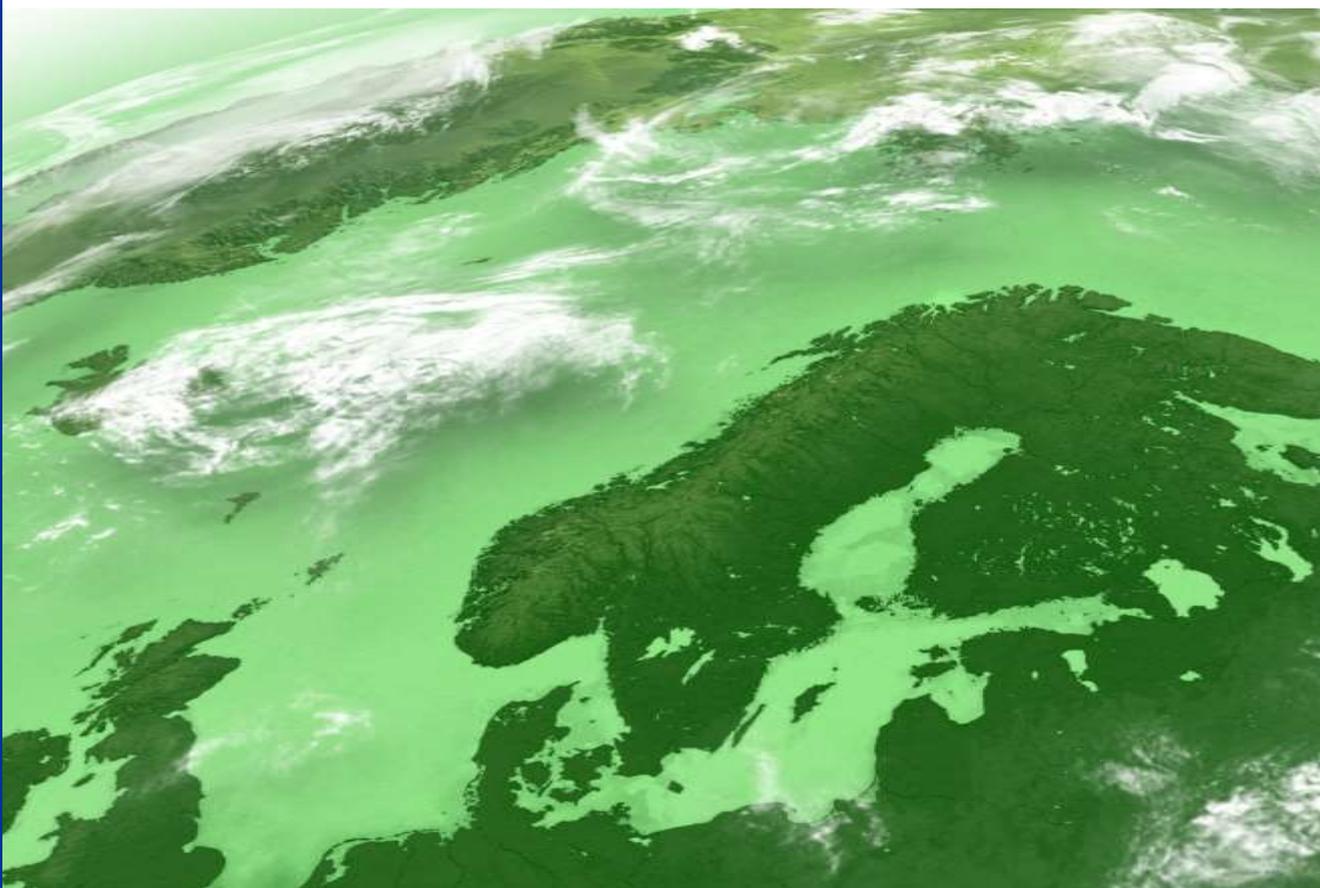




MAPPING OF TSOS' AND DSOS' ROLES AND
RESPONSIBILITIES RELATED TO MARKET DESIGN
TO ENABLE ENERGY SERVICES

Commissioned by NordREG



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Contact details

Oslo**Pöyry Management Consulting (Norway) AS**

Post Box 706 Sentrum,
N-0102 Oslo
Norway

Visiting address:
Grensen 16,
N-0159 Oslo

Telephone: +47 45 40 50 00
Telefax: +47 22 41 19 00
e-mail: oslo.econ@poyry.com

<http://www.poyry.no>

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EXECUTIVE SUMMARY

Provision of Energy Services

Energy Services means the physical benefit, utility or good derived from a combination of energy with energy-efficient technology or with action, which may include the operations, maintenance and control necessary to deliver the service, which is delivered on the basis of a contract and in normal circumstances has proven to result in verifiable and measurable or estimable energy efficiency or primary energy savings. This study investigates DSOs' responsibilities within energy services related to smart meters, ancillary services, and grid tariff adjustments.

Excluding Iceland, Nordic DSOs are commissioned with the task of installing smart meters in all customers' premises. Technical smart meter requirements in Denmark, Finland and Norway include two-way communication regarding monitoring and control, the opportunity to install monitoring in-home displays and open standards for communication with external technical equipment. No functional regulatory requirements apply for smart meters in Sweden¹, but most meters allow for remote reading and control (two-way communication). In Sweden, functional regulatory requirements are forthcoming.

DSOs' mandates also include setting grid tariffs. The current common practice is to set tariffs based on a fixed and a variable energy component. A very small number of DSOs (in Norway and Sweden) also include a capacity charge (€/kW) in their tariff structure. The tariff can be flat over the year, or the variable component can differ in time-of-use, e.g. seasonal or daily. Regulation in Denmark, Finland and Sweden allows for flexible tariffs as long as they are non-discriminatory. In Norway regulation does not put any restrictions on the use of dynamic pricing for households. All countries allow for dynamic pricing for non-household customers in practice as there is freedom to negotiate this into a network contract. In Iceland the national authority approves tariff changes, suggesting less room for dynamic pricing.

Provision of Energy Efficiency Measures

Energy efficiency measures refer to the installation of equipment or other energy services that enable customers to reduce their energy consumption.

Danish and Swedish regulation makes DSOs responsible for informing customers about energy efficiency measures, while DSOs in Finland are required to do so if they have signed up to voluntary energy efficiency agreements. No such responsibility applies in Iceland and Norway. In all Nordic countries, DSOs are responsible for providing customers with consumption information. In Denmark, Norway and Sweden this includes benchmark profiles of historical consumption.

DSOs are responsible for making consumption data accessible to customers through different communication platforms e.g. web platforms and in-home monitoring displays. In Denmark and Norway, DSOs should facilitate the installation of in-home displays (directly or through third party) if requested by the customer. In Finland, DSOs are required to offer meters with standard open interface for real time consumption data. DSOs in Iceland and Sweden have no such responsibility. DSOs across all Nordic countries (unclear for Iceland) make consumption data available via a web based portal.

Real-time grid status information could incentivise customers to reduce consumption in situations with strained grid capacity. There are no information requirements for Nordic

¹ Functionality requirements are underway according to Ei

DSOs regarding preventive measures to avoid unplanned outages or grid constraints, apart from in Finland where DSOs are required to provide information on the grid's reliability as well as interruption preparations at least every two years.

Direct and custom-made advice on energy efficiency measures can be provided by DSOs when in direct contact with the customer. Regulation in Denmark, Finland and Sweden states that DSOs are responsible for informing customers on the potential use of smart meters. This responsibility is not specified in Norway or Iceland. In Denmark, DSOs are responsible for providing individual advice on energy efficiency measures, and so are Finnish DSOs if they have signed up to voluntary energy efficiency agreements.

Participation in competitive activities

In this context competitive activity is defined as participation in activities intended to increase the production or supply part of the business. All Nordic DSOs act as neutral facilitators for competitive market activities performed by suppliers and producers, and are therefore not directly involved in competitive activities.

The income framework models used to regulate the DSOs' allowed income are designed to incentivise DSOs to be as efficient as possible. In practice this means that DSOs are competing against each other. The main difference in the income regulation models across the Nordic countries is that the regulation scheme in Denmark, Finland and Norway are based in benchmarking, i.e. measuring a company's efficiency against a reference performance, while this is not the case in Iceland and Sweden². The three countries using benchmarking of efficiency use different methods.

Denmark has decided to implement mandatory combined billing, meaning no DSO responsibility for invoicing and customer contact. This regime is currently being reviewed in Norway, and is proposed in Sweden. The opposite regime is mandatory separate billing. In cases where the DSOs have the same name and logo as an integrated supplier, the DSO's logo on the bill may have a company brand marketing effect. Regardless of the chosen billing regime, the DSOs' participation in competitive activities will be limited.

Current roll-out rates, and capabilities, of smart meters differ between the Nordic countries. The targeted roll-out-rate in Denmark, Finland, Norway and Sweden is 100%. Iceland has no stated plan of smart meter installation. Introduction of centralised data hubs will enable access to customer information and customer metering data in a standardized format. DSOs may have access to more detailed data than uploaded in the hub. According to the Electricity Directive, DSOs may not discriminate between users, but an important question is whether DSOs in practice will discriminate between suppliers by providing the integrated supplier with more detailed customer data than to others.

National unbundling rules for DSOs

Across the Nordics, the majority of the suppliers are vertically integrated, i.e. integrated with a distribution company, and these serve the majority of the customers. EU's Electricity Directive specifies the minimum requirements related to unbundling of DSOs from generation and supply companies, but implemented rules differ to some extent between the countries.

All five countries have imposed accounts and legal unbundling, though the threshold for legal unbundling differs. In Denmark, Iceland and Sweden all DSOs are legally unbundled. The unbundling threshold in Finland is distribution on the 0.4 kV network of at least 200

² Iceland aims to introduce benchmarking, and Sweden has decided to introduce benchmarking from the next tariff period (2016-2019)

GWh/year for three consecutive years. The corresponding threshold in Norway is at least 100,000 customers in addition to special requirements from NVE.

Functional unbundling is required for some DSOs in all Nordic countries except Iceland. The threshold for functional unbundling is at least 100,000 customers in Denmark, Norway and Sweden, while the corresponding number for Finland is 50,000 customers.

Unbundling of brands is not a requirement in Iceland and Norway. According to the Electricity Acts in Denmark, Finland and Sweden, DSOs should not create identity confusion in communication with costumers. However, only Finland has detailed requirements stating that a legally unbundled DSO's name and logo must differ from the competitive entities (production and supply) within the same company group.

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1 INTRODUCTION AND BACKGROUND

1.1 HARMONIZATION OF THE NORDIC END-USER MARKET

The Nordic energy regulators are working towards a harmonised Nordic electricity market with a common regulatory framework, supplier practices and procedures and commercial arrangements. The Nordic harmonisation process has been ongoing since 2006.

NordREG's supports the supplier-centric model arrangement, which implies, if the Nordic countries adopt all recommendations, that a number of responsibilities will be transferred from DSOs to suppliers³. This includes grid tariff invoicing and customer contact on grid-related issues. If this were to materialise, a DSOs role will gradually move towards being a pure provider of infrastructure services, and thus being less involved in other parts of the electricity supply chain.

System developments are making customer data more accessible to suppliers, consumers and third parties through the establishment of centralised information exchange systems, such as data hubs. While TSOs are responsible for ensuring accessibility to the hub, DSOs are responsible for uploading consumption data to the hub.

If the proposed market design changes are adopted, there is reason to believe that the DSOs' activities mainly will be related to grid operation and maintenance. Nevertheless, DSOs will remain accountable for infrastructure tasks such as upholding a well-functioning grid and security of supply, as well as economic operations through setting grid tariffs.

1.2 OBJECTIVE AND AUDIENCE OF THE STUDY

The objective of this study is to map two areas linked to the role and responsibilities of DSOs. The first area to map is the DSO's role and responsibilities with regard to energy services. The second part is to map rules for unbundling of the DSOs and the neutrality of DSOs from other market actors such as suppliers and producers. The study concerns regulatory framework in the Nordic countries' electricity markets. The report is split into three parts, where the first three relate to DSOs role with regards to energy services:

1. DSOs offering energy services
2. DSOs offering energy efficiency measures
3. Market activities DSOs can execute on the competitive side of the market

The fourth part of the report, which relates to the second point above, is to map national rules regarding unbundling.

The audience of the study is the NordREG steering group consisting of representatives from regulators for the national markets in question. The findings of the study were presented to a wider audience consisting of the NordREG steering group, representatives from national regulators as well as stakeholders from other organisations such as industry associations and the Nord Pool power exchange. The report will be made public.

1.3 CONCEPTUAL CLARIFICATION AND METHODOLOGY

The terms *Energy Service* and *Energy Efficiency* are used in a wide number of contexts, and do not always refer to a specific and well-defined practice or product. As these two concepts feature in our analysis, a clear and consistent definition of such concepts is

³ Supply in this context includes retail supply of electricity

necessary. The EU Energy Efficiency Directive and Electricity Directive provide the following definitions for terms used related to electricity and:

- **"Energy service"** means the physical benefit, utility or good derived from a combination of energy with energy-efficient technology or with action, which may include the operations, maintenance and control necessary to deliver the service, which is delivered on the basis of a contract and in normal circumstances has proven to result in verifiable and measurable or estimable energy efficiency or primary energy savings.⁴
- **"Energy efficiency improvement"** means an increase in energy efficiency as a result of technological, behavioural and/or economic changes².
- **"Energy efficiency/demand-side management"** means a global or integrated approach aimed at influencing the amount and timing of electricity consumption in order to reduce primary energy consumption and peak loads.⁵
- **"Smart metering system"** or "intelligent metering system" means an electronic system that can measure energy consumption, providing more information than a conventional meter, and can transmit and receive data using a form of electronic communication².
- **"Ancillary service"** means a service necessary for the operation of a transmission or distribution system³.
- **"Supply"** means sale, including resale, of electricity to customers³.
- **"Vertically integrated undertaking"** means an electricity undertaking or a group of electricity undertakings where the same person or the same persons are entitled, directly or indirectly, to exercise control, and where the undertaking or group of undertakings perform at least one of the functions of transmission or distribution, and at least one of the functions of generation or supply of electricity³.

Throughout this report, our definitions of the concepts discussed above are in compliance with the definitions in the EU Directive. This includes the term *Energy Services*, which is one of the two concepts this study analyses explicitly. The other is *Energy efficiency measures*, which is not represented on the list above. We define energy efficiency measures to refer to an installation (items or products) or advisory services with the purpose to better enable consumers to reduce energy consumption.

For simplicity, we will use abbreviations to denote the various countries' energy regulators:

- DERA - Danish Energy Regulatory Authority
- EV - Energy Authority in Finland
- NEA - National Energy Authority of Iceland
- NVE - Norwegian Water Resources and Energy Directorate
- Ei – Swedish Energy Markets Inspectorate

The *methodology* applied for this study is mainly consultation of EU and Nordic energy laws, regulations and DSO practices, where the ultimate aim is to identify differences between the Nordic markets. The work was mainly of a desktop nature, supplemented with discussions with the NordREG steering group, regulator and DSO representatives.

⁴ EU Energy Efficiency Directive, Directive 2012/27/EU, Article 2

⁵ EU Electricity Directive, Directive 2009/72/EC, Article 2

2 MAPPING OF DSOS' ROLES AND RESPONSIBILITIES RELATED TO PROVISION OF ENERGY SERVICES

Throughout this chapter, we review what *energy services* DSOs provide and identify whether and how this is diversified across countries. As a backdrop to this, the role of DSOs and electricity distributors is specified in the following EU directives:

- Directive 2009/72/EC; this directive concerns the common rules for the internal market in electricity in the EU. The directive includes rules for the transmission and distribution of electricity and the roles for TSOs and DSOs in the electricity system. It focuses largely on the protection of end-consumer and the quality of service of electricity undertakings.⁶
- Directive 2012/27/EU; The energy efficiency directive (EED) defines *energy service* as “the physical benefit, utility or good derived from a combination of energy with energy-efficient technology or with action, which may include the operations, maintenance and control necessary to deliver the device, which is delivered on the basis of a contract and in normal circumstances has proven to result in verifiable and measurable or estimable energy efficiency improvement or primary energy savings”.⁷

The DSOs role and responsibilities related to *energy efficiency measures* is discussed in Chapter 3.

“Energy services” as a concept is in this analysis clustered into the following categories, which are examined throughout this chapter:

- *Smart meters and ancillary services*; DSO’s responsibilities in rolling out and operating smart meters, featuring descriptions of functional requirements for smart meters and the opportunity for DSOs to provide demand response and ancillary services to system operators.
- *Grid tariff adjustments*; DSOs as determinants and issuer of grid tariffs, opportunity to use tariffs as utilisation improvement instruments.

2.1 SMART METERS AND ANCILLARY SERVICES

This section investigates rules and regulations related to the installation and functionality of advanced metering appliances, or ‘Smart meters’, in the Nordic countries, as well as energy services that can be provided by DSOs within this scope. The concept of ‘Smart meters’ refers to a type of meters capable of doing more than traditional meters, which merely register total consumption. In EU’s Energy Efficiency Directive Article 2 Definition 28, smart meters are defined the following way:

...‘smart metering system’ or ‘intelligent metering system’ means an electronic system that can measure energy consumption, providing more information than a conventional meter and can transmit and receive data using a form of electronic communication.

Throughout this report, the term ‘smart meter’ will refer to different meter technologies and conventions deployed across the Nordics. To specify, these are:

- Automated meter infrastructure (AMI);

⁶ 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

⁷ Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC

- Advanced metering and management systems (AMS); and
- Automatic meter reading (AMR).

AMI systems measure, collect and analyse energy usage and communicate with metering devices such as electricity meters. Systems include hardware, software, communications, consumer energy displays and controllers, customer automated systems, Meter Data Management (MDM) software and supplier business systems. Smart meters categorised as *AMI* meters are thus compatible with AMI systems. AMI differs from AMR in that it enables two-way communications with the meter (remote control)⁸. The term AMS, which is used in Norway, involves the same functionality as AMI, and is therefore basically the same technology.

With the exception of Iceland, Nordic DSOs are commissioned with the task of installing smart metering systems in the premises of all consumers. Installations of smart meters can provide opportunities for DSOs or third parties to steer consumption (directly or indirectly), to enable automated demand response, and to provide ancillary services to system operators.

Denmark

According to regulation⁹, DSOs are responsible for ensuring installation, operation and maintenance of meters with remote reading (“fjernafmålede elmålere”). Currently around 60 percent of Danish electricity meters are smart. It is the responsibility of the DSO to inform the consumer about the usage and the potential of the metering appliance.

Technical metering requirements include a meter reading frequency for transmission and consumption of electricity of 15 minutes or less. Remote control of the meter frequency and the opportunity to store metering data for consumption calculations is another requirement. The metering device should register distribution interruptions, and on demand from the DSO transfer interruption data.

Use of open standards on hourly meters is required for local output reading (e.g. external displays). This provides customers (or third party service providers) with the option to connect devices or units to meters in order to extract consumption data.

Finland

DSOs are responsible for installing, operating and reading smart meters, and the roll-out is about 97 percent complete¹⁰.

Technical requirements¹¹ for meters include the ability to register over 3 minutes distribution interruptions, to receive and execute or transmit forward load balancing commands coming through the network, storage of data (interruptions and hourly metering data). The meters have hourly resolution and remote reading.

Meters are required to allow for a standardised connection of equipment for real-time monitoring of electricity consumption. The DSO should upon request from the customer facilitate the provision of a standardised interface where the customer get access to real time consumption data.

⁸ AMI and AMR systems also differ in terms of technical and information security standards.

⁹ BEK nr 1358 af 03/12/2013

¹⁰ The Finnish target of covering 80% of all sites with hourly metering by end-2013 has been achieved.

¹¹ Described in the Governmental Decree on determination of electricity supply and metering (66/2009)

Iceland

DSOs are responsible for metering and for reporting data to suppliers and customers, but there is no requirement for DSOs to install smart meters. Hourly reading is mandatory for larger customers (maximal effect exceeding 100 kW).

Norway

DSOs are responsible for installing advanced metering systems (AMS) at each consumer point by the 1st of January 2019. After the 1st of January 2015 DSO have to (periodically) report to the regulator on the progress of installing the meters in the DSO's respective network areas.

Functional and technical specifications¹² include the ability to store measuring values with a frequency of maximum 60 minutes and minimum 15 minutes. AMS installations are required to facilitate a two-way communication; i.e. they are able to send and receive data on power prices, tariffs and ground fault signals. All measuring values should be registered and saved and then transmitted to the DSO after the day of physical delivery. Values should be available to the customer at 09:00 the next day, and the end-user should find this information on the internet. Information should be communicated by the DSO so that it is easy for the end-user to compare consumption, prices and costs over time. All consumers should have access to their consumption data on a web based portal, and the consumer should not be charged for this service.

Standardized interface and open standards for communication with external technical equipment is a requirement. Installed meters therefore allow customers, or third party service providers, to connect standardized interfaces and displays to read consumption and tariff information.

Sweden

DSOs are responsible for the installation, operation and maintenance of smart meters. The roll-out is complete. Hourly metering was introduced to customers with main fuses of 63 A (in 2006), while monthly reading was introduced to customers with main fuse at 63 A or less (in 2009). Customers with monthly reading can have hourly readings upon request if the contract with their supplier is based on hourly readings. It is the DSOs responsibility to supply the hourly readings to the customer.

There are no legal requirements regarding communication systems for remote reading. Most meters are nevertheless capable of two-way communication. Ei has been instructed by the Government¹³ to develop suggestions for functional specifications for future metering systems. Recommendations are due in summer (April-May) 2015¹⁴. The purpose of the study is to investigate what requirements are necessary for market participants to react to price signals (load shifting and energy efficiency), to promote efficient operation of the grid, and to better integrate decentralised energy production.

2.2 GRID TARIFF ADJUSTMENTS

EU regulation¹⁵ emphasises the importance of transparency, neutrality and finding a long term cost-optimal approach to tariff structure. Grid tariffs should be cost reflective of cost-

¹² Regulation for measuring, settlement and coordinated conduct of power trades and billing of transmission services

¹³ Regleringsbrev för budgetåret 2014 avseende Energimarknadsinspektionen inom utgiftsområde 21 Energi, 2014

¹⁴ Recommendations had not yet been made available at the time of development of this report.

¹⁵ Directive 2009/72/EC and Directive 2012/27/EU.

savings in networks achieved from demand-side and demand-response measures and distributed generation. The EED also clearly states that network regulation and tariffs shall not prevent network operators or energy retailers making available system services for demand response measures, demand management and distributed generation on organised electricity markets. This is specified to include (among other things) the shifting of the load from peak to off-peak times by final customers and energy savings from demand response.

Grid tariffs can facilitate demand response measures, and provide for better utilization of the distribution grid through e.g. load shifting and time-differentiated contracts –where prices are higher during hours where the grid is constrained. This section investigates to what extent Nordic regulation is aligned with EU regulation and recommendations on grid tariffs and dynamic pricing, and if the methodologies used can promote demand response.

The EED states that “network or retail tariffs may support dynamic pricing for demand response measures by final customers, such as: (a) time-of-use tariffs; (b) critical peak pricing; real time pricing; and (d) peak time rebates.”

In all Nordic countries the DSOs are responsible for setting the distribution tariffs, and the importance of non-discriminatory and cost-reflective tariffs is emphasised in laws and regulation. The structure of the distribution tariff is usually comprised of a fixed¹⁶ (€) and a variable (€/MWh) component for household customers. A very small number of DSOs (in Norway and Sweden) also include a capacity charge (€/kW) in their tariff structure. Large customers in Finland, Norway and Sweden have capacity based tariffs. Time-of-use contracts differentiate the variable cost on the time of usage, e.g. seasonal (yearly), monthly, weekly or daily rates and can therefore incentivise demand response in hours where the grid is constrained. These contracts are permitted¹⁷ and offered by DSOs in all Nordic countries, and the most common contracts differentiate on seasonal (yearly) or daily rates.

Denmark

According to the Electricity Supply Act¹⁸, grid tariffs must be fair, objective and non-discriminatory. Price differentiation with regards to more efficient utilisation of the power grid is permitted, but geographical pricing within one network area is only permitted under special circumstances. Grid tariffs and terms for grid usage have to be publically available.

DSOs’ tariff structure methodology has to be approved (and monitored) by DERA, the regulator. In the methodology description, DSOs explain how customer groups are categorised/split, how costs are allocated to the customer groups, and how tariffs are composed of fixed and variable pricing components. DSOs use two-part tariffs consisting of a fixed component and a variable energy component. Time-differentiated tariff methodologies have to be specified for different consumer groups, and it is also necessary to show that the same cost distribution key/principle is used for all customer groups¹⁹. Danish DSOs offer daily, weekly and seasonal time-of-use contracts. Energi Danmark provides DSOs with best practice guidance for grid tariff structuring, and in general these guidelines are aligned with the methodologies approved by DERA.

With the implementation of the Energy Efficiency Directive, DSOs will have the opportunity to offer flexible hourly billing (“fleksafregning”) to consumers, and this is expected to be

¹⁶ The fixed element is broadly based on the fuse. In Sweden e.g., most DSOs employ a fuse tariff (part of the network regulation from June 2014).

¹⁷ Mandatory for large customers <http://www.nordicenergy.org/wp-content/uploads/2014/10/Demand-response-in-the-Nordic-electricity-market.pdf>

¹⁸ LBK nr 1329 af 25/11/2013

¹⁹ BEK nr 1085 20/09/2010

introduced during year 2015²⁰ (it is indicated by DERA that it could be delayed). It is the role of the DSO to offer these grid tariff products to their customers. With the implementation of flexible hourly billing there is no regulation restricting DSOs in using tariffs as outlined in the Directive: However, the chosen tariff methodology will most likely still have to be approved by DERA.

Finland

The Electricity Market Act states that the sales price (tariffs) of system services should be equitable and non-discriminatory to all system users. It is also stated that the tariffs should “[...] take account of any terms needed for reliable operation and efficiency of the electricity system [...]”.

DSOs can charge a flat rate or a two-rated tariff. The flat rate consists of a fixed (€/month) and a variable (energy) element (€/kWh). The fixed element depends on the size of the main fuse, whereas the energy component depends on the total electricity consumption. The two-rated tariff is similar to flat rate, apart from the energy component being dependent on the time of usage (e.g. night-time has lower price per kWh than day-time). In practice, the variable energy element does typically not reflect real-time characteristics, e.g. prices are not set higher in actual hours when the grid is constrained. According to the EV the DSOs have increased the share of the fixed tariff component in recent years.

The Government Decree on determination of electricity supply and metering²¹ states that the DSO is obliged to offer metering services to customers coinciding with the time differentiated tariffs applied within the DSOs network area. This includes hourly metering services, among other time-differentiated tariffs such as e.g. day/night or seasonal variations. Current legislation also permits real-time tariff pricing as a measure to promote demand response²². The current regulation is therefore aligned with the Directive on grid-tariffs and dynamic pricing.

Iceland

According to the Electricity Act, grid tariffs are regulated and have to be approved by NEA. It is specified in the law that “each tariff zone shall have a harmonised tariff for all final customers.”

DSOs apply flat rate tariffs based on a fixed and a variable/energy component.

Norway

The grid tariff methodology is regulated by the Energy Law²³ and extended regulation²⁴. The law states that tariffs have to be non-discriminatory and objective, and it is the task of NVE to monitor that DSOs comply with the regulation.

There is no specific regulation with regards to the grid tariff methodology to be used by DSOs, though NVE specifies a set of guidelines concerning tariff structure. Tariffs are based on a fixed component (NOK/year) and a variable/energy component (NOK/kWh). The variable component is intended to incentivise efficient grid utilisation through price signals, while the fixed component covers fixed costs (metering, settlement etc.). The fixed component is intended to cover fixed costs at a reasonable rate of return.

²⁰ [Http://ec.europa.eu/energy/efficiency/eed/doc/neeap/2014_neeap_en_denmark.pdf](http://ec.europa.eu/energy/efficiency/eed/doc/neeap/2014_neeap_en_denmark.pdf)

²¹ Government Decree (66/2009) Section 1 of Chapter 7

²² Finland’s National Energy Efficiency Action Plan NEEAP-3, April 2014

²³ LOV-1990-06-29-50

²⁴ FOR-1999-03-11-302

DSOs commonly charge small customers with a two-part tariff. The most common time-of-use contracts are based on seasons (yearly).

Regulation²⁵ states that DSOs shall offer time differentiated variable components to all consumers (that are obliged to read their metering values several times over the year). The frequency of the time differentiated tariffs (hourly, monthly etc.) is not specified, and the DSO is permitted to introduce dynamic pricing under the current legislation.

Sweden

The Electricity Act requests grid tariffs to be objective and non-discriminatory. An objective tariff structure implies that the customer is incurred with a tariff that reflects the network cost for that customer or customer group. It is the responsibility of Ei to monitor that the DSOs tariff methodology is in accordance with the Electricity Act.

DSOs typically structure their tariffs with one to three tariff components, consisting of a fixed component (€/year) and one or two variable components. The variable component can be based on an energy and/or a capacity component. DSOs have the option to use one or more tariff components. The fixed tariff component is proportionally higher for smaller electricity consumers. The most common time-differentiated contracts are based on seasons (yearly).

The regulation is aligned with the dynamic tariff structuring described in the Energy Efficiency Directive. According to the Electricity Act²⁶ no added cost should be charged to electricity consumers that enter into supply agreements that require hourly readings of electricity consumption. It is the responsibility of the DSO to carry out hourly meter readings, and to report the results to relevant stakeholders.

²⁵ FOR-1999-03-11-302

²⁶ Electricity Act, Chapter 3, § 11

2.3 SUMMARY OF DSOS' ROLES AND RESPONSIBILITIES RELATED TO PROVIDING ENERGY SERVICES

Table 2.1 Smart meters and ancillary services

Topic	DK	FI	IC	NO	SE
Installation of advanced metering systems	By 2020	97% completed	No plan for roll out	By 2019	100% completed
Type of smart meter	AMI	AMI	NA	AMI (labelled AMS)	AMR/AMI
Responsibility of installation, operation and maintenance	DSO	DSO	NA	DSO	DSO
Functionality	Remote reading and control (two-way communication), open standard requirements for local data output	Remote reading and control (two-way communication), open standard requirements	NA	Remote reading and control (two-way communication), open standard requirements	Remote reading and control (two-way communication) for most meters (not a requirement)

Table 2.2 Grid-tariff adjustments

Topic	DK	FI	IC	NO	SE
Regulation for tariff setting	No regulation for tariff structure – methodology need to be approved by DERA	No regulation for tariff structure	Tariff structure to be approved by NEA	No regulation for tariff structure	No regulation for tariff structure
Tariff structures (households/small consumers)	Fixed and energy charge	Fixed and energy charge	Fixed and energy charge	Fixed and energy charge (in some cases capacity charge)	Fixed (fuse-based) and energy charge (in some cases capacity charge)
Common time-of-use tariffs	Day, week and seasonal (year)	Day/Night, and seasonal (year)	NA	Seasonal (year)	Seasonal (year)

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3 MAPPING OF DSOS' ROLES AND RESPONSIBILITIES RELATED TO ENERGY EFFICIENCY MEASURES

In this chapter we review DSO services that directly target or enable customers to increase energy savings, or enhance energy efficiency measures. Ref chapter 1, energy efficiency measures refer to installations or energy consulting services with the purpose of reducing or steering energy consumption. Steering of energy consumption could help curb grid losses, e.g. through load shifting of demand away from hours with grid constraints.

The Energy Efficiency Directive describes DSOs' roles in the provision of energy services and in providing information and services to promote energy efficiency. Nordic EU member states have submitted national energy efficiency action plans (NEEAP) and have started to incorporate this in laws and regulation. Iceland and Norway will implement the Directive after the EEA negotiations.

Here, we review the following DSO responsibilities related to energy efficiency measures:

- *Provision of information*; the DSO's obligation to inform customers about energy efficiency measures.
- *Improved user interface for consumption information*; describing communication platform(s) used by DSOs to inform customers on grid tariffs and consumption data.
- *Grid status information*; DSO's responsibility of informing customers about transmission interruptions, and information that can prevent unplanned interruptions.
- *Direct advice to end-users*; the opportunity and responsibility for DSOs to provide customers with direct and individual advice on energy efficiency measures.

3.1 PROVISION OF INFORMATION

Information made available by DSOs to consumers (directly or indirectly) can incentivise consumers to implement measures for energy efficiency. This section looks at the DSO's regulated responsibilities and obligation to inform customers within this area.

The EED states that customers (where smart meters are installed) shall have the possibility of easy access to complementary information on historical consumption allowing detailed self-check. This includes detailed data according to the time of use for any day, week, month and year, where the data have to be made available to the final customer via the internet or the (smart) meter interface for at least the previous 24 months (or start of supply contract). The minimum requirements for billing as described in the EED Annex VII include advice on energy efficiency accompanying bills and other feedback like e.g. where they can obtain advice on available energy efficiency measures and benchmark profiles for their consumption.

The directive further states that "Member States shall take appropriate measures to promote and facilitate an efficient use of energy by small energy customers, including domestic customers." It further states that this could include communication on cost-effective and easy-to-achieve changes in energy use and information on energy efficiency measures during the possible roll-out of smart meters.

Denmark

DSOs are obliged to inform customers about energy efficiency measures under the Energy Supply Act. It requires that DSOs ensure that all consumers are informed about opportunities for electricity savings, and that every consumer should get annual

information about their electricity consumption. DSOs are required to map aggregated electricity consumption in their respective concession area and ensure that this data is made available to the public.

DSOs are also required to ensure, directly or through a third party, that customers receive information about the relationship between current and historical consumption, including benchmarking and comparison of their own electricity use and against customers in the same customer category. This is intended to provide customers with best practice information on electricity use.

Finland

The NEEAP states that work is in progress to align national regulation with the requirements to provide consumption data consistent with the Directive. This includes historical consumption data and the obligation to advise customers on energy efficiency measures. The Directive will be incorporated into the Finnish Electricity Market Act.

In Finland, energy efficiency agreements, a voluntary scheme designed to promote energy efficiency, are considered important instruments in enabling the country to fulfil its obligations under EU's Energy Efficiency Directive. Most DSOs have signed up, and 90% of electricity distributed on the low voltage grid is covered. On joining the agreement scheme, DSOs commit to drawing up plans on energy services and energy efficiency improvement measures to be offered to customers. These plans involve assigning a quantitative and temporal target for each action. Companies overseeing the plans will regularly assess the implementation and impact of the actions, and make changes to plans if necessary.

Currently the Decree of the Council of State (66/2009) states that consumers have a right to access their own consumption data free of charge. The customer should get access to the information at the same time as it is given to the electricity supplier.

Iceland

There is no regulation with regards to DSOs obligation to inform customers about energy efficiency measures. Iceland will, however, be required to implement the Energy Efficiency Directive into its laws and attached regulation, compelling the country to adapt measures by which to inform electricity consumers about energy efficiency measures.

Norway

There is no specific regulation regarding DSO obligation to inform customers about energy efficiency measures. However, DSOs are asked to ensure that the grid tariff bill includes contact information to ENOVA, a state-owned entity which provides advice on how to boost energy efficiency.

Regulation²⁷ states that consumption data of high granularity should be made available to consumers on a cost-free basis. This data should be presented in a way that makes it possible for the consumer to compare consumption and costs over time. Consumer bills should also include graphic comparison of this year's consumption compared with the same period the previous year.

²⁷ Forskrift om måling, avregning og samordnet opptreden ved kraftomsetning og fakturering av netjtjenester, FOR-1999-03-11-301

Sweden

Requirements for DSO to provide information on energy efficiency measures were integrated in the Swedish Electricity Law in 2014. It states that DSOs (and electricity suppliers) are obliged to provide their consumers with information, either web-based or channels, on available energy efficiency measures and consumption benchmarking profiles. If consumers request, DSOs are required to provide hourly consumption data. DSOs are also required to inform consumers about where to find the information in the contract or in the grid tariff bill.

3.2 IMPROVED USER INTERFACE FOR CONSUMPTION INFORMATION

This section explores DSOs' roles in providing grid tariff or consumption information to consumers through communication platforms.

The roll-out of smart meters can provide end-users and DSOs with detailed information on electricity consumption. In-home displays (IHDs), web portals, mobile applications or other consumption reading devices can communicate information on e.g. electricity costs and consumption patterns. Increased knowledge of energy use and associated costs can incentivise consumers to curb energy use by taking a more active control over consumption; a control which can be exerted through the IHDs etc.

The EU Commission's recommendations for the roll out of smart meters²⁸ emphasises that consumers should be equipped with "a standardised interface which provides visualised individual consumption data to the consumer". Directive 2012/27/EU Article 9 states that information or data from smart meters should be made available to the consumer (or third party if requested by consumer) "in an easily understandable format that they can use to compare deals on a like-for-like basis", the Directive (Article 10) also states that customers should have access to historical consumption data, and that the data "shall be made available to the final customer via the internet or the meter interface".

Denmark

There are no DSO requirements to install smart displays nor on what technical specifications should be used. There is however a requirement that open standards is used to allow for communication with smart displays, and DSOs should facilitate (e.g. through third party) provision of real-time information displays if requested by the customer. In 2016 consumers will, according to regulatory plans, get access to their hourly consumption data via the DataHub or a web portal.

DSOs are responsible for providing historical consumption data to consumers. This includes consumption over the year compared with their energy consumption over the previous three years. Consumers can also compare their own consumption with similar customers²⁹. This information can be provided directly through an invoice, or the invoice has to inform the customer about how to access the data (e.g. on a web based portal).

Finland

According to Finnish metering regulation, the DSO is upon request from customers responsible for providing customers with a standardised open interface for real time consumption reporting. The validated metering data is made available for all customers,

²⁸ 2012/148/EU

²⁹ BEK nr.1452 af 16. december 2013

via a web portal the day after delivery. The DSO however is not obliged to provide the monitoring equipment itself.

Iceland

There is no regulation regarding DSOs' responsibilities.

Norway

Regulation specifies that DSOs should facilitate connection with smart meters to consumption displays if requested by the consumer³⁰. It is the responsibility of the DSO to send and update tariff information to the display. A particular technical requirement is that all smart meters should be able to receive this information. With the installation of AMS, consumption data should be made available by the DSO on the internet (or web based portal). Furthermore, the regulation states that information on consumption should be presented so that it is possible to compare consumption, prices and costs over time (historical data).

Sweden

There are limited functional requirements for in-home displays or monitoring equipment. The DSO is obliged to make metering data available on a web portal for customers with hourly metering (or contracts). Customers with less frequent reading receive consumption information on the internet or via their grid tariff bill.

3.3 GRID STATUS INFORMATION

This section assesses whether DSOs are required or are planning to improve their grid information services to consumers. Better grid status information could reduce losses and provide better utilization of the grid, e.g. if customers are informed during constrained grid situations they can be willing to reduce their consumption for certain periods or to shift consumption to less constrained hours.

For the Nordic countries, current regulation encourages ex-post information about the reason, duration and compensation of unplanned transmission interruptions. There is no regulation specifying or incentivising that customers receive frequent information about the status of the grid or the risk of interruptions.

Denmark

There is no regulation on information requirements during distribution interruption, however Dansk Energi has published best practice recommendations on communication from DSOs before, during and after interruptions³¹.

DSOs have no information requirements to customers regarding preventative measures for unplanned transmission interruptions.

Finland

According to general terms of network service, DSOs are required to inform their customers about planned interruptions³². Section 10.8. in the terms state that: '*Sufficient*

³⁰ See *Forskriftsbestemmelser om AMS, jf. kapittel 4 i forskrift 11. mars 1999 nr. 301, § 4-6.*

³¹ Dansk Energi, Best practice for kommunikation ved strømafbrudelser, 2009

information shall be provided on interruptions caused by the reasons specified in the previous article, of which the DSO has been aware of in advance. If sufficient information is not provided on an interruption referred to in this article or if the reconnection following the interruption is unnecessarily delayed from what has been stated earlier, the network service is faulty'. In the case of unexpected interruptions, DSOs are responsible for providing information about reason, consequence and duration.

DSOs are, upon entering an agreement with a customer, required to provide information on the state of the local grids supply reliability and plans that may affect this. Another requirement is for DSOs to provide grid users recommendations on how to prepare for supply disruptions at least every two years. Finally, DSOs are required to, at the request of the grid user or on their own account, provide individual recommendations for disruption preparations if the grid user in question requires a more robust supply guarantee than the usual degree³³.

Iceland

DSOs have no information requirements to customers regarding preventative measures for unplanned transmission interruptions.

Norway

According to regulation³⁴, DSOs can stop distributing electricity to customers when performing maintenance, construction, troubleshooting or repairs on the grid. DSOs have to inform customers at minimum 24 hours before planned transmission interruptions. For unplanned interruptions, the DSO is responsible (to the extent possible) of providing information to customers about the cause of interruptions and the expected duration of the interruption. It is not specified in the regulation how the DSOs should communicate planned –or unplanned transmission interruptions to end-users.

DSOs have no information requirements to customers regarding preventative measures for unplanned transmission interruptions.

Sweden

The Electricity Act states that it is the DSO responsibility to inform customers about the security of supply (grid), and customer rights concerning compensation for interruptions.

DSOs have no information requirements to customers regarding preventative measures for unplanned transmission interruptions, but are required to inform of planned interruptions well in advance.

3.4 DIRECT ADVICE TO END-USERS

When interacting with end-users, directly or through a third party, DSOs have the opportunity to inform their customers about opportunities for energy savings and energy efficiency measures. This section looks at regulation and task performed by DSOs and the responsibility they have in providing customers with individual advice on specific energy efficiency measures.

³² Terms of Network Service 2014 as recommended by Finnish Energy Industries, see <http://energia.fi/en/electricity-market/electricity-price-and-agreements>

³³ Finnish Electricity Act, article 58.

³⁴ FOR-2012-12-07-1183

Directive 2012/27/EU (Article 9) states that Member States “shall require that appropriate advice and information be given to consumers at the time of installation of smart meters, particularly with regard to their full potential of meter reading management and the monitoring of energy consumption.” The Directive further states that consumers should have access to cost efficient energy controls. These controls should be executed by a qualified (neutral) third party.

Denmark

The Energy Supply Act³⁵ states that DSOs are responsible for giving advice and information to end-users on electrical safety aspects, and to assist the Danish Safety Technology Authority with the supervision and inspection of electric installations. Further regulation states that DSO shall provide information on energy efficiency measures, including individual advice, web pages and education.

During the installation of smart meters the DSOs are responsible for informing and advising customers about the use of the remotely read electricity meters and the potential of using them³⁶.

Finland

Most DSOs have signed up to the so-called Energy efficiency arrangements, a voluntary arrangement set up to help Finland fulfil its EU Energy Efficiency Directive targets. Through this, DSOs are required to inform end-users about energy services and energy efficiency measures, and to devise individual plans on improved energy consumption (see section 3.1 for a more detailed description).

The roll-out of smart meters is about 97% complete, and Finland’s National Energy Efficiency Action Plan states that the Finnish Electricity Market Act covers *most* of the requirements with regards to the Energy Efficiency Directive Article 9.2 regarding metering and including the provision of advice and information to customers at the time of installation of smart meters.

Iceland

Regulation does not specify such tasks or responsibilities for DSOs.

Norway

Current regulation specifies in-house competence requirements for DSOs³⁷, but the regulation does not specify DSO responsibilities on provision of custom-made information to consumers.

Regulation regarding installation of smart meters does not specify the role of informing and advising customers about the use of the meter, or any energy efficiency measures. As the DSOs are responsible for installing the meters this provides an opportunity to inform customers about energy efficiency measures.

³⁵ Energy Supply Act, Chapter 4, § 22

³⁶ BEK nr 1358 af 03/12/2013

³⁷ FOR-2011-03-10-263

Sweden

The Electricity Act states that DSOs are responsible for ensuring that customers receive suitable information in connection with new (smart) meters. This was entered into the Law in 2014 as a means to comply with the Energy Efficiency Directive.

3.5 SUMMARY OF DSOS' ROLE AND RESPONSIBILITIES RELATED TO ENERGY EFFICIENCY MEASURES

A set of summary tables relating to DSOs roles and responsibilities related to energy efficiency measures are presented below.

Table 3.1 Provision of information

Topic	DK	FI	IC	NO	SE
DSO obligation to inform customers on energy efficiency measures	Yes	Yes, through voluntary Energy Efficiency Agreements	No	No	Yes
Information on consumption data and benchmarking	Provided by DSO or through third party – benchmarking and historical data	Provided by DSO – actual consumption available when given to the electricity supplier	Provided by the DSO – unclear if benchmarking and historical data is provided	Provided by DSO – geographical benchmarking and historical data	Provided by DSO - benchmarking and historical data

Table 3.2 Improved user interface for consumption information

Topic	DK	FI	IC	NO	SE
In-home display information/monitoring	Provide real-time information to display if requested by customer	Provide real-time information to display if requested by customer	No	Provide real-time information to display if requested by customer	No
Other communication platforms	Datahub or a web portal	Web portal	NA	Web portal	Web portal

Table 3.3 *Grid status information*

Topic	DK	FI	IC	NO	SE
Information requirements on grid status	No	Yes, required to provide information on robustness and on preparatory measures in the event of disruption	No	No	Not specifically but have to inform about the security of supply
Information requirements on planned/unplanned interruptions	No, but recommendations and guidelines are provided by Dansk Energi	Obligated to inform customers about planned interruptions, and consequence and duration of unplanned interruptions	NA	Minimum 24 hours before planned interruptions, cause –and expected duration of unplanned interruptions	Obligated to inform customers about planned interruptions and the right for compensation of transmission interruptions

Table 3.4 *Direct advice to end-users*

Topic	DK	FI	IC	NO	SE
Information on security of energy use	Yes	Partly, advise on better energy use through voluntary Energy Efficiency Agreements	No	No	No
Information on potential of smart meters during or after installation	Responsible to inform about the use –and potential of smart meters	Responsible to inform about the use and potential of smart meters	NA	Not specified	Responsible to inform about the use –and potential of smart meters

4 MAPPING OF DSOS' ROLES AND RESPONSIBILITIES RELATED TO PARTICIPATION IN COMPETITIVE ACTIVITIES

In this chapter, we start out by mapping DSOs' current roles and responsibilities related to participation in competitive market activities. We then go on to reviewing national DSO income regulations and remuneration models and discuss to what extent these promote competitive behaviour. We specify how DSOs' potential participation in competitive activities may vary between different billing regimes. In addition, we examine what services DSOs can offer through utilisation of data from smart meters after the introduction of a centralised information exchange system.

4.1 DSOS' PARTICIPATION IN COMPETITIVE ACTIVITIES

Since DSO income is regulated and the number of customers is given by the connection points in the distribution area, the incentive to participate in competitive market activities is limited. On the other hand, several grid and supplier companies³⁸ are co-operatively owned (vertically integrated), an arrangement which enable DSOs to participate in competitive activities on behalf of "their" supplier company. Competitive market activities in this context is defined as participation in activities that intend to increase the production or supply part of the business, e.g. to attract new customers for the integrated supplier.

DSOs may participate in the competitive market in other ways, e.g. by selling services such as maintenance, or a stand-by unit in case of emergency, to other DSOs who are unable to do so. In addition, DSOs sometimes participate in other markets such as retail market for electronic products. However, these activities are outside the scope of this project and will not be examined.

In order for the electricity markets to function properly and efficiently, DSO transparency and neutrality is essential. This is especially related to provision of metering data and information to market participants. The Third Electricity Directive makes clear that a DSO is "responsible for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity, for operating, maintaining and developing under economic conditions a secure, reliable and efficient electricity distribution system" and that DSOs not in any event must "discriminate between system users or classes of system users, particularly in favour of its related undertakings".³⁹ Accordingly, a DSO's role is to facilitate the market, not participate in it. As a result, all Nordic DSOs are currently acting as neutral facilitators for competitive market activities performed by suppliers and producers.

Even though it is not strictly a competitive activity, DSOs have the opportunity to use wholesale price information to influence consumer behaviour (high tariffs in periods with high grid losses).

³⁸ Supply in this context includes retail supply

³⁹ 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, article 25

4.2 PROMOTION OF COMPETITIVE BEHAVIOUR IN INCOME FRAMEWORK MODELS

DSO income is regulated through income framework models in all Nordic countries (ref chapter 2). These models are designed to incentivise DSOs to be as efficient as possible, as efficiency entitles the DSO to higher returns than inefficient counterparts. In practice, DSOs thus compete against each other in terms of efficiency. Even though the models are designed with the same overall goal, there are various income regulation rules in the Nordic countries. We review the income framework in each country below:

Denmark

DERA regulates the network companies' income using a grid volume model. For each DSO, a revenue cap is determined annually by multiplying the DSO's regulatory price⁴⁰ on 1st January and the expected volume distributed⁴¹ (kWh) for the coming year.⁴² The revenue cap is the maximum allowed income. According to DERA, the average DSO earned 90% of its revenue cap in 2011.⁴³ Deviation from the revenue cap is calculated at the end of the regulatory year (on 31st December). If annual income either exceeded or fell below the cap, tariffs are adjusted down/up by a corresponding amount the next regulatory period. DERA may increase a DSO's revenue cap in case of the DSO incurring costs of "necessary investments" due to public requirements that exceeds the DSOs general obligations to maintain and develop the network. However, efficiency requirements caused a reduction in the 2014 revenue cap corresponding to 5.1 percent of the DSOs' cost budgets. This efficiency requirement has, however, been disputed by the companies.

Since 2007, DERA benchmarked the DSOs' economic efficiency, quality of supply and frequencies and duration of interruption each year.⁴⁴ The benchmarking is based on information provided by DSOs using a method called COLS. Based on the results from the benchmarking, DERA sets individual efficiency requirements for each DSO. The basis for the benchmarking is reviewed at least every four years to allow for adjustments and inclusion of new assessment criteria.⁴⁵ Costs for energy saving activities are not included in the benchmarking. Efficiency requirements resulting from the benchmarking of economic efficiency are implemented as a lasting percentage reduction of the DSO's regulatory price, while requirements from the quality of supply benchmarking is implemented as a percentage 1-year reduction of the DSO's regulatory price.⁴⁶

Finland

DSOs are required to publish the general terms of sale and prices of their system services as well as the underlying criteria.⁴⁷ They also have to provide the regulator with this information on a continuous basis. The price, terms and criteria related to the system service are moreover required to be objective and non-discriminatory to all users.⁴⁸ Furthermore, the regulator approves each DSO's earnings according to reasonable earnings in its supervision decisions for the regulatory period after the period is ended.

⁴⁰ Average income per kWh delivered electricity notified by DERA to the DSO. The regulatory price is based on the DSO's income and delivered electricity in 2004.

⁴¹ DSOs are required to declare its anticipated volume supplied for the next year to DERA by 10th December

⁴² Order on revenue caps for grid companies covered by the Electricity Act, BEK 335 of 15/04/2011, § 3

⁴³ http://energitilsynet.dk/fileadmin/Files/Information/Resultater_og_udfordringer/2011/126367_UK_Results_web.pdf

⁴⁴ Benchmarking of quality included in 2008, and interruption in quality in 2011.

⁴⁵ BEK 335 of 15/04/2011, § 26

⁴⁶ BEK 335 of 15/04/2011, § 27

⁴⁷ Electricity Market Act (558/2013), § 27

⁴⁸ Electricity Market Act, § 24

Each regulatory period is four years, and the present regulatory period runs from 2012 to 2015. If the accrued earnings exceed/fall short of the reasonable level, the DSO is obligated/permitted to reduce/increase the network charges for the coming regulatory period by the same amount.

EV incentivises DSOs to make grid investments through including such investments in the regulated cost base used to determine the reasonable rate of return annually. Furthermore, DSOs are incentivised to increase operation efficiency and to maintain a high security of supply through both a general efficiency target and a company-specific efficiency target set by the Energy Market Authority. The individual company targets are estimated based on the benchmarking of DSOs by using semi-nonparametric StoNED-method (Stochastic Nonsmooth Envelopment of Data).

Iceland

DSOs are required to establish a tariff in accordance with the income possibility curve decided by the National Energy Authority (NEA).⁴⁹ The income possibility curve, which applies individually to each DSO, constitutes the revenue cap. It is established annually on the basis of operating costs (including maintenance cost, depreciation of necessary assets, leasing of transmission system and management), profitability (corresponds ordinarily to 2 percent or more, but may not exceed 2 percent of the real return on non-indexed five-year government bonds) and efficiency requirements based on assessments of reasonable costs by NEA. If DSOs' profitability exceeds/falls short of the revenue cap at the end of the regulatory period, this will be taken into account in preparing the tariff for the following year. A bill that proposed amendments to the Electricity Act was passed by the Parliament in 2011, and thus the regulatory period for the revenue cap was extended from three to five years. The current five-year period is from 2011-2015. However, the cap may be reviewed annually if any of the criteria, on which the revenue cap is based, changes materially.

DSOs may apply to NEA for permission to charge a separate, and higher, tariff in rural areas where the cost of distribution is demonstrably higher than in urban areas. To charge the rural tariff, a minimum of 5 percent of total use in the DSO's tariff zone must be defined as rural area as defined by Regulation 1050/2004. Two of the DSOs charge a higher tariff to customers in rural areas than to the customers in urban areas.

NEA aims to introduce benchmarking projects for DSOs which will be used for the next regulatory period in the form of an efficiency requirement. An independent committee that shall determine the efficiency requirement will be appointed by NEA.

Norway

NVE sets DSOs' income by using an incentive based revenue cap (RC) model. The revenue cap, determined on an annual basis, is based on a yardstick formula of 40 percent actual cost recovery and 60 percent cost norm (from benchmarking) recovery. There is a two-year lag on the cost data that includes operating and maintenance costs including cost of energy not supplied (CENS), cost of transmission losses, depreciation and return basis.

The benchmarking is based on a Data Envelopment Analysis (DEA) model comparing the companies operating in the local distribution grid. The model takes differences in network structure and operating environments into account. The "frontier" in the DEA model, comprised of the "scorecard" for the most efficient DSOs, was changed from using last year costs and outputs to using a 5-year average in 2013. This change was implemented

⁴⁹ Electricity Market Act, article 17

to minimize challenges with the DEA result as relatively large annual variations in some of the cost elements, such as pension, CENS and network losses, frequently occurred. From 2013, NVE allows excluding of R&D cost for projects (including pilots) aimed at contributing to an efficient operation, utilization and development of the network from the benchmarking. For the R&D cost to be excluded, the projects have to be recommended by the Norwegian Research Council or similar institutions, and the excluded costs are limited to 0.3 percent of the regulatory asset base for each company. 16 projects engaged by 31 companies were approved in 2013.

Furthermore, NVE regulates the allowed income through annual decisions related to reasonable income. If the income has been higher/lower than allowed, the tariffs must be reduced/increased next year. From 2015 shortfalls above 25 percent will be automatically deleted.

Sweden

Network tariffs are required to be set objective and non-discriminatory by the DSOs.⁵⁰ A network concessionaire is required to submit a proposal for a revenue cap to Ei who in turn reviews whether it is reasonable to charge the customers for the costs the DSO stipulates in the proposal. Thereafter a revenue cap is determined by Ei in advance of each regulatory period.⁵¹ Each supervisory period is four years; the current regulatory period runs from 2012 to 2015. Most companies receive a lower revenue cap than proposed by the company. If a DSO's income deviates from the revenue cap, the revenue cap for the following regulatory period is adjusted by the amount which the revenue has exceeded or fallen short of the cap. If the revenue exceeds the cap by more than five percent, an excess billing supplement reduces the revenue cap in the following period.⁵²

The revenue cap is calculated to cover reasonable costs of operating the network, as well as providing reasonable return on the required capital. Calculations of reasonable returns take into account necessary assets to conduct the network operations in addition to investments needed to sufficiently maintain the quality of the grid and depreciations during the period. Investment projections are provided by the companies, and actual investment levels are reconciled after the period and the revenue cap is adjusted in case of deviation. The CENS cost is not part of the reasonable cost compilation. In the process of deciding the revenue cap, the quality of the way of conducting the network operations is also considered. Reasonable operating costs are deemed as costs corresponding to an appropriate and efficient operation of network operations with similar and objective conditions.⁵³ A general efficiency target is used to determine if the network operations are performed in a sufficient efficient way, but there is currently no benchmarking of DSOs. However, in May 2015 Ei introduced a new regulation including benchmarking for the regulation period 2016-2019.

4.3 COMPETITIVE ACTIVITIES UNDER VARIOUS BILLING REGIMES

In this section we review possible competitive activities DSOs can retain under the following three billing regimes:

⁵⁰ Electricity Act, Ch. 4, § 1

⁵¹ Electricity Act, Ch. 5, § 1

⁵² Electricity Act, Ch. 5, § 21

⁵³ Electricity Act, Ch. 5, § 8

- **Mandatory combined billing**

Electricity suppliers invoice both the cost of electricity supply and network service through a combined bill. In this billing regime, DSOs do not invoice the customer for network cost directly, but via a supplier.

DSOs will be responsible for invoicing grid connection fees for new connection points or reinforcement of the network of existing customers (continue current practice).⁵⁴

- **Voluntary combined billing**

Suppliers can choose either to provide the customer with a bill containing both the cost of electricity supply and network service, or with a bill that displays the supply cost only.

DSOs are obliged to facilitate combined billing for all the suppliers that decide to offer this to customers. For customers where the supplier does not provide combined billing, the DSO is responsible for invoicing the customer for the network cost directly.

DSOs are responsible for invoicing grid connection fees also in this billing regime.

- **Mandatory separate billing**

Suppliers invoice the customer for the cost of electricity supply while DSOs invoice the network cost. In this regime, DSOs invoice the customer directly for network cost, and any form of combined billing is not allowed.

In addition, DSOs are responsible for invoicing grid connection fees.

NordREG has recommended implementation of mandatory combined billing, but as the decision on billing regimes is ultimately taken on a national level, other future regimes are possible. Denmark has decided to implement mandatory combined billing from 1st March 2016. No other Nordic country has made a similar decision. Nevertheless, mandatory combined billing is currently being reviewed in Norway, and is proposed in Sweden. Different billing regimes require different responsibilities for DSOs. Below we review possible competitive activities that the DSOs can retain under each billing regime.

4.3.1 Competitive activities under mandatory combined billing

In this regime, DSOs are no longer responsible for invoicing the customer for network service. In addition, the supplier will take the role as main customer contact point. Consequently, DSOs will lose some of the current customer interaction. They will, however, be responsible for invoicing grid connection fees and handling related customer contact, but this involves relatively limited customer contact compared to invoicing of the network cost. The possibility for DSOs to conduct competitive activities under this regime is thus limited.

There is no recommended specification on the bill layout in case of combined billing. The bill may be detailed with all prices and tariffs, both constant and variable, and taxes listed, or it may the sum of these represented as a total cost. In Denmark the regulator decided upon a simplified bill, though customers may request a detailed bill. If the bill only contains a number for the total cost, the DSOs possibility to use the price as a signal is limited. Nevertheless, the total cost may have the same effect on the consumers' behaviour as specified tariffs.

⁵⁴ Connection fee, or construction fee, is a cost paid by the consumers for new connection points or reinforcement of the network of existing customers

4.3.2 Competitive activities under voluntary combined billing

Suppliers decide if the customers should receive a combined or two separate bills. The DSO will be responsible for invoicing customers where the supplier chose separate billing, and can thus provide these customers with preferred information. Suppliers that are vertically integrated with a DSO will most likely choose combined billing, as this is the preferred alternative for these companies today. As many customers prefer to receive only one bill, it is likely that also several of the non-integrated suppliers chose combined billing. The possibility for DSOs to conduct competitive activities will thus be limited also under this regime.

Tariffs can be specified for the customers with separate bills, and for customers with combined bill it depends on the chosen layout of the bill.

4.3.3 Competitive activities under mandatory separate billing

A regime with mandatory separate billing implicates that the DSOs invoice the customer for network service directly. In this situation the DSO may provide all customers with preferred information and tariffs can thus be specified on the bill. Nevertheless, DSOs are obliged to act in a non-discriminating way according to the EU Electricity Directive, and the participation in competitive activities will thus still be limited. However, as some DSOs have the same company name and logo as an integrated supplier, there is a possibility to use the bill as a form of company brand marketing. For this to have a positive effect for the integrated supplier, it requires active consumer behaviour. Furthermore, active consumers tend to take price and other conditions into consideration. Hence, the integrated supplier must offer a better contract than the customers' existing supplier to actually trigger a supplier switch.

4.4 PROVISION OF CUSTOMER DATA AND INFORMATION PRODUCTS

Part of the DSOs' role as a neutral facilitator of competitive markets is to guarantee that all market players have access to the same information. DSOs can contribute to an efficient competitive market by providing reliable and transparent information service to both suppliers and customers. This includes granting all market players access to networks and providing consumption information in a non-discriminatory way. With the introduction of smart meters, data information availability will increase significantly. Clever utilisation of this increased data availability will in turn require introduction of efficient information exchange systems. Increased data availability and access allows DSOs to offer statistical service related to consumption patterns to third parties. Potential future role and responsibilities related to the abovementioned changes is discussed below.

4.4.1 Increasing information availability

NordREG has recommended implementation of automatic meter reading (AMR), with meters capable to register energy usage at least on hourly basis and with daily reading of the meters, for all customers. The time frame for implementation is, however, recommended to be taken on a national basis. The current status for the roll-out and technical meter capabilities differs between the Nordic countries. Below we shortly discuss the status and plans in each country.⁵⁵

⁵⁵ Source: NordREG report 2/2014, NordREG report 1/2012, NordREG report 3/2009, Ecofys and ECN "The role of DSOs in a smart grid environment" 2014, CEER 2013 report C13-RMF-54-05, Regulation No. 1050/2004 for Iceland

Denmark

DSOs are responsible for metering. Around 60 percent of the meters are either “smart” or in the process of becoming smart. The roll-out target rate is 100 percent by 31st December 2020.⁵⁶ DSOs manage the metering data and ensure that the data is sent to the data hub managed by the TSO. The TSO, in turn, has the role as a neutral market facilitator ensuring that consumption data is available for the relevant DSO, supplier and consumer. Hourly metering is mandatory for customers with annual consumption exceeding 100,000 kWh/year. At present, about 50,000 customers (2 percent) have hourly metering. The smart meters in AMR-systems installed after 2011 are able to register the delivery of electricity at least every 15 minutes.⁵⁷ When a model for hourly settlement for all end users is included in the regulation, DSOs must submit hourly metered consumption data to the data hub for all users with smart meters.⁵⁸ The manually read meters must be read at least once a year, and this is normally done by the customer. Customers with hourly metering should be read daily.

Finland

DSOs are responsible for metering and for reporting data to suppliers and customers. If a data hub is introduced, the TSO will, assumingly, manage the hub and take on the role as a neutral market facilitator. In 2009, Finland made a decision to implement hourly metering and remote reading.⁵⁹ At least 80 percent of all customers per DSO were targeted to have a smart meter by the beginning of 2014.⁶⁰ Exception in hourly metering is allowed for maximum 20 percent of the customers if the delivery site is equipped with max 3*25A main fuse, electricity consumption is less than 5,000 kWh per year or the customer is buying electricity according to the terms of obligation to supply. Hourly metering is mandatory for customers with main fuse exceeding 3*63A (from January 1st 2011). A 100 percent roll-out rate for smart meters is not mandatory, but it is expected that close to 100 percent of the customers will be equipped with hourly registering and remotely readable meters as many DSO are installing smart meters for small costumers on a voluntary basis. Current status is approximately 97 percent⁶¹. Customers with hourly metering should be read daily. Customers without hourly metering should be read at least three times per year (at least one of these under the DSO's responsibility), set to increase to four times per year in the future.

Iceland

DSOs are responsible for metering and for reporting data to suppliers and customers. There is no specific roll-out target for smart meters. Hourly metering is mandatory for customers with estimated maximal effect exceeding 100 kW. These customers use approximately 80 percent of the electricity, but they constitute less than 1 percent of the customers. Meter readings for other customers must be done by DSOs every four years, and DSOs are obliged to gather information on the metering status annually from the customers with estimated energy flow below 100 kW. Customers may request hourly metering, provided they pay the reading costs.

⁵⁶ Government order 1358 of 03/12/2013

⁵⁷ Order 1358, § 4

⁵⁸ Order 1358, § 8

⁵⁹ The Government Decree on balance settlement and metering (66/2009)

⁶⁰ According to the decree of the Council of State

⁶¹ The Finnish target of covering 80% of all sites with hourly metering by end-2013 has been achieved.

Norway

DSOs are responsible for metering and for reporting data to suppliers and customers. When the Norwegian data hub is operative, the consumption data should be sent to the hub. As in Denmark, the Norwegian TSO will take on the role as a neutral market facilitator ensuring that consumption data is available for the relevant DSO, supplier and consumers. Third parties may also extract data from the hub, given authorization from the customer. The Norwegian term for smart meters is Advanced Metering and Management Systems (AMS), and it has corresponding functionality as Advanced metering infrastructure (AMI). The meters will be installed with maximum time resolution of 60 minutes, and be prepared for reading of 15 minutes intervals. The roll-out rate currently stands at about 7 percent, while a 100 percent roll-out rate is targeted by 2019. Exemption is granted if consumption in the meter point is very low and predictable or installation is causing a substantial documentable disadvantage. Hourly metering is mandatory for customers with annual consumption exceeding 100,000 kWh per year. Currently the customers with hourly metering are read once a week, but after installation of AMS this will be done daily. According to the existing regulation all metering points must be measured at least once a year. Customers with annual consumption above 8,000 kWh shall be read at least four times a year. Often the DSOs ask the customers to read the meter every month or every second month. After installation of AMS, hourly consumption data will be available for suppliers via the data hub within 09:00 the following day.

Sweden

DSOs are responsible for metering and for reporting data to suppliers and customers. If a data hub is introduced as proposed, the consumption data will be sent by DSOs to the hub managed by the TSO. As in Denmark and Norway, the TSO will take the role as a neutral market facilitator providing data to all relevant stakeholders. In Sweden the roll-out of smart meters is complete. From July 1st 2006 hourly metering was introduced to customers with main fuse of 63A or more. From July 1st 2009 monthly metering was introduced for customers with main fuse under 63A, and thus a major roll-out of smart meters was conducted. Meter reading for customers with hourly metering is daily, while the corresponding for customers without hourly metering is monthly. According to an amendment to the Electricity Act that came into effect on October 1st 2012, all customers with main fuses of 63A or less are entitled to hourly metering free of charge upon request if their supply contract is based on hourly metering. There are no legal requirements regarding communication systems for remote reading in Sweden. Results from a survey published by Ei in May 2010 indicate that 91 percent of the remotely read meters were able to register hourly values but only 30 percent of the meter data management systems could handle the hourly values.⁶²

4.4.2 Introduction of centralised information exchange systems

Increased consumption registration will raise the amount of consumption data and thus yield higher requirements related to exchange and storage of data. Competition between suppliers in the Nordic markets can be facilitated in a good way by DSOs if compatible data models for information exchange are being used. Status related to introduction of centralised information exchange systems differ between the Nordic countries. Denmark introduced a data hub in 2013, and will launch a new version in 2016. Norway has decided to implement a data hub that will be operational from October 2016. A political decision regarding a Finnish data hub is expected in 2015. Ei proposed a centralized information exchange model to the Swedish Government in June 2014, but no decision has yet been

⁶² Ei (2010) report R2010:22

made. There are no statements regarding a centralised information exchange system in Iceland.

Introduction of centralised information exchange models, such as data hubs, will enable access to customer information and customer metering data in a standardized format. When the data hubs are operational, they will become a neutral foundation for information exchange in the electricity market. Data hubs in Denmark and Norway will be capable of handling hourly volumes (N=24), and will also be prepared to handle a 15-minute resolution (N=96).

The current installed meters have a registration frequency of one hour or 15 minutes. Some meters provide more frequent reading. For instance, Aidon, a provider of smart meters, deliver meters with 1 minute intervals. Providers of smart meters are also able to provide meters with registration frequency down to ½ seconds. DSOs might use the detailed data for maintenance and investment purpose, and may also use the data to offer load steering service to customers if this functionality is included in the smart meter. There will most likely be a higher share of advanced smart meters in the future, and time resolution for the installed meters might be higher than for current meters. As a result, the DSOs may have access to data with a higher time resolution than the data uploaded in the data hub. If so, it will be possible for DSOs to discriminate between suppliers by providing the integrated supplier with more detailed customer data than to others via the hub. If this type of discrimination will happen is unsure. Exchange and utilization of customer data with a high time resolution, e.g. ½ sec, will require both large storage capacity and resources to extract the additional information in the data. The benefit of internal exchange of data with high time resolution is therefore highly uncertain. In addition, DSOs "shall provide system user with the information they need for efficient access to, including use of, the system" and "not discriminate between system users" according to the Electricity Directive.⁶³ The likelihood for this type of discrimination is thus small, but it should be considered whether this should be monitored or not.

4.4.3 Possibility to provide information products

DSOs' role as information providers is increasingly important in the future market as the share of customers with advanced smart meters increase. The new task and services depend on the availability of data. The increased information about customers' consumption can provide the DSOs a *possibility* to offer statistical services, e.g. provision of detailed customer demand patterns, to suppliers, customers or third parties that want to use the information to sell products or services.

⁶³ Directive 2009/72/EC, article 25

4.5 SUMMARY OF DSOS' PARTICIPATION IN COMPETITIVE ACTIVITIES

Table 4.1 Current status for DSOs' participation in competitive activities

Topic	DK	FI	IC	NO	SE
Direct involvement in competitive activities	No	No	No	No	No
Possibility to specify tariff on bill	Yes	Yes	Yes	Yes	Yes

Table 4.2 Income framework models for DSOs

Topic	DK	FI	IC	NO	SE
Income regulated by revenue cap	Yes	Yes	Yes	Yes	Yes
Energy Authority sets the revenue cap in advance	Yes	No, after	Yes	Yes	Yes
Regulatory cap period	One year	Four years	Five years	One year	Four years
If deviation from revenue cap, accordingly adjustment next period	Yes	Yes	Yes	Yes	Yes
Benchmarking of DSO	Yes Efficiency, quality/security of supply, frequency and duration of interruption	Yes Efficiency, security of supply (CENS)	No Aims to introduce	Yes Efficiency, security of supply (CENS)	No Will be introduced in next regulatory period (2016-2019)
Efficiency target	Company specific	General and company specific		Company specific	General (Specific target to be introduced in 2016)
Benchmarking frequency	Annually, base year reviewed at least every four years	Annually, basis is average of 2005-2010		Annually, basis consist of average of "front" for the five last years	
Costs excluded from benchmarking	Energy saving activities			If approved: R&D costs for efficiency projects	

Table 4.3 *Competitive activities under various billing regimes*

Topic	DK	FI	IC	NO	SE
Mandatory combined billing national status	Planned introduced	Not planned	Not planned	Being reviewed	Proposed by Ei
Marketing by DSO on behalf of supplier through invoice	Not possible	Limited Not possible if one bill	Limited Not possible if one bill	Limited Not possible if one bill	Limited Not possible if one bill
Distinguish between network cost and cost of electricity on bill (DSO price signal)	No, but customers can ask for a detailed bill	Mandatory to distinguish energy and network costs	Not decided	If one bill, yes	If one bill, yes

Table 4.4 *Smart meters and information exchange possibilities*

Topic	DK	FI	IC	NO	SE
Smart meter roll-out status	About 60 % complete	About 97 % complete	No plan	About 7 %	Complete
Targeted roll-out rate	100 %	80 %		100 %	100 %
Timeframe for roll-out of smart meters	By 2020	2014		By 2019	July 1 st 2009
Meter data manager	DSO (sends to data hub)	DSO	DSO	DSO	DSO
Threshold for obligatory hourly metering	100 000 kWh/year	Fuse 3*63 A	100 kW	100 000 kWh/year	Fuse 63 A
Hourly metering for customers below obligatory threshold	Will be all with smart meter installed	All with smart meter installed	By request (customer charged)	Will be all with smart meter installed	By request (free of charge)
Reading for hourly registering meters	Daily	Daily	Daily	Daily when AMS (now weekly)	Daily
Reading for non-hourly registering meters	Annually (may change to monthly)	Three times per year, to increase to four	Every four years (annually by customer)	Quarterly (small users annually)	Monthly
Capabilities for installed smart meters	15 minutes	Hourly		Hourly (prepared for 15 minutes)	Hourly
Information exchange system	Data hub	Data hub reviewed	No plan	Data hub from Oct 16	Data hub proposed
TSO role related to data hub	Neutral market facilitator	Neutral facilitator if hub		Neutral market facilitator	Neutral facilitator if hub
Time resolution in data hub	Hourly (15 min)			Hourly (15 min)	

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5 MAPPING OF NATIONAL UNBUNDLING RULES

An important way to ensure DSO neutrality is separation of regulated activities, i.e. network operation, from competitive activities. According to the Directive 2009/72/EC, lack of effective unbundling creates "an inherent risk of discrimination not only in the operation of the network but also in the incentives for vertically integrated undertakings to invest adequately in their networks". In this chapter we will discuss unbundling of distribution operations from generation and supply in the Nordic countries.

5.1 OVERVIEW OF VERTICALLY INTEGRATED COMPANIES

Many Nordic power companies are vertically integrated companies that participate in distribution, generation and supply/sales of electricity. Below we provide an overview of the number and share of vertically integrated suppliers and their customer shares in 2014. In all Nordic countries the majority of the suppliers are vertically integrated companies with relation to a DSO, and in some cases also a producer. These companies have high market shares, and serve the majority of the customers in all countries.

Table 5.1 Vertically integrated suppliers and their customer share

Topic	DK	FI	IC	NO	SE
Number of vertically integrated suppliers	44	66	5	106	107
Share of vertically integrated suppliers	83 %	93 %	71 %	91 %	94 %
Share customer sale (in form of MWh)	Majority	Majority	82 %	77 %	Majority

Source: DERA, Finnish Energy Authority, NEA, NVE, Ei

Note: For Norway the calculation is based on a dataset for 2013 provided by NVE

5.2 UNBUNDLING RULES

In this chapter we discuss current and, where applicable, future unbundling rules. We will distinguish between the following types of unbundling:

- **Unbundling of accounts**
This implies that the DSOs must keep separate financial accounts for different network activities. Separate accounts for each activity in internal accounting are a requirement of Directive 2009/72/EC.⁶⁴
- **Legal unbundling**
This requires that network activities are unbundled from generation and supply by separate legal entities. This is a method to ensure that vertically integrated DSO have independent organisation, and thus is excluded from decision-making on activities not related to distribution in terms of legal form. Legal unbundling is, however, not

⁶⁴ 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, article 31

required if the number of connected customers is less than 100,000 or the DSO is serving small isolated systems.⁶⁵

- **Functional unbundling**

This requires that the management of DSOs cannot be involved in the management of a generation or supply company within the same group of companies. To ensure that the DSO is independent in its decision making from generation and supply, the "persons responsible for the management of the distribution system operator must not participate in company structures of the integrated electricity undertaking responsible, directly or indirectly, for the day-to-day operation of the generation, transmission or supply of electricity." Also functional unbundling may be exempted if the DSO has less than 100,000 customers⁵⁶.

- **Unbundling of brands**

This requires that vertically integrated DSOs shall not cause confusion in their communication and branding in respect of company identity. The separate identity of the DSO and the supply branch should be clear⁵⁶.

The Electricity Directive represents the minimum requirements related to unbundling of DSOs from generation and supply companies. The Nordic countries have, to some extent, implemented different unbundling rules, and these are discussed below:

Denmark

Unbundling of accounts:

DSOs are required to have unbundled accounts.⁶⁶

Legal unbundling:

Licensed network activities must be legally unbundled from other activities such as production and trading. Municipalities may carry out grid-related activities and electricity production by waste incineration if the number of customers is less than 100,000.⁶⁷ All Danish DSOs are legally unbundled.

DSOs may only conduct activities that are deemed to be in accord with the terms of the licence in the company.⁶⁸ The Danish ministry of climate, energy and building may permit some outside-license activities for DSOs with less than 100,000 costumers. A DSO may, for instance, operate in electricity production or other affiliated operation provided that the total revenue from this activity does not exceed 5 percent of the revenue from the distribution activity.⁶⁹ The requirement of unbundled accounts is nevertheless still valid.

Functional unbundling:

The Danish Electricity Act also includes obligations in article 26 of the EC Directive related to functional unbundling. According to the Danish Electricity Act, "directors, deputy directors, assistant directors and senior staff of a DSO or TSO may not, directly or indirectly, participate in the operation or management of electricity production or electricity trading company in the same company group, or a related company that directly or indirectly owns these, unless there is a public electricity utility. Board members in a DSO

⁶⁵ Directive 2009/72/EC, article 26

⁶⁶ Danish Electricity Supply Act, Act no. 1329 of 25 November 2013, § 47

⁶⁷ Danish Electricity Supply Act § 47 and § 4

⁶⁸ Danish Electricity Supply Act § 47

⁶⁹ Government Order number 358 of 20/05/2003

or TSO company may not directly or indirectly participate in the operation or management of an electricity production company or electricity trading company".⁷⁰ The rules do not apply to companies with less than 100,000 customers. In 2014, there were 6 DSOs with more than 100,000 customers.

Unbundling of brands:

DSOs are requested to not create confusion about the DSO's separate identity in its communication with customers.⁷¹

The Danish Energy Agency stated in a press release 1st December 2014 that they have proposed to strengthen the rules in the Electricity Act related to separate identity for network operators to increase the competition. The proposal states that the name and logo of a monopoly company should differ from a competitive company.

Finland

Unbundling of accounts:

DSOs are required to publish unbundled accounts. Unbundled financial statements shall be published as a part of the statutory financial statement, annual report or corresponding other public documents available to the stakeholders. The income statement and the balance sheet, which shall be derivable from the utilities' accounts, shall be drawn up in accordance with the provisions of the Accounting Act (1336/1997).

Legal unbundling:

According to the Electricity Market Act, electricity network operations must be legally unbundled from trade and generation if the distributed electricity on the operator's 0.4 kV distribution network has been at least 200 GWh/year during three consecutive years.⁷² However, a system operator may be engaged in energy supply and sales if the purpose of the operation is to cover network losses, manage duties under the system responsibility, manage transmission restrictions, operate movable reserve power machinery, supply internal consumption or to supply users in a situation where the delivery of a supplier has been interrupted for a reason attributable to the supplier.⁷³ At the end of 2013, 35 DSOs were over the threshold value. If annual distribution is lower than 200 GWh, legal unbundling is not required. Some DSOs whose annual distribution falls below this level have nevertheless voluntarily implemented legal unbundling of network activities. A total of 52 DSOs were legally unbundled in July 2014.

If a DSO exceeds the threshold value, there is a transition period of two years to legally unbundle network activities. There are no requirements for legally unbundled DSOs to be structured in any special legal form. The only limitation is that the separated companies cannot both be public utilities (part of the same legal entity).

Most of the legally unbundled DSOs belong to same company group as suppliers and/or generators.

Functional unbundling:

The functional unbundling requirements are restricted to legally unbundled DSOs because the requirements are related to the legal organs of the company (the board of directors

⁷⁰ Danish Electricity Supply Act § 45

⁷¹ Electricity Supply Act § 20

⁷² Electricity Market Act (588/2013), § 60

⁷³ Electricity Market Act, § 30

and the managing director) and are therefore not applicable to vertically integrated companies.

Separate management is required for legally unbundled DSOs with at least 50,000 customers. At the end of 2013, 18 DSOs were above this threshold value. A person managing a legally unbundled DSO with 50,000 customers or more may not act as the managing director of a utility in charge of electricity generation or supply or as a member of its board of directors or a corresponding organ, if the DSO and the utility belong to the same company group.⁷⁴

Further requirements related to ensuring independence in decision-making of the manager and non-discriminatory pricing principles, may be given to some DSOs by the ministerial decree. DSOs with at least 50,000 customers had to prepare a compliance program and send it to the Energy Market Authority according to a ministerial decree.⁷⁵

Unbundling of brands:

Requirements regarding communication and branding of the DSOs set out in the Electricity Directive was implemented in the regulation in fall 2013. This means that DSOs shall not create confusion about the DSO's identity in communication with customers. Furthermore, a legally unbundled DSO must ensure that the name and logo differ from the entities that produce or sell electricity.⁷⁶

Iceland

Unbundling of accounts:

DSOs that are engaged in other activities than distribution are required to keep accounts for distribution separate from accounts for other activities.⁷⁷ Furthermore, DSOs that operate in several tariff zones must keep separate accounts for each zone. A DSO may not subsidise a competing operation in which the DSO is engaged by means of distribution operations.

Each activity must be accounted for separately both internal and in the annual account.⁷⁸ The itemisation must be reported to NEA in a form decided by the Authority. Joint operating revenues and operating expenses which cannot be attributed directly to a single activity shall be allocated in accordance with generally accepted accounting standards.

Legal unbundling:

A license from the Minister is required to construct and operate a distribution system in a specific distribution zone.⁷⁹ The license is exclusive and entails an obligation to distribute electricity. DSOs must be independent legal and taxable entities.⁸⁰ There are 6 DSOs in Iceland, and all are legally unbundled.

⁷⁴ Electricity Market Act, § 61

⁷⁵ The decree of the Ministry of Trade and Industry on the functional unbundling requirements of the electricity distribution system operator (922/2006). The threshold value was lowered from 100,000 to 50,000 customers by the updated ministerial decree in September 2013.

⁷⁶ Electricity Market Act, § 60

⁷⁷ Electricity Act (65/2003), article 16

⁷⁸ Electricity Act, article 41

⁷⁹ Electricity Act, article 13

⁸⁰ Electricity Act, article 14

Functional unbundling:

The board of directors of the TSO shall be independent of other companies engaging in the generation, distribution or sale of electricity.⁸¹ However, the Electricity Act does not require functional unbundling for the management or board members of DSOs.

Unbundling of brands:

There is no requirement related to unbundling of brands in the Icelandic Electricity Act.

Norway

Unbundling of accounts:

In accordance with the Norwegian Accounting Act, financial statements should be separated for competitive activities and monopoly activities by separate accounts.

Concessionaires are also required to provide separate information concerning the network activities (monopoly activities) in their annual report.

Legal unbundling:

DSOs with more than 100,000 customers must be legally unbundled.⁸² At the end of 2013, there were eight DSOs of this size, covering 57 percent of all customers.

DSOs with less than 100,000 customers are exempt from legal unbundling requirements. At the end of 2013, 128 DSOs were below this threshold value. However, in the case of merger or acquisition that triggers an obligation to acquire a trading license, NVE may require the distribution and generation or supply activities in the vertically integrated company to be reorganized into separate legal entities. Therefor also 33 DSOs with less than 100,000 customers are legally unbundled.

DSOs may be organised as a subsidiary with a parent company not engaged in activities requiring a trading license or competitive activities.

Functional unbundling:

DSOs with more than 100,000 customers must be functionally unbundled.⁸³ A person employed in the management of a DSO may not participate in the management of a vertically integrated company conducting competitive activities. This does not apply to board members of the holding company or controlling owners given that the board only has superior control.

Further, a parent company or controlling owner may not give instructions to the DSO regarding daily operations or decisions related to development or upgrading of the grid that does not exceed the DSO's specified economic limit.

In addition to the unbundling requirements, the companies with more than 100,000 customers are obliged to participate in a compliance programme in accordance with the electricity directive. The participants of the programme are obliged to provide a yearly report to NVE, and this report functions as a device for NVE to monitor the DSOs fulfilment of the regulations regarding legal and functional unbundling.

⁸¹ Electricity Act, article 8

⁸² Energy Act, §4-6

⁸³ Energy Act, §4-7

Unbundling of brands:

There is no requirement related to unbundling of brands in the Norwegian Energy Act.

Sweden*Unbundling of accounts:*

Financial accounts related to distribution activities must be separated from other operations.⁸⁴ Furthermore, accounts should be separated by concession areas. However, the network authority may decide that all areas of a network concessionaire shall be accounted jointly if the areas are in territorially close to each other. One exception to this is if the areas together comprise an inappropriate unit for a network operation.⁸⁵

Legal unbundling:

An individual with legal responsibilities who conducts network operations may not be involved in generation or supply activities within the same company group.⁸⁶ There are, however, two exemptions from this rule. Generation may be conducted together with network operations by the same legal entity if the production is exclusively intended to cover network losses, or temporarily conducted with the aim of replacing a shortfall in electricity in conjunction with a power outage (mobile reserve plant). At the end of 2012, there were 161 legally unbundled DSOs in Sweden.

There are no requirements for ownership unbundling of the DSOs.

Functional unbundling:

Functional unbundling is mandatory for DSOs that is a part of a company group with more than 100,000 network customers.⁸⁷ An undertaking that conducts network operations must be separate from undertakings that conduct generation or trade of electricity in its organisation and decision-making. This implies that members of the board, managing directors or other persons authorised to sign for the network undertaking may not have one of the above mentioned roles in an undertaking that conducts generation or supply of electricity. In 2013 there were 6 DSOs with more than 100,000 customers, covering 60 percent of all customers.

Furthermore, the functionally unbundled DSO undertakings may not award employees in senior positions salaries or other benefits based on results of the generation or supply part of the group.⁸⁸

A DSO belonging to a company group which also includes generators or suppliers shall prepare a monitoring plan stating the measures taken to counteract discriminatory practices in relation to other stakeholders, and ensure compliance with this.⁸⁹

Unbundling of brands:

DSOs that are integrated with undertakings conducting generation or trade, shall provide identification in such a way that it is clear which operation the DSO conducts when contacting an individual consumer.⁹⁰

⁸⁴ Electricity Act (1997:857), chapter 3, §2

⁸⁵ Electricity Act, chapter 3, §3

⁸⁶ Electricity Act, chapter 3, §1a

⁸⁷ Electricity Act, chapter 3, §1b

⁸⁸ Electricity Act, chapter 3, §1c and d

⁸⁹ Electricity Act, chapter 3, §17

5.3 IMPACT OF PLANNED REGULATION ON VERTICALLY INTEGRATED COMPANIES

5.3.1 *Arguments for and against unbundling*

It is broadly agreed that in a deregulated and competitive energy market, a certain degree of unbundling is necessary to ensure non-discriminatory access to the grid and to avoid conflicts of interest within vertically integrated energy companies. Most of the arguments for and against unbundling are however related to issues concerning ownership.

Arguments for unbundling:

- Theoretically, vertically integrated companies have an incentive to increase the price of the monopoly product and lower the price of the competitive product (this argument is mitigated by regulated monopoly pricing for grid services).
- Disproportional allocation of costs to the regulated function, i.e. unbundling removes undesirable cross-subsidies between monopoly and competitive business (argument mitigated by account separation requirements).
- Unbundling reduces the scope and incentive for discrimination between market players within the distribution network area (non-discriminative behaviour is eliminated by regulation).
- Vertically integrated companies can exploit their monopoly advantage to deliver market power to the integrated generator or supplier.
- Unbundling improves supply competition.
- Difficult to prove if sensitive information "leak" between network and commercial activities

Conversely, arguments opposing unbundling are as follows:

- Separation is costly in terms of transaction
- Ownership unbundling reduces economics of scale
- Long-term benefits may be achieved with less serious infringements

5.3.2 *Impact of NordREGs recommendations on integrated companies*

NordREG has recommended several regulatory changes that curb competition advantages for vertically integrated companies. In all Nordic countries, vertically integrated suppliers serve the majority of the customers, ref. Table 5.1. This is in part attributable to customers wanting to support the local supplier. Consequently, customers' benefit of choosing the local supplier may exceed the benefit of receiving lower price from another supplier. The potential saving of switching supplier may also be negligible. Nevertheless, in some cases the customers are clients of a vertically integrated supplier due to lack of information about potential benefits of switching, or because they do not prioritise on the effort of looking into the possibilities. With introduction of the supplier-centric model, as suggested by NordREG, the supplier will be the main contact for the customer. This means that all suppliers are providing customers with information and will have the role as the customers first contact point. The introduction of the supplier centric model thus may reduce the possibility to deliver market power to integrated suppliers.

⁹⁰ Electricity Act, chapter 3, §23

Some vertically integrated DSOs and suppliers have the same company names. This may cause confusion amongst customers that do not understand in what way a DSO and a supplier are different. Unbundled vertically integrated companies also sometimes retain similar names. For instance some company groups use the group name in all companies, and then add "power" or "grid" to distinguish the entities from one another. These companies often have the same logo. Denmark, Finland and Sweden have imposed the requirements in the third Electricity Directive stating that the DSOs shall not create confusion about its identity in communications with customers. But as long as names are similar, confusion may very well persist. To rectify this situation, the Danish Energy Agency has proposed to strengthen the rules related to identity separation by requiring that name and logo for the monopoly company differ from the competitive company.

Another argument is that unbundling improves competition. In theory, more competition lowers prices. A counter-argument, however, is that long term benefits may be achieved in another way. For instance one of NordREG's recommendations is the introduction of combined billing where the suppliers are responsible for invoicing and for customer contact related to invoicing – an effort that will boost competition in itself. In a situation without mandatory combined billing, some customers stay with the supplier integrated with the local network operator because this means receiving one bill – something that is highly appreciated for some customers. With mandatory combined billing all suppliers will be able to provide one bill, and the customers that prefer one bill may therefor switch to another supplier than the integrated supplier.

The last argument for unbundling is that it is difficult to prove if information is being "leaked" from the DSO to an integrated supplier. Introduction of a centralised information exchange system, such as a data hub, will however reduce the incentives and opportunities of skewing the provision of information all suppliers have access to the uploaded consumption data regarding their customers.

An argument against unbundling is that it is costly to separate integrated companies. It is also costly in terms of contract negotiation if the separation requires signing of new contracts. At the same time, introduction of combined billing and data hub already require changes in terms splitting of customer data bases and new roles related to customer data and contact responsibilities for the integrated companies.

Ownership unbundling is the most discussed unbundling requirement, and it is argued that unbundling of ownership reduces economics of scale. Reduced economics of scale may be regarded as a cost, and is thus important to include in the evaluation of costs and benefits of imposing further unbundling rules.

Stricter unbundling rules may improve competition further. At the same time, some of the benefit of strengthening the unbundling rules is reduced by the planned regulatory changes in line with NordREGs recommendations since these changes to some degree have the same effect as stricter unbundling rules. Whether or not the additional benefit of stricter unbundling exceeds the cost of further unbundling is uncertain.

5.4 SUMMARY OF NATIONAL UNBUNDLING RULES

Below we summarise similarities and differences related to unbundling by country. All five countries have imposed accounts and legal unbundling. The threshold for legal unbundling is however different between the countries. In Denmark, Iceland and Sweden all DSOs are legally unbundled. In Finland the threshold for legal unbundling is distribution of at least 200 GWh/year the last three years, with some exceptions, while the threshold in Norway is at least 100,000 customers in addition to special requirements from NVE.

Functional unbundling is not a requirement in Iceland, but is required for some DSOs in Denmark, Finland, Norway and Sweden. The threshold for functional unbundling is at

least 100,000 customers in Denmark, Norway and Sweden, while for Finland the corresponding number is 50,000 customers. Requirements of functional unbundling also differ to some degree. In Finland managing directors or board members of DSOs may not participate in the management of a competitive company within the same company group. Managing directors, other individuals in managing positions or board members may participate in neither operation nor management of a competitive company within the same company group in Denmark. In Sweden managing directors, authorised signatory or board member may not participate in the same roles in a competitive company within the same company group. The functional unbundling is related to management employees in Norway. For all countries, the DSOs above the thresholds are big companies in terms of relatively high customer share.

Unbundling of brands is not a requirement in Iceland and Norway. According to the Electricity Acts in Denmark, Finland and Sweden, DSOs should not create identity confusion in communication with costumers. However, only Finland has detailed requirements stating that a legally unbundled DSO's name and logo must differ from the name and logo for competitive entities (production and supply) within the same company group. The Danish Energy Agency has proposed to strengthen the rules in the Danish Electricity Act by requiring that the name and logo of a monopoly entity should differ from a competitive entity.

The table below summarizes the present requirements for DSOs in the Nordic countries related to accounting, legal, functional and branding unbundling.

Table 5.2 *Unbundling rules in the Nordic countries*

Topic	DK	FI	IC	NO	SE
Number of DSOs	67	80	6	136	161
DSO unbundling regimes	Accounting, legal, functional	Accounting, legal, functional	Accounting, legal,	Accounting, legal, functional	Accounting, legal, functional
Threshold for legal unbundling	All DSOs May operate with other activities if <100,000 customers and related revenue is <5%	Electricity distributed at 0,4 kV level is at least 200 GWh for three year	All DSOs	>100,000 customers or by request of NVE in case of merger or acquisition that trigger licensing obligation	All DSOs
Number of DSOs above the legal threshold	67 (100%)	35+17 voluntary (65%)	6 (100%)	8+33 required (30%)	161 (100%)
Threshold for functional unbundling	>100,000 customers	>50,000 customers	N/A	>100,000 customers	>100,000 customers
Number of DSOs above the functional threshold	6 (9%)	18 (23%)	0	8 (6%)	6 (4%)
Requirements for functional unbundling	Leading employees or board members may not participate in operation or management of trading or generation within the same company group	Managing directors or board members may not participate in management of trading or generation within the same company group	N/A	Management employees may not participate in management of trading or generation within the same company group	Managing directors, authorised signatory or board members may not participate in the same roles of trading or generation within the same company group
Unbundling of branding	Should not create identity confusion in communication Proposed to strengthen by requirement of different name and logo for monopoly and competition entities	Should not create identity confusion in communication Legally unbundled DSO must have different name and logo from competition entities	No requirement	No requirement	Should not create identity confusion in communication

6 SUMMARY

The energy regulators in Denmark, Finland, Iceland, Norway and Sweden are working towards a harmonised Nordic electricity market. NordREGs mission is to promote legal and institutional framework and conditions necessary for developing the Nordic and European electricity markets. A firm ambition for NordREG is the establishment of the supplier-centric model, which implies that a number of responsibilities might be transferred from distribution system operators (DSOs) to electricity suppliers. In the supplier-centric model, DSOs will be required to disentangle from activities involving consumer contact, and focus more on core services, which broadly imply the provision of a reliable and efficient distribution grid.

In this study we explore current and future roles and responsibilities for TSOs and DSOs involving 1) Provision of energy service, 2) Provision of energy efficiency measures and 3) Participation in competitive activities. We also assess a fourth element; unbundling rules.

Provision of Energy Services

Energy Services means the physical benefit, utility or good derived from a combination of energy with energy-efficient technology or with action, which may include the operations, maintenance and control necessary to deliver the service, which is delivered on the basis of a contract and in normal circumstances has proven to result in verifiable and measurable or estimable energy efficiency or primary energy savings. This study investigates DSOs' responsibilities within energy services related to smart meters, ancillary services, and grid tariff adjustments.

In Denmark, Finland, Norway and Sweden DSOs are commissioned with the task of installing smart metering in the premises of all customers. In Iceland there is currently no plan to roll out smart meters. Smart meter installation can open opportunities for DSOs to facilitate consumption steering through third parties and to provide ancillary services to system operators. The technical requirements for smart meters in Denmark, Finland and Norway include two-way communication for reading and control and the opportunity to install monitoring displays. There are no functional regulatory requirements for smart meters in Sweden, but most meters allow for remote reading and control. There are no requirements for DSOs to install in-home displays in the Nordic countries, but in Denmark, Finland and Norway smart meters should use open standards for communication with external technical equipment.

Table C summarises the roll-out of smart meters in the Nordic countries, and the responsibility of DSOs within installation operation and maintenance of the meters.

Table C *AMS and ancillary services*

Topic	DK	FI	IC	NO	SE
Installation of advanced metering systems	By 2020	97% completed	No plan for roll out	By 2019	100% completed
Type of meter	AMI	AMI	NA	AMI (labelled AMS)	AMR/AMI
Responsibility of installation, operation and maintenance	DSO	DSO	NA	DSO	DSO
Functionality	Remote reading and control (two-way communication), open standard requirements	Remote reading and control (two-way communication), open standard requirements	NA	Remote reading and control, open standard requirements	Remote reading and control (two-way communication) for most meters (not a requirement)

Setting grid tariffs fall within the mandate of DSOs. In the future, DSOs may be enabled to use grid tariffs to more actively influence consumption, e.g. by using time-specific tariffs. EU regulation⁹¹ encourages the use of dynamic grid tariff pricing, including time-of-use – and real time pricing. The current common practice in the Nordic countries is to use set tariffs by a fixed and a variable energy component. The tariff can be flat over the year, or the variable component can differentiate on the time-of-use, e.g. seasonal or daily. Regulation in Denmark, Finland and Sweden allows for time-of use pricing. In Norway the regulation does not put any restrictions on the use of dynamic pricing, whereas in Iceland the national authority will have to approve changes in grid tariffs –thereby suggesting less room for dynamic grid tariffs. Time-of-day pricing is typically not applied in the Nordics.

Table E summarises regulation within tariff setting and the most common tariff structures across the Nordics.

⁹¹ Directive 2009/72/EC and Directive 2012/27/EU

Table E *Grid-tariff adjustments*

Topic	DK	FI	IC	NO	SE
Regulation for tariff setting	No regulation for tariff structure – methodology need to be approved by DERA	No regulation for tariff structure	Tariff structure to be approved by NEA	No regulation for tariff structure	No regulation for tariff structure
Tariff structures (households/small consumers)	Fixed and energy charge	Fixed and energy charge	Fixed and energy charge	Fixed and energy charge (in some cases capacity charge)	Fixed (fuse-based) and energy charge (in some cases capacity charge)
Common time-of-use tariffs	Day, week and seasonal (year)	Day/night and seasonal (year)	NA	Seasonal (year)	Seasonal (year)

Provision of Energy Efficiency Measures

Energy efficiency measures refer to installation of equipment or other energy services that enable consumers to either steer or reduce their energy consumption. According to the Energy Efficiency Directive, Member States should implement intelligent metering systems and roll out smart meters for final electricity customers. The Directive also emphasises that access to consumption information and benchmarking can provide customers with incentives for energy savings. Danish and Swedish regulation makes DSOs responsible for informing customers about energy efficiency measures, while DSOs in Finland are required to do so if they have signed up to voluntary energy efficiency agreements, whereas in Iceland and Norway this is not specified. DSOs are responsible for providing customers with consumption information in all Nordic countries, and in Denmark, Norway and Sweden this includes benchmark profiles of historical consumption.

Table F summarises DSOs responsibilities in providing customers on energy efficiency measures, and on consumption data with benchmarking profiles.

Table F *Provision of information*

Topic	DK	FI	IC	NO	SE
DSO obligation to inform customers on energy efficiency measures	Yes	Yes, through voluntary Energy Efficiency Arrangements	No	No	Yes
Information on consumption data and benchmarking	Provided by DSO or through third party – benchmarking and historical data	Provided by DSO –actual consumption available when given to the electricity supplier	Provided by the DSO – unclear if benchmarking and historical data is provided	Provided by DSO – geographical benchmarking and historical data	Provided by DSO - benchmarking and historical data

DSOs are responsible for making consumption data accessible to customers through different communication platforms e.g. web platforms and in-home monitoring displays. Smart meters installed in Denmark and Norway should allow installation of real-time displays that provide consumption and tariff information. In Finland, DSOs are responsible for providing customers with a standardised open interface for real time consumption

reporting, while validated metering data is made available for all customers, via a web portal the day after delivery.

It is the DSOs responsibility to facilitate the installation of displays if requested by the customers, either directly or through third parties. DSOs are not responsible for facilitating the connection of in-home displays in Iceland and Sweden. Nor are DSOs obliged to provide technical equipment for in-home displays in any of the Nordic countries. In Denmark, Finland, Norway and Sweden consumption information is provided via a web platform, and in Denmark customers will also have access to this information via data hubs.

Table G summarises the DSOs role in providing information to in-home displays or through other communication platforms.

Table G Improved user interface for consumption information

Topic	DK	FI	IC	NO	SE
In-home display information/monitoring	Provide real-time display information if requested by customer	Provide real-time display information if requested by customer	No	Provide real-time display information if requested by customer	No
Other communication platforms	Datahub or a web portal	Web portal	NA	Web portal	Web portal

Real-time grid status information could incentivise customers to reduce consumption in situations when grid capacity is strained. This could induce more efficient utilisation of the grid, reduce losses and prevent unplanned distribution interruptions. There are no information requirements for DSOs regarding preventive measures (ex-ante) for unplanned distribution interruptions or grid constraints in the Nordic countries, except in Finland where DSOs are required to inform grid users about the local grid's supply reliability, and inform grid users on how to prepare for supply disruptions at least every two years.

Table H summarises DSOs information responsibilities with regards to interruptions.

Table H Grid status information

Topic	DK	FI	IC	NO	SE
Information requirements on grid status	No	Yes, required to provide information on robustness and on preparatory measures in the event of disruption	No	No	Not specifically but have to inform about the security of supply
Information requirements on planned/unplanned interruptions	No, but recommendations and guidelines are provided by Dansk Energi	Obligated to inform customers about planned interruptions, and consequence and duration of unplanned interruptions	NA	Minimum 24 hours before planned interruptions, cause and expected duration when unplanned	Obligated to inform customers about planned interruptions, and the right for compensation of transmission interruptions

Direct and custom-made advice on energy efficiency measures can be provided by DSOs during home visits or when in direct contact with the customer. Regulation in Denmark, Finland and Sweden states that DSOs are responsible for informing customers on the potential use of smart meters. This responsibility is not specified in Norway (or Iceland). Regulation in Denmark makes DSOs responsible for providing information about electrical safety aspects and to assist with the supervision and inspection of electric installation. DSOs are also responsible for providing individual advice on energy efficiency measures. Finnish TSOs are, through voluntary energy efficiency agreements, required to provide advice on better energy use. In the other Nordic countries such responsibilities remain unspecified.

Table I summarises DSOs responsibilities with regards to custom made advice on energy efficiency measures.

Table I *Direct advice to end-users*

Topic	DK	FI	IC	NO	SE
Information on security of energy use	Yes	Partly, advise on better energy use through voluntary Energy Efficiency Agreements	No	No	No
Information on potential of smart meters during or after installation	Responsible to inform about the use –and potential of smart meters	Responsible to inform about the use –and potential of smart meters	NA	Not specified	Responsible to inform about the use and potential of smart meters

Participation in competitive activities

DSOs are monopolies with regulated income, and hence their incentive to participate in competitive activities is limited. According to the EU Electricity Directive, DSOs are responsible for operating, maintaining and developing, under economic conditions, a secure, reliable and efficient electricity distribution system in a non-discriminating manner.⁹² As a result, all the Nordic DSOs act as neutral facilitators for competitive market activities performed by suppliers and producers. Although it is not a direct competitive activity, DSOs currently have the opportunity to use wholesale price information to influence consumer behaviour (high tariffs in periods with high grid losses).

A summary of the DSOs' participation in competitive activities is given in Table J.

Table J *Current status for DSOs' participation in competitive activities*

Topic	DK	FI	IC	NO	SE
Direct involvement in competitive activities	No	No	No	No	No
Possibility to specify tariff on bill	Yes	Yes	Yes	Yes	Yes

The income framework models used to regulate the DSOs' allowed income are designed to incentivise DSOs to be as efficient as possible. In practice this means that DSOs are competing against each other. Even though the models are designed with the same overall goal, there are various income regulation rules in the Nordic countries. Except for Finland, the revenue cap is determined ex-ante the regulatory period – a period of one year in Denmark and Norway, four years in Finland and Sweden and five years in Iceland. The main difference across the countries is that the regulation scheme in Denmark, Finland and Norway are based in benchmarking, i.e. measuring a company's efficiency against a reference performance, while this is not the case in Iceland and Sweden. The three countries using benchmarking of efficiency use different methods.

⁹² Directive 2009/72/EC, article 25

Table K shows a summary of the income framework models in the Nordic countries.

Table K Income framework models for DSOs

Topic	DK	FI	IC	NO	SE
Income regulated by revenue cap	Yes	Yes	Yes	Yes	Yes
Energy Authority sets the revenue cap in advance	Yes	No, after	Yes	Yes	Yes
Regulatory cap period	One year	Four years	Five years	One year	Four years
If deviation from revenue cap, accordingly adjustment next period	Yes	Yes	Yes	Yes	Yes
Benchmarking of DSO	Yes Efficiency, quality/security of supply, frequency and duration of interruption	Yes Efficiency, security of supply (CENS)	No Aims to introduce	Yes Efficiency, security of supply (CENS)	No Will be introduced in next regulatory period (2016-2019)
Efficiency target	Company specific	General and company specific		Company specific	General (Specific target to be introduced in 2016)
Benchmarking frequency	Annually, base year reviewed at least every four years	Annually, basis is average of 2005-2010		Annually, basis consist of average of "front" for the five last years	
Costs excluded from benchmarking	Energy saving activities			If approved: R&D costs for efficiency projects	

NordREG has recommended implementation of mandatory combined billing. Only Denmark has decided to implement this. Other future billing regimes are thus possible in the other Nordic countries as the decision is ultimately taken on a national level. Mandatory combined billing is currently being reviewed in Norway, and is the proposed billing regime in Sweden. Regardless of the chosen billing regime, the DSOs' participation in competitive activities will be limited. In a situation with mandatory combined billing, DSOs are no longer responsible for invoicing the customer for network service. In addition, the supplier will assume the role as main customer contact point, and as a result the DSO will lose some of the current customer interaction. Some DSOs have the same name and logo as an integrated supplier and the possibility to use the bill for company brand marketing is therefore highest under the mandatory separate billing regime. However, the value of this is unsure.

A summary of competitive activities under various billing regimes is given in Table L.

Table L *Competitive activities under various billing regimes*

Topic	DK	FI	IC	NO	SE
Mandatory combined billing national status	Planned introduced	Not planned	Not planned	Being reviewed	Proposed by Ei
Marketing by DSO on behalf of supplier through invoice	Not possible	Limited Not possible if one bill	Limited Not possible if one bill	Limited Not possible if one bill	Limited Not possible if one bill
Distinguish between network cost and cost of electricity on bill (DSO price signal)	No, but customers can ask for a detailed bill	Mandatory to distinguish energy and network costs on the bill (by regulation)	Not decided	If one bill, yes	If one bill, yes

NordREG has recommended implementation of automatic meter reading (AMR), with meters capable to register energy usage at least on hourly basis and with daily reading of meters, for all customers. The time frame for implementation is, however, decided on a national basis. The current status for the roll-out, and implemented capabilities, of smart meters differs between the Nordic countries. While the current roll-out rate is 60 percent in Denmark, 97 percent in Finland and complete in Sweden, the current status in Norway is below 10 percent. However, planned smart meters in Norway are more advanced than the majority of meters currently installed. Iceland, on the contrary, has no stated plan of smart meter installation. With the introduction of smart meters, data information availability will increase significantly. Increased data availability will in turn require introduction of efficient information exchange systems. Denmark has already introduced a centralised data hub and will launch a new version in 2016. Also a Norwegian data hub will be operational in 2016. A political decision regarding a Finnish data hub is expected in 2015. Ei has proposed a centralised information exchange system to the Swedish Government, but no decision has yet been made. There are no statements regarding a centralised information exchange system in Iceland. Introduction of centralised data hubs will enable access to customer information and customer metering data in a standardized format. Data hubs in Denmark and Norway will be capable of handling hourly volumes, and will also be prepared to handle a 15-minute resolution. As smart meters installed in the future might be capable to register consumption with higher time-resolution than 15 minutes, the DSOs may have access to more detailed data than the data uploaded in the hub. The question, which answer still remains unsure, is if the DSOs will discriminate between suppliers by providing the integrated supplier with more detailed customer data than to others via the hub. As DSOs, according to the Electricity Directive, "shall provide system user with the information they need for efficient access to, including use of, the system" and "not discriminate between system users", it is unlikely that discrimination will occur.⁹³ Nevertheless, it should be considered whether this should be monitored.

Similarities and differences between the Nordic countries related to smart meters and information exchange possibilities is given in Table M.

⁹³ Directive 2009/72/EC, article 25

Table M Smart meters and information exchange possibilities

Topic	DK	FI	IC	NO	SE
Smart meter roll-out status	About 60 % complete	About 97 % complete	No plan	About 7 %	Complete
Targeted roll-out rate	100 %	80 %		100 %	100 %
Timeframe for roll-out of smart meters	By 2020	2014		By 2019	July 1 st 2009
Meter data manager	DSO (sends to data hub)	DSO	DSO	DSO	DSO
Threshold for obligatory hourly metering	100 000 kWh/year	Fuse 3*63 A	100 kW	100 000 kWh/year	Fuse 63 A
Hourly metering for customers below obligatory threshold	Will be all with smart meter installed	All with smart meter installed	By request (customer charged)	Will be all with smart meter installed	By request (free of charge)
Reading for hourly registering meters	Daily	Daily	Daily	Daily when AMS (today weekly)	Daily
Reading for non-hourly registering meters	Annually (may change to monthly)	Three times per year, to increase to four	Every four years (annually by customer)	Quarterly (small users annually)	Monthly
Capabilities for installed smart meters	15 minutes	Hourly		Hourly (prepared for 15 minutes)	Hourly
Information exchange system	Data hub	Data hub reviewed	No plan	Data hub from Oct 16	Data hub proposed
TSO role related to data hub	Neutral market facilitator	Neutral facilitator if hub		Neutral market facilitator	Neutral facilitator if hub
Time resolution in data hub	Hourly (15 min)			Hourly (15 min)	

National unbundling rules for DSOs

An important aspect ensuring DSO neutrality is separation of regulated activities, i.e. network operation, from competitive activities. Many Nordic power companies are vertically integrated companies that participate in distribution, generation and supply/sales of electricity. In all Nordic countries the majority of the suppliers are vertically integrated companies, and these companies serve the majority of the customers in all countries.

EU's Electricity Directive specifies the minimum requirements related to unbundling of DSOs from generation and supply companies. As a result, the implemented unbundling rules differ to some extent between the Nordic countries.

All five countries have imposed accounts and legal unbundling. The threshold for legal unbundling is, however, different between the countries. In Denmark, Iceland and Sweden all DSOs are legally unbundled. The threshold for legal unbundling in Finland is

distribution on the 0.4 kV network of at least 200 GWh/year during three consecutive, while the threshold in Norway is at least 100,000 customers in addition to special requirements from NVE.

Functional unbundling is not a requirement in Iceland, but is required for some DSOs in Denmark, Finland, Norway and Sweden. The threshold for functional unbundling is at least 100,000 customers in Denmark, Norway and Sweden, while for Finland the corresponding number is 50,000 customers. Requirements of functional unbundling also differ to some degree. For all countries, the DSOs above the thresholds are big companies in terms of relatively high customer share.

Unbundling of brands is not a requirement in Iceland and Norway. According to the Electricity Acts in Denmark, Finland and Sweden, DSOs should not create identity confusion in communication with costumers. However, only Finland has detailed requirements stating that a legally unbundled DSO's name and logo must differ from the competitive entities (production and supply) within the same company group. The Danish Energy Agency has proposed to strengthen the rules in the Danish Electricity Act by requiring that the name and logo of a monopoly company should differ from a competitive entity.

Stricter unbundling rules may improve competition further. At the same time, some of the benefit of strengthening the unbundling rules is reduced by the planned regulatory changes in line with NordREGs recommendations since these changes to some degree have the same effect as stricter unbundling rules. One example is that introduction of the supplier-centric model may reduce the possibility to deliver market power to integrated suppliers because all suppliers will be the main contact for the customers. Another example is that the implementation of combined billing is expected to boost competition since customers that prefer one bill may switch to another supplier than the integrated supplier (expected to increase the number of customer switches). Whether or not the additional benefit of stricter unbundling exceeds the cost of further unbundling is uncertain.

The unbundling rules in the Nordic countries are summarized in Table N.

Table N *Unbundling rules in the Nordic countries*

Topic	DK	FI	IC	NO	SE
Number of DSOs	67	80	6	136	161
DSO unbundling regimes	Accounting, legal, functional	Accounting, legal, functional	Accounting, legal,	Accounting, legal, functional	Accounting, legal, functional
Threshold for legal unbundling	All DSOs May operate with other activities if <100,000 customers and related revenue is <5%	Electricity distributed at 0,4 kV level is at least 200 GWh for three year	All DSOs	>100,000 customers or by request of NVE in case of merger or acquisition that trigger licensing obligation	All DSOs
Number of DSOs above the legal threshold	67 (100%)	35+17 voluntary (65%)	6 (100%)	8+33 required (30%)	161 (100%)
Threshold for functional unbundling	>100,000 customers	>50,000 customers	N/A	>100,000 customers	>100,000 customers
Number of DSOs above the functional threshold	6 (9%)	18 (23%)	0	8 (6%)	6 (4%)
Requirements for functional unbundling	Leading employees or board members may not participate in operation or management of trading or generation within the same company group	Managing directors or board members may not participate in management of trading or generation within the same company group	N/A	Management employees may not participate in management of trading or generation within the same company group	Managing directors, authorised signatory or board members may not participate in the same roles of trading or generation within the same company group
Unbundling of branding	Should not create identity confusion in communication Proposed to strengthen by requirement of different name and logo for monopoly and competition entities	Should not create identity confusion in communication Legally unbundled DSO must have different name and logo from competition entities	No requirement	No requirement	Should not create identity confusion in communication

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Pöyry Management Consulting (Norway) AS

Grensen 16
N-0159 Oslo
P.O. Box 706 Sentrum,
N-0106 Oslo, Norway

Tel: +47 45 40 50 00
Fax: +47 22 41 19 00
E-mail: oslo.econ@poyry.com
www.poyry.no

