Chapter 9
New Governance Challenges and Conflicts of the Energy Transition: Renewable Electricity Generation and Transmission as Contested Socio-technical Options

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9.1 Introduction

Countries around the world are currently going through an energy transition. In Europe this implies the move from large-scale electricity generation based to a great extent on imported fossil fuels to renewable, mostly locally available energy sources. The exact structure or design of this transition remains open and contested, however. This energy transition is mainly driven by two policy goals: the massive reduction of greenhouse gas emissions according to national and international climate policy regimes, and national and European energy security goals.

The UNFCCC Paris Agreement (enforced in November 2016) limits the acceptable degree of global warming to 1.5–2 °C. This internationally binding goal implies a reduction of global GHG emissions by at least 80% until 2050 compared to 1990 (Kunreuther et al. 2014; GEA 2012; COM 2014). The almost complete decarbonisation of the world economy has clear implications for the European power sector and by itself asks for a massive increase in renewable energy sources (RES). These ambitious climate policy goals are reinforced by energy security goals, leading to a shift away from imported fossil fuel sources, especially from politically 'instable' regions, mainly towards domestically available renewable

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energy sources. In addition to their regional/local availability, these sources offer the advantage of affordable costs, at least in the middle term (Yergin 2006).[1]

While climate and energy security goals drive the rise of renewable energy sources (RES), it is by no means clear what exactly will be the sustainable energy system structure of the future, and how the transition process to this sustainable structure will be managed and governed. The European electricity system that has evolved roughly during the past century is mainly coined by centralized structures of generation and distribution, together with a decentralized landscape of electricity consumption, embedded into a favourable setting of political and jurisdictional institutions at national and European levels. Other than fossil fuel based systems, RES based generation and distribution systems offer the *option* of much more decentralized solutions, with major implications for spatial location, cost structures, and revenue distributions. At the same time, RES can also be integrated into the existing, mainly centralized system. So the question arises, how a future electricity system might look like, not only technologically, but also institutionally.

This chapter tries to answer the question of how a sustainable electricity system, coined by a high share of RES, might look like, and what new types of conflicts may rise from this transition process. We will do so by following an idealized—and thus simplified—polarity between a centralized and a decentralized set-up (explained in more detail in Sects. 9.2 and 9.3). We will illustrate the decisions needed and the conflicts involved with case studies from Germany, Austria, and Europe and use China as a non-European reference case (Sect. 9.4).

Together these cases should illustrate a major conclusion of this chapter: While energy systems—for various reasons—need to shift towards RES, this energy transition is a major socio-technical change that involves many frictions and conflicts that need new governance modes. In particular, RES open up the option space along the centralized-decentralized polarity. As we will show in the next sections no simple choice can be made here, but rather new combinations of both options will occur, leading to an energy system pattern of higher complexity than we used to know in the past. Exactly this higher complexity of the future energy system—including the emergence of new types of conflicts—defines the needs for new forms of both private and public governance by adaptive and learning institutions.

9.2 The Electricity System as a Strategic Action Field

The transition towards a RES based system fit to meet the energy security and climate change mitigation goals goes well beyond a simple technological change. We conceive that the emergence of RES at scale will lead to a socio-technological

[1]Energy security has been -and continues to be-treated as a national objective and priority. In the EU electricity sector efforts to be as much as possible independent from electricity imports have led to massive investments in national generation capacity. Combined with forecasts overstating future demand this policy goal has resulted in substantial overcapacities.

transition process, which will be combined with a major shift in generation and distribution technologies, business models, governance structures, consumption patterns and related values and worldviews. There are examples in history when such phases of comprehensive economic, technological, cultural and political change, largely created by introduction of new technologies, did affect not only individual niches and sectors but also transformed whole societies. During such processes of changing practices, structural change and exogenous tendencies occur in parallel to each other and may sometimes interact so as to produce non-incremental changes in practices and structures (Grin et al. 2010; WBGU 2011). As in other transition processes in history—e.g. the industrial revolution or the abolition of slavery or the on-going digitalisation—the current energy transition does not run 'smoothly', without conflicts, frictions or backlashes. Quite the opposite: given the broadness (domains) and depth (intensity) of required changes, and the future uncertainties involved, the energy transition towards climate-friendly RES is and will continue to be a process charged with alternative interests and visions, leading to many conflicts on its way. And as there is neither perfect foresight nor anything like a 'blueprint' for it, the energy transition is and will continue to be an open search-and-learning-process, a real-world experiment (Gross and Mautz 2015).

The evolution of energy systems from fossil fuel based to renewable energies can be seen as strategic action fields or arenas, where different individual or corporate social actors, endowed with knowledge and values as well as interests and power compete for the understanding of the situation, legitimate action and organizational survival in the future (Fligstein and McAdam 2011, 2012). Strategic action fields can be more or less dynamic or 'settled'. The energy system for example used to be a rather settled action field during the phase of the dominating fossil-nuclear power mix provided by large producers and transmitters that evolved during the 20th century mainly in the USA and Europe (Hughes 1983, 1987). Large providers, usually either state-based or public limited companies, did generate and distribute fossil or nuclear fuel based electricity to households and firms, often in monopolistic market situations. The high energy density of the energy carriers and conversion technologies involved strictly favoured centralised solutions. At the 'rear end' of the power lines one could find end-consumers of electricity, who did not produce but only use electricity, and who did not have to care about it—except for rare moments of larger energy crises during the 1970s/1980s. Similar structures could be found in the gas and fuel sectors.

The few large actors of the strategic action field in that period, e.g. electricity providers, coal, oil and gas companies, nuclear power utilities can be seen as *incumbents*. Incumbents are those actors who wield disproportionate influence within a field and whose interests and views tend to be heavily reflected in the dominant organisation of the strategic action field. Thus, the purposes of the field are shaped to their interests, the positions in the field are defined by their claims on the lion's share of the resources in the field, the rules tend to favour them, and shared meanings tend to legitimate and support their privileged position within the field. One of the reasons for this privileged position is the fact that government actors, who set the rules for the field, have regarded energy provisioning as a key strategic factor, with large players in centralised systems as an option without alternative. In addition, and in part as a consequence of this strategic 'fit' between government expectations and field structures, large energy providers and their lobby groups did have privileged access to decision makers, influencing their views and actions. This not only holds for interests (e.g. sunk costs), but also for worldviews (values and interpretations of facts and trends). For this reason, traditional energy systems display a significant inertia, leading to path dependencies and carbon lock-ins (Unruh 2000; Unruh and Carillo-Hermosilla 2006), i.e. self-reinforcing techno-institutional complexes based on fossil fuels.

With the emergence of RES, the strategic action field has completely changed and has become increasingly dynamic. New technologies with new ownership options, new players and new governance modes have emerged. Today it has become obvious that these options are associated with specific features and related risks and benefits. With respect to the ongoing transition towards a RES a major cleavage both in discourse and in real system design options is the one between established energy technologies and renewable distributed energy resources technologies.

While in reality the option space is slightly more complex and mixed, for reasons of simplicity—and because the energy policy discourse is structured along these poles—we structure the electricity system according to this polarity. The emergence of RES has broadened the option space of the modern energy system: While the conventional system, based on fossil fuels and nuclear power, was large scale and centralized by nature, some RES are very modular and therefore can both be large scale and centralized as well as very small scale—decentralized. Due to RES the energy system of the future thus has the option and opportunity to integrate both dimensions.

At the core of the electricity system are technological or physical system components for the generation, transmission, storage and consumption of electricity. 'Behind' these technologies we find social actors that develop, own or use them, endowed with different interests and worldviews. In any given point of time these actors do hold specific preferences towards a centralised, monopolistic system based on fossil fuel and nuclear or a system which is more fragmented, largely based on renewable sources and complementary technologies.

The energy transition can be described as a move from fossil to renewable generation technologies, and related transmission, storage and use system components (see Fig. 9.1). At the upper ('fossil') end we find conventional coal, oil or gas fired power plants. They are part of a traditionally centralized system structure, mostly run by large corporations. Nuclear power plants are less carbon intensive, however due to the involved physical and financial risks they are the most centralized system components so far. Following Schmid et al. (2017) we assume that owners of conventional and nuclear power plants are incumbents and favour its structure and ownership to remain centralized. The transmission grid (extra-high voltage) is owned and operated by transmission system operators (TSOs) which are responsible for system stability in their respective region. Historically, these

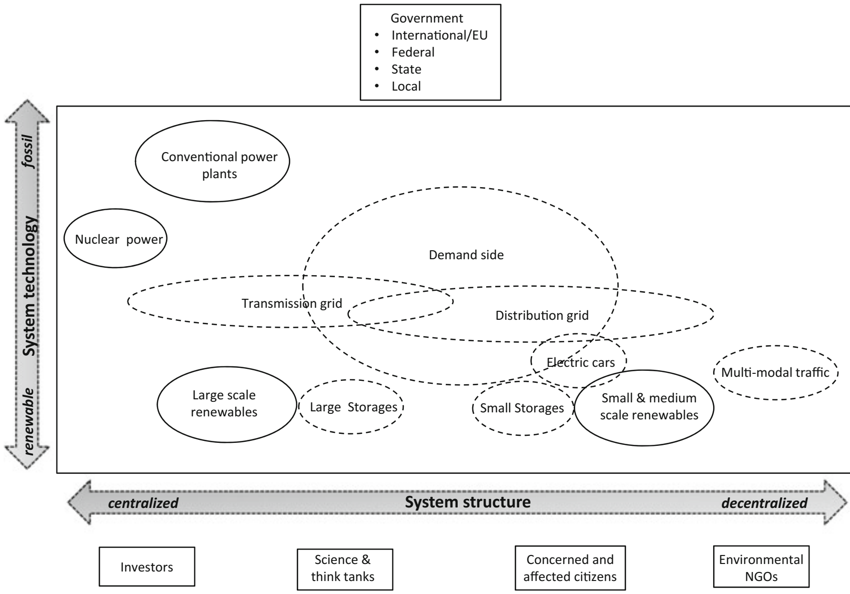

Fig. 9.1 Idealized matrix of the electricity system transition from fossil to renewables (vertical axis) and from centralized to decentralized system structures (horizontal axis). Notes: solid lines = generation; dotted lines = transmission, storage, use

operators emerged from the power plant sector, but have mostly (e.g. in the EU) been separated from it due to market liberalization processes (unbundling). Both for historical and for structural reasons TSOs are incumbent due to their highly regulated and established position, although their role is rapidly changing. We define large-scale renewables as technical devices that generate electricity from renewable energy sources in large quantities per site, typically wind offshore, large onshore wind farms or large photovoltaic (PV) open area parks. Many actors from this field are spin-offs of currently incumbent companies and the general idea of large-scale renewables fits well with existing field rules and ownership structure, at least for the time being.

On the other end of the energy system, we postulate that actors owning small and medium-scale renewables are challengers and require its structure to become decentralized. Small and medium-scale renewables include all technical devices that generate electricity from renewable energy sources in small to medium quantities per site, typically rooftop PV, small to medium-sized onshore wind parks or biomass plants. Their owners often dwell in local or regional proximity and include diverse institutional arrangements ranging from individual households or farmers over collectively organized citizens, e.g. cooperatives, to municipal utilities. Actors from this field are challengers as by the act of generating electricity on the local or regional level they put into question the fundamental field rule that electricity is generated in large-scale units and then distributed hierarchically.

No clear preference with respect to a centralized versus a decentralized structure can be attributed to the demand side, i.e. the sectors agriculture, industry, commercial and service sector, public facilities, private households, and transport. There are some more challenger actors, such as private households preferring green local electricity, or municipal utilities that have the same preference. There is also an increasing number of small and medium size industrial units that are investing in own generation and are slowly shifting their role in the battlefield. However, in the residential sector incumbent basic suppliers currently have market shares of 80% or more. The same openness with respect to the central versus decentral divide holds with respect to storages. Many incumbents hold larger storage capacities, e.g. pumped hydro-storage. Many other storage solutions that would support or complement a decentralized energy system, such as batteries, air pressure or sodium hydrate storage, are still in an early stage of development and penetration.

With the re-emergence of the electric car the electricity system will more and more encompass individual mobility devices which had been external to it due to the coupling of the internal combustion engine to a direct supply with oil products. Electric cars not only consume electricity, they can also serve as storage systems. Their post-fossil potential clearly depends upon the general decarbonisation of the electricity system. Their general fit to a more decentralized energy system will be reinforced if the electric car is not only a substitute for its fossil predecessor.

This core of the electricity system is embedded in a social world of other involved actors that also influence the governance of the system heavily. This clearly holds for the *government* at its various levels: international and national energy and climate change policies, all kinds of electricity market regulation, subsidies for specific technologies, R&D expenditures, incentives, energy fees and taxes, but also process and spatial planning agencies or directives are relevant here. Even at the local level we find governments intervening in the electricity system, e.g. via spatial planning or city owned public utilities. The direction of these various relevant policies with respect to our two axes (fossil/renewable and centralized/decentralized) is not clear or without contradictions yet. This is why we excluded them from the core matrix structure. On the one hand, we find strong government push factors towards decarbonisation (mainly from climate policies). But there are still branches of government or whole governments that favour more or less directly a fossil fuel based energy system. Despite the ambitious climate policy goals of most countries, G-20 countries for example spend more than 440 billion US $ annually as subsidies for fossil fuel production (Bast et al. 2015).

But while governments and electricity system actors are key to the electricity system governance, they do not make it up completely. *Investors* do play a crucial role as well, as they can provide or restrain financial funds for the energy sector.[2] Between 2010 and 2016, for example, investment in renewable energy systems

[2]As we have included the incumbent players, namely large-scale fossil-nuclear providers, to the energy sector itself (box in Fig. 9.1) we include their substantial investment capacities in the sector. Investors as separate actors outside the energy sector thus mainly include large or small scale providers of funds other than traditional energy providers.

accounted for 230–310 billion US $ annually (including asset finance, venture capital, public markets or government spending) (BNEF 2017, 12; Bloomberg new energy finance's NEO 2017). While fossil fuels in 2016 received a funding of about 100 billion US $, and nuclear power of about 40 billion US $, renewables (excluding large hydro) received about 250 billion US $ (BNEF 2017, 34). This actor group is very heterogeneous, as it includes both small, individual investors (such as self-employed professionals) as well as institutional investors, e.g. pension funds. Most investors, especially large and/or institutionalized ones, are only oriented towards their returns and thus only have secondary preferences according to the centralization/decentralization polarity: they prefer whatever kinds of profits look more promising and low-risks. Some actors though, combining profit orientation with energy-policy preferences, do deliberately invest in small projects, e.g. lean toward the decentralized pole. Moreover, increasingly, institutional investors try to channel investments in decarbonised assets, away from coal.

The second actor group that influences the governance of energy systems are environmental NGOs. This heterogeneous actor group covers local and national actors, but also international organizations, such as *Greenpeace, CAN* (*Climate Action Network*) or *WWF*. Their positions towards energy and climate policies not only influence actors from the energy sector, but also governments and citizens. And of course they influence their members' attitudes and investment behaviours. NGOs have even entered the energy sector directly, e.g. by founding renewable energy supplier firms such as *Greenpeace Energy*[3] or facilitating RES procurements for households and small communities such as the Dutch Natuurenmilieu. Despite their heterogeneity in terms of national/international degree of organization, environmental NGOs in general tend to favour decentralized solutions and position themselves strictly against further fossil—and often nuclear—fuel use.

A third group we see as relevant for energy governance are concerned and affected citizens. According to our view, citizens as consumers are part of the energy system (cf. demand side in Fig. 9.1). Consumers react on signals of price and other product/service or provider specifications. But energy systems in general do also have non-market impacts on citizens, e.g. via the environmental effects of their production or transmission portfolio. According to the environmental preferences of citizens, their attitudes do indirectly (mostly via NGOs or governments) influence the policies of energy providers in the system core. A classical case in point would be nuclear power health and environmental risk assessments of citizens. In countries like Germany a high average risk awareness of citizens (and voters) has substantially contributed to the political phase-out of nuclear power. In other countries, where citizens are less sensitive—and thus governments less pressed—nuclear power is still a rather accepted option in the energy sector (e.g. UK and France among others).

Finally, we would like to mention science and think tanks as governance actors. This is mainly due to the fact that climate change, a major driver of restructuring

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[3]In that case we include NGO-founded actors into the energy sector directly.

energy systems and of RES rollout, is a highly scientifically mediated fact. Not only with respect to climate impact assessments, but also—and primarily—with respect to future mitigation scenarios that need to translate acceptable temperature increase goals (such as 'well beyond two degrees' from the 2015 Paris agreement) into ppm-concentration and then total and annual GHG emission budgets and pathways for technologies. This is a complex challenge that requires interdisciplinary cooperation (e.g. climate science, technological expertise, economics, political science etc.) and transdisciplinary skills (e.g. cooperation with business and political stakeholders). While the science system—not only universities, but mainly extra-university research—has developed these skills, many think tanks do provide related data, scenarios and policy recommendations today. Some of them are funded by industries or NGOs, others are independent, but it is not always easy to figure out to what degree. In any case science and climate/energy policy think tanks provide political actors and the general public with analyses and try to influence government actions—and thus must be counted in as energy governance actors. Their preferences with respect to the two axes chosen are heterogeneous.

9.3 Conflicts and Governance of a Renewable Electricity System

Our general observation so far is that the current energy transition is not only an interest-driven and conflict-prone shift from fossil to renewable sources and technologies, but also confronted with a (stylized) choice between a more centralized and a more decentralized electricity system structure. The option space of a renewable electricity system thus has increased, and the technological possibility of sector coupling (indicated by the electric car) reinforces this opening process (Schäfer et al. 2013). We also see structural path-dependencies, and we see incumbent and challenger actor constellations. This almost automatically leads to the question of adequate governance structures that are able to deal with newly emerging conflicts and a necessary reduction of complexity provided by the new option space (Bernhagen et al. 2015).

The term 'governance' has become very popular since the 1990s, reacting upon the growing complexity of decision making processes in modern societies. Many definitions exist. While more conventional ones see 'governance' as an extension of 'government', e.g. as improved coordination of different branches and levels of government, more innovative ones focus on political decision making in general and see government action as a subfield (Ney 2009). Governance is particularly needed because the new option space of renewable energy systems has led to new conflicts with respect to renewable energy systems (cf. Devine-Wright 2011 in the case of wind). RES introduce new technologies, new ownership structures and business models, RES on average have lower energy densities, thus need to occupy more space, which affects the process of RES planning and implementation procedures. On top of that, the general question of how a new energy system with high

Table 9.1 Facet of governance and typical conflicts

Facet of governance	Typical conflict issues
Technology risks	Technology/risk conflicts, human health and environmental impacts
Ownership structure and payoffs	Distribution of economic and other benefits
Spatial location and identity	Spatial distribution conflicts, regional identity conflicts, landscape aesthetics
Procedures and participation	Participation conflicts, procedural justice
System structure	Centralized/decentralized design, type and side-effects of policies

shares of renewables should look like (system structure) moves from the domain of more or less unquestionable niche development towards a societal mainstream issue. All this has led and will continue to lead to new types of conflicts within the emerging energy system of the future (see Table 9.1).

Although the average environmental impact of individual RES technologies (such as a wind turbine or a solar PV panel) is much lower than the one of an individual coal or nuclear power plant, due to their lower energy density and grid expansion requirements, RES in total need more space and thus affect more landscape 'portions' and more people than conventional plants, especially in visual terms. This leads to new conflicts between citizens (e.g. proponents and opponents of wind farms) as well as between citizens and government bodies and project realizers. So the fact that RES has widened the potential group of concerned and affected citizens leads us to include this latter group into the governance structure of modern energy systems. These local conflicts are, however, by no means confined to purely local issues, such as the spatial location and questions of local/regional identity. Protesters as well as supporters also debate about general technology risks, as well as about the general system structure, especially centralization versus decentralization, and about the adequate policy tools (e.g. whether feed-in tariffs are good or bad in general).

Conflicts are no static features of a socio-technical system, but dynamic events between social actors. In order to better understand the nature of new energy system conflicts, we need to briefly conceive how a stakeholder comes to a certain action and enters the action arena. Interests and worldviews are key for action. We assume that actors formulate their interests according to the asset structure they are endowed with at any moment in time, e.g. oil fields, solar power parks or car manufacturing facilities. But it is important to see that while assets *influence* interests, they do not *determine* them. Actors *evaluate* their assets in the light of current, but especially future *options* for their assets, e.g. in terms of market development, regulatory framework or societal values. This evaluation is thus an *interpretation* of the given asset structure by an individual actor (e.g. a firm), in which societal discourses can and do intervene. It is not assets, but interpreted assets that determine the interests of actors. For that reason, the incumbent

—challenger—structure sketched above is in itself a *dynamic* characteristic of a strategic action field. This can be illustrated with respect to climate change: If anthropogenic climate change is a fact, and if avoiding dangerous climate change is a meaningful or even necessary goal, then the de-carbonization of the global economy has to be the answer. This 'scientific' finding does clearly challenge a range of existing practices, routines, business models, and related policies. It does also devaluate—in a very economic sense—formerly very precious assets, such as coal, oil and gas fields. They turn from private goods to public debts. Owners of fossil based assets now have at least two possibilities: neglect the facts, e.g. by undermining the scientific credibility of the diagnosis—which has been chosen by the US oil and car industries in the 1980s and 1990s (McCright and Dunlap 2003)—or accept the facts and try to re-organize the own product portfolio (e.g. by investing in renewables) or strategy (e.g. by planning to buy renewable portfolios in the future). The point we want to make here is: physical asset structures *as such* do not *determine* interests. Interests arise from *interpreted* assets, i.e. from perceptions and expectations with respect to the physical asset, which again is influenced by public discourses (e.g. science, public opinion). This is an important point with respect to change and transitions: actors do not only change their interests and worldviews once their asset base has changed, they can also change the interpretations of their assets—and thus their interests—in the light of new discourses.

Increasing shares of RES challenges the old system, leading to a transition process. It is important to notice that the RES transition is by no means a 'pre-determined' technological evolution, with quasi-inevitable steps, but a contested shift of the strategic action field. Various factors drive this transition, but in an open, often conflicting manner. Electrification of other sectors such mobility and heating add to the already complex environment while providing clear opportunities to both overcapacity in the short term, and to system stability in the medium to long term. And if actors can change their strategies in the light of new discourses, the incumbent-challenger-divide can also 'migrate' into formerly incumbent actors, e.g. by the conflict between different branches of an energy providers.

In the next section we would like to describe the dynamics of the strategic action field by looking at three examples from cases in Germany and Austria as well as the visionary suggestion of a global grid promoted by the president of the Chinese TSO, State Grid of China Corporation. The following case studies show the need for transparent and inclusive participatory governance process, able to address conflicting opinions, develop compromised solutions and shape discourse and decision making processes.

9.4 RES Conflicts at Different Governance Levels—Four Case Studies

9.4.1 Local and Regional Level—Case of Austria

The "***BESTGRID***" project[4] identified concerns from inhabitants and stakeholders regarding deployment of electricity transmission grids in the UK, Belgium and Germany. Looking at these concerns, Komendantova and Battaglini (2016) identified that they are strongly influenced and related to the decision-making process leading to the identification of the need of the project. The results showed that inhabitants are supporting energy transition but they question the need for large-scale infrastructure like the German SuedLink project in light of perceived or documented available alternatives. In particular for SuedLink local opposition against the project was and continues to be supported by some local governments and some—but not all—local organised civil groups and NGOs. Stakeholders demanded procedural justice such as availability of clear and transparent information and timely engagement of local stakeholders in the decision-making processes. Information should be made available for criteria of assessment of alternative solutions such as underground cable. The affected communities and the organised stakeholders also wished to have a better representation of the impacts of the planned electricity transmission infrastructure, which would go beyond the pure economic assessment.

The BESTGRID project developed and implemented new participatory governance measures. Involved stakeholders and inhabitants evaluated them as positive especially because they provided an opportunity for direct and personal dialogue with employees of the transmission systems company. The most of existing participatory governance measures for stakeholders engagement were at the level of tokenism, including different kinds of information events but any feedback from stakeholders had a consultative and non-obligatory character. Actually, tokenism is the most frequent level of stakeholders' engagement into infrastructure projects necessary for energy transition not only in developed but also in developing countries (Xavier et al. 2017). The BESTGRID project showed that solutions could be found to eliminate or minimize impacts of the grids on human health or environment if a fair and transparent engagement process is on place.

In the "***Linking climate change mitigation, energy security and regional development in climate and energy model regions in Austria***" (LINKS) project[5] concerns from inhabitants and organised stakeholders about energy transition in the Austrian Climate and Energy Model (CEM) regions were identified. The results also showed typical level and forms of inhabitants' engagement into decision-making processes at the local level. The actuality of the project is

[4]The project was supported by the Intelligent Energy for Europe Program.

[5]The project was supported by the Austrian Climate Research Program.

explained by the ongoing energy transition in Austria, which is reflected in its target to increase the share of renewable energy sources in gross final energy consumption up to 34% by 2020 (National Renewable Energy Action Plan for Austria 2010). This goal, which was settled at the national level, is implemented at the regional level in frames of the CEM regions, some of those are planning to become energy self-sufficient by 2050 based on locally available renewable energy sources.

The CEM Güssing became well-known in Austria and was promoted as a best practice for other Austrian regions and also abroad. The concept of CEM Güssing is based on synergies between energy security, climate change mitigation and socio-economic development strategies, with an assumption to transform the rural region, which was previously poorly structurally developed, to a flourishing region with the help of investment into renewable energy sources and substitution of energy imports. Currently the region is producing all electricity it needs and several small and medium enterprises were deployed in the region to benefit from the available renewable energy. However, the whole model came to jeopardy with cancellation of subsidies leading finally to the defeat of the major, who was a driving force behind the energy transition, at local elections in 2013. One of the reasons for such development was that the CEM model was settled through top-down decision-making process. Inhabitants were hardly involved and did not feel ownership of this model (TERIM 2014).

Bramreiter et al. (2016) conducted cluster analysis of all existing CEMs in Austria and found that all CEMs could be grouped into three clusters: suburban, semi-rural and rural. The majority of CEMs are rural and are located in the East of Austria. Truger et al. (2016) analysed targets of energy security in the implementation concepts of 94 CEM regions. They find that 26% of all CEMs settled a target to become self-sufficient in electricity and heating energy. However, despite efforts from the Austrian government institutions to stimulate measures of participatory governance, the CEM process is still highly centralised top-down process. The stakeholders mapping and analysis of decision-making processes showed that the mayor and the CEM manager are the driving force behind energy transition. However, at the local level there are measures such as energy groups, where all interested inhabitants in cooperation with organised stakeholders can take decisions about application of national funds for different kinds of energy transition projects (Komendantova et al., in review). Even though, there are different participatory governance measures supported by the national and local government, the majority of them are concentrated at the level of providing information and consultation, showing again a certain degree of tokenism. They include different types of public awareness campaigns such as climate cinemas, special programs for elderly people and young people, newsletters and social media reports curing different types of risk perceptions (Riegler et al. 2017). Except energy groups, all other measures raise awareness about energy transition but they don't allow for involvement of feedback from local people nor for their engagement into decision-making processes. Currently engagement of local people mainly take place through different forms of financial participation and engagement in the decision-making process itself takes place only in one CEM, Freistadt, in the framework of energy groups.

The evaluations among stakeholders conducted in frames of the projects described above showed that energy transition is not a conflict-free process and that there are several opinions and conflicts might arise from differences in these opinions regarding future of energy system.

First, several conflicts are appearing regarding the need and the location of necessary for energy transition infrastructure. In the BESTGRID project the need of large-scale transmission lines was questioned in light of available alternatives. In the LINKS project inhabitants did not question the need of energy transition was not questioned but rather the need of energy independence through renewable energy sources was questioned. The government is trying to address this conflict by providing information about the need of infrastructure or transition process but the results from both projects show that this information campaign is still taking place in frames of DAD and NIMBY concepts. Organised stakeholders and laypeople wish to have more information, going beyond simple arguments for the need. They also wish to have more procedural justice by having a chance to participate in the decision-making process and to provide feedback, which will be heard. Energy groups might be a good practice for stakeholders' involvement but further research is necessary on feasibility of such practice.

Second, conflicts are appearing in opinions among decision-makers at the local and national levels when energy transition becomes a topic for political process going beyond discussion about the need of infrastructure. The recent protests in Bavaria against transmission lines, which were driven by local politicians, are an example of such conflicts. Another example is conflicts against around the costs of energy transition and its economic feasibility in the CEM regions in Austria. The CEM Güssing is an example of such conflicts. Also the factors, outlined above, which drive energy transition and factors of traditional energy system put decision-makers under heavy pressure.

Third, there are conflicts among targets of energy security policy settled at the national level and feasibility of its realization at the local level. For instance, review of energy transition concepts of CEM regions in Austria, conducted by Truger et al. (2016) showed the mismatch between goals of energy independence and available in the region resources to reach it. Some of the regions were claiming to reach 100% renewable energy independence target at the same time as their potentials to reach such target for electricity were not exceeding 40%.

9.4.2 National Level—Case of Germany

The German word for energy transition is *Energiewende*. This term has been used by the federal government in order to label a shift in its energy policy after the Fukushima nuclear power plant accident in spring 2011. But both, the term and the action field it refers to, are much older. They date back to the 1970s and 1980s, when the so-called 'energy crises' led to a re-adjustment of the German energy policy. Due to the uncertain provisioning of oil from OPEC countries, first energy saving acts together with a promotion of nuclear power was put in place. Even some large, experimental wind power facilities got funded, but by and large failed due to technocratic over-ambition. It was again a major political factor that triggered major changes in the German energy policy from the late 1980s onward: The nuclear power plant disaster of Chernobyl in spring 1986 popularised the pre-existing anti-nuclear power movement, inspired grassroots initiatives for renewable energy, brought about (and to parliament) a green party, and started to influence the (energy) political sphere. The upcoming climate change debate, brought about by science, reinforced by the mass media, and taken up by politics, strengthened the political relevance of RES. By the early 1990s, these trends had brought about a critical mass of engaged social activists, scientific experts, business stakeholders, and politicians to craft a new law, the Electricity Feed-in Act from 1990, which was the first green electricity feed-in tariff scheme in the world, offering a state-supported market niche for renewables. This law was passed in parliament by a novel coalition of liberals, green and conservative party members, seizing the opportunities offered by the German reunification and the EU attempts to liberalise energy markets of the time (Lüdeke-Freund and Opel 2014). These first attempts to promote RES have then been reinforced by the red-green government in 2000 with the establishment of the renewable energy sources act (EEG—*Erneuerbare Energien Gesetz*) for government established feed-in tariff for the period of 20 years. This federal law was a major change in the action field, as it provided guarantees for RES provisioning, attracting many individual and corporate investors outside the traditional energy sector. Farmers, cooperatives, small-scale private investors could thus be attracted. Even today, the RES sector in Germany is dominated by small-scale owners/investors, mostly due to the incentives given by the 2002 law.

The red-green government also wanted to phase out nuclear power in Germany, and had already passed a law for that purpose. The 2005 elections however brought a conservative-liberal coalition into power, which did away with that law immediately, clearly representing the interests of the incumbents of the action field, owning large shares of nuclear power next to coal. Interestingly, the nuclear accident of Fukushima made exactly this government change its mind within a few months—most probably driven by the fear to lose federal state elections that were due a few months later that year. Chancellor Merkel clearly felt that her own energy policy would not survive a second Chernobyl in the German public. Together with rather ambitious climate policy goals, the planned phase-out of nuclear power until 2022 left the government with a very ambitious energy policy goal, which could only be achieved by a massive growth of renewables. In 1990, 18·9 billion kWh of renewable based electricity have been produced in Germany, mainly from hydroelectric plants. This figure did rise up to 188 billion kWh in 2016, mainly from wind, biomass and solar PV (FMEE 2016). 35% of the installed capacity is owned by private households, 11% by farmers, only 5% by large energy providers. A policy-led change in the incentive structure has thus led to an energy system with a high share of decentralized systems and incumbent actors.

More renewable energy capacity has led to more citizen protests and conflicts, mainly against wind power plants and grid extension. While the acceptance of the

German *Energiewende* by the general public has been and is very high—93% in 2016 support the further expansion of renewables, with support being higher once people have already been living next to e RES device (REN 2017)—local protests have increased in number and intensity. This constellation has led many observers to adopt the so-called NIMBY (Not In My Back Yard) syndrome as an explanatory figure: people protest against a local project due to egoistic motives (health concerns, property devaluation fears etc.), although they in general accept (and profit from) a quasi-public good such as a renewable energy system. Research in many countries has shown that this analytical figure is much too simplistic (cf. Devine-Wright 2011). It misrepresents the motives and discourses of many protest groups, highlighting not only 'egoistic' interests, but also 'altruistic' ones such as nature conservation issues or landscape aesthetic preferences. We also find that criticism with respect to planning and implementation procedures as well as criticisms towards the technological and political design of the energy transition motivate protesters (Reusswig et al. 2016). This not only means that local RES conflicts are conflicts about the correct (local) interpretation of the common good (and not common good versus private interests) (Hoeft et al. 2017), but also that different, sometimes competing views of a sustainable (environmentally friendly, economically feasible and socially just) energy transition are motivating many protests. More recently, right wing populism has grown also in Germany, and a new populist party (AfD) has been successful in entering local and regional parliaments. The AfD is the first party in Germany that rejects the findings on anthropogenic climate change and deliberately is opposing the German *Energiewende* as a whole. Should the party succeed in getting hold of the local protest movements—which is not the case today—local protests will rapidly spread at the national political level.

While both the 2000 feed-in tariff law and the measures taken in the course of the 2011 *Energiewende* had helped to increase the share of renewables significantly in Germany, the government decided to change the policy design in 2014—partly as a reaction to local protests. From then on, tender offers have replaced the feed-in tariff system, with the result that transactions costs for small actors (e.g. citizen associations) have been rising substantially. This policy change is clearly favouring incumbent over challenger actors and will most probably shift the German RES from a more decentralized to a more centralized system. And this in turn will affect local conflicts. Today, in the rhetoric of many protesters, proponents of RES are profit driven outsiders, despite the mentioned real ownership structure valid for Germany so far (cf. Hoeft et al. 2017; Etscheit 2016). In the future, this polemic rhetoric figure might more and more fit to reality. Taken together with the populist claim that 'true alternatives' which have been concealed from the public are in fact available (e.g. dismantling the energy transition towards RES) the future of the German energy system is open in a new sense.

9.4.3 Continental Level—Case of Desertec and the North Sea Grid

In continental Europe there are two areas that have attracted the attention of supporters of renewable energy sources: the sun rich and vast deserts in the south including neighbouring North African countries and the windy North Seas. Over a decade ago, the publication of several studies supported the idea that the cheapest option to decarbonise the European power system is the build-up of a European grid, which stretches also to North African (see Czisch 2005 among others). However, to access the vast resources new cooperation across border needed to be put in place. Desertec Industrial Initiative (DII), a spin off the DESERTEC Foundation, was set up by large and powerful companies as a legal company based in Germany in 2009. DII intended to contribute in creating a suitable investment environment to develop large-scale renewable power in North Africa and related needed interconnection to export part of the generated power to Europe. The economic power and almost unique level of influence of the involved companies gave the impression that a new strong leader was entering the market and it would be able to overcome many hurdles and political barriers present at the time. Things however turned to be rather different and today DII is no longer active in Europe.

The main principle of the Desertec concept was to integrate all renewable energies in a trans-national Supergrid by using a mix of the most efficient and available renewable energy technologies—concentrated solar power in desert areas, wind in coastal areas, hydro in mountainous regions, as well as photovoltaic, biomass and geothermal—in locations where costs could be reduced thanks to the high geographical potentials and to scale. The electricity generated would then be transmitted and traded across regions over several thousand kilometres of distance using HVDC. According to DII, low carbon electricity from the MENA region could provide up to 15% of the European electricity needs. The level of production costs in the MENA region would have outweighs the low transmission losses of HVDC between the MENA region and Europe (Czisch 2005).

Despite the fact that DII still exists as a company today, its focus and shareholders base have changed substantially. Today DII is concentrating in developing RES projects mainly in the Middle East and in some North African countries; the focus on the European market has been abandoned, at least for the time being. There are many reasons for this change and we do not intend to cover them all. The purpose of the DII example in this paper is to stress that regional collaboration is a great opportunity but it is also very difficult to realise. In the special case of DII, concerns about potential European increased dependency on the MENA region as well as the political instability of the region substantially reduced the implementation of projects and the required investments. Moreover, environmental considerations and fairness issues towards the increasing energy need of the MENA region as well as European local RES generators keen to secure their own market shares further contributed to undermine DII objectives.

In the north of Europe, a series of political initiatives aimed at creating the environment suitable for the exploitation of the abundant wind resources. There is no need here to describe the almost two decade long efforts. We want to rather focus on the most recent developments and the ambitious and innovative proposition of TenneT, the Dutch/German TSO, to build energy islands for an optimal exploitation of wind resources.

Offshore wind costs have decreased substantially in the past 2 years with recent bids well below expectations. For example the award price for Germany subsidy-free offshore wind bids in 2017 has been as low as 0.44 Euro cents per KWh.

While this is a very positive trends, it should however not be neglected that grid connection is a costly additional element, which needs to be taken into consideration. TenneT's vision is to create modular islands of a size of circa 6 km^2 where numerous wind farms with roughly cumulated 30 GW capacity can be connected, instead of having each of them being connected to the mainland grid individually. From the islands the electricity could be transmitted over direct current subsea cables to North Sea countries i.e. the Netherlands, the UK, Belgium, Norway, Germany and Denmark. From there thanks to interconnectors and the European electricity market the electricity can flow across the Union and beyond. To realise such projects, collaboration across the North Sea countries is needed as well as harmonised regulatory regimes. Political leadership remains fundamental, in particular in promoting the need to address energy security at regional level, while overcoming national perspectives. Moreover, a strong collaborative process involved all interested stakeholders, designed to identify challenges and develop approaches to remove or mitigate impacts should be put in place. This will contribute to avoid conflicts at a later stage and delay or destroy the options provided by the TenneT proposal. Why did DII fail—or change its design substantially—while the island vision of TenneT looks quite promising so far? We see four interconnected reasons: (1) DII spans regions/countries that are very heterogeneous in their technological and overall developmental levels, while TenneT's energy islands can be built between countries of similar technological and developmental standards. (2) DII's vision included countries from various political backgrounds, while TenneT's project refers to EU member countries as a coherent institutional context. (3) DII was heavily relying on onshore RES in combination with a long distance grid, the need to transit countries with overhead lines without delivering any evident benefit to the potentially directly affected a large number of people, while the TenneT islands operate offshore in combination with subsea cables, affecting much less people directly. (4) Environmental protection is doubtful in several of the countries covered by the DII visions, while TenneT is carefully addressing the environmental concerns of different stakeholder's groups. (5) Burdens and benefits of the DII vision have been distributed rather unevenly, while TenneT's plan includes a rather even burden-benefit sharing between countries.

The planet as a whole is more looking like the DII than the TenneT 'world': uneven or heterogeneous in terms of technology, economic development, political institutions and benefit-creating opportunity structures. What do the success of TenneT and the failure of DII tell us with respect to a future global energy system? Before we try to answer this question we would like to add one more case: China's energy and climate policy and its global grid visions.

9.4.4 Global Level—Case of China's Climate Policy and Its Global Grid Vision

As a huge and economically growing country, China has been grappling with its energy system in general and the extension of its power grid in particular for quite some time. But also in China the transformative power of the two drivers of an energy transition—climate change and energy security—can be felt. China's greenhouse gas emissions, traditionally dominate by coal emissions from electric power plants, have been stagnating or even declining in 2016 for the third year in a row. Observers discuss the possibility that China might have reached its emission peak well before 2030, the year that the Chinese government had promised to do so during the 2009 UNFCCC conference in Copenhagen. China has meanwhile ratified the Paris Agreement on climate change, and its Nationally Determined Contributions (NDCs) include a promise to peak CO_2 emissions latest by 2030 (no new goal, but may be outdated), a share of non-fossil fuels of 20% by 2020, a reduction of the carbon intensity of its economy by 60–65% by 2030 (base year: 2005), and a substantial increase of carbon sinks, mainly due to reforestation (CAT 2017). After US President Trump had announced the intention of his government to withdraw from the Paris Agreement, the Chinese government was among those to complain publicly about this step, arguing in favor of the benefits of both a national and a global de-carbonization of the economy.

A few years back, China operated as a clear incumbent in the energy domain: rejecting any climate change responsibilities as a developing country, and defending its massive use of coal. We would like to briefly note the facets and reasons for this change of policy before we look into the Chinese power grid plans in more detail.

China's cities—home to more than 750 million people—are severely suffering from air pollution, mainly due to coal fired power plants and traffic emissions. According to some reports, 1·6 million people are killed annually due to air pollution. Chinese cities have been among the first political entities to ask for and implement counter measures, with RES as a core option. The negative environmental side-effects of fossil fuel based energy and traffic systems are primarily felt in Chinese cities, affecting the interpretation of their physical asset structure, leading to a re-definition of the public interest.

As part of its industrial modernization strategy, China has built up an impressive technological and industry capacity for RES production. It is home to five of the top six solar panel manufacturers and five of the top 10 wind turbine makers. Chinese investments in RES have been the highest in the world (88 billion US $ in 2016)

(BNEF 2017). The positive economic side-effects of the growing renewable asset structure (RES industrial capacities) is leading to a re-definition of the national interest.

After having experimented with regional emissions trading schemes, the Chinese government is planning to implement a nation-wide carbon trading system later in 2017. While China is not accepting any direct (external) intervention into its climate policy, it has set up regional carbon market experiments and tries to upscale them at a national level.

China is also establishing new financial instruments to finance a low carbon transition, including green bonds markets or a mandatory disclosure of climate-related financial risks.

China is also active in foreign markets, especially in other developing countries in Asia and Africa. In 2016, a record of 32 billion US $ have been invested on renewable projects abroad. This underlines how RES have become part of China's overall strategy to become an industrial leader, challenging others.

While coal is still the dominant energy source in China today, we have seen a rapid upswing of RES and a change in climate and energy policy positions both domestically and at the international level. Other than the US government, the Chinese government seems to believe in the future opportunities of RES, not only for the sake of the global climate, but also for reasons of vulnerability reduction, public health, and industry policy. RES has become an issue of competitiveness in China.

This is also clearly visible in China's recent plans for a global grid. The State Grid Corporation of China's Chairman Mr. Liu Zhenya started to promote the plan of the global grid in his book Global Energy Interconnection (2015). Mr. Zhenya believes that this plan will help to mitigate climate change, to create millions of jobs and to bring peace to the world by 2050. The State Grid Corporation operates the majority of the Chinese grids, including all voltage levels. With more than 1.3 million employees, it is one of the largest employers globally. Following this plan already since 2014, China spent $65 billion on upgrading of its high-voltage lines (Bloomberg new energy finance, 2016).

The global grid vision is to connect different regions with high-voltage direct current (HVDC) and ultra-high-voltage direct current (UHVDC) lines across the world to harness wind from the poles and sun from the deserts. While this global 'masterplan' may sound unrealistic or even presumptuous, the vision behind it is based on realistic technical capabilities and considerations, which make it feasible from a technical point of view.

There are many advantages of this super-global grid vision such as deployment of RES where they are most abundant, optimization of the costs of RES generation and possibility to use the grid to smoothen variability over large distances and dispersed geographical locations. As RES are available at different locations at different periods of the day, the global grid will facilitate electricity to flow day and night independently from local weather conditions. Moreover, HVDC technologies have been increasingly deployed in areas where large generation sites, such as hydroelectrical dams in Africa, are generally located far away from consumption centres. Also direct current (DC) technologies offer technical advantages over the more widely used alternative current (AC) lines. These advantages include low, in comparison to AC, transmission losses over long distance transmission. These DC grids are also known as “supergrids”.

Despite its utopic character the global grid vision has potentials to become real. Supporters of large scale RES generation already advocated for building a Supergrid across Europe as an overlay to the existing one. The concept of Supergrid is already known in Europe; it became an important topic in relation to exploitation of wind resources in the North Seas and was strongly pushed by Friends of the Supergrid, an organisation promoting offshore expansion. Moreover, it should be noticed that the majority of cross borders interconnectors are using the HVDC technologies. Also more DC lines will be constructed or upgraded from AC to DC lines to accommodate growing volumes of wind electricity generation. The State Grid Corporation is already bidding for electricity assets, where there are opportunities, to diversify their portfolio. Such acquisition of assets around the globe is a fundamental element to achieve the global grid vision. Cooperation already exists with Italian, Portuguese, Brazilian, Philippines and Australian companies and they are the main shareholders of today’s DII.

However, the political feasibility to realize this vision is very difficult. There are several geopolitical hurdles, which are driven by the risk perception of the dominance of China in strategically important critical infrastructure. Attempts of China’s investors to purchase critical assets are often seen controversial and not always successful, despite high bids. Moreover, a global grid implies a completely new definition of energy security, which should be achieved in a fair and non-discriminatory way at the global level. The trust required to achieve this new approach to energy security across countries is enormous; it is often conflicting with our history and current political controversies. Even within the European Union and the US energy security remains a national/state objective. Despite existing technical capabilities, it will take decades to develop a new governance framework, which would be needed for such transboundary infrastructure. In Chairman Liu promotion book for this vision he describes that there would be no central power distributing authority but rather an Internet-like smart grid that would distribute power as needed. The question about the financing of the grid also remains open especially in view of the fact that costs allocations may not generally match benefits. Already today public and social opposition for electricity transmission infrastructure is dramatically slowing down realization of projects in Europe as well as in several world regions. Lack of acceptance and related delays are increasingly a global problem, it raise the question about the ability of policy makers to pursue the realization of any mega-large project. While public opposition has become a well-known phenomenon in Europe and in other Western economies and efforts are put in place to deal with it in a constructive and inclusive way, in the rest of the world it is often not understood and usually ignored, thus causing increasing conflicts both at local and national level. Taken into consideration existing fierce opposition on the ground against electricity infrastructure projects, a significant risk exists that severe social and political conflicts may further increase, making the realization of this vision impossible. The fact that the Chinese political system is not well prepared when it comes to deal constructively with civil protest and opposition additionally burdens its capability of designing a global grid.

9.5 Discussion and Conclusion: The SuperSmart-Grid as a Concept to Overcome the Centralised-Decentralised Divide

The emergence of RES has opened up the option space for energy systems—they can become (much) more decentralized in technological and economic terms. Next to technological changes this widening of the energy system option space has been driven by social movements and by regulatory decisions of governments. Today, virtually all countries are more or less intensely confronted with the opportunities and risks of this widened option space. This technological option space is ‘populated’—and driven—by energy system actors that follow their interests and worldviews. We have characterized them by using the incumbent-challenger-distinction from the theory of action fields. While many grassroots activists and sympathizing think-tanks clearly favour decentralized solutions with today’s challengers as the future incumbents, the traditional large energy providers and still many government actors seem to favour a centralized solution with today’s incumbents staying in place. Their willingness and ability to rapidly decarbonize remains doubtful, although some of them have started to diversify their assets and invest heavily in RES, and especially large-scale renewables have experienced a substantial boost under their hands.

Our short digression into the nexus between assets, interpretations and interests has shown that actors can change their interests despite of an unchanged asset structure—just because they interpret the future options of their assets differently due to changed discourses and regulations. This does also hold for nations, as our example of the changing position of China’s energy and climate policies should illustrate. The recent slow-down of RES growth in Germany shows, on the other hand, that incumbent actors do still dispose of sufficient power to ‘smoothen’ or ‘stretch’ the necessary transition process towards RES. The contrasting fate of DII versus TenneT’s energy islands reminds us that a more electrified and renewable energy future needs a careful design of its integrating grid, taking into account the heterogeneity of technologies, institutions, and fair burden sharing.

In order to limit global warming to under 2°, urgent measures are required to move towards low carbon energy generation. This requires a significant acceleration in the growth of RES. Additionally, the goals of European energy security policy require diversification of energy supply, including a greater use of domestic renewable resources that are both decentralised and at scale. In this context, the two goals are strongly related to each other and their success depends on the ability and willingness to pursue them in parallel in a coherent and visionary way. In order to guarantee an efficient, economic and socially acceptable energy transition, the growth of RES will have to include both large and small-scale electricity generation, the use of all distributed resources, and the participation of all interested actors.

In our view, the future of the energy system with respect to its structure will not be one of *either* centralized *or* decentralized. Instead, we will most probably see a mix of both options. Large and small scale renewables are a reality even today, the same holds for storage systems and the distribution of 'prosumers' at the (former) demand side. The very nature of RES allows for a combination of centralized and decentralized systems, according to local energy availability, technology and ownership structures. Accordingly, the incumbent—challenger—dichotomy will be realized in a multitude of energy actors in the field. While centralized fossil actors will—hopefully very rapidly—vanish from the scene, a shift in political regulations and societal discourses will probably have a double effect: (1) Former incumbents will add 'challenger' branches, over time change their views and interests, and at the end of the day shift their asset structure towards RES. (2) New, rather decentralized actors will continue to enter the arena, challenging less the technology but more the business models of the more centralized (former) incumbents. It will heavily depend upon the governance process of the energy transition towards RES to find out whether these changes will happen fast enough compared to climate policy goals.

If our analysis is correct, two trends will become clearly visible in the future: (1) The RES based energy system of the future will be *more*, not less complex than the one we have now. Given the dynamic interplay between assets, interests and worldviews we will probably not witness a simple 'phasing out' of former incumbent actors, but rather their attempt to change their asset structure, may be accompanied by some attempts to slow down processes in order to buy time—time that the climate system may or may not have. In any case the RES action arena will be populated by a heterogeneous mix of actors, leading to more instead of less complexity ad competing interests within single organisations. (2) A second trend that we believe to be obvious is the increase in energy related conflicts in the future. Due to their lower energy density, RES systems and their grid connection will affect more space and people than the fossil-nuclear system of the past. As the NIMBY interpretation falls short in explaining these conflicts, a more even distribution of (monetary) benefits from RES will not be sufficient.

This double diagnosis raises the question: How can a more complex and conflict-prone energy system best be governed?

Purely technological changes will not be sufficient. We have seen that energy conflicts arise from RES systems and related grid extensions. It is not by accident that the Chinese proposition for a global grid does severely underrate this issue—a country where civil protesters are not tolerated can hardly deliver a blueprint for how to deal with growing RES conflicts. But how can it be done then?

Given the heterogeneous reasons for conflicts (cf. Sect. 9.3) one would also have to deal with questions of location and local identity, of procedures and participation, and of societal benefits (payoffs). It is less for egoistic reasons that people protest against wind parks or grid extensions, although they play a role (and should not be blamed, especially in an egoistic society). In their self-perception, protesters act as advocates of the common good—or at least their interpretation of it. We thus need a much more elaborated discourse on the common good and heterogeneous interpretation of it. While many active protesters would not accept personal benefits from a disliked project, the often undecided local majority would appreciate regional benefits—especially in less densely populated, often marginal regions.

In order to meet objections against the fairness of procedures preceding a project approval, we need transparent and fair processes of citizen participation. This has to go beyond existing forms of formal participation which usually come late and get access only to a narrowly defined group of potential opponents. Also the scope of existing procedures needs to be expanded. This requires the establishment of regional and national discourse spaces and professional agencies that can impartially manage such discourses. People should be both invited and empowered to discuss their regional energy futures, the option space and the benefit-burden-sharing associated with it. The more regionally available challenger actors (or regionally active incumbent ones) there are, the higher the probability that local actors are among the beneficiaries of the energy transition.

However we will also need a clear understanding of the democratic character of energy related decisions, i.e. that discourses can be open and long, but decisions have to be taken, they can be taken based on a majority vote (instead of a consensus of all), and that decisions are binding even for opponents—at least for a given period. If designed well, such processes of organizing the energy future at a regional or national scale can be linked together.

The failure of DII as well as the critical aspects of Chinese super grid plans show that a technologically feasible and economically well-calculated global master plan will not be sufficient. We will need a virtually global grid that is able to combine distributed small and large-scale resources and will thus allow the optimisation of the usage of local resources whilst ensuring a secure and flexible electricity system.

Such an integration of RES into the European electricity system—as well the electricity system of any other region—requires the existing grid to be upgraded. This includes new projects and the improvement of existing infrastructure, as well as the deployment of new technologies to increase automation and make the entire system smarter.

Such developments would allow the electricity grid to connect millions of new small generation units to large remote generation and distant load areas to fully satisfy demand independently from local resources and generation capacity. This would enable the decarbonisation across regions in the most economically efficient way.

In order to achieve such efficiencies on the scale required, what we call a SuperSmart-Grid is needed. A Supergrid, which is large enough to connect different world regions via high voltage direct current (HVDC) technologies, will enable access to RES where they are most abundant and to balance variability over large geographies. A Smart grid, supported by digitalised, automated advanced features, intelligent and able to safely integrate millions of small and large prosumers, will enable optimal utilisation of local resources while bringing the safety elements to island the local grid in case of need. When complemented by a favourable market design, existing technologies can deliver the required decarbonisation targets in the electrified system. The technical ability, still to be further developed, to islands grids—and connect them again—will be fundamental to move towards an electricity system which is stretching over continents as promoted by Mr. Liu Zhena. This will provide the security features required to maintain reliability of the system also in case of disruption. Of course, further considerations need to be made with regard to generation strategic reserves.

Such a SuperSmart Grid is a very powerful approach supported by sound ongoing technological development. It will require maintenance, control and inclusion.

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