegean islands are expected to be interconnected with the continental grid [324]. Based on these, key technology in this pathway will be the electricity interconnector's submarine cable. Further, several renewable

[322] Iberdola-Rokas came up with a similar proposal, in its attempt for an energy transition back in the early 2010s, although, in that case, only a single connection with the inland electricity network was intended to be carried out.
[323] See the country's long tern energy planning, which prioritized interconnecting all large and medium size islands with the continental grid (ΥΠ.ΠΕ.ΕΝ., 2018:38).
[324] For more information, see ΑΔΜΗΕ, «Δεκαετές πρόγραμμα ανάπτυξης συστήματος μεταφοράς 2018-2027, 2017».

technologies transitions will be run, while small wind powered and roof solar technologies for electricity production will be the initial ones (table 13).

A grid connection is of vital importance for an insular area, as it secures the system's stability and validity. Such a project could also facilitate increasing the national grid's penetration with renewable powered production and as well as reducing the average cost for producing electricity (ΥΠ.ΠΕ.ΕΝ., 2018). Moreover, it ensures that the system will be constantly operating and energy will be exported or imported according to the local network's needs. In fact, such a project requires installing two grid connections so that they ensure constant electricity flow. An interconnection scenario would allow the island's energy-sufficiency without the need for any renewable technologies in the nested regime to be installed, however, such a trajectory will not guarantee a sustainable transition. Regarding this, a sustainable transition requires installing renewable technologies on a local scale and engaging civil society in this pathway. On the other hand, central institutional actors like the government support interconnections as a way to increase renewable technologies penetration into the national grid (ΥΠ.ΠΕ.ΕΝ., 2018). Thus, in case of interconnecting the island, installing renewables is considered a taken-for-granted process. In this framework, if the local community appears to be sluggish in engaging in the energy transition which in the making, then other actors will take over, based on their terms and the way they conceptualize sustainable pathways. Hence, a transition to renewable technologies perceiving sustainable development in the way that it has been delimited in this research thesis requires engaging the local actors. In this sense, the steering actor’s role, attempts and flexibility in activating and engaging the local society quickly as well as their response have a considerable impact on the outcome of this pathway. Other key actors will be the local regime’s actors like APEPEA, engaging in the process and establishing energy communities (table 14). Further, in regard to alternative pathways, in this one, the IPTO's role is very important.

As it has been made clear, the above mentioned framework almost necessitates installing renewable energy technologies in the nested regime[325]. In addition, the interconnection technology pathway means that electricity could be massively

[325] In a sense that, one way or another, a renewable projects series will be constructed on the island because interconnection will necessitate so.

commercialized and exported from the islands, as many national and international attempts indicate[326]. Relying on the way sustainable development has been conceptualized in this research thesis, such a pathway is not considered sustainable. In this manner, the transition's sustainable dimension will be ensured through the continental interconnector's technical characteristics[327]. Additionally, the total capacity of electricity local production in this project will be the same with the former ones, thus 79MW[328]. Following this view, new renewable technology projects of 64MW installed capacity need to be constructed for the energy needs of the island, while the interconnection will be used only for security reasons. Further, in order to ensure a reasonable deployment of renewables due to interconnections, the steering actor will activate actors having a more environmentally sensitive approach in these issues, such as users-citizens and the universities, by allowing for more sustainable directions to be followed**.** Besides, this level of power capacity enables the partial exportation of electricity, at least seasonally.

This pathway does not require extensively adopting storage technologies. Nonetheless, a narrative revolving around the island's energy self-sufficiency as well as the economic perspectives of such a decision would be promoted by the steering actor so that local actors support energy storing. For the rest, interconnection pathway resembles the “Flourish of Renewables” one. In this manner, the sub-projects that will be prioritized will be those that pave the way for local participation. In regard to the power plant's condition, this will be modified based on how fast the interconnection process moves along. During the initial stage, until 2030, installing the first grid would allow the hot standby of the power plant. Until 2040, the second grid connection will have been submerged, thus the station's condition will switch to a cold standby, and afterwards, to shutdown.

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[326] See for instance the attempts of two wind actors for large-scale transitions in Crete https://energyin.gr/2016/05/18/%cf%8c%cf%87%ce%b9-%cf%84%ce%b7%cf%82-%cf%80%ce%b5%cf%81%ce%b9%cf%86%ce%ad%cf%81%ce%b5%ce%b9%ce%b1%cf%82-%ce%ba%cf%81%ce%ae%cf%84%ce%b7%cf%82-%cf%83%cf%84%ce%b7-%ce%bc%ce%b1%ce%b6%ce%b9/

[327] The interconnector's capacity will take into account the energy demand peak for all five islands that will be connected to the continental grid. Based on this, current energy demand approaches 170MW, while the thermoelectric plants' installed capacity is close to 220MW (source: ΔΕΔΔΗΕ, 2018). In previous reports, IPTO has argued that the interconnector’s capacity could be even less than the demand peak, based on the international practices regarding these kinds of projects (ΑΔΜΗΕ, 2014:147). However, judging by the actor’s and RAE’s propositions in the case of a particular project in Crete (ΑΔΜΗΕ, 2014:147), we view an interconnector between 170 and 240 MW as the optimum high-reliability solution.

[328] The total capacity is a result of 52MW for electricity use and an extra 27MW for transportation needs .

With reference to renewable technologies projects, the main difference with the initial scenario is that storage technologies are not necessary because of the interconnection. This change will reduce the transition projects' cost-per-kWh, thus making them more affordable to individual users. On the other hand, this alteration could negatively affect the change of users-consumers' practices, since, in case a deficit in the local energy supply emerges, this will be covered by imports from the continental network. This difference will create divergent perception of the energy sufficiency in the nested regime. In any case, DSM and other tools and technologies that have already been proposed in previous sections will be used so that they can at least ensure limited changes in the energy practices, thus allowing for a "weak" sustainable development pathway.

Relying on these elements, constructing a project regarding photovoltaics on roofs and a small wind turbines one will be scheduled for the first decade. The local steering actor will aspire to engage primarily the local community. The initial planned installed power will be 20MW, but their final capacity will depend on the projects' dynamics. Over and above, establishing energy communities will work as the umbrella for civil society's participation. Starting from the mid 2030s, other large wind turbines and photovoltaic projects will be initiated. Their actual size will rely upon the success or failure of the two aforementioned projects, as well as upon the deliberation process and whether local society will be interested in investing. Regarding the inland turbines project, if large investors participate in the process, a joint venture will be established to ensure that small local actors will be involved, as it has been argued earlier. A public-private partnership will be scheduled for this reason too, provided that the Municipality is interested in it. Besides, as the nested regime will be interconnected with the main grid, other transition projects could be planned by incumbent actors; these plans need to be taken into account by the local steering actors. Furthermore, if the initial projects fail, transforming the conventional power plant to a biogas one by PPC or constructing a new one will be explored. In that case, constructing a plant producing biogas locally will be required, while other local stakeholders like PCWSS and the farmers will be engaged. Further, the likelihood of a biogas plant will lead transportation and heating/cooling transition to follow a pathway similar to the former one (Scenario 2) in the nested regime.

If the planned projects fail to deliver the necessary capacity so as to ensure the energy network's stability, the steering actor, employing a reflexive process, will propose a final project. Subsequently, from 2040 onwards, building floating wind turbines will be scheduled. Its exact capacity will depend on the results rendered by the other sub-projects, but it won't be less than 14 MW. Initially, the steering actor will invite PPC, ELLETEAN and other incumbent actors to participate in fulfilling the particular sub-project. In case this is deemed essential, other large investors will be invited too.

The particular scenario doesn't necessitate a storage technology implementation. The grid connection will allow for exporting energy, when there is a surplus, or importing, in an opposite condition.

Scenario 5 – Interconnection with Others

In the past, there have been suggestions in the public discourse by the policy makers that the North Aegean islands be connected with the Turkish electricity network[329]. Hence, the particular pathway is based on this narrative. In this case, the electrical interconnection of the North-East Aegean island with the Turkish coast will be studied as an alternative scenario to the "Continental solution to the Motherland". Both of them have many similarities, although connection with another country's electric network creates a few differences. Regarding this, and despite the fact that the country's relation with its east bound neighbor is not exactly amiable, the two countries are involved in many business transactions including those pertaining to energy and tourism. Besides, this will not be the first time the Greek energy network is interconnected with that of Turkey[330]. Further, the thermal power plant will remain in a cold standby position even after the project is accomplished, for security reasons. In the same direction, this pathway will entail installing storage technologies, in contrast to the case of an interconnection with continental Greece. With that in mind, the basic technologies will be the same ones as in the aforementioned pathway, while storage technologies will be used additionally (table 13). It will require, additionally, two grid connections with the Asia Minor coast until 2040 so that they guarantee the security and reliability of the islands' energy network. The local steering actor's role will be essential in this pathway too since it is essential that renewable technologies

[329] Regarding the particular public discourse, see https://energypress.gr/news/nd-o-papakonstantinoy-na-xekatharisei-ta-peri-diasyndesis-nision-me-tin-toyrkia and http://chiosnews.com/36774.
[330] See ΑΔΜΗΕ, «Δεκαετές πρόγραμμα ανάπτυξης συστήματος μεταφοράς 2017-2026», 2016: 27305-27306.

be installed to a great extent in order to ensure the nested s-t system's reliability, as in the case of the “Continental solution to the Motherland” pathway. Thus, the steering actor’s effort to engage the local regime and its quick response will be important. On the other hand, this pathway does not imply that these projects have to be installed in the short-run. For the rest, the project follows the same pathway as that of the interconnection with continental Greece. In the following section, I will present the particular ways and steering methods that the steering actor will follow so as to instigate the nested tourism regime actors’ to join in the transition. In addition, other measures that could further deepen the tourism energy transition will be discussed.

Sustainable energy transition on tourism

Hospitality industry on the island constitutes a large energy user. In this way, the sector's engagement in the deep energy transition will be of vital importance. Furthermore, installing renewable and efficient energy technologies in the hotels will enforce local participation. Such a transformation will also allow tourism to be redirected into more environmentally and socially friendly pathways. Subsequently, regardless of the energy pathway that will be followed, the steering actor must strive to achieve the sector's participation. More specifically, the actor steering the transition has to invite the hospitality sector as a whole and its association in the deliberation process and the energy meetings at the beginning of the energy transition project. Big enterprises belonging to this sector as well as businesses with a more environmentally and socially friendly imprint need to be approached separately so that they are convinced of the collateral benefits associated with participating in the transition. Further, a workshop informing the nested tourism regime about the efficient technologies that hotels could install in regard to energy saving, electricity and hot water need to be organized. Besides, as it has turned out by my primary research, the relevant local companies are showing great interest in investing in this kind of projects, in case that economic benefits come into view[331]. Producing the energy they need as well as participating in energy communities could decrease or even completely eliminate hotels' electricity demand from the conventional network,

[331] These are facts deriving from the interview with local hotel association's actors.

through net-metering and virtual net-metering[332] (Bischoff et al, 2016). In addition, installing roof pvs will cover the sector's need for hot water.

In the long run, the nested tourist regime could even deepen further its energy transition based on a framework similar to the one that was used in one of the exemplary cases in the third chapter. With reference to the case of Gotland, establishing a new state actor which consulted small hotel enterprises was a way of deepening its tourism nested energy transition. In this context, in the Chian case, the local steering actor will need to activate the nested regime’s actors, like the Hotels Union and the Chamber of Commerce, so as to deepen the hospitality sector's electricity transition. Engaging these two actors is necessary so that the latter hires an economic advisor specialized on European subsidy programmes issues and other financial tools in order to motivate local small tourist enterprises to follow the energy transition. In addition, these three actors will ensure that the new private one will have an experience on small tourist enterprises financing and on alternative eco-friendly logics. Local governments could support the action in several ways[333]. This private actor, together with the steering one, could provide assistance and support to small tourist businesses in energy and finance issues, promoting a sustainable culture. More particularly, these actors will inform tourism businesses through discussions, workshops and seminars regarding the financial tools that are available for an energy transition, while they will propose the more appropriate technologies to them so that the latter can cover their energy needs, such as pv panels and heating pumps[334]. In respect to rental cars[335] transition, regardless of the transition pathway that will be followed and the other changes in the nested transportation regime that will also influence the rental car actors, deepening the nested tourism regime's sustainability further, the steering actor needs to prompt these local actors to transform their cars to electric technology ones in the long run. The government’s role in this direction is critical. Therefore, its initiative for constructing AC electric cars charging stations on the islands (ΥΠ.ΠΕ.ΕΝ., 2018:67-68) within the following years and its statement in the current energy plan for tax reductions in the sector's actors aiming at buying new

[332]There have been surveys dating back to the late 2000s showing the economic efficiency that several renewable technologies installed in hotels can deliver. See, for instance, related studies (Bischoff et al, 2017; Dalton et al, 2009).
[333] For instance, by financing the project or by promoting these enterprises in its tourism campaigns.
[334] This actor's characteristics are similar to those of the corresponded actor established in the Gotland case.
[335] While being interviewed, this actor conveyed the association's need to be financially supported, while further sharing its concerns on reliability and maturity issues that novel technologies are associated with. Finally, it requested that a charging stations network for electric vehicles be pre-constructed.

electric cars (ΥΠ.ΠΕ.ΕΝ., 2018:156) will be an initial step towards achieving a long-term transition of the sector.

Conclusion –
Configuring a deep transition: sustainability, energy and tourism

The aim of this research thesis has been to steer a deep energy transition including tourism. For this reason, a hybrid model was developed based on transition theories, focusing on governance issues. The hybrid approach has been used in running five different sustainable transition pathways. In addition, in the third chapter, two exemplary cases regarding energy transitions from the North were studied so that I could enrich my approach as well as facilitate and, in a way, guide my objective of running divergent transition pathways. From these cases, I mainly utilized institutional and technical solutions and tools which inspired the transition pathways in my empirical case, taking, however, the Greek framework into account. In this chapter, I will try to outline some critical features pertaining to this research thesis. In this manner, I will afterwards present the key elements regarding the two transition cases of the North and what could be learned from them so as to be, it turn, employed in the Greek political context. Furthermore, I will highlight the fifth chapter's central issues by illustrating institutional frameworks and the way my approach operates. What I also consider necessary is to underline aspects of the way I tried to embed my approach in the national and the local rationality. In addition, paradigms of the existing practices in the national framework will be illustrated so that I could point out the novel characteristics of my hybrid approach, which contributes and enriches the transition studies theory in regard to the Greek framework. Finally, in these concluding remarks, I would like to stress future actions and elements which are necessary in deepening the s-t transition further and steering the s-t tourist regime to sustainable development.

North-South comparison: A nested energy transition in South Europe

The two exemplary cases that have been studied in this thesis, despite setting of from a common base –engaging local society in an energy transition– and having similar aims –deepening these transitions further to renewable technologies–,follow, however, different pathways. In the Danish case of Samso, the state was a critical actor in steering the process during the very initial stage. Thus, this actor created visions for a “green energy island”, launched a competition, financially supported the winner and established a local actor mediating the transition, while further, it had already set the regulatory framework facilitating the process. Nonetheless, the transition paradigm of Samso was in a way an ad hoc one, in the sense that the Danish state adopted a special framework for the Samso nested regime through the competition context. In the nested transition, the role of the local intermediary institutional actor was vital in steering the local process: since the transition began, it created visions, entangled and engaged locals, supported collaborative schemes and showed reflexivity in the way the nested transition was steered. That role became even wider during the following years, since it got in charge of mediating and legitimizing a long-term vision for the island, further deepening the energy transition, as well as undertaking a role in a national and international energy transitions framework. In the particular nested regime, the individual entanglers' role in activating local users and, in many cases, accelerating the transition’s time scale was also pivotal. Further, an individual entangler's participation in the local steering actor institutionalizes and strengthens its voice in the public discourse, enabling the local community to engage more easily. Additionally, special features that the nested energy transition of Samso displayed were the extensive deliberation process and the local engagement. It is worth noting once again that the steering actor acknowledged and integrated the majority of suggestions –made by the locals during the meetings– into the transition framework. Moreover, the local government assumed a positive role even from the very beginning of the transition, legitimizing certain technologies and establishing intermediary actors. Its transformation to a very active actor undertaking in a central role, steering the nested transition in the following years, was very fundamental for deepening the energy transition to a greater degree as well as for the long term visions pertaining to a 100% renewable energy local regime (Mathiesen et al, 2015). Finally, in regard to the technologies that have been used in the transition, wind and biomass technologies are the major ones in both cases; besides, these are the dominant renewable technologies in the national regime in both countries. On the other hand, a limited number of medium scale in-land wind turbines and an off-land wind park pathway were chosen in the case of Samso. Solar technology for hot water and electricity production was also developed in many cases, to a rather wider extent than in the national regimes. In addition, in the nested regime, as also happened in the case of Gotland, the electricity s-t system has been interconnected with the in-land grid.

In the Swedish case of Gotland, the nested transition followed an alternative, rather more intervening pathway. The state, in this nested transition, was involved by setting a national energy framework, engaging local governments, facilitating the latter's planning and granting energy transitions, while creating a national green vision. Subsequently, this nested transition featured a major role by the local government. This actor created visions, engaged the locals, affected local practices, set objectives and requirements for other actors, thus steering the process. This pivotal position was also dictated by the Swedish political culture and framework, granting a central intervening role to the national and regional governments, even in the market economy. This feature allowed the local government-steering actor to affecting and control in a sense, directly or indirectly, many local regime's actors and, in this way, steer a sustainable transition. As in the case of Samso, this nested energy regime showcased a transition which was assisted by local actors and individual users being extensively engaged as a result of deliberation processes. However, in this case, the local steering actor kept a rather more decisive and intervening role in the s-t transition. On the other hand, an objective of a sustainable transition, as it has been perceived in this research thesis, is changing energy practices in a sustainable way. In this context, diminishing the nested regime's energy needs through managing demand and employing energy saving measures, in contrast with the case of Samso, is an element exemplifying a sustainable transition. With reference to the renewable technologies that were employed in this transition, wind turbines technology –in a massive scale– and bio- energy were the most developed ones.

In general, I argue that the two exemplary nested transitions have resulted from different political, institutional, and cultural frameworks, as well as from national energy regimes with different dynamics. Towards this direction, I maintain that the Danish energy regime has integrated a more co-operative culture, owing to the bottom-up process, through which it emerged back in the 70s and the 80s, also reflecting, historically, a societal mentality of this kind. Additionally, the major incumbent regime actors are mainly wind turbines producers and not utility companies, like in the Swedish case, something that has a dramatic impact on the dynamics and the pathways the regime has followed. On the other hand, the Swedish energy regime displays a different situated rationality, as it was influenced by the Swedish state's more normative and intervening role, as well as by large incumbent actors, mainly utilities, which perceive certain technologies and pathways as sustainable. However, as it has already been mentioned, there are important similarities allowing, in both cases, for the transition to be made. Two critical issues that, in my opinion, should be underlined are the local societies engaging and the local governments very actively participating. In addition, the extensive use of wind and bio-energy technology is another common characteristic of the pathway that it was followed. In regard to these two nested energy transition paradigms, I argue about their uniqueness for the national ones, as well as for the transition studies analysis. About this issue, in my view, on the one hand, what was distinct in the Samso case revolved around establishing an institutional local actor which steered the energy transition. This can be more clearly seen in the fact that, nowadays, this actor has more than just a local scale role and orientation. In regard to the steering approach that the actor followed in the nested regime, its objective is evident in engaging society and protecting local and co-operative schemes. On the other hand, Gotland's nested regime is about a case of a large island that has thrived into a massive tourist model after achieving an energy transition engaging locals and altering, in a sense, the energy practices, while its vision centered upon deepening this transition to other s-t regimes. A particular feature related to this s-t transition was that it included the nested tourist regime in it by using mediating actors, thus activating the local regime and ultimately cultivating a sustainable tourist narrative.

These two fundamental cases could inspire us in granting institutional and other tools so as to organize the steering approach in a direction that engages local society, following different sustainable transition pathways, also encompassing the nested tourism regime. Towards this direction, in my opinion, establishing an intermediary institutional actor that would mediate the transition process was significant, as it brought the national and the local level closer, while steering the transition locally. In the Danish case, the actor has developed a flexible, very “open”, non-governmental and deliberative structure which dovetails with the Danish framework. The Greek political paternalistic context, with a divergent political and institutional deliberation culture cannot support such a multi-level governance pattern. In regard to this, political science scholars (Ladi, 2004; Spanou, 2008; Andreou, 2006) have been alluding to the highly centralized Greek political system even since its establishment. Further, although, over the past thirty to forty years, European cohesion pressures as well as other parameters have contributed to a partial shift to more open schemes, diffusing –at least theoretically– participation in governance in the regional level, they haven't allowed for fundamental changes in the power relations (Andreou, 2006; Lampropoulou and Oikonomou, 2018). Thus, particular legislative changes due to European pressures led to existing processes, policies and institutions adapting rather than to inducing radical changes to the spirit that typifies the Greek framework in a way that could integrate collective understandings in harmony with the European perceptions (Andreou, 2006). Besides, the Ministry of Economy and Finance has the first and the last word in all the divisions regarding public revenues and expenditures (Ibid). Thus, all innovative legislative frameworks, such as the Energy Communities one, are individual and fragmented, while further, social dialogue is in general underdeveloped (Bache et al, 2011). This feature is made clear in the insufficiency displayed in other social actors' institutionalized participation in the monitoring process pertaining to the majority of the operational programmes (Ibid). In short, the Greek political framework has not changed significantly over the past twenty years, and neither have the power relations (Ibid). In this framework, I argue that this actor needs to exhibit an innovative character, engaging social actors in the transition process, but also to follow aspects of the national institutional framework, blending actors from the local and the national level as well as providing the state with a monitoring role. In regard to the tourism energy transition in the Gotland case, a very important feature, in my view, was establishing a mediating actor that would facilitate this transition in the long run. On the other hand, I argue that setting up a state actor of this kind would be demanding in the Greek bureaucratic and sluggish state machinery. In this framework, I supported a rather alternative perception which would engage nested tourist regime and private actors.

In regard to the technologies employed, I argue that the grid interconnection in both exemplary cases is what sets the framework apart compared to the majority of my pathways in the case of Chios, where a grid connection doesn't exist. Further, a series of innovations like bio-energy or off-shore wind turbines have been developed either to a smaller extent or not at all in the Greek energy regime. Bio-energy consisted a pivotal innovation in the energy policy of both countries in my exemplary cases, mostly owing to these countries' tradition in district heating technology, which since the 90s, has led to this innovation being extensively used. In the Greek case its development is slower, while its use in district heating networks probably requires the mediation of natural gas, in the sense that only the constructing district heating –initially for natural gas use– could probably result in bio-energy being used in the long run. Natural gas technology for electricity production is another major dissimilarity with the paradigms from the North. The grid connection in those cases and the huge power production by nuclear and hydro technology in the Swedish s-t regime rendered the use of natural gas unnecessary. In the Greek case, the island's lack of interconnection in most of the pathways, boosting natural gas in the national regime since the 90s as well as geopolitical reasons subscribe to this technology being considered a significant one in case of a transition. Finally, in regard to off-shore wind technology, I argue that the deep Aegean sea archipelagos[336]renders installing this technology difficult and very costly; that is why, in the first scenario, using floating wind turbines instead of others was proposed, as part of a reflexive process. In the next section, I am going to sketch the steering approach, shedding the light on its key elements.

Steering methodology and the engagement of locals

This section's central objective is to outline my approach's steering methodology, as it was followed in the fifth chapter of this research thesis, explaining mainly institutional frameworks and tools used in the making of the transition. In regard to this, I argue that an initial finding –influenced by the experience deriving from the exemplary cases as well as from the relevant literature– is that steering a nested transition makes establishing an intermediary institutional actor mediating the process essential. In regard to this view, I have been influenced by the pertinent literature presented in the second chapter, arguing for the need for new institutional actors (Meadowcroft, 2007), but principally by the case of Samso, which has been presented in the third chapter. To adopt this actor in the Greek reality, I used an innovative legislative framework that has been established by the Ministry of Environment and

[336] CRES had made a research regarding the possibility of installing off-shore wind turbines in the Aegean sea, in which it alludes to the large difficulty that the particular pathway is associated with (source: interview with CRES representative). However, off-shore wind technologies have made headway over the past years, which could change this condition.

Energy in the “Protected Natural Areas” context (Law 4519/18). I maintain that this framework can ensure the transition process's institutional continuity, while it can carve the whole concept to the Greek institutional and political reality. I also highlight the need for entanglers inside this mechanism. Although this has not been an issue in the framework of protected areas law, I claim that the technological transition process is a rather more dynamic and transformative one, thus particular actors activating and entangling local society are needed. Additionally, as it has been illustrated in the third chapter, these actors' role was fundamental in the nested transition process. Besides the relevant literature, as it has been discussed in the third and the fifth chapter, reference is made to these mediating actors' significance in achieving transition objectives (Van der Vleuten, 2018; Hess, 2018). As far as the above are concerned, I suggested that one or two entanglers participate in the institutional steering actor. I also claimed that certain individual actors such as the NGOs are more likely to play such a role.

Furthermore, in order to ensure the steering actor's flexibility in case that the transition process reaches an impasse, I use the reflexive modes of governance concept so that the steering actor can adapt to the “new reality”, thus achieving the transition. In regard to this, I have mentioned, in the second chapter, the way many transition scholars approached the reflexivity and reflexive mode of governance concept (Hendriks and Grin, 2007; Smith and Stirling, 2007; Vob and Kemp, 2006; Rip, 2006; Kemp and Loorbach, 2006; Vob, Truffer and Konrad, 2006; Meadowcroft, 2007). Further, I explained the way the concept is used in this research thesis, relying on Meadowcroft’s (2007) perspective, as well as on the way sustainable development is perceived in it.

Another central issue of the steering approach underlined in the fifth chapter is that, in nested s-t transitions, local engagement is essential. Armed with the experience deriving from the North's exemplary cases, I argue that engaging the local community is vital so that we accelerate the transition to renewables, prevent tensions with the local society and diffuse energy governance in a more democratic way, ultimately making the transition pathway sustainable. Relying on this perception, the local steering actor exerts consistent efforts, employing various ways, to engage local society. In respect to this attempt, the new energy communities’ institutional framework is extremely important, as it activates bottom-up processes, thus engaging the local society. But even in those cases that such extensive participation in accomplishing mainly bottom-up projects does not exist, the steering actor employs other collaborative schemes in order to further engage local society, like resorting to public-private sector partnerships or establishing joint-venture “umbrella” companies, allowing small local investors to participate in large transition projects. Besides, this last tool was an innovative way that was used in the Samso case so as to engage local society even in huge projects, like the ten off-shore wind projects that were constructed in the nested energy regime. The steering actor's attempts to activate and engage other mediating groups, like the engineers and the electricians, in the transition also subscribe to this locals-engaging direction. In addition, as it was discussed in the second chapter, energy transition scholars underline user-consumers' role in relation to energy providers, arguing for the co-providers as the ones that could easier change their patterns and practices in a sustainable way (Van Vliet, 2005). In respect to this, I regard local engagement in the energy transition, mainly through particular renewable energy pathways, as a way to facilitate the change of current energy consumption patterns and practices.

With reference to local engagement during the transition, and primarily during the initial stage, when the short-term and long-term visions and objectives are set, the local steering actor follows processes and assumes initiatives in order to shield it. This perception of steering brings about the exclusive local meetings without incumbent actors participating in them during the initial stage. As it has been made clear in the second chapter of this thesis, many transition scholars argue about the power relations and the transition processes' politics (Smith et al, 2005; Shove and Walker, 2007; Meadowcroft, 2007), clarifying, among other things, the incumbents' dynamic in directing the transition based on their narratives and objectives. Besides, this was also the way that Samso Energy Academy[337], the local steering actor in the Danish case, approached the process, initially deliberating with the locals. Finally, engaging locals is dictated by the way sustainable development has been conceptualized in this research thesis. More specifically, as it has been illustrated in the first chapter, many transition scholars have argued that s-t transitions need to be connected to concepts like energy democracy and good governance (Hess, 2018; Stirling et al, 2018) so that they steer to sustainable development pathways. I agree with this perception which

[337] More specifically, the proceeding institutions.

conceives sustainable development in energy as a shift of governance in the local level, democratizing it, so I have integrated these concepts in the way sustainable development has been perceived here. I consider this framework of top-down and fully coordinated transitions, which however also engages civil society, as a contribution of this research thesis to the transition studies literature as well as to contexts of a political culture similar to the Greek one. As it has been made clear in the third chapter, transition scholars have referred to civil society-led changes as those that are based on boosting social movements' efforts in figuring out bottom-up solutions to energy-related environmental and social problems (Foxon, 2013). Further, they note that government-led transitions are highly coordinated state-driven transformations, aiming at achieving certain objectives or responding to landscape pressures (Smith et al, 2005; Meadowcroft, 2007; Foxon, 2013). In contrast to this conceptualization, my framework could not be considered civil society-led, as it revolves around a highly coordinated planning process of the state engaging the local society. Hence, this is an important contribution to the relevant literature setting governance in the core of its analysis. Besides, in the next section, I will analyze in detail the significance of my context, establishing a local steering actor and engaging civil society in making transitions in countries with more intervening political cultures.

I further argue that, in my notion it is critical to perceive sustainable development by taking into account not only its environmental and economic perspective but also the social one, which I consider is related to a multi-level governance which engages civil societies and other social actors. In regard to this, I also maintain that, although in this research energy democracy is conceived with an intention of shifting energy governance as governing, at least partially, in the local level, a steering actor could even prompt local governments to install renewable technologies projects whose electricity production will cover the energy needs of institutional actors which protect the oppressed as well as low-income households; that is what Greenpeace's actions have been aiming at in a few Greek municipalities cases. Toward this directions, for instance, Greenpeace, together with the Municipality of Larisa, is bound to install at least 200KW pvs on public buildings roofs, so that energy production from them will cover the energy needs that other municipal social structures have, through the virtual net-metering framework[338]. Similar attempts have been made by Greenpeace in conjunction with other Municipalities[339] too. In regard to the Chian case, the impression I got from the interviews with the local actor is that, in regard to pvs on public roofs, it was rather skeptical and conservative too, thus in my view it will be difficult for it to be interested in such innovative actions. Afterwards, I will try to focus my attention on these issues that show my approach's innovative character as well as its bounded rationality.

Situated rationality, innovation and engagement in the steering approach

This section's main objective is to highlight all the elements of the steering approach, illustrating its embedded character in the national and local framework, as well as its significance in facilitating and expediting renewable energy transitions. With reference to these issues, I argue that the hybrid model that has been developed for the need of this research has provided the state with a pivotal role so as to coordinate and ultimately steer, in a way , the transition process in a national level. Towards this direction, back in the second chapter, I enriched my conceptual framework with transition approaches placing the state in the centre of this dynamic process (Meadowcroft, 2007),–in contrast to MLP culture–, in order to create a steering actor traditionally relying on the Greek paternalistic political framework. In regard to this, the steering actor is shaped based on a Greek institutional framework and features a ministry's representative, as I mentioned in the former chapter, while in addition, the related ministry monitors the institutional steering actor. To clarify the state's central role, I would once again like to point out that the local steering actor's role is to operate as the mediator between the different national and local actors as well as between the society and the s-t energy regime, engaging locals, minimizing tensions and following reflexive ways in achieving the transition. In this manner, this actor steers the transition mainly in a local level, linking different governing state's levels. At the same time, in the nested regime, when the local actor struggles to steer a transition into a sustainable pathway due to power relation with incumbent actors, it is the state that steers the transition in a national level, through institutional and financial

[338] About this, see https://iliemou-iliesou.gr/larisa-kai-greenpeace-ependioun-stin-iliaki-kinoniki-politiki/
[339] These were the actor's intentions as expressed in our interview.

tools. That was the case in the second transition pathway illustrated in the former chapter, where, in order for a transition to be made from natural to biogas technology in the long run, steering in a national level by the state was necessary. In addition, in regard to the situated-rationality character of my approach, it has already been explained in the fourth chapter that it takes into account the national and the nested energy regime dynamics, as well as the social, economic and geographical localities, so as to evaluate the nested framework. Besides, the actors' dynamics and characteristics is a result of a series of semi-structure interviews, presenting us with a more accurate perspective regarding their agency and role. Finally, also employing other institutional innovations from the Greek framework, as are the energy communities, is also an element of the model's situated-rationality character. Besides, the technologies that have been chosen in the different pathways are contingent on the special characteristics of the area that is in transition. Thus, different technologies and pathways will be followed, for instance, in cases of systems connected to the national grid compared to those of autonomous electrical ones. After all, this is a reason for studying the geographical and socio-economic features of the area in transition. With reference to the technologies that are used in each scenario, I regard my framework as a contribution to the transition approaches setting governance in the core of their analysis. Governance theories models like those that have been integrated in my hybrid approach give little or no attention to the way artifacts and networks exert agency and power through their materiality but also through the actors involved, and in this view, co-construct socio-technical reality. Following this perspective, Meadowcroft (2007), in his approach, that has been presented in the second chapter, paid no attention to the importance of technology. This is why I have enriched this approach with other elements and parameters in my hybrid model including a more dynamic perception of technology. In a similar way, Smith et al's (2005) model perceives technology only as resources. On the other hand, even scholars that conceive the importance of technology, like Foxon (2013), do so in a different way. In this direction, the related literature (Foxon et al, 2010; Foxon, 2013) connects different pathways and thus divergent actor-driven solutions as a reason for alternative technologies to be used. However, these scholars planned scenarios for a national transition[340], thus they did not take into account the local special

[340] The framework of my analysis is interested in the nested-local level, as it has been made clear, in contrast to the national level analysis that these scholars follow. Besides, this is a clear difference of my modelcompared to the

characteristics of each place, a factor which influences technologies' efficiency. My hybrid approach, influenced by the STS analysis, draws attention to the fact that different technologies involve different actors exerting other pace of power, namely changing the power relations in the process, while further, these infrastructures have divergent dynamic (agency), entailing alternative s-t transition pathways. This kind of understanding as well as the way sustainability has been delimited in this research thesis are the main reasons why we have bounded certain technologies the way we did; for example, this has been the case either with determining interconnector's capacity (which would potentially link the island to the national grid) or with laying down the institutional context we consider necessary in achieving the transition from natural gas to biogas..

In respect to the aforementioned innovative institutional framework, its role is significant in rendering the s-t nested transition successful by engaging the local society. As it has been mentioned in the fourth chapter, the Energy Communities framework is a co-operative scheme which secures favorable terms for these actors to be formed as well as to operate, making it mandatory for at least 51% of the members to be related to the particular region, thus, in this way, facilitating the engagement of locals. The scheme is very innovative as, through this, Greece has become the only European country which allows all user-consumers to use virtual net-metering. The Energy Communities framework substantially becomes a critical tool in the steering process, engaging local community. In respect to the specific institutional framework, it could be asserted that this innovative scheme and the existence of "mature" renewable technologies have to be the only elements that are strictly necessary in achieving sustainable nested transitions. Hence, its adoption makes establishing an intermediary institutional actor unnecessary. Regarding this argument, I would like to underline that the historical reality of the Greek energy regime is full of cases where these two elements did exist, however the renewable transition either failed or delivered relatively poor results. For instance, as it has been discussed in the fourth chapter, the innovative, at that time,1985 regulation (Law 1559/85) has laid down a

way MLP approaches transitions. Consequently, although MLP could be used in several spatial contexts, its ordinary framework is a national one. Further, the approach perceives transitions focusing mainly on the importance of regime level as well as on niche management issues. On the other hand, my hybrid approach conceives sustainable transitions as alterations, engaging civil society, thus having on the core of its steering methodology tools and perceptions protecting the participation of local actors, something that could even be in contrast to the MLP approach analysis, while further is interested only in mature technologies. I also consider this alteration as a contribution to the MLP theory.

renewable energy framework[which allows small actors to engage in the energy transition, as well as a series of other regulations (as is the Law 2244/94), subsidizing small actors and compelling PPC to buy part of the energy they produced] that has created expectations from the state for an extensive transition to renewable technologies until the late 90s, which, however, never materialized. Further, during the same period, PPC's perception that large geothermal technology power plants could be constructed on the islands without engaging locals, based on the then institutional framework and technologies that enabled it, resulted in an energy transition to geothermal technology either failing or becoming inert for more than twenty years. Last but not least, I would like to point out that, in the late 2000s, a series of laws (as were Law 3815/10 and 4014/11) that promoted large renewable investments as well as spurred large wind actors to invest massively and on a large scale on the Greek islands wind projects failed, to a large extent, due to huge public tensions raised by the locals in many Greek islands, ending up in the majority of these projects being paused or canceled, thus delaying the renewable technologies transition. Based on this framework, I would like to highlight that, in most of cases, institutional innovations and the maturity of technologies are indispensable but not sufficient preconditions in terms of achieving a transition in the Greek framework. What's more, the national context does not guarantee pathways which support social engagement. Consequently, establishing an intermediary institutional actor which will mediate the process by locally steering the transition, engaging local society and limiting local tensions could be a decisive factor in the making of a s-t transition in the national s-t regime. Finally, I would like to note that the intermediary actor’s institutional framework that has been presented is not a bottom-up context; on the contrary, it is about a coordinated state-driven process which engages local society as it has been also explained in the former section. In the next section, I would like to refer to the contribution of my hybrid model in transition studies in terms of steering nested transitions, within the political framework of the South, and more particularly, in that of Greece.

Renewable transition practices in the Greek islands: Securing local engagement in planning

In this section, I would like to stress elements and features of my approach which provide it with an innovative character in regard to the existing national practices pertaining to renewable transitions. To do so, afterwards I am going to present paradigms which show the existing practices of nested insular sustainable energy transitions in renewable technologies, looking for similarities and differences with my steering approach. A well-known nested insular transition in Greece is that regarding Tilos island. In this particular case, the nested regime transitioned to a renewable technologies micro-grid, covering the electricity needs of the small Dodecanese island (Notton et al, 2017). The transition project was financed by European Horizon 2020 (Ibid). In a governance view, the process was steered by a group of public and private actors, like the Piraeus University of Applied Science, which was the coordinating one, HEDNO as well as other national and European actors from seven European countries (Kaldelis et al, 2015). As it could be easily deduced from the above, this transition project was an ad hoc process. In addition, the transition pathway did not require nor sought the local community's engagement in the transformation process. Following a similar ad hoc process over the past years, HEDNO and the government have scheduled renewable transitions of small unconnected to the national grid islands, mainly due to their high average electricity production cost[341]. All these cases are results of top-down processes, without diffusing energy governance or engaging local society. On the other hand, a very different case, that of planning a renewable electricity transition by engaging local society, is the case of a small Cycladic island Sifnos. On the island, a local cooperative has been established since 2013, that has from the very beginning supported an energy transition of the unconnected to the national energy grid nested regime to a hybrid technologies pathway (Katsaprakakis, Voumvoulakis, 2018).The local cooperative as well as other local actors, such as the island's municipality, joined in the transition process. In addition, PPC which runs a small thermal power plant on the island supported the project by expecting an economic reduction of its average cost (Ibid). In 2016, the local actors filed a request to RAE asking for license for electricity production coming from a hybrid technology

[341] See, for instance, the article in HEDNO's official site. in https://www.deddie.gr/el/stratigiki-eksugxronismos/kainotomia/eksypna-nhsia/ and the actor's press release in https://www.deddie.gr/el/kentro-enhmerwsis/deltia-tupou/deltia-tupou-2017/aprilios-2017/dunamiki-simvoli-deddie-stin-eurwpaiki-protovoulia/

power station, so that they can proceed with constructing the project during the years to come.

Evaluating the existing practices in renewable nested transitions, it could be argued that, in the majority of the cases, it is about ad hoc, in a way top-down, processes, without engaging the local societies. In the very rare cases where local societies are engaged in the transition pathway, like in the Sifnos case, it is about a process of uncoordinated pressures and actions targeting at an energy transformation, which is activated as a result of local entanglers supporting actively the process. This kind of transitions, from a governance perspective, is not a result of state's (or other incumbent actors) coordinated process aiming at facilitating and accelerating renewable energy transitions, engaging local societies and assisting in steering to more sustainable pathways. In addition, these kinds of bottom-up transitions are much more difficult and slow processes in case of large islands or cities, rendering uncertain transition results. In contrast to the existing practices, my steering model features a planned framework, thus does not derive from an ad hoc process, while it has developed many mechanisms and tools in engaging the local society. As it has been discussed in the previous section, Greek historical reality has showed us that innovative institutional frameworks and mature renewable technologies, albeit an essential precondition for sustainable transitions, is not a sufficient one in ensuring a coordinated, accelerated energy s-t system transformation, engaging the local society. On the other hand, employing an intermediary steering actor together with an innovative framework could facilitate –under a fully coordinated state's process– accelerating the transition, putting a brake on potential local social oppositions and contributing to democratizing the energy regime.

Hybrid model's and divergent pathways' extensions in energy policy issues

The hybrid approach framework used in this research thesis perceives transitions as socio-technical entities and relies on MLP model and multi-level governance perspectives, following a more prescriptive approach in relation to the former steering a transition to sustainable development by engaging local society. In regard to the policy implications of the approach, what needs to be clarified is the importance of a steering actor in this context who will facilitate the whole process. This is significant in frameworks with a more interventionist political culture, similar to the Greek one. As I have already argued in a previous section, in this particular political context, I regard this actor as extremely necessary in order to accelerate the transition process, limit possible oppositions and engage civil society.

I would also like to refer to the policy extensions of the different scenarios in spatial contexts similar to my empirical case one, namely either insular areas or continental cities of similar size. Towards this direction, following a 100% renewables transition pathway, similar to the initial scenario of this research thesis, relying on storage technologies and chiefly small-scale renewables could be a solution to sustainable development in many insular areas of the Eastern Aegean, as well as in Sporades, namely islands that are still not connected to the national grid. Such pathway will ensure sustainable scale projects and local participation in energy transitions on islands like Skyros or Lymnos, where huge oppositions to large scale wind parks transitions were raised, or it could result in thermoelectrical systems in more populated and touristic islands, like Samos and Lesvos, restricting their use, or even shutting down, thus potentially ensuring a more sustainable trajectory of an energy transition. As far as the second scenario is concerned, although in the case of Chios, according to the interviewees, such a pathway is considered in economic terms by the PPC, irrespective of DEPA's decision for a bunker infrastructure, I argue that similar approaches could be used in insular areas, where DEPA is going to construct bunkering infrastructures, namely the ship transition to leverage a natural gas energy transition. In this case, it needs to be noted that natural gas infrastructures and the relative network have their own dynamic, therefore this feature has to be taken into account by the steering actor so that the natural gas issued only as a mediating power technology. Interconnection of autonomous electrical systems, such as the one in the case of my third scenario, could allow diffusing renewables and shutting down many of the thermoelectric plants of the non-connected islands, decreasing their energy cost while involving local society in the energy production. Hence, this pathway could be promoted in the case, for instance, of the Cycladic islands where connection with the national grid hasn't been scheduled yet. However, in the case of North East Aegean, socio-economic features and the high distance of the particular insular cluster from continental Greece make this project probably more attractive. Further, adopting a pathway of interconnection with the neighbor Turkish electrical grid could stabilize the electrical networks of the autonomous electrical systems, diminishing their cost by utilizing renewable energy. Thus, for instance, in islands like Rhodes, such an interconnection could result in the power plant operating less, curtail the energy cost as well as allow renewable energy to be diffused, ultimately creating an energy hub, importing and exporting energy and facilitating the energy needs of other, neighboring to Rhodes, islands. Finally, a scenario which promotes the interconnection of an island with the national grid could lead to higher increase in the renewable installed capacity in the area. Therefore, in this case, endeavors pertaining to participating in the decision of the interconnector's capacity as part of the steering methodology are of major significance. Insular areas, being isolated places, face more degradation risks, thus large-scale renewable projects for commercial export reasons could be extremely harmful and dangerous. Besides, as it has been discussed elsewhere in this conclusive chapter, my hybrid approach ranks localities very high, namely the particular local socio-economic, technical and geographical characteristics of each area. Hence, a series of interviews giving us details about the dynamics and the visions of the nested regime's actors as well as other important elements, such as the socio-economic and the geo-morphological ones, have to be evaluated so that the particular model could be transferred to another area/island. Besides, in my notion, this has to be part of the future research agenda in order to appraise the usage and limitations regarding this model. I argue that the model could operate in regional areas with populations of fifty to one hundred residents, namely on insular municipalities or in medium size cities of the continental Greece. Over and above, the approach has been already operated in the exemplary case of Gotland, in which population and touristic activity is extremely higher compared to Chios. In regard to the case of cities in continental Greece, it has to be noted that the infrastructures and the network already developed as well as the area's economic activities will dramatically change the actors' dynamics and limits. Further, in the case of very large islands like Crete, I support the notion that, in order for the approach to be implemented on the island, we need to study the different municipalities separately. I argue that the approach could not be used successfully in large cities or regions, where proportions are huge, social parameters are more complicated, regime actors assume a more active, and probably more interpretative, role and it is also difficult to determine probable user entanglers. Finally, with reference to the future research agenda, I also regard the transition of other socio-technical systems, and mainly those of transportation from and to touristic destinations, of water and waste systems, as well as the transformation of the agro-food one, as a following objective of such a research. In addition, concerning the research in the tourist literature, adopting the approach on islands with different grades of tourist development, according to Butler's (1980) life cycle typology, could be a future target.

Deepening further the transition in tourism

In this research, I used the idea of deep transitions as a concept which the field's scholars propose in order to shift contemporary industrial unsustainable societies to more sustainable orientations (Kagner and Schot, 2018; Van der Vleuten, 2019). As it has been extensively discussed in the second chapter, a deep transition concept refers to making and expanding a wide range of s-t systems in the same direction (Ibid). In this framework, I use the concept in order to turn tourism to more sustainable pathways. As a first step to this direction, an energy s-t transition also including the tourist regime was steered. Tourism being one of the biggest world s-t regimes sand being interrelated with other ones, such as energy and mobility, follows a very unsustainable direction, as it has been discussed in the first chapter. The regime is responsible for about 5% of the world's CO2 emissions and for a close to 10% share in other global warming gasses (UNEP, 2008). Still, in Greece, owing to the sector being the country's "heavy industry", this s-t regime's transition becomes more than a necessity. What's more, in many cases, tourism is an economic monoculture for the Greek islands, while additionally, it is responsible for degrading the environmental and cultural wealth, as well as for creating extreme energy needs. With reference to the need for a deep transition including tourism, my analysis was restricted to the electricity s-t regime as well as the nested transportation regime concerning mobility inside the island. In regard to this, as it has been discussed in the first chapter, many tourist scholars (Scott et al, 2016b; Gössling and Peeters, 2015; Peeters and Dubois, 2010; Scott et al, 2010) argue for the significance of viewing transportation from and to a tourist destination as a critical factor for this sector's unsustainable character, which is also a very substantial issue that has not been discussed in this research thesis. It requires deepening further the transition including, in addition, other s-t regimes. Besides, steering tourism into sustainable development also calls for other s-t regimes' transition–like the water, waste and food, apart from the mobility one that is being now discussed– as well as for the patterns and practices of the parties involved. What is more, the two exemplary cases presented in this research thesis, envisioning deepening their transitions further in the years to come, but also following deep transition pathways –such as transforming transportation by ship to natural gas technology in the previous years and the forthcoming transition to biogas one (on both islands) as well as the tourist regime's actors providing tourists with incentives to travel to the island by ship(in the Gotland case)– show us the way to make tourism s-t regime sustainable. Finally, I would like to note that I regard this perspective of seeing the whole energy production chain which makes tourism sustainable as a contribution of my thesis to the sustainability on tourism literature that achieves to re-connect sustainable tourism with the sustainable development concept.

ABBREVIATIONS/ ΣΥΝΤΜΗΣΕΙΣ

- **ANT:** Actor Network Theory
- **AoD:** Arenas of Development
- **APEPEA**: The Association of Production of Energy from Photovoltaics of . East Aegean
- **CCS:** Carbon Capture and Storage
- **CHP:** Combined Head and Power
- **CIECB:** Change of Individual Energy Consumption Behavior
- **CRES:** Centre for Renewable Energy Sources and Savings
- **DEPA**: Public Gas Corporation
- **DESFA** National Natural Gas System Operator
- **DR :** Demand Response
- **DSM:** Demand Side Management
- **EIA:** Environmental Impact Assessment
- **ELLET:** Elliniki Etairia
- **ELLETAEN:** Hellenic Wind Energy Association
- **ETS:** Emissions Trading System
- **GAIS:** Greek Association of Investors of Small Wind-turbines
- **GAIS:** Greek Association of Investors of Small Wind Turbines
- **GDP**: Gross Domestic Product
- **GEAB:** Gotland Energy AB
- **GHG:** Greenhouse Gas
- **HEDNO:** Operator of the Electricity Distribution Network
- **HOT:** Hellenic Organization of Telecommunication
- **HTSO:** Hellenic Transmission System Operator S.A.
- **IGME**: Institute of Geology and Mineral Exploration
- **IPTO:** Independent Power Transmition Operator SA
- **LTS:** Large Technological Systems
- **MLP:** Multi-level Perspective
- **NGO:** Non- Governmental Organization
- **NRGi** Danish Electricity Company

- **NTUA:** National Technical University of Athens
- **OEM:** Operator of the Electricity Market
- **PCWSS:** Corporation of Water Supply and Sewage
- **PCWSS:** Public Corporation of Water Supply and Sewage
- **PPC:** Public Power Corporation
- **PPCR:** PPC Renewables
- **pvs:** Photovoltaic Cells
- **QoL :** Quality of Life
- **RAE:** Regulatory Authority for Energy
- **RE:** Renewable Energy
- **RES** Renewable Energy Systems
- **SEA:** Samso Energy Academy
- **SEC:** Energy Company
- **SEMK:** Samso Energy and Environmental Office
- **SNM:** Strategic Niche Management
- **s-t:** Socio-technical
- **STS :** Science, Technology and Society
- **TAP:** Trans Adriatic Pipeline
- **TEP:** Techno-Economic Paradigm
- **TGC:** Tradable Green Certificates
- **TM:** Transition Management

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