January 2013
ISSN 1863-2025

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

eco@work

Sustainable reading from the Oeko-Institut

Sustainable energy system transformation

Are we making progress?

Europe
Dr Susanne Nies on investing in power generation

Moving a step closer to energy system transformation?

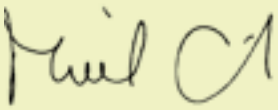
Autumn 2012 was dominated by energy transformation issues. The controversy among Germany's energy experts over the restructuring of the electricity markets has been ongoing since September. In October, the increase in the 'green electricity' surcharge payable under the Renewable Energy Sources Act featured prominently on the energy policy agenda. And at an energy summit in the Federal Chancellery in November, the Federal Government and the German states agreed to do more to work in tandem and adopted joint targets for grid expansion and the development of renewables.

The Oeko-Institut has provided major input to these discussions. In the heated debates about rising electricity prices, we took a closer look at whether the reasons for the price hikes relate solely to energy policy (see first article in the 'Knowledge' section). The answer is no – as we explained in numerous discussion sessions. We are also convinced that the general public needs to be involved in the debates about the costs of energy system transformation and on other often contentious infrastructural planning issues – and that a high degree of transparency is essential here. Not least, we are devising solutions to practical issues such as the restructuring of the energy markets and are encouraging debate about these solutions among policy-makers and the energy industry alike (see the two main articles in this issue of eco@work).

Our annual conference this year focused on energy system transformation and made a further contribution to the policy debate. Key topics on the agenda at this day-long event, which attracted more than 160 participants, were grid expansion, electricity market design, ways of involving the public, and the specific conditions required for the expansion of storage systems and other flexibility options. This issue of eco@work includes a review of the conference and summaries of various contributions to the debate. It also presents the latest research findings.

One day is certainly not enough to profile all the challenges we face in the transformation of our energy systems, let alone find solutions – nor is there enough space in eco@work to answer all the questions. But as always, our online issue offers you further links and a full conference report, including videos, a picture gallery and access to all the presentations (www.oeko.de/jahrestagung2012). I personally am convinced that every day brings us a step closer to sustainable energy systems. And that's a must – for there are no alternatives to a low-carbon world.

I hope you enjoy this issue of eco@work and are excited by the insights it offers into our work.



Michael Sailer
CEO, Oeko-Institut
m.sailer@oeko.de

Contents

Impressum

eco@work – January 2013, Published by: Oeko-Institut e.V.

Edited by: Mandy Schossig (mas), Christiane Weihe (cw)

Responsible editor: Michael Sailer

Translated by: Christopher Hay, Klaus Sticker

Design/Layout: Tobias Binnig, www.gestalter.de

Technical implementation: Markus Werz, Wilhelm Innovative Medien

Address of editorial office: P.O. Box 17 71, 79017 Freiburg, Germany
Phone: +49 (0) 761/452 95-0, Fax: +49 (0) 761/452 95-288,
redaktion@oeko.de, www.oeko.de

Account Details for Donations:
Sparkasse Freiburg – Nördlicher Breisgau,
Bank Code No.: 680 501 01, Account No.: 2 063 447
IBAN: DE96 6805 0101 0002 0634 47, BIC: FRSPDE66
GLS Bank, Bank Code No.: 430 609 67, Account No.: 792 200 990 0,
IBAN: DE50 4306 0967 7922 0099 00, BIC: GENODEM1GLS

Donations are tax-deductible for German income tax purposes.

Increased incentives for investing in European power generation

By guest columnist Dr Susanne Nies

Investing into the long-term power future of Europe is a particular challenge these days. Distorted markets, decreased demand while ensuring security of supply against the backdrop of missing interconnections – all of this is fuelling the challenge. Moreover, a tightened financial framework as well as insufficient profit margins make it imperative for power producers' financing partners to scrutinize envisaged investments.

The main problem as regards the currently poor investment climate are volatile and unpredictable fast-shot policies, creating a vicious circle of volatile regulation, decreased attractiveness of utilities and deterred investment. Other factors such as the sovereign debt crisis or power prices which are not delivering meaningful signals further contribute to the currently depressed business sentiment.

However, regional or national trends are often more nuanced. Scandinavia, for example, is facing investment difficulties to a lesser extent than other regions, at least until 2020, thanks mainly to a more stable regulatory framework. A more regional approach, the structure of the generation portfolio as well as more consistent policies can all explain these national/regional differences. Moreover, the sovereign debt crisis has translated into tighter (i.e. costlier) lending conditions in some countries and has forced several companies to adopt divestment programmes to maintain their credit ratings.

In times of economic down-turn, capital rationing makes prioritisation in budget allocation even more crucial. We need to keep Europe's competitiveness in mind, because economic efficiency must be the key principle in transitioning to a low-carbon economy. This necessitates a more European approach and stronger confidence in the markets to avoid stranded subsidies and stranded investments.

We need to strengthen the European energy industry's strategic position in the emerging global low-carbon economy. What we further need is a well-developed innovation policy, targeted towards the entire energy value chain. Such a pragmatic refocusing can give rise to innovative, cutting-edge products that can also be exported to the rest of the world.

After more than a decade with liberalisation as the cornerstone of the EU's energy policy, new priorities like emissions reduction now require that a new balance be struck between market forces and government intervention. Governments, however, appear to be tending towards re-regulating the energy systems – even before liberalisation and the internal energy market are fully implemented in Europe.

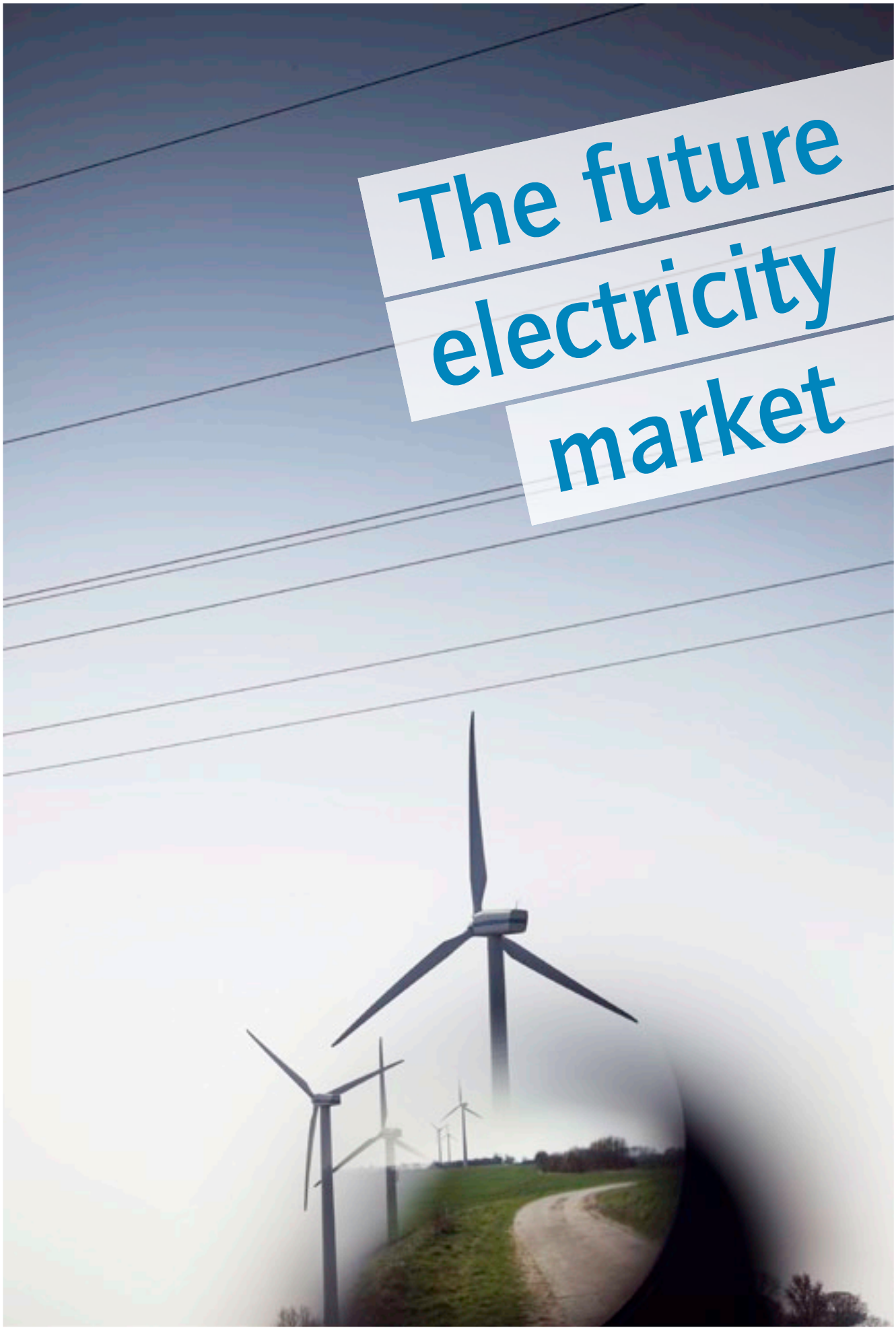
What is more, we need centralised and decentralised power generation as well, depending on where plants are located. Focusing decentralised generation seems like a return to the past when electricity generation and supply were a local affair – until it was found that economies of scale would lower overall costs. Among European regions there appears to be a trend of setting 'energy independence/autonomy' objectives, attaching little value to the level of inter-connection in Europe. Decentralised solutions, of course, are of particular importance. However, they are no panacea.

Capacity remuneration mechanisms (CRMs) are increasingly common in Europe. Nevertheless, they are no miracle cure against all ills of the current market design. Instead, we should deal with the root cause of the currently weak price signals and remove market distortions. Specific initiatives to additionally remunerate conventional back-up and reserve capacity might be appropriate in some Member States to ensure security of supply. Yet there is reason for concern that diverging decisions and proposals will hinder market integration, increase fragmentation and lead to distortions in competition between power producers. To avert this, the European Commission needs to elaborate guidelines and determine criteria to better streamline and coordinate different national policies. Decision makers should strive for a common understanding – that we must be more European while keeping with the principle of subsidiarity, that we must be more market-oriented, and that we, in a joint effort, must advance renewables, investments and innovations.

snies@eurelectric.org
www.oeko.de/124/values

Dr. Susanne Nies is Head of Unit Energy Policy & Generation at EURELECTRIC, the sector association of the European electricity industry, having as it's full members 33 national associations, and through these, the power industry. www.eurelectric.org informs about the results of the organisation's investment action plan.

The future electricity market



Market design and capacity markets

'How' is a complex question. How must our electricity supply system be restructured to accommodate renewable energies? How can we develop an appropriate infrastructure? And how can we make emissions trading fit for purpose? The question, then, is 'how', not 'if': for there is no alternative to energy system transformation. It has a vital role to play in mitigating the impacts of climate change and in avoiding the uncontrollable risks associated with nuclear power. The restructuring of the fossil fuel-based energy supply towards a renewable system will take decades – and many of the questions to be resolved will start with 'how'. One of the most important issues is the design of the future electricity market.

Energy system transformation needs a long-term approach and long-term planning – as the debates at the Oeko-Institut's annual conference in September 2012 clearly showed. 'We need to get used to the idea of a restructuring process comprising many small steps,' says Dr Felix Christian Matthes, energy and climate policy research coordinator at the Oeko-Institut. 'After all, there are numerous aspects to consider – from technical matters to the European dimension.' He emphasises the need to focus on overarching issues and set the right policy course – for example, by designing an infrastructure with the capacity to accommodate an expanded renewable energy sector (see 'Well networked? A smart infrastructure for energy transformation', p. 8). 'In addition, the future design of the electricity market is a key issue in the current debate about energy system transformation,' say Felix Matthes. 'With the market in its current shape, sustainable integration of renewable energies is unworkable.' The Oeko-Institut expert is therefore a fervent champion of capacity markets – and in his view, a redesign of the current market is unavoidable in the medium term.

The 'energy only' model: are its days numbered?

Over the long term, today's 'energy-only' market cannot safeguard security of supply in the wake of energy system transformation and increasingly variable electricity generation from renewables, says Felix Matthes. 'Our horizontal electricity supply system with base, medium and peak load will become obsolete over the short or long term,' he says. 'So we need a vertical system which can accommodate many different aspects. For example, is the wind power feed-in high or low right now? Are imports up or down? Is the load high or low?' An electricity market based solely on payments for each kWh sold cannot cope with these diverse demands. 'We need an electricity market which also rewards the provision of capacities,' explains Felix Matthes. 'That's the only way to ensure that it is worthwhile for power plant operators to invest in the power plant capacities which we urgently need to cover residual energy demand.'

But creating strategic reserves – similar to the strategic petroleum reserves – which would ensure security of supply in the event of bottlenecks occurring in the renewables sector makes little sense, according to the energy and climate policy researcher. 'That simply postpones the problems – it's not a long-term solution,' says Felix Matthes. 'We need to start thinking today about appropriate market mechanisms – and allow plenty of time to implement them effectively.'

Capacity markets – the alternative

So it seems that 'capacity market' is the key phrase for now – but what does it actually mean? It means creating power plant capacities which can be deployed on a flexible basis if bottlenecks arise in the renewable-generated power supply. In the Oeko-Institut's view, highly efficient power plants fired by natural gas or combined cycle gas turbine (CCGT) plants (which use gas in combination with steam turbines) are particularly good solutions here, also from an environmental perspective. Operators are paid for creating and maintaining power plant capacities. 'At present, our residual energy demand is being met primarily by existing conventional power plants which date back to the era of the state monopolies and in most cases are destined for closure,' says Felix Matthes. 'But now that the transition to a liberalised electricity market is complete, new investment is needed. Incidentally, that would be the case even without energy system transformation.'

So which specific form should capacity markets take? To answer this question, the Oeko-Institut, in cooperation with LBD Beratungsgesellschaft and law firm RAUE LLP, has produced a study on 'Focused Capacity Markets' for the World Wide Fund for Nature (WWF). The proposed model consists of two different segments: 'existing power plants' and 'new power plants'. In the 'existing power plants' market segment, power plants at risk of decommissioning compete with dispatchable load (demand response) for capacity payments for one or four years. This takes place via an auction at the Power Exchange (bourse). In the 'new power plants' market segment, power plants which fulfil high flexibility demands and environmental requirements and new electricity storage compete for capacity payments over 15 years.

'Regardless of which capacity market model we're talking about, five aspects must always be considered in its evaluation,' says the Oeko-Institut expert, outlining researchers' basic expectations of any proposed model. 'These five aspects are: the contribution it makes to security of supply on the electricity market, minimising the costs for consumers, maintaining a high level of competition on the electricity mar-

How – and how soon?

ket, environmental and climate goals, and the contribution to restructuring the supply system.' The 'focused capacity market' model outlined, with its different operating times, offers numerous advantages – a point which is underlined by Felix Matthes. 'It offers investors and operators more security for their forward planning, while also boosting competition and thus exerting downward pressure on costs,' he explains. 'The focused capacity market also enables dispatchable load to be accommodated, storage facilities to be integrated effectively, and a highly flexible generation mix to be developed.' When looking at possible ways of implementing the model, the Oeko-Institut's experts considered not only how this can be achieved but also how soon. And they conclude that the first auctions could take place in the next three to four years, with the first new power plants coming into operation within seven to eight years – providing effective support for the final phase-out of nuclear power.

Christiane Weihe

f.matthes@oeko.de
www.oeko.de/124/knowledge1

Energy system transformation and electricity prices

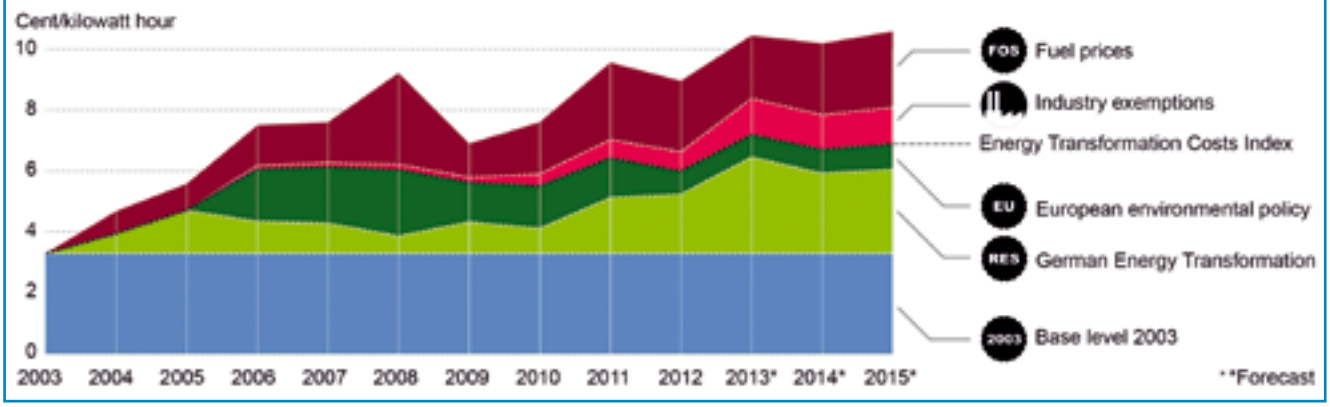
The costs of transforming the energy sector account for just over half the electricity price increases since 2003, according to an analysis by the Oeko-Institut. The Energy Transformation Costs Index (ETCX) tracks the development of key factors influencing electricity price trends from 2003 to 2015 (see graph). It distinguishes between costs attributable to energy system transformation – i.e. the surcharge to promote renewable energies ('EEG apportionment') and the costs of CO_2 allowances – and general electricity price trends. These are influenced by rising fossil fuel prices, but also by redistribution effects. They arise because major electricity consumers and energy-intensive industries pay far less or, indeed, nothing at all towards funding renewables under the Renewable Energy Sources Act (EEG) and promoting combined heat and power generation (CHP). It must also be borne in mind that the quantities of promoted electricity in the wholesale electricity market have a downward effect on prices.

The ETCX shows that for the average of a typical procurement structure for supplies to final customers in Germany, the fuel price increase amounts to approximately 2.1 ct/kWh for the period 2003-2013. The practice of offering exemptions to industry led to a price increase of 1.2 ct/kWh. Due to energy system transformation, electricity prices will have increased by 3.9 ct/kWh by 2013, compared with 2003. Overall, general electricity price trends account for around 46 per cent of the price increases between 2003 and 2013 (fuel prices: 29 per cent, exemptions for industry: 17 per cent), while 54 per cent of the costs can be attributed to energy system transformation in the broadest sense (surcharge to promote renewables: 44 per cent, CO_2 costs: 10 per cent). Looking ahead, the Oeko-Institut's experts anticipate that the renewable energy surcharge will stabilise by 2014.

The key difference between the ETCX and many other analyses, which mainly investigate the impact of the Renewable Energy Sources Act (EEG) on price trends, is that it focuses on the other price elements mentioned as well. Furthermore, the ETCX takes account of the price-dampening effects of the promoted electricity quantities in the wholesale electricity market. It can thus be regarded as a robust indicator which is a useful and appropriate tool in assessing key factors influencing electricity price trends. In the view of the Oeko-Institut, the ETCX should therefore be used as an assessment indicator for energy policy instead of the parameter currently used for this functionality (i.e. cost apportionment under the German EEG), which is unsuitable for this purpose.

The Energy Transformation Costs Index (ETCX), 2003-2015

Development of key factors influencing electricity prices



Well networked?

A smart infrastructure for energy transformation

Renewable energies are sustainable, good for the climate and future-proof. What they cannot offer, however, is long-term predictability. They supply large amounts of energy on sunny or windy days, but when the wind drops, for example at night, so does output. In short, renewable energies fluctuate. It's a factor which the power infrastructure must accommodate, so radical adaptations will be required as renewable energies are integrated more fully into the power supply. For example, high-voltage transmission lines will be needed to connect northern regions, with their growing wind power output, to the south of Germany, which until now has relied heavily on nuclear power. Three corridors for high-voltage DC transmission lines will be required over the next 10 years, at least according to Germany's 2012 Network Development Plan for Electricity.

By 2050, the proportion of gross electricity consumption contributed by electricity from renewable energy sources should be at least 80 per cent in Germany: that's the target set in the German Government's Energy Concept. By comparison, renewables accounted for around 20 per cent of gross electricity consumption in 2011. The planned increase will make major demands on infrastructure and especially the power transmission grids. Hauke Hermann, a researcher at the Oeko-Institut, knows that these demands will be much greater than ever before. 'In order to integrate renewable energies, we need a new and smarter infrastructure,' he says. At present, the transmission network is mainly geared towards fossil fuels and short distances between producers and consumers. 'But the energy transformation means that this will have to change,' says Hauke Hermann. 'The future power grid will have to cope with fluctuating feed-in from renewable energies, as well as much longer transmission routes.' There's no doubt that this will require major restructuring of the system, as well as substantial investment. 'But in recent years, investment has remained at a fairly low level,' the Oeko-Institut's researcher explains.

The power grid in 2022

Which steps need to be taken to upgrade and expand the power grid? The answer to this question will be provided year on year by the country's four grid operators – 50Hertz, Amprion, TenneT and TransnetBW. They have drawn up a joint Network Development Plan for Electricity, which identifies the necessary grid expansion measures over the coming 10 years. The objective is secure and reliable network operations. The Network Development Plan is based on various predicted electricity consumption and production scenarios, including the B 2022 scenario, adopted by the Federal Network Agency as the lead scenario in the 2012 Network Development Plan. This envisages a 48 per cent share for renewable-generated electricity in feed-in by 2022, with 26 per cent coming from wind farms (17 per cent onshore and 9 per cent offshore), 8 per cent from photovoltaics, and 14 per cent from other renewable sources.

But before a Federal Demand Plan based on the Network Development Plan can be presented as anticipated in 2013, it underwent close scrutiny by the Federal Network Agency as well as two public consultations in 2012. 'This process is of course based on best practice and is important in increasing 'ownership' of infrastructural expansion and restructuring,' says Hauke Hermann. 'After all, projects of this nature often cause conflicts, especially at the local level.' The 2012 Network Development Plan, which has been approved by the Federal Network Agency, does not define any specific power transmission routes, nor does it make decisions on overhead power lines or underground cables. However, it does recommend the use of high-voltage DC transmission lines and states that three corridors are to be created for this purpose by 2022. The Federal Network Agency is also preparing an environmental report which assesses the environmental impacts of the planned grid expansion and will be published together with the Network Development Plan.

According to Hauke Hermann, the outcomes of the 2012 Network Development Plan point in the right direction. For example, new transmission lines will undoubtedly be required to complete the final steps in the nuclear phase-out as well. Nonetheless, in his view, the Plan needs some fine-tuning. 'Together with the Technical University in Berlin and the German Institute for Economic Research, we submitted a position paper for the first consultation,' Hauke Hermann reports. 'In it, we pointed out that there is considerable room for improvement, for example as regards transparency and data availability, the credibility of the figures on which network modelling is based, and also with regard to alternative market designs for managing supply bottlenecks.' Furthermore, in their joint paper, the three institutions lament the lack of coordination in the planning process under the Plan, notably as regards transnational grid expansion. They also cast a glance to the future development of the Plan beyond the years modelled, and call for a consistent focus on the goal of renewables expansion and safeguarding a secure and affordable power supply.

One significant, indeed fundamental problem affecting grid expansion is the failure to demand an appropriate contribution from fossil power plants and electricity transits towards covering the costs of grid expansion within Germany, says the Oeko-Institut expert. 'This is due to the current market design with its single price zone,' he explains. 'Solutions to this problem will have to be found over the next few years – starting at the political level.' This is unlikely to affect the Network Development Plan – whose general tenor is very much welcomed by Hauke Hermann – until the second phase. 'If the energy transformation is to succeed, we will definitely need new north-south electricity transmission routes,' he says. 'And in determining the exact dimensions of these routes, the Network Development Plan and its associated process are the right way to go.'

Christiane Weihe

h.hermann@oeko.de
www.oeko.de/124/knowledge2

Flexibility and storage systems

Increased storage capacities and more flexibility options are essential for the efficient expansion of fluctuating renewable energies. Until now, conventional power plants have been used to adapt output to the available supply of renewable-generated electricity on a flexible basis. Over the medium term, however, a sustainable electricity supply needs alternative flexibility and storage options in order to increase efficiency and cut costs and CO_2 emissions – despite the high initial investment costs.

As part of the E-Energy project 'eTelligence', researchers from the Oeko-Institut have studied and modelled the use of storage systems and flexibility options. They found that even in the short term, these can help to increase the efficiency of the conventional power plant fleet by reducing start-up and shut-down costs, for example. In the medium term, however, the researchers are predicting an increase in the use of storage systems and flexibility options to accommodate more surplus renewable-generated electricity. For example, pumped storage facilities or load management can be used to store power for an hour or so at a time when the use of photovoltaics causes the supply to peak, while small-scale combined heat and power (CHP) units with suitable heat storage facilities can be used on a flexible basis in the morning and evening to supplement power generation from photovoltaics. The range of storage and flexibility options must be expanded so that they can operate for longer periods as well. Potential solutions include chemical storage systems, such as those which produce hydrogen from renewable-generated power, and the expansion of the European electricity grid.