STANDING IN THE WAY OR PAVING THE WAY?

A Case Study Of Energy Valley Cluster as An Intermediary Actor in Energy Transition.

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Abstract

Energy transitions have historically been slow often taking several decades. The current threat to human existence however calls for a more urgent deliberate, and global change of the fossil fuel based energy system. As an oil economy Norway is facing increasing pressure to reduce carbon not diversifying the Norwegian economy is an irresponsible and risky strategy. This thesis is about how the oil and gas industry respond to these transformation pressures. In particular, this study examines how Energy Valley Cluster responds to these transformation pressures and what roles, they play in the ongoing energy transition.

This study employs a qualitative case study approach. Through the lenses of a Triple Embeddedness Framework this study finds that Energy Valley cluster has since 2015 strategically reoriented and subsumed the roles of a regime-based transition intermediary. This study shows that Energy Valley cluster significantly contributes especially through its incubation platform *Energy.Invented* in supporting niche build up and creating valuable collaboration both within and outside the industry. Energy Valley has also played important role in raising public awareness and creating legitimacy for sustainability transition. As an intermediary actor rooted in the dominant industry regime however Energy Valley Cluster may be limited and inadvertently standing in the way for a sustainable energy future.

Acknowledgements

As I complete this multidisciplinary master's program I feel like I have been on a swing ride. At one extreme end I have encountered concepts and ideas that make the complex world clear and tangible while at the other end I am wrought with feelings of peering into an abyss, an entangled web of knowledge that leads to where it started. In a way writing a master's thesis has been like a fast ride on this swing. Although I certainly am more knowledgeable now than I was when I started, the one major thing I have learnt is how acutely diverse and vast there is still to learn. As I conclude this journey, I yearn to learn more, contribute to the conversation and hopefully act for a sustainable future.

My masters writing journey would have been impossible if it weren't for the support, guidance and encouragement of the people around me. I would first like to express my heartfelt gratitude to my supervisor Allan Dahl Andersen. Your wealth of knowledge, clarity of insight and practical suggestions has been a beacon of light throughout this study. I am grateful to my respondents in Energy Valley Cluster and Norwegian Innovation Clusters for sharing with me your knowledge. I am grateful too to my colleagues at *Uteseksjonen*, taking a masters studies while working full time would have been unbearable without your help, encouragement and sometimes light-hearted questions about my sanity. At times I question this too.

And to my close friends and family, thank you for your faith in me and for providing shoulders to lean on when the journey seemed difficult. And finally to my daughter Liyana, who was born as I began this masters study. I promise to make up for all the missed playdates. Daddy is all yours now.

List of abbreviations

CCS	Carbon Storage and Capture
CEO	Chief Executive Officer
EV	Energy Valley Cluster organization
GCE	Global Center of Expertise
HSE	Health Safety and Environment
MLP	Multi-Level Perspective
NCE	National Center of Expertise
NCS	Norwegian Continental Shelf
NIC	Norwegian Innovation Clusters
OG	Oil and Gas
OTC	Offshore Technology Conference
SME	Small and Medium-sized Enterprises
SSV	Subsea Valley Conference
TEF	Triple Embeddedness Framework

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1.0 INTRODUCTION

Energy transitions have historically been slow often taking several decades (Grubler, 2012). The current threat to human existence however calls for a more urgent deliberate, and global change of the fossil fuel based energy system. Grand challenges such as climate change, pollution, and depletion of natural resources have shown that this fossil fuel based system is economically and environmentally unsustainable. Despite warnings by the IPCC that the world needs to rapidly reduce carbon emissions in order to limit global warming to below 1.5 degrees (IPCC, 2018), global emissions continue to rise to record breaking levels. On the supply side, the global energy system is dominated by an incumbent industry consisting of large oil and gas (OG) firms and their suppliers. These often defend the established sociotechnical energy regime and resist transitions towards renewable energy sources (Geels, 2014c). Although some studies indicate that this is not always the case (see e.g Hockerts & Wüstenhagen, 2010), change cannot come fast enough.

As one of the most profitable industries in Norway, there is considerable and ongoing investment in the OG industry. The latest being the discovery and exploitation of the Johan Sverdrup oil field. This is one of the largest oil discoveries ever made on the Norwegian Continental Shelf (NCS) and is expected to operate for the next 50 years (Equinor, 2019). These massive investment point to strong path-dependency and lock-in. And in fact seems to stand in stark contrast to the Norwegian goal to reduce 40% of its emissions by 2030 and 95% by 2050 (Klima-og miljødepartementet, 2019). Emissions from Norway's extraction and production of OG have increased since 1990 although there have been a slight decrease in the past two years (SSB, 2019). It must be noted however that while Norwegian national energy system is unique in that over half of its domestic energy demand is covered by renewable energy sources (mainly hydropower) (Bendiksen, 2014, p. 6), it is among the top exporters of OG globally and thus contributes to significant emissions when these fuels are burned elsewhere (Andrew, 2016).

Seen as the major culprit, the OG industry is facing increasing pressure to reduce carbon emissions. International oil companies have responded differently to adapt to these pressures. Some focus on integrating low-carbon technologies into OG production, others divest into renewable energy sources and others focus on lowering operational emissions (Shojaeddini, Naimoli, Ladislaw, & Bazilian, 2019). Since climate change emerged as a global issue in the 1980's oil companies have developed proactive decarbonization practices such as improving

efficiency, electrification of the production process and capturing and storing carbon (CCS). They however intentionally misled the public about climate change (Boon, 2019, p. 109). Due to growing demand for energy, industry's vested interests, and the voluntary nature of climate governance, there have been very little meaningful action to achieve decarbonization (Boon, 2019). Although there have been documented attempts of divestment by oil companies, their engagement and commitment to renewable energy is inconsistent. A recent study in Norway for instance shows how oil companies invested in offshore wind power during market downturns and reverted back to oil and gas when oil prices went up (Mäkitie, Normann, Thune, & Gonzalez, 2018).

Despite the oil companies response, renewable energy transition is advancing faster than it was anticipated even a few years ago. Although there is still a long way to go, most analysts expect that the OG industry will increasingly face uncertain times in terms of both demand and price (DNV-GL, 2019). Being an oil economy Norway is financially vulnerable to international downturns in OG. It has therefore been argued that not diversifying the Norwegian economy is an irresponsible and risky strategy due to climate risks. A world that reaches the goals of the Paris Agreement would be disastrous for the Norwegian economy, in other words these issues create uncertainty about the long term future and profitability of the industry despite continued support from the Norwegian government. And the question of what will Norway live off after oil is becoming more and more pressing.

New youth movement on climate change has brought more attention to the topic. These issues related to climate change, economic diversification and public finances create transformation pressures in the Norwegian OG industry. This thesis is about how the OG industry respond to these transformation pressures. Such responses include how individual firms respond e.g. try to become more competitive in oil or diversify while keeping one foot in oil ('green oil') or exit oil altogether; so firms and parts of the industry can follow different pathways. Looking at Norwegian OG supplier industry in particular, this thesis will examine how intermediary actor respond to these transformation pressures and what roles, if any, they play in the ongoing energy transition. While it is well documented that intermediary actors such as cluster organizations are important for creating industry resources such as networks and knowledge to fuel the emergence and growth of an industry and its competitiveness (van Lente, Hekkert, Smits, & Van Waveren, 2003), their role in industry re-orientation in response to transformation pressures related to societal goals is less explored .

So why focus on intermediary actors such as cluster organizations and why should we expect them to be important in Norway ? I give two main arguments for this. Firstly since 2005 there have been a growing number of cluster organizations across Norway within the OG industry (Samfunnsøkomisk Analyse AS, 2017) and lately within renewable energy such as offshore wind and hydrogen technology (Innovasjon Norge, 2018). As such cluster organizations are emerging as a significant actor in the energy transition. Despite this growth there are few studies that have focused on these. Moss 2009, (p.1481) notes that in sustainability transition literature little attention has been paid to actors who do not fit into one of these three categories; supplier, user or regulator. Scholars have extensively studied the response and roles of incumbents, emergent firms, policy makers and users since these are seen as major actors (Hockerts & Wüstenhagen, 2010; Mäkitie et al., 2018; Thune, Wicken, & Engen, 2019).

Although there are numerous studies about industrial clusters and cluster organizations, all of these emphasize in one way or another the crucial contribution to competitiveness, economic development and innovation. In this study I will look at what role Energy Valley cluster plays in the transition towards sustainable energy. Energy Valley cluster was in 2017 awarded status as a Norwegian Center of Expertise (NCE) in energy technology. The second argument is that in the latest Norwegian national strategy for R&D on climate-friendly energy technology (Energi21) recommends, among other things, the establishment of energy clusters which brings energy stakeholders and other actors to collaborate and make use of synergies between industrial operators in order to improve integration of energy systems, and energy use (Energi21, 2018). Energi21 is an integral component of Norwegian energy policy and cluster organizations are emerging as key players.

1.1 Aims and objectives of study

With over 200 members, Energy Valley cluster represents firms in the entire value chain of the OG industry located between Oslo and Kongsberg region. These include oil operators such as Equinor and Lundin, system integrators such as Aker Solutions and TechnipFMC as well as service and equipment suppliers. However majority of the members are small and medium sized enterprises (SME) who specialize in supplying subsea equipment and services. As such the cluster represents a significant part of the Norwegian upstream OG sector. The Energy Valley Cluster organization claim that "By offering infrastructure for collaboration, knowledge transfer and new insight, we help our members adapt to, benefit from, and contribute to the

energy industry in transition.[1]" Given that most of the members of the Energy Valley cluster are in the OG industry, doesn't the push for transition contradict the (short term) interests of these firms? How does the cluster organization respond to this dilemma? Is the cluster standing in the way or paving the way for a sustainable energy future? In order to explore the claim by Energy Valley cluster and the issues raised above, this study has formulated the following research question;

How does Energy Valley cluster contribute to sustainable energy transition in Norway?

I break down this research question into the following three sub-questions;

a. What roles did EV play between 2010 and 2015?
b. What roles does EV play now and why did these roles change?
c. How do these roles accelerate or slow down the ongoing energy transition?

This study seeks to contribute to literature on sustainability transitions in two ways. Firstly this study is an attempt to expand our understanding of what roles cluster organizations play in sustainability transition through empirical research on a particular cluster organization. Recasting clusters as intermediaries i.e actors that 'connect, translate and facilitate flows of knowledge' between many actors (van Lente et al., 2003) allows us to closely examine these roles. Several studies have used similar approach to examine the roles of clusters in sociotechnical transitions such as green energy clusters in Central Massachusetts USA (McCauley & Stephens, 2012) and cleantech cluster in Quebec Canada (Hatch, Tremblay, & Cazabon-Sansfaçon, 2017). I discuss these further in chapter two.

Secondly the findings of this study may help tap into the potential of cluster organizations in accelerating change and understanding bottlenecks that may inhibit transitions towards sustainable energy systems. Sociotechnical transitions are complex processes that require coordinated effort by diverse actors. As such successful energy transitions require policies that are among others persistent, aligned and balanced (Grubler, 2012, p. 14). By explicitly exploring the roles and responses of the Energy Valley cluster to transformation pressures, this study may help equip policymakers with information that can enable them make better policy interventions which may in turn expedite the energy transition. Norwegian government has

[1] Quote from: https://energyvalley.no/about-us/

implemented a policies to strengthen its business and industrial clusters. The Norwegian Innovation Clusters program was launched in 2014 supports cluster projects at three levels. The Arena program is aimed at clusters in the early phase. Norwegian Centers of Expertise (NCE) at clusters with a national focus and Global Centers of Expertise (GCE) at mature clusters with a global focus. Under this policy the Norwegian government has supported over 80 cluster organizations(NIC, 2019). Although this policy has led to more innovation-oriented collaboration enhancing firms competitiveness and growth (Samfunnsøkomisk Analyse AS, 2017), there is limited discussion on cluster organizations contribution to sustainable transition.

1.1 Structure of the study

This introduction is followed by a literature review on cluster organizations, sustainability transitions and intermediary organizations. Each section briefly presents relevant concepts and major frameworks that inform this study. In addition to discussing major debates in some of these themes, the literature will highlight the gap that this study seeks to contribute to. The literature review will be followed by a synthesized analytical framework that will be used to analyze the case study. This will give way to a chapter on methodology detailing the research design, methods used and the data collected. The discussions on the methodology will end with a reflection of the ethical considerations and on the research process and limitations. Thereafter I present the empirical data and discuss my findings in light of the analytical framework.

In order to contextualize the empirical data I will briefly give an overview of the Norwegian OG industry focusing on the supplier side where the Energy Valley cluster is located. A description of the Energy Valley cluster organization and its past and present activities will form as part of the discussion. This will be followed by a discussion of the roles and strategic response of Energy Valley cluster in energy transition based on the transition intermediary typologies and Triple-Embedded Framework (TEF). The analysis and discussion takes each sub-question in turn. As I conclude my study I suggest topics for further research.

2.0 LITERATURE REVIEW

This study will largely be informed by the sustainability transitions literature, literature on intermediaries and clusters. Here I briefly review some of the pertinent and relevant issues within these three literature.

2.1 Sustainability transition literature

Sustainability transitions has emerged as a popular and persuasive approach and has rapidly expanded over the past decade. The underlying motivation for this literature is the recognition that current grand societal challenges such as climate change is a result of unsustainable production, distribution and consumption patterns in socio-technical systems. Incremental improvements and technological fixes cannot solve these grand challenges. This literature acknowledges that such changes are too inadequate to cope with sustainability challenges and therefore seeks to promote and govern a faster transition towards sustainable modes of production and consumption (Markard, Raven, & Truffer, 2012).

In this field, four frameworks have become prominent. These are transition management , strategic niche management, technological innovation system and the multi-level perspective (MLP) (Markard et al., 2012). The starting point of sustainability transitions is that it conceptualizes systems that offer crucial services to society such as energy, transportation etc. as a socio-technical system. Socio-technical systems consists of network of actors, institutions, material artefacts, and knowledge which are tightly interrelated, interdependent and interact to provide these specific services to society (Markard, Raven, & Truffer, 2012). Since the various aspects of the socio-technical system are interrelated and interdependent they tend to be relatively stable and resistant to change. Transitions therefore require a fundamental shift in these systems and involves far-reaching changes in technological, material, organizational, institutional, political, economic and cultural dimensions (Markard et al., 2012). Transitions therefore often takes many decades.

In this study the energy sector is conceptualized as socio-technical system. This energy system is defined as "a constellation of energy inputs and outputs" which involves suppliers, distributors, end users and intermediary actors as well as institutions of regulations, conversion and trade (Araújo, 2014, p. 112). According to Smil (2010) there isn't a single generally accepted definition of energy transition. However this term is commonly used to describe the

change in the composition of primary energy supply and the gradual shift from a specific pattern of energy provision to a new state of an energy system. There is a growing number of studies that have used these four frameworks to examine energy transitions in various countries. Since this study is largely informed by the Multi-Level Perspective, this is explicated below. Discussions about the other frameworks thus fall beyond the scope of this study.

The multi-level perspective and transition pathways

One of the most developed frameworks within the sustainability transition literature is the Multi-Level perspective (MLP). This framework argues that transitions within a given system are driven by interactions between three analytical levels; niche innovations, socio-technical regimes and sociotechnical landscapes (Geels & Schot, 2007). See figure 1 below for an illustration of the MLP. At the microlevel are niche innovations which involve 'protective spaces' or incubation rooms' where pathbreaking innovations and unstable configurations are protected such that they are able to compete with more existing dominant systems (Geels, Sovacool, Schwanen, & Sorrell, 2017; Smith & Raven, 2012). These protective spaces are important in shielding nascent innovations from adverse selection environments of the current socio-technical regime. In addition to shielding Smith & Raven (2012) identify two other crucial processes; nurturing and empowering. The former involves "processes that support development of path-breaking innovation" through positive expectations and creation of network of actors e.g start-ups, incubator platforms. Empowerment processes make niche innovations competitive by either making them preform profitably within existing regime (fit and conform) or changing the mainstream selection environment to favor path-breaking innovations (stretch and transform) (Smith & Raven, 2012, p. 1034).

At the meso level is a relatively stable socio-technical regime. This includes among others existing technologies, current markets, user preferences and industry for a given system. Since there is considerable sunk investment in terms of infrastructure and competencies there is mutual adaptation of lifestyle and thus innovations tend to be incremental along path-dependent trajectories (Geels & Schot, 2007; Geels et al., 2017). Incremental innovations such as electrification and digitalization of oil production in order to reduce emissions is an illustrative example of the latter while renewable energy sources such as solar, biogas and wind exemplify radical niche innovations. Stability of the regime can also be seen as the 'outcome of active resistance by incumbent actors'(Geels, 2014, p. 3). Using a Triple Embeddedness Framework

(TEF) and examples from the UK electricity system Geels (2014) shows how regimes resist low-carbon transitions through instrumental (by using resources such as money, positions of authority) discursive (shaping dominant discourse and setting the agenda), material (technical capabilities and financial resources) and institutional strategies (advocating for liberal markets which favor regime actors).

At the macro level is the landscape which is an exogenous environment that cannot be directly influenced by niche and regime actors and hence change over many decade (Geels & Schot, 2007). Rapid changes in the landscape level may be caused by shocks such as wars or economic crisis. When changes in these three levels align, they create a window of opportunity for niche innovations. These niche innovations mature and in time form the new sociotechnical regime. Different kind of alignments based on the timing and nature of these interactions leads to one of four socio-technical pathways; transformation, technological substitution, reconfiguration and de-alignment/realignment pathways (Geels & Schot, 2007).

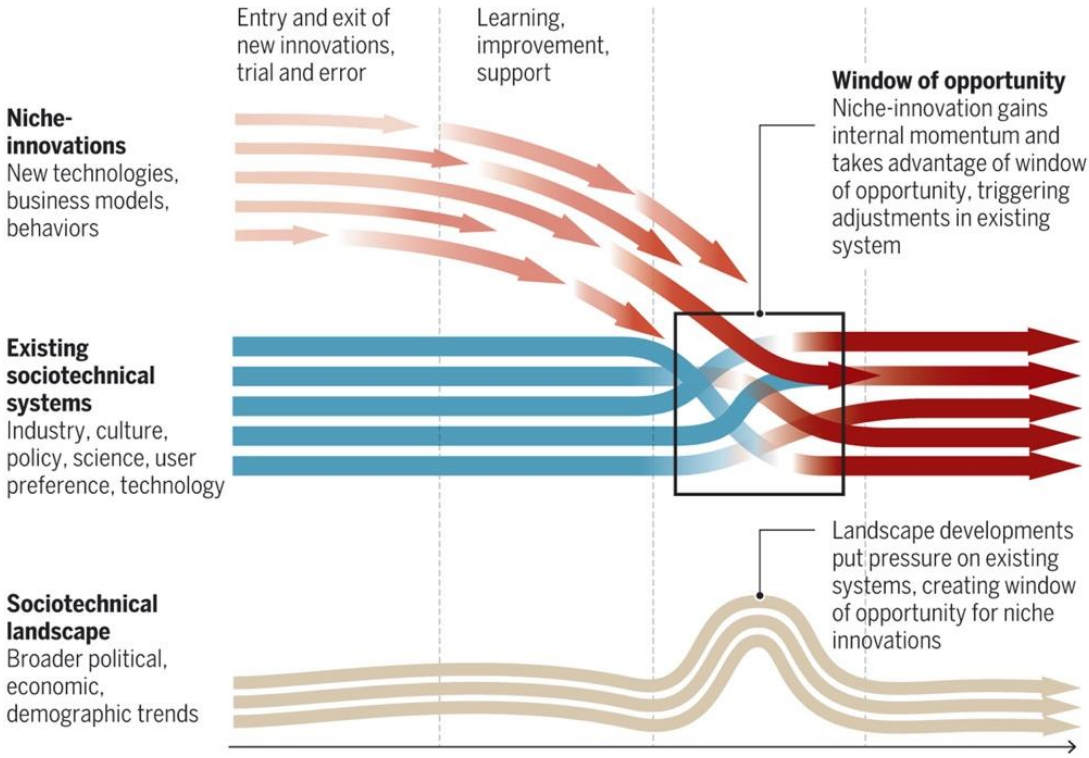

Figure 1. Illustration of the Multi-level Perspective. Adapted from Geels, Sovacool, Schwanen, & Sorell (2017, p. 1242)

Although there are a number of criticisms raised against the MLP , for the purposes of our discussion I will only address two of these. The first criticism levelled against MLP is that it has a bias towards 'bottom-up' innovations (Smith, Stirling, & Berkhout, 2005). Responding to this Geels (2011) argues that it is important to pay more attention to multi-regime interactions since niche-innovations by definition requires interactions between two (or more) regimes which may be positive or negative. To illustrate this they give the example of how innovation in batteries for electric powered vehicles link transport and electricity regime. Turnheim & Geels (2012) also acknowledge that there is a lot of focus on novelty and innovation and therefore investigate what transitions look like from the incumbents' perspective. Taking the example of the fossil fuel industry , they argue that since regimes are stable and tend to reproduce themselves deliberate destabilization of fossil-fuel based industries may play an important role in sustainability transitions because it creates more space for renewable energy i.e windows of opportunity. Using historical case of the British coal industry they show that destabilization is a multi-dimensional and enacted process that 'results from the increase of external pressure and the weakening of actor commitment to established regimes' (Turnheim & Geels, 2012, p. 38).

The second closely related criticism is that the sociotechnical transition pathways as envisioned by MLP pay 'limited explicit attention to agency and institutions'(Geels et al., 2016, p. 896). As mentioned above the transition pathways emerges as a result of timing and nature of interaction between the processes in the three levels. Geels et al. (2016) acknowledges this showing that changes does not only depend on timing and nature, but also how the actors interpret and mobilize resources. Current ensuing debates and the varied response by different countries about the IPPC report is an illustrative example of how different countries interpret these pressures and react accordingly. Although the reformulated typologies still maintain four major pathways, technological substitution and transformation pathways are further differentiated The reformulated typologies also show that the pathways do not necessarily follow a linear progression but can be reversed or switch from one to another (Geels et al., 2016).

The Triple Embeddedness Framework (TEF) gives a better understanding of the agency and response of actors in a particular industry regime. TEF suggests that when firms face pressure from external environments (economic and socio-political environments) they respond to these differently depending on a set of industry-specific institutions (Geels, 2014a). 'Industry regime'

is set of institutions that are specific to a particular industry that enable and constrain behavior and action (Turnheim & Geels, 2012). I use the TEF as my analytical framework and explain this further in section 3.1 of this study.

To conclude this part, sustainability literature in general and the MLP and transition pathways in particular offer important concepts and mental maps that help contextualize the dynamics between the current fossil fuel based socio-technical regime and niche actors. According to the MLP therefore the Energy Valley cluster can be placed as an actor embedded in the prevailing socio-technical regime. This is because it represents firms in the OG industry. This is discussed and elaborated further in the analytical framework and discussed in chapter 6.

2.2 Clusters and cluster organizations

The concept of cluster was popularized by Michael Porter in his famous book *The Competitive Advantage of Nations* (1990). He defines clusters as 'geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in a particular field that compete but also cooperate' (Porter, 2000, p. 15). His main argument is that nations that have competitive advantage in certain industries tend to have clusters of related companies that are geographically co-located and through cooperation became more innovative. The success of Silicon Valley in California with its high concentration of advanced technology companies is a good example of this. Porter proposed the so called 'diamond model' which posited that the interplay between four relations and their attributes can explain the competitive advantage of a country or region. These are; (1) input conditions e.g human and capital resource and necessary infrastructure, (2) demand conditions (3) firm strategy that encourages investment through healthy rivalry, and (4) presence of related and supporting industries (Porter, 2000, p. 28).

In Norway Porters ideas were taken up by the growing oil industry in the early 90's in fact the National Association of Mechanical Firms (*Mekaniske bedrifters landsforening*) carried out its own Porter project. This was followed by several Norwegian economists who used the diamond model to analyze various sectors of Norwegian business (Ryggvik, 2013). This gave rise to a strong support of industrial cluster as a policy to stimulate growth and competitiveness of the Norwegian OG industry. Today the OG industry in Norway is characterized by highly specialized regional clusters notably in Stavanger, Bergen and Oslo. Recently there have been

a move towards broadening the scope of these cluster organizations from only OG focus to energy or ocean and maritime technology such as GCE Node in southern Norway and GCE Ocean Technology in Bergen (NIC, 2019).

Cluster theory gave way to the establishment of cluster organization. A cluster organization is a 'formal institution that is established to facilitate increased interaction and cooperation between participants in the cluster'(NIC, 2019). The NIC is a government program instituted in 2014. This program supports cluster organizations in Norway by supporting collaborative development activities in clusters. The major goal is to increase the individual company's innovativeness and competitiveness. The NIC is owned and jointly operated by Innovation Norway, Siva and the Research Council of Norway. It is funded by the Ministry of Industry and Fisheries and the Municipal and Modernization Ministry. Industrial cluster policy has the ultimate goal of harnessing cluster organizations to make a country or a region more competitive.

According to Schot & Steinmueller's (2018) three frames of innovation policy, industrial cluster policy falls into framing two. This framing, characterized by national systems of innovation is preoccupied by competition between countries by explaining differences in industry innovative and productive performance. They note that national innovation system approach is complementary to the competitiveness agenda envisioned by both cluster theory and industrial cluster policy. Policies based on framing two have an optimistic view about innovation and assumes that 'innovation is a force for creating a better world'(Schot & Steinmueller, 2018, p. 1561). The preoccupation of this policies is thus economic growth and better competitive position, negative externalities such as pollution are hence believed to be mitigated and managed through regulation. History is replete with evidence to the contrary. Arguing for an alternative third framing Schot & Steinmueller (2018, p. 1562) claim that current policies are unfit for addressing the environmental and social challenges. The industrial cluster policy, informed by cluster theory is a good example of this. Cluster theory and policies based on these focuses, and rightly so, on the *rate* of innovation, however there is need to recognize that innovation represents also a certain *direction* (Schot & Steinmueller, 2018). In our case the direction is towards a sustainable and low carbon future.

From this brief discussion we can conclude that although literature on clusters has led to insightful discussions about how clusters emerge, are organized and managed, its preoccupation

with competitiveness and unlimited growth has a blind spot in relation to this study. A promising approach is therefore to study cluster organizations as an intermediary actor. In the following part I will discuss literature on intermediary followed by a review of three studies that apply this perspective.

2.3 Intermediaries – what are they?

Following the advent of the innovation systems approach, it was recognized that such a system necessarily contains a number of interconnected actors (Howells, 2006; van Lente et al., 2003). A given system of innovation may therefore contain firms, universities, research institutes, political institutes and intermediaries. These intermediaries act as brokers between the various parts and actors in the innovation system (van Lente et al., 2003). Howells (2006) notes that 'intermediary' is a broad term that has previously been described by various names such as third parties, bridgers, brokers, superstructure organizations and boundary organizations. What seems to be common to all this however is the 'intermediary nature of the work that they do' and that their 'arenas of action are defined by their 'in-betweenness' cutting across the provider-user-regulator triad' (Moss, 2009, p. 1481). Although an intermediary could be an individual, an organization or a network (Moss, 2009), for the purposes of this study I will focus on organizations that work as intermediaries.

In general there are three categories of organizations that may act as an intermediary. These include (a) Knowledge Intensive Business services (KIBS) such as management consultants who operate between their source of knowledge and their client, (b) Research and Technology Organizations which are publicly financed and operate between science and industry and (c) industry organizations. The latter involves associations formed by industries to represent their interests and to supply members with relevant knowledge (van Lente et al., 2003). Cluster organization such as the Energy Valley fits in this latter category.

Van Lente et al. (2003) further distinguishes between traditional and systemic intermediaries. Traditional intermediaries operate mainly bilaterally i.e between two parties while systemic intermediaries function at a system level. They identify three major functions of the systemic intermediary; articulation of needs and options, alignment of relevant actors and the support of learning and experimentation processes (van Lente et al., 2003). Noting that a transition goes through four phases namely, exploration, take-off, entrenchment and stabilization, they argue

that each of this phase require different forms of articulation, alignment and learning. Later Howells (2006) examined the roles of intermediaries in the UK. He doesn't differentiate between traditional and systemic intermediaries but rather treats this under one category of 'innovation intermediaries'. He produces a longer list of functions and concludes that 'intermediaries provide a much wider, more varied and holistic role for their clients in the innovation process than has generally been acknowledged' (Howells, 2006, p. 726)

Intermediary actors are viewed as 'key catalysts that speed up change towards more sustainable sociotechnical systems' (Kivimaa, Boon, Hyysalo, & Klerkx, 2019, p. 1062) More recently there seems to be a disambiguation between an 'innovation intermediary' and a 'transition intermediary' in the literature. Building on earlier studies on intermediation Kivimaa, et al. (2019) make three important contributions. First they give a broad definition of a transition intermediary. Secondly they introduce the concept of 'ecology of intermediaries'. Since transition processes are multidimensional and complex one intermediary alone is insufficient (Kivimaa, et al., 2019). Therefore a number of intermediaries, placed in different positions, with different competences and operational models are necessary. Thirdly, they propose a typology consisting of five intermediaries based on their context of action, emergence and goal of intermediation. These are; systemic intermediary, regime-based transition intermediary, niche intermediary, process intermediary and user intermediary.

2.4 Characteristic and roles of intermediaries

According to van Lente et al.(2003) systematic intermediaries are 'crucial ingredients' in an innovation system. A system of innovation involves networks "of interconnected institutions that create, store and transfer knowledge, skills and artefacts which define new technology" (Metcalfe 1995 cited in van Lente et al., 2003, p. 2). The intermediary is located between these interlinked institutions connecting, translating and facilitating flows of knowledge within the system. They act as bridges or links between the various building blocks of the system.

Given that systems of innovation are unique, the actual roles played by systemic intermediaries are highly context specific. However there are three major basic roles systemic intermediaries play. These are firstly articulating demand and strategy development for the field and members. Secondly, they align different diverse actors, organize discourse, broker consensus and manage

complex and long-term innovative projects. Finally systemic intermediaries create conditions for interacting, learning and searching, and provide actors with customized strategic information (van Lente et al., 2003 p. 11). As sustainability literature studies grew in the last few years, several scholars begun to explicitly explore the functions of intermediary actors both in innovation and transition processes (Kivimaa, Hyysalo, et al., 2019, p. 111).

As mentioned above recent literature on intermediaries make analytical distinction between innovation intermediaries (e.g Howells, 2006) and transition intermediaries (e.g Kivimaa, 2014; Kivimaa et al., 2019). However these two are closely related and perhaps even indistinguishable in real life given that innovation intermediaries may also function as transition intermediaries (Kivimaa, Boon, et al., 2019). van Lente et al. (2003) do not differentiate between innovation and transition intermediary in their study. They argue that sustainability transitions involve complex and long-term changes in the way firms, research institutes, the public, and intermediaries operate. In other words *transitions* involves major changes in *innovation systems* (van Lente et al., 2003 emphasis mine). Other scholars view sustainable transition as additional roles innovation intermediaries can play. For instance Gliedt, Hoicka, & Jackson (2018, p. 1257) demonstrate how sustainability-oriented innovation intermediaries foster more openings for innovation to breakthrough from niche to regime level and hence accelerate the timeframe of sustainability transitions. For the analytical purposes of this studies, I differentiate between innovation intermediary and transition intermediary.

Innovation intermediary can be defined as "an organization or body that acts [as] an agent or broker in any aspect of the innovation process between two or more parties" (Howells, 2006, p. 720). This definition is broad and encompasses both systematic and traditional intermediaries. This definition also stresses that innovation intermediaries are defined by their 'in-betweenness' rather than how they are organized (Moss, 2009, p. 1481). Transition intermediaries on the other hand can be defined as;

> "actors and platforms that positively influence sustainability transition processes by linking actors and activities, and their related skills and resources, or by connecting transition visions and demands of networks of actors with existing regimes in order to create momentum for socio-technical system change, to create new collaborations within and across niche technologies, ideas and markets, and to disrupt dominant unsustainable socio-technical configurations." (Kivimaa, Boon, et al., 2019, p. 1072)

Based on the above definition therefore transition intermediaries differ from innovation intermediaries in three ways. Firstly although they are both characterized by their 'in-betweenness' transition intermediaries have a normative orientation towards sustainability while innovation intermediaries are focused on novelty and improvement. Secondly transition intermediaries have a socio-technical orientation while innovation intermediary may be preoccupied with an artefact, process or single technology. Thirdly transition intermediaries often envision a much longer time period (Kivimaa, Boon, et al., 2019). It is also important to note that the definition highlight two simultaneous processes (1) niche creation and (2) disruption of dominant regime.

2.5 Cluster as intermediary actors

Here I review three empirical studies that view cluster organizations as intermediary actors within the broader framework of MLP in different countries, the first in Sweden, the second in USA and the third in Canada.

Laur, Klofsten, & Bienkowska (2012) study four cluster initiatives in Sweden from various regions and industries. They propose and utilize a theoretical framework that views the cluster organization as an intermediary mediating between three categories of actors. These actors are, (1) key players who provide resources and set the agenda, (2) target group whose needs serve as the basis for the organization's operation and lastly (3) support group who join in for diverse reasons but add to the cluster organization's value through their competence, political and social influence. One of the major observation from their study is that cluster organizations open themselves up to local communities in order to 'provide themselves with greater legitimacy and visibility and to attract members to both their target and support groups' (Laur et al., 2012, p. 1916). Viewing cluster organizations through the prism of intermediary framework, the authors conclude that rather than govern and control the cluster, these intermediary organizations play a more subtle role as 'dream-catchers'. That is by striking a balance between exploitative and exploratory activities they gather and visualize potential opportunities in regional contexts by articulating these and realizing them through entrepreneurial process.

Although this Swedish study offers nuanced observation of a cluster's role it doesn't discuss how clusters may contribute to transition. Two studies examine clusters as intermediaries focusing explicitly on how these contribute to socio-technical transition to a 'green economy'.

Looking at Green energy cluster in Massachusetts USA, McCauley & Stephens (2012) begin by questioning whether the use of cluster policy, a mainstream economic development tool, can be used to achieve energy sustainably. Using the MLP framework, the authors demonstrate that the Green Energy Cluster play an intermediary role by connecting the niche-level activities with regime-level institutions. However they caution that the cluster's intermediary role may act as a double-edged sword (McCauley & Stephens, 2012, p. 218). On the one hand the cluster has the potential to accelerate regime level changes by generating 'buzz' around sustainable energy, building trust, and offering a common vision between diverse actors. On the other hand by supporting key players with high growth potential in the current regime, other actors who may be working on radically different ideas may be deemed impractical. Based on this they argue that the use of economic cluster approach as a strategy for sustainability transition may raise a 'paradox' (McCauley & Stephens, 2012, p. 222). They point out that for the Green Energy Cluster the strong involvement of non-firm actors such as universities and non-profit organizations 'de-centered the notion of market competitiveness and firm expansion' and highlighted the importance of community development and cultural change related to energy practices. The progress towards sustainable transition and green energy economy is therefore heavily reliant on the integration of these non-business sectors. They conclude that applying the cluster strategy to sustainable energy sector requires a 'more holistic approach' with an appropriately broad and inclusive framework in order to facilitate sustainable energy transition (p.224).

The third study examines how Quebech's Cleantech cluster addresses the institutional challenges of the green transition in Canada. This study acknowledge the preoccupation of cluster in promoting firm productivity, innovation and economic prosperity and therefore apply the intermediary perspective to study how cluster dynamics influences the mobilization of actors with respect to a more sustainable economy (Hatch et al., 2017). This study shows that the cluster organization plays a crucial role in socio-technical transition by creating favorable local institutional conditions. It does this in two ways. Firstly through its 'traditional innovation role' where it brings together diverse actors such as firms and unions to enhance knowledge sharing through joint taskforces, lobbying for favorable conditions and through promotion of technology to end-users. And secondly through its nontraditional role where it shapes the positionality of the actors, facilitates their collective mobilization and foster participation in the transformation towards a sustainable economy (Hatch et al., 2017, p. 82). They illustrate the latter by showing how historically apolitical actors such as firms assume a more political role

by engaging in outreach and activists effort in an attempt to raise awareness on climate issue. In contrast the unions mostly linked to fossil-fuel industries which are traditionally known to be politically active came late to the scene although this is rapidly changing.

The above studies on different clusters in Sweden, USA and Canada echoes van Lente et al. (2003) conclusion that intermediaries are useful and necessary in long-term and complex changes but are not sufficient per se and therefore depend on actions of other actors and require an ecology of intermediaries. They also show that cluster organizations unique position means that they have the potential to facilitate or inhibit the pace of sustainability transitions.

3.0 ANALYTICAL FRAMEWORK

Here I turn to the analytical framework, the lens through which I make sense of the collected data. The roles and functions identified in these framework were coded and checked against interview transcripts, documents and other sources in the analysis stage. In particular I use Kivimaa, et al.,(2019) typology to place and give a more nuanced discussion of the clusters roles and functions as a transition intermediary actor. The Multi-level perspective discussed in section 2 above gives an overall framework of how transitions occur. In order to conceptualize the pressures that influence cluster organizations and analyze the response of the cluster organization to these I use the Triple Embeddedness Framework (TEF). TEF gives a better understanding of how firms in a given industry respond to and co-evolve with their economic, political, cultural, and social environment. I show how this framework can be extended to study cluster organization in the OG industry.

3.1 The Triple Embeddedness Framework (TEF).

MLP suggests that regime actors such as incumbent firms tend to be reluctant to change and prefer incremental innovation. But incumbent firms can play a role in addressing grand challenges by developing radical innovations. This however requires pressure from consumers, policymakers and social movements to stimulate these in order to overcome lock-in mechanisms (Geels, 2014a). TEF suggests that when firms face pressure from external environments (economic and socio-political environments) they respond to these differently depending on a set of industry-specific institutions (Geels, 2014a). 'Industry regime' is set of institutions that are specific to a particular industry that enable and constrain behavior and

action (Turnheim & Geels, 2012). Industry regime contains four elements; (1) technical knowledge and capabilities (determine what firms can/cannot do), (2) mindset and cognitive frames (influences how actors perceive social reality), (3) values identity and mission (determines what actors see as appropriate), and (4) formal regulations, laws and standard that govern the actors. The economic environment includes suppliers and customers while the socio-political environment includes policymakers, civil societies, media and the general public. In a given industry there are three types of firms: core firms (which shape regime rules), firms 'in the middle', and peripheral firms (new entrants for whom it is relatively easier to deviate from regime rules) Geels, 2014a, (p. 266). See figure below for an illustration of the TEF.

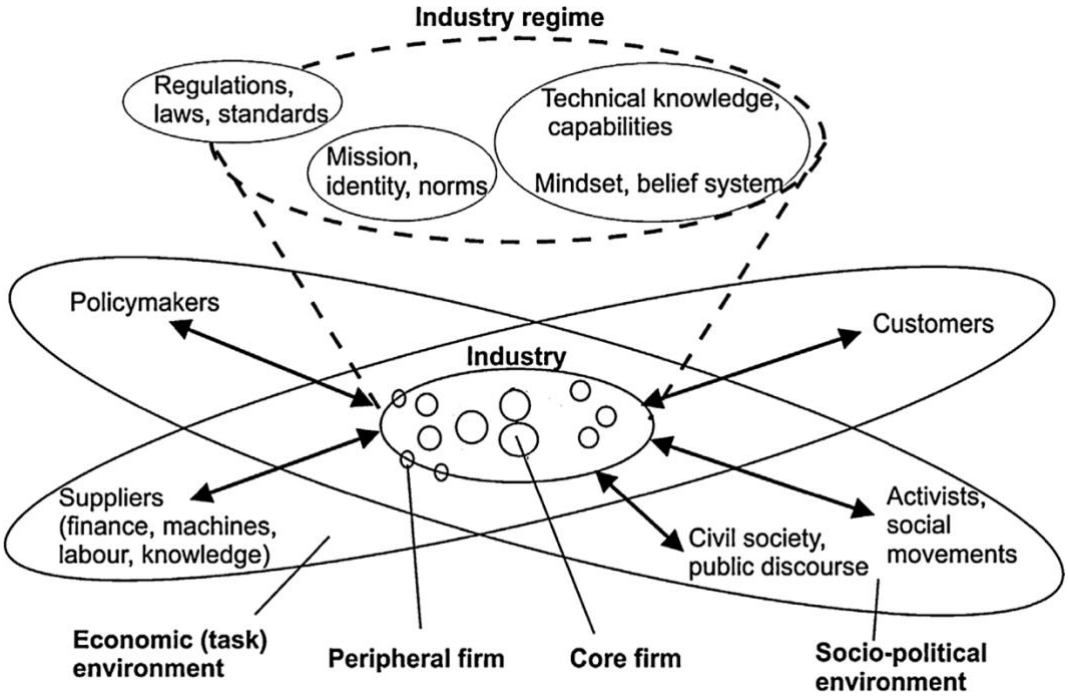

Figure 2 Triple Embeddedness Framework source Geels (2014a, p. 266)

The interactions between a firm and its economic and socio-political environments are further conceptualized as bi-directional (Geels, 2014a, p. 266). This means that firms "not only *adapt* to external pressures but also strategically attempt to *shape* their environment". This is illustrated by the double-headed arrows in the figure above. These strategic responses may be directed outwards towards economic and socio-political environments, or inwards changing the firms core characteristics. The response strategies are guided by industry regimes (Turnheim & Geels, 2012, p. 37). Externally-oriented responses are largely defensive and include processes such as marketing, or direct lobbying. Turnheim & Geels (2012) categorize these into four

major strategies directed towards various environments. Political strategies are directed towards government policies and may include lobbying and financial contributions. Innovation strategies may include investment in R&D and knowledge management. Economic positioning include strategies such as marketing and sales. And fourthly socio-cultural strategies which are aimed at influencing public opinion through public relations and advertising.

Internally-oriented strategies may include change of routine and belief systems which leads to reorientation of the firms at different 'depths' depending on what kind of organizational elements are adjusted (Geels et al., 2016, p. 898). This strategic reorientation goes through four stages where increasing pressure from the environment and performance problems stimulate actors to overcome lock-in mechanisms and increasingly question more foundational regime elements (Geels 2014, p. 271).

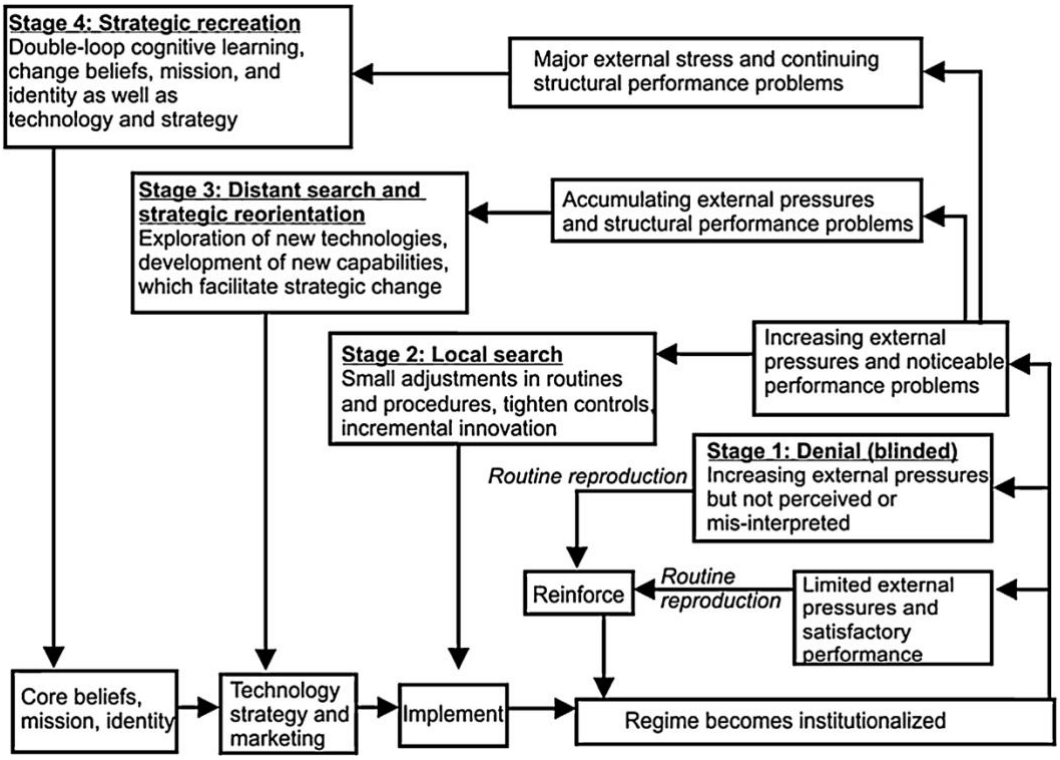

Figure 2 Dynamics of Strategic Orientation (Geels, 2014b, p. 272)

In the first phase firms downplay pressure from external environments and refuse to take action. In the second phase firms start searching but stay close to existing regime elements. Some common response by firms in this stage include cost-cutting, improving efficiency and downsizing. Firms may make 'symbolic' changes without 'substantive' action (p. 271). While

core firms engage in incremental innovation peripheral firms begin to explore more radical technical solutions. In the third phase, firms move from local search to distant search and begin to explore radical alternatives at the expense of exploitation of existing technologies. There is also increasing collaboration between core firms and peripheral firms.

In the final stage firms take substantive action and begin "to examine deep-structural elements such as core beliefs, mission and identity" (p. 271). Geels (2014) states that core beliefs and missions are more difficult to change than technology and capabilities. The former involves 'strategic recreation' while the latter involves 'strategic reorientation' i.e creating something new as opposed to changing direction. Figure 3 above shows the four stages a firm goes through depending on the amount of pressure external pressure.

3.2 Types of transition intermediaries

In chapter 2 a transition intermediary was defined as an actor who positively influence sustainability transition processes by linking different actors creating momentum for change through new collaborations within and across niche technologies and by disrupting dominant unsustainable regimes (Kivimaa, Boon, et al., 2019, p. 1072). In section 2.3 of this study I mentioned five different types of transition intermediaries as identified by Kivimaa et al (2019). Although these are separate categories they are not mutually exclusive. In practice transition intermediaries are likely to be categorized more as one type with a few characteristics reflecting other types. This typology differentiates transition intermediary based on the level they operate, how they emerge, their goal and normative position.

It is important to point out here that systemic intermediaries as defined by Kivimaa et al. (2019) is similar to van Lente et al. (2003) definition in that they both function at the system level. Nevertheless Van Lente et. al.'s (2003) concept refers to an intermediary placed within an innovation system while Kivimaa et. al.'s (2019) refers to an intermediary acting at the landscape level. Table 2 below gives an overview of the different categories of transition intermediaries.

TABLE 1 TYPES OF TRANSITION INTERMEDIARIES

CATEGORY	LEVEL OF ACTION	EMERGENCE	GOAL OF INTERMEDIATION	NORMATIVE POSITION	
				Position vis-à-vis niche	**Neutrality**
Systemic intermediary	Intermediating on system level between multiple actors & interests	Typically established to intermediate	Pursues given (sustainability) goals on a system level; ambitiousness towards disruption to existing system	Outsider to specific niches, creating space for multiple, alternative niches	Typically regarded as a position of neutral, unbiased facilitator and broker, despite having an interest in stimulating transitions
Regime-based intermediary	Intermediating on system level between multiple actors, within mandate given by dominant regime actors	Existing actor subsuming intermediary roles; or established by dominant regime actors to intermediate for transition	Pursues given (sustainability) goals through typically more incremental solutions or political aims	Outsider to specific niches, creating space for multiple, alternative niches	Regarded as a player in the dominant system but pursuing or empowered for change
Niche intermediary	Intermediating between local projects, and/or higher level of aggregation	Often emerging to intermediate when a niche (or TIS) develops	Pursues given (sustainability) goals and solutions from a perspective of a given niche (or TIS)	Insider to a specific niche (or TIS)	Regarded as player advancing a particular niche (or TIS)
Process intermediary	Intermediating within experimental projects or specific processes contributing to transitions	Typically established/ employed to intermediate day-to-day action in transition projects or processes	Implementing context specific priorities, informed by broader transition trajectories	Typically outsider to specific niche	Regarded as a neutral, unbiased "networker" that does not have specific "agenda" in the process
User intermediary	Intermediating between technology (provided) and use, and/or niche technology and dominant configuration	Emerges from amidst users and consumers	Acts as facilitator, representative, or broker of end-use or end-users.	Insider or outsider to specific niche	Leans towards user interests (in some cases even as activists)

Table adapted from Kivimaa et al., 2019 (p. 1069)

3.3 The roles of transition intermediaries

Although empirical research has established that transitions are complex, iterative, co-evolutionary and multilinear processes with many feedback loops (van Lente et al., 2003), many studies find it useful to apply the 'linear model' to differentiate between various transition phases. These are destabilization phase, exploration phase, acceleration phase and stabilization phase[2]. As such transition intermediaries play a distinct role in sustainability transition depending not only on the level at which they operate, as discussed above, but also on the particular transition phase. Kivimaa, Hyysalo, et al. (2019) offer an aggregated analytical framework that classifies intermediaries based on the level, type and transition phase. For the purposes of this study I will only explicate further on the regime-based intermediary. This is because I identify Energy Valley cluster as regime-based intermediary. I explain this further in chapter 6.

[2] Other scholars use different terms for this phases but they refer to similar processes see van Lente, Hekkert, Smits, & Van Waveren (2003, p. 15)

The destabilization phase is characterized by uncertainty and decreasing public legitimacy which threaten existing networks and markets this may be due to unforeseen circumstances such as external pressure in the landscape level according to the MLP. A good example is the financial crisis in 2008 and the oil price downturn in 2015 which apply pressure to the economic environment. The regime-based transition intermediaries at this phase translate these destabilizing policies into practice by helping to make sense of the complex and changing policy environment (Kivimaa, Hyysalo, et al., 2019). In the exploration phase there is an ongoing experimentation at the niche level. Although regime-based intermediaries may play a limited role they can help find new sources of funding, support network building and innovation processes. In the acceleration phase regime-based intermediaries play a crucial role in supporting niche build up through practical action such as creating new networks with other actors and even engaging in market creation. In addition these intermediaries raise public awareness and create public legitimacy for the new pathway (Kivimaa, Hyysalo, et al., 2019). In the stabilization phase in addition to funding niche R&D activities, new regime-based intermediaries may emerge or previous ones subsume new roles to fill institutional gaps.
According to the above discussions there are four major roles that a regime-based transition intermediary plays. These are;

1. Translate destabilizing policies into practice or making sense of complex and changing policy environment
2. Support niche build up through practical action and forming networks with other intermediaries and engaging in market creation
3. Raise public awareness and creating legitimacy for the new pathway.
4. Finding funds and directing these to niche and R&D activities

Since these roles are conceptualized at the meso level of MLP, in order to make these applicable to my case I adapt these to the 'industry regime' based on the TEF. This is because in the MLP the socio-technical regime refers to "the 'deep structure' that accounts for the stability of an existing socio-technical system" and includes several sub-regimes such as policy regime, science regime and so on (Geels, 2011, p. 27). In this study I focus on the rather narrow OG industry regime. As such instead of translating the broad destabilizing policies, a regime-based intermediary, in the OG industry, will focus on external economic and socio-political pressures which directly impact the 'firms-in-industry'. This means that a mismatch between general institutions such as broadly accepted norms and industry specific institutions affect firms indirectly through the activities of socio-political actors (Geels, 2014b). To illustrate this

with an example we see that despite climate change being on the global agenda for a long time it was not until the school children took to the streets that core firms in the OG reacted using several strategic responses. Equinor has for instance lately increasingly placed several adverts in the national newspaper [3].

Following these discussion, a transition intermediary in our case can be said to play the following major roles;

a) Translate external economic and socio-political pressures to make sense of these
b) Support niche build up through practical action and forming networks with other intermediaries and actors – within and outside the industry
c) Raise public awareness and creating legitimacy for the new direction(s).
d) Finding funds and directing these to niche and R&D activities

The analytical framework is utilized as follows in this study. The MLP is used to frame the overall argument about how transitions emerge. Based on the premise that climate change is a grand societal challenge I use The Triple Embeddedness Framework (TEF) to better examine how the Energy Valley cluster respond to pressures from the economic and socio-political environment and its strategic response to these. The typology and roles of a regime-based transition intermediary discussed above will be used to examine the actual roles Energy Valley cluster plays. Before I discuss this, I first explain the research method used in this study.

4.0 METHODOLOGY

In this part I explain the methods used to collect and analyze the empirical data for this study. I begin by explaining the reason I chose qualitative approach as opposed to quantitative or mixed method approach. I then explain why I use a case method. I will detail the three data collection methods used in this study namely interviewing, observation and document analysis. This will be followed by a description of my analytical strategy. This part will end with a reflection on credibility of the research process by discussing validity, reliability and end with a reflection on the limitations of this study.

[3] See https://www.aftenposten.no/brandstudio/feature/v/equinor/johansverdrup/ Last accessed 18.10.2019

4.1 Qualitative approach

There are three main research approaches, qualitative approach, quantitative approach and mixed methods approach. Although these are often presented as distinct or discrete, Creswell (2014) argues that they should instead be seen as representing different ends of a continuum with the mixed methods approach in the middle. Quantitative research is an approach for testing objective theories by examining the relationship among measurable variables generating numbered data that are then analyzed using statistical procedures. Creswell (2014, p. 32) defines qualitative approach as one that seeks to 'explore and understand the meaning individuals or groups ascribe to a social or human problem'. In other words qualitative research refers to meanings, concepts, definitions and description of things while quantitative research refers to counts, measures and distribution of the matter in question (Berg & Lune, 2011). Given this study's research purpose was to explore and understand the roles and response of a cluster organization , the qualitative approach was deemed most suitable. Explicating roles and responses requires definition and interpretation by the researcher to make meaning of the data.

4.2 Qualitative case study

In addition to having a qualitative approach this study followed case study as a research method. Choosing a research method is largely determined by the purpose of the study and the suitability of the method to answer the research question (Berg & Lune, 2011). A case study is here defined as an empirical method 'that investigates a contemporary phenomenon in depth and within its real-world context especially when the boundaries between the phenomenon and context may not be clearly evident' (Yin, 2018, p. 15).

Contrasting between five different methods Yin (2011) argues that there are three main criteria for choosing case study research. Firstly that the research question is formulated as a 'how' or 'why' question, secondly that the researcher has little or no control over the behavior of the events and thirdly that the focus of the study is contemporary. My research question; *How does the Energy Valley cluster contribute to sustainable energy transition in Norway?*, fulfills these three criteria. This research question will seek to explore and describe what roles the Energy Valley as a cluster organization is currently doing to contribute to energy transition is an ongoing current event. The case study method also follows a certain research design or a 'blueprint' of what data to collect, how to collect and analyze this. Although the research design

usually starts with preparation, data collection, analysis and dissemination, these steps are iterative and not linear.

4.3 Case selection

One of the major initial tasks in case study is defining the boundaries of the case to be studied. Cases can be concrete or less concrete depending on the phenomenon under scrutiny. For this study the case was the Energy Valley cluster organization. Energy Valley cluster describe themselves in their 2019 statutes as 'an interdisciplinary, standalone business and expertise cluster for companies and knowledge environments in Eastern Norway with interests in subsea in particular and energy in general.' As an organization it has clear organizational structure and mandate. The cluster was established in 2010 and its headquarters is located in Oslo. The cluster was chosen as a case for this study for several reasons. To begin with, given the limited time of the study Energy Valley being located in Oslo makes it easier to access informants, and attend meetings for observation and complete this study within the stipulated time. I also became aware of this cluster when I first attended this year's Subsea Valley conference. I later learned that the Energy Valley was collaborating with the University of Oslo which made it easier to contact the administration.

Multiple-case studies are often preferred over single-case studies and viewed as more robust . Yin (2018) gives five rationales for choosing a single-case study as an appropriate design as opposed to a multiple-case study. These rationale are that; the case represents critical test of existing theory, represents an unusual circumstance, or the case serves revelatory or longitudinal purpose (Yin, 2011 p53). I argue that my case fulfills three of these rationales. Firstly the case selection is critical to the theory that I am proposing – that cluster organizations can play a role in energy transitions. Arguably a multiple-case study would indeed give more credence to this proposition nevertheless as far as I know I haven't come across another similar study in Norway. A notable exception is Karen Landmark's doctoral dissertation *Enabling corporate sustainability transition: The case of the Norwegian process industry* which focuses on Eyde Cluster a Norwegian business cluster organization in southern Norway. This study examines how collaborative and open partnership between the industry and university allows both to build their capacity on sustainability in a mutually beneficial way (Landmark, 2018).
As such I argue that my case is an unusual one since it is about a cluster embedded in the current fossil-fuel based socio-technical regime. Thirdly I take a longitudinal view on the

Energy Valley cluster, not only describing its role now but how these were before and why these have changed.

4.4 Data collection

I used three sources of evidence to collect data for this study. These are interviews, documentation and direct observation.

Interviews

Interviews are one of the most important sources of case study evidence since they help in explaining 'the hows' and 'whys' of key events (Yin, 2018) . Initially this study was set to interview a sample of selected informants to represent the value chain of the member firms in the Energy Valley cluster, respondents from the administration of the cluster itself and other relevant actors. I randomly selected several firms and emailed them with a short request about my study. However I got no response from majority of these. Some firms declined to participate. As such only two face-to-face interviews were conducted as summarized here.

TABLE 2 OVERVIEW OF INTERVIEWEES

Organization	Interviewee	Position	Duration	Reference in this study
Innovasjon Norge	Line Magnussen	Senior Advisor	45 mins	Interview A
Energy Valley Cluster	Preben Strøm	Managing Director	90 mins	Interview B
	Katrine Vetlesen	Project Manager		

The first was conducted with a senior advisor in Innovasjon Norge working in the Norwegian Innovation Cluster (NIC) program on 20.08.2019 in Oslo. Given that this was an exploratory interview the researcher didn't record the interview but took notes. In hindsight, I realize that I should perhaps have recorded this. The second interview was conducted with two senior officials from the Energy Valley cluster on the 18.09.2019 in Oslo. This was a central interview that was recorded and transcribed. For both interviews, the interviewer clearly stated the purpose for the interview and informed the respondents on their right to freely participate. This was to ensure informed consent. The interviews were semi-structured and were sent to the respondents prior to the interview. See appendix A for a copy of the interview guides.

Although collecting data through interviews can provide targeted information and offer insightful explanation and perceptions, poorly articulated questions, response bias, inaccuracies due to poor memory and reflexivity may weaken the quality such interviews (Yin, 2018). To counter this I prepared an interview guide that I tested with a fellow student as well as discuss this with my supervisor. Sending the interview guide to the respondents beforehand was also an attempt at ensuring that the respondents were well prepared. To minimize reflexivity – interviewee saying what the interviewer wanted to hear – I formulated open ended questions. Yin (2018) also suggests carefully wording questions in order to appear genuinely uninformed about the topic.

Documentation

Due to the low response to interview, documentation became the most prominent source of data for my case study. According to Yin (2018) the main importance of document is to confirm and augment evidence from other sources. Furthermore documents can give specific and broad information and are unstable in that they can be reviewed repeatedly. As an organization, Energy Valley cluster produces an annual reports, newsletters and publishes a website and has been profiled in the media. The table below gives a summary of the documents collected and analyzed.

TABLE 3 SUMMARY OF DOCUMENTS COLLECTED AND ANALYZED

	Type of Document	**Year**
1.	Energy Valley's Annual report	2010, 2016 - 2018
2.	Statutes for Energy Valley	2012 and 2019
3.	Presentation by Energy Valley (both in newspapers and in conferences/meetings)	2010, 2013, 2015, 2018, 2019
4.	SSV Conference program	2010 -2019
5.	Energy Valley current website (www.energyvalley.no)	2017 - 2019
6.	Energy Valley old website (www.subseavalley.com)	2010 -2017

Despite the advantages named above Yin (2018) cautions that documents are written for a specific purpose and maybe biased. He therefore calls for a critical and objective appraisal of such documents. As a measure to counter bias, two other sources of documents were collected. Firstly I used Atekst to collect relevant information from the Norwegian newspapers. Atekst is

a searchable archive that contains the original papers of the national region and local newspapers, as well as a variety of magazines and journals in Norway. In order to limit selectivity bias Yin (2018) recommends a systematic search for relevant documents. Another weakness of documents according to Yin (2018) is that these can be hard to retrieve. To access the old website I used the Wayback machine[4] which is an internet archive portal that captures and stores copies of old websites in retrievable timeseries.

To collect relevant data on the Energy Valley I used the following parameters in Atekst. First the search period was set to between June 2010 (when Energy Valley was established) and August 2019. Then the search area was reduced to the following sources which were deemed most relevant based on location, coverage and specialization of content;

1. Three regional newspapers (Drammenstidende, Budstikka, Laagelandsposten to represent the three areas Energy Valley is located)
2. Two national newspapers Aftenposten and Dagsavisen
3. Three financial newspaper – Finansavisen, Sysla and E24
4. One technical magazine – Teknisk Ukeblad
5. Three online sources specializing in energy news– EnerWe, Petro, Offshore

A generic search of the phrase 'Subsea Valley' (which was the name of the Energy Valley cluster until April 2019) gave 427 hits. To reduce this number to a manageable size the following three search strings were included *grøn**, *omstill**, *fornybar*. These Norwegian words reflect the purpose of the case study. Use of the asterisk allows the database to search for different iteration of the word such as *grønne* or *grønt*. This yielded 64 results. These 64 articles were quickly skimmed through to remove similar and or irrelevant articles. This yielded 48 articles which were analyzed. A list of titles, dates and source of these articles in provided in appendix B.

Direct observation

As mentioned earlier my interest in studying Energy Valley started when I participated in their 2019 Subsea Valley conference. Observations can become a useful source of case data and can range from formal to casual data collection activities. In April I had not decided on the theme of my master's thesis when I attended the conference but this influenced my choice of research

[4] This can be accessed at https://web.archive.org/web/*/subseavalley.com last accessed 13.09.2019

topic. Later when I had refined my research question I contacted Energy Valley who invited me to two meetings with member firms and first public meet and greet for their incubator platform.

In June 2019 I was invited to two meetings arranged by Energy Valley for its Small and Medium Sized Enterprises (SME's). About 150 of the member firms in Energy Valley cluster fall under this category. The first meeting was held on the 18th in Oslo and the second on the 26th in Drammen. In both meetings Energy Valley cluster explored what issues and technologies the different companies are concerned with, what the cluster can do for them and what they can do for the cluster. Attending the meeting offered valuable insights in how varied and different the various competence, service and products provided by the member firms were. In addition to companies, representatives from academia were also present in the meeting. This meeting and a series of informal conversation also offered a unique perspective on how these firms viewed their contribution to climate change.

On the 12th September 2019 I was invited to Energy Valleys meet and greet for their energy incubator platform in Oslo. The start-up incubator , *Energy.Invented*, was launched earlier this year as a joint project between Energy Valley cluster, Solar Energy cluster and Institute for Energy Technology (IFE). In this event several start-ups presented their activities and visions and representative from Equinor informed about their scale-up projects. The information gathered here helped to shape my interview with Energy Valley. During each of these meetings I took field notes and after the meeting I wrote down my observations and impression. This text together with transcribed data from the interview and the documents collected were then analyzed using NVivo.

4.5 Data analysis

Analysis involves "careful, detailed, systematic examination and interpretation of a particular body of material in an effort to identify patterns, themes, biases and meanings" (Berg & Lune, 2011, p. 349). Yin (2018) suggests that having a general analytic strategy is important when preparing to conduct a case study. My interests for energy transition was piqued during my studies and as I gained an interest in these I paid particular attention to the various theories and frameworks. Data collection went hand in hand with a search for suitable analytical framework. The search for a suitable analytical framework and collection of data went back and forth.

I relied on theoretical proposition from the MLP and transition intermediary framework to create a coding table. Later the TEF framework was deemed most suitable in explaining the response of Energy Valley and the strategic reorientation. This coding table included the different roles suggested by theories on intermediary actors and concepts from multi-level perspective. Using NVivo the data was then sorted into the different codes. Yin (2018) refers to this method as pattern matching. In addition to themes identified from theories I examined the data for patterns (often repeated phrases, frequency), commonalities and differences. The latter was made easier with NVivo's inbuilt features. These two procedures reflect a long standing debate on whether analysis should focus on manifest content i.e elements that are present and countable or latent content that is the interpretative meaning of the elements (Berg & Lune, 2011, p. 355). By undertaking both however and revising the coding themes allowed for a more robust analysis.

4.6 Quality, limitations of the research and ethical considerations

The quality of any research is based on four criteria; are construct validity, internal validity, external validity and reliability (Yin 2018). I discuss these criteria in light of my study reflecting over the limitations and weaknesses of my study and end with a discussion on ethical considerations.

Construct validity is concerned with identifying correct measures for the concepts under study. For my study I was interested in the roles that Energy Valley plays, to operationalize this I looked at the projects initiated by the cluster as well as activities they are involved in using multiple sources. Internal validity is often addressed at the analysis stage and involves the question of how causal relationships between two conditions are established (Yin, 2018). External validity addresses issues of generalizability i.e whether the conclusion of a certain research can be applied to a similar case. Finally reliability of a research study means that if the study were to be repeated by different researcher using the same procedures and instruments, both studies would produce similar results. To achieve this Yin (2018) suggests maintaining a chain of evidence and developing a case study database. All the documents were saved using the Nvivo program.

As a novice researcher, these criteria worked more as a guideline and hence strictly speaking this study doesn't fulfill all these criteria especially internal and external validity. Since this is

a single case study, the results may not be generalizable to other cases. Although I do not claim this I show, how according to the framework these findings can be similar and guide future research. Another weakness of this study is lack of informants representing the member firms. Although I informally talked to a few during the meetings in Drammen and Oslo, an in-depth interview with a number of them would have produced a more robust study. In addition this study would have benefitted from a multiple-case study looking at other similar clusters and contrast and compare their roles and response. However given the limited amount of resource and low response from informants this was not possible. Nevertheless I argue that the results of this study adequately answer my research question.

Lastly in social science research, ethical issues mostly revolve around various issues of harm, consent, privacy, confidentiality of data and bias (Berg & Lune, 2011, p. 61; Yin, 2018). Since this study did not collect any personal information it didn't require approval from Norwegian Centre for Research Data (NSD). Nevertheless I followed certain guidelines to ensure that this study adhered to research ethical standards. To begin with all informants were duly informed about the purpose and goal of study, their right to remain anonymous if the so wished and their right to rescind permission anytime during the process. During one interview the respondent informed me of a strategic document that would have contained useful information but since this was deemed extremely sensitive and containing strategic plans I was not granted access. The informants were also given the option to review transcripts but none asked for this. Lastly all data was stored in my password protected computer and have only been accessible to me and my supervisor.

5.0 EMPIRICAL FINDINGS AND ANALYSIS

I begin this part by giving a brief background of the Energy Valley cluster and describe economic environment, socio-political environments and its 'industry regime' based on the Triple Embeddedness Framework (TEF). Using the typologies of transition intermediary frameworks I then discuss the roles Energy Valley played over time. Following my research sub-questions and in order to demonstrate this change clearly, I discuss roles played by EV before and after 2015 separately giving concrete examples and explain why this changed. I show how EV has subsumed the roles of a regime-based transition intermediary and argue that this be viewed as strategic reorientation i.e. substantial change in some regime elements.

5.1 The Energy Valley Cluster - an overview

Energy Valley cluster organization (EV)[5] was established in June 2010 as a supplier network by TESS, FMC, Aker Solutions and BI Norwegian Business School (Subsea Valley, 2010). It was then called Subsea Valley cluster (SSV) and primarily consisted of engineering firms that supplied subsea technology to the oil and gas industry. The name comes from this region, a 75 Km stretch between Oslo and Kongsberg which had since the 1980's been populated by engineering firms in the OG industry (Ryggvik, 2013). Some of the core firms have their production and headquarters located in the subsea valley. In 2013 EV joined Arena program under the Norwegian Innovation Cluster (NIC). Arena program is targeted at immature clusters that are in an early phase of organized cluster collaboration. Funding from the Arena program enabled EV to employ its first full-time managing director. EV begun also to collaborate with other public research institutions such as Kjeller Innovation through joint projects. A good example is Techmakers which was a 3 -months accelerator program for tech start-up companies in the energy sector. Most of the start-up that participated in this targeted the OG industry.

Following declining oil price in 2014, several firms in the subsea valley were forced to downsize while some went bankrupt. This meant loss of membership for the EV cluster. Reflecting these difficulties and changing times EV began to appreciate other related industries that its members could venture in. In 2014 EV signed a memorandum of understanding with Aerospace Valley a French cluster of aerospace engineering firms (Subsea Valley, 2014). This was the first time EV was collaborating with a partner beyond OG industry. The reason for this collaboration was to strengthen international research, enable technology transfer across industries and give SME in the cluster international exposure. In 2016 EV developed a new strategy the 'Strategic Roadmap Towards 2025' with the objective of transitioning from an industry cluster for subsea to a competence cluster for engineering (Subsea Valley, 2016, p. 11).

About 70% percent of the total revenue of EV member firms in 2017 was from OG, 5% from renewable energy and the rest from other markets (Subsea Valley, 2017, p. 9). In the same year EV became a national center of expertise (NCE) for energy technology. Its strategy was revised to include engineering and competence focusing on a broader portfolio of energy markets but with a particular focus on the subsea industry. After becoming an NCE, EV describes its main

[5] From here on Energy Valley Cluster organization is abbreviated as EV to ease readability

objective is to "accelerate the energy transformation and foster cross-industry collaborations to create value and advance innovative technologies in energy and beyond"(Subsea Valley, 2017b, p. 10). This objective is translated into four strategic focus areas; sustainability, accelerating innovation, digital transformation, and new markets & technology transfer. To further operationalize these strategic areas EV established four corresponding flagship projects. These are (1) SME Climate Roadmap, (2) SME Digital Transformation, (3) Energy Tech Accelerator and (4) Blutech Ocean. I describe and discuss these projects later in this chapter.

In 2019 EV changed its name from Subsea Valley cluster to Energy Valley cluster. EV states that this name reflects their new strategy, new position and visionary ambitions (Energy Valley, 2019a). They emphasize that the name change "does not mean that we are leaving subsea behind, but that we are embracing the opportunities, taking on a broader scope, addressing the energy transition and the opportunities in our evolving industry" (Energy Valley, 2019a).An incubation platform, *Energy.Invented* was launched in 2019 as a joint project between Energy Valley cluster, Solar Energy cluster and Institute for Energy Technology (IFE).

In terms of organization EV is led by a board of directors, an advisory board and administrative staff. The administration includes a managing director, three project managers a finance controller, and events manager. These carry out the daily functions of EV. Major resolutions are decided by the board of directors who are elected annually during its general meeting. Members of this board represent the various categories of firms in the cluster. These include at least one representative from oil operator firms, system integrator firms, SME's and academia (Energy Valley, 2019b). Lastly the advisory board offers competence and network-related support to the cluster. The advisory board is established based on the main strategic focus areas (Energy Valley, 2019a) and includes international and national experts from academia and energy engineering sector.

Today Energy Valley has about 210 member firms who represent the entire value chain of the OG industry. Members in the EV get access to strategic collaboration platforms such as meeting places, opportunity to participate in innovation projects and external funding. Every year EV organizes several activities and events for its members. These include technical meetings, industry science meetup events, CEO forums, project workshops, Masterclasses, Subsea Valley (SSV) Conference, *SpeedMeet* and funding delegations to international forums mainly the Offshore Technology Conference (OTC) in Houston Texas.

5.2 Energy Valley Cluster's external environment

According to the TEF, firms are embedded in two external environments (economic environment and socio-political environment) and in an 'industry regime' which mediates perception and actions towards both environments (Geels, 2014a). Although the TEF was formulated to illustrate the external pressures affecting a firm i.e a for profit organization, I argue that with a slight adjustment this framework is still useful in our case. Since EV is a non-profit organization it is not directly affected by pressures from the economic environment such as price and cost. Nevertheless given that the cluster represents firms that are directly influenced, they ultimately get affected by and respond to these pressures. For example after the 2014 oil price downturn some firms went bankrupt while others downsized which led to EV losing members. Another adjustment to the TEF is that EV represents all the three types of firms in the industry. These include core firms which in our case include oil operators, major equipment and service providers (e.g Equinor, Lundin Norway, Aker solutions), firms 'in the middle' (e.g TechnipFMC, ABB) and peripheral firms (e.g a few SME's and law firms)[6]. The modified TEF figure below represents where EV can be located.

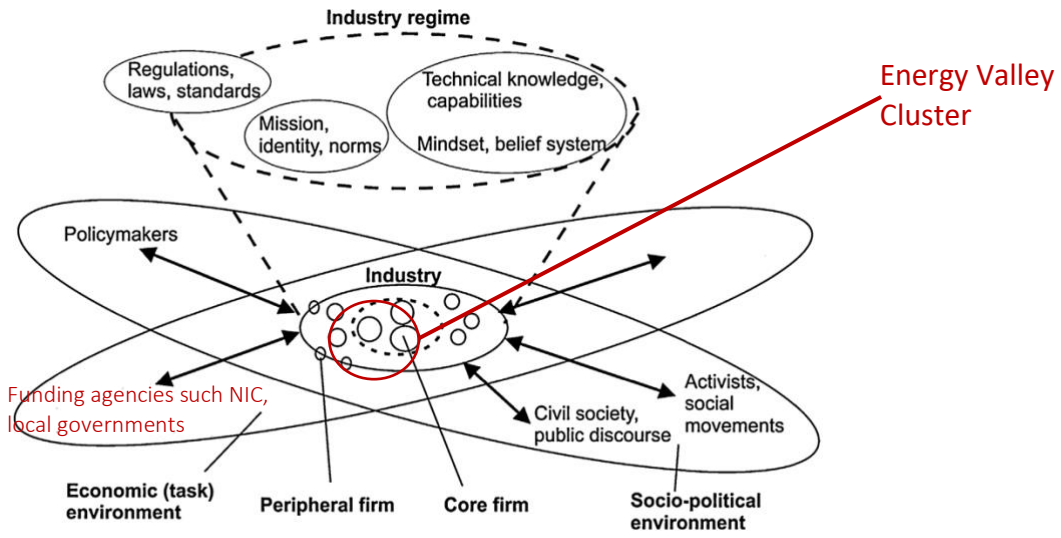

Figure 4 Locating Energy Valley Cluster in the Triple Embeddedness Framework adapted from (Geels, 2014a, p. 266)

[6] See https://energyvalley.no/members/ for a list of members

With these adjustment of TEF in mind, the economic environment of Energy Valley include funding agencies such local and state government. Although EV depends on membership fees from the firms, they also get funding from regional and state government. The main funding agency is the state government. EV has received state funding and support under the Norwegian Innovation Clusters since 2013. At first under the Arena program and now under the NCE program. As discussed in the previous section this has enabled the cluster to not only develop and grow but also initiate several major projects. Under the NCE program cluster organizations are given an annual funding of NOK 5 million for a period of 5 years (Norwegian Innovation Clusters, 2019, p. 11). Commenting on the significance of this funding respondents from EV remarked that they can now plan several years ahead which helps the quality and commitment to projects with longer time frames (interview B).

The second external environment is the socio-political environment which includes policymakers, civil societies and social movements. The major mechanisms in the socio-political environment is social fitness and legitimacy which determines the industry's 'license to operate' (Turnheim & Geels, 2012, p. 37). For the purposes of this study I will limit myself to recent public opinion regarding the OG industry. Public opinion regarding extraction of oil has changed over time, with the most visible opposition manifested by the recent school children strikes. In Norway public opinion is divided on whether to continue exploration and extraction of OG. To give an example of two opposing positions on the climate change debate, Norsk Olje og Gass[7] which is an interest organization for OG companies advocates for profitable and safe production of oil at current levels and suggest implementation of CO2-reducing measures from 2020. On the other hand the Norwegian Green party calls for immediate stop of all new explorations on the NCS and suggests that a gradual phasing out of petroleum activities within a 15-year period[8].

As for the industry regime these remain largely the same for the cluster as for the firms since these are specific to the OG industry. Industry regime elements such (a) mindset and cognitive frames (influences how actors perceive social reality), (b) values identity and mission (determines what actors see as appropriate), and (c) formal regulations, laws and standard that

[7] https://www.norskoljeoggass.no/miljo/klima/veikart-for-norsk-sokkel/ Last accessed 02.10.2019
[8] https://www.mdg.no/klima Last accessed on 02.10.2019

govern the actors are quite similar. The major difference between a firm and a cluster is mainly in their technical knowledge and capabilities .

Having briefly presented the major development of the EV and discussed the external environments and industry regime I now look at the roles EV played before 2015.

5.3 What roles did Energy Valley play between 2010 and 2015?

Although there were close to 600 firms located in the subsea valley, there was lack of a neutral mutual meeting place (Harbo, 2013). My respondents from EV pointed out that the major driver for the cluster organization establishment in 2010 was to fill this gap by creating a meeting place. EV was then established as a supplier network. EV has since then continued to offer its members an informal meeting place and participation in different projects. Another major driver was the need to boost internal supplies and selling services to each other. They adopted a *SpeedMatch* concept which involved brief meetings between SME's and procurement officers from the major suppliers such as Aker Solutions and TechnipFMC. According to a survey of the members 40% reported to have made new connections through these platforms and 21% said they received new orders from these connections (Subsea Valley, 2013).

In its first years EV started to map out the different competencies in the region in order to establish effective network management and strengthen the knowledge interaction between these firms. Among other things this evaluation showed that there was a shortage of engineers and IT specialist. EV became a vocal reginal platform calling for investment in education research and innovation. More concretely EV together with Kongsberg Innovation cluster worked to establish a bachelor's degree in subsea science and a specialization module in subsea within the Master's program Systems Engineering at Buskerud University College and Vestfold (HBV).

Between 2010 and 2014 EV had three major projects which focused on Health Safety and Environment (HSE), quality, competence and international technology needs. The HSE projects aimed at making it easier for suppliers to meet stringent pre-qualification requirements in the industry. Under the quality project EV worked on harmonizing the new standards and technology requirements of the operators and system integrators that were affecting the entire value chain. For instance EV worked on a Joint Industry Project to standardize subsea

documentation. Under its competence project EV launched a subsea introduction program for cluster members. The purpose of this program was, among other things, to assist in training SME in various project management. What all these projects had in common was that it sought to make firms more competitive within the OG industry. This was, one would argue the raison d'être of a cluster. EV was by all accounts, a vibrant and successful cluster organization as evidenced by the growing membership.

According to the TEF there was limited external pressure and satisfactory performance which reinforced routine reproduction in this period. This is represented by stage 1 as visualized in figure 3 shown in section 3.1 of this study. An analysis of newspaper articles from this period shows that EV and the OG industry were represented in positive and optimistic terms such as '*oljeventyr'* (oil adventure). As an actor embedded in the prevailing industry regime, EV played by and sought to strengthen the prevailing institutions or 'rules of the game'. Although there were concerns about the unsustainability of oil industry, increasing returns from OG in this period as well as opportunities elsewhere may have contributed to denial or blindness. The leader of EV remarked then that;

> "We notice that several people make gloomy predictions about the prospects of the industry. We think they are wrong. Norway is the world leader when it comes to oil technology… The focus in Norway is on Lofoten and Vesterålen, where there is talk of drilling eight to ten holes. We are instead looking at the global market, where nearly 10,000 holes will be drilled" (Finansavisen, 2013 *translation mine*).

Discussions about renewable energy or other markets were rare in this period. This is clearly visible when one takes a closer look at the themes of EV's annual conference before 2015. This conference which takes place annually can be considered EV's major public platform and includes exhibition by member firms, keynote speeches of pertinent themes and technical sessions. The themes of the conference therefore reflect what the cluster is preoccupied with. Between 2010 and 2014 the themes mainly revolved around oil and gas. Invited guests included high ranking experts in this field and government officials such as the minister for of oil and energy. In 2014 Erna Solberg the Norwegian Prime Minister giving a speech in this conference, reiterated the importance of oil and gas sector as the cornerstone of the economy and promised that the "government will continue to offer new blocks at a steady rate. This is important for maintaining a high level of exploration activities (Statsministerens kontor, 2014)." As a policymaker, this statement can be interpreted as support from the socio-political environment.

5.4 Pressure from external environments and EV's strategic response

As indicated above there was limited pressure from the external environment on the OG industry in Norway in this period. Oil price is known for its volatility meaning that it fluctuates from time to time. In 2014/15 however, the sudden and sustained decrease in oil prices substantially affected the OG industry and especially the supplier industry. Firms responded differently to these pressure from the economic environment. Although some SME's went bankrupt core and other 'firms in the middle' applied various economic positioning strategies such as cutting costs and downsizing. Energy Valley reported that in this period 10,000 jobs were lost in the subsea valley (Subsea Valley, 2017b, p. 9) which led to loss of members for the cluster.

EV cluster begun to strategically respond to these pressures. These included both local and distant search. The former includes small adjustments in procedures and routine. An illustrative example of this is that in 2015 EV made entrance to the annual SSV conference free which increased the number of attendants reaching an even wider audience. During this time EV was still receiving support under the Arena program and was thus able to expand its administrative staff in 2015 despite the loss of funding from members (Subsea Valley, 2015). In the years following the oil price downturn EV made several changes. As mentioned earlier EV had already in 2014 begun cooperating with firms in other industries such as Aerospace Valley in France (Subsea Valley, 2014). This external collaboration was further strengthened and grounded in EV's new strategy 'Strategic Roadmap 2025'. Through this new strategy EV established formal collaboration with academic and research institutions and opening up the scope of EV beyond subsea to encompass energy engineering competence. This included exploring other markets their members firms could deliver technology and competence to. For instance it begun to cooperate with Oslo cancer cluster and partners in Norwegian Space center (Subsea Valley, 2016, p. 5). During the interview one respondent from EV remarked that in the wake of the oil price downturn;

> "the companies were searching for new things and that is when we [Energy Valley cluster] shifted from seeing subsea technology and competence as the core to seeing subsea as one market among a broader portfolio of energy markets (…) as well as technology transfer into aquaculture, health space and into more distant industries. I think that was the start of the whole innovation minded cluster. It [the oil price

> downturn] was a bad thing for the industry but a good thing for creativity, innovation and new thought and we have been building on this since then." (Interview B)

This quote illustrates how EV responded to pressure from their members through internally-oriented strategy. These response correspond to stage 2 (local search) and later stage 3 (distant search and strategic reorientation). For EV this meant expanding the search areas exploring new technologies and markets. As opposed to firms, cluster organization seems to be more agile in responding to external pressure and strategically responding to these. Although they share the same industry regime, firms and cluster organization have different technical knowledge. I argue that in this sense EV subsumed the roles of a transition intermediary actor and exhibits characteristics of a regime-based intermediary. I now turn to my second sub-question below to discuss the roles played by EV since 2015 to date.

5.5 What roles does Energy Valley Cluster play now?

Although regime-based transition intermediaries are part of the prevailing industry regime they are inclined towards transformative change (Kivimaa, Hyysalo, et al., 2019, p. 1070). They mediate between multiple actors both within and outside the industry. Inspired by Kivimaa et al., (2019) discussions of the roles of a regime-based intermediary I adapted these for the OG industry regime as discussed in section 3.3 in this study.

The first role is translating external economic and socio-political pressure and to make sense of these for the members. EV played an important role in articulating these external pressure into practice. We have seen how the economic pressure induced by the oil price downturn led to EV looking beyond the OG industry. In addition to this the Paris Agreement was ratified by the Norwegian government in 2016 committing to at least 40% reduction of emissions by 2030. This policy change is an example of pressure from the socio-political environment which made an impact on the actions and strategies of the core firms in the cluster. EV response to this was that it acknowledged energy sustainability as a grand challenge and argued that ‘‘this calls for innovation and development of advanced technology for cost-effective, sustainable production of natural resources and a transformation of the energy industry"(Subsea Valley, 2017b, p. 10). EV thus formulates this grand challenge as an opportunity for the member firms to contribute with technological solutions such as a developing zero emission technologies.

In order to concretely operationalize this strategic focus and make it relatable to its members EV developed SME Climate Roadmap project. Under this projects EV facilitates meetings where both oil companies and the SME's agree on common requirements for environment and sustainability. Since oil operator companies are committed to the Paris Agreement this means new requirements and specifications in tenders for the supplier companies. Under its SME Climate Roadmap project EV works therefore to articulate the new requirements for technologies. In addition following its focus on sustainability EV has become a partner in several ongoing innovation projects in renewable energy that its members can participate in such as Deep Purple[9] which explores offshore hydrogen technologies.

The second role is supporting niche build up through practical action and collaborating with other intermediaries and actors within and outside the industry. EV fulfills this role through the establishment of the incubation platform *Energy.Invented* in April 2019. Incubators can be seen as 'protective spaces' where pathbreaking innovations are protected so that they are able to compete with more existing dominant systems. EV has supported niche innovations in previous years through its *Techmakers* project (2013) and *Technology Park*. Launched in 2015 Technology Park offered SME's with unique projects the possibility to present this during its annual SSV conference since 2015.

Energy.Invented[10] is different from the previous projects in that it focuses on energy more broadly and not only OG. One of the criteria to participate in the platform is that the technology should contribute in reducing carbon emissions. This incubator program has also a longer time-period (currently 3 years) and is jointly run by EV, Solar Energy Cluster and Institute for Energy Technology. There are currently 10 start-up companies in the incubator program which work with among others digital technology, solar energy and hydrogen technology[11]. These companies have access to investors, help with intellectual property rights and patent, as well as pitch training. This is an example of niche-regime intermediation where EV contributes to shielding and nurturing processes. The *Energy.Invented* platform can therefore be viewed as an

[9] See https://energiogklima.no/spirprisen/vil-lage-hydrogen-fra-havvind-og-lagre-pa-havbunnen/

[10] https://energyinvented.com/about/ Last accessed 18.10.2019

[11] See https://www.innovasjonnorge.no/no/subsites/forside/aktuelt/aktuelt-artikler/energy.invented/ Last accessed 26.10.2019

interface where EV links niche actors (the start-ups) with dominant industry regime. Support from regime actors can assist niche actors in negotiating change by building alliances and bringing in supporters from the dominant regime (Kivimaa, Boon, et al., 2019).

The third role of a regime-based intermediary is raising public awareness and creating legitimacy for the new path. Since making access to its annual SSV conference free and open to the public in 2015, attendance has sharply increased. In the last two years there have been over 1500 delegates. The conference includes exhibition by member firms, keynote speeches of relevant themes, technical sessions and masterclasses. The masterclasses which started in 2016 are in-depth 'sessions that offer current views, knowledge and debates by top experts covering specific pertinent topics' (Subsea Valley, 2017a, p. 6). Of the 29 masterclasses held since 2016 seven have focused on renewable energy; offshore wind (four times), solar technology (twice), hydrogen technology (once). This reflects the current focus on investment in offshore wind megaprojects by the core firms in the industry such as Equinor and Aker Solutions.

Keynote speakers in the SSV conference have over the years been high ranking politicians and ministers of finance and minister of petroleum and energy in Norway. Since 2017 however there have been an increasing number of experts who focus on themes related to lowering emissions such as electrification of the oilfields, digitalization and automation. Apart from bringing together key stakeholders in the energy industry the conference, also invites and arranges activities for students and pupils from the region. The idea behind this is to stimulate these children interest within science, technology and engineering.

Despite these positive view of the SSV conference some have raised concerns about the publicity of such an arena arguing it caters to the established actors at the expense of 'green entrepreneurs'. Writing in an opinion piece in the regional newspaper local representatives of the Green Party (Miljøpartiet De Grønne) questioned why the region organizes such an event annually. They state that in order to hasten the pace for 'the green shift' there is need for an arena for networking, learning and exposure for "entrepreneurs who think differently, act fast and dare to make a difference in the society" (Liu & Rugset, 2019 *translation mine*). Replying to this statement EV wrote that what was needed is closer cooperation between established actors and new entrants. Seemingly advocating for incremental rather than a radical innovation they add that "… we do not need to think completely new. We just have to think bigger, and

make some new links" (Strøm, 2019 *translation mine*). This debate echo Hockerts & Wüstenhagen (2010) observation that the interplay between 'Greening Goliaths' and 'Emerging Davids' can promote sustainable transformation of industries. EV cluster can be viewed as an intermediary actor between incumbents and niche actors as well as creating an arena for this interaction.

The fourth role is finding funds and directing these to niche R&D activities. EV has over the years helped its members get funding for several projects by informing them of these and advising them on the application process. The most visible is the travel grants to SME's to attend international workshops as described earlier. Through the newly established projects EV has identified several ongoing innovation projects that its members can participate in or benefit from. Due to the lack of informants from member firms however , I have not come across any concrete case where EV has helped in finding and directing funds to niche R&D.

Based on the discussions above it is evident that EV acts as a regime-based transition intermediary. Its sphere of influence can be located 'in-between' the various actors it brings together and across the different levels it acts on. We have seen how for instance it facilitates meeting between core and peripheral firms within the regime and also between niche and regime actors and how EV strategically responds to pressure from both economic and socio-political environment. According to the figure 2 (section 3.1) EV has since 2010 moved from stage 1 (denial) to making small adjustment in routines and procedures and is currently in the third stage where it is facilitating exploration of new technologies and taking the roles of transition intermediary.

6.0 Discussion and conclusion

Having discussed the roles and strategic responses of the EV, I now turn to my final sub-question. How do these roles accelerate or slow down transition to sustainable energy? According to the definition suggested by Kivimaa, Hyysalo, et al., (2019) transition intermediaries positively influence sustainability transition processes by linking different actors, skills and resources internally within the regime and also between regime and niche. I noted earlier that these entails two simultaneous processes (1) supporting niche creation and (2) destabilizing the regime. Industry destabilization can be described as 'the process of

weakening reproduction of core regime elements' (Turnheim & Geels, 2012). This may happen either because industry actors reorient to a new regime or because incumbent actors are replaced by new entrants. Core firms are often committed to prevailing industry regimes and tend to resist major changes in technical competencies, core beliefs and mission.

The majority of the roles and activities EV has carried out since 2015 however seems to support niche technologies and incremental innovation. Although the cluster itself shows signs of reorientation as shown by its new strategy – from subsea to energy technology, majority of the member firms seem to be lagging behind (stage 2). This is perhaps not surprising since as noted by Laur, Klofsten, & Bienkowska, (2012) rather than govern and control the member firms, cluster organizations play a more subtle role as 'dream-catchers' - they gather and visualize potential opportunities. This is illustrated by their new slogan "Engineering the Energy Future". In this sense the cluster is especially useful to the SME's who may be more receptive to ideas and suggestions about new markets unlike core firms who have their own strategy. By exploring different markets that its member firms can supply technology to, EV may help in reducing regime resistance. Generating support for sustainability transition depend not only on perceived urgency of problems but also on attractive visions of alternative futures (Turnheim & Geels, 2012, p. 48).

EV seems to pursue sustainability through incremental innovation while seemingly defending the current regime. EV's position characterizes a 'paradox' of using a cluster approach as a strategy for sustainability transition as observed by McCauley & Stephens (2012). On the one hand the cluster has the potential to accelerate industry regime changes by translating external pressures and articulating a common vision, creating protective spaces for start-ups, and supporting diversification of markets. On the other hand since the majority of its member firms are still active in the OG industry EV may protect prevailing industry regime. As a response to the ongoing public debate on climate change respondents from EV explained they take a pragmatic approach . During the interview respondent from the EV explained it thus;

> "We are trying to position ourselves in a pragmatic role. The [climate change] debate is much more nuanced and we can take a good position in developing Norway as an energy nation instead of oil and gas, or renewables or something else. [We] have to do everything and that is what we have done by opening *Energy.Invented* (…). We need to look at oil as a global commodity and considering that Norway only has 1.8% of the global oil production in the world and that it will only take two weeks to replace the

> entire Norwegian production if we shut down oil and gas production today. This can be replaced by other producers(...) That is why we believe that what we need to do is to produce oil and gas as green as you can with as less carbon footprint but on the other hand we need to be very decisive and put a lot of money into developing renewable energy." (Interview B)

The above statement and also our discussion above we see that pressure from the economic environment is more important than socio-political pressure in inducing change. Turnheim & Geels, 2012, (p. 48) make a similar observation stating that social concerns about climate change are not likely to destabilize existing industries. They add that socio-political pressure regarding environmental issues can however become significant if it coincides with economic pressure.

In conclusion I argue that EV has the potential and indeed played important role as a transition intermediary in translating external economic and socio-political pressures and articulating these into attractive futures – opportunities beyond OG and other distant markets. It has also through its incubation platform *Energy.Invented* ,though still in its early stages, supported niche build up and creating valuable collaboration both within and outside the industry. EV has also plays important role in raising public awareness and creating legitimacy for a transition towards a sustainable future although being a part of the industry regime itself may be defend these. It is important therefore that Energy Valley Cluster continue to support these but also aware of its limitation which may inadvertently result in them standing in the way for a sustainable energy future. Lastly given that this study , despite its limitation, has shown that it is important to study cluster organizations. There is therefore need to research further on these. A comparative study comparing cluster organizations can offer more conclusive insights into how they can contribute to an energy transition.

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8.0 APPENDICES

APPENDIX A - INTERVIEW GUIDES

Interview guide for Energy Valley Cluster

1. Energy Valley cluster was established (then called Subsea Valley) in 2010. What was the main reason for this establishment?
2. What are some of the major roles and functions you carried out then? Can you name some of the major projects and achievements?
3. Have these roles and projects changed over time? If so why? What do you attribute these changes to.
4. Early this year you changed your name to Energy Valley from Subsea Valley. Why the change in strategy?
5. Apart from your members which other actors and stakeholders do you closely collaborate with and why?
6. In your recent presentation you mention that Energy Valley is looking to transform from 'a cluster to energy engineering eco-system'. Could you elaborate further on this.
7. One of your most known events is the SSV conference which has been held annually since 2010. How do you decide on the theme of the conference?
8. Looking forward:
    a) What do you expect will the roles and functions of EV be in 5-10 years? Why?
    b) How do you expect the OG / subsea industry to evolve?
    9. What are the main challenges for your members these years?
10. What can EV do to support its members in meeting these challenges? And to what extent and how is this done?

END

Interview guide for Energy.Invented.

1. What was the main reason for the establishment of Energy Invented platform, and who were the driving force behind its creation?
2. Who are your main target? Are the services you offer open only for members of the cluster?
3. You currently offer three services to potential clients, office facilities, incubator services and mentor program. Could you briefly tell me about how these works?

4. In your website you ask potential clients to 'pitch their ideas amongst the world leading energy technology networks'? Do you vet these ideas beforehand? What are the criteria you use to accept/reject ideas pitched?

5. How crucial is it that the idea presented contribute to sustainable energy?

6. In your website you indicate that the 'world needs new energy' but don't elaborate further. What do you mean by 'new energy'?

7. What role do you think such a platform can and should play in the transition towards sustainable energy?

8. What are some of the challenges that you have encountered during the establishment of the platform?

9. Do you have any suggestions (in terms of policy) you think will enable you to reach your goals?

10. Any other relevant information that we haven't discussed yet.

END

APPENDIX B - LIST OF NEWSPAPER ARTICLES FROM ATEKST

Search period: 01.06.2010 to 15.09.2019
Key word search: Subsea Valley + grøn*+fornybar+ omstill*

	TITLE OF NEWSPAPER ARTICLE	SOURCE	PUBLICATION DATE
1	Her kan Norges nye milliardbedrift bli skapt	Finansavisen	10.04.2019
2	Møteplasser for grønne gründere	Budstikka	04.04.2019
3	Grønne gründere er fremtiden	Budstikka	23.03.2019
4	Mål: 1.000 nye arbeidsplasser	Budstikka	22.01.2018
5	Østlandets nye industrieventyr	Drammens Tidende	16.11.2017
6	Ny rapport: Fortsatt 44 prosent olje og gass i 2050	Budstikka	11.09.2017
7	Oljebyen Bærum	Dagsavisen	23.08.2017
8	Ingen reserver igjen	Budstikka	19.05.2017
9	Tror på lysere tider	Budstikka	07.04.2017
10	Det er mulig at oljeprisen må ned først, men vi tror den skal gå opp	EnerWE	06.04.2017
11	Håpet er lysegrønt	Budstikka	06.02.2017
12	Det er nettopp nå du bør bli gründer	EnerWE	17.11.2016
13	Åtte oljegründere satser midt i oljekrisen	EnerWE	14.11.2016
14	Konkursbølge i oljefylkene: Disse satser videre etter konkurs	E24	23.05.2016
15	Vi skriker ikke like høyt	Finansavisen	09.05.2016

16	Fersk rapport: Slik kan Norge og Sverige hevde seg sammen	E24	26.04.2016
17	En av medisinene vi må ta	E24	06.04.2016
18	Tror på flere konkurser i oljeindustrien	E24	06.04.2016
19	Sætre skryter av leverandørene	EnerWE	06.04.2016
20	Her kommer smartere arbeidsplasser	EnerWE	25.09.2015
21	Viktigere enn noen gang	Laagendalsposten	03.09.2015
22	Går i grønt mot MDG	Budstikka	26.08.2015
23	Bærum må ut av oljeklisteret	Budstikka	07.08.2015
24	De gjorde sort gull til gråstein	Budstikka	11.07.2015
25	Flyktninger og det viktige	Drammens Tidende	10.07.2015
26	Subsea Valley vil ha NCE-status	Teknisk Ukeblad	16.04.2015
27	Gründere må tenke marked i utviklingen	Teknisk Ukeblad	16.04.2015
28	Vi har ikke sett alle konsekvensene av oljeprisfallet ennå	Dn.no	15.04.2015
29	Neste uke braker det løs	EnerWE	09.04.2015
30	Tro på ny skole	Dagsavisen	08.04.2015
31	Tenk stort, Drammen	Drammens Tidende	18.01.2015
32	Industriens Motemesse dedikert til ny energi	Sysla	26.09.2014
33	Krever gassvelsignelse	Offshore	14.04.2014
34	Ikke akseptabelt å kutte utnyttingsgraden	E24	02.04.2014
35	Norge er en miniputt på grønn teknologi	E24	11.12.2013
36	Tenk stort, Drammen	Drammens Tidende	07.12.2013
37	Åtte gode råd fra Tess	Drammens Tidende	30.10.2013
38	Første stopp: Tess i Lier	Dagsavisen	30.10.2013
39	Industribygger med egen flyplass	Teknisk Ukeblad	08.08.2013
40	Fnyser av nedgangsspådommer i subseadalen	Finansavisen	15.07.2013
41	Begrav ordet «oljeeventyr»	Drammens Tidende	29.06.2013
42	Østlandets oljeeventyr øker mest	Aftenposten	01.11.2012
43	Tittelen på dette intervjuet kunne godt ha vært «Slangen i paradis».	Teknisk Ukeblad	04.04.2013
44	Store utfordringer for bedriftene	Drammens Tidende	08.11.2012
44	Landets største klynge	Drammens Tidende	24.05.2012
46	- Sats mer på vinnerne	Budstikka	06.02.2012
47	Jaktet unge talenter	Drammens Tidende	02.02.2012
48	Mer hitech, mindre dans	Drammens Tidende	22.09.2010