

Article

A Comparison of Energy Transition Governance in Germany, The Netherlands and the United Kingdom

Erik Laes *, Leen Gorissen [†] and Frank Nevens [†]

Flemish Institute for Technological Research (VITO), Boeretang 200, Mol 2400, Belgium;

E-Mails: leen.gorissen@vito.be (L.G.); frank.nevens@vito.be (F.N.)

[†] These authors contributed equally to this work.

* Author to whom correspondence should be addressed; E-Mail: erik.laes@vito.be;
Tel.: +32-14-335-909.

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Abstract: This paper reviews and analyzes the challenges of energy transition governance towards a low-carbon society as a political achievement. The main research question is how specific “transition governance approaches” (as advocated by transition theory) can be embedded/anchored in the policy-making logics and practices. We analyze three country cases, known for their path-breaking efforts in the area: Germany (due to its pioneering role in the development and diffusion of renewable energy technologies), the Netherlands (due to its pioneering role in launching the transition management framework), and the United Kingdom (due to its pioneering role in adopting a long-term legislative commitment to a low-carbon future). The paper identifies best governance practices and remaining challenges in the following areas: (i) connecting long-term visions with short- and mid-term action; (ii) innovation (technological as well as social); (iii) integration (of multiple objectives and policy areas and levels); (iv) societal engagement; and (v) learning/reflexivity.

Keywords: energy transition; transition governance; climate policy

1. Introduction

Over the past two decades sustainable development has become increasingly accepted as an important overarching objective for governments and societies. The recognition that meeting the long-term challenge of sustainable development requires restructuring of key subsystems of modern

industrial societies guided by long-term policy designs grows steadily in policy circles [1]. Developments in energy policy provide a good example [2]. In addition to, and interwoven with, the liberalization agenda an important transition in energy policy design has started at the EU level a few years ago and is intensifying rapidly. In line with the position endorsed by world leaders in the Copenhagen and Cancun agreements (in December 2009 and 2010), the European Council, in February, 2011, reconfirmed the EU objective of reducing greenhouse gas emissions by 80%–95% by 2050 compared to 1990 in order to keep global warming below 2 °C compared to pre-industrial levels. Following up on this commitment, the European Commission has recently published its “Roadmap for moving to a competitive low carbon economy in 2050” [3], which sets a framework of milestones, policy challenges, investment needs, and opportunities for the EU member states.

Due to the co-evolution of energy systems and other important societal subsystems (e.g., transportation, housing, industry), the transition to a low-carbon energy system presents first and foremost a “systemic” challenge [4]. Technologies, institutions, (political) culture, and social practices should be reformed in a coordinated way in order to guarantee a more environmentally sound and equitable development trajectory. Such processes of systemic change are studied in the emerging field of transition theory [5]. Starting from the insight that “system innovation” (rather than just incremental changes) will be required to make key economic sectors more sustainable, transition scholars have developed theoretical insights as well as practical guidance to steer socio-technical changes along desired pathways. Following an early research focus on historical transitions and theoretical work mainly inspired by evolutionary economics and complex systems thinking, transition research has recently expanded into the areas of governance [6–8], power [9], and the politics involved in transition processes [10–12]. Other papers have already provided overviews and analyses of the general policy frameworks established by EU member states in the context of the transition to a low-carbon economy, but not yet specifically from the point of view of transition theory [13,14].

In line with the recent research focus within transition theory, this paper will review and analyze how specific approaches to the “management” of transitions (*cf.* Section 2) can be embedded/anchored in policy-making logics and practices. We consider the experiences of three EU countries known for their innovative policy making in this area: Germany (due to its pioneering role in the development and diffusion of renewable energy technologies), the Netherlands (due to its pioneering role in launching the transition management framework), and the United Kingdom (due to its pioneering role in adopting a long-term legislative commitment to a low-carbon future). The paper starts off with a discussion of the particular features of the transition management approach, which challenge more “conventional” policy-making (Section 2). Sections 3–5 present the country cases, with particular attention to how the key transition governance features were handled in each country-specific context. Section 6 draws lessons from a comparative analysis. Section 7 concludes the paper.

2. Transition Theory

Just as there is no silver bullet solution to decarbonize the energy system, there is no single universal approach for transition governance towards a post-carbon society. As cultures, structures, and practices are context dependent, transition approaches will have to be tailored to the local circumstances. However, by observing and comparing existing/tried strategies and trajectories towards

low carbon solutions and framing them according to the local context, more can be learned in terms of the range, effectiveness, and mixture of ingredients that are imperative/recommendable for navigation towards a low-carbon energy system. Such processes can only be explored in case studies. Hence, in this paper three country cases will be explored regarding how central features of transition governance are put into place (these features are identified in Sections 2.1 and 2.2).

However, before embarking on our case investigations a few clarifications are needed. Firstly, the focus of this paper is on energy transition governance. Even though the “transition to a low-carbon energy system” and “sustainable development” (understood by the World Commission on Environment and Development [15] as “*development that meets the needs of the present generation without compromising the ability of future generations to meet their needs*”) are intimately related, the focus in this paper is not on general sustainability strategies. Secondly, the discussion will not cover every possible aspect of low-carbon energy transitions. In this paper, attention is primarily directed to process and institutional reforms (rather than to specific policy areas or policy instruments). Thirdly, as the energy transition is only taking off and will take a number of decades to be completed, it is much too early to present a definitive statement about the overall effectiveness of the governance frameworks under investigation. In this sense this paper is explicitly not intended as an end point, but rather as a modest contribution to the learning process for effectively initiating/establishing a low-carbon energy transition governance framework, both in theory and in practice.

2.1. Transition Theory as the Study of Historical Transitions

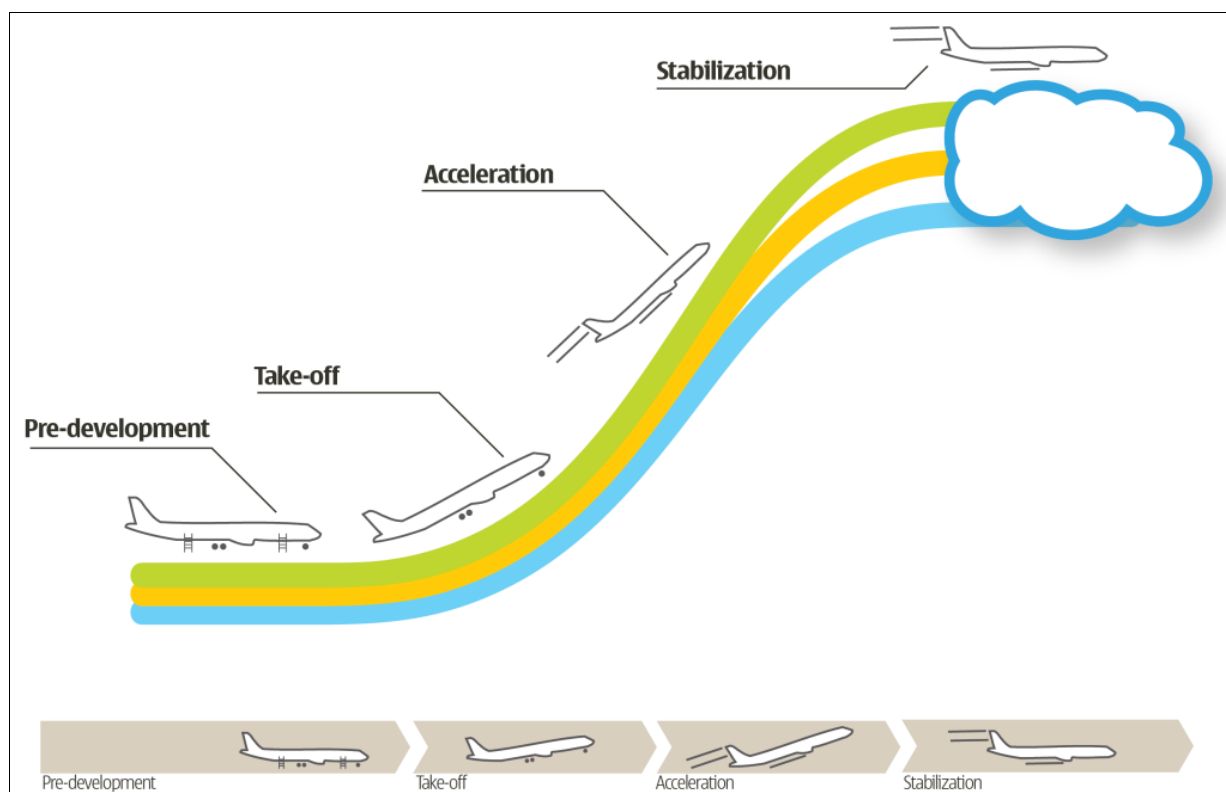
Transition theory represents an important synthesis of ideas and concepts, which have emerged over the past decades in historical research on past socio-technical transitions. Historical transitions of this kind share some general characteristics [7]:

- Transitions are co-evolutionary processes that require changes at the micro-level of “niches” (*i.e.*, protected spaces where new technologies and/or practices are not exposed to the full selective pressures operating in the incumbent regime), at the meso-level of “regimes” (*i.e.*, a dominant set of stable but continuously evolving artefacts, actors and institutions), and at the macro-level of the “landscape” (*i.e.*, the set of processes which operate beyond the direct influence of actors in a given regime);
- Transitions are multi-actor processes, involving a large variety of social groups and cutting across established functional specializations and jurisdictional boundaries;
- Transitions involve moving away from established ways of doing things (in terms of principles, business models, end-user practices, *etc.*), and this inevitably provokes resistance from groups that fear that their interests will be harmed;
- Due to the inherent complexity of contemporary industrial societies and the rigidity of the systems in place, transitions are long-term processes [16], as witnessed also by historical evidence on past energy transitions not driven by sustainability concerns [17].

A first ordering frame to describe and clarify transition processes is a sequence of four phases, shaping a characteristic S-curve (*cf.* Figure 1):

- **Pre-development:** During the pre-development phase the system status quo remains, but small-scale initiatives arise in which completely new working and thinking paradigms are employed. Early experiments fitting in innovative system structures are established. There is a kind of “nervousness” within the system caused by external (landscape) pressure or tangible consequences of unsustainable practices (“symptoms”). The appropriate way for finding solutions for the complex problem settings is being explored.
- **Take-off:** The take-off is the phase during which the regime in place starts to absorb the transition impulses and shows a visible—be it cautious—start of a change process. It is the phase during which a number of reactions to the unsustainable situation get higher visibility, are mutually connected and reinforce each other.
- **Acceleration:** In the acceleration phase structural changes occur and are translated into mainstream practice of many actors; caused by an accumulation of mutually reinforcing socio-cultural, institutional, technological, economical, *etc.*, moves. The new ways of working, thinking, and learning get “anchored” or “embedded”.
- **Stabilization:** During a stabilization phase, the speed of change decreases, a new system in a dynamic equilibrium is established (in which new niches develop, marking a new cycle, and so on).

Figure 1. Archetypical phases in a transition process.



Arguably, the average position of EU member states regarding low carbon transitioning is one of pre-development: there seems to be a growing “sense of urgency”, climate change related issues increasingly appear in policy agendas, specific (often technology based) action programs are deployed. However, the overall change process is not (yet) in pace with envisaged/projected targets that comply with far reaching ambitions, such as (nearly) complete mitigation of greenhouse gas (GHG) emissions.

However, for the “frontrunner” states selected for our case studies (Germany, the Netherlands, and the UK) it can be argued that they have at least succeeded in moving energy transition governance into a take-off phase. Therefore, a first part of our analysis is aimed at understanding how these countries succeeded in taking this step. This is reflected in the chronological presentation of the development of policy initiatives in each of the cases, showing the “tipping point” between the “pre-development” and the “take off” phases.

2.2. Transition Management as the Attempt to Influence Energy Transitions towards Sustainable Solutions

Transition management can be considered as a “prescriptive” application of transition theory—*i.e.*, as an intentional governance design aimed to steer important societal subsystems (such as the energy system) in a more sustainable direction. The transition management discourse consists of a deliberate attempt to work towards a transition in important societal subsystems in a forward-looking, yet adaptive manner, using strategic visions and actions. The concept is situated between two different views on governance: the incremental “learning by doing” approach and the “blueprint” planning approach. The concept of “transition management” therefore implies a deliberate effort and willingness to adjust existing institutional energy policy structures and processes in order to effectively support a low-carbon development trajectory. This “adjustment” should take the shape of a “goal-oriented modulation” occupying the middle ground between planning and incrementalism [18]. Four different types of governance activities assume central stage: strategic, tactical, operational, and reflexive [6,18]:

- The strategic level is concerned with all activities and developments that deal primarily with the “culture” of a societal (sub-)system as a whole: debates on ethics, long-term vision development, collective goal and norm setting, long-term foresight, *etc.* At this level, transition management aims for the integration (and, hence, institutionalization) of long-term governance activities in the realm of “ordinary” policy making.
- The tactical level is concerned with rooting the visions developed in the transition arenas in the strategies of various networks, organizations and institutions. In this process, visions are further translated into so-called “transition paths”—*i.e.*, (technical, regulatory, cultural) routes to a transition image via intermediate objectives, possibly formulated in a quantitative way (the so-called “transition agenda”).
- At the operational level, transition management is concerned with translating visions and transition paths into “transition experiments”—*i.e.*, “iconic” projects with a high level of risks (hence, the need for a protected setting or “niche”) that can make a potentially large innovative contribution to furthering the transition agenda.
- Finally, the reflexive level is concerned with monitoring and evaluating the transition process itself, as well as the functioning of the specific transition management “tools” (arenas, coalitions, experiments).

In sum, transition management can be characterised as a deliberate effort to complement and transform policy making by working as a kind of “meta policy” that integrates various sectoral policies by setting up broad collaborative innovation networks, including representatives from business, government, science, and civil society. However, at each of the levels identified in the transition

management literature questions regarding the actual implementation in specific contexts of policy making can be raised:

- Connecting (a) long-term vision(s) with short-term action: long-term desirable visions can only inspire significant change to start up when the future narratives/images find ways of connecting with contemporary illustrative actions/experiments. Measurable targets and objectives also have an important role to play in ensuring the connection between short-term actions and long-term guiding visions. However, it is notoriously difficult to unequivocally measure progress on the multiple (and often incommensurable) dimensions of sustainable development ([19]; see [20] for a discussion on sustainability impact assessment of energy systems). How do government initiatives connect long-term guiding visions for the energy transition with concrete short-term action, and how is progress measured in achieving the long-term visions?
- Innovation beyond (technological) innovation: Genuine system innovation will be the word of order if we are to move to a low-carbon society. Traditionally, the innovation agenda is often related to technological progress in support of the creation of new jobs and markets, the growth of competitive businesses, and general prosperity. Transition management however stresses that technological, as well as social innovations (in business practices, financing mechanisms, consumption practices, community activism, and so on) will be needed, allowing individuals, families, and communities to flourish without imposing undue stress on the global environment. How do states promote governance practices, which accelerate socio-technical innovation, encourage experimentation, orient inventiveness, and speed up the processes of diffusing beneficial societal advances from a sustainability perspective?
- Integration: Low-carbon development requires the simultaneous pursuit of multiple goals and the management of issues that cut across established administrative responsibilities. Transition governance stresses that economic, social, and environmental concerns should not just be balanced and traded off against each other; instead, a creative search for win-win situations offers chances of better integration of low-carbon concerns over administrations. However, such integration is notoriously difficult to achieve, as existing administrative structures and procedures tend to encourage a partial vision of problems [21]. Moreover, short-term political and policy imperatives frequently preclude longer-term and integrated thinking. How can states promote or institute transition governance approaches, which encourage such integration?
- Societal involvement and engagement: Low-carbon development cannot be achieved by governments alone. To achieve such far-reaching changes requires strong and consistent public support and understanding, self-directed change in many domains of society, and collaboration among diverse social actors. Multi-stakeholder processes have been a distinctive feature of governance for sustainable development ever since the publication of the Brundtland report [15]. Information and understanding from many actors is required to make sense of issues, plot appropriate transition trajectories, and implement sustainable solutions. How can societal engagement be encouraged and structured? And, how can the quality of debate in the public sphere be raised regarding complex issues related to sustainability?
- Learning/reflexivity: Learning is a constant feature of navigating the inherently uncertain transition to a low-carbon future. Individuals and groups continuously draw lessons from their experiences,

but there is no guarantee these lessons will advance particular social goals. They may also be about political strategies and blocking change [22]. Reflexivity implies more than the usual “incremental adjustment” associated with the traditional policy cycle, as it involves deeper reflection on the goals of action and wider societal participation [1]. How can states promote fruitful social learning and reflexive low-carbon transition governance frameworks?

In order to understand how and why particular transition governance arrangements took shape in actual policy-making practices the way they did, the following section addresses these questions to each of our cases in turn. The data for our case analyses were acquired through literature reviews, government documents, energy statistics and unstructured interviews with key stakeholders, where and when possible.

3. The German Energy Transition

3.1. Case Description

3.1.1. Pre-Development

Regarding climate policy specifically, Germany took on a pioneering role as early as the mid-1980s. The global warming debate in Germany had its origins in the controversy over nuclear power triggered by the 1986 Chernobyl nuclear accident. With calls for either an immediate shutdown (by the Green party) or a gradual phase-out (by the social-democrat party SPD (Sozialdemokratische Partei Deutschlands) of all nuclear plants, the construction of additional coal-fuelled power plants was proposed to compensate for the lost capacity of nuclear facilities. The parties supporting nuclear power (the Christian-democrat CDU/CSU) found in the issue of climate change what they hoped would be an effective counterbalance, arguing that nuclear power made good environmental sense when confronted with the ominous threats posed by global warming. Within the context of conflicting scientific claims and political polarization, it was decided to establish an “Enquete” (Inquiry) Commission, which was crucial in the formative years of German climate policy. The commission concluded that early action on climate change was needed in the face of “overwhelming evidence” [23]. By the end of the 1980s, a political closure on the importance of climate change was achieved which, up until now, has not been seriously challenged. Already, in June, 1990, the German government adopted the precautionary principle as a basis for the national climate policy and finalized and set for itself a unilateral target of 25% reduction of GHG emissions by 2005 (compared to 1987 in West-Germany) [24]. This was later on replaced by the 21% reduction goal (for the whole of Germany, compared to 1990) accepted in the Kyoto protocol. The early commitment has allowed Germany to be a frontrunner in the international climate change negotiations. The nuclear debate on the other hand resulted in a phase-out decision established by law in 2000 (phase out by the year 2022). This phase-out plan was initially delayed by 12 years in late 2010, but after the nuclear accident in Fukushima the original ultimate closure date of all nuclear power plants in Germany (*i.e.*, 2022) has been reconfirmed (*cf.* Section 3.1.2).

The aggressive promotion of renewable energy sources (RES) is probably the most significant and successful—however, in view of the immediate costs incurred, not uncontroversial—policy measure in the transformation of the German electricity system. These sources have grown from a share of 3.1%

in the German electricity mix in 1990 to some 25% in 2013 [25]. For a full-scale transition to a low-carbon economy, the heating and transport sector would of course also increasingly have to rely on RES; however progress there has been limited so far. Following the intense nuclear controversy in the 1980s, a strong environmental movement, the spread of green ideas throughout society, and the rise of the green party helped to push renewable energy sources as an alternative to a nuclear economy [24]. Under pressure from this movement, governments first reluctantly but then with increasing enthusiasm began to support the renewable energy development. Even the reluctant support at the early formative stages (roughly 1975–1990) in the form of a gradual reorientation of research and development (R&D) funds was enough to open up small space for experimentation and learning in wind and solar power for a range of companies and academic departments [26]. Since the beginning of the 1990s, the primary tool to enhance the share of RES has been a strong feed-in tariff system in electricity generation that provides renewable producers with a guaranteed, attractive rate for electricity production and ensures access to the power grid. The rapid growth of renewables drew in new actors into the RES policy network, including environmental associations, the renewable energy sector (equipment producers, owners and operators of installations, and their associations), and “conventional” associations (most notably the investment goods industry association and the metalworkers’ union).

3.1.2. Take off

In 2000, with the adoption of the Renewable Energy Act [27] (“Erneuerbare-Energien-Gesetz” or EEG) the crucial argument was added that support for RES technologies represented a long-term commitment to bring down the costs of such sources. The goal was the creation of a whole new industry (replacing industries expected to decline), with new employment and new exports. Finally, RES were expected to lower the long-run costs of energy supply [28]. Here, a clear transition vision was already apparent in Germany at the turn of the 21st century. Renewable energy policy consequently has made Germany a world market leader for some areas of renewable energy technology (such as wind and photovoltaics).

In recent years, inspired by the German experience feed-in tariffs have been adopted by about two thirds of EU member countries, as well as in many other non-EU countries. Perhaps more importantly, Jacobsson and Lauber [26] conclude that the German RES success story has led to a strong legitimacy and an increasing acceptance of visions with RES providing very substantial shares of energy in the future. The German federal government’s so-called “Energiekonzept” sets out the ambition to transform energy supply and provides a roadmap to a truly genuine “renewable age” (in 2050, 80% of energy supply should come from RES) [29]. The aims of the plan are very ambitious: the securing of a reliable, economically viable and environmentally sound energy supply to make Germany one of the most energy-efficient and green economies in the world. The defining activity areas of the “Energiekonzept” set out the establishment of renewable energies as a cornerstone of future energy supply; energy efficiency; the creation of an efficient grid infrastructure for electricity and integration of renewable energy sources; energy upgrades for buildings and energy efficient new buildings; and the country’s mobility challenge (one million electric vehicles on the road by 2020 and six million by 2030).

Against the backdrop of the nuclear meltdown at Fukushima, in March, 2011, and following the advice of the German National Ethics Commission [30], the role assigned to nuclear power in the

energy concept was reassessed (a complete phase out must be implemented by 2022) and the seven oldest nuclear power plants were shut down permanently. Furthermore, the Ethics Commission proposes that the post of an independent “Parliamentary Representative for the Energy Transition” is established in the German Bundestag and that a “National Forum for Energy Transition” is created. The parliamentary representative should monitor progress on the goals set out in the “Energiekonzept” on a yearly basis. The Ethics Commission explicitly recognizes the crucial role played by towns, cities, local communities, and companies in the energy transition. It specifically frames the German energy transition as a collective process, implying a shared responsibility for government, business, civil society, and individual citizens. In sum, the German experience shows us that the take-off of an integrated long-term governance perspective is the outcome of a process of cumulative causation where institutional change, market formation, entry of firms and the formation and strengthening of advocacy coalitions are the constituent parts.

3.2. Overall Assessment with Regard to the Implementation of Transition Management Core Ideas

Germany is generally considered to be an environmental and climate frontrunner. For instance, its ratio between carbon productivity growth and GDP per capita growth has been the highest of all G20 countries between 1990–2005 [31]. This statement applies to not only Germany’s reduction in GHG emissions but also to its development of a high level of overall institutional, informational-cognitive, technological, and scientific capacities. The extent to which there has been an international diffusion of Germany’s policy instruments (e.g., the feed-in law for renewable electricity promotion) and technologies (especially wind and solar power) speaks also to the international position of Germany as a leader.

By adopting a frontrunner position in climate policy and showing international leadership, Germany has been able to capitalise on an intense learning experience spanning about three decades in order to reconcile the more short-term oriented RES development targets to longer-term sustainability visions (as laid out in the Energiekonzept). In the course of this process experiments have been scaled up, a strong advocacy coalition has been built up and visions have become more specifically centered on RES development. Notably, since the definite closure of the nuclear chapter (following the Fukushima disaster) the goals set out in the original Energiekonzept (2010) have been reaffirmed also on an ethical basis, and their pursuit has been accelerated. Furthermore, this has been done by a conservative government, while the opposition is even more progressive on this topic. This means that within German society and politics a strong consensus and institutional commitment exists on the general direction of the energy transition, and that concrete measures are taken in an integrated way (across administrations) to accelerate it.

One crucial factor for the gradual increase of the influence of the RES advocacy (besides the actions of the RES coalition) is the societal engagement by the general public. The German public shows strong sentiment against conventional energy sources, most notably against nuclear power. It is willing to take to the streets to prevent nuclear waste transports or the lowering of RES feed-in tariffs [32]. This topic is so pressing for part of the German public that it influences their voting behavior. Extending the lifetimes of nuclear plants proved detrimental to the federal government’s approval rates and, especially after Fukushima, led to defeats in state elections. Furthermore, renewable energy policy has enabled an increasing number of private persons to play an active role in the energy transition by

becoming energy producers. This evolution has been supported by the initiative of numerous German regions and communities wanting to become energy autonomous and thereby spreading ecologically conscious lifestyles [33]. This makes the contribution of the public tangible and visible: over 50% of the current installed renewable capacity is owned by private citizens or farmers, compared to less than 10% by the four largest utilities [34].

Even though the transition to an energy system dominated by RES has clearly entered a take-off phase in Germany, the German model is nowadays facing significant challenges, which are set to increase in the coming years. Public support for RES over the last two years has been increasingly put under stress due to the rising contribution to the RES deployment costs by households. This is due to the fact that (i) the electricity price in Germany has decreased because of the merit order effect caused by the deployment of RES itself (and, hence, more support is needed to introduce RES into the electricity market); and (ii) energy-intensive industries have been increasingly exempted from contributing fully to the deployment of RES, causing a larger share of the deployment costs to be contributed by households and SMEs. Currently a reform of the EEG, meant to stabilize the electricity prices, is set up that will be finished in the summer of 2014.

Furthermore, in order to obtain high levels of RES penetration new RES projects will focus more on large-scale applications (most notably offshore wind energy), hence, putting a lot of decision power back in the hands of the big utilities. Finally, even though the German energy transition has so far been largely a national affair, much closer coordination and integration at the EU level will be needed in the future in terms of electricity grid interconnections, harmonization of RES support schemes, *etc.* In short, Germany faces the challenge of maintaining its role as an energy transition frontrunner while not “running” too far ahead of other EU countries.

4. The Dutch Energy Transition

4.1. Case Description

4.1.1. Pre-Development

Since 2001, a transition management experiment is going on in the Netherlands, of which the so-called “Energy Transition Program” (ETP) is arguably the best-known (and most documented) exponent (see e.g., ([7], pp. 180–198); [35–37]). Smith and Kern [37] describe how the Dutch research tradition in studying relations between technology and society (supported since the 1970s by several environment-technology research programs) provided ample opportunities for dialogue between researchers and policy makers. In this context transition theory was developed under a rather small research program. However, clever advocacy, boundary work (ensuring legitimacy to both the “world of science” and the “world of politics”), and coalition-building between researchers eager to see their ideas having a policy impact and policy advisors in need of new ideas to invigorate the national environmental planning (NMP) process led to the adoption of the transition management approach in the fourth NMP [38,39]. A number of policy evaluation reports clearly showed that the incremental approach adopted in earlier NMPs (with a focus on cleaner technology, partnerships between government, business and civil society, and a preference for market-based solutions) did not succeed in an absolute decoupling between environmental degradation and economic growth.

A crucial success factor here was the presentation of the transition storyline as “complementary” to the discursive commitments and institutional priorities of the two ministries critical for the NMP process, to wit the “ecological modernization” agenda (supported by the Ministry of Housing, Spatial Planning and Environment (VROM)) and “energy market liberalization” and the “knowledge economy” agenda (supported by the Economics Ministry (EZ)) [37] (p. 88). EZ subsequently appointed itself as the “transition manager” of the energy transition [40]. Following initial stakeholder consultations and based on insights gained from a long-term energy scenario study, four energy transition themes were chosen in 2004–2005, which formed the cornerstones for a sustainable (*i.e.*, “clean”, “affordable”, and “secure”) energy system in any of the four scenarios investigated in the study. Later on three more themes were added, and seven “transition platforms” (corresponding to the “transition arena” concept in TM literature) were created around these themes, forming the heart of the ETP: green resources, new gas (*i.e.*, efficient use of gas and development of “green” gas), chain efficiency, sustainable mobility, sustainable electricity, the built environment, and the energy-supplying greenhouse. These platforms’ task was to develop and facilitate different energy pathways by encouraging market developments and advising the government on creating appropriate framework conditions [39].

As these pathways serve as criteria of eligibility for obtaining public funding they had to be officially certified by EZ. As such, the pathways were intended as the central part of a new “social contract” between government and stakeholders in the energy transition: through the official adoption of the pathways the government gave clear directions to the energy market, while stakeholders committed themselves to a partnership with government in a search for the appropriate innovations, as the pathways were explored further in numerous experiments.

4.1.2. Take off (as Part of Innovation Policy) and Subsequent Decline

In later stages of the ETP better coordination between these platforms and better connection to the formal institutions of Dutch representative democracy were established [41]. Firstly, an “Interdepartmental Directorate Energy transition” (IDE) was created encompassing civil servants from six ministries, whose task was to better coordinate energy policy initiatives with system innovations over the longer term. Secondly, the transition platforms were complemented by a “Taskforce Energy transition” (TFE). The TFE membership included high-level representatives of leading Dutch energy industry players (e.g., Shell, Gasunie, *etc.*) and the public sector. Due to its high-level profile, the TFE created significant political salience for the ETP, whereas before (between 2001–2005) the ETP was regarded more as a policy experiment conducted by the relevant ministries [42].

However, subsequent interventions have again lowered the ETP’s political visibility. In February 2008, following a change of cabinet, most of the policy work and funding for energy transitions was removed from EZ (responsible for energy policy) to VROM (responsible for environmental policy), while the TFE was replaced by a new entity, the “Energy transition Governing Organ” (REN)—a less “high-profile” (and politically controversial) group than the TFE [41]. Finally, in 2011 (again following a change of cabinet and as a result of general cutbacks in government spending) the energy platforms were abolished and the ETP reduced to a small unit within EZ. Innovation policy is now focused on a set of selected economic sectors and targeted areas within these sectors where the Netherlands already has a

strong competitive position internationally—the so-called “top areas” (one of which is energy). This new policy of concentrating resources to achieve critical mass in a few targeted areas and sectors represents a significant break with the past policy of broad allocation of research resources. The new government argues that the Dutch energy transition has entered an implementation phase and that the “lessons learnt” from the energy platforms will be integrated in policy making. Critics however retort that real implementation is unlikely to happen, given that the Netherlands is more and more openly embracing a neo-liberal mindset (stressing the economic dimension of sustainable development and the need to secure win-win outcomes), which is inimical to many of the core ideas of TM [43].

4.2. Overall Assessment with Regard to the Implementation of Transition Management Core Ideas

It is important to realize that in the Netherlands transition thinking has been introduced as part of innovation policy, and, more specifically, as a socio-technical alignment mechanism situated in a complex network of technology push and market pull policies [35]. As such, the ETP can be described as a more “soft” policy approach. The ETP approach has been instrumental in introducing the idea of vision-guided energy governance in the Netherlands, albeit that strong choices on potentially incompatible visions have been avoided so far: for instance, fossil-fuel based visions centered on carbon capture and storage are accepted alongside visions, based on renewable energy [42]. Formal sustainability assessment played no role in the selection of the pathways. Socio-technical learning was incorporated as an explicit ETP process goal. Hundreds of transition experiments have been funded and extensive learning has occurred on transition theory as such and on the functioning of innovation systems, following the model proposed by Hekkert [44,45]. However, because of the dominance of incumbent business interests in the transition platforms the transition experiments have been oriented mainly on technological learning and short-term gains in terms of lowering GHG emissions. Experiments have hardly been aimed at institutional or cultural change [36]. Some integration between the ETP transition platforms has been achieved; however Kern and Smith [36] point out that the impact of the ETP on core Dutch energy policy issues, such as security of supply, liberalization, renewable energy, and nuclear power has been very limited. This is not surprising since ETP goals and priorities were often inconsistent, incoherent, and incongruent with the mainstream energy policy mix [46]. The focus on energy market liberalization is dominant. In this perspective, the position of the current Dutch coalition government on sustainability as “green growth” may be less a radical departure from earlier policy and more a continuation of a long-standing *de facto* position with the main difference only that policy is now stated more explicitly. In the recent period of change and in the context of a deepening public debt and a need to try to stimulate greater private investment in R&D, the government has entrusted business with a much more overtly dominant role in setting the research agenda. There is a risk that concentrating public research investment in the currently dominant economic sectors and allowing business leaders from these to steer the research agenda may lock out the potential for system innovation in the form of entirely new production-consumption systems to emerge. With the future of significant top-down (*i.e.*, state-led) support for the energy transition in doubt, Dutch transition scholars turn towards local sustainability initiatives (“let a thousand flowers blossom”) as their new hope [47].

5. The UK Energy Transition

5.1. Case Description

5.1.1. Pre-Development

The UK engaged early with the climate change issue. This early engagement is the result of a number of factors: (i) a firm commitment at the prime ministerial level; (ii) a strong and influential scientific input; and (iii) fortuitous circumstances that resulted in significant emissions reductions (the switch from coal to gas). As a result, the UK has emerged as an international leader in this area. One of the most notable transition initiatives in the UK has been the 2008 Climate Change Act, which makes the UK (for the time being) the only country in the world that has enshrined its long-term commitments to reduce GHG emissions in a legally-binding framework. The focus of the UK case review will be on this Climate Change Act and the institutional transition framework set up in accordance with this act [48]. The push for legislation enshrining the UK's targets in a legally binding framework started in 2005 and the concept of a climate law made up of targets and budgets became the focus of a major public and political campaign effort [49]. The campaign was initiated and led by the environmental non-governmental organization (NGO) Friends of the Earth and involved interested local people and local members of parliament (MPs). Concurrent with the campaign, the so-called "Stern review on the economics of climate change" was published in October, 2006 [50]. The report argued that climate change is the prime example of massive market failure, and concludes that early action on climate change by far outweighs the costs. The Stern review can be seen as an attempt to form a consensus on a target level for emissions reductions and therefore act as a reference point for both UK and international energy policy. In the end, the combined pressures of public campaigning and scientific authority led to the government announcing in November, 2006, that it would bring forward the Climate Change Act. The publication of a draft act in March 2007 was followed by a period of intense parliamentary scrutiny, a public consultation and continuing public campaigning on specific issues, leading to the passing of the Climate Change Act by the UK Parliament in 2008.

5.1.2. Take off

An important feature of the UK effort on climate change has been the emphasis on institution building, *i.e.*, the creation of publicly supported bodies with explicit remits linked to climate change [51]. These institutions are legally enshrined by the Climate Change Act. Key provisions of this legislation include:

- Providing a statutory foundation for the official UK greenhouse gas emissions targets of at least a 34% reduction by 2020, and an 80% reduction by 2050 (both based on 1990 levels), through action in the UK and abroad. The 80% target is a unilaterally binding target set by the UK in the absence of a binding agreement at the EU or international level. The UK government has the power to amend this target, but only if specific circumstances present themselves (a significant development in the science of climate change or in European law or policy);
- Establishing a system of five-year carbon budgets that set annual levels for permissible emissions. Three budgets spanning a 15-year time horizon will be active at any given time,

presenting a medium-term perspective for the evolution of carbon emissions over the economy as a whole. The first budgets relate to the years 2008–2012, 2013–2017, and 2018–2022. A fourth budget relating to the years 2023–2027 was recently introduced (June 2011), setting out a target of a 50% reduction of GHG emissions on average (compared to 1990 levels);

- Establishing a Committee on Climate Change (CCC), as an independent expert advisory body that can make recommendations to government concerning the pathway to the 2050 target. It is composed of five to eight high-ranking scientists + a chair and chief executive, all of whom are influential in business and politics. The CCC reports annually to Parliament, and the government is required to formally reply to its reports. The merit of having an independent watchdog lies in forcing government to publically justify its own actions on a regular basis. This in turn contributes to a credible government commitment to long-term policies, which is a necessary precondition for creating a stable investment climate [52]. The CCC therefore has a central role in the UK transition to a low-carbon economy [53]. However, although the CCC does give detailed advice on specific policies available in for moving different sectors of the economy along a low-carbon transition path, it is not within their remit to suggest the optimal policy mix (this is left to the government's discretion).

According to ClientEarth [49], the influence of the CCC on government policy so far has been very substantial, e.g., in proposing an 80% reduction target in 2050 and in setting the interim carbon budgets. Other examples include the CCC's recommendations to establish a framework for developing clean coal technologies, which was taken up by government. In sum, the core philosophy of the UK Climate Change Act is that the series of built-in duties and reporting requirements, combined with the monitoring function of the CCC and the scrutiny role of parliament, will create transparency, accountability, and political pressure to ensure that governments will comply. However, what happens when the UK government is not able to comply with a carbon budget limitation remains an open question. Critics, such as Pielke [54], therefore argue that the UK Climate Change Act will collapse under the pressure of the (according to Pielke) unrealistic speed of decarbonization implied by the carbon budgets. Criticism is also aimed at the inclusion of nuclear power in the low carbon transition path [55].

5.2. Overall Assessment with Regard to the Implementation of Transition Management Core Ideas

The UK Climate Change Act in itself does not include a vision on a low-carbon society—it simply specifies that such a society should reduce its GHG emissions by 80% or more compared to 1990. This long-term goal does include however a moral judgement on the “right” amount of responsibility (*i.e.*, a burden-sharing obligation based on the principle of common but differentiated responsibilities) to be taken by an industrialized country, such as the UK, in order to reduce global GHG emissions by 50% in 2050. The government has also developed a “carbon plan”, which sets out three different transition scenarios for achieving the 80% reduction in 2050. The carbon plan specifies the implications of the transition paths for the coming decade (in great detail), the 2020s (in less detail), and rather qualitatively for the period 2030–2050. Hence, it combines short- and long-term thinking.

In line with the UK focus of seeking the most cost-effective transition path, a bottom-up engineering-economics optimization model (MARKAL-TIMES) has been used to provide the “core” 2050 pathway around which variations were explored. In addition, a user-friendly “online 2050 energy

calculator” allows for a transparent comparison of the consequences of the different transition paths [56]. The online calculator even allows its users to explore other transition paths at will. The carbon plan focuses predominantly on technology (with a major role foreseen for nuclear power and carbon capture and storage), and not so much on behavior or lifestyle changes [57]. There is a marked difference between the Dutch TM discourse (with its focus on envisioning, stakeholder arenas, niche arenas, *etc.*) and the approach adopted by the UK government and administration because of a pragmatic culture of “getting things done” (*i.e.*, a focus on reaching clearly verifiable targets) and evidence-based policy making (whereas it is hard to give quantitative evidence on how much lifestyle changes could contribute to the decarbonization of the UK economy).

The UK Climate Change Act also promotes learning/reflexivity (by establishing targets and organising regular reviews, monitoring, and assessment) and integration (the carbon budgets proposed by the CCC have to take into account a range of economic and social issues). However, it is important to note the legislation itself does not achieve or incentivise any actual emissions reductions. The Act is only a framework and therefore its effectiveness ultimately depends upon its translation into a large number of other programmes, policies and plans. The carbon budgets therefore provide consistency and certainty to government and its departments but not directly to businesses. The government is ultimately responsible for choosing the policy mix needed to deliver the promised GHG emission reductions. The consistency, congruence, and coherence of this policy mix is however not guaranteed by any mechanism foreseen in the Climate Change Act.

6. Tentative Lessons Learnt from the Three Country Cases

It is hard to underestimate the profound implications of energy transitions for the relationship between states and national economies. Intergenerational concerns lie at the heart of transition governance, involving not just the preferences of existing people (and therefore existing consumers and voters), but also future ones too. Hence, the traditional approach to economic regulation and governance adopted by welfare states needs to be shifted in favor of the interests of future generations worldwide. The case studies discussed in this paper allow us to draw some tentative conclusions on how this can be achieved, and to point out areas where more research is needed. Table 1 summarizes our findings.

However, one always has to take into account specific country contexts so that the “lessons learnt” should certainly not be read as a “blueprint” to be applied in other political contexts. We discuss the “lessons learnt” here in turn for each of the transition elements identified in Section 2.1.

Given the long-term nature of transition processes, the most important challenge for energy transition governance lies in ensuring that future governments will remain credibly committed to overall transition visions and goals. Such commitment is always a matter of degree, since no government can “bind” future governments to carry out specific plans or programs (laws, even constitutional ones, can always be overturned by future (qualified) majorities). Nevertheless, the case studies point out a range of “commitment devices” making it considerably harder for future governments to overturn previous commitments. In the UK, grassroots efforts, based on using local groups and supporters to build a public campaign, as well as lobbying and working with MPs who backed the initiative, were critical in securing climate change legislation setting out long-term targets. Also the very thorough

process of pre-legislative parliamentary scrutiny, the public consultation and the backing by the scientific authority of the CCC strengthened the Climate Change Act. The German experience in addition underlines the importance of early engagement with the climate change issue, gradual, and sustained building of new advocacy coalitions centered on RES deployment, and principle-based reasoning (*cf.* the role of the Ethics Commission) in support of the long-term commitment to building a low-carbon society powered largely by RES. Each of these “commitment devices” plausibly augment the “political costs” (in terms of losing public support) of not meeting transition visions or goals for government, particularly if they are combined with public scrutiny by advisory committees (such as the CCC in the UK) [53]. The Dutch case study provides a counter example, where the political costs of abandoning the ETP (due to its embedment in innovation policy) apparently were not high enough to warrant its continuation. Further research should indicate which “commitment devices” are most suitably deployed in particular national circumstances.

Credible commitment to long-term carbon constraints is essential. Equally important, however, is breaking up long-term commitments into near- and mid-term incentives of which impacts can be timely monitored and evaluated. To this end, the UK Climate Change Act introduced a carbon budgeting system, which not only takes into account the overarching long-term target but also a wide range of near-term factors such as economic and technological development. There is however disagreement in the literature on whether short- to mid-term incentives should take the form of target-setting or a commitment to particular types of regulation [28]. This is not the place to review the pros and cons of both approaches; an important research task therefore lies in assessing the strategic importance of target-setting *vs.* regulatory commitments for transition governance taking into account national contextual factors.

A crucial part of transition governance is the horizontal and vertical integration of societal dynamics (policy processes, investment decisions, *etc.*) relevant to realising transition visions. Our case review has shown numerous examples of such “integration devices”, ranging from the “soft” coordination practices by *ad hoc* advisory committees (IDE, TFE, REN) in the Dutch ETP to the “hard” distribution of responsibilities for meeting carbon budgets over different government departments in the UK. However, one issue that stands out concerning integration is whether a proposed set of transition pathways (including the institutional changes implied) can contribute in a coherent way to a transition vision. In particular, the UK government has decided that nuclear power and new coal-fired generation are needed for meeting the twin challenge of security of supply and climate change mitigation, whilst simultaneously advocating a massive expansion in RES. The question here is whether the institutional and infrastructural pathways towards the RES option can be made compatible with the further development of nuclear power and coal + carbon capture and storage (CCS) [22]. In contrast to statements by Stern [50] and the UK government [55] that the widest range of technological portfolios should be developed, there is evidence that several components of such portfolios are antagonistic and internally inconsistent [42,58]. Hence, an important research question for transition governance consists in exploring transition pathways from a socio-technological and institutional perspective using advanced scenario techniques in order to reveal possible inconsistencies [59,60].

Table 1. Synthesis of findings from the three case studies.

	Germany	The Netherlands	United Kingdom
<i>Main transition governance innovation</i>	Promotion of development and diffusion of RES in electricity generation through feed-in tariffs	Adoption of transition governance as the reference framework for innovation policy	Adoption of a long-term legislative commitment to a low-carbon energy future
<i>Pre-development</i>	Early action for combatting climate change combined with protracted nuclear controversy opened up a space for the promotion of RES as a real alternative	Clever “boundary work” by transition researchers led to the adoption of the transition framework in the national environmental planning process	Early engagement in the climate change issue due to strong public and political campaign effort backed by leading scientists (e.g., Stern)
<i>Take-off</i>	The EEG (adopted in 2000) combined with irreversible nuclear phase out (due to strong public support) has established a long-term commitment to RES as the main power source of the future	Transition governance was adopted as the frame of reference for innovation policy; hundreds of transition experiments have been funded and extensive learning has occurred	Long-term commitment to a low-carbon economy embedded in a legal framework with clear targets and responsibilities
<i>Success factors</i>	A process of cumulative causation has been put into motion by the adoption of the EEG with institutional change, market formation, entry of new firms and the strengthening and formation of advocacy coalitions as main constituent parts	Promoting the acceptance of the “transition governance” discourse in “traditional” policy circles based on its complementarity to other goals such as ecological modernization, energy market liberalization and stimulating the knowledge economy	Strong institutional base for supporting the transition to a low carbon economy, including mandatory long-term targets, system of carbon budgets, independent advice and scrutiny
<i>Pitfalls</i>	Managing the costs of RES deployment, especially for households	Colonization of transition governance by vested interests, implying limited impact on mainstream energy policy	Robustness of the climate policy framework when speed of decarbonization lags behind official government targets

Regarding innovation, it is apparent from the country case studies that the low-carbon innovation agenda is predominantly “framed” in terms of technological progress, the creation of new jobs and markets, the growth of competitive businesses (allowing a country or region to take advantageous positions in the low-carbon economy of the future), and general prosperity. Therefore, this can be seen as a “robust” strategy for building strong alliances. It fits into a ruling paradigm of “technological innovation” as an incremental optimization process; an indispensable asset. However, if we are to move towards a low-carbon society, genuine “system innovation” will be the word of order. Technological as well as social innovations will be needed, allowing individuals, families, and communities to flourish without imposing undue stress on the global environment. New low-carbon social practices—sometimes but not always involving new technologies—are emerging in localised niches. Examples include grassroots action on climate change (e.g., the Transition Towns movement originating in the UK), social innovation in work places (stimulated by, e.g., regulatory pressures or corporate social responsibility strategies), wind energy cooperatives, or community sustainability initiatives [61]. The distance of these social innovations from the established power structures however make these innovations less visible and hence also less supported. In addition, these initiatives come in non-commoditised form, which fits less well with mainstream, market-oriented ways of diffusing new ideas across society. Furthermore, social innovations do not lend themselves well to the cost-benefit analysis schemes, which usually inform choices of the public policy instruments used in climate mitigation strategies. For all of these reasons, social innovations—especially those not involving new technologies—often find it hard to get political, financial or institutional support. For instance, even though the Dutch theoretical transition discourse explicitly takes social innovation in account; in practice, it proved to be difficult to retain this focus against the forces in the Netherlands pushing for “clearly demonstrable technological progress”. Further research should, hence, point out how transition governance practices could actually stimulate social (behavioral) innovations in “real” political settings. Some promising ideas could be extend the idea of creating protected niches for technological experimentation to policies [62] or technologies and forms of social organization together [63].

Thus far, we have established that state institutions will have a crucial role to play in transition governance. However, one should not be naïve about what governments can and are prepared to do. They are bound by internal and external structural factors that make it difficult for them to be the key change agents that they need to be. To achieve far-reaching changes requires strong and consistent public support (translated in a cross-party consensus on the need for an energy transition), interest and understanding, self-directed change in many domains of society, and collaboration among diverse social actors (*cf.* Germany in particular). Societal involvement and engagement processes are a necessary feature of transition governance. Of course, governments cannot create social movements but they can recognise and help stimulate wider social change in a number of ways:

- In promoting and stimulating local or regional initiatives (drawing on resources of regional/local identification);
- In stimulating wider involvement in the actual practice of conducting transition experiments;
- In stimulating the actual practice of building coalitions around technological options for transition paths (e.g., the German RES policy design);

- In allowing stakeholder input into the formulation of concrete measures for initiating a transition;
- In setting up multi-stakeholder processes for developing scenarios, pathways, and visions.

Important research contributions to this field from which transition scholars can draw inspiration are [64–66]. Recent contributions are also starting to investigate the role of civil society in sustainability transitions in a systematic way [67,68]; further research to explore the implications of the transition governance framework in relation to civil society actors seems certainly warranted.

Finally, learning/reflexivity are integral parts of energy transition governance frameworks because of the big uncertainties and risks involved in “steering” a crucial societal subsystem in a radically new direction. The case studies have pointed out important learning achievements in individual energy technologies, the design of RES support systems, the functioning of innovation systems, political strategies for setting up energy transition governance frameworks, *etc.* These learning achievements by frontrunners already constitute a valuable resource for other countries following in their steps. Looking ahead however, a full-scale energy transition will increasingly require a coordinated approach at the European level and beyond [69]. Careful long-term infrastructure planning at larger geographic scales than currently practiced at the national scale will be needed, as well as new institutions such as trading mechanisms for renewable energy and international trading in balancing capacity. Thus, the needed learning will not just be derived from experimenting with new technologies to bring their costs down, but in experimenting with them at sufficient scale so as to force the institutional development issues that come with them.

7. Conclusions

For most of the twentieth century the energy sector in developed states was subject to high levels of state control. Even despite an established tendency since the mid-1980s for governments to pull back from direct intervention in energy affairs, energy overall remains among the most densely regulated economic sectors in industrialized countries. Thus, it is crucial to understand the role of governments in the transition to a sustainable energy future. This paper has contributed to this task by giving some indications on how core transition management designs can be implemented in actual policy making. The cases investigated suggest a need for a clear strategic vision and planning from central governments addressing all relevant policy areas (not just innovation policy) (*cf.* the UK and Germany, with the Netherlands acting as a counter-example). In particular, governments need to show that they are credibly committed to the long-term visions they set out. Precisely because processes of long-term structural change are rife with uncertainty, societal actors (such as firms and households) need to be relatively sure of the basic direction of government policy in the coming years/decades. This can be achieved by relying on (or even creating) constituencies with an established interest and enough political clout in keeping the energy transition on track (e.g., civil society movements, scientific committees, ethical committees, advocacy coalitions supporting technological pathways, *etc.*). Target setting is the preferred strategy to link long-term visions with short(er)-term agendas and/or to distribute responsibilities over government departments (*cf.* the UK carbon budget system). However, target-setting alone will not suffice to “steer” investment decisions in the appropriate direction: in particular, the coherence of policy implementation (e.g., RES support schemes, infrastructure planning, energy market regulation, *etc.*) with the overall energy transition goals needs to be ensured,

increasingly also at the European level. In addition, innovation policy needs to be an integral part of the energy transition governance framework, stimulating R&D over decade-long development cycles rather than just the sequential launching of promising technological options, based on short-term profit calculations and business interests. Finally, the social aspect of “socio”-technical innovations has so far been largely neglected. The transition management model developed by Dutch scholars is in theory very attentive to this, though its application in practice was found to be deficient in this precise aspect. Transition scholars can however not be blamed for this, since the political circumstances in the Netherlands were found to be challenging (to say the least). The German context however shows great promise for framing the energy transition as a collective endeavor (*cf.* the work of the Ethics Commission). In view of the vital importance of securing societal support for the energy transition in the coming decades (when the full implications of this transition will become visible), further research should bring together the most advanced theoretical understanding on civil society’s role in the energy transition (including the state’s role in mobilizing this potential) with the most advanced “social experiments”—wherever they might be situated.

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Author Contributions

Each co-author contributed equally to the reported research in terms of conception and design, acquisition and analysis and interpretation of data. The corresponding author was the main responsible for drafting and revising the article. All authors contributed to the final approval of the version to be published of the paper.

Conflicts of Interest

The authors declare no conflict of interest.

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