



# How future frames materialize and consolidate: The energy transition in Denmark



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## ARTICLE INFO

### Keywords:

Materialisation  
Consolidation  
Green energy transition Denmark  
Stories about the future  
Future frames

## ABSTRACT

The energy transition towards a more carbon neutral energy production has become a major topic for policy makers in recent years. Although the importance of a long-term vision and planning is widely acknowledged, the idea to speed up the energy transition with binding targets and timetables has also been criticised. Instead, societal transformations are created by the messy combination of actors and networks, stories and visions, regulations, agreements, local and regional initiatives, etc. Yet, there is still a lack of systematic analyses of *how* futures become mainstream in policy and practice. This article analyzes the context and actors in which the Danish energy transition emerges. We describe this process as materialization, referring to the process in which different representations of a future come together and incrementally organize the future. Although the Danish energy case has been analyzed by many authors over the last years, most analyses of the Danish energy transition are done from an institutional perspective. The importance of stories (about the future) has been mentioned as an important factor, but it has not been the focus of research. This research combines a *discursive* dimension with an institutional perspective to analyze how the future of renewable energy materialized and consolidated in Denmark. The case not only shows different phases of materialization, it also shows that different combinations of the interplay between actors, context and stories led to materialization and consolidation of the energy transition in Denmark.

## 1. Introduction

The energy transition towards a more carbon neutral energy production has become a major topic for policy makers in recent years. Reports and strategies at different levels and by different actors that envision clean energy futures bear witness to this development (European Commission, 2012; The Danish Government, 2011). Although the importance of a long-term vision is widely acknowledged, the idea to speed up the energy transition with binding targets and timetables has also been criticised (e.g. Ostrom, 2010; Rayner, 2010). Instead of the policy centric system referring to the dependence of other stakeholders to comply with the rules and policy, societal transformations are created by the messy combination of actors and networks, stories and visions, regulations, agreements, local and regional initiatives, start-ups, etc. (Brown, 2003).

It is therefore important to analyze the context and actors in which the energy transition emerges and is embedded; yet there is still a lack of systematic analyses of *how* futures become mainstream in policy and practice. We describe this process as materialization, referring to the process in which different representations of a future come together and incrementally organize the future

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to ‘understand how certain futures become explicit objects of common concern, and how the capabilities to influence these processes, and with them, the present as well as the future, are differentially distributed’ (Goves, 2017, p. 31). These representations can be combinations of knowledge, forms of social actions, written material, institutional developments, etc. Once a future is put down in policy, we consider it to be consolidated. It is then the dominant discourse. Hence, the aim of this paper is to answer the research question: How do green energy futures materialize and consolidate?

The renewable energy transformation in Denmark provides the empirical case for the paper, as the country has been rather successful in implementing an energy strategy involving the transformation into renewable energy (RE). The historical roots of the modern Danish energy transition go back to the 19<sup>th</sup> century, but its most important foundations were laid in a highly dynamic, diverse and broad societal process taking place from the oil crisis in 1973 until 1985 when the parliament decided to ban nuclear power. In order to study how the green energy future materialized, the case study mainly covers this period, but also the time after this period to analyze its consolidation. Hence, the more specific research question is: How did the future renewable energy frame materialize and consolidate in Denmark in the period from 1973 to 2001?

To answer this question, this research combines a *discursive* dimension with an institutional perspective. Although the Danish energy case has been analyzed by many authors over the last years (see e.g. Mey & Diesendorf, 2018), most analyses of the Danish energy transition are done from an institutional perspective (Mey & Diesendorf, 2018; Meyer, 2004b; Meyer & Koefoed, 2003). The importance of stories (about the future) has been mentioned as an important factor in the Danish energy transition (Mey & Diesendorf, 2018; Meyer, 2004a, 2004b; Meyer and Koefoed, 2003, etc.), but it has not been the focus of research. In that sense, this research is an important addition to the existing literature. Furthermore, although there is increasing attention for the materialization of futures in general (Granjou, Walker, & Salazar, 2017), much of the research on materialization of the green energy transition has dealt with institutions and direct policies. However, also in this area, there still is a lack of analyses covering the historical and sociological roots of the Danish energy transition, for instance, in terms of pre-existing institutional, industrial as well as independent knowledge and innovative structures (Hvelplund, 2013). This paper will contribute both to a better understanding and to further academic elaboration of the materialization and consolidation of futures, with a focus on historical and sociological factors of the Danish green energy transition.

For the data collection, we draw on three types of data. First, we conducted a document analysis based on policy documents, research reports and biographies. Second, we used authoritative scholarly reconstructions of how the energy transition in Denmark took place (Beuse et al., 2000; Kooij et al., 2018; Mey & Diesendorf, 2018; Meyer, 2004b; Meyer & Koefoed, 2003). Third, we corresponded with key actors of the Danish energy transition. Two of these actors - Niels Meyer and Karl Vogt-Nielsen - provided information that was directly useful for the article, regarding the instrumental Committee for Renewable Energy. Meyer’s significance is further explained in Section 3.2.2, but it was perhaps most visible when he was the chairman of the Committee for Renewable Energy. Karl Vogt-Nielsen had been the Committee’s secretary and could provide important first-hand information about the functioning of the Committee, amongst others.

In order to answer the research question, Section 2 presents the conceptual framework that is used to analyze the socio-technical and political materialization and consolidation of the Danish energy transition, explicitly focusing upon actors, storylines and context. Section 3 gives an overview of the most important elements for starting the Danish energy transformation and outlines the materialization and consolidation of the incipient frame of renewable energy. Section 4 discusses the findings and adds concluding remarks.

## 2. Future frames

The theoretical starting point is the recognition of actual, yet often implicit, processes of the ‘making of futures’ (Inayatullah, 1993; Mannermaa, 1988; Masini, 2006), working from the premise that ‘different futures are lurking in the present’ (Dinerstein, 2017). Within the process of making futures, stories are the bridge between the past, the present and the future (Holmes, 2009). Stories about the future are constitutive or performative (Borup, Brown, Konrad, & Van Lente, 2006) in the sense that they constrain and/or expand the range of possible futures while closing down others. The strength of stories has been proven in different disciplines. Most of the research concerns stories on specific technological innovations (see for example (Metze, 2017)), but there are a few examples of studies that take a broader perspective on stories, for example in economics (Beckert, 2013; Holmes, 2009; Piotti, 2009) and in public administration concerning ageing (van der Steen, 2008; Veenman, 2013).

In the energy transition, the use of stories and visions are common, for example the long-term goal of the EU to reduce greenhouse gas emissions by 80–95% by 2050 compared to 1990 levels and the Energy roadmap 2050, which explores different ways to reach these reduction targets. However, so far the implementation of such visions and stories do not seem to go flawlessly, because they are strongly intertwined with practice and the institutional context, stories do not per se lead to alternative futures (Metze, 2017). Rather, they might lead to political or storytelling path dependency: these ‘guiding visions’, or leitbilder (Späth & Rohrer, 2010) are often instrumental trying to shape policy and practice. Späth and Rohrer (2010) clearly outline that ‘Leitbild’ refers to cognitive and discursive constructs decisive for the co-ordination of the behaviour of the various actors involved in the development of technology’ (p. 450). As such, Leitbilder and visions have been criticized for underrating struggles about discursive hegemony. We follow this critique, quoting Groves (2017, p. 32) when he points out that futures ‘are not free-floating cultural structures (...). They are always already stitched into material environments, both socio-technical and socio-natural. Often, these environments appear in social science as tools or resources, that is, as only having instrumental value. Yet they also have a constitutive role, particularly as they are composed of systems which also anticipate futures’.

Hence, to analyze how futures materialize and consolidate, a starting point should be the embeddedness of existing ideas rather

than the instrumental formulation of a vision (Späth & Rohrer, 2010, p. 450). Taking this perspective, alternative stories and visions, also considered as discourses become relevant ensembles of ideas, concepts and categories through which meaning is given to social and physical phenomena, and which is produced and reproduced through an identifiable set of practices' (Hajer, 1995, p. 44). Moreover, we follow the analysis of van den Brink and Metzger (2006), seeing a discourse as including different frames (for an in-depth discussion about the ontological and methodological features of this interpretation of framing and discourses, see van den Brink, 2009). In general, discourses and frames refer to the role of stories in policy-making processes (Fischer & Forester, 1993; Hajer, 1995; Stone, 1997): Stories are shaping one's view of the world and, vice versa, one's view of the world is shaping stories. Following this thinking, a frame consists of different stories. Different frames with each their different stories show different 'futures in making', hence, analyzing different frames and stories will help understanding how different futures materialize and consolidate. Because of the future orientation of this research, we look at *frames about the future*, here called 'future frame'.

Translating the concept of discourses, future frames and stories to the case of Denmark, the discourse on energy in the early 1970s was that the almost 100% dependency on foreign oil required immediate action. For the Danish energy transformation, the discourse concentrated on 'solutions that could work', but two highly different and contested future frames on 'what could work' emerged in this discourse (Jakobsen, 1975; Sørensen, 1975). The frames regarded which road to take: 1) renewable energy combined with energy savings and energy efficiency (starting in the late 1960s), and 2) nuclear energy (starting in the 1950s). Even though both tracks had their origin in the years before the first oil crisis in 1973/1974, this event as well as the subsequent collision of the two tracks in the public debate triggered their serious and widespread formulation and discussion (Blegaa et al., 1976; Blegaa, Josephsen, Meyer, & Sørensen, 1977; Sørensen, 1975). We focus on the future frame of renewable energy as one of the frames under the discourse 'solutions that could work'. Within this future frame, there are different stories: the story of energy conservation, the story of technology, the story of sustainability, etc. (Blegaa et al., 1976; Hvelplund & Linderroth, 1976; Hvelplund, Illum, Jensen, Meyer, & Sørensen, 1983; Sørensen, 1975). As the case study below shows, these stories each played a role in the transition towards renewable energy.

In order to analyze how the future frame of renewable energy has materialized and consolidated in Denmark, the framework recently developed by Rosenbloom, Berton, and Meadowcroft (2016) has been applied as the basis for our framework (see Fig. 1). While other frameworks might be suited for an analysis of future frames, such as the Causal Layered Analysis (CLA, Inayatullah, 1998, 2017) or the niche-regime-landscape model (Geels, 2014), the selected model has a multi-level governance and *discursive* perspective on socio-technical transitions (Rosenbloom, Berton, & Meadowcroft, 2016). This perspective enables us to analyze the linkages between different actors, stories and context developments and the constitutive roles that they play in materializing and consolidating a future frame in policy-making processes, i.e., how the renewable energy frame developed and how it was implemented in policy and practice.

The content consists of different stories and claims. As the case study below shows, in the Danish discussion on renewable energy, the stories of energy conservation, technology, sustainability, etc. play a role (Blegaa et al., 1976; Hvelplund & Linderroth, 1976; Hvelplund et al., 1983; Sørensen, 1975).

The context elaborates the necessary embeddedness of a certain element for the future frame to materialize and consolidate. The context can hinder or stimulate the development of future frames, interacting with actors and stories. The context encompasses the landscape and the regime (Rosenbloom et al., 2016): The landscape embodies the broad demographic, technological, cultural, environmental, economic and political patterns that make up for the future frame to materialize and consolidate. Developments in the landscape, for instance climate change or exogenous shocks, create pressure on the established regime (Geels, 2011). The regime consists of rules and institutions, lifestyles and practices, competences and capabilities, shared beliefs and cognitive routines, technologies and infrastructures, meanings and logics. It changes only incrementally along stable trajectories, because the regime is path-dependent and locked in (Geels, 2004, Rosenbloom et al., 2016). For changes within the regime, the semi-coherence of the

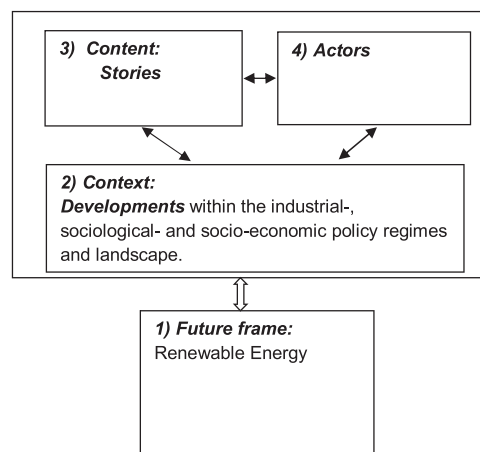


Fig. 1. Schematic overview of the linkages between actors, stories and context development, and the constitutive roles they play in materializing and consolidating a future frame in policy-making processes, inspired by Fig. 1 of (Rosenbloom et al., 2016).

regime is important (Geels, 2014). Semi-coherence is originally understood as ‘a semi-coherent set of rules’ referring to the institutional structure within a regime, emphasising the tension between rules (Geels, 2004). Apart from the institutional perspective of semi-coherence, we also consider the discursive semi-coherence, referring to the ambiguity of *ideas* (stories and future frames) within a regime (see Rosenbloom et al., 2016).

Because Rosenbloom et al. suggest that the actor dimension in their framework will benefit from a more in-depth and dynamic analysis (p. 1286), we place a greater emphasis on actors to create insight into the specific actions and ideas of key persons in the process of materialization and consolidation (Granjou et al., 2017). This is consistent with the focus on the semi-coherence of a regime, both institutional and discursive. Tension within a regime refers to disagreements and conflict of interests concerning rules and ideas at the actor level, both individual and as a group (Fuenfschilling & Truffer, 2014).

### 3. How the future frame of renewable energy was materialized and consolidated in Denmark

Prior to the analysis of RE in Denmark, a brief discussion of the regime and the landscape is presented.

#### 3.1. The landscape and regime

Two landscape elements are of particular interest to this analysis. First, a number of interlinked socio-economic crises (oil crisis, negative balance of payment, inflation, unemployment) put a strong pressure on Danish society. Before the first oil crisis in 1973, the Danish energy system was nearly 100% dependent on fossil fuels, and especially imported oil. As a consequence, the oil crises had a severe impact on the Danish economy and put the country in a situation of crisis. This created an open attitude in the parliament towards alternative ideas for tackling the energy crisis. The discourse at the time was based on a story telling that renewable energy creates jobs, reduces import, and assures relatively fixed prices on energy over time (Blegaa et al., 1976).

Secondly, as a special characteristic of the Danish energy system, there was a pre-existing socio-technical infrastructure for this fossil fuel-based energy supply. It consisted of 100% consumer- and municipality-owned electricity and district heating companies under a cost covered non-profit regulation regime. The fact that the costs were always covered at the end of the year made transition possible, as for instance the power companies could survive a loss of market shares without going bankrupt. Experiments were made with prototypes of electricity producing wind turbines around 1900 by the engineer Poul LaCour (Nissen et al., 2009) and with one larger electricity producing wind turbine (The 200 kW Gedser wind turbine).<sup>1</sup> In parallel, the existing industrial structure with its many small, innovative companies and craftsmen producing machinery for the agricultural sector was protected due to a particularly slow process of industrialization in Denmark throughout the 19<sup>th</sup> and 20<sup>th</sup> centuries (Ingemann, 2007; Meyer, 2013).

The culture of experimentation in the smaller manufacturing companies led to a relatively large number of small-scale enterprises developing and testing RE technologies locally (Arler, n.d.-b). In the wind turbine sector, many of these local entrepreneurs knew each other and shared knowledge on the latest wind turbine specifications (Arler, n.d.-b).

The role of the welfare state at the time of the oil crisis was of crucial importance to the work of NGOs and independent networks. Until 1993, provided that they fulfilled a number of basic requirements, unemployed individuals could receive unemployment benefits for many years. Therefore, many unemployed activists and small entrepreneurs could engage themselves full time with new innovative topics, such as the development of renewable energy technologies.

#### 3.2. Materialization of the future frame of renewable energy and energy conservation

It is worth mentioning that due to historical experience, it was not in general a question whether any kind of RE technology was able to function and reliable, but rather *how much* fluctuating renewable energy could realistically be integrated into the energy system. Wind turbines, for instance, were widely considered a ‘functioning’ technology since the beginning of the 19<sup>th</sup> century.<sup>2</sup> Instead, proponents of RE aimed to prove that the technology could be developed into a modern product at reasonable costs, which could make a serious contribution in the energy system - more than ‘a few per cent’.

##### 3.2.1. The very beginning: the first organizational networks

In the wake of the first oil crisis in 1973, a strong societal movement concerned with alternative energy had begun to develop, having its roots mainly in existing formal and informal organizations, such as NOAH (“Friends of the Earth”), Øko Ra and the Freja group (Beuse et al., 2000; Jamison, Eyerman, & Cramer, 1990). These networks created a platform in which stories were built and exchanged between different proponents and developers of renewable energy: ‘networks served [also] as platforms to encourage the

<sup>1</sup> By Johannes Juul, a pupil of LaCour in 1904 at Askov folk high school. In the “inventor spirit” of LaCour, Juul sought to demonstrate for the utility company SEAS that a large-scale wind turbine design was practically feasible. Even though he succeeded and the Gedser wind turbine was in operation for 10 years, SEAS – together with the Association of Danish Electricity Producers, which had funded the project - concluded that wind power could not compete with the declining oil prices in the 1960s. Juul did not agree with this decision (Danish Wind Turbine Owners Association, 2013).

<sup>2</sup> In the early 20<sup>th</sup> century, around 100 MW of electricity producing wind turbines were in operation in Denmark (Beuse et al., 2000) The Gedser turbine, for example, the largest wind turbine in the world at the time, had a capacity of 200 kW and operated without major technical problems, which even convinced the proponents of nuclear power about the fundamental technical reliability of wind power.

purchase of early and still expensive wind turbines by idealistic visionaries' (Mey & Diesendorf, 2018 p. 112).

Two stories merged: one concerning sustainability (then called environmental protection, pollution and resource depletion) and one on technology, which enabled activists and technology entrepreneurs and students to experiment with small-scale renewable energy. Concerning the latter, groups like Øko Ra at the Building Technology College in Copenhagen organized exhibitions on alternative building technology and RE during the first oil crisis in 1973/1974. Their story was that solar and wind technology can actually be re-developed. From this perspective, Øko Ra provided practical help for people with an interest in low energy buildings, solar energy and biogas, which for example inspired wind turbine pioneer Christian Riisager, who later made the first wind turbine produced in series (Beuse, 2000b). The abbreviated name of the Øko Ra group translates into "Ecologic Resource Use". Together with the activities of NOAH, the work of Øko Ra illustrates that already around the first oil crisis, broad environmental concerns had laid the foundation for concrete practical experiences with renewable energy.

The sustainability story was especially strong among folk high school<sup>3</sup> teachers, students as well as members of NOAH and Øko Ra. The story emerged out of a broad concern for natural resource limitations (Beuse, 2000b). In 1970, even before "The Limits to Growth" (Meadows, Meadows, Randers, & Behrens, 1972) was published, NOAH published the report: "Some information about the Earth we inhabit together"<sup>4</sup> (NOAH's Informationsgruppe, 1970), which outlined many environmental, resource and social problems in relation to the socio-economic development of the time. The report provided a rough sketch of a Danish energy supply based on 90% RE, and noted that: "There are elementary technical problems to be solved [...], political activity is needed to turn the development in the right direction"<sup>5</sup> (NOAH's Informationsgruppe, 1970). In other words, from a technical point of view, 90% RE was a realistic vision. Even though energy occupied only a minor part of the report, it already argued for a transition to domestic, renewable energy sources on the grounds of resource limitations and as an integral part of a pollution reduction strategy. With reference to the limited availability of oil, coal and uranium, NOAH foresaw the possibility of energy crises as well as security and democracy issues related to nuclear power. Incidentally, with its focus on supplying factual knowledge and some immunity towards radical (left-wing) political ideologies, NOAH resembled the structure of the Organization for Information about Nuclear Power (OOA), which was founded later (Jamison et al., 1990).

The NOAH report served as a 'bible' to some groups from folk high schools and academia, and within 3 years, it had been printed 40,000 times (NOAH's Informationsgruppe, 1970). Incidentally, the architect Carl Herforth, one of the early NOAH activists, later co-authored a key handbook on solar and wind energy for RE practitioners and entrepreneurs (Herforth & Nybroe, 1977).

### 3.2.2. Practical materialization

With the growing societal interest in energy issues, the existing networks helped organize summer camps with workshops on alternative energy (Beuse, 2000b). Local energy offices were formed at many folk high schools around 1975, which were sometimes set up due to the growing interest from outside visitors in practical, 'showcase' examples of RE (Beuse, 2000a). At 'The Little Folk High School' (Den lille Højskole), Carl Herforth provided inspiration for the use of solar thermal technology in the school's buildings built in 1972/1973 (Nielsen, 2000). Also in this context, the environmental groundwork of NOAH served as guidance for some schools (Nielsen, 2000).

Besides exploring the potential of renewable energy, these existing, independent networks also helped organize storylines against nuclear energy. Few individuals wrote critical articles on nuclear power in the media at the time. Here again, NOAH provided an important platform by hosting a Copenhagen-based discussion group on nuclear power in 1973. This pioneering initiative within the emerging RE network and other activities led to the formation of the OOA, the merge of the Organisation for Renewable Energy (OVE) and the Federation of Energy Offices (Meyer, 2000). These organizations formulated the first shared story. The terminology that was used was *technology entrepreneurship* to 'entail the discovery of opportunities by alerting individuals [...] on the future [and] [...] the creation of new opportunities by a collective' (Mey & Diesendorf, 2018, p. 112). This is a clear result of the technical and sustainability driven initiatives within the early networks, but also explicitly pushes the economic profit claim to the front.

The stories found fertile soil in the abovementioned 'culture of experimentation'. During the end of the 1970s and the beginning of the 1980s, 'learning by doing' was practiced. Projects like the Tvind wind turbine had a symbolic effect: it was the first large-scale wind turbine (designed as a 2 MW turbine, but eventually operating at 800 kW), built by voluntary workers at the folk high school in Tvind in 1975–1978. The Tvind turbine has been referred to as an important kick starter by actors in the Danish wind power industry and is sometimes called the "mother wind turbine" (Østergaard, 2000). Also in 1978, the National Wind Turbine Test Center was established at Risø (Technical University of Denmark). The Risø test center and other local pilot renewable energy installations showed that it was possible to implement the analyses in the Alternative Energy Plans (AEPs) and further materialized this future. In other words, the many pilot plants justified the claims and stories that renewable energy was a 'real thing', not just idealistic dreams, and could be part of the modern energy system (Madsen, 2000) as a realistic possibility.

It is very likely that this served as an important political signal concerning the commitment and professionalism of the growing wind turbine industry. In 1979, the Parliament introduced the crucial 30% investment subsidy for wind turbines that were tested and certified at Risø (Meyer, 2000) and contributed to the story that RE could work. The test center activities together with this strong political support, helped reinforce the authoritative view on RE as modern and reliable, which was essential to the credibility of the

<sup>3</sup> Folk high schools are a particular Danish type of non-formal adult education, rooted in the teachings of N.F.S. Grundtvig. The focus is on developing students' individual skills in a broad spectrum of topics that are not well covered in formal education.

<sup>4</sup> In Danish: "Nogle oplysninger om den jord, vi sammen lever på".

<sup>5</sup> Own translation



future RE frame.

For the growing wind industry, an economic profit story emerged in the early 1980s. A well-known example is the ‘Californian adventure’: ‘entrepreneurs heard about the large subsidies that were provided in the US for wind installations. They responded rapidly by constructing a 55 kW wind turbine, exporting it, and thus bringing California to the forefront with respect to the quantity of installed wind power’ (Meyer, 2004b, p. 28). Because the Danish turbines were of a better quality, they made a strong case for the large wind power export to California from 1982 and onwards.

### 3.2.3. The role of actors

The development and materialization of the Danish future RE frame were initially based on a close cooperation between different actors from existing NGOs, folk high schools, academia, small-business circles, engineers and later on also politicians and large agricultural companies. The actors often joined several of the many initial networks, and thereby also helped to infuse momentum into the whole RE movement: it is common to join each other’s organization as board members. It was through this broad engagement in many small organizations and groups that some individuals could see when the time had come to form larger umbrella organizations, such as the OOA and OVE (Meyer, 2000).

In the situation of intensive search for solutions, renewable energy activists, who had become specialists, had good qualifications to take up (new) official positions that turned out to be crucial to the development of an alternative future. Many of these actors had links to existing NGOs (NOAH) and a moral and professional interest in developing clean energy (Beuse et al., 2000). They played a crucial bridging role, because they were able to understand the technological possibilities and bring together different agendas and improve the flow of knowledge at the growing energy scene. For instance:<sup>6</sup>

- Niels I. Meyer as president of the Danish Academy of Technical Sciences (ATV)<sup>7</sup> took the initiative to establish a number of committees and councils that provided analyses of RE potentials, and set up and administered central funding for RE demonstration projects. This included two ATV-internal Wind Power Committees from October 1974 and September 1975, which proposed a central, five-year R&D program with a budget of 56 million DKK and the vision to have wind power supply 10% of the Danish electricity demand (Meyer, 2000). The effect of this number is remarkable: the 10% wind power “goal” was never officially acknowledged, but it entered the 1981 official energy plan as a ‘future possibility’, from where it was directly translated into a concrete development goal for the wind turbine producers (Madsen, 2000). And as an esteemed scientist, Meyer was able to frame ideas and facts in a convincing manner, which increased public attention and political impact around the various RE committees, councils and reports that he headed (Meyer, 2004a).
- Uffe Geertsen is another example of an RE activist who managed to (briefly) gain direct influence inside the central administration: as a high school teacher in Askov and Kolding, he had worked with wind turbine models. The director of the Krogerup folk high school appointed Geertsen as the secretary of the Committee for Energy Information<sup>8</sup> organized by the Ministry for Trade in 1974 (Meyer, 2000). When Geertsen left the ministry, he focused on the work at his folk high school, and in particular, the local energy office. In 1977, he took the initiative to invite folk high school employees and members of OOA and OVE in order to unite the local energy offices in a national association (Beuse, 2000a).

Thus, key actors with ties to several networks within the emerging RE frame had the possibility to take up key positions in the central administration. This speaks for these actors’ “maneuvering abilities”, but it was also helped by the fact that the Parliament and central administration remained “approachable” during the critical years after the oil crises. The general openness of (parts of) the Parliament towards looking for solutions in many directions contributed to the consolidation of the RE frame. The frame was safeguarded until around 2001, when the small Danish Social Liberal Party strongly contributed to keeping RE on the political agenda. In the Danish multi-party parliamentary system, smaller parties like the Social Liberals were able to secure the majority for both conservative and social democratic governments – often with an environmental and RE agenda as the condition for their support. Apart from that, the Social Liberals and other parties had good relations with key actors, such as Niels I. Meyer.

One common feature in the strong, aligned network of proponents was an emphasis on positive and constructive communication, focusing on developing concrete alternatives to nuclear power, instead of ‘pure’ protest (Mey & Diesendorf, 2018).

### 3.2.4. Transferring stories to the national level

One of the concrete outcomes of the ‘knowledge exchange’ (or discourse) between the central administrative levels and society was a series of *official energy plans* (1976 and 1981) and *alternative energy plans* (1976 and 1983) (Meyer, 2000). The alternative energy plans ‘served as an interpretative frame and guide for action for the proponents as well as a tool to further mobilize support’ (Mey & Diesendorf, 2018, p. 112), aiming at diffusion of the future RE frame. The authors of the alternative energy plans came from 5 different universities and had interdisciplinary economic and technical expertise as well as connections to provide well documented alternatives in response to the official energy plan (Kooij et al., 2018). ‘All of us who ran around and suggested RE suddenly got a

<sup>6</sup> Only a few important names are mentioned in this article. The various chapters in (Beuse et al., 2000) give a more complete overview of the diversity and multifunctionality of actors and RE networks.

<sup>7</sup> Founded in 1937, the ATV is an independent, member-driven think tank that funds research and demonstration activities (<https://atv.dk/about-atv>).

<sup>8</sup> In Danish: EnergiOplysningsUdvalg.

reference, which made it probable that the transition to RE was a realistic possibility and not just a foggy vision'<sup>9</sup> (Vogt-Nielsen, 2018).

'Getting the facts right' has been a strong story in Danish energy transition towards RE. It was, for example argued that 'knowledge is the best weapon' (Christiansen, 1977): 'Creating authoritative knowledge that stated that RE was true and reliable was essential for the credibility of the RE frame' (Kooij et al., 2018, p. 55). The AEP made sure to use the same technical and economic assumptions as the official energy plan. Several calculations were done, also backed up by American studies on RE (Arler, n.d.-a), which proved that RE was possible. A strong story in the AEP is the possibility of energy savings, which should be encouraged in all sectors. '[...] further reductions would be possible with realistic policies, and technically feasible savings have been identified, particularly in the building area' (Blegaa et al., 1976).

The AEP also used some features of the Danish landscape as a story: The claim was that 'Of the various renewable energy systems assessed, the following [are] most likely to be available early and to suit Danish conditions. Solar heating systems [...] are being developed by several Danish firms, and prototypes are being tested on a number of buildings' (Blegaa et al., 1976). Various state-financed RE support programs were set up based on the initiative of the renewable energy NGOs, Meyer and others. It was also crucial that many of the authors behind the AEP also had (international) experience with e.g. solar energy, which they had seen in operation outside Denmark.

There were also some broader storylines relevant to the general development of the Danish society that shaped the future frame of renewable energy. First, and in line with the economic profit story, the AEP also underlined that RE would benefit the overall economy in the form of added employment and improved balance of payment. These socio-economic and ethical considerations were elaborated on in later publications (Hvelplund, Illum, & Teglskov, 1980). Secondly, the expected shortage of fossil fuels was one argument for a change to RE, which was linked to both the unstable political climate in many oil exporting countries and thus, an insecure supply of energy, as well as to future environmental problems. As the AEP states: 'given the choice between energy technologies of comparable social and economic viability, based on either exhaustible or renewable resources, we think the latter is preferable' (Blegaa et al., 1976).

Some influence of the AEP was already noticeable in the second official energy plan of 1981 (Energiministeriet, 1981). The plan contained a long-term perspective on wind energy, as well as a concrete vision to install 60,000 small wind turbines and 5000 biogas plants supplying up to 10% of the electricity consumption by 2000 (Energiministeriet, 1981). Meyer (2004b, p. 26/27) stresses that the 1981 plan 'shifted the focus to the problem of foreign trade and large unemployment' [- similar to the AEP 1976]. Security of supply was still an important factor but this problem was not so acute at this time.

### 3.2.5. Consolidation

Soon after the publication of the second AEP in 1983, the nuclear energy frame came to a halt with the nuclear power ban in 1985. 'This decision', as Meyer states in 2004, 'was influenced by several factors, but there is no doubt that the alliance between independent university experts and competent NGOs in connection with broad information campaigns on alternative possibilities was one of the factors'. Apparently, the storylines turned out to be strong enough to materialize and consolidate the future frame of RE. After all, although the calculations in the plan of 1983 were based upon already known technology, mostly concerning wind turbines, the application in a modern energy system was still in its infancy and hence was to a large extent still based upon a story. But a story backed up with many ongoing prototypes of wind power turbines and also by the fact that the wind power factory Vestas in the years 1981–1985 employed 800–900 people and in this period exported several hundred wind turbines to California.

With time, pro-RE activists, scientists and regime actors cooperated more closely. For example, in 1988 and 1990, several *independent* (instead of 'alternative') reports on energy were published. The reports (and background reports) involved a certain amount of cooperation with the Danish Energy Agency, and Danish energy policy was moving more into the direction recommended in previous alternative plans (Arler, n.d.-a). Danish stories were also influenced by 'outside' events: the Chernobyl accident in 1986 and the focus on climate change. Among others, the Brundtland, Khalid, Agnelli, Al-Athel, and Chidzero (1987) and the IPCC (Intergovernmental Panel on Climate Change, 1990) reports had a strong impact (Meyer, 2004b). The story about economic potentials together with technology advancement through e.g. larger-scale wind turbines and wind farms also helped the political ambitions to reduce greenhouse gas emissions.

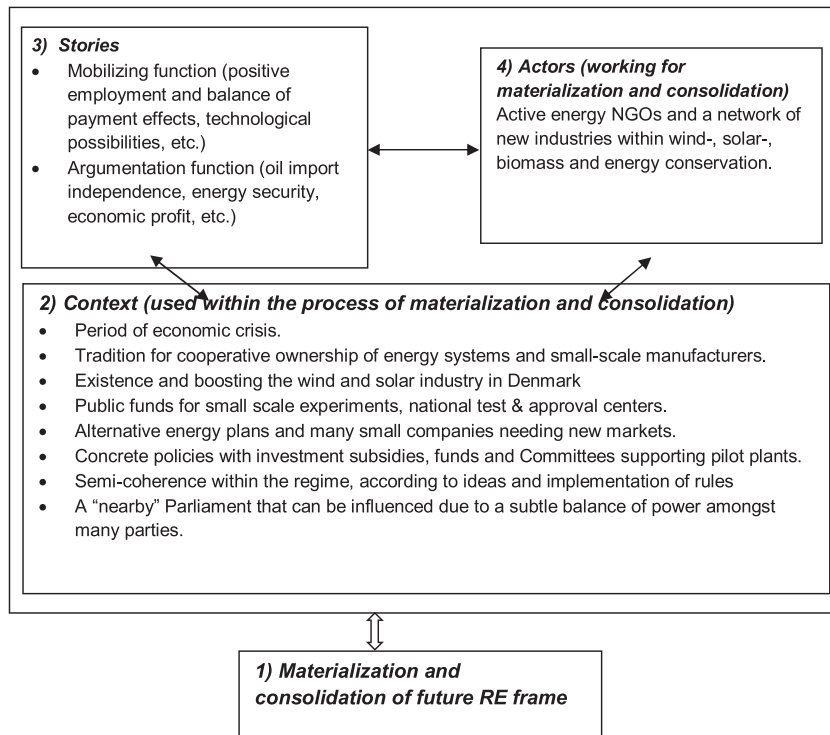
From 1975 to 1985, there was a strong support for nuclear energy from the power companies and the majority of members of the Parliament. The arguments for nuclear power were primarily that nuclear energy was a cheap source of electricity and needed in a situation with steeply increasing electricity demand and future fossil fuel scarcity (Sidenius, 1986).

The parliamentary ban of nuclear energy in 1985 seem to be due to the information activities of OOA, which put such a pressure on the Parliament that the large Social Democratic party finally decided against nuclear energy. Here, we can add OOA's systematic search for objective facts in their information policy in combination with their collaboration with all the agents for the development of alternatives to nuclear energy.

Furthermore OOA was acting in a "population environment" with a deeply rooted conviction that it is possible to create decentral energy solutions, and not solely to rely on energy solutions suggested by a potential distant state and distant power companies. This attitude had been developed over decades, among other factors caused by a strong tradition for cooperative ownership of dairies, district heating companies, water supply companies, power supply and distribution companies, retail shops, cold stores, etc.

The (temporary) merging of independent and official RE frames can partly be traced back to the role of individual actors and the

<sup>9</sup> Own translation.



**Fig. 2.** The combination and interaction between actors, stories and context in terms of the materialization and consolidation of the future frame of renewable energy. The materialization of the future frame is understood as the sum of smaller, specific materialization processes in the various elements.

energy NGOs. For instance, one of Meyer's main activities at the central level was the establishment and management of the Committee for Renewable Energy (CRE) in 1982–1991. As a special characteristic, the CRE members were known supporters of RE, sharing similar storylines, which was an unusual "committee construction" at this time, as it is today. Usually, ministerial council members were selected to represent all specific interests (Meyer, 2000). Furthermore, the CRE had its own secretariat, which allowed it to distribute funding more freely according to the committee members' interests. Even though one of CRE's objectives was to support Danish industrial development, it was able to fund start-up projects at the many small RE producers. As described by CRE's case officer, who also had his roots in the RE 'scene': 'I assisted with devising the right wordings and requirements for the projects, so that they could formally get through the eye of the needle' (Vogt-Nielsen, 2018). With this kind of organizational construction, new technological solutions based on local innovation and societal support were developed strategically (Hvelplund, 2013).

#### 4. Discussion and conclusion

The discursive approach in combination with an institutional approach has proven fruitful for answering the research question 'How did the future renewable energy frame materialize and consolidate in Denmark in the period from 1973 to 2001?', elaborating on three elements: actors, stories and context. It has brought insight into how the interaction between actors, stories and the context play a role in the process of materialization and consolidation of a future frame. Although the case has shown different phases of materialization (the very beginning, practical materialization and the transfer to the national level) and it has shown different combinations of the elements have led to materialization and consolidation, the analysis has also emphasized that materialization and consolidation is a "messy" combination of individuals, stories and context factors rather than a subsequence of a planned logical order. Here, we reflect on some of the main determining elements, following the interrelationships in the conceptual model and highlighting the combinations of elements that mattered most. Even though Fig. 2 shows the interrelations between actors, stories and context as three distinct interrelations, and this discussion is structured accordingly, we are aware that it is a simplified illustration: the context might, for example, also facilitate the close connection between stories and actors, and *vice versa*.

##### 4.1. Stories and actors

Concerning the actors, stories and context, the first step of materialization of the future frame is the dissemination and merging of ideas (stories) in various networks (actors) (of universities, NGOs, colleges, technicians, etc.), for example formulating the ideas and developing stories on environment and technology, in (hand)books etc. The interaction between the environmental story (created by and mobilizing environmental activists) and the belief that RE technologies could fit into a modern energy system (wind turbine



pioneers), which mobilized universities and folk high schools, to start experimenting with RE. From there, materialization became more 'practical' in the hands of small-scale entrepreneurs, but also within organizations like OVE and OOA and also, contextual factors, such as the surplus capacity in the agricultural sector, spurring entrepreneurial experimentation, came into play.

A close analysis of the interrelationship between stories and actors shows that stories fulfilled two functions, which mobilize different actors: 1) the stories that generate wider (implicit) public and political support for RE, and 2) the function to mobilize specific actors. Concerning the first, stories on energy security, the ethical and social-economic side of RE, but also the story that the pro-RE actors were aiming at 'getting the facts right,' played a role in convincing the broader public of the possibilities of RE in the sense that NGOs focused on the dissemination of trustworthy and reliable information. In addition, for the diffusion and consolidation of the future frame of renewable energy, the economic story on employment and trade was crucial in the argumentation. Concerning the second function, for instance, the economic profit story about the potential of wind power and the development of solar panels in Denmark mobilized entrepreneurs in wind power such as farmers, other local stakeholders as well as (potential) manufacturers. The socio-economic benefit story provided a stimulus for the national government to introduce subsidies for, e.g., wind turbines.

#### 4.2. Stories and context

Different stories that were rooted in society played a role in the materialization by creatively and selectively linking up with the landscape and regime, eventually adding to the future frame of renewable energy. The follow-up steps within the process of materialization as described above was strengthened by the characteristics of Denmark's landscape, such as an abundance of small-scale manufacturers. For example, an elaborated knowledge base among the different small-scale manufacturers (wind turbines, pilot plants and small-scale RE experiments) created a fertile ground for the stories of economic profit, societal mobilization and citizen ownership. As such, the context played a role in the further development and materialization of these stories.

Furthermore, interaction between stories and context should explicitly be mentioned concerning the process of materialization into consolidation. The publication of alternative and official policy plans, national test and approval centers, and investment subsidies were based upon stories of economic profit, socio-economic arguments and technological possibilities concerning wind and solar. Decisive impetus for the coherent and solid consolidation of the future frame came from the combination of legislation (the ban of nuclear power), in the regime (e.g. the CRE): the closer cooperation between different actors from society, for instance, scientists and activists, and governmental actors, which is the topic of the next paragraph

#### 4.3. Actors and context

Finally, the emphasis on the role of actors has shed light on the complex and dynamic interactions between different actors within the policy-making process and the role of semi-coherence of the regime (context). It turned out that key actors have played an important role in materializing the future frame of renewable energy due to their strategic and dynamic positions and the possibilities provided by the contextual factors. Before the alternative discourse was adopted by the regime, the semi-coherence of the regime, both discursively and institutionally, played a crucial role. For example, discursively, the CRE supported actors with a strong support for RE, while within the regime the option for the nuclear pathway in the energy transition was still dominant. Also institutionally, this committee exhibited semi-coherence, which led to distributing funding more freely toward RE projects than following strictly the rules set at the ministry level. Further discussions of different stories, their alignment and merging into a future frame and their relationship to certain actors and contextual factors would be interesting.

### Acknowledgements

The work presented in this article is a result of the research activities of the projects "Mobilizing grassroots capacities for sustainable energy transitions: path improvement or path change?" (MobGIs), which has received funding from NWO (the Netherlands) and Innovation Fund Denmark (grant number: 4194-00001B) as a part of JPI Climate, and "Ethics and Energy" (E&E) funded by the Danish Council for Independent Research/Humanities (FKK).

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