

Technical University of Denmark



The residential electricity sector in Denmark: A description of current conditions

Kitzing, Lena; Katz, Jonas; Schröder, Sascha Thorsten; Morthorst, Poul Erik; Møller Andersen, Frits

Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):

Kitzing, L., Katz, J., Schröder, S. T., Morthorst, P. E., & Møller Andersen, F. (2016). The residential electricity sector in Denmark: A description of current conditions. Department of Management Engineering, Technical University of Denmark.

DTU Library

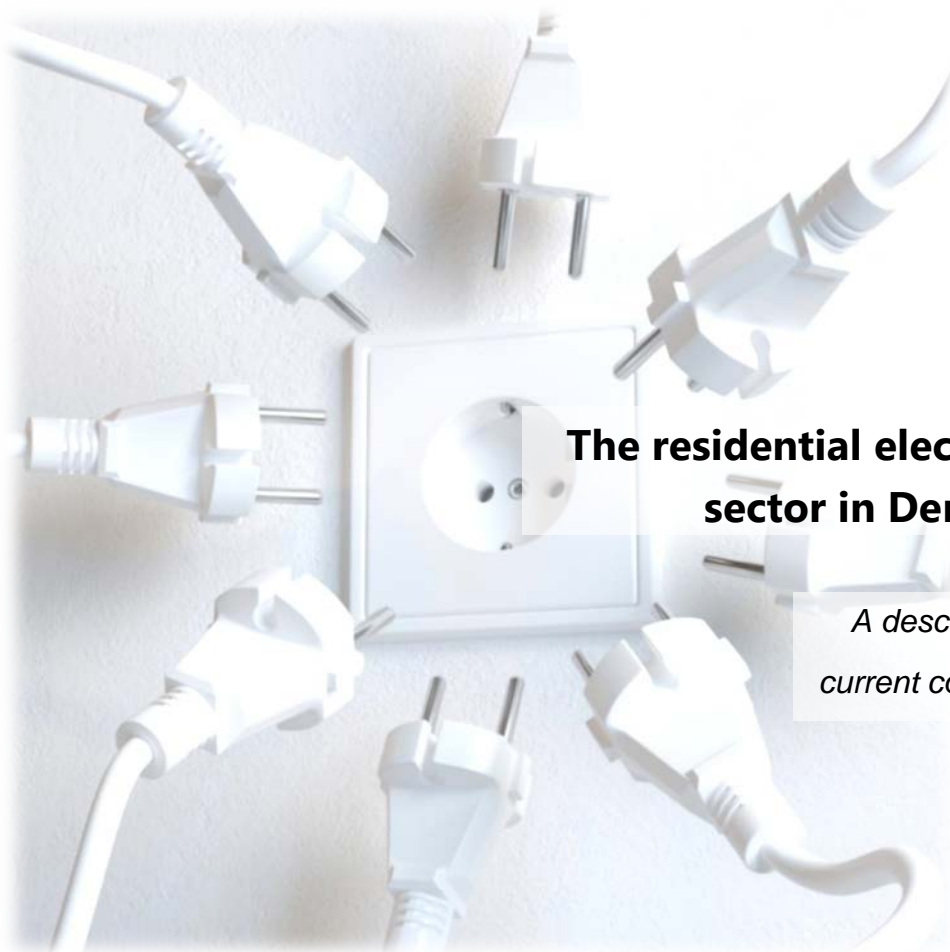
Technical Information Center of Denmark

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



The residential electricity sector in Denmark

*A description of
current conditions*

1

**Lena Kitzing, Jonas Katz, Sascha T. Schröder,
Poul Erik Morthorst, Frits Møller Andersen**

Working paper

February 2016

*Technical University of Denmark,
DTU Management Engineering,
Systems Analysis,
Produktionstorvet 426
2800 Kgs. Lyngby, Denmark*

¹ *Picture: Colourbox*

The residential electricity sector in Denmark

A description of current conditions

Contents

| | | |
|-----|--|----|
| 1 | Introduction..... | 3 |
| 2 | Residential electricity consumption | 3 |
| 3 | The electricity retail market model..... | 5 |
| 3.1 | Roles and responsibilities of the market actors..... | 6 |
| 3.2 | Retail market operation..... | 11 |
| 4 | Retail prices for electricity..... | 13 |
| 4.1 | Supply tariff | 15 |
| 4.2 | Distribution grid tariff | 20 |
| 4.3 | Transmission grid tariff..... | 21 |
| 4.4 | PSO element | 21 |
| 4.5 | Electricity taxes..... | 23 |
| 4.6 | Value Added Tax | 25 |
| 4.7 | Affordability issues | 25 |
| 5 | Conclusions and outlook..... | 26 |
| | Acknowledgement | 27 |
| | Glossary | 28 |
| | Relevant data & Information sources | 28 |
| 1 | General information on the sector and prices..... | 28 |
| 2 | Market regulations and Methods..... | 28 |
| 3 | Regulated prices..... | 29 |
| 4 | Commercial products: | 29 |
| 5 | Market Actor Register | 29 |
| | References..... | 30 |
| | Appendix A: Roles and responsibilities (detailed)..... | 34 |

1 Introduction

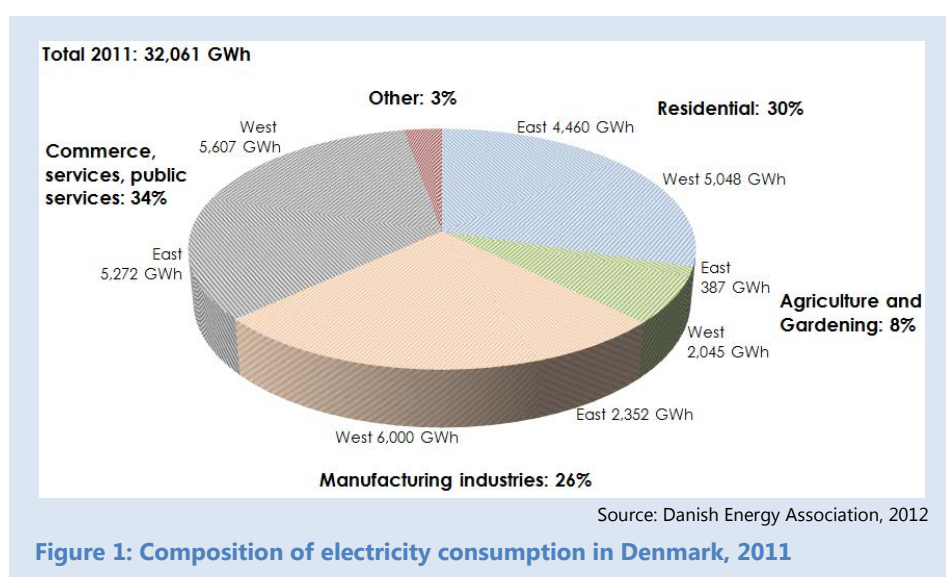
We provide an overview of the current conditions and framework for residential electricity consumption in Denmark. This includes a general overview of the sector, the retail market and the regulatory framework. We describe the regulations currently in place and changes which have been decided for the coming years.

The information and data described are all publicly available, though much of it only in Danish language. This description is to our knowledge one of the first comprehensive overviews of the Danish residential sector in English language. We have translated a number of terms commonly used in the area, which are listed in the Glossary towards the end of the report. We also attach a list and description of the major sources of information and data that can be obtained and downloaded for analysis of the Danish residential electricity sector.

2 Residential electricity consumption

Residential electricity consumption is a comparatively large part of the electricity sector in Denmark. It accounts for about 30% of the total electricity consumption. Residential consumption has in the last decade between 9.5 and 9.9 TWh annually with a slight downward trend. Figure 1 shows the composition of electricity consumption for the year 2011 across the different sectors and for both market areas Denmark West (DK1) and Denmark East (DK2).

There are approximately 2.8 million residential customers (number of grid connection points) in Denmark, with 54% of them connected in West Denmark and 46% in the East.



We distinguish two major types of residential customers: 1) Apartments in multi-family houses, which account for ca. 38% of the residential connections and 27% of the residential consumption; and 2) One- to two-family houses, which account for the rest. The total number of connection points, the share of consumption as well as the average annual consumption are shown in Table 1 for the year 2011, differentiated into consumption units without electric heating, with electric heating, and with heat pump. The group of weekend cottages comprises all dwellings which are not permanently inhabited, typically bungalow type summer houses.

| 2011 | | Number of connections ('1000) | Share of residential consumption | Average annual consumption (kWh) |
|-----------------------------------|--------------------------|-------------------------------|----------------------------------|----------------------------------|
| Apartments in multi-family houses | without electric heating | 991 | 20% | 1.944 |
| | with electric heating | 13 | 1% | 4.813 |
| | joint consumption | 69 | 6% | 8.761 |
| One- and two-family houses | without electric heating | 1.350 | 53% | 3.709 |
| | with electric heating | 120 | 11% | 8.796 |
| | with heat pump | 12 | 1% | 9.244 |
| | weekend cottages | 237 | 8% | 3.123 |
| Total residential | | 2.792 | 100% | 3.448 |

Source: Danish Energy Association, 2012

Table 1: Residential consumption in categories, 2011

'Standard' residential consumption in houses and apartments without electric heating makes about 73% of the total residential consumption and about 84% of the connections. As of end of 2011, there were approximately 145.000 residential consumers with electric heating and heat pumps accounting for 13% of the residential and ca. 4% of the total electricity consumption, respectively.

The rather low share of electric heating in Danish houses is related to a general ban on electric heating from 1994 (Danish Ministry of Energy, 1994), which does not allow new and existing houses with water-based heating systems in collective supply areas to use electricity as major heat source. A number of exemptions exist, e.g. for low energy houses, weekend cottages, and more. Electricity consumed for electric heating benefits from reduced taxes (see section 4).

For households and other small consumers (with a consumption of less than 100 MWh per year), there is currently no legal requirement to measure electricity consumption on an hourly level. It is here sufficient to settle the consumption on monthly or yearly basis. These consumers are so-called standard profile customers (*skabelonkunder*), because their individual profile of electricity consumption is currently unknown. For forecasting and billing, they are assigned a standard profile, which is created from the aggregated consumption profile of all such consumers in a specific area. This is described in more detail below.

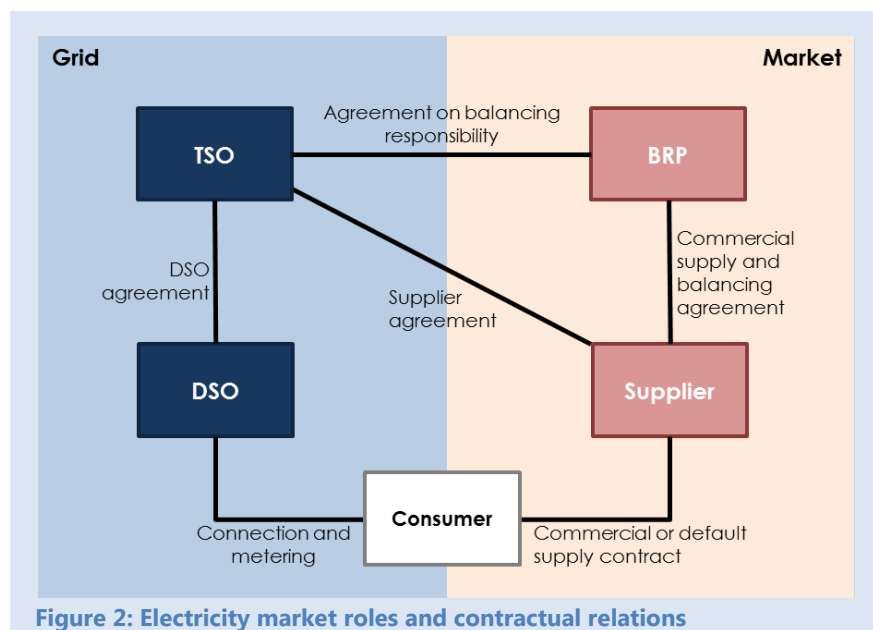
3 The electricity retail market model

The retail electricity market in Denmark has been fully liberalised since January 2003. All electricity consumers have the freedom to choose their electricity supplier. The use of the electricity network (also referred to as the grid, or the infrastructure) is however not part of the free market. The electricity infrastructure is a natural monopoly, both on the local (distribution) and the national (transmission) level. Customers are connected to the electricity network of the respective owning and operating company and thus use the services of a monopolist without being able to choose an alternative.

The liberalisation of the Danish electricity market is significantly influenced by European developments and the target to develop an internal energy market in Europe. It has also developed alongside the liberalisation in the other Nordic countries. Although the wholesale electricity market in the Nordic region is very much integrated, the retail markets remain to a large extent national (NordREG, 2012, p. 38).

NordREG is currently working towards a common harmonised Nordic end-user market, based on a road map published in 2009 (NordREG, 2009). The main target is to align market design in the Nordic countries to make it easier for suppliers to operate across all Nordic countries. This would increase competition and finally result in additional benefits for customers. The vision for the Nordic retail market is that all electricity customers will “enjoy free choice of supplier, efficient and competitive prices and reliable supply through the internal Nordic and European electricity market” (NordREG, 2009, p. 9).

The market actors will remain the same also under a harmonised market model. Most likely, though, a new model results in a change in the responsibilities of different actors and will change the way different roles interact. In the following we provide an overview of current market roles and their responsibilities. Where appropriate we provide an outlook on foreseeable changes as well. Figure 2 shows the most important roles and their contractual relations with one another.



3.1 Roles and responsibilities of the market actors

3.1.1 Suppliers

Suppliers act as the contractual counterparty to their customers in delivering electricity. Delivery can take place either under competitive commercial terms or under the regulated supply obligation. In Denmark, a total of around 51 suppliers deliver electricity to residential consumers. 39 of them also have supply obligation tasks meaning that they will deliver electricity to those customers that have no commercial contract (Elpristavlen, 2015).

Some of the supply companies regard themselves as regional or local supplier and are not active in the rest of the country. Only approx. 25 suppliers operate nationwide (NordREG, 2014, p. 44).

Of the active suppliers, only 7 are not in some way or another connected to a distribution grid company. Although the Danish retail market shows a significant number of different suppliers, it is still dominated by incumbent players.

Suppliers take on certain responsibilities. Before becoming active, any potential supplier must commit to his responsibilities by entering into a standard contract with Danish Energy Net (*Dansk Energi – Net*), the umbrella organisation of all network companies in Denmark. The contract establishes the minimum requirements to be able to act in the market as a supplier, such as assuming balancing responsibility, guaranteeing economic security, and basic data exchange (NordREG, 2009, p. 69). Also, the supplier commits to act according to the market rules of the TSO.

3.1.2 Supply Obligation Companies (Suppliers of last resort)

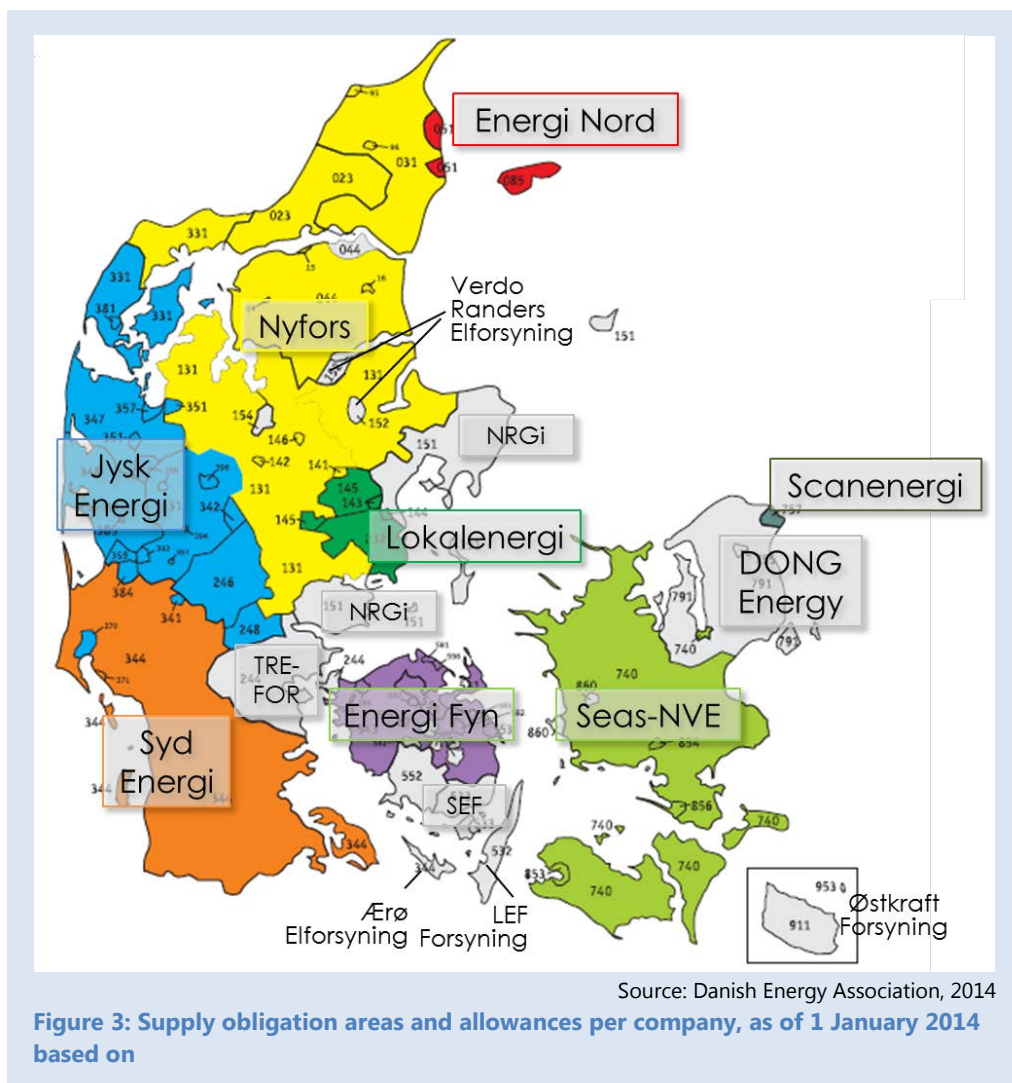
In the European Union residential customers have the right to be supplied with electricity at reasonable prices (EU Directive 2009/72/EC, 2009). This is the main reason that Supply Obligation Companies exist. They are also called suppliers of last resort (as a legal term defined in EU legislation) and are obliged to deliver electricity to any consumer in their area who expresses the wish to receive electricity while being able to pay for the received electricity. In general, the supply obligation companies have the same responsibilities as all other suppliers. In addition they underlie special regulation with regard to their tariffs and contractual terms.

In Denmark, traditionally the supply obligation companies functioned as default suppliers. They have automatically been assigned all customers that were passive and had not chosen a supplier. However, with the regulatory changes in December 2012 (LOV no. 1352, now succeeded by LBK no. 1275), this has been changed slightly (Committee for Electricity Regulation Review, 2013, p. 16). These changes in regulation mean that supply obligation areas are tendered for a specified time period. Tenders are organised by the Danish Energy Agency. The Agency also defines the detailed terms. Whenever the obligation allowance ends and a tender for supply obligation is held, any customer under the regulated tariff can be offered to switch to a similar tariff with his supplier. Otherwise the customer may actively choose to stay in the supply obligation or, of course, switch to a different supplier.

These rules do not change the fact that any customer has the right to be supplied by a supply obligation company under a regulated tariff. However, supply obligation is no longer the default option. In the case of moving, though, many customers still receive the supply obligation company as the default supplier. Also customers that for any reason lose their contract with a commercial supplier (e.g. due to payment issues) may end up with the obligation supplier if they don't find a new commercial one.

In order to create a more competitive market the supply obligation is going to be phased out (LOV no. 633, 2014). See more on this issue in section 4.1.2. At present the tendered licenses are set to end by 1 April 2016 (DEA, 2015). While the date has been postponed several times to give market actors, especially grid companies, sufficient time to prepare, all parties seem to be committed to start up the new supply model in April 2016.

The new model will cease to define suppliers of last resort to supply customers that do not actively choose an electricity supplier. Instead, the supply obligation companies will be replaced by a general obligation for all suppliers to supply any household customer upon request.



3.1.3 Distribution System Operators (DSOs)

Residential customers are connected to distribution grids. Formally there is no clear distinction of transmission and distribution grids. In terms of market roles, any grid with customer connections is a distribution grid and will have to be operated by a distribution grid operator (DSO). Usually such grids will have a voltage level up to 60 kV and down to 0.4 kV.

There used to be about 110 DSOs in Denmark (DERA, 2012a, p. 16), owned directly by local consumers (cooperatives), by municipalities or by DONG A/S, the largest energy company in Denmark (NordREG, 2009, p. 47). Throughout the past years there has been a strong consolidation of DSOs, such that by the end of 2012, only 75 of the DSOs remained.

The DSOs are responsible for operating and maintaining the lower voltage infrastructure, i.e. distribution network. DSOs handle grid losses (Energinet.dk, 2011), and they may be held responsible by the regulatory authority for poor quality of supply (Committee for Electricity Regulation Review, 2014). Other responsibilities of the DSO include giving guidance to customers on efficient energy use and collecting all energy taxes (NordREG, 2009).

Each DSO is responsible for their own grid area, in which they are monopolists. DSOs are not subject to direct competition, and are regulated by the Danish Electricity Supply Act (LBK no. 1329, 2013) and secondary legislation. DSOs should act as neutral, non-discriminatory market facilitator, providing the same market conditions for all customers and suppliers in their area. In particular this is achieved by non-discriminatory access to the use of their grids.

Due to the fact that DSOs in most cases are a part of the traditional local monopolist supplier, neutrality of the DSO is mandated through legal unbundling and separation of financial accounts. This is regulated in the Electricity Supply Act (LBK no. 1329, 2013) and the related executive orders (most recent: BEK no. 667, 2015). DSOs with less than 100.000 customers are not obliged to unbundle if the network activity does not exceed 5% of the total turnover of a company. Employees of a network company cannot be active in any trading or generation company and neither in the holding of an integrated company.

The European Electricity Market Directive (EU Directive 2009/72/EC) demands in Article 26 that all DSOs establish and publish a compliance program to ensure neutrality. In Denmark, this must contain a description of treatment of sensitive and confidential information as well of rules and implementation of neutrality and unbundling (NordREG, 2009, p. 58ff.). No exemptions are made regarding the size of DSOs in this regard.

The DSO is also generally responsible for metering and owns the meters. The DSO has to install new meters and maintain existing meters. It is, however, possible to have an independent meter operator; for instance if the owner (or collective owners) of e.g. an apartment complex decide to take over that responsibility for themselves.

The DSO thus plays an important role in information exchange between market actors. Suppliers therefore relied on receiving metered consumption data from the DSOs to be able to bill their customers. This resulted in a number of practical issues, e.g. regarding customer switching to

new suppliers, as potentially a supplier needed to communicate to 75 different companies with slightly different procedures. The introduction of a centralised data hub operated by the TSO is now making such transactions easier.

3.1.4 Transmission System Operators (TSO)

The Danish Transmission System Operator *Energinet.dk* is responsible for operating and maintaining the high and medium voltage infrastructure in Denmark. By 2012 the company also took over the 14 regional transmission companies responsible for voltage levels of 150-50 kV. The company is a monopoly fully owned by the Danish state and regulated based on a cost-plus system (i.e. necessary costs plus a necessary rate of return), as defined in an executive order (BEK no. 965, 2006). The responsibilities of the TSO are legally defined within the Act on Energinet.dk (LBK no. 1097, 2011) and the Electricity Supply Act (LBK no. 1329, 2013).

The TSO's primary task is to ensure stable operation of the system. This includes balancing the system at any point in time, in particular also when unplanned outages of plants occur. For this purpose the TSO operates several balancing and reserve markets. Moreover, Energinet.dk has to ensure a functioning grid and is responsible for the long term planning of investments into the grid infrastructure. A well-functioning electricity market is also one of the tasks of the TSO. This way, Energinet.dk is a central actor in the electricity system.

With regard to the retail market, the role of the TSO is rather limited. There is no direct contact between Energinet.dk and the customers. However, by defining technical and market rules, the TSO has significant influence on the type of products that can be offered in the retail market. In terms of data communication, Energinet.dk also has become the central responsible party for all customer data with the introduction of a central data hub for the Danish electricity market.

It should be noted that Energinet.dk is responsible for the off-take from small renewable producers and therefore is a market participant as well. However, volumes are merely passed through and thus the neutrality of the TSO should not be affected by its market participation.

3.1.5 Balancing Responsible Parties

A balancing responsible party is economically responsible towards the TSO to have a balanced portfolio in every single hour. All production and all consumption have to be registered with a balancing responsible party in order to allocate metered volumes to a balancing account.

In Denmark there are several different types of balancing responsibility for consumers, producers and traders. This is due to differentiation between how imbalances are settled for the different types. This also means imbalances from consumption won't necessarily be cancelled out with opposite imbalances from production economically. The principle behind the imbalance settlement is that consumption is settled in a one price system while production is settled with a two price system. In this way consumption imbalances may both generate costs and earnings while production imbalance will always be negative. In this way it is ensured that a

balance responsible party is not charged for unsystematic errors of the stochastic variations from demand forecasting (Bang et al., 2012, p. 18).

In total, there are about 40 balance responsible parties in Denmark (Energinet.dk, 2015). Only 14 of those are registered to handle consumption, though.

A consumption responsible party will have to do load forecasting for his customers and trade on the market accordingly. A portfolio of retail customers behaves rather predictable and thus quantities will typically be traded once a day. However, with increasing electrification of heating and transport this may change significantly in the future.

It is possible within the electricity market role model to separate balancing responsibility from customer supply. This means that a supplier does not necessarily need to do the balancing by themselves but can assign a third party for the task. In fact, most supply companies outsource the balancing task to a trading company. Only five Danish suppliers are balance responsible parties themselves (cp. Elpristavlen, 2015; Energinet.dk, 2015).

3.1.6 Energy Regulatory Bodies

The Danish Energy Regulatory Authority (DERA) *Energitilsynet* has certain regulatory powers. It was first established in 1999 (LOV no. 375, 1999), with further clarifications of its organisation and additional tasks in 2011 (LOV no. 466, 2011). DERA is an independent body, separated from the Energy Ministry and the parliament.

DERA monitors the activities of energy companies (including various activities, amongst others the compliance with billing). It can issue orders to adjust illegal actions. DERA can fine companies that do not comply with energy regulations. DERA approves the regulated tariffs for the obligation supply customers.

DERA monitors the branding and communication surface of DSOs, so that they stand out as a separate entity (even if their company name suggests an affiliation with another supplier), in order to ensure that no suppliers are indirectly discriminated. DERA has made several rulings on that issue (DERA, 2013, p. 5).

Decisions of DERA can only be appealed to The Energy Board of Appeal (*Energiklagenævnet*) – an independent appeal authority. The Energy Board of Appeal is an organisational part of the Ministry of Environment.

Suppliers operating on the free commercial market are not regulated by DERA. Here, the Danish Competition Authority can intervene against market abuse.

The Danish Energy Agency (*Energistyrelsen*) is a governmental body under the Danish Ministry for Climate, Energy and Building, and is thus subject to parliamentary control. It has regulatory powers as well, a.o. for electricity in the areas of network project licensing and transmission

investment regulations of the TSO Energinet.dk. The Danish Energy Agency has also until now issued the licenses for the obligation supply companies.

The TSO Energinet.dk has a broad range of obligations, including market monitoring tasks, which is rarely seen among other TSOs (NordREG, 2006, p. 24). Energinet.dk also issues rules on market access, net metering and balancing settlement. The regulatory authority may intervene if deemed necessary.

3.1.7 Energy Supplies Complaint Board

The Energy Supplies Complaint Board (*Ankenævnet på Energiområdet*) is an institution to handle disputes arising from the contractual relationship between energy consumers and an electricity supplier. The Board handles no disputes that are settled by court judgement. Ongoing disputes which are being dealt with by a Court of Law must be postponed and transferred to the Board if they decide so. The Board will handle cases for a fee of 160 DKK (approx. 21.5 EUR), which is paid back if the consumer's contention is upheld. Then, a fee of 7,000 DKK (approx. 941.6 EUR) applies to the energy company. On average, complaint handling takes five months. The Board consists of a neutral chairperson, who is a city court judge, and two members each from the Consumer Council and representatives from the energy trade area. The energy trade is represented by the Danish Energy Association, DONG Energy, HMN Natural Gas, Natural Gas Funen and the Danish District Heating Association. In 2011, the Board settled 94 complaints on electricity and answered 467 inquiries. The nature of the complaints and inquiries is not published (DERA, 2013, p. 11ff.).

3.2 Retail market operation

3.2.1 Making and ending contracts, supplier switching

Customers have a right to have a supply contract. Supply companies cannot supply electricity without entering into a contract with their customers (latest regulated in executive order BEK no. 1233, 2015). Supply contracts have to be entered into in writing. The contract can be concluded over the internet, but then the customer has the right to get a written contract from the supplier afterwards (NordREG, 2009, p. 82). There is no requirement for a written contract between a consumer and the distributions grid operator. Consumers do, however, have the right to receive a contract if asking for one.

Consumers may switch to a new supplier with 10 working days lead time. Switching is free of charge. A regret period of 14 days is defined in the Act on Consumer Agreements (LOV no. 1457, 2013) for agreements made by distance selling, which is the typical case with electricity.

Moving is one of the most common situations to initiate a change in contract. In Denmark a consumer does not automatically keep the same supplier after a move. This is supposed to change when the supply obligation is phased out in 2016. Most recently, executive order BEK no. 1233 from November 2015 does give suppliers the possibility to keep customers when they

move. If not actively choosing the supplier at the new address, the consumer will be automatically assigned to the supply obligation company of the area.

It is prohibited by law to bind consumers contractually for longer than 6 months. It is still possible, though, to have contracts with longer duration. From the consumer side, these contracts can then always be cancelled with 1 month lead time after 5 months latest.

3.2.2 Billing

As described above, all electricity customers have two contractual relations: 1) with the distribution network company, which is entered into implicitly, i.e. without an explicit contract; and 2) with the supplier, with whom the customer has entered into a contract.

In both of these relations, the customer is billed. In Denmark there is currently no obligation to a single point contact, so in many cases customers are exposed to dual billing: A bill from the network company and another bill from the supplier. Only if the supply company delivering the electricity is affiliated with the network company (e.g. both are part of DONG Energy A/S), Danish residential customers receive one combined bill. Regulation has been open for the option to single billing through an industry agreement system. However, this system was in practice not implemented due to impeding administrative and economic barriers (Danish Energy Regulatory Authority, 2012, p. 24).

With the implementation of the new wholesale market model (*engrosmodel*) in April 2016, this situation will change and customers will receive only one bill (DEA, 2012).

3.2.3 Metering and settlement

The information exchange between market participants is organised through a central data hub operated by Energinet.dk. Suppliers have the right to access customer information if authorised by the consumer. Consumers also have the right to access their own data free of charge (DERA, 2013, p. 17).

Retail customers are subject to special settlement rules due to the fact that they are not yet metered on a real-time basis. This means that although every customer is choosing his supplier and is registered in a balancing account, the actual specific consumption of the customer is unknown to the supplier or even the grid company. Only periodically the meter is read and a finalised settlement will be done.

In order to work around the missing metering data on a continuous basis, deliveries to consumers are based on the total consumption of not hourly metered connection within the grid area the consumer is connected to. The so-called hourly residual load (total hourly grid load minus load of hourly metered customers) is divided between different suppliers according to their share of customers within the grid area.

After meter readings have been received, the actual consumption within a certain period is known and reconciliation has to take place. The shares between different suppliers are corrected to fit the actual customer off-take. These volumes are settled with the distribution grid company at the corresponding spot prices.

A crucial part of the Smart Grid Strategy formulated in 2013 (Danish Ministry of Energy, 2013) is the metering and settlement by the hour for all consumers. At the time of formulating the strategy, 1.6 million consumers in Denmark were already equipped with remotely-read meters, corresponding to 50% of consumers with load profile settlement (i.e. not the typical household, see above) (Danish Ministry of Energy, 2013, p. 19). A full roll-out of remotely-read hourly meters is also part of the Growth Plan DK (Danish Government, 2013) and was stipulated in executive order BEK no. 1358 (2013), which requires grid companies to install remotely-read meters at all their customers by latest end of 2020. The meters have to be able to register consumption at least every 15 minutes and have to be able to communicate with the data hub. In parallel to this roll-out, the Danish Energy Association and Energinet.dk are in the process of developing a model for hourly settlement for small consumers. The model must be ready by the time of introduction of the new wholesale model (*engrosmodel*) in April 2016 (Danish Ministry of Energy, 2013, p. 20).

4 Retail prices for electricity

Household customers in Denmark pay a comparatively high price for electricity. Figure 4 shows the retail electricity prices in different European countries for the first half of 2015. It becomes apparent that in Denmark, the retail prices are a “special case”, where the cost of energy represents only around 20% of the overall price, and where energy taxes are three times the European average (Dromacque, 2013).

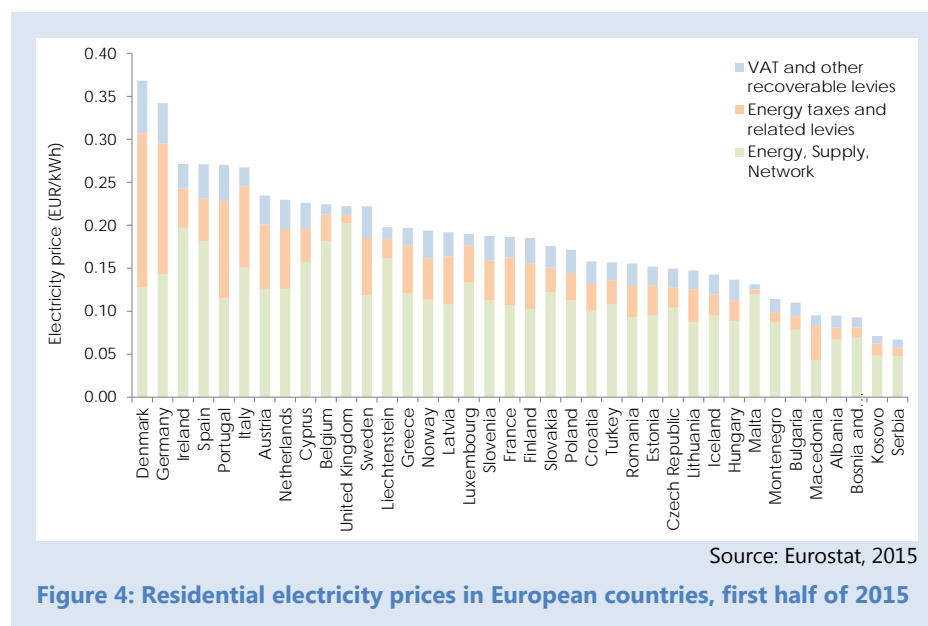
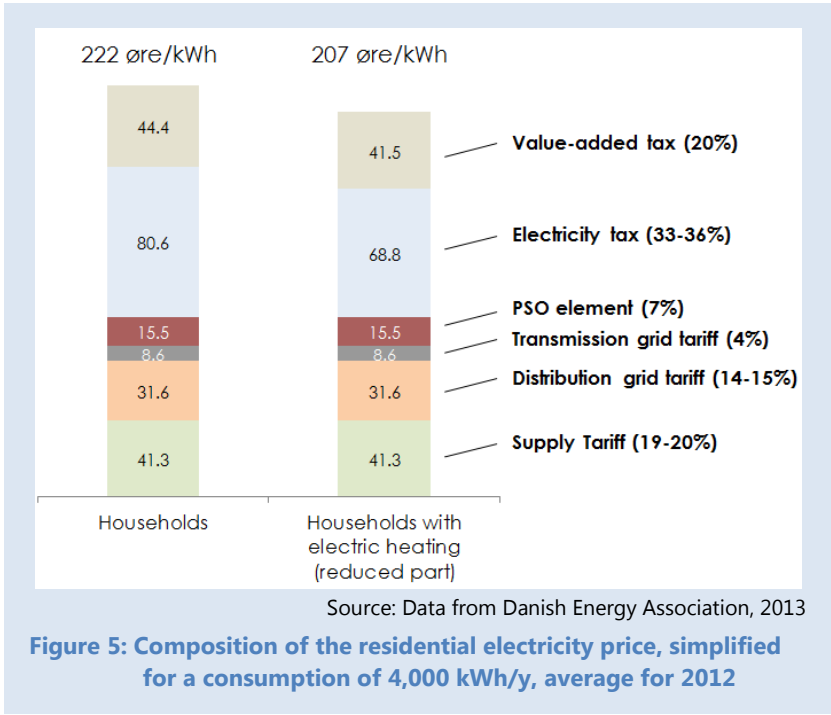


Figure 4: Residential electricity prices in European countries, first half of 2015



The annual turnover on the Danish residential electricity market (trade and distribution of electricity) was 43 billion DKK (approx. 5.8 billion EUR) in 2010, making for 68% of the total turnover in the electricity sector, which has been 63 billion DKK (DERA, 2012a, p. 8).

The retail tariff can be divided into six broad categories as illustrated in Figure 5. The **(1) Supply tariff** accrues from the production cost of electricity (or cost of energy) and related services. The **(2) Distribution grid tariff** accrues from providing access and services in the distribution network on medium and low voltage levels. The **(3) Transmission grid tariff** accrues from providing access and services in the transmission network on high voltage levels, as well as from ancillary services. The **(4) PSO element** relates to payments under the Public Service Obligation Act, amongst others for the support of renewable energies and decentral production. The **(5) Electricity taxes** have to be paid to the state and relate to a range of electricity specific taxes. Different levels of electricity taxes apply to different customers. Some exemptions apply for certain consumers. For example, households that use electric heating benefit from a slightly reduced electricity tax for part of the consumption. The **(6) Value added tax** is imposed on all other elements of the price including the PSO element and electricity taxes at the usual rate of 25%. Each of the categories is described in detail in a separate section below.

As mentioned in section 3, residential customers are part of a market with free choice of supplier and of electricity product. This free choice applies only for the purchase of the electricity itself, here represented by cost element (1), the supply tariff. Grid tariffs (2)-(3) and state levies and taxes (4)-(6) apply to consumers regardless of their supplier choice. This means that in Denmark merely a fifth of the overall electricity cost for a residential consumer is in fact subject to competition on the retail market.

| Prices in øre/kWh, averages for 2012 | | Households (at 4.000 kWh/y) | |
|---|--|---------------------------------|----------------------------|
| | | Consumption- based (øre/kWh) | Monthly cost (kr/month) |
| (1) Supply tariff | Electricity supply | 38.6 | |
| | Supply contract charge | | 9.1 |
| (2) Distribution grid tariff | Local grid tariff | 16.9 | |
| | Grid access charge | | 52.4 |
| (3) Transmission grid tariff | Transmission grid tariff | 4.2 | |
| | System tariff | 3.4 | |
| (4) PSO element | Public service obligation | 15.5 | |
| (5) Electricity taxes | Electricity tax | 63.5 | |
| | Other electricity charges ¹ | 17.1 | |
| (6) Value added tax | VAT, 25% | 39.8 | 15.4 |
| TOTAL consumption-based elements | | 199 øre/kWh | |
| TOTAL monthly elements | | 77 kr/month | |
| TOTAL (at 4.000 kWh/y) | | 222 øre/kWh or 740 kr/month | |

¹ Electricity distribution charge, Energy savings tax I + II, Supplementary charge

Source: Data from Danish Energy Association, 2013

Table 2: Composition of the residential electricity price, detailed for an average household without electric heating, average for 2012

4.1 Supply tariff

The supply tariff is usually split into two different elements: A charge per unit of electricity consumed (*eltarif*) and a monthly or quarterly charge (*elabonnement*). The specific contribution of each element depends on the supplier and on the product chosen by the consumer. The charge per unit of electricity also depends heavily on the product chosen. The two major options consumers currently have are *variable price products* and *fixed price products* (more details in section 4.1.1).

Since liberalisation in 2003, the competition on the retail market has been promoted and best practices have been sought after that would ensure an efficient operation on the market and fair and competitive prices for costumers. Currently, the market in Denmark is separated into a free market with commercial prices and a regulated market. All customers can actively choose a supplier and a commercial product on the free market. If they remain passive, customers were until recently automatically assigned the regulated tariff with the obligation supply company in their area. This practice is changing at the moment, as described below.

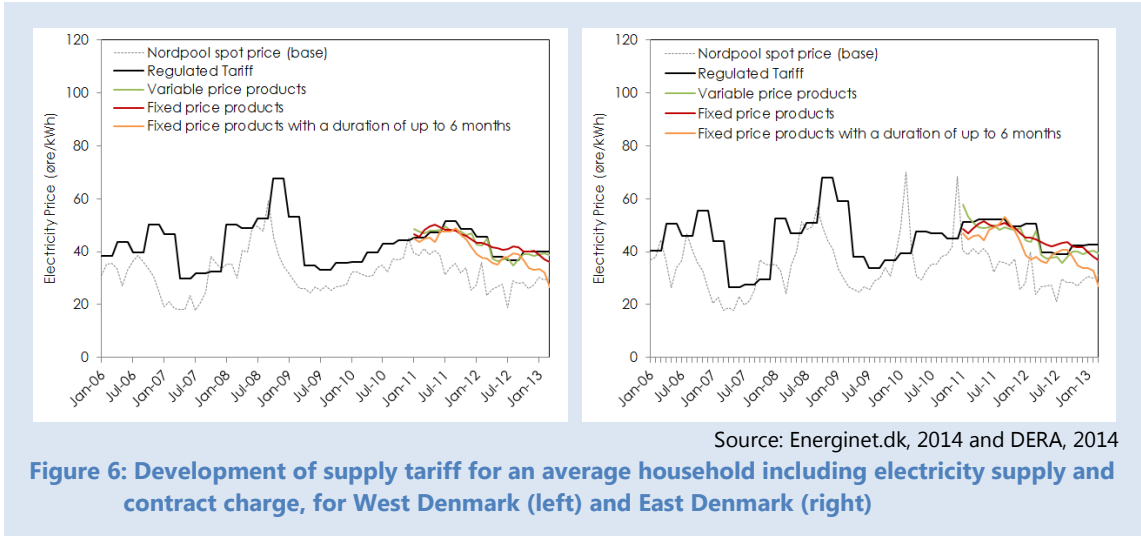


Figure 6: Development of supply tariff for an average household including electricity supply and contract charge, for West Denmark (left) and East Denmark (right)

Most suppliers in the Nordic region source their electricity from the wholesale market Nord Pool, up to 77% (NordPoolSpot, 2013). In Denmark, even more than 90% of the national demand is traded at power exchanges (in 2011 it was 94%), which is extremely high compared to other European markets such as France (13%), UK (15%) or the Netherlands (32%) (ACER, 2012, p. 61). Consequently, the retail prices are very much depending on the wholesale market prices and follow their development (as shown in Figure 6).

Of the Nordic countries, Denmark has the lowest supplier switching rate, i.e. consumers changing their supplier, as shown in Table 3. Potential annual savings from supplier switching are estimated by Dromacque (2013) to amount to approx. 100 EUR per consumer (difference between the default option and the best offer on the market). This is in the mid-range of Europe, just below EU-15 average.

| | 2008 | 2009 | 2010 | 2011 | 2012 |
|---------|------|-------|-------|-------|-------|
| Norway | 9.0% | 8.0% | 10.2% | 11.2% | |
| Denmark | 2.8% | 6.1% | 4.2% | 3.5% | 6.7%* |
| Sweden | 9.0% | 11.0% | 10.0% | 11.3% | |
| Finland | 4.4% | 8.1% | 7.6% | 7.6% | |

Source: NordREG, 2012, DERA, 2013

Table 3: Switching rates in the Nordic countries, 2008-2012

DERA estimates savings potential of switching the supplier for a variable price between 17 and 220 EUR (depending on the size of the annual consumption, with the largest savings at the highest consumption, here around 15,000 kWh), and for a 12-month fixed price at 2-30 EUR (DERA, 2013, p. 74). The absolute saving potential may in Denmark have less influence on customer choice than in other countries as the supply tariff is a relatively small part of the overall bill – incentives to switch might thus be distorted by high taxes and levies.

4.1.1 Commercial Prices

The electricity suppliers can design the commercial products in different ways. In Denmark, there are currently a number of different products on the market, which can be analysed according to five categories:

- 1) **variable or fixed price:** Is the price variable, i.e. can be changed during the contract period e.g. following the spot price development, or is the price fixed, i.e. pre-determined at the beginning of the contract period?;
- 2) **contract duration:** How long is the customer bound to the contract?;
- 3) **relationship supply/contract charge:** How much is the charge per unit of consumed electricity as compared to the fixed quarterly charge?
- 4) **green products**, e.g. electricity from wind power, CO₂-free electricity
- 5) **additional services**, e.g. free guidance on energy matters.

In mid July 2013, electricity consumers in the greater Copenhagen area could choose between 98 products from 26 different electricity suppliers, each offering between 1 and 15 different products. The in total 52 different variable price products featured a choice between quarterly, monthly, and even hourly price adjustment (the latter following the spot market directly), with a minimum contract duration of between 0 and 16 months. In total 46 fixed price products were offered, ranging from fixing the price 6 months in advance to up to 3 years. Some products offered were rolling, i.e. for the contracted months ahead, whereas others were fixed for calendar years (available were 2013, 2014 and 2015). Most fixed price products were to be contracted for minimum 6 months, whereas a few required commitments for up to 24 months. In most of the products, the quarterly (or monthly) contract charge contributed between 7% and 10% to the total cost for an average household. 13 of the products had no fixed contract charge at all. 30 of the 98 variable price products had green characteristics, including offers on 100%-wind energy, renewable energy in general (both existing and new-builds), and CO₂-free electricity. 14 of the 98 variable price products included additional services, such as free telephone consultations, rebate programs or free energy guidance at home and on the telephone. (Elpristavlen, 2013)

4.1.2 Regulated Prices

The tariffs that obligation supply companies offer under the obligation supply product are regulated. This regulated price system has until recently been applicable for the majority of residential electricity customers in Denmark, as ca. 85% had remained passive and not chosen a commercial product (Committee for Electricity Regulation Review, 2013). However, the system of supply obligation is being phased out (see also section 3.1.2). In March 2013 a number of concessions of supply obligations companies were expiring and were being tendered out again. All customers that previously had been under the regulated tariff in one of these companies have been transferred into a commercial product with their previous supply obligation company. For each customer, the commercial product they were transferred to had to be on comparable conditions than they previously had under the regulated tariff. Because of this recent obligatory product switch, there are currently very few customers who actually receive electricity based on the regulated tariff. As of January 2015, only 8.1% of household consumers received regulated prices (DERA, 2015). In fact, there are only few circumstances in which customers can get back

into the regulated tariff: 1) They can actively choose it; 2) A customer moves into a new area, cannot keep the old supplier and does not choose a new commercial supplier; or 3) A contractual relationship between the customer and the commercial supplier either expires, is terminated by either party or otherwise not accepted, e.g. due to bad payment reputation (Committee for Electricity Regulation Review, 2013).

The Committee for Electricity Regulation Review has recommended discontinuing the regulation of supply obligation tariffs altogether (Committee for Electricity Regulation Review, 2013). As mentioned above, the supply obligation is going to be phased out in 2016 (LOV no. 633, 2014). For comparison, Sweden and Finland do not have regulation on residential electricity prices. In Norway, the obligation supply tariffs are regulated for the first six weeks of supply (NordREG, 2009).

For the currently still operating regulated supply obligation tariff system, the Danish Energy Regulatory Authority (DERA) approves two sets of regulated prices for each obligation supply company: **(1) a quarterly fixed price** and **(2) a quarterly fixed mark-up** on the hourly Nordpool spot price. In principle, all consumers have the right to choose between the two regulated prices. In the default situation, customers with a consumption of below 100 MWh per year are assigned the quarterly fixed price.

The quarterly fixed price is a constant price that is pre-determined for three months at a time. For example, the price for the second quarter 2015 (i.e. April through June) was published on 31 March 2015 on DERA's homepage².

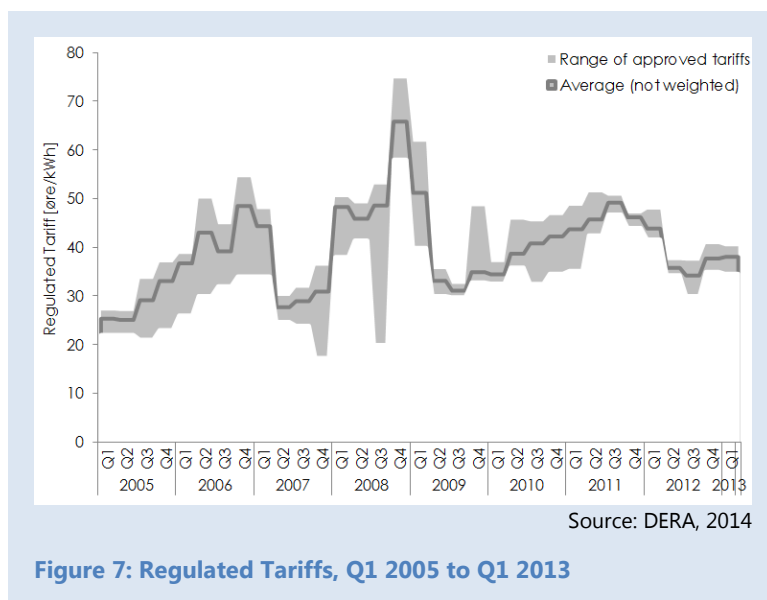


Figure 7: Regulated Tariffs, Q1 2005 to Q1 2013

A separate price is approved for each supply obligation company to reflect the exact cost of providing the consumers of each area with electricity. All regulated consumers within one supply obligation company are charged the same price. The regulated price can vary between the

² <http://energitilsynet.dk/el/priser/godkendte-el-forsyningspligtpriser/>

companies reflecting specific aggregated profile of all consumers of that company, for example if one company has many consumers with a strong peak-profile and another company has consumers with more off-peak-profiles. Differences are shown in Figure 7. Here, the regulated tariffs are simplified for an average household. The actual tariffs consist of a consumption based element, on average 93-95% of the supply payments, and a fixed monthly or quarterly payment (5-7% of the payment). The allocation between fixed monthly and consumption based payments also depends on the supplier and varied between 0% and 10% in the last five years. In the past, the regulated tariffs could vary significantly.

DERA determines the regulated price based on a method adopted by DERA in 2005 and amended in 2010 (DERA, 2015). For consumers with the quarterly fixed price, the supply tariff should reflect "the market's price level for similar customer segments" (LBK no. 279, 2012, §72). Based on the method applied by DERA, the estimated fair price consists of three elements **(1) baseload price, (2) cost of profile delivery, (3) mark-up.**

The **baseload price** (*grundlastpris*) for the respective quarter is determined from the average of all relevant forward contracts on Nord Pool traded in the period from the first trading day in the quarter prior to the respective quarter and up to the 11th trading day before the end of that quarter. System and CfD contracts are taken into consideration where relevant.

The **cost of profile delivery** (*profiltillæg*) is specific for each obligation supply company. Every half year, these companies have to update (and submit to DERA) the hourly consumption profile aggregated from all customers that have the regulated fixed price. DERA then calculates based on the recent data, how much more the purchase of electricity for the specific profile may have cost on the short-term markets compared to a baseload delivery.

The **mark-up** (*spotpristillæg*) covers all cost a supplier has in addition to the pure procurement of electricity, namely balancing cost, portfolio management, billing and administrative cost, as well as a margin as profit for the supplier. The mark-up is determined based on market observations from commercial product offerings on Elpristavlen.dk. It is thus difficult to determine how much each of the above mentioned elements contribute to the mark-up. The mark-ups between Q4 2013 and Q1 2016 are presented in Table 4.

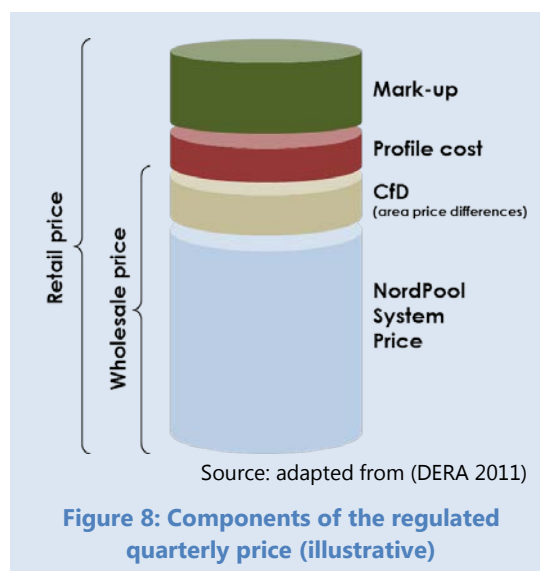


Figure 8: Components of the regulated quarterly price (illustrative)

| | Mark-up (DKK/MWh) |
|-----------------|----------------------|
| 1. kvartal 2016 | 66.50 |
| 4. kvartal 2015 | 61.73 |
| 3. kvartal 2015 | 60.76 |
| 2. kvartal 2015 | 60.43 |
| 1. kvartal 2015 | 60.57 |
| 4. kvartal 2014 | 60.95 |
| 3. kvartal 2014 | 60.53 |
| 2. kvartal 2014 | 60.20 |
| 1. kvartal 2014 | 61.59 |
| 4. kvartal 2013 | 46.99 |

Source: DERA, 2015

Table 4: Regulated mark-ups for the spot price product, 2013-2016

These values include an allowance for volume risk (of 0.06 øre/kWh). The mark-up is each quarter regulated to equal parts with the consumers' price index (PRIS10) and the index for salaried employees in the industry (ILON2).

The termination of the regulated tariffs will be a step towards making flexible demand possible. As DERA made clear in 2012, they did not find it desirable (regarding incentives for customers to move away from obligation supply tariffs) nor practically possible (regarding administrative cost) to introduce a regulated tariff for households with a varying mark-up based on actually measured hourly consumption (DERA, 2012b. p. 94).

4.2 Distribution grid tariff

Distribution network tariffs are determined by the local Distribution System Operators (DSO). The tariffs shall be adequate, objective and non-discriminating. This means every consumer (or consumer group) shall cover those cost that he is directly responsible for through his utilisation of the grid. The methods for determining the tariffs are governed and regulated by the Danish Energy Regulatory Authority (DERA) according to a benchmarking method. As shown in Table 2, the distribution grid tariff consists of two elements, a monthly (or quarterly) grid access charge, and a consumption-based local grid tariff.

The **grid access charge** (*netabonnement*) is usually fixed for a quarter at a time and generally covers for operation and maintenance of the low voltage distribution grid (0.4 kV), general technical and administration cost of the DSO, customer services, cost of meters including depreciation of the equipment, administration and meter-reading.

The **local grid tariff** (*lokal nettarif*), which currently also is fixed for a quarter at a time based on average costs, covers for grid losses in the distribution grid, operation and maintenance of the medium voltage grid (60/10, 50/10 or 10/0.4 kV level), depreciation of assets (except meters), cost of decommissioning of infrastructure (overhead lines), insurance premiums, energy saving activities, and similar.

In an average distribution grid, approximately 30% of the costs covered by the tariff are related to depreciation of assets (the cost of having the infrastructure) and 70% are related to operation and maintenance of the distribution grid. Of the latter part, ca. 23% are related to grid losses within the distribution grid (DEA, 2010, p. 25).

4.3 Transmission grid tariff

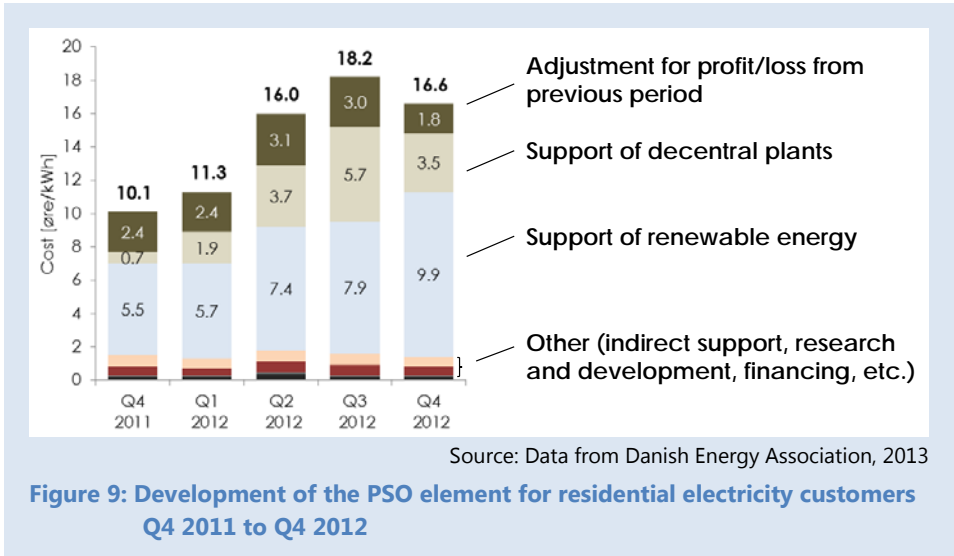
Transmission network tariffs are determined by the national Transmission System Operator (TSO), Energinet.dk. The transmission network tariffs are purely based on the electricity consumption of each consumer; there is no fixed monthly or quarterly element. Before 2011, there have been separate tariff levels for West and East Denmark – reflecting the physical separation of the Western and Eastern electricity system. Since the interconnection cable between the two market areas has been opened, also the TSO tariffs have been aligned. As shown in Table 2, the transmission grid tariff consists of two elements, the grid tariff itself and a system tariff.

The **transmission grid tariff** (*nettariif*) covers Energinet.dk's costs related to make the high voltage infrastructure available. More specifically, it contains grid losses on 400 kV, 150 kV and 132 kV lines as well as on interconnectors to other countries. Losses account for approx. 0.9 øre/kWh, i.e. ca. 20% of the tariff (DEA, 2010, Appendix 1). In the current methodology, this tariff element is fixed and does not immediately depend on the spot prices, although energinet.dk has to source the electricity lost in the grid from there. The rest of the tariff covers for Energinet.dk's operations and administrative cost, depreciations of infrastructure assets and financial cost. The above costs are partially compensated by Energinet.dk's revenue from utilisation charges of the Danish transmission grid as well as potential bottleneck income from auctioning of cross-border capacity.

The **system tariff** (*systemtariif*) covers Energinet.dk's cost from acting as system balancing responsible. It contains costs of capacity reservations, cost for ancillary services and balancing power.

4.4 PSO element

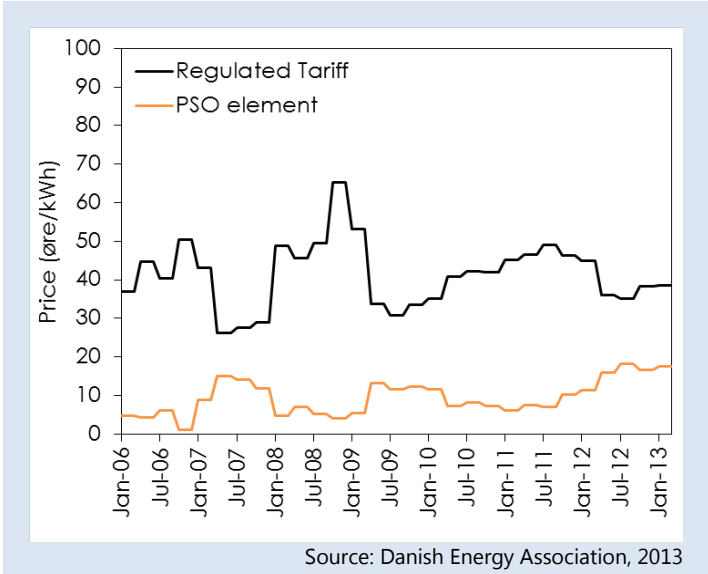
The Public Service Obligation (PSO) is a charge that is collected from the consumers to finance some political initiatives in the energy area, such as the support for renewable energies and decentralised plants as well as research and development for the electricity system. Figure 9 illustrates that there are two major commitments that drive the level of the PSO element: the direct support payments for renewable energy and decentral plants. They make between 60% and 80% of the total PSO element.



The third significant element is an adjustment for profit/loss from previous periods. This occurs because the PSO element is predetermined on quarterly basis based on forward prices and held constant over 3 months at a time. The support payments and some other cost elements are though variable, e.g. depending on the spot market price of electricity. Therefore, there is a requirement for post-regulation (reconciliation) of the element.

The other parts of the PSO element include grid connection costs of renewable energy and decentral plants, research and development initiatives, other PSO-related cost and financing cost.

Because the support for renewable energies is to a large extent based on guaranteed prices, the PSO element is strongly influenced by the difference between the respective guaranteed price and the market price. When the market price is high, the PSO element is low as shown in Figure



10, since the payments to 'top up' from the market price to the guaranteed price decrease.

Large consumers, with a demand of more than 100 GWh per year are eligible to a reduced PSO element.

The PSO element is collected through the electricity bill by the local Distribution System Operator (DSO) and then passed on to Energinet.dk, who is in charge of distributing the payments to all eligible parties (DEA, 2010).

4.5 Electricity taxes

The different state taxes account for approximately 60% of the consumers' payments. The state taxes consist of several energy taxes, which are all specific taxes at a fixed øre/kWh-level, and the Value Added Tax (VAT), which is an ad valorem tax, levied at a fixed percentage of the full underlying price. The energy taxes are updated and changed almost on an ongoing basis. The following description is based on the updated law on taxes on electricity from 1 April 2011 and the law on CO₂ tax from 4 April 2011 (as part of *Forårspakke 2.0*). Most elements of these laws are in force as from 1 July 2011. As of 1 January 2014, all different tax elements have been summarised under one comprehensive energy tax (*Vækstplan DK*) (Danish Government, 2013). As shown in section 3.2.2, the electricity taxes are collected by the local Distribution System Operator (DSO), together with the PSO element. Table 5 gives an overview over the tax levels and their development.

| Prices in øre/kWh (nominal) | Households | | | | | Households with electric heating ¹ | | | | |
|---|-------------|-------------|-------------|-------------|-------------|--|-------------|-------------|-------------|-------------|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Electricity tax <i>energiavgift</i> | 62.4 | 63.5 | 64.7 | | | 50.8 | 51.7 | 52.6 | | |
| Electricity distribution charge <i>el-distributionsbidrag</i> | 4.0 | 4.0 | 4.0 | | | 4.0 | 4.0 | 4.0 | | |
| Energy savings tax I <i>energisparebidrag</i> | 0.6 | 0.6 | 0.6 | | | 0.6 | 0.6 | 0.6 | | |
| Supplementary charge <i>tillægsavgift</i> | 6.0 | 6.1 | 6.2 | | | 6.0 | 6.1 | 6.2 | | |
| Energy savings tax II ² <i>energispareavgift</i> | 6.3 | 6.4 | 6.5 | | | 6.3 | 6.4 | 6.5 | | |
| TOTAL | 79.3 | 80.6 | 82.0 | 83.3 | 87.8 | 67.7 | 68.8 | 69.9 | 41.2 | 38.0 |

¹ part of consumption > 4,000 kWh/y
² previously CO₂ tax (*CO₂ afgift*)

Source: Ministry of Taxation, 2010, LBK no. 310, 2011 and Danish Government, 2013

Table 5: Electricity Taxes in Denmark 2011-2014

Many, but not all electricity consumers have to pay the energy taxes. Embassies, consulates and other representative institutions of foreign states as well as international organisations, in which Denmark is a member, are exempt from paying the energy taxes. From all other consumers, the energy taxes are collected. VAT-registered consumers, however, are (like in the VAT procedure) paid back the energy taxes. Though, the refund is reduced by 1 øre/kWh. For all consumption over 15 mio. kWh/y, the energy taxes are paid back fully. The refund only includes the additional energy tax of 6.0 øre/kWh in case the electricity is used for heating, agricultural, metallurgical or chemical purposes.

An exception are the so-called 'liberal' businesses who generally do not use electricity for production processes. These VAT-registered businesses have to pay the full energy taxes and

are not refunded any of it. The law of electricity taxes from 1 April 2011 includes a positive list of these 'liberal' businesses, which includes law firms, architects, agencies, entertainment enterprises (incl. cinemas, theatres etc.), real estate agents, accountants, advertising offices, engineering consultants, etc. (LBK no. 310, 2011, Appendix 1).

The **electricity tax** (*energiavgift*) was first introduced in 1977, at the time with 2 øre/kWh. Today, it is with 62.4 øre/kWh the major element of energy taxation. The electricity tax is yearly regulated along a usual increase in prices, until 2015 the rate of increase is fixed at 1.8%. From 2015 and onwards, the applicable basis for the increase is the Danish net price index for consumers. Note that houses with electric heating are subject to a lower tax: The electricity consumed in houses with electricity heating that is above 4.000 kWh per year is subject to a special electricity-heating tax level (*elvarmesats*), which is reduced in comparison to the electricity tax (BEK no. 456, 1986).

The **electricity distribution charge** (*el-distributionsbidrag*) was implemented in 1999 alongside the liberalisation of the electricity market. It was expected that liberalisation will lead to lower electricity prices and therefore it was argued that an additional charge on electricity could be implemented to strengthen state finances (Ministry of Taxation, 2010, p. 35). The electricity distribution charge was introduced at 4 øre/kWh and was kept constant since. There is no regulation mechanism for this charge, so the nominal state revenue from this charge is continuously decreasing over the years.

The **energy savings tax** (*energispæredrag*) of 0.6 øre/kWh was introduced to finance the newly established national energy saving fund (Elsparafonden) and later the Center of Energy Savings (*Center for Energibesparelser*). This tax element is not indexed.

The **supplementary charge** (*tillægsavgift*) of 6.0 øre/kWh had to be paid since 1 January 2011. It will be regulated with the same rate of increase as the electricity tax, i.e. at 18% per year and from 2015 onwards with the net price index.

The **energy savings tax II** (*energispæreaftgift*), based on the law on CO₂ tax, was in 1992 originally introduced as CO₂ tax at 10 øre/kWh and constituted a payment similar to the tax on fuels consumed in other areas with the assumption that all electricity was produced in coal power plants. Here, not the producers but the consumers of the product are charged with the tax due to the otherwise distortive effects, a.o. on cross-country electricity trade. The tax was originally intended to be discontinued with the introduction of an EU emissions trading system with full auctioning (Ministry of Taxation, 2010, p. 34 and 36). However, due to the increased government ambitions to energy savings, the tax was assigned a new purpose and since became a second energy savings tax. The tax is regulated with the same rate of increase as the electricity tax.

As the above descriptions indicate, the different taxes have historically developed and led to the situation that there were several different taxes governed by several different laws. As mentioned above, the different energy tax elements are consolidated into a single element as of January 2014 (Danish Government, 2013).

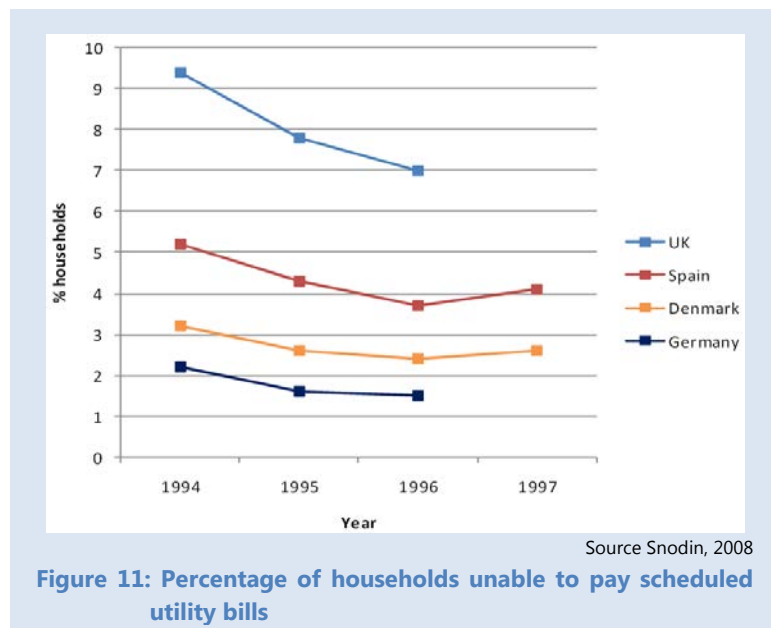
4.6 Value Added Tax

The applicable VAT is the usual 25% applicable for final use of goods and services. VAT-registered enterprises are also exempt from paying VAT on electricity.

In contrast to the other taxes, which are all collected by the DSO, the VAT is collected by each separate institution, i.e. the DSO collects the VAT for the amount he bills to the customer, and the electricity supplier collects the VAT in his own bill.

4.7 Affordability issues

In 2012, an average household has used around 5-6% of its disposable income for electricity. This figure for Denmark is high compared to the EU-15 average of 3-4%, where only Portugal has a higher relative cost (after Portugal has recently increased applicable VAT from 6% to 23%) (Dromacque, 2013). The vast majority of households are capable of paying their electricity bills. Figure 11 illustrates this for the years 1994-97.



Vulnerable customers are handled through the social security system. The general social welfare benefits for financially distressed households incorporate general allowances for housing cost including utilities. Help on particular unpaid bills is generally not granted, although exceptions are possible (LBK no. 190, 2012).

The normal process for a residential electricity customer in Denmark who has problems with paying his electricity bills is, based on DCA (2012), the following: His supplier can claim the late or missing payments and send up to three notices with a minimum of 10 days between them. If no payments are received then, the supplier can terminate the contractual relationship. The

customer will however not be disconnected yet. He will be transferred to the supply obligation company, which is immediately obligated to deliver electricity to the customer.

Case example: Energi Fyn

The supply obligation company Energi Fyn prompted the disconnection of 1,000 residential customers in 2008 and 1,100 in 2009. In approx. 10% of the cases, the company had to get help from the local bailiff to accessing the respective apartments and houses.

Source TV2 Fyn, 2010

The supply obligation company is not authorised to disconnect customers on the basis of them having not paid their bills for consumed electricity. If the supply obligation company has, after a specific credit risk evaluation, reason to believe that a customer will not be able to pay future bills, then the company can request a bank guarantee or similar. The customer has then usually two months' time to

provide this guarantee. Only if the customer does not meet this request, the supply obligation company can send a request to the respective distribution grid operator to disconnect the customer.

Unpaid bills, both from the commercial supplier and from the supply obligation company, can become a case for a government authorised debt collection entity.

5 Conclusions and outlook

Many households in Denmark have started not only to be a consumer of electricity but also to produce themselves, e.g. by installing solar power systems or household wind mills. Consumer site production and related schemes of net metering have not been described in this report. We will leave this to future work.

In the future, households are expected to contribute to the integration of variable renewable energy sources into the energy system by providing flexibility. The ongoing smart meter roll-out is a first step into this direction but by far not enough to activate consumers. The current pricing system does not allow or encourage very much flexibility from residential electricity customers. New regulations and fee structures are probably required.

New types of electricity consumption, especially heat pumps and electric vehicles, need to be embraced and well integrated into the system so that their potential for flexibility provision can be exploited. This might require more dynamic electricity supply tariffs, network tariffs and even dynamic taxation.

Acknowledgement

This report is undertaken as joint effort under the ENSYMORA project (Energy systems modeling, research and analysis) and the iPower project with gratefully acknowledged funding by the Danish Council for Strategic Research.

Glossary

DCA Danish Competition Authority, *Konkurrence- og Forbrugerstyrelsen*

Danish Energy Association, *Dansk Energi*

Danish Energy Net, *Dansk Energi - Net*, the umbrella organisation of all network companies in Denmark. The association represents the interests of Danish network companies towards authorities, organisations and society as a whole. Established in 2001. Until 2006 with the name Elfor. Since 2002, joint secretary with Danish Energy Association.

DEA Danish Energy Agency, *Energistyrelsen*

DERA Danish Energy Regulatory Authority, *Energitilsynet*

DSO Distribution System Operator

Energinet.dk, the national TSO of Denmark

Energy Board of Appeal (*Energiklagenævnet*)

Energy Supplies Complaint Board (*Ankenævnet på Energiområdet*)

PSO Public Service Obligation. It is through this price element that a.o. support for renewable energy is financed.

Standard profile customer, *skabelonkunde*, a customer which is not metered on hourly basis is given a standard profile, which is used for forecasting and billing.

Supply obligation company, *forsyningspligtselskab*

TSO Transmission System Operator

VAT Value Added Tax (*MOMS*)

Relevant data & Information sources

1 General information on the sector and prices

- <http://www.danskeenergi.dk/AndreSider/Energifakta.aspx>

PSO:

- <http://energinet.dk/DA/El/Engrosmarked/Tariffer-og-priser/PSO-tariffen/Sider/Specifikation-af-PSO-tariffen.aspx>

2 Market regulations and Methods

- <http://energinet.dk/EN/El/Forskrifter/Markedsforskrifter/Sider/default.aspx>

- <http://energitilsynet.dk/el/afgoerelser/tilsynsafgoerelser/2013/energinetdk-metodegodkendelse-og-gennemgang-af-forskrifter-datahubben/>

3 Regulated prices

Data (as pdf and spreadsheet), explanation and method description can be downloaded here:

- <http://energitilsynet.dk/el/priser/prisstatistik-for-el-forsyningspligt/>
- http://energitilsynet.dk/fileadmin/Filer/0_-_Nyt_site/EL/Prisstatistik/2012/Metodebeskrivelse_november_2012.pdf
- Guidelines on regulated prices:
<http://energitilsynet.dk/el/selvbetjening/forsyningspligtpriser/vejledninger-og-skemaer/11/>

4 Commercial products:

Data (as pdf and spreadsheet), explanation and method description can be downloaded here:

- <http://energitilsynet.dk/el/priser/prisstatistik-for-el-handelsproduk-ter/>
- <http://www.elpristavlen.dk/>
- Database of commercial products on the Danish retail market, available in excel (Monthly files, available from January 2013):
<http://www.elpristavlen.dk/Artikler/ElprisensUdvikling.aspx>

5 Market Actor Register

The Market Actor Register is a common web-based system where information about the market actors is registered. It can be found on: www.ediel.dk

References

- ACER, 2012. Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2011. ACER/CEER. Agency for the Cooperation of Energy Regulators and Council of European Energy Regulators.
- Bang, C., Fock, F., Togeby, M., 2012. The existing Nordic regulating power market, Copenhagen: EA energianalyse. www.ea-energianalyse.dk/reports/1027_the_existing_nordic_regulating_power_market.pdf.
- BEK no. 1233, 2015. Bekendtgørelse om elhandelsvirksomhedernes opgaver og forpligtelser i forbindelse med levering af elektricitet til elkunder (Executive Order on the delivery of electricity), Copenhagen: The Danish Ministry of Energy, Supply and Climate, 06/11/2015. www.retsinformation.dk/Forms/R0710.aspx?id=175118.
- BEK no. 1358, 2013. Bekendtgørelse om fjernaflæste elmålere og måling af elektricitet i slutforbruget, Copenhagen: The Danish Ministry of Energy, Supply and Climate, 03/12/2013.
- BEK no. 456, 1986. Bekendtgørelse om afgiftsberigtigelse af elektricitet til opvarmning af helårsboliger, Copenhagen: Danish Ministry of Taxation (Skatteministeriet). 10/07/1986. www.retsinformation.dk/Forms/R0710.aspx?id=163294.
- BEK no. 667, 2015. Bekendtgørelse om program for intern overvågning for net - og transmissionsvirksomheder og Energinet.dk i henhold til lov om elforsyning (Executive Order on the program for monitoring of grid and transmission companies and Energinet.dk), Copenhagen: The Danish Ministry of Climate, Energy and Building, 21/03/2012. www.retsinformation.dk/Forms/R0710.aspx?id=170186.
- BEK no. 965, 2006. Bekendtgørelse om økonomisk regulering af Energinet.dk (Executive Order on the economic regulation of Energinet.dk), Copenhagen: The Danish Ministry of Climate, Energy and Building, 21/09/2006. www.retsinformation.dk/Forms/R0710.aspx?id=22603.
- Committee for Electricity Regulation Review, 2013. Forslag til en fremtidig regulering af forsyningspligten (Proposal for the future regulation of supply obligation), Copenhagen: Committee for Electricity Regulation Review (Udvalg for el-reguleringseftersynet).
- Committee for Electricity Regulation Review, 2014. En fremtidssikret regulering af elsektoren. ISBN: 978-87-93071-85-8.
- Danish Energy Association, 2012. Data collection on transport of electricity (supply) and metering points (customers) by consumer categories. Available on request. Frederiksberg: Danish Energy Association (Dansk Energi).
- Danish Energy Association, 2013. Gennemsnitlige månedlige el-forsyningspligtpriser for forbrugere og virksomheder i Danmark, Frederiksberg: Danish Energy Association (Dansk Energi).
- Danish Energy Association, 2014. Elforsyningens tariffer & elpriser pr. 1. januar 2014. Frederiksberg: Danish Energy Association (Dansk Energi).
- Danish Energy Regulatory Authority, 2012. Analyse af konkurrencen på detailmarkedet for el.

Valby.

- Danish Government, 2013. Vækstplan DK: Stærke virksomheder, flere job (Growth Plan DK: strong companies, more jobs). Copenhagen: Danish Ministry of Finance, The Danish Government.
- Danish Ministry of Energy, 1994. Forbud efter varmforsyningsloven mod etablering af elopvarmning i eksisterende og ny bebyggelse beliggende i kollektive forsyningsområder. Jr.nr. 6111-14, Copenhagen: Danish Ministry of Energy (Energistyrelsen). www.ens.dk/sites/ens.dk/files/undergrund-forsyning/el-naturgas-varmforsyning/forsyning-varme/regulering/elvarmeforbud/Elvarmeforbud_060594.pdf. Copenhagen.
- Danish Ministry of Energy, 2013. Smart Grid Strategy. The intelligent energy system of the future, Danish Ministry of Climate, Energy and Building. www.ens.dk/sites/ens.dk/files/undergrund-forsyning/el-naturgas-varmforsyning/Smart-grid/smartgridstrategy_uk_web.pdf.
- DCA, 2012. Advice on electricity consumption in Denmark., Copenhagen: Danish Competition and Consumer Authority (Konkurrence- og Forbrugerstyrelsen). www.forbrug.dk/Test-og-raad-foer-du-koeber/Bolig-og-fritid/El.
- DEA, 2010. Redegørelse om mulighederne for og virkningerne af dynamiske tariffer for elektricitet (Opportunities and effects of dynamic tariffs for electricity), Copenhagen: Danish Energy Agency (Energistyrelsen). www.ens.dk/sites/ens.dk/files/dokumenter/publikationer/downloads/redegoerelse_om_mulighederne_for_og_virkningerne_af_dynamiske_tariffer_for_elektricitet.pdf.
- DEA, 2012. Engrosmodellen. J.nr. 3401/1001-4031. Copenhagen: Danish Energy Agency (Energistyrelsen).
- DEA, 2015. Forsyningspligtbevillinger forlænges, Copenhagen: Danish Energy Agency (Energistyrelsen). www.ens.dk/info/nyheder/nyhedsarkiv/forsyningspligtbevillinger-forlaenges.
- DERA, 2012a. Analyse af konkurrencen på detailmarkedet for el, Valby: Danish Energy Regulatory Authority (Energitilsynet). www.energitilsynet.dk/fileadmin/Filer/0_-_Nyt_site/EL/Nyheder/Analyse_af_detailmarkedet_for_el.pdf.
- DERA, 2012b. Analyse af konkurrencen på detailmarkedet for el, Valby: Danish Energy Regulatory Authority (Energitilsynet).
- DERA, 2013. 2012 National Report to the European Commission, Valby: Danish Energy Regulatory Authority (Energitilsynet).
- DERA, 2014. Prisstatistik for el-handelsprodukter og el-forsyningspligtprodukter, Valby: Danish Energy Regulatory Authority (Energitilsynet). www.energitilsynet.dk/el/priser.
- DERA, 2015. Forsyningspligt (Supply Obligation). Valby Danish Energy Regul. Auth. (Energitilsynet). www.energitilsynet.dk/el/regulering/forsyningspligt/.
- Dromacque, C., 2013. European Residential Energy Price Report 2013. Helsinki: Vaasa ETT Global Energy Think Tank.
- Elpristavlen, 2013. Database of commercial products on the Danish retail market., Frederiksberg: Danish Energy Association (Dansk Energi). www.elpristavlen.dk.
- Elpristavlen, 2015. Liste over elleverandører, Frederiksberg: Danish Energy Association (Dansk Energi). www.elpristavlen.dk/Artikler/Elleverandoerer.aspx.

- Energinet.dk, 2011. Regulation C1 – Terms of balance responsibility (No. 783245-07), www.energinet.dk/SiteCollectionDocuments/Engelske dokumenter/EI/Regulation C1 - Terms of balance responsibility.pdf.
- Energinet.dk, 2014. Download of market data. Energinet.dk, the Danish Electricity Transmission System Operator. www.energinet.dk/DA/EI/Engrosmarked/Udtraek-af-markedsdata.
- Energinet.dk, 2015. Balanceansvarlige aktører, <http://www.energinet.dk/DA/EI/Engrosmarked/Aktoerer/Sider/Balanceansvarlige-aktoerer.aspx>.
- EU Directive 2009/72/EC, 2009. Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC (Text with EEA relevance). Off. J. Eur. Union L 211, 55–93.
- Eurostat, 2015. Electricity prices for domestic consumers - bi-annual data (from 2007 onwards), Download of data. Code: nrg_pc_204. <http://ec.europa.eu/eurostat>.
- LBK no. 1097, 2011. Lov om Energinet.dk (Act on Energinet.dk), Copenhagen: The Danish Government, Ministry of Climate, Energy and Building, 08/11/2011. www.retsinformation.dk/Forms/R0710.aspx?id=139077.
- LBK no. 1275, 2013. Lov om elforsyning (Electricity Supply Act), Copenhagen: The Danish Government, Ministry of Climate, Energy and Building, 11/11/2013. <https://www.retsinformation.dk/Forms/R0710.aspx?id=158866#Kap6>.
- LBK no. 1329, 2013. Lov om elforsyning (Electricity Supply Act), Copenhagen: The Danish Government, Ministry of Climate, Energy and Building, 25/11/2013. www.retsinformation.dk/Forms/R0710.aspx?id=159158.
- LBK no. 190, 2012. Lov om aktiv socialpolitik (Act on active social policy), Copenhagen: The Danish Government, Ministry of Employment, 24/02/2012.
- LBK no. 279, 2012. Lov om elforsyning (Electricity Supply Act), Copenhagen: The Danish Government, Ministry of Climate, Energy and Building, 21/03/2012.
- LBK no. 310, 2011. Lov om afgift af elektricitet (Electricity Taxation Act), Copenhagen: The Danish Government, Ministry of Taxation, 01/04/2011. www.retsinformation.dk/Forms/R0710.aspx?id=133843.
- LOV no. 1352, 2012. Lov om ændring af lov om elforsyning og lov om naturgasforsyning - Udstedelse af forsyningspligtbevillinger (Act on changes in the Electricity Supply Act - Concessions for supply obligations companies), Copenhagen: The Danish Government, Ministry of Climate, Energy and Building, 21/03/2012. www.retsinformation.dk/Forms/R0710.aspx?id=144751.
- LOV no. 1457, 2013. Lov om forbrugeraftaler (Act on Consumer Agreements), Copenhagen: The Danish Government, Ministry of Justice, 17/12/2013. www.retsinformation.dk/Forms/R0710.aspx?id=160666.
- LOV no. 375, 1999. Lov om elforsyning (Electricity Supply Act). Superceded., Copenhagen: The Danish Government, Ministry of Climate, Energy and Building, 02/06/1999. www.retsinformation.dk/Forms/R0710.aspx?id=12196#K11.
- LOV no. 466, 2011. Lov om ændring af lov om elforsyning (Act on changing the Electricity Supply Act), Copenhagen: The Danish Government, Ministry of Climate, Energy and Building, 18/05/2011. www.retsinformation.dk/Forms/R0710.aspx?id=136991.
- LOV no. 633, 2014. Lov om ændring af lov om elforsyning, lov om naturgasforsyning og lov om

- Energinet.dk. (Ophævelse af forsyningspligten, indførelse af leveringspligt, udskydelse af engrosmodellen m.v.). Copenhagen Danish Gov. Minist. Clim. Energy Build. 16/06/2014. www.retsinformation.dk/forms/R0710.aspx?id=163864.
- Ministry of Taxation, 2010. Redegørelse om muligheder for og virkninger af ændrede afgifter på elektricitet med særlig henblik på bedre integration af vedvarende energi (dynamiske afgifter) (Opportunities and effects of changes in taxes on electricity, with special focus on a better integration of renewable energy (dynamic taxes)). Energy policy Committee (Det Energipolitiske Udvalg). 2009-10. EPU alm. del Bilag 329. Copenhagen: Danish Ministry of Taxation (Skatteministeriet). www.ft.dk/samling/20091/al.
- NordPoolSpot, 2013. The power of transparency - Annual Report 2012.
- NordREG, 2006. A Common Definition of the System Operators' Core Activities. Eskilstuna.
- NordREG, 2009. Market design: Common Nordic end-user market, Oslo: Nordic Energy Regulators. www.nordicenergyregulators.org/wp-content/uploads/2013/02/Market_Design_Common_Nordic_end-user_market_200905072.pdf.
- NordREG, 2012. Nordic Market report 2012: Development in the Nordic Electricity Market. Report 3/2012. Helsinki: Nordic Energy Regulators.
- NordREG, 2014. Nordic Market report 2014: Development in the Nordic Electricity Market. Eskilstuna: Nordic Energy Regulators.
- Snodin, H.M., 2008. Fuel Poverty in Great Britain, Germany, Denmark and Spain - relation to grid charging and renewable energy. Rep 1028/001/001A. Glasgow: Xero Energy.
- TV2 Fyn, 2010. Newspaper article by Alfred Rosenfeldt: Flere får lukket for strømmen (More customers get cut off from their supply). Odense: TV2. www.tv2fyn.dk/article/222212:Flere-faar-lukket-for-stroemmen.

Appendix A: Roles and responsibilities (detailed)

The tables below is a copy from Energinet.dk's market regulation F: EDI communication, Appendix report 3: The Danish role model.

ETSO/ebIX role: Refers to the English terms defined by ETSO and ebIX. In some cases a Danish player covers two or more ETSO and ebIX roles.

| ETSO/ebIX role | Description |
|---------------------------------|--|
| Balance responsible party | Buys and sells electricity in the wholesale market and settles with the "imbalance settlement responsible". The role as balance responsible party is a collective term for the balance responsibility found in the market (production, trade and consumption responsible parties). It is not a role in itself. |
| Production responsible party | Responsible for any imbalance between electricity sold and produced for all associated metering points. May have a contract with a balance supplier to buy electricity from a "party connected to grid". |
| Trade responsible party | Buys and sells electricity. Must ensure balance before the notification and schedule phase ends. |
| Consumption responsible party | Responsible for any imbalance between electricity bought and consumed for all associated metering points. May have a contract with a balance supplier to supply electricity to a consumer. |
| Balance supplier | A player supplying/buying electricity to/from a consumer/producer. Has a contract with a balance responsible party. |
| System operator | Has overall responsibility for creating balance in the market and for handling transmission grid operation and ensuring stable electricity supply. |
| Transmission capacity allocator | Manages the allocation of transmission capacity between the defined areas where the balance responsible parties operate. Transmission capacity between market balance areas is allocated separately. |
| Market operator | The market operator determines the market energy price for a market balance area after applying the technical possibilities and constraints given by the responsible system operator. Trading notifications from balance responsible parties are also included in the price determination. |

| ETSO/ebIX role | Description |
|----------------------------------|---|
| Metering point administrator | Responsible for the relationship with players connected to the meters. Is also responsible for creating and terminating metering points and for the contractual relationship to the "party connected to grid". |
| Metered data aggregator | Responsible for qualifying metered data from the metered data responsible. |
| Metered data responsible | Responsible for keeping and validating metered data based on collected data from the metered data collector. The meter reading data are forwarded to the balance supplier, who uses the data for billing electricity. |
| Metered data collector | Responsible for reading meters. |
| Grid operator | A player that operates one or more physical electricity grids. |
| Grid access provider | Responsible for providing access to the grid for a "party connected to grid" and for securing power supply. Applies to both producers and consumers. |
| Meter operator | Responsible for installing, maintaining, testing and decommissioning meters. |
| Party connected to grid | "Party connected to grid" is a general term for all players connected to the grid. It is not a role in itself. In practice, it is the producer and the consumer. |
| Producer | A producer that owns one or more electricity producing facilities. |
| Consumer | A consumer of electricity. |
| Settlement responsible | A player responsible for settling the difference between contractual obligations and actual production/consumption. |
| Imbalance settlement responsible | Responsible for settling the difference between contractual obligations and actual consumption/production for the balance responsible parties in a market balance area. |
| Reconciliation responsible | Responsible for reconciling the imbalance between consumption according to balance settlement and metered consumption for a profile-settled metering point in a grid area. The statement is submitted to the parties that are "reconciliation responsible" for the given metering area. |
| Reconciliation accountable | Financially responsible for settling the energy volume supplied to a local metering point according to the reconciliation. |

Source: Energinet.dk, Market regulation F, appendix 3

| Danish players | Roles (ETSO/ebIX) |
|---|--|
| Electricity consumer | Consumer |
| Balance responsible party (BRP) BRP for production BRP for trade BRP for consumption | Balance responsible party Production responsible party Trade responsible party Consumption responsible party |
| Electricity supplier | Balance supplier Reconciliation accountable |
| Transmission company ³ | Grid operator Meter operator Metered data collector Metered data responsible Metered data aggregator |
| Transmission system operator | System operator Responsible for balance settlement |
| Transmission capacity allocator ⁴ | Transmission capacity allocator |
| Meter operator (may be part of grid company) ⁵ | Metered data collector Metered data responsible Meter operator Metered data aggregator |
| Grid company | Grid operator Grid access provider Metering point administrator Meter operator Metered data collector Metered data responsible Metered data aggregator Reconciliation responsible |
| Supply obligation company / Electricity supplier (with special obligations) | Balance supplier |
| Electricity producer | Producer |

Source: Energinet.dk, Market regulation F, appendix 3 (*slightly adapted*).

³ A transmission company, as a player, is not responsible for system operation. The player's responsibility is best compared to that of a grid company, yet without direct contact with the electricity consumer.

⁴ Performed by E.ON - Transmission system operator/ Transmission company south of the Danish-German border

⁵ In rare cases, some of the grid company's duties are delegated to a meter operator. In these cases, the meter operator's duties include collecting, storing and qualifying metered data. The meter operator takes over the duties – responsibility remains with the responsible grid company. The ETSO/ebIX roles of the two players therefore overlap.