Transforming the Grid: Electricity Network Governance in the UK and Denmark

Dierk Bauknecht & Alexander Schrode

Abstract

This contribution deals with the transformation of electricity networks towards more decentralised systems. Our objective is to discuss how network governance can be adapted to enable network transformation. A core element of network governance is the regulation of electricity networks by independent regulatory authorities. We

– analyse how network regulation can evolve to promote network transformation (UK case study),

– and discuss a network governance mechanism to promote system transformation where network regulation plays only a minor role (Danish case study).

The case studies confirm that standard network regulation that has been introduced in most liberalised markets and focuses on short-term efficiency and market-based incentives will not be sufficient to achieve such a transformation. Although the two case studies are very different, we observe that cooperative governance mechanisms play an important role in the transformation process in both cases.

Introduction

This chapter deals with the transformation of electricity networks towards more decentralised systems. Increasing the share of distributed generation will require changes in the overall electricity system architecture. The question is how the challenge of network transformation can be dealt with from a governance point of view.

Network regulation is an important element of the governance of liberalised electricity markets. We contrast the standard model of network regulation that is being applied in most liberalised electricity markets

with the requirements of network transformation. The standard model of network regulation is unlikely to be sufficient when the objective is to—jointly—transform the network and generation structure, rather than 'simply' maximising the efficiency of the existing system. In this contribution, we are not so much interested in the detailed mechanisms of electricity network governance, but rather its set-up in principle.

The next section briefly provides some background about decentralisation and system transformation, describes the current standard model of network regulation as a core element of network governance and shows how this model needs to be adapted to promote system transformation.

In the following two sections, we will present two country studies, showing how the challenge of decentralisation and network transformation is dealt with from a governance perspective. UK and Denmark represent two interesting polar cases of network governance and DG integration.

We analyse

– how network regulation can evolve to promote network transformation (UK case study),
– an example of network governance to promote system transformation that is not driven by network regulation (Danish case study).

Electricity network transformation: A changing role for network regulation

Decentralisation and network transformation

For many decades, the electricity sector has been dominated not only by large vertically integrated monopolies, but also by centralised power generation in large-scale plants. With generation and network being closely intertwined, the network infrastructure has developed accordingly: Most power plants are connected to the high-voltage transmission grid, while the distribution network mainly serves as a distributor of power. The governance structure and the technical layout of the sector have been closely aligned.

While monopolies have been replaced by more or less liberalised markets in many countries (for an up-to-date overview see Sioshansi &

Pfaffenberger 2006), the centralised technical layout of the electricity system has in recent years increasingly been challenged by small-scale generation technologies, which are connected to the distribution system and often located close to the point of consumption (distributed generation / DG). DG can have economic, environmental and security of supply advantages compared to large-scale, centralised plants (Swisher 2002). The increasing share of DG partly results from political efforts to promote renewables and combined heat and power (CHP) plants.

The more DG capacity increases, the more it challenges traditional approaches to both network operation and development and the more the network needs to be adapted to be able to accommodate these generators. Exactly how the future grid will look if it is to integrate an increasing share of DG is largely unclear. There are a number of concepts and scenarios to accommodate an increasing share of DG, e.g. active networks, microgrids and virtual power plants (Bach et al. 2003; EA Technology Ltd 2001; European Commission 2003; Strbac et al. 2007; Varming et al. 2002). Some of these concepts represent long-term visions, whereas some of them are already being implemented (e.g. in Denmark, see below).

What is important here is that if DG is to supply more than only a niche market, the electricity network needs to be changed too, in order to remain stable and efficient. Changing the generation structure necessitates a more encompassing system transformation. In such a case the developments ahead will go beyond incremental innovations in some parts of the network developed and implemented by individual network operators, but may lead to an overall transformation of the network structure involving a large number of actors and including both transmission and distribution networks. As Harrison and Wallace (2004, 76) have put it: 'Government targets for CHP and other DG will require more holistic development of the available potential and network infrastructure'.

Electricity network regulation and network transformation

In the previous section, we have explained why distributed generation not only changes the generation structure, but also depends on and affects the development of the network. With a growing share, DG therefore

becomes a question of electricity market and network governance. Our objective is to discuss what network governance can look like in order to enable network transformation. A core element of network governance is the regulation of electricity networks by independent regulatory authorities. An increasing number of studies has examined how network regulation can incorporate the requirements of DG and incentivise network operators to connect DG to their network (Bauknecht et al. 2007; Bauknecht & Brunekreeft forthcoming). However, our main interest in this chapter is to understand how the principles and the design of network regulation need to be adapted, rather than merely adjusting its instruments.

The standard model of network regulation in liberalised electricity markets

Network regulation is an important element of the governance of liberalised electricity markets. It is now widely agreed that competitive markets can best achieve efficient outcomes for electricity generation and supply. The rationale for regulating networks while opening other parts of the system to competition is that electricity networks (as opposed to many telecommunication networks) are still natural monopolies. The main objective of network regulation is to correct this market failure and promote short-term efficiency (Joskow 2006; Wild 2001). This is to be achieved through

(a) increasing the efficiency of network operation and investment (productive efficiency),
(b) ensuring efficient charges for network users, i.e. avoiding monopoly rents (allocative efficiency), and
(c) ensuring non-discriminatory charges for all network users in order to promote competition in generation and supply.

This is generally seen as a relatively technical task that can and should also be separated from the political process. Political influence could favour certain economic actors and increase the time inconsistency problem, i.e. 'government might *ex ante* encourage investors to sink money into new assets,

and then *ex post* renege on their side of the deal, pushing down prices' (Helm 2004, 15). This is why independent regulatory authorities were put in charge of regulating networks.

Network regulation seeks to emulate the price mechanism of the market in that it gives network operators financial incentives to become more efficient or achieve other targets defined by the regulator. Incentive regulation, which is increasingly being applied, is based on regulatory periods of three to five years.

Network regulation and transformation

The standard model of network regulation that we have described above is unlikely to be sufficient when the objective is to—jointly—transform the network and generation structure, rather than 'simply' maximising the efficiency of the existing system. Even renewing the existing system and enabling a sufficient level of investment requires a revision of the standard model of network regulation (Helm 2004; 2005). Transforming the grid goes even further.

To promote a long-term transformation of the network, the regulatory process needs to be complemented by instruments that go beyond one regulatory period, enable the regulatory process to deal with future structural changes and future uncertainty and provide coordination mechanisms for the stakeholders involved (network and plant operators, technology developers etc.). As long as the focus was on (short-term) efficiency, it seemed clear what the regulator was supposed to do. With network transformation, networks become political in that the need arises to define what kind of electricity system society wants.

What is required is a broadening of network regulation in several dimensions, both in terms of its time-horizon, its remit and its objectives. The following table compares the current standard model of network regulation with the requirements of network transformation as we see them.

Table 1. Network regulation and transformation

	Standard network regulation	Network governance and transformation
Objective	Cost reduction (OPEX), short-term efficiency of networks and promotion of competition	Development and transformation of the network to support the transformation of generation
Instruments	Incentive regulation gives network operators financial incentives	Financial incentives, complemented by more long-term coordination mechanisms (e.g. to coordinate development by different network operators and other actors)
Time-Horizon	Short-term, regulatory period	Long-term development, needs to be consistent with short-term framework
Regulatory Remit	Regulation of networks	Networks in the context of electricity system development
Role of Investment	Investment need neglected or investment only to renew existing system	Investment need as a window of opportunity for structural change
Role of innovation	Innovations to improve efficiency Trade-off between static and dynamic efficiency	Innovations is not just about cost savings, but about system transformation Various complementary innovations make up system transformation
Regulation and policy	Regulation is to be detached from the policy process Increasing efficiency as technical problem, hold-up problem ->independent regulator	Transformation in which direction? Political nature of regulation becomes more prominent

Coordination between generation and network development	Coordination through price signals	Transformation aggravates coordination problem Coordination through cooperation, shared vision of the future energy system necessary to coordinate system transformation

Source: Authors

In the following two sections, we will present two country studies, showing how the challenge of decentralisation and network transformation is dealt with from a governance perspective. The UK and Denmark represent two interesting polar cases of network governance and DG integration:

– The UK provides an example as to how network regulation can evolve to promote network transformation. The focus of our analysis is on the objectives of regulation, the relationship between regulation and policy and new mechanisms to coordinate different actors.
– Denmark provides an example of network governance to promote system transformation that is not driven by network regulation. Instead, there are a number of other coordination mechanisms.

Network transformation in the UK: A new role for the regulator?

Distributed generation and network transformation in the UK

With a share of distributed generation well under 10%, the UK is roughly average in Europe. DG plants are wind and hydro plants and mainly gas-driven CHP plants. Both CHP and renewables more than doubled their output between 1995 and 2005. How the grid can be transformed, however, is not being discussed because the share of DG has already reached a critical level, but because network development is seen as a prerequisite to meet DG targets.

The share of DG needs to increase in order to reach the goal of a low-carbon economy, as demanded in the 'Energy White Paper' of the British government. Consequently DG is one of the main topics of the 2006 Energy Review, where it is officially seen as a 'long-term alternative or supplement to our current highly centralised system' (Cabinet office 2006, 61). And the perceived merits of DG go beyond environmental ones. According to the latest Energy Review, 'a "distributed" system could fundamentally change the way we meet our energy needs, contributing to emissions reduction, the reliability of our energy supplies and potentially to more competitive energy markets' (Cabinet office 2006, 62).

Broadening the objectives of network regulation

The UK energy regulator is the only regulator in Europe that explicitly takes DG into account in the design of network regulation and provides (privately owned) network operators with an incentive to connect DG. The revenue cap formula has been adapted to include DG and give companies DG-related profit incentives (Ofgem 2004). There are different ways this can be interpreted:

(1) Network regulation remains unchanged in principle, but takes DG into account as a new phenomenon to enable an efficient integration of these plants into the network.

(2) The regulator's objectives are being extended to support the political goal, in this case to increase the share of DG. Ofgem's task is to deliver this goal in the most efficient way.

(3) Ofgem itself takes over a more proactive role in defining the development of the future network structure.

John Scott, Technical Director at Ofgem in charge of DG, has emphasised the importance of the various DG incentives that have been included in the revenue cap formula, but at the same time has questioned whether 'this is sufficient to energise the "supply chain" of parties across the wider sector that will be needed?' (Scott 2004).

There are a number of developments in the UK—not all of them to do with DG—that extend the objectives of regulation beyond short-term efficiency and competition and could open the door to a broader understanding of network regulation (as outlined in the previous section). This pertains both to the objectives of regulation and the institutional set-up and includes a discussion as to the relationship between policy and regulation. A more comprehensive approach to regulation is facilitated by the relatively broad remit Ofgem has always had: It is not only a network regulator, but oversees the electricity and gas markets in general.

Initially the electricity regulator Offer (which was later to become Ofgem) had mainly economic duties and focused on promoting and maintaining competition. Regulation was seen as a much narrower process compared to the USA, where the independent regulator model has the longest tradition. Energy regulators in the USA have always been more concerned with balancing the interests of various stakeholders, namely the regulated companies and consumers (MacKerron 2003, 45). Institutionalist economists who emphasise the importance of broader objectives have always had more influence in the USA. In their view, regulation should also include social and environmental objectives to contribute to a 'good society' (Leprich 1994, 43–52; Miller & Samuels 2002).

In the UK, the new Labour Government changed the objective of regulation with the 2000 Utilities Act. One important change was that the new law enabled the energy minister to issue guidance to Ofgem to take into account environmental and social objectives. This was done in 2002 by drafting a social and environmental guidance to Ofgem. While the Labour Government was initially mainly concerned with improving equity (rather than merely overall efficiency), environmental objectives are increasingly coming to the fore (Helm 2005; MacKerron 2003). According to the OECD (2002, 26), 'compared with arrangements in other jurisdictions Ofgem's role (…) represents a "quasi-policy" function and is an interesting institutional innovation that is driven by the Utilities Act'.

Even with these changes put in place, economic duties are still the main objective of Ofgem. However, as Helm (2004, 34) has pointed out, unofficially the government wants Ofgem to go beyond its primary

duties and implement the 2003 Energy White Paper, 'Our Energy Future—Creating a Low-Carbon Economy' (DTI 2003). Yet there is still a struggle between neo-liberal economists at Ofgem who see environment-related objectives for Ofgem as political interference and those in government who envisage a wider role for Ofgem (Green 2004, 7).

The UK water regulator Ofwat provides an example of a more explicit consideration of sustainability objectives in the regulatory framework and it has been proposed to include a sustainable development duty into Ofgem's duties based on Ofwat's example (Owen 2004, 27).

Amending the institutional structure of network regulation

With a more encompassing role for the regulator it becomes more urgent to properly define the interface between regulation and policy and ensure political control of the regulator. In the UK, it has been criticised that Ofgem and its director have too much discretion and that there is a lack of political accountability (Helm 2004). More work needs to be done in this area, especially if regulation becomes more than a simple technical task to ensure efficiency in the existing system, but more concerned with shaping the future development of the electricity system.

The changing character of network regulation is also reflected in the institutional set-up, where new coordination mechanisms are emerging to deal with the challenges of network transformation.

In 2000, DTI and Ofgem established the Embedded Generation Working Group (EGWG) which should identify barriers to DG. Two years ago the Electricity Network Strategy Group (ENSG) was created by merging two subgroups of the EGWG. This group explicitly deals with the long-term transformation of the network, bringing together both different market players and the regulator, but also the regulator Ofgem and the energy minister in charge at the DTI.

Members of the ENSG include the DTI and Ofgem, and senior representatives from the Scottish Executive, the Welsh Assembly, DEFRA, the network operators, generators and other industry participants. The task of ENSG is to 'identify, and co-ordinate work to address the technical, commercial, regulatory and other issues that affect the transition of electricity

transmission and distribution networks to a low-carbon future' (ENSG 2006, 2) and aims to formulate 'a holistic view of the strategic development of transmission and distribution networks' (ENSG 2006, 3).

In 2005, a 'Technical Architecture Report' was drawn up jointly by academics, manufacturers, consultants, distribution network operators, and generators including representatives of micro-generation and CHP. It confirms the need that 'a single entity is given responsibility to be the focal point for developing future technical architectures' (DGCG 2005, 8). A joint thinking would be necessary because 'the largest identified barrier to Distributed Generation (DG) being adopted in large scale was the "lack of joined up thinking" in the industry'.

Two aspects are important for us: First, Ofgem's role in this process goes clearly beyond implementing political objectives defined somewhere else. Rather, it has a dominant role in the process of defining the future development of the network. Second, the DG incentives in the revenue cap formula that give price signals to individual network operators are complemented by coordination mechanisms that are based on cooperation and joint vision building, encompassing a broad range of actors and oriented towards long-term network development (rather than the next five-year regulatory period).

While the Network Strategy Group represents an attempt to complement the work of the existing regulator by additional cooperative, long-term arrangements, there is also a discussion to more fundamentally revise the model of the regulatory office which is primarily based on economic duties.

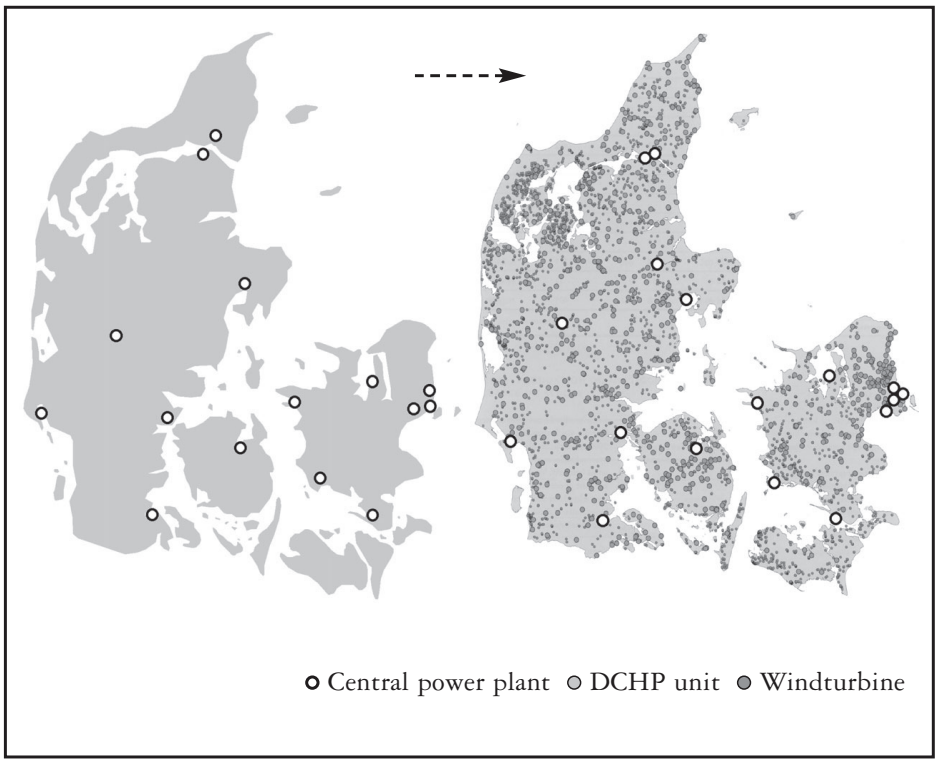
Helm has proposed the 'agency model' as an alternative to the regulatory office model that Ofgem is based on. The agency model has already been implemented in other regulated sectors in the UK. A new Energy Agency would work with a stronger element of political control. At the same time, its relationship with policy would be more of a two-way process, with the agency both advising the government and implementing policies. Also, the 'agency model is not primarily focused on economics and efficiency to the practical exclusion or marginalisation of other objectives' (Helm 2004, 34) and is more democratically accountable. Alternatively, Owen (2004, 30) has put forward the idea of giving the Environment Agency a role in network regulation to ensure that different objectives are balanced.

Network transformation in Denmark: State-ownership and cooperation

Distributed generation and network transformation in Denmark

DG from wind, other renewables and CHP plants account for 44 per cent of Denmark's power generation (Skytte & Ropenus 2005, 22). This is the top position in Europe, where the DG share in most countries ranges between eight and 20 per cent. Only twenty years ago Denmark was in a similar situation, with electricity generation taking place mostly in large-scale plants. The following Figure shows the transition from a centralised to a decentralised electricity generation system.

Figure 1. Decentralisation of electricity generation in Denmark from 1980 to 2000



Source: Eltra

As in most countries, the electricity grid was built after the Second World War and designed for central generation, which was characteristic of the energy system. As a consequence, Denmark's transmission network operator has experienced problems to balance its grid and several times the system was close to a breakdown (Jensen 2002). This is why the expansion and transformation of the grid is one of the main topics of the Danish electricity agenda. Denmark is a pioneering country when it comes to implementing and testing new network concepts. The transmission operator Energinet.dk is currently implementing the cell concept, shifting more responsibility for network control to the distribution networks and enabling islanding of individual cells (Lund et al. 2006).

In contrast to the UK, the need to adapt the network has been triggered by the high level of DG which has been reached and which requires the decentralization of the network to ensure an efficient and secure supply.

Long-term planning and joint vision building

Danish energy policy has been characterised by strong cooperative elements, with energy policy, market and other actors working together.[1] However, the playing field has substantially changed in recent years. On the one hand, the electricity market has been liberalised and companies now operate in a competitive market. On the other hand, a new actor, Energinet.dk, the state-owned transmission company, was created. Thus, the transformation process is taking place in an evolving playing field, a quite different situation from that in the UK.

Denmark has a long tradition of a consensus oriented policy and most energy policy targets and instruments, e.g. to support CHP, renewable energy and energy saving programmes, are drawn up jointly with a large number of stakeholders. In the 1970s, Denmark was greatly shocked by the oil crisis, because it was 90% dependent on oil imports. In the following years there was a major discussion about future energy policy. The government invited economic, civil, and scientific groups to jointly draw up a long-term plan. The result was published in the 'Energy Plan', which became the central place to discuss energy policy visions. The first plan of 1976 was aimed at the transition from oil to coal, nuclear power and

renewables. However, the vision of a 'solar society', brought forward by green civil groups, gained influence and was the basis of the second Energy Plan of 1981. For example, it set the target to build 60,000 wind turbines by 2000.

The fourth Energy Plan of 1996, setting out the national action plan 'Energy 21', confirmed the objective of establishing a sustainable energy system and included the objective of increasing the share of renewables by one per cent each year. Yet at the same time the plan called for establishing a competitive electricity market. This focus was reinforced by the latest Energy Plan that was issued in 2005 by the new conservative government. It does not set any targets for renewables and focuses on their economic efficiency (van der Vleuten & Raven 2006).

Although the Danish policy on renewables has become less ambitious and competition has been introduced, the government promotes the expansion of the grid due to the introduction of renewable energy. In recent years the framework was set to deal with system transformation in a way that is quite different from the UK approach: The state took over the ownership of the transmission network and the cooperative approach to energy policy is now being applied to network transformation. The Copenhagen Strategy of the Danish Energy Authority (DEA) has called for overall energy planning to be supplemented by long-term grid planning at all political levels because 'any short-term solution should fit into a long-term strategic vision' (DEA 2005, 6).

The role of the regulator

The Danish Energy Regulatory Authority (DERA), Energitilsynet, regulates the network tariffs through a revenue cap model. Unlike in the UK, the Danish regulator DERA is not particularly active in the process of network transformation but leaves this to the transmission company Energinet.dk. There are no incentive-based mechanisms as in the UK providing innovation incentives, nor does the regulator play a moderating role in the transformation process. The comparison with the UK is all the more interesting as network transformation in Denmark is already happening 'on the ground', while in the UK it is still mainly 'paperwork'.

In the wake of liberalisation, DERA had to revalue the assets of all companies to differentiate between free capital and tied-up capital that had to be paid back to the consumers. Although DERA officially should also support the structural development in the energy sector (DERA 2005, 2), it is fully occupied with this task, which involves long negotiations with the companies. DERA itself seems to be unsatisfied with its role and has pointed out the need to clarify its management basis (DERA 2005, 6).

The role of Energinet.dk

Energinet.dk was founded through a merger of Eltra, Elkraft System and Elkraft Transmission. It acts both as the network owner and system operator. While the previous transmission system operators were owned by regional grid companies, which in turn were owned by local authorities or consumer co-operatives (IEA 2002, 111), the new transmission system operator has been transferred into direct state-ownership.

In return, a number of obligations were lifted from the distribution companies and they were given unrestricted access to 20 to 25 billion DKK (three billion euros) of their capital that had previously been tied-up.

Energinet.dk now owns and operates the 400 kV grid and is also responsible for overall system operation. Interestingly, as a state-owned company it is responsible for tasks which in other countries are carried out by regulatory authorities:

> As the system operator, Energinet.dk administers the regulations pertaining to grid companies' public obligations. Energinet.dk also has authority to require that the owners of the transmission grids make specific investments and maintain the electricity grid. In return for this, Energinet.dk pays the owners of the grid for making capacity available for the system operators (DERA 2006, 16).

Energinet.dk is officially responsible for the network transformation process and the development of a vision for the future energy system. Hence, it is the key actor in the electricity system promoting decentralisation of the system, as it was the first to recognise that a central control system is no longer up to the job. This is different from the UK, where the

regulator Ofgem has taken the initiative, while network operators are relatively passive and the transmission system operator has hardly been involved. As compared to the UK, network transformation in Denmark is based on a top-down approach and joint vision building and planning, promoted by Energinet.dk, rather than regulatory incentives for individual network operators to innovate and develop their part of the network.

It seems plausible to assume that Energinet.dk was able to adopt this strong role in the transformation process because it is a state-owned company. One of the predecessors of Energinet.dk, Eltra, which had started the network transformation process a couple of years before Energinet.dk was set up, was also owned by public authorities, together with consumer cooperatives. This would support the argument of Leprich (2005), who has argued in favour of state-owned network operators in Germany because this would facilitate network transformation towards a more decentralised system. Exactly how this ownership structure has influenced the transformation process requires additional research. In any case, Denmark provides a unique set-up that is very different from the UK example, where the regulator seeks to give privately owned companies profit incentives.

While a lot of network innovations are developed and implemented by Energinet.dk, it is one of the main features of the network transformation taking place that different network levels are to operate in a more integrated way. The local distribution companies are to be included in the technical regulation of the system and take over system responsibility from the transmission system operator.

Energinet.dk has therefore also made an effort to bring together all the network operators and other relevant actors. The grid committee was established to enable cooperation with the distribution companies. Its task is to 'ensure economic operation and development of the entire power system, including coordination of the planning of the transmission grids and the distribution grids'.[2] For example, the members of the grid committee and external advisors have cooperatively set up the so-called 'System21' project, where the transmission operator and distribution companies could work out the details of the future network.

Conclusion

The starting point of this contribution was that if the share of distributed generation is to increase to make the electricity system more sustainable, the electricity network must also be changed if it is to remain stable and efficient. A transformation towards a sustainable electricity system therefore requires more than replacing 'dirty' plants by 'cleaner ones'. Rather, a change in the generation structure necessitates a more encompassing system transformation, including generation and network.

We have analysed two country cases to improve our understanding of network governance in the context of network transformation. The following table provides a comparison of the two cases.

Table 2. Network governance and transformation in the UK and Denmark

	Denmark	UK
Status of DG development and system transformation	Generation already to a large extent decentralised (more than 50%), increasing pressure on traditional grid system to adapt Ambitious plans for system transformation being developed and implemented (cell concept)	Low DG penetration, no pressure on existing system yet The political goal is to further increase the share of DG
Central actor	State-owned transmission system operator Energinet.dk	Network regulator Ofgem
Network governance approach	State-owned transmission network operator drives system redesign Top-down process Very strong cooperative elements (instead of market-based incentives)	Network governance mainly driven by network regulation, based on revenue incentives But not only the mechanisms of network regulation are being adapted, but network regulation itself is changing Some new cooperative elements (electricity networks strategy group)

The case studies have confirmed that standard network regulation that has been introduced in most liberalised markets and focuses on short-term efficiency and market-based incentives will not be sufficient to achieve such a transformation.

Even in the UK, where network regulation mechanisms are being adapted to promote network innovations, new approaches are emerging. There are a number of developments that extend the objectives of regulation beyond short-term efficiency and competition and could open the door to a broader understanding of network regulation. The changing character of network regulation is also reflected in the institutional set-up, where new coordination mechanisms are emerging to deal with the challenges of network transformation.

While the focus in the UK has so far mainly been on innovation incentives for individual network operators, the Danish approach is more about jointly developing and implementing a new, more decentralised system architecture, with a strong state-owned network transmission system operator as the central actor. Network regulation does not play an active role in this process.

Although the two case studies are very different, we observe that co-operative governance mechanisms play an important role in the transformation process in both cases.

Acknowledgements

The authors would like to thank the German Federal Ministry of Education and Research for supporting the project 'Transformation and Innovation in Power Systems' (TIPS – www.tips-project.de), of which our research on 'Transforming the Grid' is a part.

Notes

1 For a detailed analysis of the history of Danish energy policy and the transformation to DG, see van der Vleuten and Raven (2006).

2 www.energinet.dk/da/menu/Om+os/Samarbejdsorganer/Netudvalg+el/Netudvalg+(el).htm (19.12.2006)

References

Bach, Paul-Frederik, John Eli Nielsen, Markus Hindsberger, Søren Varming, and Christian Gaardestrup (2003), 'Active Networks as a tool to integrate large amounts of distributed generation', paper presented at the conference 'Energy Technologies for post Kyoto Targets in the Medium Term', 19–21 May 2003, Risø: Roskilde.

Bauknecht, Dierk and Gert Brunekreeft (2008), 'Integrating distributed generation into liberalised electricity markets—the role of network regulation', in Sioshansi, Fereidoon P. (Ed.), *Competitive Electricity Markets: Design, Implementation and Performance*, Oxford: Elsevier.

Bauknecht, Dierk, Uwe Leprich, Philipp Späth, Klaus Skytte, and Benoit Esnault (2007), *Regulating Innovation and Innovating Regulation*, DG-GRID project report.

Cabinet office (Ed.) (2006), *The Energy Review Report 2006. The Energy Challenge*, London.

DEA (2005), 'Copenhagen strategy on offshore wind power deployment', paper presented at the conference 'European policy seminar on offshore wind power', 27 October 2005, Copenhagen: Danish Energy Authority.

DERA (Danish Energy Regulatory Authority) (Ed.) (2005), *Annual Report 2004*, Copenhagen.

DERA (Danish Energy Regulatory Authority) (Ed.) (2006), *Annual Report 2005*, Copenhagen.

DGCG (Distributed Generation Coordination Group) (Ed.) (2005), *Technical Architecture—A First Report: The way ahead*, London.

DTI (Department of Trade and Industry) (Ed.) (2003), *Energy White Paper: Our Energy Future—Creating a Low Carbon Economy*, London.

EA Technology Ltd (Ed.) (2001), *Likely Changes to Network Design as a Result of Significant Embedded Generation*, London.

ENSG (Electricity Networks Strategy Group) (Ed.) (2006), *Annual Report 2005*, London.

European Commission (Ed.) (2003), *New ERA for Electricity in Europe—Distributed Generation: Key Issues, Challenges and Proposed Solutions*, Brussels.

Green, David (2004), 'Rethinking energy regulation', paper presented at the conference '19th World Energy Congress', Sydney, Australia.

Harrison, Gareth, and Robin Wallace (2004), 'Network integration of CHP', *Cogeneration & On-Site Power Production* 5 (4): 69–76.

Helm, Dieter (2004), *The New Regulatory Agenda*, London.

Helm, Dieter (2005), 'The case for regulatory reform', in Helm, Dieter (Ed.), The *Future of Infrastructure Regulation*, Oxford: Oxera, 1–9.

IEA (International Energy Agency) (Ed.) (2002), *Energy Policy of IEA Countries: Denmark 2002 Review*, Paris.

Jensen, Jytte Kaad (2002), 'Integrating CHP and Wind Power—how western Denmark is leading the way', *Cogeneration & On-Site Power Production* 3 (6): 55–62.

Joskow, Paul L. (2006), 'Incentive regulation', in *Theory and Practice: Electricity Distribution and Transmission Networks*, Cambridge, MA: MIT.

Leprich, Uwe (1994), *Least-Cost Planning als Regulierungskonzept. Neue ökonomische Strategien zur rationellen Verwendung elektrischer Energie*, Freiburg: Öko-Institut.

Leprich, Uwe (2005), 'Stromnetze neutralisieren!', *Energiedepesche* 4: 32–33.

Lund, Per, Sunil Cherian, and Thomas Ackermann (2006), 'A cell controller for autonomous operation of a 60 KV distribution area', *International Journal of Distributed Energy Resources* 2 (2): 83–100.

MacKerron, Gordon (2003), 'Electricity in England and Wales: Efficiency and equity', in Finon, Dominique, and Jean-Michel Glachant (Eds.), *Competition in European Electricity Markets—A Cross-Country Comparison*, Cheltenham: Edward Elgar, 41–56.

Miller, Edythe S., and Warren J. Samuels (Eds.) (2002), *An Institutionalist Approach to Public Utilities Regulation*, East Lansing: Michigan State University Press.

OECD (Organisation for Economic Co-operation and Development) (Ed.) (2002), *Regulatory Reform in Gas and Electricity and the Professions*, Paris.

Ofgem (Ed.) (2004), *Electricity Distribution Price Control Review. Appendix—Further details on the incentive schemes for distributed generation, innovation funding and registered power zones*, London.

Owen, Gill (2004), *Economic Regulation and Sustainability Policy*, London: Sustainability First.

Scott, John (2004), 'Culture & relationships: Processes, mindsets and professionalism—initial thoughts', paper presented at the conference 'Visions for Distribution Networks of the Future', 2 November 2004, IEE.

Sioshansi, Fereidoon P., and Wolfgang Pfaffenberger (Eds.) (2006), *Electricity Market Reform—An International Perspective*, Oxford: Elsevier.

Skytte, Klaus, and Stefanie Ropenus (Eds.) (2005), *Regulatory Review and International Comparison of EU-15 Member States*, DG-GRID project report.

Strbac, Goran, Nick Jenkins, Tim Green, and Danny Pudjianto (2007), *Review of Innovative Network Concepts*, DG-GRID project report.

Swisher, Joel N. (2002), 'Small is profitable. The economic benefits of distributed generation', *Cogeneration & On-Site Power Production* 3 (4): 17–27.

van der Vleuten, Erik, and Rob Raven (2006), 'Lock-in and change: Distributed Generation in Denmark in a long-term perspective', *Energy Policy* 34 (18): 3739–3748.

Varming, Søren, Christian Gaardestrup, and John Eli Nielsen (2002), *Review of Technical Options and Constraints for Integration of Distributed Generation in Electricity Networks*, Sustelnet project report.

Wild, Jörg (2001), *Deregulierung und Regulierung der Elektrizitätsverteilung—Eine mikroökonomische Analyse mit empirischer Anwendung für die Schweiz*, Zürich: vdf.