HEINRICH BÖLL STIFTUNG

A EUROPEAN UNION FOR RENEWABLE ENERGY –

POLICY OPTIONS FOR BETTER GRIDS AND SUPPORT SCHEMES

By Sascha Müller-Kraenner and Susanne Langsdorf

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Edited by Silvia Brugger

*The present paper is the outcome of a series of expert meetings. It was written jointly, with verbal and written commentary over the course of several sessions, and with individual contributions by the experts Bas Eickhout, Daniel Fürstenwerth, Frede Hvelplund, Katja Rottmann, David Toke, Claude Turmes, Andreas Wagner and Paul Wilczek. Consequently, not every point made in this paper necessarily represents the opinion of all members of this working group. Oliver Geden, Helmuth-M. Groscurth, Rainer Hinrichs-Rahlwes, Martin Kremer, Oliver Krischer, Christine Lucha, Karsten Neuhoff, Lutz Nothbaum, Fabian Pause, Raffaele Piria, Mario Ragwitz, Gustav Resch, Michaele Schreyer, Stephan Sina and Frauke Thies also made valuable contributions.

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FOREWORD

The European Union needs a common vision for the future of its energy supply. Such a vision should be based on the principle of sustainability and must respond to the urgency of climate change. Some Member States have decided to phase out nuclear power and to accelerate the deployment of renewable energy sources. At the same time, others intend to build new nuclear power plants, are proclaiming a new golden age of gas or are pinning their hopes on carbon capture and storage technology (CCS).

EU Member States have the right to determine their own energy mix as foreseen by the Lisbon Treaty. However, the cross-border impacts of individual decisions made by Member States underline the need for more coordination of energy mix choices at a European level. The European Commission has made attempts to 'Europeanise' national energy policies and is exploring long-term scenarios for the European energy future in order to pursue the common goals of security of supply, competitiveness and sustainability. But given the different energy pathways that are currently being pursued at the national level, and without a common vision for the energy mix of the future, such proposals remain without substance.

The Heinrich Böll Foundation, in its proposal for a European Community for Renewable Energy (ERENE),[1] argues for a transition to 100 per cent renewables by 2050. Numerous studies show that such a transition is not only feasible but that there are also multiple economic and societal reasons for completely covering European electricity needs through renewable energy sources. These include benefits in terms of global competiveness, security of supply and employment.

In order to stimulate debate about the future of renewables in Europe at both EU and Member States level, the Heinrich Böll Foundation's European Union Office organised a series of expert meetings focusing on two key areas: grids, and support and remuneration schemes for renewables. The meetings took place in Brussels, an important but by no means the only location where the future of renewables in Europe will be shaped. This publication is the result of these expert meetings and comprises the individual contributions and reflections of the members of the working group. We want to open and encourage a Europe-wide debate which takes specific national and local conditions into account, while at the same time bringing in the European dimension.

We would like to express our thanks and gratitude to all the participants for the time and knowledge they have invested in this project, and for their commitment. We know they will continue to contribute to this debate. We would especially like to thank Sascha Müller-Kraenner for leading and moderating the expert meetings, as well as Susanne Langsdorf for channelling the results of the expert discussions into a coherent report. We look forward to a fruitful debate on a European Union for Renewable Energy.

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1 Heinrich-Böll-Stiftung (ed.): ERENE – European Community for Renewable Energy. A feasibility study by Michaele Schreyer and Lutz Mez, Berlin 2008, http://www.boell.de/downloads/ERENE-engl-i.pdf

THE ENERGY TRANSITION – CHALLENGES AND OPPORTUNITIES

By Franz Untersteller, Minister of the Environment, Climate Protection and the Energy Sector, Baden-Württemberg

As a result of the Fukushima nuclear disaster at the beginning of 2011 and against the backdrop of the continuing warming of the Earth's atmosphere, climate and energy policies stand more than ever at the centre of both public interest and political discussions – also and especially at the European level.

The green/red state government of Baden-Württemberg has set itself ambitious goals in the fields of climate and energy policy. We will actively push forward the *Energiewende* – the energy transition – which was also agreed upon by the federal government and is based on a broad social consensus.

The decision to phase out nuclear power, the demands of climate protection and the limited availability of fossil fuels demonstrate that over the long term there is no reasonable alternative to a shift to renewable energy sources. The state of Baden-Württemberg is meeting this challenge with the aim of advancing the restructuring of the energy supply in a timely and consistent fashion.

The proportion of renewable energy that makes up Baden-Württemberg's total energy supply is increasing year on year. The pace of growth is remarkable, particularly in the electricity sector. In 2011, renewable energy already made up 19 per cent of gross electricity generation. The green-red state government has set itself the goal of raising the share of renewable energy in this sector to at least 38 per cent by the year 2020.

Aside from CO_2 reductions, a secure and economical energy supply is of the greatest importance to both Baden-Württemberg, one of Germany's leading industrial regions, and to me personally in my capacity as Minister of the Environment, Climate Protection and the Energy Sector. With every political action, we must take care to ensure that a balanced approach is taken to the three primary energy policy objectives – environmental sustainability, security of supply and affordable energy prices – and that discussions remain free of the usual energy policy dogmas.

The phasing out of nuclear energy and the rapid expansion of renewable energy place new demands on energy supply systems and the associated infrastructure. Given the fluctuating supply from renewable energy sources and with it the increasingly unstable but also indispensable balance between supply and demand, we must direct our attention to answers that are not only intelligent but also marketable. The rapid expansion of electricity grids is therefore vital. The existing distribution networks should also be expanded and further developed into intelligent energy networks – the so-called 'Smart Grids.' Such systems require the integration of additional capacity, namely storage and controllable loads. In addition, we must ensure in the future that, in times of low supply from renewable sources, conventional power plants with the necessary highly flexible generation capabilities are available to cover energy demand.

The restructuring of the energy supply system is, however, not a task that can be undertaken by government alone; it calls for the constructive cooperation of all stakeholders, from companies to individual citizens. Through our actions, each of us can contribute to the success of the *Energiewende*. The local level – cities and communities – is also an important partner in the implementation of the *Energiewende* and in the expansion of decentralized power generation. It is clear to me that good energy policies grow from the bottom up. In Baden-Württemberg, we rely on the willingness of society to achieve the *Energiewende* together.

The *Energiewende* represents a major economic opportunity. In Baden-Württemberg alone, more than 40,000 people are already employed in the renewable energy sector. And in 2010, around 3.4 billion euros were invested in new facilities related to renewable energy in the state.

The transition to renewable energy also offers significant opportunities in the field of research. Charged not only with the task of accelerating the transition from fossil fuels and nuclear power to renewable energy, research also provides industry with the necessary basis to allow it to play a leading international role in the field of the new energy economy in the years and decades to come.

The same also applies to two fields that are essential for the success of the *Energiewende*: energy efficiency and energy conservation. A sustainable energy supply based on renewable energy can only be achieved through the exploitation of the significant potential for energy saving and increased efficiency to be found in the generation and distribution of energy. There are major energy reserves in the building stock in particular – herein also lie opportunities for the economy and for research.

I am convinced that the *Energiewende* can succeed. It is also clear to me that the necessary conditions must be created in order for it to do so – at a European as well as at national and regional levels. I am therefore following the European-level discussion with great interest and am sure that the present publication by the Heinrich Böll Foundation can make a valuable contribution to this.

Franz Untersteller,
Minister of the Environment,
Climate Protection and
the Energy Sector, Baden-Württemberg

PREFACE

When combined with energy conservation, Europe can cover all of its electricity needs using renewable sources of energy. In order to convince governments, businesses and European citizens to support that shift, however, it is necessary to demonstrate the practical feasibility of the vision.

The transition must take place in a way that is both technically sound and socially and economically feasible so that the current dependency on energy imports can be reduced and energy security be further increased. The decision-making process on the road to Europe's energy future must be open to all stakeholders, transparent to the public and follow democratic procedures.

The Heinrich-Böll-Stiftung has long argued for the vision of a European Community for Renewable Energy (ERENE). ERENE would provide the institutional framework for Europe-wide policies to support renewable energy.

This debate gained new impetus and a renewed focus when, in spring 2011, the German government announced the '*Energiewende*' (energy transition): an accelerated phase-out of nuclear power and its full replacement, over time, by renewable energy.

This report, 'A European Union for Renewable Energy', now looks at concrete policy options for two key areas that will define the future of renewable energy development in Europe: the future of grids and the development of support and remuneration schemes. With regard to grids, it will focus on the decision-making process for electricity grid planning while, at the same time, arguing for the better integration of all energy sectors and thus ultimately all types of grid.[2]

A working group of experts from the European institutions and multiple Member States, as well as the worlds of politics, the renewable energy industry, applied science and civil society, have considered these challenges and produced the report and recommendations below.

The questions posed at the outset included the following:

Which competencies are necessary at the European level to develop grid extensions that would enable the transition to renewable energy sources? How can grids be designed in a way that is compatible with the production of renewables? What kind of support is needed to enhance the transition to renewables in Europe? And how can a European alignment of support and remuneration schemes increase the share of renewables while avoiding negative effects on producers, consumers and taxpayers?

The working group focused on the practical vision of 100 per cent renewables for the electricity sector. This would only constitute a first step, however; the transition of our energy system requires the strong integration of all energy markets – electricity, heating, cooling and transport. Perhaps paradoxically, focusing on electricity alone lowers the likelihood of achieving 100 per cent renewable energy in this sector, while the integration of all energy sectors increases the likelihood. This example illustrates one of the main challenges in the transformation of the energy system: it is practically impossible to look at one issue in isolation, as the energy system is made up of an array of elements that are interrelated and subject to frequent change.

This report strongly argues for further integration within the energy system. As it cannot cover all energy markets, however, the electricity market remains at the centre of the debate. The report will feed into the ongoing dynamic political debates surrounding support schemes for renewable electricity and grids. Nevertheless, the local integration of electricity into other energy markets remains a major element for the success of Europe in the years to come.

2 These include (district) heating grids and gas grids. As it was not possible for the report to cover all energy sources and their means of transportation due to time and space constraints, the scope of the report is limited to electricity grids.

Equity considerations have not been at the centre of our discussions in this project but deserve increased attention in the near future. We do wish to note, however, that claims that the push for renewables will lead to rising electricity costs, particularly for low-income households, have been proven false: rising consumer prices can be attributed to the increased cost of fossil fuels, rising taxes and higher profit margins for energy companies, among other reasons. Public participation and a democratic discourse on the future of renewable energy in Europe can help to spread the benefits more equally between individuals and communities and thereby increase political as well as economic ownership of the technology and of the policies behind it.

Currently, interest in and support for renewable energy technologies as a mainstream solution for our energy economies as well as for addressing climate change is unevenly spread within the European Union. Some Member States, including Scandinavian Member States, Austria and Germany are strong supporters of the renewable energy vision. These countries have already built a strong industry in that sector which, as a result, has generated strong cross-party political support. The picture in other countries remains mixed, although progress has been made almost everywhere.

Several Member States, including France, still support the nuclear vision. The newly elected French government might, for the first time, slowly reduce the country's dependency on nuclear electricity. This is a unique opportunity to start a discussion with the new French leadership about alternatives to the nuclear pathway. An attractive framework to support renewable energy in a European context would ensure that this does not remain a purely 'Germanic' political and economic vision and would be paramount in convincing the French elite that the renewable pathway is an opportunity rather than a threat to French industrial strength and can help create jobs in a time of crisis.

Certain Central and Eastern European Member States have reacted cautiously to the energy transition in Germany. One question asked is whether the accelerated phase-out of nuclear will lead to increased gas imports, particularly from Russia, with the associated economic and political dependencies. Those concerns can be addressed if Germany's energy transition, as well as ambitious buildout plans for renewables in other Member States, can be anchored in the European energy market, backed up by the appropriate infrastructure.

With economists from the European Investment Bank, as well as others, our working group discussed how renewable energy could become a central pillar of the growth initiatives currently under negotiation. Sustainable growth is not only a challenge for the moment but is likely to remain on the agenda for the next decade or longer. The transition to renewable energy could become a central tenet of the 'Green New Deal' proposed by, among others, the Greens in the European Parliament (EP).

Germany's *Energiewende* was announced at a moment of deep economic and institutional crisis in Europe. A European Union built upon renewable energy supplies could be a positive project to give not only the eurozone but in fact the whole EU a new push for integration. Renewable energy, as well as the related infrastructure, could be a driver for sustainable economic development and job creation, particularly in Europe's currently most economically depressed regions.

While renewable energy is not a panacea to solve all of the world's problems, it remains an indispensable part of a global transformation towards inclusive and sustainable development. At the Rio+20 Conference on Sustainable Development held in June 2012, governments, businesses and civil society representatives from all over the globe took note of the renewable energy revolution underway in Europe, and of Germany's *Energiewende* in particular. This is one of the few areas in which Europe, an ever-smaller economic and political power in a rapidly changing world confronting increasing scarcity, can truly lead and make a valuable contribution for all.

INTRODUCTION

The transition to a European energy system that produces 100 per cent of its electricity from renewable energy by 2050 is possible, on the condition that the necessary investments and adjustments are made.[3] A complete shift in electricity generation is viable even with the technology that exists today, and at costs only slightly higher than under business-as-usual scenarios[4] in the short to mid-term, offering strategic long-term economic and environmental benefits.

The growing dependency on fossil fuel imports is continuing to weaken Europe's economy, distorting the trade balance and negatively impacting public budgets in a time of crisis. EU Member States have to spend more and more on imported fossil fuels and other non-renewable raw materials. This has added considerably to the current budget deficit of some Member States and has thus had a negative impact on the stability of the eurozone.[5] Fossil energy prices will increase over the coming decades due to the massive growth of global energy consumption and the end of the cheap oil era. This affects energy importing countries economically, and also politically: the search for alternative supplies and suppliers recently led the European Parliament down the misguided path of relying on 'new conventional fuels' such as oil sands and shale gas from Canada, the United States, Brazil and the Arctic region, among others. While the shale gas revolution is delivering low gas prices in many parts of the world, it has high environmental costs, and does not change the fact that natural gas is a finite resource. Nuclear energy is one of the most expensive energy sources, with the general public picking up the major share of the bill for the billions spent on nuclear waste transport and storage. Moreover, no insurance company is willing to insure nuclear power stations, leaving society not only with the risk of an accident, but also potentially with all of the associated costs.[6] The only conventional energy source which is still available at a relatively low price is coal, but this has a comparatively low energy value and is the conventional fuel with the worst climatic effects.

Dependency on oil and gas imports from Russia and the Middle East also impact energy security – a major concern, especially for Central and Eastern European Member States. Such dependency also impairs the Union's ability to act as an independent foreign policy actor in regions on which its economy depends.

The EU-27 currently imports more than half of its energy. Without the expansion of renewables, this share is expected to rise further in the future. If implemented in the right way, a greater share of renewable energy will strengthen all of the EU's major energy goals by increasing security of supply at lower prices, fostering the competitiveness of

3 European Climate Foundation: Roadmap 2050: a practical guide to a prosperous, low-carbon Europe. Berlin 2010.
German Advisory Council on Global Change: World in Transition – A Social Contract for Sustainability. Berlin 2011.
Heinrich-Böll-Stiftung: ERENE – European Community for Renewable Energy. Berlin 2008.
Öko-Institut: The Vision Scenario for the European Union, Berlin 2006.
Sachverständigenrat für Umweltfragen (SRU): Wege zur 100% erneuerbaren Stromversorgung, Berlin 2011.
Gregor Czisch: Möglichkeiten des großräumigen (transeuropäischen) Ausgleichs von Schwankungen großer Teile intermittierender Elektrizitätseinspeisungen aus regenerativen Energiequellen in Deutschland im Rahmen einer 100% regenerativen Stromversorgung mit dem Zeithorizont 2050, Berlin 2009.
European Renewable Energy Council (EREC): REthinking 2050. A 100% Renewable Energy Vision for the European Union. Brussels 2010.

4 European Commission: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Energy Roadmap 2050, Brussels, 15.12.2011 (COM(2011) 885 final).

5 Giegold, Sven: Aus der Eurokrise geht es nur mit dem Green New Deal!, Düsseldorf 2012.

6 Symptomatic of the lack of competitiveness of nuclear energy is the debate currently being held in the UK, in which nuclear project developers are openly calling for significantly higher subsidies than those needed to deploy a relatively expensive renewable technology such as offshore wind.

the European economy and facilitating sustainability. Reduced dependency on imports from energy exporting countries – which are often undemocratic and have little respect for human rights – would furthermore improve the political position of the EU Member States.

This report looks at two policy fields that will be defining factors for the smooth transformation to a renewable energy-based system. It provides a collection of policy ideas, for the grid and for remuneration and support schemes in Europe, that are conducive to the achievement of the 100 per cent renewable energy target in the electricity sector by 2050 at the latest as part of the general growing independence from fossil fuels in other energy sectors. The integration of electricity production, transport and storage with the heating and cooling sectors will be paramount to create an integrated, economically feasible and stable system, particularly at the local and regional levels. Transport is the third pillar of this transition, including the potential storage and balancing capabilities of a transport system based on renewable electricity.

Increased energy efficiency and a reduction in overall energy demand are crucial prerequisites for the successful transformation of the energy sector. This report advocates for binding energy efficiency targets and measures for 2020 and 2030.

As a footnote on language, which is of importance for defining the terms of the debate and for setting the right agenda, the authors of this report have decided to use the term 'remuneration and support schemes' as opposed to simply speaking of 'support' for renewable energy. This reflects the fact that renewable energy is no longer a rare and threatened flower that has to be carefully tended and supported (or subsidised); it is the mainstream source of energy for our near future, for which we have to find fair mechanisms of remuneration.

Today is a critical point in time to accelerate the transition to 100 per cent renewable energy in Europe. Around two thirds of all power plants will have to be replaced in the coming years. At the same time, large parts of the European transmission and distribution grid require modernisation or rebuilding and are in need of reinvestment.

With the phase-out of nuclear energy in several European countries, opportunities to replace large quantities of nuclear energy with clean renewables are plentiful. For this to happen, investors need a secure perspective for return on their investments. Investment security and leverage investments in renewables generation and electricity grids will therefore be decisive for the success of the transition. Investment in inflexible power plants, such as nuclear and coal-fired, will hinder the development of renewable energy and lock in conventional fuels for decades to come.

The future system has fundamentally different characteristics to the old fossil fuel baseload systems. The right balance has to be found between the generation capacities of non-variable and variable renewable energy (solar, wind and in the future possibly wave or tidal energy), as well as the flexible resources and technologies needed to balance variable energy. This implies investment in transmission grids and in distribution grids that must become able to integrate a high share of small-scale distributed generation with flexible and responsive demand, as well as distributed storage. It is for this reason that this report does not simply promote measures for the better integration of renewable energy into the existing energy system; instead, it promotes a systemic change to a smart energy system[7] which is able to deliver the flexibility that variable renewable energy needs.

The support of renewable energy and the development of a pan-European electricity grid are at the heart of current European climate and energy politics and are therefore subject to dynamic debates and policy developments. In December 2011, the European Commission adopted the Communication 'Energy Roadmap

7 Lund, Hendrik/ Andersen, Anders N. / Østergaard, Poul Alberg et al.: From electricity smart grids to smart energy systems: A market operation based approach and understanding. In: Energy 42 (2012)1, p. 96-102.

2050'.[8] Two months prior to this, it had published the proposal 'Guidelines for a trans-European energy infrastructure'[9] which aims to ensure that strategic energy networks and storage facilities are completed by 2020. Both publications partly build on the Communication 'A Roadmap for moving to a competitive low carbon economy in 2050',[10] also published by the Commission in 2011, which underlines the EU's climate objectives. These documents, as well as the EC Communication 'Renewable Energy: a major player in the European energy market'[11] from June 2012 work towards supporting the goal of reducing European greenhouse gas emissions to 80 to 95 per cent below 1990 levels by 2050. The broad pictures painted of the decarbonised economy and energy system in the Roadmaps are complemented with more detailed plans related to grid planning.

Germany's *Energiewende* has brought the topic of 'grid extension', formerly restricted to those with expert knowledge of the field, to newspaper front pages. European grid planning is now widely discussed, with the Ten-Year Network Development Plan[12] (TYNDP) of the European Network of Transmission System Operators for Electricity (ENTSO-E) attracting particular interest. At the same time, however, the actors and processes involved in grid planning for the continent are little known outside of the small expert community and the processes of grid planning lack transparency and legitimacy. The current grid planning processes can be improved in order to provide faster, more cost-efficient ways of reaching an electricity system fully based on renewables. The transparency of grid planning processes and civil society participation can be enhanced in order to boost acceptance of renewables generation and grids. This report will identify some of these shortcomings and propose measures to help achieve the right balance between power grids and other flexibility solutions.

The European institutions' framework laws, policy discussions and initiatives are supplemented and responded to by numerous actors from civil society, science, business and foundations. In its report 'World in Transition – A Social Contract for Sustainability',[13] published in time for the Rio+20 summit, the German Advisory Council on Global Change highlighted the need for a common European energy policy. The Council's recommendations include the stepwise harmonisation of EU feed-in tariffs, as well as the launch of an initiative to introduce similar instruments elsewhere. The Council also supports the further integration of renewable energy into the internal energy market. In its Communication on renewable energy, the European Commission announced to provide guidance'[14] on support scheme reform, indicating the likely benefits of enhancing cooperation and coordination.

The pooling of renewable energy potential in Europe – including enhanced (and better designed) collaboration and connections between national remuneration and support systems, to

8 European Commission: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Energy Roadmap 2050, Brussels, 15.12.2011 (COM(2011) 885 final).

9 European Commission Proposal for a Regulation of the European Parliament and of the Council on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC, Brussels, 19.10.2011, (COM(2011) 658 final).

10 European Commission: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A Roadmap for moving to a competitive low carbon economy in 2050, Brussels, 8.3.2011, (COM(2011) 112 final).

11 European Commission: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Renewable Energy: a major player in the European energy market, Brussels, 6.6.2012, (COM(2012) 271 final).

12 ENTSO-E: Ten-Year Network Development Plan 2012, Brussels 2012.

13 German Advisory Council on Global Change: World in Transition – A Social Contract for Sustainability, Berlin 2011.

14 European Commission: Renewable Energy: a major player in the European energy market, p. 5.

be agreed by Member States – can accelerate the energy transition. The benefits can fully materialise if more and more Member States committed themselves to the transition to renewable energy. When making changes to the remuneration and support schemes currently in place, however, it is important to keep sight of the fact that current positive developments in renewable energy development must not be undermined, and that investor confidence should be boosted and not reduced as a result of uneven development.

Given that there is currently no agreement between all Member States on a 100 per cent renewable energy target, this report proposes the connection of front-runner countries in macro-regions and enhanced cooperation.

As enshrined in the Treaty on the Functioning of the European Union (TFEU), it is currently the prerogative of Member States to determine their own energy mix. The Commission can nevertheless put forward proposals which have an impact on the energy mix of the Union under article 194 TFEU, which states that it is the task of the EU to promote the development of renewable forms of energy. If this impact is significant, there must be unanimity in the Council and there is no co-decision with the European Parliament. This shows that the political will for a transformation towards 100 per cent renewable energy must be generated within Member States. For as long as this is not the case in all Member States, it will be necessary to put in place collaborative mechanisms and the right infrastructure to keep open the option of an EU-wide shift to 100 per cent renewable energy.

Most European citizens are in favour of a stronger role for renewable energy. Consumers are, however, wary of additional costs, and of what they perceive as the risks of new technological developments they do not fully understand. A fully and openly informed EU citizenry will therefore be an indispensable ally for the transformation of our energy systems. Access to transparent and comprehensive information on the full costs of all energy sources should be the right of every EU citizen.

It is hoped that this report will serve as a stepping stone on the path to our sustainable and renewables-based future and will enrich discussions by providing policy ideas. It indicates alternative routes to some of the policies that are currently being proposed in order to facilitate the development of a sustainable pathway. At the same time as advocating what it labels a 'low-carbon' future, the European Commission is currently continuing with the simple integration of renewable energy into the present system, which remains structured around the logic of fossil and nuclear fuels. Some of the core elements the Commission includes into its vision of Europe's energy future, such as the roles for nuclear and carbon capture and storage (CCS) technology, are rejected by this report as unsustainable solutions. This report adopts an open approach to regulatory philosophies, but with a clear positioning for 100 per cent renewable energy[15] and against nuclear and CCS.[16]

This long-term vision needs to be backed up by ambitious medium-term targets. The next goal, as enshrined in the Renewable Energy (RE)

15 This report is positioned in favour of renewables targets and against low-carbon targets as these are often abused to greenwash undesirable technologies such as nuclear energy and CCS. This so-called 'technology-neutral' approach would lead to fossil fuel lock-in, inappropriate infrastructure and high costs for consumers and taxpayers. With the no-regret option of renewables at hand, it is unwise to again create waste that has to be stored ad infinitum, bearing incalculable risks and keeping Europe dependent on fossil fuels.

16 Carbon dioxide capture and storage (CCS) is a process by which the carbon dioxide released during the combustion of (mostly) coal is condensed and stored underground. The aim is to reduce the greenhouse gas emissions of coal-fired power plants. CCS requires large amounts of energy; the efficiency of coal-fired power plants is thus reduced and more fossil fuels must be used. The application of CCS would also create new legacies for future generations. The main economic argument against CCS is that it needs a utility factor of around 7,000 hours to be economically feasible. In a system with a high percentage of wind power, fossil fuels will only work for 3,000 to 4,000 hours in the coming years. Consequently, the CCS plants would have a low utility factor and would not be economically viable.

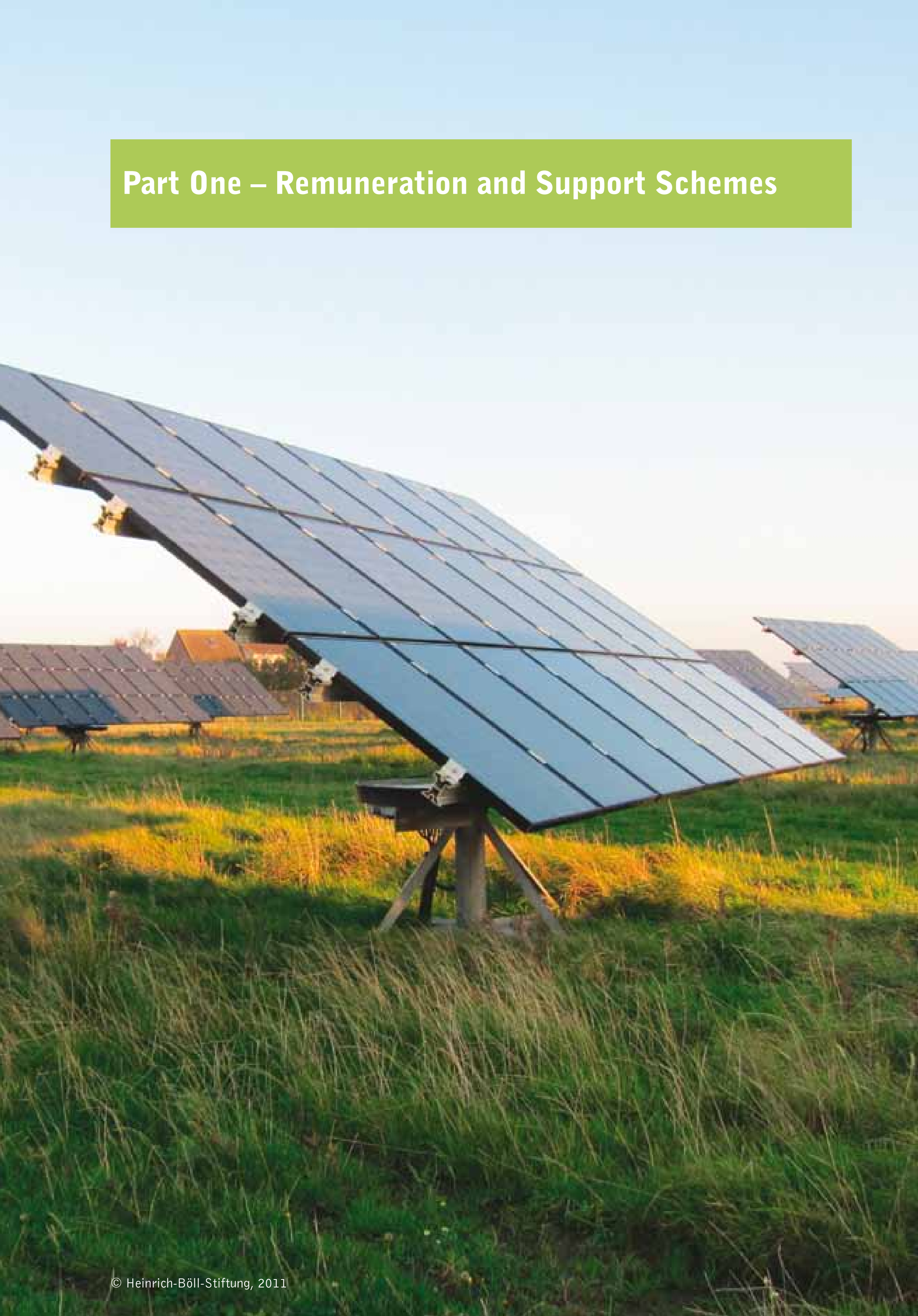
Directive,[17] is at least 20 per cent renewable energy of final energy consumption by 2020. The following step must naturally be a binding and ambitious renewables target for 2030. This expert group advocates a binding target of 45 per cent renewable energy share by 2030. In line with the logic of the RE Directive, this should be an overall renewable energy target, leaving the decision on how to divide the renewables share between the energy sectors (electricity, transport, heating/cooling) to Member States.[18]

A detailed plan of the path to be taken until 2050 cannot be drawn up today, given that technological developments and other opportunities will occur along the way. Regular monitoring is needed in order to prevent lock-in situations. The entire energy and transmission planning process must be carried out using a system that is capable of learning. This is essential in order to constantly improve this process and thereby increase our chances of reaching 100 per cent renewable energy by 2050.

17 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

18 A 45 per cent overall renewable energy target will most likely translate to a share of 65 to 70 per cent of renewable electricity in 2030 in most Member States. A trajectory for the share of electricity is important for the security of grid planning and should be elaborated by Member States and published in the National Renewable Energy Action Plans.

Part One – Remuneration and Support Schemes



1. Today's market, its shortcomings and our vision

1.1. Starting point: From fossil to renewables markets

The present European energy market is far from functioning effectively as a driver for an efficient and sustainable energy system: competition is distorted by externalities such as damage to the environment and to health, as well as by open and hidden subsidies for fossil and nuclear power generation.[19] Market transformation is hindered by a lack of adequate infrastructure and conflicting national regulatory approaches and corporate strategies. The so-called 'electricity market' is still widely dominated by the incumbent utilities from the age of fossil and nuclear energy; these represent a classic case of privatising gains and socialising costs.

Renewable energy breaks with this pattern by creating benefits for both the climate and for society. In order to overcome and balance existing market distortions, mechanisms are needed to level the playing field between conventional fossil-based and renewable energy. Key elements of this exercise include ensuring stable and reliable remuneration for investors, as well as framework conditions for grid access and priority dispatch for (the mix of) renewable energy. Such stability can be organised via support instruments such as feed-in tariffs and/or long term power purchase agreements (PPAs) for renewable energy technologies. Many renewable energy technologies, for example wind and solar power, require high upfront capital investment and hence need a more stable framework with reliable returns for investment during their operation time. With regard to (balancing) infrastructure, policies for district heating and cooling, the introduction of heat-cooling pumps, hydro storage, electric automotive infrastructure and other policy areas need to be established.

The Renewable Energy Directive (RE Directive) of 2009 followed the 2001 Renewable Electricity Directive,[20] the Biofuels Directive[21] and the long-standing demand for a Directive promoting the use of heat from renewable energy sources. It is a very successful piece of European legislation in that it creates an enabling environment to facilitate the deployment of renewables. Its binding targets and provision of guaranteed or priority grid access and dispatch of electricity from renewable energy sources led and still lead to favourable growth conditions for renewables. As national targets, the respective 'National Renewable Energy Action Plans' (NREAPs) and national commitments vary from country to country, some Member States are moving faster than others; on the whole, however, positive developments in the deployment of renewable energy have been observed in recent years. The RE Directive has broadened not only the legislative but also the explanatory framework of renewable energy from a focus on environmental and climate concerns to the recognition of the importance of renewable energy for security of supply and competitiveness.[22]

The second piece of framework legislation of importance for the current market is the 'Third Energy Liberalisation Package'.[23] Most prominently, the Third Energy Liberalisation Package

19 See for example: UNEP: Reforming Energy Subsidies. Opportunities to Contribute to the Climate Change Agenda. 2008. In 2010 subsidies for fossil fuels alone amounted to 406 billion USD while subsidies for renewable energy sources reached only 66 billion USD. See: International Energy Agency: IEA analysis of fossil-fuel subsidies, World Energy Outlook 2011, Paris 2011.

20 Directive of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market, (2001/77/EC).

21 Directive of the European Parliament and the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport, (2003/30/EC).

22 See: Callies, Christian/Hey Christian: Erneuerbare Energien in der Europäischen Union und das EEG: Eine Europäisierung "von unten"?. In: Müller, Thorsten: 20 Jahre Recht der Erneuerbaren Energien, Nomos 2012.

23 The 'Third Energy Liberalisation Package' or 'Third Energy Package' refers to a package of EU legislation on European electricity and gas markets that entered into force on 3 September 2009. The purpose of the Third Energy Liberalisation Package is to further liberalise European energy markets.

requires ENTSO-E to develop a pan-European ten-year network development plan and transmission system operators to develop ten-year investment plans for energy networks, as well as drafting European-level network codes. These are binding EU regulations on cross-border network management and market integration.

In its recently published strategy papers,[24] the European Commission states that the goal is a transition to a low-carbon Europe by 2050. All scenarios calculated by the European Commission indicate a growing share of renewable energy; this remains robust against national preferences on the energy mix. Even under the 'diversified supply technologies'[25] scenario, which relies strongly on nuclear and coal, the share of renewable electricity would reach at least 59 per cent by 2050[26] despite some methodological bias against renewables.[27] However, the scenarios developed by the Commission do not yet outline how a renewables-based low-carbon Europe will be achieved by 2050. Not only do they continue to include unsustainable or unproven technologies such as 'carbon capture and storage' and nuclear energy in their scenarios for the energy transition, they also lack clear and unambiguous post-2020 targets for renewable energy deployment and fail to provide a combined high renewables and a high energy efficiency scenario. The greenhouse gas (GHG) reduction goal has also been shifted from '80 to 95 per cent' to an 80 per cent minimum level. These are backwards steps from the earlier positions agreed in the EU, away from the spirit and from the path that the EU started to walk with the Climate and Energy Package of 2007, and particularly with the RE Directive – in which high energy efficiency and a high share of renewables were rightly seen as major pillars of a sustainable energy future. Although reform might be necessary for the period after 2020, the RE Directive should not be amended too early in order to maintain a stable framework for the implementation of current commitments. The Commission should foster the implementation of the RE Directive in all aspects and complement these efforts with guidance to allow better coordination between national support schemes, as announced.

Compromise is part of the nature of the EU and trade-offs will be necessary to balance the competing objectives of EU Member States. The RE Directive successfully took this into account by having an overall EU target for RE delivered by differentiated national targets, thus allowing for varying policy designs in the Member States.

In its recent Communication 'Renewable Energy: a major player in the European energy market' the Commission supports the gradual integration of renewable energy into the market with reduced or no support, depending on the technology. In the associated impact assessment, the European Commission presents, among other scenarios,[28] the option of harmonised support schemes, as well as the option to introduce tradable renewable energy certificates. The rationale behind both options is increased cost-effectiveness, as suggested by the 2007 OPTRES study.[29]

24 Such as the above-mentioned 'Energy Roadmap 2050', the 'Roadmap for moving to a low-carbon economy in 2050' and the Communication 'Renewable Energy: a major player in the European energy market'.

25 See: European Commission: Energy Roadmap 2050.

26 54.6 per cent renewable energy share of final energy consumption and 59.1 per cent renewables share in the electricity sector under the least ambitious scenario.

27 The methodological bias against renewables included overly pessimistic assumptions on the learning cost curve of renewables, extraordinary conventional back-up capacity because of a limited range of assumed storage technologies, excessive reliance on grid investment as a solution to the balancing challenge and over-optimistic assumptions on nuclear and CCS costs. For further information see: Matthes, F. C. (2012): Langfristperspektiven der europäischen Energiepolitik – Die Energy Roadmap 2050 der Europäischen Union. Energiewirtschaftliche Tagesfragen 62 (1-2), p. 50-53. Hey, C. (2012): Low-carbon and Energy Strategies for the EU. The European Commission's Roadmaps: A Sound Agenda for Green Economy? GAIA 21 (1), p. 43-47.

28 One of these scenarios involves continued national support policies with more cooperation and coordination among Member States.

29 OPTRES 2007. Assessment and optimisation of renewable energy support schemes in the European electricity market. Authors: M. Ragwitz, A. Held, G. Resch, T. Faber, R. Haas, C. Huber, R. Coenraads, M. Voogt, G. Reece, P. E. Morthorst, S.G. Jensen, I. Konstantinaviviute and B. Heyder. Final report. Karlsruhe 2007.

In the public consultation on the Communication, this option received some support, mainly from energy traders and utilities, but was dismissed by the majority of respondents, including a majority of Member States and within the European Parliament.

The rationale behind the opposition to harmonised support schemes was that the expiration of the current remuneration and support mechanisms would decelerate the deployment of renewable energy in Europe in the critical period leading up the 2020 target.

The Renewable Energy Directive is working well and should therefore remain unchanged for the time being. The current framework for renewable energy development in Europe, most importantly the RE Directive, contains many valuable design elements that should be preserved even beyond 2020. Additional elements to advance Europe's energy markets and to further develop current remuneration and support schemes have to be identified, keeping in mind the perspective that they favour a renewable energy-based system rather than current fossil fuel-based structures.

A stable investment framework for renewable energy deployment which provides clear guidance for investors at the same time as attracting the necessary capital is critical to the further success of renewable energy deployment. Furthermore, priority access to the grid and the priority dispatch of renewable energy remains crucial for the necessary increase in the speed of the deployment of renewables.[30] On the other hand, as the Commission rightly states in its recent strategy paper on renewables,[31] subsidies for conventional fuels have to be phased out; the same needs to be applied to (open and hidden) subsidies for nuclear energy. Additionally, it is necessary to agree upon binding targets for renewables in order to provide a high level of investment security.

The market of the future will be characterised by the generation of energy from renewables and the balancing solutions that this will require. The transmission of electricity will be only one of the balancing solutions – albeit one of particular importance. The following chapters will shed more light on some of the listed measures to facilitate the transformation of the energy system.

1.2. Optimistic and realistic: Setting targets for 2030

This report promotes a Europe-wide binding target of at least 45 per cent renewable energy for the energy sector and advocates following the basic logic of the RE Directive by breaking down the European target into binding national targets. This would imply a commitment to prolonging the ambition that needs to be made in the short term (up to 2020).

Countries which have in the past relied on voluntary targets and other soft measures to support renewables have fallen behind and today find themselves at a lower level of development in terms of this crucial industry. A binding European target, combined with effective and mutually compatible national support mechanisms, will provide high investment security, which in turn is important to bring down the costs of capital for renewable energy development. It is important to note, that past targets in the renewable energy sector have frequently been over achieved. Being optimistic when it comes to the future of renewable energy in Europe therefore equals a realistic approach.

The impact assessment (IA) carried out by the European Commission following the recent publication of the Communication on Renewable

30 In most EU Member States, the penetration of variable renewables such as wind and solar is still very low: less than 5 per cent of electricity consumption in 21 Member States, as noted in the recent Communication of the European Commission. The experiences of forerunner countries like Denmark and Germany show that the power system can easily cope with priority access for renewables up to much higher shares, and that the principle of priority access should not be questioned unless other means have been found that guarantee the necessary continuation of investments in additional renewable generation capacities.

31 European Commission: Renewable Energy: a major player in the European energy market, p. 4.

Energy, which included an analysis of social impacts, states that national post-2020 RE goals, combined with cooperation between Member States (option 3),[32] is the option with the greatest and most stable employment benefits. The reason for this is that this model actively promotes not only mature but also innovative renewable energy technology possibilities. This leads to a smoother investment in RE over time and consequently a more stable employment environment. The IA also highlights that the financial and regulatory incentives associated with this model could offer the necessary framework to establish domestic industry with the potential to expand into the growing export markets.

Binding targets enhance the visibility of the technology supply chain and thus contribute to more innovation and an appropriate build-up of production capacity. This leads to cost reductions for renewable technologies. Targets are therefore not only an efficient but also a cost-effective strategy for steering the development of this sector in the right direction.

The working group welcomes the fact that achievement of the 20-20-20 targets is a core goal of the EU's Europe 2020 Strategy for intelligent, sustainable and inclusive growth. We support the inclusion of these targets in the Integrated Guideline No. 5 of the EU 2020 Strategy[33] which not only deals with climate and energy policies but also asks Member States to phase out environmentally harmful subsidies, invest in smart energy infrastructure and improve resource efficiency in general. The 20-20-20 targets are crucial to economic development in the EU. Aside from the monitoring process enshrined in the RE Directive, the European Semester for fiscal and macroeconomic surveillance provides a good opportunity to check on progress made in the Member States. The results of this monitoring process should be included in the annual growth report and in country-specific recommendations to ensure that the developments taking place in the Member States are on the right track.

1.3 Design matters: Options for remuneration and support schemes

Changes to support and remuneration schemes should not destabilise the market and must keep investment risks low. Most importantly, retroactive changes as undertaken in Spain, the Czech Republic and the United Kingdom in 2011 are an absolute no-go. They undermine investor confidence on a long-term basis, are incompatible with legal principles and are counterproductive to economic innovation in these countries. As retroactive measures may lead to non-compliance with the Renewable Energy Directive, the European Commission should deploy all of the diplomatic and legal means at its disposal to insist on compliance.

National feed-in tariff systems have so far proven to be the most effective and efficient support mechanism for providing cost-effective support to renewables. Moreover, national feed-in tariffs or remuneration schemes are a reflection of the polluter pays principle, which is enshrined in the European Treaties.

However, the specific design of feed-in tariffs matters, as does the design of remuneration mechanisms in general. Decisions on specific remuneration and support mechanisms should therefore never be made on the basis of an applied generic description, but by taking a close look at the specific architecture of the scheme proposed and its ability to further the deployment of renewable energy in a sustainable, efficient and cost-effective way under the specific national circumstances in question. On the basis of historical experience, this paper expresses a preference for feed-in tariffs as originally introduced in Denmark and Germany, without foreclosing

32 European Commission: Commission Staff Working Paper, Impact Assessment accompanying the document: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Renewable Energy: a major player in the European energy market SWD(2012) 149 final, Brussels 2012, p. 22 f.

33 European Commission: Europe 2020. Integrated Guidelines for the economic and employment policies of the Member States, Brussels 2010. URL: http://ec.europa.eu/eu2020/pdf/Brochure%20Integrated%20Guidelines.pdf

other options if they can be proven to achieve comparable or better results. A regular review of environmental effectiveness, social fairness and cost should be part of the process. Reliability for investors should remain a paramount consideration. Convergence of national support systems on the basis of feed-in tariffs is therefore the preferred option. Some convergence in the support of renewables can already be observed – meanwhile more than 20 Member States (and over 40 countries worldwide) have introduced feed-in systems or variations thereof.

Tariff levels and structures (feed-in tariffs) should be technology specific, and take the different stages of development of renewable technologies into account. Regional and site-specific differences play a role, but should not lead to a system of remuneration that cancels out the comparative advantages of the best sites for renewable energy installations. As an investment in the commons, it is legitimate to provide greater financial support to some technologies than to others.[34] The cost reduction potential[35] within certain renewable energy technologies is more relevant than across technologies. The last years have witnessed steep learning curves for those renewable energy technologies that have seen growing market penetration (supported by appropriate remuneration and feed-in tariffs). Growing production capacities and learning curve effects have brought costs down considerably, e.g. in the case of onshore wind or, more recently, solar photovoltaics (PV). Competition between different renewable energy technology suppliers has sped up this development by providing strong incentives for technology development. It is therefore important to provide a framework in which renewable energy technologies can develop on the market, thereby taking advantage of learning curve effects by growing economies of scale. As a result, there will be a sufficient number of market players (i.e. technology providers, investors, etc.) who would foster even more competition. If market volumes are too small, there is limited competition and prices for renewables installations will go up due to the high demand.

Offshore wind development is currently suffering from the effects of such limitations: the market is still in its infancy – as was onshore wind in the early to mid-1990s and solar PV some five to ten years ago. In addition, there is a bottleneck with advanced (subsea) grid connection technology. Currently, there are only three cable suppliers on the market who can offer the high-voltage direct current (HVDC) technology which is needed to connect offshore wind farms.

In the photovoltaic sector, the high prices seen several years back were countered by positive long-term prospects. This led to large investments in supply chains – that is, in production and installation facilities. These investments were followed by strong cost and even stronger price reductions. The case of PV underlines the importance of ambitious and binding targets for 2030. In order to achieve cost reductions in offshore wind power or other renewable energy technologies, clear and positive long-term prospects are needed for investors. With long-term target setting, supplemented by the right price-setting signals, new renewable energy technologies can create the supply chain industry required to harvest their cost reduction potential.[36]

Support schemes should reflect cost reductions as closely as possible in order to avoid unjustifiable profit margins. At the same time, it is important that the costs and benefits are shared between consumers and producers: the value of the energy delivered should be reflected in the system. Shifting support to energy technologies that harvest considerably more energy in a certain

34 See also: European Court reports 2001 Page I-02099, Case C-379/98. Judgment of the Court of 13 March 2001. PreussenElektra AG v Schleswag AG, in the presence of Windpark Reußenköge III GmbH and Land Schleswig-Holstein.

35 It is important to note that if the externalities related to fossil fuels were taken into account, most renewable energy technologies would today be cheaper than fossils.

36 For example, the UK aims to reduce the generation costs for offshore wind energy to 10 pence per kWh, i.e. a cost reduction of 30 per cent between now and 2020.
See: http://research.scottrade.com/qnr/Public/Markets/Article?dockey=100-163x3047-1; 6.8.2012

regional area is not only common sense, it is also important for the ongoing acceptance of renewables in the society that foot the bill for the support schemes.[37]

Another way to reap the benefits of the EU's renewable energy potential is to adjust the mechanisms, rules and regulations of energy markets to the specific needs and characteristics of the different renewable energy technologies. In addition to incentivising flexibility solutions, variable renewable energy technologies also benefit from the creation of a more responsive environment, for example by a reduction in forecasting errors and a stronger focus on intraday power markets.

Decentralised vs. centralised energy system structures: Definitions

Almost every debate on the Europeanisation of renewable energy leads at some point to a discussion on the centralised or decentralised nature of the energy system. But what is actually meant by this distinction?

For the electricity sector, the following four indicators play a key role in the debate:

- **a)** The size of the installed capacity of electricity generation facilities;
- **b)** The distance between the place of production and the place of consumption;
- **c)** The dependence of the supply system on high-voltage transmission lines;
- **d)** The ownership structure of generating plants or networks.

a) A move to the production of electricity from 100 per cent renewable sources involves a paradigm shift. Fuels no longer need to be transported from all over the world to the sites of power generation; instead, electricity is generated 'on site' at the location of the renewable energy sources. These sources are geographically widely spread and exist in different forms and in differing concentrations as determined by nature. In contrast to fossil fuels, technological developments in the field of renewable energy allow the efficient exploitation of renewable energy sources on a small scale and even in areas with low concentrations. Small, even micro installations for electricity generation achieve sufficient efficiency levels. It is also possible to increase the installed capacity of each individual installation on the spot (for instance by the repowering of wind turbines). The threshold for the distinction between decentralised or centralised electricity production, based on the indicator 'installed capacity', is thus technologically variable. In addition, individual installations are often bundled into so-called 'parks'. Here the following question arises: at what level of combined installed capacity do decentralised installations become a centralised supply structure? There is no general, Europe-wide response to this question.

b) The geographical distance between the place of production and the place of consumption serves as a second indicator. Entities ranging from single buildings to whole regions – defined according to different administrative criteria – are associated with power supply systems that are defined as decentralised according to geographical criteria.

The shift of electricity generation to renewables has different impacts on the distance between the places of production and consumption, depending, for instance, on the settlement structure. For rural and sparsely populated areas, the switch to renewables opens up the opportunity to achieve a self-sufficient energy supply. For those population centres with high electricity demands as a result of the number

37 Determining the value of the energy is not a simple task, as socio-economic and environmental concerns need to be calculated against different time horizons. For example, many current European support systems offer higher tariffs for small-scale rooftop PV installations, thus rewarding their lower impact on landscapes and lower grid costs. See: Schleicher-Tappeser: 'How renewables will change electricity markets in the next five years'. In: Energy Policy, Volume 48, September 2012, p. 64-75.

of inhabitants and the scale of economic activity, the consequence of the shift to renewables is currently rather the opposite: while large power stations were located in or near these centres in the fossil-nuclear age, the distance between these places and the sites of renewable power generation is tending to increase. The form taken by developments often depends on a country's settlement pattern and the spatial distribution of its renewable energy sources; it will therefore differ quite significantly between Member States.

c) A further indicator of centralisation or decentralisation is the share of electricity obtained from high-voltage grids. Again, it is difficult to define a commonly agreed threshold and the following questions arise: can a system in which electricity is generated in small-scale installations be considered as centralised if this electricity is finally fed into a high-voltage grid? Is it important for the high-voltage network to be limited to national territory or can it operate across borders? Is the distance between the consumer and the production structure of relevance?

The shift in electricity generation to RES means on the one hand that new transmission lines are needed, e.g. for the connection of offshore wind parks. On the other hand, the share of electricity obtained from the trans-regional, national grids will shrink significantly in some regions thanks to new opportunities for local and regional self-sufficiency in renewable energy supply. The energy revolution will be associated with an altered spatial distribution of the transmission and distribution networks.

d) The fourth dimension to the debate concerns ownership structures – primarily of generation facilities but also partly of (distribution) networks. Renewable energies allow small and micro facilities to operate profitably, which opens up new opportunities for private households, farmers, local cooperatives or municipalities to take ownership of energy supply facilities. But is this an indispensable condition for the qualification of a structure as decentralised? Does investment in energy supplies by large companies or financial investors necessarily mean centralisation? And which classification should be used in the event that municipalities acquire shares in large offshore wind parks, with the electricity transported over long distances via high voltage networks? Here, too, the threshold for the distinction between decentralised and centralised can hardly be defined in general terms on the basis of one indicator alone.

But what does all of this mean for the debate on the Europeanisation of renewable energy?

The Europeanisation of renewables:

1. Does not automatically mean the centralisation of the energy supply system; nor does the management of the entire supply system at the national level automatically mean decentralisation.

2. Does not mean exploiting renewable energy sources in areas of high concentration only and then transporting the electricity generated over maximum distances via new European high-voltage networks which constitute a new layer of grids above and in addition to the existing national transmission grids.

3. Does mean that their use should not be confined within national borders. It means connecting networks across borders in order to allow for the optimised use of renewable energy, to balance variable energy supplies and to ensure the optimal mix for a secure energy supply from 100 per cent renewable sources independent of national borders.

2. Tackling the flexibility challenge

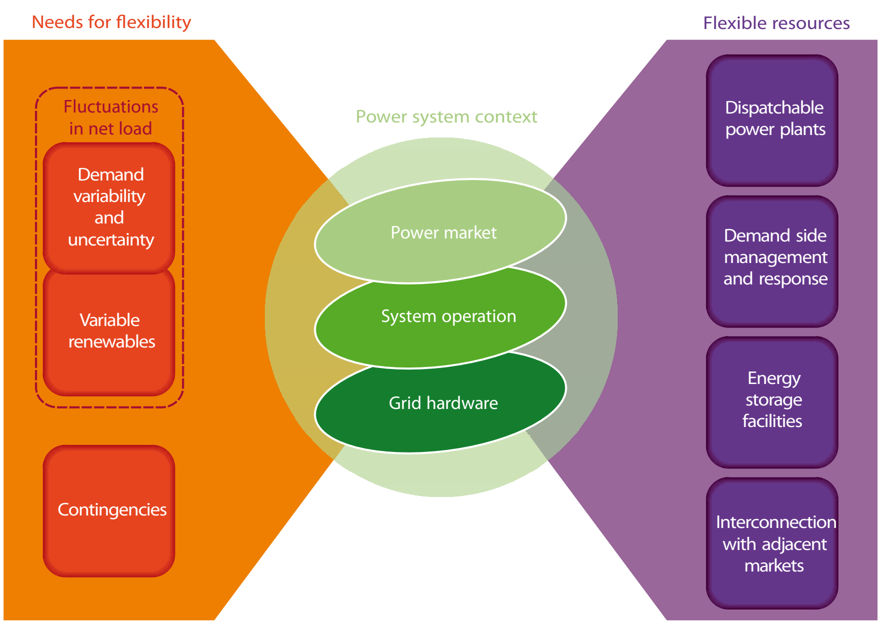
Variable energy sources such as solar and wind energy play a decisive role in the transition to an energy sector based on renewables. With an increasing supply of variable energy sources to be fed into the different grids, improved infrastructure and flexible solutions are necessary. This flexibility challenge is going to increase substantially due to the growing share of variable renewables and the geographical reshaping of the power system: renewable energy is generated in remote areas (with little or no local demand) such as offshore wind parks on the one hand, and generated very close to the consumers such as the electricity from PV on the other hand. The latter is embedded in the local low or medium-voltage distribution networks.

Greater flexibility in the power system is part of the answer to the challenges above. The integration of the electricity market with the other energy markets – heating/cooling and transport – is another important of the solution to the variability challenge. Sources of flexibility to balance variability include dispatchable (or flexible) power plants, demand-side management and demand response, energy storage facilities and increased interconnection with adjacent markets. [38]

'Interconnection with adjacent markets' includes the extension and optimisation of transmission grids as well as the integration of power markets to make best use of the interconnections. Demand response can be connected with storage opportunities in the heating/cooling or in the transport sectors.

Flexible services can usually be delivered by more than one of these sources. Due to this interchangeability, the transition to renewables can be achieved even if the deployment of one or another of the flexibility sources is hindered.[39]

Fig. 1: Flexibility challenge and solutions



Source: Harnessing Variable Renewables – A Guide to the Balancing Challenge © OECD/IEA 2011, figure 4, page 36

38 International Energy Agency: Harnessing Variable Renewables – A Guide to the Balancing Challenge, Paris 2011.
39 ISEA, RWTH Aachen: Technology overview on electricity storage, 2012.

Tackling the flexibility challenge first of all implies a substantial reform of the design of the power market, which needs to provide the necessary incentives to deploy the most efficient mix of flexible resources. The market is also in need of reform in order to benefit from the advantages offered by integration with the other energy sectors. [40]

The future power market must firstly mobilise the huge potential for flexible and responsive demand in industrial processes, in the tertiary sector and in the residential sector. These resources can often be made available with small investments in smart information and communication technologies. The power market must send out the necessary signals to encourage behavioural change; this must also be encouraged by other means such as awareness raising and information campaigns. The Directive on Energy Efficiency that was agreed in June 2012 sets a supplementary cornerstone for a paradigm shift to the energy market by laying the legal foundations for the development of a market for demand-side management.

Power market reform also requires the introduction of capability mechanisms to ensure the availability of flexible generation capability (such as hydro power, biomass and open-cycle gas turbine power plants) and/or storage capabilities at the times and in the places where they are needed. All of these measures can reduce the transmission grid expansion necessary to integrate any given share of variable renewable generation.

To balance variable renewable energy, it is necessary for the transmission grid to be extended and reinforced at the interregional and international levels ('electricity highways'), as well as at regional and local levels (distribution networks, smart grids).

Peak electricity supply[41] from strong wind power generation in the North Sea can then be stored and/or transported to the areas where electricity is needed, such as central or southern Germany, the industrial areas of the Benelux countries and other (to be) connected areas where there might simultaneously be no wind or sun. Intelligently connected and extended infrastructures can complement each other and flatten the peak load curve.

The storage of peak electricity and the better integration of electricity production systems with the heat market (and, as a longer-term prospect, integrated e-transportation systems) are solutions to the challenges of electricity peaks and times of low electricity supply. Pumped hydro storage, concentrated solar power plants and other technologies will need to play a bigger role in the future energy system. Cooperation within the EU and with non-EU countries, especially with Switzerland and Norway or with accession candidates such as Iceland, holds a lot of so far untapped potential.

However, from a current techno-economical point of view, at present there is insufficient storage potential available at a reasonable cost to balance the variable power produced by renewables. Further investment into the research and development of storage capacities is therefore needed.

2.1. The price of electricity and policy options to counter price deterioration

The variability of renewable sources, or rather the abundance of renewable energy, has consequences for electricity wholesale prices and poses challenges for the grid system, as electricity supply and demand must always be balanced.

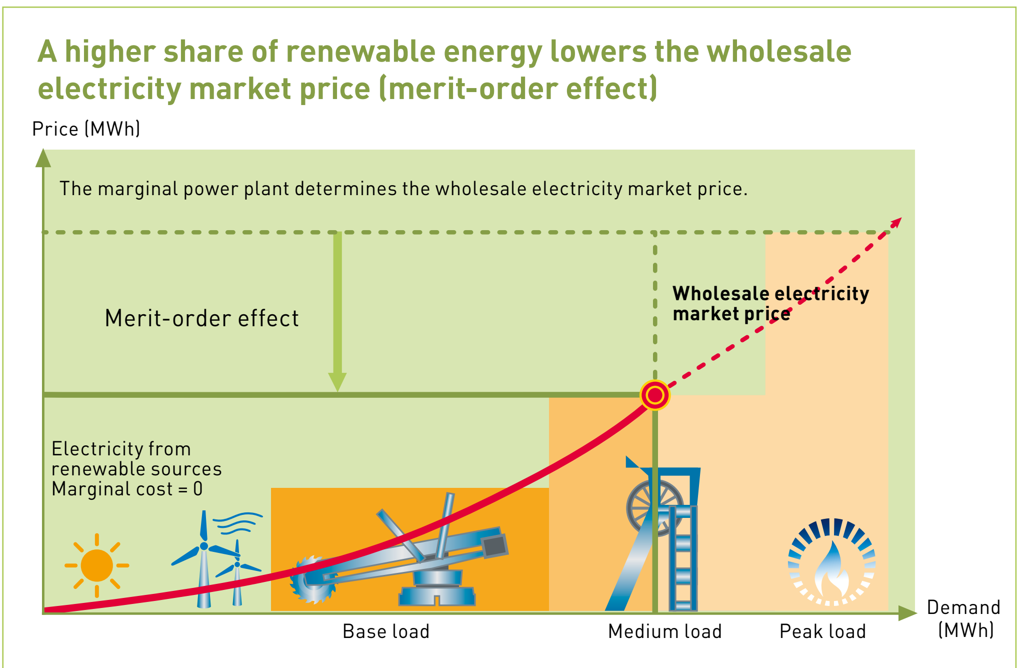
Even today, on peak days of wind energy production in Denmark, Germany, Spain, and Portugal, supply can exceed domestic demand. Currently, the ability of the grid to export electricity to neighbouring markets is partly capable of buffering that effect, but as the share of renewable energy grows, additional measures will need to be taken.

40 For example, the cheap storage facilities of the heat market. Further information in section 2.2.

41 Periods in which electricity generation exceeds immediate demand in the local area.

In the current price formation in the electricity wholesale market, prices depend on the marginal cost for a power plant to meet demand at a given moment, including fuel prices or emissions trading certificates. The fixed costs, investments in power plants, are only recovered during periods in which more expensive technologies or demand response set the price and thus the market price exceeds costs. Renewable energy sources such as wind and solar involve no fuel costs and very small variable (operation and maintenance) costs, but relatively high upfront fixed costs. In a world of 100 per cent renewable energy the electricity price would therefore sink to close to zero if no storage were available, if there were insufficient connections between the heat, transport and electricity markets and if the design of the market was not adapted to variable renewables and smart balancing. This effect is called the merit-order effect after the basic mechanism for peak-load power trading, in which the last electricity supplier that is needed to satisfy demand determines the price for all suppliers. A world of 100 per cent renewables might still be some decades away, but the effect of diminishing prices on a market with a high share of renewable energy will already kick in much earlier. While this reduction in electricity prices is positive for the consumer, it will serve to reduce and eventually remove any incentive to invest in energy installations, as the market no longer provides a suitable price signal for necessary investments in system stability, backup and storage.

Fig. 2: The merit-order effect



The merit-order effect, based on AEE, 2011

Over the medium or long term, operators of renewable energy installations will probably need to secure remuneration beyond spot price revenue for plant construction. Long-term power purchase agreements could be one option to incentivise installations and keep them up and running. Price guarantees for electricity from renewable energy might be another option.

One alternative model that has been suggested to build on the feed-in tariff (FIT) system is the volume market model.[42] It aims to provide investment incentives for renewable energy in the event that a liberalised electricity market fails to do so. Our main criticism of this model is that tenders will increase the level of uncertainty and therefore lead to higher costs and lower volumes of installed capacity. This is due to the apparent danger of gaming by large market participants, the tendency to place uneconomically low bids, and in many cases the failure to achieve planning consent for many projects with successful bids. For the medium term, the integration of power markets and demand-side response mechanisms will help to even out the merit-order effect and keep prices at levels that do not purge investment incentives in renewable energy.[43]

2.2. Power market integration

The flexibility challenge cannot be solved within the electricity sector alone; a solution can only be found through the integration of electricity markets with other markets such as heating/cooling and transportation. In order to permit the gradual change of the power system, it is therefore advisable to better integrate the energy markets, that is the electricity markets, with the heating- / cooling sector and the transport sector.

The necessary technical infrastructure for integration already exists (although it will have to be extended). It includes:

- smart meters and accompanying regulatory / financial incentives for demand response, load shifting or energy conservation, and energy efficiency;
- pumped hydro;
- district heating cogeneration;
- heat pump and heat storage capacity;
- compressed air;
- e-vehicles;
- syn-gas.

In the case of wind energy, the use of varying turbine sizes can facilitate flexible responses to changing wind speeds, different landscapes and the demands of public acceptance. The integration of variable energy into the local heating, cooling and transport markets reduces the constrained power – the renewable electricity potential lost at peak times – and can help to reduce congestion in the grid system. As congestion – so-called bottlenecks – makes up the biggest and most cost-intensive item in European grid operation and planning, the integration of energy markets can help to bring down costs considerably as it reduces the need for new grids. This would in turn accelerate the transition of the energy system, as the integration of the energy systems necessitates some new build-up but often requires the optimised use of existing infrastructure.

42 The FIT of the volume market model is determined via a process of tenders, which should create competition and thus reduce installation costs, with different reward mechanisms for variable and non-variable technologies. Remuneration should be awarded for a fixed volume of electricity in order to connect production to demand and to compensate installations for fluctuations of the annual average of the respective resource. Tenders could be differentiated with respect to capacity, technology, the requirements of the regional grid and the provision of system services. They should be placed continuously in order to prevent strong market fluctuations. For a discussion of this model see arrhenius Institute: Sven Bode / Helmuth-M. Groscurth: Elements of a Sustainable Design for Electricity Markets, Discussion Paper 6, Hamburg 2011. Helmuth-M. Groscurth / Sven Bode: Das Mengen-Markt-Modell Discussion Paper 4, Hamburg 2011.

43 By integrating electricity, the price for electricity will not be lower than the price of the oil or gas it can replace on the heat market. At times the price might be even higher in the event that 'electricity for heat' consumers are obliged to install heat pumps if they wish to use electricity for heat. In that case, 1 kWh of electricity could replace 3 kWh of oil/gas.

As will be elaborated in more detail in the second part of this paper, the current process for grid planning in Europe is organised in such a way that results in high grid kilometrage. The mechanism is not yet fit to model how much grid extension can be avoided by integrating electricity into other energy markets or by taking advantage of other flexibility solutions. For Denmark, energy modelling has shown that the local integration of wind electricity is more economical than exporting electricity to neighbouring countries, despite it being one of the most interconnected countries in the world.[44] While it is not possible to make the generalisation that the local integration of energy is always more economical than exporting electricity, the Danish example shows that the potential of local integration should be examined closely.

Investments in the power grid system are necessary, on all voltage levels. The challenge is to find the optimal balance between investment in power grids and other flexibility solutions. The high percentage of cogeneration and district heating in Denmark favours the local integration of electricity. In other cases, the transmission of electricity will be more economical. This transmission can take place on either a national or an international basis; in some regions of Europe, cross-border transmission will be shorter than the use of national lines and more cost efficient than other options. Considering the physics of energy transmission, the kilometres travelled by an electron in the system may sometimes be greater for locally integrated energy than for transmitted energy. It is therefore not possible to make generalisations for any one flexibility solution. The optimal mix has to be investigated on a case-by-case basis. The current focus of European policymakers in relation to the construction of a trans-European electricity grid, not least to link new offshore installations in the North Sea to major centres of industrial production in Central Europe, therefore has to be complemented by a stronger focus on local distribution networks and other flexible resources as described above.

2.3. Ownership

Renewable energy – as with other large-scale installations – sometimes faces resistance from the residents of areas close to installation sites. Conflicts between local residents and the owners of renewable energy installations hinder renewable energy deployment and harm the positive image of renewables. A high share of local ownership, as an addition to the non-local and often private ownership of renewable energy (and where possible grids), is an effective tool to ensure that owner interest is also local interest[45] and has contributed significantly to the success of renewables in the past. At present, however, there is a tendency for more distant ownership. This development should be reduced, particularly as the infrastructure required (cars, heat/cooling pumps, etc.) will rely heavily on local involvement.

The local ownership of renewable energy installations, such as wind turbines, can be private (e.g. farmers, energy cooperatives or local distribution companies) or public (community ownership e.g. municipalities). For larger investments, a mixture of these owners would be most appropriate. So far, most small and medium investments are (at least partly) locally owned, but as wind parks are often widely visible and particularly contested, big energy cooperatives, large associations of consumers or municipalities should be encouraged to take on the ownership of these large-scale investments.

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44 Lund, Hendrik / Münster, Ebbe: 'Integrated energy systems and local energy markets'. In: Energy Policy 34 (2006), p. 1152-1160.

45 Common sense is backed up by basic neoclassical economics: according to its rationality and utility maximisation principles, people tend to prefer a situation in which they make a profit to one in which they get no profit. Consequently, they are more likely to accept wind power projects, for instance, if they receive a profit than if they receive no profit. The profit they make increases their benefits, and the costs are constant for the two alternatives 'no local ownership' versus 'local ownership'. See for example the case studies: Musall, Fabian David / Kuik, Onno: 'Local acceptance of renewable energy – A case study from southeast Germany'. In: Energy Policy 39(2011), p. 3252-3260; Warren, Charles R. / McFadyen, Malcom: 'Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland'. In: Land Use Policy 27(2010), p. 204-213.

Local and regional ownership enhances public acceptance and support for renewable energy projects as it creates local revenue. Furthermore, stronger public participation is also important for the 'emotional ownership' of and identification with renewable energy and the transition of the energy system.

Public participation through local ownership should be incentivised by adequate support design. To be attractive, the schemes have to be designed in a simple and transparent way so as to not create de facto barriers to newcomers to the renewable energy business. Additional support might be necessary, for example through bonuses or tax exemptions.

To take full advantage of the positive effects of local ownership, the Commission should not interfere with local legislation that requires project developers to offer a substantial local ownership share. In the case that current EU competition law impedes such legislation, at least beyond a certain share (e.g. 20 per cent in Danish legislation), it should be reviewed in order to enable the promotion of the public acceptance of renewable energy installations through local ownership as an important element of the promotion of renewable energy.

2.4. Demand-side response and storage

Next to grid reinforcements, low supply of renewable electricity in areas with no wind and sun also has to be dealt with via intelligent demand-response mechanisms, energy conservation incentives and storage facilities. As prices increase during times of low electricity supply, it is more attractive to expand demand-side responsiveness or invest in storage. Storage capacity increases flexibility as surplus power is bought and sold at times of higher scarcity.

It will be important to facilitate this gradual development – of investment in storage, demand-side management and corresponding contract cover – to hedge the financial exposure to higher prices. Such a hedge does not remove the incentive to respond as any energy saved will be rewarded when there are high market prices. As regulators and system operators have limited experience with demand-side response, they might have a tendency to ensure system adequacy with generation capacity. In that case, the capability of demand-side response will not be demonstrated. Dedicated programmes will be necessary to overcome this lock-in.

The power price helps to coordinate production, demand and power storage and provides commercial incentives for the international balancing of supply and demand. These interactions in turn create substitution opportunities across fuels, usage and time – and thus increase positive power price periods and reduce price spikes.

It is essential to further develop the competitive power market for the effective operation of a renewable energy system. Scarcity value will increase in anticipation of a potential shortage, for example during the infamous cold and windless winter week. Market clearing prices will therefore be maintained for many hours in the year with mid-range prices.

2.5. Triple-A options for renewable energy investments

In order to reach the European renewable energy target of a 20 per cent share by 2020, investments in renewable energy need to double from the current levels. The ongoing financial crisis has reduced growth in the energy sector and has also negatively affected renewable energy developments. It has driven up costs, as investors act in a risk-averse fashion despite having large sums open for investment.

In the current financial climate fewer projects are bankable, which is affecting independent power producers and technologies in particular. The debt and credit crisis has also led to dramatic differences between the cost of capital in different countries, in particular leaving southern European countries with high potential for renewables with a lack of investors.

In order to facilitate investments, it is important to distinguish between two perspectives in financing: the project economics perspective and the macro-economic perspective. As the risk – or the perceived risk – for a project is a deciding factor in finding an investor, methods to distribute the risks (and benefits) between the project developer and society need to be defined. The parties have different options to mitigate risks at varying costs and with different societal benefits. The macro-economic result will vary between technologies and countries.

As financial situations and the conditions for the deployment of renewables vary between EU Member States, the policies need to be adapted to the specific needs of each. Optimal allocation and the treatment of risk will differ between countries and technologies. One policy does not fit all, but certain policies for minimising the risk of renewable energy investment can be identified. The authors of the study 'RE-Shaping: Shaping an effective and efficient European renewable energy market'[46] labelled these policies 'Triple-A policies.'[47] These include:

- Increasing policy stability
  - No retroactive changes
  - No abrupt policy changes for upcoming projects
  - Simple and transparent permitting and grid access procedures.
- Minimising policy-related cost and risks
  - No budget/capacity caps
  - Continual access to support.
- Considering the (perception of) risk among investors and lenders
  - Allocate the risk to the party that can bear it best and design regulatory frameworks in such a way as to ensure macro-economically optimal treatment in order to stabilise policies.
  - Reduce project revenue risks.
- Removing barriers.

Macro-economically optimal allocation and the treatment of risk and cost will differ between countries and technologies, based on:

- technology-specific risks and technology maturity;
- the country-specific deployment status of that technology;
- the country-specific electricity market design and structure;
- project size and investor group;
- macro-economic paradigms.

These policies help reduce the risk perceived by investors and can, according to the RE-Shaping study, potentially reduce levelised costs by up to 50 per cent for specific technologies or Member States.

Most prominently, renewable support mechanisms need to provide a robust investment framework for capital-intensive technologies which underpins the importance and adequacy of feed-in tariffs. For some large-scale cross-border renewables projects, tenders can offer secured revenue streams and facilitate access to financing. They do, however, hold the danger of shifting opportunities away from new market entrants and from smaller-scale installations.

Risks of target non-compliance (as tenders sometimes fail to be implemented, for example due to lack of finance or inappropriate upfront calculations) need to be counteracted by the specific design of the tender. In cases where the tender winner does not follow the timetable or other provisions laid out in the tender, penalties need to be applied.

Well-designed tenders provide information about total costs, and supporters of tenders furthermore expect cost-reduction effects due to competition in cases where there are rules and financial possibilities for a broad range of investors – including municipalities, local and regional households and firms. In the past, bidders have sometimes placed uneconomically low bids in the tender process in order to win the bid. Again,

46 European research project RE-Shaping: RE-Shaping: Shaping an effective and efficient European renewable energy market, Karlsruhe 2012. URL: http://www.reshaping-res-policy.eu/

47 This classification is taken from the bond rating assigned to an investment grade debt instrument. AAA is the highest possible rating.

the design of the tender process needs to counter these incentives. Extra costs resulting from uneconomically low bids need to be borne by the bidder. Furthermore, tendering can only be applied to projects for which the site conditions are well known. Overoptimistic assumptions on site conditions, for example with regard to wind speeds, lead to uneconomically low bids. The same holds for uncertainties concerning grid connection charges if these charges are underestimated in the bidding process.

As past experience with tenders for renewable projects has been predominantly negative at the European level, the use of tenders has to be accompanied with improvements to their design. While in most cases FITs will provide more stable – and thus cheaper – conditions for renewable energy deployment, tenders can play a role for international cross-border cooperation for large-scale renewables projects or large infrastructure investments such as transnational grids.

2.6.The European Investment Bank

The European Investment Bank (EIB) is the long-term financing institution of the European Union and is its house bank. The financing it provides should support the EU's policy objectives.

The EIB focuses on six priority objectives, among them the development of Trans-European Networks of transport and energy (TENs) and sustainable, competitive and secure energy. In order to finance projects in line with its main objectives, the EIB borrows on the capital markets. It operates on a 'not for profit maximising' basis.

In the current financial crisis, the importance of the EIB for the financing of renewables has increased. Whereas renewable energy investments showed a certain immunity to crisis in 2008 and 2009, more recently there has been a declining trend in renewable energy investments due to policies which have created market uncertainties and hindered access to finance.

Case study: Photovoltaics in Spain

Retroactive policy changes are a major problem for the deployment of renewables. Solar photovoltaic (PV) electricity in Spain serves as an example of the damaging effects of such measures.

At the end of 2010, the Spanish government decided to cut the FIT support level for PV. While adjustments to the support level are necessary when module prices drop, these cuts must only apply to future remuneration and should be applied in a transparent manner. The Spanish cuts, however, were applied retroactively. This retroactive cut of remuneration for PV deployment was the fourth regulation in only four years for the PV sector, which indicates a structural failure of the country's energy planning. Such a policy environment creates regulatory instability and undermines investor confidence. In order to gain support from the general public for this cut in FIT, a campaign was launched by the government which alleged major deficiencies in the Spanish PV industry.

Large investments had been made in previous years in the growing PV market in Spain. The level of support given created the framework conditions for these investments. After the implementation of the regulation, the number of new PV installations has decreased. The outlook for Spain's PV industry within the country remains bleak.

The retroactive change not only violated investor confidence and rights but also undermines the prospects for Spain to become one of the key players in this future market, in which global competitiveness is a major asset, creating domestic jobs and wealth.

In January 2012, the new Spanish government has put in place a moratorium on all new renewable energy installations. This will further undermine investor confidence and thus reduce the likelihood of Spain achieving its renewables targets.

The EIB can play a pivotal role in reducing risks for investors and thus facilitate renewable energy investment in these countries. The financing EIB provides can help to disconnect renewables investments from the non-favourable economic climate. The selection of a project by the EIB for funding usually sends a quality signal to other investors. These projects are generally perceived as a low-risk investment. Thus, the EIB can serve as a catalyst for renewables investments, reducing the risk for investors and indirectly increasing investment in renewables as a whole. The purpose of the EIB (as of other European–level investment) must be to leverage investments from public and private investors.

Overall EIB investments in 2011 came to over 60 billion euros. Of this, 18 billion euros were invested in energy projects (including transmission lines – 14.5 billion within the EU, 3.6 billion outside the EU). According to the EIB, its lending for renewable energy projects has more than doubled over the past four years, from 2.2 billion euros in 2008 to 5.5 billion euros in 2011. This is a positive development which needs to be continued by the bank. Between 2007 and 2010, a third of EIB loans in the energy sector still went into fossil fuels (16 billion euros against 13 billion euros for renewables), with investments in renewables *and* fossil fuels growing. At the same time, investments in energy efficiency were almost neglected (only around 5 per cent of energy investments).[48] For EIB investment to be supportive of the EU 2020 targets and the long-term target of a cut of 80 to 95 per cent in EU greenhouse gas emissions, its ongoing support for carbon-intensive energy generation needs to be phased out and investments in energy efficiency and renewable energy must be enhanced. This is all the more true as the EIB has strongly supported fossil fuel investments in central and eastern EU states, locking in fossil fuels in these Member States. No further fossil fuel investments should be given financial support, and ongoing projects should be phased out. In its ongoing policy review, the EIB should ensure that its future lending is targeted towards the achievement of the EU 2020 goals and the long-term climate objectives of the EU. To help finance the transition to a sustainable energy future, the lending portfolio of the EIB requires additional capital or risk guarantees.

3. What role for the Europeanisation of support and remuneration schemes in the medium and long term?

The role of support schemes is evolving alongside the technologies themselves.

First, as new renewable technology costs significantly exceed power prices because many externalities are not internalised, support mechanisms are needed primarily as instruments for market entry and to enable the development of new technologies. At this stage, European discussions will focus on effort sharing between countries.

In the second phase, cost differences will decline and the emphasis of renewable support mechanisms will shift to providing a robust investment framework. This will reduce the rates of return required to raise capital for capital intensive technologies, thus both increasing their competitiveness and reducing costs for consumers. In the second phase, the focus of EU discussions will shift to access and the cost of finance and industry interests.

In the third stage, renewables will become the dominant energy source. Variations in resource availability are likely to increase the scale of the renewable energy trade. EU discussions on renewable energy cooperation will at this stage focus on the topics covered in the energy charter[49] – protecting

48 CEE Bankwatch Network: Carbon rising - European Investment Bank energy lending 2007-2010, 2011, p. 4; according to EIB the actual figures for energy lending 2007-2010 are the following: 5.9 billion euros for fossil fuels, 15.8 billion euros for renewables and 10 per cent for energy efficiency. The reason for the difference between Bankwatch and EIB figures is that there are major differences between EIB and Bankwatch methodology and categorisation of projects (see CEE Bankwatch Network, p. 29-32).

49 Energy Charter Secretariat: The Energy Charter Treaty and related Documents. A Legal Framework for International Energy Cooperation, Brussels 2004. See: http://www.encharter.org/fileadmin/user_upload/document/EN.pdf#page=211

the respective interests and needs of energy exporting- and importing countries and energy technology exporting- and importing countries.

The positioning of a country – or a technology – on this development trajectory has implications for the interaction of EU rules, guidelines and national autonomy with respect to the energy technology mix.

Longer-term visibility and credibility will help to attract investment in pipelines and the supply chain, facilitating increased innovation and reducing costs. The European scale of renewable energy policy will help to match the horizon of internationally active utilities, thus impacting their technology and not only their choice of location.

Stronger Europeanisation in the renewable energy field will help markets with stable investment frameworks to lend some of their credibility to partner countries. The more countries that pursue similar schemes, the larger the common market that will be established. Smaller countries in particular may benefit from more visibility, allowing them to attract additional competitors in a larger scheme for project planning, development and financing. The design of schemes will have to avoid and/or compensate for the risks inherent in their enlargement; the credibility transfer, for example, must not lead to a reduction in the credibility of any of the partner countries.

The governance structures and administrative procedures must be kept as simple and as lean as possible so as to avoid eating up the benefits of inter-European schemes in slower decision-making, higher transaction costs, increased uncertainty and less well-informed decisions. A certain learning process is inherent in all transformations; the primary objective must therefore be to build up an inter-European cooperation scheme that is transparent and is accompanied by a common legislative framework that allows latecomers to enter the scheme easily and accelerate the transition.

Feed-in systems are not inconsistent with the long-term requirement for the flexible operation of renewable technologies once they contribute a major share of power generation. They can, for example, allow system operators to use wind turbines for spinning reserve, or even spill wind, when necessary for the system. In order to retain the stable investment framework, the future energy system needs to incentivise investment in balancing solutions for variable renewables.

3.1. Front-runner groups

Certain countries have been pioneers in advancing the policies and politics of renewable energy in Europe. A group of such front-runner countries can lead by example; it should support the full implementation of the Renewable Energy Directive and, as a next step, should politically advance a meaningful interim renewable energy target of at least 45 per cent for the whole energy sector by 2030. Furthermore, a front-runner group should advance cooperation on research and development and the necessary infrastructural build-out, as well as the flexible balancing of the overall system.

National borders are drawn neither to provide a safe energy supply generated by an optimal mix of renewable energy sources, nor to facilitate the necessary power grid and balancing solutions. Whereas most countries rely exclusively on domestic efforts to reach their renewable energy targets by 2020, many countries underline in their National Renewable Energy Action Plans that, beyond 2020, stronger cooperation with other countries will be necessary. Cross-border cooperation can bring an array of positive synergies, for example in flattening peaks of variable renewable energy and with regard to storage capacities. Cross-border power grid cooperation should be balanced with local and regional integrative energy systems.

National governments need to enhance information exchange and coordination when designing and adjusting national support systems. This can serve to further strengthen policy frameworks. Existing national support systems should be coordinated without endangering the policies that have allowed smart support schemes to help develop a viable industry. Such interlinked remuneration and support schemes should take into account the differing economic and political starting points of different countries. Regional, local and site-specific differences, as well as the need to create a level playing field for producers and stable and affordable prices for consumers, should be recognised during the process of designing these interlinked systems. All such systems should remain open and offer interface options to existing and future support systems in the EU's partner countries, particularly in our immediate eastern and southern neighbourhoods. The key challenge is to develop a system that is sufficiently open and flexible while at the same time providing adequate incentives to ensure investor confidence.

The convergence of support schemes can be most advantageous for renewable energy deployment in a European Union in which more and more Member States are working towards the transition of the energy system fully based on renewables. This paradigmatic change should be supported by the European institutions. In the meantime, the most suitable alternative to the EU-wide harmonisation of support schemes is the connection of front-runner groups, consisting of EU Member States which are already committed to the transition to renewable energy.

While the need for action is too pressing to wait for a Europe-wide consensus on the perfect energy mix, the current national prerogative over the energy mix does not allow for another approach. The past has already shown that front-runner countries can lead technology and policy innovations and others will eventually follow. We therefore suggest that countries that are already committed to a systemic transformation towards renewable energy enter into new cooperative relationships based on the EU Treaty's enhanced cooperation provision. Cooperation could but must not necessarily start at a regional level. Depending on their different starting points, one or more groupings could go ahead, converging medium-term vision and their energy needs.

Investment security must be guaranteed, particularly in the crucial transition phase from national to macro-regional schemes. This could lead to a step-by-step process towards a European Community for Renewable Energy as proposed by the ERENE report. The EU Treaty's enhanced cooperation provision could provide the legal basis for this approach, making full use of the European institutions and the support they can provide.

Countries that join at a later stage could benefit from these insights, as could other Member States that wish to increase cooperation but are located too far away from the first head group.

We promote closer EU cooperation to reach our climate and energy goals. The front-runner group(s) must therefore be open to any Member State that wishes to join. In order to enable the smooth integration of latecomers, the regulation establishing regional cooperation needs to be simple and transparent.

3.2. Cooperation mechanisms

The current cooperation mechanisms provided in the Renewable Energy Directive are a natural starting point for cooperation. These mechanisms theoretically offer the tools for cooperation while accepting that differing Member States have different renewable energy potentials. In practice, however, the cooperation mechanisms of the Renewable Energy Directive are not yet used by Member States. The primary motivation seems to be the availability of local resources and the preference for Member States to attract local investment. Hence, there are no agreements on joint projects or FIT/FIP (feed-in premium) schemes to date. A small number of projects are currently being discussed and negotiations are ongoing in only a few cases.

The exception in the EU is Luxembourg (and possibly Italy), which plans to use cooperation mechanisms to meet its 2020 targets. Furthermore, a joint Tradable Green Certificates (TGC) system has recently been established by Norway and Sweden.

Cooperation mechanisms within the RE Directive and their major characteristics (2009/28/EC)

Statistical transfers between Member States (article 6):
- Only if trajectory and targets are not endangered.

Joint projects between Member States (articles 7 & 8):
- Private operators may be involved.
- New and refurbished installations only.

Joint support schemes (article 11):
- Member States may join or partly coordinate their national support schemes on a voluntary basis
- Distribution by statistical transfer or agreed distribution rule.

Joint projects with third countries (articles 9 & 10):
- Private operators may be involved.
- New and refurbished installations only.
- No support received other than investment aid.
- The electricity produced must be consumed in the EU.

So far, the cooperation mechanisms have been used in very few cases only. The Directive came into force in June 2009 and had to be transposed into national law by the end of 2010. The national action plans already had to be delivered one year after the Directive came into force. Six months earlier the Member States had been required to indicate if they were planning to use cooperation mechanisms to reach their targets and provide quite some detail in their responses. This timeframe played a role because, in order to use the Directive's cooperation mechanism, certain administrative procedures have to be put in place and the country's national legislation has to be amended.

Member States have recognised in their NREAP planning that, in general, their 2020 renewable energy targets do not seriously require cooperation for compliance. Six Member States did however indicate that they could produce a surplus and there should be political consideration of how this potential surplus could best be realised.

In order to reap the benefits of European cooperation, the mechanisms need to be scrutinised and refined. There is a strong case for cross-border cooperation, but the existing mechanisms either lack attractiveness or require further guidance on the details of their use.

Cooperation needs to be facilitated by the EU, and pilot projects should be put in place with the active support of the EU, notably in the offshore wind sector. Procedures, technical codes and legal requirements have to be simplified, open questions about the impact of cooperation on national support schemes must be answered and minimum criteria for support frameworks have to be developed by the EU.

While the use of the cooperation mechanisms remains very limited at present, there is nevertheless evidence to suggest that, to a certain extent, support mechanisms are converging across Europe. A tendency towards evolving cooperation can be observed, but questions of reliability, stability and technology differentiation must first be answered in order for this to flourish.

3.3. Non-compliance

Since the introduction of the RE Directive there have been positive developments in the field of renewable energy in the EU. A preliminary evaluation of the NREAPs finds that Member States envisage delivering a surplus of about 0.7 per cent above the 2020 target. Twenty-five Member States forecast that they will achieve or exceed their binding 2020 targets within national borders. According to the projections of the renewable energy industry, the EU-27 could achieve even better results than these current projections; the industry foresees 24.4 per cent.[50] The national reports on progress made in

50 See: EREC_EU Roadmap 5.

2010 were due at the end of 2011. Some reports were submitted with some delay, but to date, all Member States have submitted the required reports.[51] It is positive to note that most Member States have reached or exceeded their indicative trajectories.

Aside from these positive findings, another recent trend can be observed: Some countries have fallen below their 2009 shares of RE[52] and some countries are revising their NREAPs and/or support policies including downwards revisions of renewable energy targets.[53]

These framework revisions and target reductions undermine investor confidence and risk endangering the achievement of targets. To counteract this negative trend, a clear commitment to the 2020 targets is indispensable. The European Commission has initiated infringement proceedings against several countries whose legislation is not in line with EU legislation. This also underlines the need for specific post-2020 renewables targets. Such targets are essential in order to achieve compliance today as they give a long-term incentive for countries to bring their legislation into line with EU legislation; they also open up the possibility of legal action in the case of non-compliance.

Precautionary action is necessary to pre-empt a trend of non-compliance. It is crucial for a certain course of action to be modelled – and ultimately taken – before there is a high level of non-compliance. A first step on such a course should be the establishment of an 'early warning system' to identify significant deviation from a plan or trajectory.

We suggest that the European Parliament call for the performance of a policy assessment study to examine the likelihood of non-compliance by individual Member States. Such a study would put political and public pressure on those Member States that are at risk of missing their targets before they actually do so. In a second step of the infringement proceedings, the usual tools for enforcing EU law should be initiated. The Commission has already taken this step in recent years, including in 2012. The mere possibility of such an action often has the positive effect of the Member State in question taking corrective action, thus preventing the need to go to court.

4. Recommendations

- The current Renewable Energy Directive creates the right framework for the further growth of the renewable energy industry up to 2020 and has to be fully implemented by all Member States.

- A Europe-wide binding target of at least 45 per cent renewable energy for the energy sector by 2030 should be achieved by building on the current structure of the Renewable Energy Directive, especially by breaking the European target down to binding national targets.

- Markets need to be redesigned for variable renewable energies and their balancing solutions: dispatchable (or flexible) power plants, demand-side management and demand response, energy storage facilities, increased interconnection and the flexible use of all transmission capacity with adjacent markets. The integration of all energy markets (electricity, heating/cooling and transport) as well as balancing and reserve markets, needs to be fostered. Power markets need to be designed in such a way as to provide incentives to deploy the most efficient mix of sources of flexibility.

- Remuneration and a stable framework for investments in renewable energy will be necessary beyond 2020 and needs to be complemented by the necessary administrative or other non-financial measures. The convergence of national support systems in the EU on the basis of feed-in tariffs is the favoured option.

51 See: http://ec.europa.eu/energy/renewables/reports/2011_en.htm

52 See: http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/8-18062012-AP/EN/8-18062012-AP-EN.PDF; http://ec.europa.eu/energy/renewables/reports/doc/2010_list_renewable_energy_targets.pdf

53 Revisions are discussed or planned in 2012 in the Netherlands, France, Spain and Portugal among others.

Tenders can play a role for international cross-border cooperation for large-scale renewable energy projects. The design of tenders needs to take past shortcomings into account and must ensure that a sufficient number of bidders can enter each bid.

Macro-regional cooperation between front-runner groups, consisting of EU Member States which are already committed to the transition to renewable energy, should be fostered. The associated mechanisms should be able to generate incentives for countries to establish a common infrastructure for the use of renewable energy sources, and to voluntarily open up their support systems – or better still have a common support system for the feed-in of power generated in the macro-region. Such a Europe-wide approach of interlinked support schemes should take regional (climatic, geographical) differences, as well as individual countries' different economic and political starting points, into account. It should remain open and offer interface options to existing and future support systems in the EU's partner countries. Inter-European cooperation must be transparent and should be accompanied by clear legislative guidelines, allowing latecomers to enter the scheme easily and accelerating the transition.

Guidance on policies that foster investment in renewable energy and establish a growth-friendly framework for renewables is needed. Such 'Triple-A policies' for renewable energy investments include:

- Increasing policy stability and removing barriers: no retroactive changes, no abrupt policy changes for upcoming projects, simple and transparent permitting and grid access procedures.
- Minimising policy-related costs and risks: no budget/capacity caps, continual access to support.
- Considering the risk (perception) of investors and lenders: allocate risk to the party that can bear it best and design the regulatory framework in such a way that macroeconomically optimal treatment is ensured in order to stabilise policies; reduce project revenue risks.

Part Two – Grids

5. Governance
Where we stand: Current measures to Europeanise electricity grids

The transformation of the European energy system – upgrading Europe's electricity networks to be compatible with an energy future fully based on renewables – is a matter of urgency. Trans-European networks can connect and upgrade national networks (inter alia for higher voltage which can minimise losses) and need to be combined with balancing solutions at the local and consumption unit levels. Decentralised and centralised suppliers provide abundant but variable renewable energy from the sunbelts and windy coasts, or from their own rooftops. In order to transport this electricity to consumer centres, new but also reinforced and upgraded transmission lines, cross-border interconnections and better local distribution networks are required. The renewable energy available locally and regionally often transforms 'classical' consumers into producers, changing the former one-way street of electricity production and consumption to a two-way flow of electricity.

Existing power lines will have to be upgraded and connections to 'energy islands' and new areas of supply and demand strengthened, while separate network capacities (e.g. company or railway networks) will have to be integrated into the grid. The strengthening of public oversight and coordination will also be necessary.

The current electricity grid and energy transport infrastructure, however, has been developed for the needs of the old fossil and nuclear fuel world. This means that not only is it organised around big fossil fuel power plants, it also functions according to a 'base load logic' which will not apply the same way in the future. The European grid therefore requires no less than the entire energy system, a transformation rather than a mere extension.

5.1. What is necessary for the development of a European grid?

The design of the grid is a three-step process:

1. Energy planning: a decision on the energy scenario(s) for the coming decades.

2. Grid planning: a secure and affordable grid for renewable energy must be designed based on the future energy scenario(s).

3. Grid implementation and transformation: the implementation of the grid in line with environmental, social and cost-efficiency concerns, including proper democratic and public participation.

The first two steps, energy and grid planning, are becoming – and have to become – increasingly parallel processes in order to ensure that the planned actions are undertaken in a timely fashion and to enhance investment security. As renewables take on an ever-greater share of the energy mix, both processes have an influence on each other and grid planning can no longer be driven by demand alone. Opinions on the technical feasibility of such a grid and the level of trust in the political will to build a certain grid structure will have a major influence on European energy planning, and vice versa. The successful organisation of this process requires multi-level governance at its best. The energy mix and consequently energy planning remain primarily the prerogative of Member States, although EU renewable energy and climate change targets, as well as the underpinning legislation, are increasingly limiting Member States' room for manoeuvre in this area. Grid planning, on the other hand, has become a mixed responsibility under the provisions of the internal energy market. On the European side, the European Commission – and to a lesser extent the European Parliament – make suggestions concerning energy planning, e.g. the Roadmap 2050. These documents acquire a binding nature until they are enshrined into European law – like the Renewable Energy Directive – decided by the EP and the Council.

A clear guiding principle is important for grid planning, which has long lead times of up to ten years or more. There must therefore be a robust indication of the power mix and the location of renewables infrastructure ten to 20 years in advance to ensure that investor risk can be calculated. A renewables target for 2030 thus minimises this risk, also in relation to transmission and distribution networks. Furthermore, the grid must provide security of supply at all times and be built as cost efficiently as possible. To meet these goals, grid planning and grid implementation have to become faster, more transparent and more predictable. Some of the renewable energy generated in Europe today is already curtailed ('constrained power') because the current underdeveloped grid cannot integrate all of the energy generated from renewable sources. In the long run, in a market with a dominant share of renewable energy, accepting a certain level of curtailment may be cheaper than dimensioning the grid and storage systems for maximal power generation. In the short and medium term, the development of the grid, storage and demand-response and the integration of the energy sectors must aim at reducing the curtailment of renewable energy.

Furthermore, the entire process of grid planning and permitting procedures has to be sped up in order to integrate all of the renewable energy generated and to prevent the deceleration of the pace of development. This is necessary to allay the fears of those investing in power generation facilities of disconnection from the grid.

The optimised use of the transmission grid and integration infrastructure such as storage capacity, demand-side management and the optimisation of local distribution can reduce the need to build new transmission lines and would further speed up the transformation. Storage capacity will have an important role to play in the future energy system; for the time being, however, other flexibility solutions are often more feasible options to balance the grid. An integrated and continuous assessment of the different options to provide a power system largely based on variable generation with the required flexibility is needed – as well as an immediate push for research and demonstration projects.

In the past, grid planning and implementation (both construction and operation) has been almost exclusively a national task. Given that a stronger grid in Europe is already necessary, and will be even more so after 2020 in order to provide Europe-wide clean energy in a stable grid system, a European level has been added to national-level grid decision-making, which has itself had to adapt to the new challenges. Grid planning at the national level has to be advanced, not least through improved internal market rules. At the same time, EU-level grid planning needs to be strengthened via the EU's energy infrastructure package.

We are in a situation of greatly enhanced complexity in which new, old and restructured organisations at both the European and the national level are responsible for managing the biggest energy and grid system transformation ever undertaken. At the same time, the existing legal provisions for nature conservation at the national and European levels have to be fully implemented and taken into account in current and future policy proposals.

5.2. Responsibility for grid planning and implementation

National level: Regulators and transmission system operators

In EU Member States, grid planning is the responsibility of strongly regulated transmission system operators (TSOs). Regulators rely on practical information from the TSOs, who are in charge of transporting electricity and coordinating the supply and demand of electricity and also make detailed proposals for grid extensions to the regulator. In compliance with the Third Internal Energy Market Package,[54] TSOs are required to suggest ten-year grid development plans to the regulator, who will review them and give their

54 See Regulation 714/2009 EC (Art. 8) and Directive 2009/72/EC (Art. 22).

final approval. The implementation of these plans then falls to the TSOs. In contrast to the regulator – which is a public agency – TSOs are companies that are part privately and part publicly owned.[55] In most European countries a single TSO operates in the market, but there are exceptions: the German market, for example, is divided among four TSOs.

European level: ENTSO-E and ACER

The two most important bodies for grid planning and implementation on the European level are the European Network of Transmission System Operators for Electricity (ENTSO-E) and the Agency for the Cooperation of Energy Regulators (ACER).

ENTSO-E was established in order to improve cooperation between TSOs. It currently represents 41 TSOs from 34 countries. A successor of European Transmission System Operators founded in 1999, ENTSO-E was created with the Third Energy Package (Regulation (EC) 714/2009) and became operational in July 2009.

One of ENTSO-E's main tasks is the development of grid codes and of ten-year grid development plans. These plans aim to combine the various national network development plans and to draw attention to projects with particular European added value. Furthermore, ENTSO-E is currently initiating some long-term planning efforts. In 2011, ENTSO-E laid out a three-year study roadmap through the 'Modular Development Plan on pan-European Electricity Highways System'[56] which shall lead the way to a pan- European electricity highway system by 2050.

In the study roadmap, ENTSO-E states that the integration of renewables in the energy system is one of the main objectives of grid planning. In order to achieve this, the linkage to renewables targets and, especially beyond 2020, to grid planning and implementation, needs to be included in the mandates of ENTSO-E and ACER.

As ENTSO-E connects the national TSOs, ACER is its European counterpart for national regulators. It was also founded through the Third Energy Package and started work in 2011. ACER was established to improve cooperation between national regulators and to monitor the work of ENTSO-E.

The process of grid planning between ENTSO-E and ACER involves several steps and includes the development of European network codes. Network codes are basically rules for the secure operation of power systems as well as on power market integration. In the European case they will furthermore set the framework for trading in a European-wide electricity market. Based on the framework guidelines provided by ACER, detailed codes are developed by ENTSO-E. The codes have to be approved by ACER and the European Commission.[57]

The creation of European bodies for grid planning and management with the Third Energy Package, in addition to the establishment of a process in which these European institutions organise grid planning in cooperation with the Commission, was an important forward step in relation to meeting the upcoming challenges. It remains, however, that further improvements to the process of grid planning and a more satisfactory division of power and responsibilities between the actors involved are needed in order to achieve cost-efficient and environmentally sensitive long-term grid and energy system

55 Most TSOs have at least a minimum share of public ownership, with German TSOs being a prominent exception.

56 ENTSO-E: Study Roadmap towards Modular Development Plan on pan-European Electricity Highway System. Way to 2050 pan-European Power System, Brussels 2011.

57 For example, ACER assigns ENTSO-E with a task relating to congestion management. ENTSO-E then has one year to define a network code, which it presents to ACER. In a final step, the European Commission has to approve the proposed network code. If the European Commission does not give its approval, the entire process must be re-started. ENTSO-E's network codes will cover 12 topic areas related to operations, development and market integration. The congestion management and balancing market network codes that are currently developed will have a big impact on the role of renewables in the energy market.

planning. Inherent in the current process is the danger that it may be too bureaucratic and slow to effectively address the challenges involved in grid planning and implementation. At the same time, it lacks the elements of transparency and public participation that are important for the identification of the best solutions and to gain widespread acceptance for the grid.

The European bodies for grid planning are fairly young and some of the existing problems may diminish over time. But as many decisions concerning the European grid will need to be taken in the coming years, the process needs to be improved urgently.

Of the bodies involved in grid planning, it is ACER that brings in the European perspective. In practice, however, the institution does not reflect the EU's stated preference for transformation towards a sustainable society – not to speak of this report's vision of transforming European grids to serve an electricity system based on 100 per cent renewable energy, plus the adjacent heat and transportation systems. ACER also suffers from low visibility and poor recognition within the European institutions and Member States.

In order to ensure that the public interest is taken into account, it is important to strengthen ACER within the grid planning process vis-à-vis both ENTSO-E and, provided the institution receives a mandate to explicitly support a renewables development mission,[58] the Member States and their regulatory agencies. ENTSO-E needs to provide ACER with transparent information. Its tasks and rights need to be clearly defined and enforceable. It is also necessary for ACER to be sufficiently equipped with the technical expertise required to analyse the network and energy market data. Apart from a clear mandate, ACER needs the economic means to finance the extensive data management that is required to fulfil its role.

5.3. Current legal developments in the EU

At present the most relevant legislation with regard to grid implementation are the 'Connecting Europe Facility' (CEF), its separate legislation on the pilot Project Bond Initiative and the proposed Regulation on 'Guidelines for trans-European energy infrastructure,' all published in October 2011.

The Connecting Europe Facility is the financial instrument of the Infrastructure Package and aims to allocate around 9.1 billion euros from the EU budget over the 2014-2020 period to energy infrastructure projects in a combination of innovative financing instruments and grants – so far without differentiating between expenditure on gas infrastructure, CCS, transport infrastructure and electricity networks.

The CEF is a continuation of the development of trans-European energy networks (TEN-E). Despite the rather symbolic nature of the amount available to it for grid planning,[59] for the time being it remains unclear if it can actually be allocated. It is expected that those responsible for budgetary policy at the national level will be particularly likely to oppose this proposal. Investment in grids remains predominantly the preserve of grid companies; the CEF, however, can provide financial support to infrastructure that is not sufficiently attractive to private investors (e.g. interconnectors) but that is necessary for the better integration of the European grid, primarily via financial instruments. Given the current economic state of the EU and the limited funds available, leveraging funding to secure access to capital should be a key priority of the CEF. We support the proposal for a Connecting Europe Facility. The establishment of joint undertakings for the construction and operation of projects financially supported by the Connecting Europe Facility, including the Member States involved in the project and the EU, could also be considered.[60]

58 ACER needs a clear mission to support the transformation of the EU electricity network towards the needs of a system that is aiming for a 100 per cent supply of renewable energy by 2050.

59 As a comparison, in Germany alone, more than 10 billion euros are required by 2020 to connect 10 GW offshore wind capacity. EU-wide, the amount of investment required (calculated on a rather less detailed basis) is over 100 billion euros.

60 See ERENE p.61 f.

The energy infrastructure guidelines set out criteria for the selection of so-called 'projects of common European interest' (PCIs) in the grid system within nine identified priority corridors and three thematic areas. Four of the priority corridors cover electricity networks: **1.** North Seas Offshore Grid, **2.** South West Electricity Connections, **3.** Central South Eastern Electricity Connections and **4.** Baltic Energy Market Interconnection Plan. The proposal also specifies how the selection procedure for projects of common interest in these corridors should be carried out in regional groups. The proposal requires Member States, regulatory authorities, grid operators, ACER and the European Commission to cooperate on cross-border planning and regulation, cost-benefit sharing, pricing and several other issues. It also contains mechanisms for strengthened cooperation in case of difficulties (e.g. the European coordinators) and requirements to improve investment incentives (articles 13 and 14).

Storage is considered to be part of 'infrastructure', which might be especially relevant for pump storage. Furthermore, the proposal elaborates on how the implementation of PCIs should be secured and monitored. Another important goal for the EU in this regard is to considerably shorten the permitting procedures for these PCIs. Every country is asked to establish a one-stop shop or stronger coordination between the authorities involved, and public participation is to be increased in order to make the permitting process faster and leaner and to identify potential obstacles and possible solutions early on. Most of the requirements contained in the proposal are of a very general nature. The European Commission, the Council and the European Parliament need to work towards their specification and implementation.

This working group believes that the proposal on priority corridors is an interesting planning approach. What is missing, however, is the clear commitment that the grid investments in these corridors will facilitate the transition of the energy system to renewable energy. There should be clear benchmarks which serve the overall goal of this transition at all planning levels, in addition to democratic control. The national TYNDPs should be decided on by the national parliaments, while the priority corridors, although not individual projects, should be approved by the European Parliament.

Case study: Offshore wind in Germany

While each renewable energy source has its own particular specifics, the case of offshore wind (OW) energy in Germany nevertheless provides a good illustration of some of the grid-related problems faced by renewable energy.

The first government strategy setting targets for German OW was adopted in 2002. The initial targets were not reached; this was mainly due to insufficient support systems and a lack of binding targets. OW nevertheless remained high on the agenda of the German government, through several changes of government. The current German target for offshore wind is to install 10 GW capacities by 2020 and 25 GW by 2030 (15 per cent of German electricity consumption by 2030).

In Germany, as in Denmark, TSOs are obliged to connect offshore wind farms to the grid.[61] In the 2008 revision of the Renewable Energy Act (*Erneuerbare-Energien-Gesetz* – EEG), this obligation only stood until 2015, creating major uncertainty for the developers of offshore wind farms and for TSOs. In the 2011 revision, the time limit clause was abandoned, putting TSOs fully in charge of offshore grid connection. Nevertheless, this short episode is illustrative of how inadequate policymaking harms investment security and slows down the construction of the necessary grids to offshore parks.

Challenges on the technical side include the long distance of German offshore wind farms from the shore. These challenges can be

61 Effective since December 2006, with the revision of EnWG §17(2a).

overcome, but they do add to the costs: 75 to 100 billion euros of investment are needed to install 25 GW OW in the next 20 years, of which up to 20 per cent would have to go to building grid connections to the mainland. TSOs like TenneT have claimed that the investments required exceed their resources. Critics argue, with some justification, that the TSOs have known of the authorised wind farms for a long time but failed to prepare themselves accordingly. As the connection of offshore wind farms remains highly capital intensive, new investment sources need to be found, whether via public ownership or private provisions. There should also be a stronger role for public banks (EIB, KfW) to facilitate these infrastructural investments.

A stable and long-term regulatory and legislative framework for OW and the related infrastructural set-up could help to reduce investment insecurity, especially the risk of stranded investments, and cut lead times. This would significantly advance the development of OW across Europe.

In the longer run, a more coordinated European approach to OW development and grid connection could bring costs down further. The connection of Europe's large OW farms (40 GW by 2020) would help to make it cheaper to transport the huge capacities generated to load centres on the mainland, as clusters could be created connecting them one by one (hubs), transporting the power generated offshore to the shore via HVDC cables. This procedure might be more expensive in the short term, but would be more cost effective in the long run, thereby creating a more stable grid infrastructure. Again, adequate economic incentives and the provision of investment security are paramount to set the right incentives for operators to choose the long-term option.

5.4. The potential of a European grid: The energy we want and the grid we need

The electricity grid we need in Europe depends on the energy mix – which is only partly determined by European law and otherwise decided in Member States – and the energy system envisioned for Europe's future. The solutions applied for the integration of electricity into the energy system and the mix of other flexible resources will influence the size of grid needed. Possibilities such as the stronger integration of electricity into the heat market are not being taken into account by current grid planners. Currently, the very nature of grid planning prevents the full utilisation of the existing options in order to bring about the transition to 100 per cent renewable energy as quickly and cost-effectively as possible.

Grid planning today can be described as 'coordinated bottom-up planning.' At the European level, ENTSO-E is in charge of coordinating the TYNDPs provided by the national TSOs. The key responsibilities remain with national planning systems. Most importantly, the grid planning process is not yet fit to bring together all of the relevant elements – transmission, distribution and all flexibility solutions.

Grid planning is a reiterative learning process, the TYNDPs are drafted every two years. As experience improves with regard to decentralised solutions or other items, any new insights gained can be integrated into the next plan.

This report focuses on the improvement of the grid planning process in Europe. The policies proposed by the actors involved in grid planning, especially the ENTSO-E TYNDPs, naturally mirror the shortcomings of the system in which they are developed. The following section therefore gives a brief overview of the content of the TYNDPs before moving on to the process of grid planning.

5.5. ENTSO-E's Ten-Year Network Development Plan

Content

The current ENTSO-E TYNDP, published in July 2012, is a clear step forward from the first pilot TYNDP released in 2010. In response to pressure from stakeholders, ENTSO-E included the EU 2020 targets in its new plan. This represents quite some progress from the 2010 version, which was simply a compilation of national grid development plans and had very low expectations for the capacities of installed renewable energy. The new network development plan is thus the first (non-binding) master plan for a European grid.

A further step forward is the prioritisation of infrastructure-related projects in the plan, which includes 100 projects of pan-European significance. These projects represent the major bottlenecks which must be tackled in order to achieve an integrated European grid. Many of these projects consist of several power lines, and there are many grid extension projects. The further prioritisation of the most relevant and important projects therefore seems necessary in order to identify those grid extensions that are most urgent. Apart from clearly identified transmission lines, the network plan also includes so-called 'investment clusters' which cover geographically extensive areas; large parts of the North Sea, for example, are labelled as an investment cluster. The clusters have not yet been described in greater detail; there is no information of landing points within the cluster or capacities. A decision on how the TYNDP and investment clusters will relate to the selection of the 'projects of common interest' is urgently needed.

In total, ENTSO-E recommends building 42,000 km of new assets, of which 70 per cent would be overhead and 30 per cent underground or subsea lines. This is a substantial amount for a ten-year timeframe. Ten thousand kilometres of the lines suggested are existing lines that would undergo refurbishment.

The investment costs of the projects of pan-European significance are calculated at 104 billion euros, which is less than one per cent of the end user's electricity bill over ten years. Five billion euros would be saved per year in system operation costs.

ENTSO-E claims that 80 per cent of its proposed transmission lines are related to the integration of renewable energy. Most of the lines also serve the other major EU energy goals, security of supply and the internal energy market.

Process

The projects featured in the plan were identified using a multi-criteria analysis, with nine different categories. While this more systematic approach is welcomed, the data and the market and grid model used by ENTSO-E are not accessible to third parties. It is therefore difficult to assess if sufficient sensitivity analysis has been undertaken, and to ascertain how many lines could be avoided by a different distribution of renewable energy generation technologies, including more decentralised technologies, and the use of other options to provide flexibility to the system, such as demand-side management (i.e. more intelligent communication within the energy system), further storage technologies and higher energy efficiency. Sensitivity analyses of the refurbishment of lines on the distribution level, and of the establishment of integrative smart energy systems locally and regionally (which can be a cost-effective alternative to the building of transmission lines), have not been taken sufficiently into account.

In addition, the multi-criteria analysis fails to analyse the environmental or social costs or benefits of possible power lines and therefore needs to be improved.

ENTSO-E, being the network of transmission system operators, has provided a power system study which claims that a high number of transmission lines is needed in order to provide the energy system with the necessary flexibility. While it is clear that Europe does indeed need a high number of transmission lines, all other flexible resources available remain untapped or underdeveloped and need to be brought into the future process.

6. Elements for improved European grid planning

The planning of the electricity grid is a huge task and must be carried out in a system with many moving parts. Policies within countries change; the nuclear phase-out in Germany, the development of renewable energy in Spain and the long-term price development of fossil fuels on international markets all have an influence on the European energy market.

Creating an institution to take over the entire energy planning process is therefore inadvisable. An approach that would attempt to bring everything together would be neither politically practicable nor technically feasible. The task is therefore to create a system in which the various gear wheels interlock, rather than turn next to each other.

6.1. Coordinating sources of flexibility: Bringing the actors together

Intelligent grid planning is only possible when all of the elements that bring flexibility into the system are taken into account. Expanding the transmission grid is only one of several options for providing flexibility to a future European energy system based largely on variable renewable energies. To reach a cost-efficient flexible energy system that fully adheres to existing standards of energy security, a broader integrated planning process will be necessary. Over the long term, this will require an integrated planning process in which the relevant actors representing the key options for flexibility (flexibility in demand, flexibility in generation, storage and grids) together contribute to optimal solutions. At this early stage of the energy transformation, it is still challenging to identify key actors or institutions to represent the options beyond grids.

Three improvements could nevertheless be implemented. Firstly, the process initiated recently (with the TYNDP published in 2012) must be improved to include other forms of flexibility, beyond grids, in the planning process. It must be ensured that, for instance, options for demand and generation are sufficiently brought into the grid planning process – for example by involving DSOs, the providers of smart grid technology, actors in capability markets[62] (existing or in the future), and civil society stakeholders. This involvement must go considerably beyond mere 'dialogue without impact', which is how the initial ENTSO-E consultation on the TYNDP is widely perceived.

Secondly, coordinated efforts, including research efforts, should be undertaken by both the EU and Member States to improve understanding of the potential of different flexibility options, including their long-term potential to reduce the need to build long-distance transmission grids. Such efforts should focus on scientific analysis and involve relevant stakeholders (as above) in order to support their involvement and contribution to the grid planning process.

Thirdly, best practices related to the use of flexibility options in national grid planning should be exchanged between Member States. National regulators, as well as ACER, could take on an active role in such an exchange and develop specific knowledge and capacities.

In the long term (e.g. beyond 2025), an improved process and possibly also new institutions may be required in order to achieve an effective and efficient plan for an energy system that makes full and cost-efficient use of all flexibility options. The initial preparations needed for the development of these processes and institutions in the future should begin now, together with the implementation of the improvements described above.

62 See: Meg Gottstein / Simon Skillings, Regulatory Assistance Project (RAP): Beyond Capacity Markets - Delivering Capability Resources to Europe's Decarbonised Power System, IEEE, 2012. URL: http://www.raponline.org/featured-work/beyond-capacity-markets-delivering-capability-resources-to-europes-decarbonised-power

In order to facilitate this, a forum should be established which brings together not only transmission system operators but also distribution grid operators, representatives of the heat and transportation sectors (to allow for the establishment of a smart energy system) and other stakeholders such as energy producers and consumers as well as environmental and civil society organisations.

The forum's exact structure and its membership would depend on the tasks allotted to it. For a continuous dialogue between different stakeholders, a consultative forum at which grid planning could be discussed in more detail should be established. The respective European associations would have to be part of such a forum. At the same time, however, a bridge to the national level needs to be created in order to better link the two levels. This is of particular importance as it is essential that both EU and national-level discussions take into account the debates taking place at the other level. These consultations should not conclude with a binding outcome, but rather give the responsible regulator a better knowledge base for grid planning that is more in line with the needs of the public. This would help to prevent opposition at the later implementation stage – and therefore also help to avoid costly delays.

The consultative process on EU grid planning via ACER and the Commission should be strengthened. The Third Energy Package already contains some requirements on public consultations at the EU and national levels. This framework can still be improved, inter alia by better connecting both levels. Improved consultation processes on grid planning and draft national grid development plans, as well as the underlying assumptions at the national level, can influence the EU level. National regulators should report on the results of the national consultations, both for the scenarios and the draft national grid development plans. The reports should include the arguments put forward by those consulted and an indication of which have been taken into account and which have not. Furthermore, national regulators should be required to carry out strategic environmental assessments (SEAs) and issue an environmental report, as it is requested by the SEA Directive that such an assessment be carried out for national plans with considerable impact on the environment. The results of the national consultations and the SEAs should also be discussed at the EU level and be fed into the European TYNDP consultation.

Information about the national grid planning processes and the results of the national consultations should be made public via a European website to be operated by a public body (either ACER or the Commission) in order to give citizens the chance to compare grid planning procedures in a broader context.

6.2. Transparency and participation

Transparency and the participation of citizens in grid planning, development and implementation are important conditions for public acceptance. The European energy transformation will succeed only if it is a people's project as much as it is a political and technical project.

The majority of European citizens are in favour of renewable energy and are willing to accept new renewable energy installations or the expansion of existing grids for this purpose. At a local level, however, strong public opposition may often arise – particularly in the neighbourhood in which such projects are located. The so-called 'NIMBY' problem ('Not In My Back Yard') cannot always be fully solved, as there may always be a certain level of opposition from residents directly affected by new infrastructural projects. But acceptance of grids and renewable energy installations can be enhanced if the public is involved in the decision-making process, from grid planning to the implementation of single power lines or the planning of RE installations. While it may not be possible to reach full acceptance (meaning that people actually like the outcome), it is possible to reach full legitimacy (meaning that people accept the process as being right and fair). Furthermore, the inclusion of local citizens can actually improve outcomes, with decision-makers able to take advantage of their knowledge of the area. The values and preferences of the local population can be identified and obstacles for implementation identified at an early stage.

The need for grids has to be determined through a transparent process, based on energy planning and fully taking into account alternatives to grid extension. It is important that the public understands which projects or lines need to be built, and on which assumptions, in order to increase acceptance. This is why public participation and transparency should be implemented at the earliest possible point in the process – the energy planning stage. Public participation is furthermore crucial in the spatial planning process in order to bring alternative corridors or technologies into the discussions. It should be the objective of the participatory process to bring the best available arguments into discussions at an early stage in order to increase the likelihood of an optimal outcome and to avoid public resistance where possible. Benefit-sharing schemes for local stakeholders can increase the level of public acceptance and could be made possible on a Europe-wide scale. European law needs to be reviewed in order to enable benefit sharing and public ownership of RE infrastructure.

For participatory processes to become a success, it is important to clearly communicate their purpose, and for the outcome of the process to be open. Not only the opportunities but also the limits of the process need to be clear to all participants in order to avoid raising unrealistic expectations. Furthermore, in order to gain public acceptance of the grid it is essential to effectively communicate the 'whys' – the reasons for its construction – in particular to those citizens that will have to accept an outcome they did not wish for. Aside from early involvement, a continuous dialogue is also necessary to ensure that the different proposals brought to the table are properly addressed in discussions, and to provide the public with feedback explaining which arguments have been taken into account and which have not. This dialogue may help to create mutual trust and willingness to agree on common solutions on both sides, which is indispensable.

Regarding the organisational side of participation, the method needs to be chosen carefully, the right target groups must be involved and the process needs to be professionally moderated.

While some Member States have developed good participatory methods, EU-level grid planning is in need of improvement. ENTSO-E's planning process has to become more transparent, and stakeholders need to have access to all grid and market planning data. With the increasing complexity of energy planning and thus electricity grid planning, the building of stakeholders' and other actors' capacities to fully participate in the planning process is essential.

Transparent, participative processes are vital in order to convince civil society of the need for grid investments. Public acceptance is then needed to ensure fast and cost-effective grid implementation.

In addition to increased transparency and public participation, other elements could also enhance the acceptance of new energy infrastructures. These include benefit-sharing models, attempts to avoid settled areas and alternative technologies such as HVDC lines or undergrounding solutions. Such alternatives should be considered on a case-by-case basis. Deliberations should take into account the budgetary effect of the more rapid implementation of alternatives, e.g. due to the higher acceptance of underground solutions compared to overhead lines. For example, recent studies have shown that the additional costs related to cables are limited. This means that in some cases it can be more cost effective to partly use cables instead of overhead lines as this might reduce public resistance and hence speed up permitting procedures and reduce the overall cost of the project.[63]

63 BMU-Studie 'Ökologische Auswirkungen von 380-kV-Erdleitungen und HGÜ-Erdleitungen'. This study concludes that costs for a HVDC cable compared to a high-voltage alternating current cable (HVAC) overhead line rise by a factor of 2.1 to 8.8 which is significantly below previous estimates.

Grid planning in the context of the German energy transition

In the context of the *Energiewende*, the German parliament has decided to amend existing rules on grid planning and to adopt a new law on permitting procedures for intra-regional power lines. At both levels of the process, public participation shall be promoted and transparency increased.

The revision of article 12 of the Energy Act (*Energiewirtschaftsgesetz* – EnWG) deals with new provisions on grid planning and shall contribute to a more transparent and participatory process. Furthermore, the process consists of several steps. The idea is that once a decision has been taken at one level, the same issue shall not be discussed again at a later stage. TSOs are obliged to develop a set of three energy scenarios for the next ten years in line with the political goals of the government. These three scenarios are evaluated and approved by the German regulator (*Bundesnetzagentur* – BNA) after a public consultation. More than 70 organisations participated in the first scenario consultation in autumn 2011. In December 2011, the *Bundesnetzagentur* amended the TSO proposal and changed some of the assumptions within in. Based on this, TSOs have to propose a draft grid development plan which shall also be open to public participation. In May 2012, the first draft was presented to the public via the Internet (www.netzentwicklungsplan.de).

After the public consultation and possible changes, the TSOs will transmit their draft to the regulator. At this stage, a strategic environmental assessment (SEA) as well as an additional public consultation will be carried out by the regulator. The regulator will then prepare a draft proposal for a federal grid plan which has to be approved by the German parliament. This law then determines the need for grids for the coming years. It will be subject to review every three years. Another important provision of the Energy Act is the fact that the relevant data, including load flow data, is passed to the responsible ministries and can under certain circumstances also be obtained by third parties.

When it comes to the implementation of intra-regional power lines, the new Acceleration Law (*Netzausbaubeschleunigungsgesetz* – NABEG) will streamline and speed up permitting procedures. Spatial planning shall be implemented at the national level by the regulator. Under certain circumstances, the regulator may also lead the permitting process, which is traditionally managed by the regional authorities. The new permitting procedures go hand in hand with improved public participation. The application conference which determines the scope of the application file for a power line shall be open to the public. Furthermore, a consultation as well as a public hearing shall be held. Information on the permitting procedures will be made available not only by local authorities but also via the Internet and the local press.

As these rules on grid planning and permitting procedures are still very new, it remains to be seen how much they can contribute to increasing the legitimacy of new power lines. The process has become much more transparent than in the past. Some criticism has already been voiced, however, due to the fact that some issues such as demand-side management and other means to reduce the need for grids have not been taken into account in the scenarios. As TSOs have to develop a new draft of the national grid development plan every year, however, there is still the opportunity to bring in a learning process in which new ideas and knowledge are taken into account.

6.3. Using what we have: Best practice in Europe

The fragmented nature of the planning process can be an asset, with the different systems offering various ways of tackling the problems that arise at a national level before they begin to become troublesome at the European level. The strongest points of the national grid planning systems should be identified and transferred to the European level. The development of a strategic vision will therefore be a dynamic ping-pong process: the EU formulates some general requirements (e.g. the Third Energy Liberalisation Package), Member States go beyond compliance and best practice serves as a blueprint for improved EU rules on participatory, transparent grid planning which puts public policy goals such as climate mitigation and renewable promotion at centre stage. In such a system, the second and third ENTSO TYNDPs should match public policy goals better than the first version. For example, grid planning in the Nordic countries and in Germany has identified solutions to participation and transparency problems that remain unsolved in the European arena. In the German grid planning process, a set of scenarios is developed and the strongest are identified. While the scenarios are developed and presented by the TSOs, other stakeholders have the opportunity to give their feedback. Furthermore, the regulatory agency has a key role in matching private business models with public policy goals. The final decision lies with the parliament. Functioning solutions that already exist in Europe, for example for the stronger integration of stakeholders, should be Europeanised.

6.4. A hybrid approach

It is necessary to find a middle way between a purely step-by-step approach and a big blueprint for Europe. The latter holds the danger of getting mired in discussions that cannot be solved in due time, given the existing European decision-making process. The risk of the former is that poorly fitting systems may be constructed adjacent to one another, thus making it more difficult to transform the whole energy supply towards renewable energy and deprive us of the chance of reaching 100 per cent renewable energy by 2050.

It is therefore advisable that forums be created in which the European system can be developed while leaving the binding decisions to Member States or to regional groupings. The Europe-wide model is needed not only from a technical perspective but also in order to enhance cooperation on a political level as the energy system evolves. Existing feasibility studies state that 100 per cent renewable energy in Europe will only be possible with strong European cooperation; there is therefore no alternative to greater Europeanisation in the long term. The foundations need to be laid now.

7. Recommendations

- The process of grid planning has to be re-designed to ensure maximum flexibility and resilience within the system, while guaranteeing a planning process that is inclusive, transparent and democratic. Options to be included are demand-side management, the integration of energy systems and the potential of smart grids, including decentralised generation capacities and the optimisation of power lines and storage, as well as a more intelligent communication within the energy system.

- A stakeholder forum should be established using the smart grids task force as a model. A complete list of stakeholders still needs to be drawn up but would include ENTSO-E, ACER, the DSOs, providers of smart grid technology, actors in capability markets and representatives of the heat and transportation sectors. Other stakeholders such as energy producers and consumers as well as environmental or civil society organisations should also be included.

- The public interest needs to be better reflected in European grid planning. Public participation and transparency should be brought into the process as early as possible – thus at the energy planning level and in the spatial planning process – so that alternative corridors or technologies can be discussed in order to identify the optimal outcome and to avoid public resistance where possible.

ENTSO-E's grid planning process still lacks transparency. Public involvement needs to be enhanced and consultation procedures improved. Stakeholders must have access to all grid planning and market planning data. With the increasing complexity of energy planning and thus electricity grid planning, the capacities of stakeholders and the various other actors have to be built up to allow them to fully participate in the planning process.

The EU grid planning consultation process could be strengthened by incorporating a public consultation carried out by official EU bodies (either ACER or the European Commission), who would then in a next step give an opinion on the TYNDP proposal. Improved consultation processes at the national level can influence the EU level: national regulators should report on the results of the national consultations, including the arguments put forward by those consulted and an indication of which of these have been taken into account and which have not. The results of the national consultations should also be discussed at the EU level and fed into the European consultation.

Best practice should serve as blueprint for improved EU rules on participatory, transparent grid planning which puts public policy goals such as climate mitigation and renewable promotion at centre stage.

ACER's mandate should be altered to ensure that the European public interest is served with regard to grid planning. To fulfil this task, ACER needs to be sufficiently equipped with the necessary technical expertise to analyse the network and energy market data. ACER needs the economic means to finance the extensive data management. ACER should become a bridge between the different levels – local, national and European – of European grid and energy system planning in order to identify the right balance between the European grid and the potentials of regional, often labelled 'decentralised,' electricity and energy solutions, ACER will need sufficient resources in order to do justice to this expanded role.

Benefit-sharing schemes for local stakeholders can increase the level of public acceptance and should be made possible on a Europe-wide scale. European law has to be reviewed in order to enable benefit sharing and public ownership of renewable energy and grid infrastructure.

The process of selecting and developing the infrastructure needed for a transformation to a renewable future needs to be both streamlined and accelerated. The current proposals should be improved; this can be done by establishing a clear link to the EU's long-term energy and climate targets, by better public involvement in the PCI selection procedure and by fully implementing nature protection legislation.

A revision of the Treaty Establishing the European Atomic Energy Community is overdue. All provisions on creating the conditions for the speedy establishment and growth of the nuclear industry should be deleted and the Treaty should concentrate on protection and security matters. The democratic deficit must be closed, giving the European Parliament full co-decision rights and the European Citizens the right to take European Citizens Initiatives on the issues of that Treaty.

In a future revision of the European Treaties, the provision of article 194 (2) TFEU which states that it is the right of Member States to determine their energy mix and the general structure of their energy supply should be reconsidered. This provision should be clarified so as to guarantee that national energy policy choices do not foreclose European policy options. There should also be a clear preference given to renewable energy, environmental integrity and the fight against climate change.

LIST OF ABBREVIATIONS

ACER	Agency for the Cooperation of Energy Regulators
BNA	Federal Network Agency (Bundesnetzagentur; Germany)
CCS	Carbon Capture and Storage
CEF	Connecting Europe Facility
CHP	Combined Heat and Power
DSO	Distribution System Operator
EC	European Commission
EEG	Renewable Energy Act (Erneuerbare-Energien-Gesetz; Germany)
EIB	European Investment Bank
ENTSO-E	European Network of Transmission System Operators for Electricity
EnWG	Energy Act (Energiewirtschaftsgesetz; Germany)
EP	European Parliament
EREC	European Renewable Energy Council
EREF	European Renewable Energies Federation
ERENE	European Community for Renewable Energy
ETS	Emissions Trading System
EU	European Union
FIP	Feed-in premiums
FIT	Feed-in tariff
GHG	Greenhouse gas
GW	Gigawatt
HVAC	High-voltage alternating current
HVDC	High-voltage direct current
IA	Impact assessment
IEA	International Energy Agency
kWh	Kilowatt-hour
MoDPEHS	Modular Development Plan on pan-European Electricity Highways System
NABEG	Acceleration Law (Netzausbaubeschleunigungsgesetz; Germany)
NIMBY	'Not In My Back Yard'
NREAP	National Renewable Energy Action Plan
OW	Offshore wind
PCI	Project of common interest
PPA	Power purchase agreements
PV	Photovoltaics
RE	Renewable energy
RES	Renewable energy sources
SEA	Strategic environmental assessments
TEN-E	Trans-European energy networks
TFEU	Treaty on the Functioning of the European Union
TGC	Tradable Green Certificates
TSO	Transmission system operator
TYNDP	Ten-Year Network Development Plan
VMM	Volume market model

DEFINITIONS

Carbon capture and storage
Carbon dioxide capture and storage (CCS) is a process by which the carbon dioxide released during the combustion of coal is condensed and stored underground. The aim is to reduce the greenhouse gas emissions of coal power plants. CCS technology is currently still under development: there are only small-scale pilot plants in operation at present exhibiting low performance and low efficiency. As CCS requires large amounts of energy, the efficiency of coal-fired power plants is thus reduced and more fossil fuels must be used. The use of CCS would also create new legacies for future generations.

Network codes
The third legislative package for the internal energy market calls for ENTSO-E to draft network codes on the basis of framework guidelines adopted by ACER. The network codes will cover 12 topic areas related to operations, development and markets. These codes will establish a framework that guarantees effective system operation, market integration and system development in the form of a binding EU regulation.

Variable power
Wind and solar produce variable amounts of electricity, depending on weather conditions. Variable power needs a new energy and grid system to balance supply. Solutions to the challenges of variable power include bigger and smarter grids that are able to balance weather conditions and storage capacities. Dispatchable renewables such as pumped storage or biomass can cover times of low supply from variable sources.

Syngas
Syngases (synthetic gases), generated through electrolysis in a process which can be powered by renewable electricity, consist primarily of hydrogen (or, via a modified process, methane). Peak electricity supply from variable sources can be used to produce syngas, which, in contrast to electricity, is easily stored.

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The European Union needs a common vision for its energy future. A shift towards renewable energy sources will increase the security of supply, foster the competitiveness of the European economy and facilitate sustainability. In order to convince governments, businesses and European citizens to support this shift, it is necessary to demonstrate the practical feasibility of the vision.

We are now at a critical point in time to accelerate the transition to renewables in Europe and to make necessary investments and adjustments. Around two thirds of all power plants will have to be replaced in the coming years. At the same time, large parts of the European transmission and distribution grid require modernisation and are in need of reinvestment. With the phase-out of nuclear power in several European countries, opportunities to replace large quantities of nuclear energy with renewables are plentiful.

The Heinrich Böll Foundation commissioned a working group of experts from politics, industry, applied science and civil society who have considered these challenges. As a result of a series of expert meetings, this report 'A European Union for Renewable Energy' provides a collection of policy ideas for two key areas that will define the future of renewable energy development in Europe: grids, and support and remuneration schemes for renewables. The report shall serve as a stepping stone on the path to our sustainable and renewables-based future. At a moment of deep economic and institutional crisis in Europe, the vision of a 'European Union for Renewable Energy' is a positive project to give the EU a new push for integration.

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