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A Flexible and Customer-driven Electricity System

Final report by the Smart Grid Working Group

Ministry of Economic Affairs
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Flexible and customer-centred electricity system

Final report of the Smart Grid Working Group

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Abstract

The smart grid working group was commissioned to review and present concrete actions that would improve consumers' opportunities to participate in the electricity market and that would promote security of supply.

The working group considers demand response to be a competitive business, thusload control by distribution network operators should be dismantled in a controlled manner. Market participants would own and use energy storages. Voluntary single invoice covering both grid fees and energy sale would create more options for consumers.

The working group welcomes energy communities and aggregators that combine small-scale consumption and generation into larger flexible units. The goal is to enable new participants to join the electricity markets on equal and market-based terms.

The working group agrees that the fixed distribution charge could be replaced with a power component to give consumers better chances of influencing their distribution costs. Harmonised structures for distribution charges would increase transparency. The working group does not support the adoption of a proportional electricity tax due to its many problems.

The load control capability for the new smart meters would introduce demand response to a great number of consumers. Technical systems in buildings should be designed to support demand response. A sufficient level of cyber security should be ensured in light of the increasing number of smart devices in use. The proposal would introduce many changes to the customers making communication and advice essential.

The proposed measures would mean significant changes for the customers, and it would be important to provide information and guidance.

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Tiivistelmä

Työryhmän tehtävänä oli selvittää ja esittää konkreettisia toimia, joilla älykäs sähköjärjestelmä voi palvella asiakkaiden mahdollisuuksia osallistua sähkömarkkinoille ja edistää toimitusvarmuuden ylläpitoa.
Työryhmä katsoo, että kulutusjousto tulee olla kilpailtua liiketoimintaa. Näin ollen jakeluverkkoyhtiöiden kuormanohjauksesta luovutaan hallitusti. Myös varastojen omistaminen ja käyttö kuuluvat markkinatoimijoille. Sähkönsiirron ja -myynnin yhteislaskutuksen mahdollistaminen lisää asiakkaan vaihtoehtoja.
Työryhmä suhtautuu positiivisesti energiayhteisöihin sekä asiakkaiden sähköntuotantoa ja kulutusta suuremmiksi kokonaisuuksiksi kerääviin aggregaattoreihin. Tavoitteena on uusien toimijoiden osallistuminen sähkömarkkinoille tasapuolisesti ja markkinaehtoisesti.
Työryhmä suhtautuu positiivisesti sähkönsiirron kiinteän maksun korvaamiseen tehokomponentilla, jolloin asiakkaalla on paremmat mahdollisuudet vaikuttaa siirtolaskuunsa. Siirtomaksurakenteiden harmonisointi selkeyttää siirtymää. Työryhmä ei kannata suhteellisen sähköveron käyttöönottoa sen monien ongelmien vuoksi.
Uusiin älymittareihin ehdotettu kuormanohjaus tuo kulutusjouston suurelle määrälle asiakkaita. Rakennusten tekniset järjestelmät tulisi suunnitella joustoa tukien. Älylaitteiden lisääntyessä on varmistettava järjestelmän kyberturvallisuuden riittävä taso.
Ehdotukset tuovat asiakkaille merkittäviä muutoksia, jolloin viestintä ja neuvonta ovat erittäin tärkeitä.

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Arbetsgruppen för smarta nät har haft som uppgift att utreda och föreslå konkreta åtgärder genom vilka ett smart elsystem kan stödja kundernas möjligheter att delta på elmarknaden samt främja upprätthållandet av leveranssäkerheten.
Arbetsgruppen anser att förbrukningsflexibiliteten bör vara konkurrensutsatt affärsverksamhet. Följaktligen bör det ske ett kontrollerat slopande av distributionsnätsbolagens laststyrning. Även ägandet och användningen av lager föreslås höra till marknadsaktörerna. Kundens alternativ ökar om samfakturering av elöverföring och elhandel möjliggörs.
Arbetsgruppen förhåller sig positiv till energikooperativ samt till aggregatorer som samlar kundernas elproduktion och förbrukning till större helheter. Målet är att nya aktörer ska kunna delta på elmarknaden jämlikt och på marknadsvillkor.
Arbetsgruppen förhåller sig positiv till att den fasta avgiftskomponenten för överföring ersätts med en effektkomponent, vilket gör att kunden får bättre möjligheter att inverka på sin överföringsräkning. En harmonisering av överföringsavgifternas struktur gör övergången tydligare. Arbetsgruppen förespråkar inte att en relativ elskatt införs, eftersom en sådan innebär många problem.
Den laststyrning som föreslås i nya smarta elmätare möjliggör förbrukningsflexibilitet för ett stort antal kunder. Byggnaders tekniska system bör planeras så att de stöder flexibiliteten. I takt med att smarta enheter blir vanligare bör man säkerställa att systemets cybersäkerhet håller en tillräckligt hög nivå.
Förslagen medför betydande förändringar för kunderna, vilket innebär att kommunikation och rådgivning är mycket viktiga.

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1 Purpose and mandate of the working group

Greenhouse gas emissions resulting from human activities are a key cause of climate change. This is why many countries have pledged to significantly limit their greenhouse gas emissions. The objective of international climate agreements is to keep the increase in the global average temperature rise well below 2°C from pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels.

Reducing the emissions from power production plays an important role in combatting climate change. The measures to reduce the emissions from power production will significantly increase the amount of the weather-dependent wind and solar power in the electricity system. At the same time, some of the controllable power production from fossil sources is eliminated from the market. The term energy transition is often used to refer to this change. In addition, Finland is building new nuclear power capacity which typically generates electricity at a constant output. Variable production and the large size of the power plants increase the challenges in maintaining a balance between the generation and consumption of electricity.

An important change has also taken place in customers' attitudes to how they consume energy. Many are interested in making choices based on different values in their energy consumption and in self-generation of the electricity they consume. The lower costs of technology and, on the other hand, various smart solutions improve customers' opportunities to participate in the achievement of climate targets through their own investments. Electricity storages and electric cars with their storage and smart charging functionalities bring new opportunities for the full use of self-generated electricity or new possibilities to time the consumption of electricity to when it is less expensive. At the same time, smart applications are increasingly

used in homes and individual household appliances, so the electricity use of homes may automatically react to factors such as the price of electricity and thus bring benefits to customers.

As the level of smartness of devices connected to the electricity network increases, the amount of information obtained through the electricity network will also see a huge increase. By utilising the available information, it is possible to use the resources connected to the electricity network more efficiently for the benefit of both the customer and society. On the other hand, when malfunctions occur, the increasing exchange of information and the possibilities for remote control may cause harm to customers and may at worst open up opportunities for criminals to disturb the functioning of society. Ensuring adequate data security and data protection will play an increasingly important role. On the other hand, new ways of exchanging information and concluding contracts, for example, through blockchains may challenge the operating logic of the current energy market, which will bring additional challenges and provide new opportunities in ensuring data security and in the maintenance of the electricity system.

The cooperation of several different actors is required in the energy transition and in making the electricity network smarter as the resulting changes will widely affect the entire society. In September 2016, the Ministry of Economic Affairs and Employment established a working group to explore the potential of a smart electricity system for the electricity market. The aim of the Smart Grid Working Group was to create a shared view of the smart electricity system of the future. The goal of the working group was to explore and propose concrete measures through which the smart electricity system could both facilitate the ability of customers to actively participate in the electricity market and promote the maintenance of security of supply. The goal of the working group was to seek concrete and realistic solutions for developing the electricity market. The goal of the working group was not to take a stand to issues such as energy aids or the level of taxation, but to focus on the development of the market structures and practices. The time perspective for implementing the changes is 2025.

Senior Adviser Tatu Pahkala from the Ministry of Economic Affairs and Employment was appointed as the chair of the working group. The following people were appointed as members of the working group: Jukka Kaakkola (Finnish Competition

and Consumer Authority), Bettina Lemström (Ministry of Economic Affairs and Employment), Suvi Lehtinen (Energy Authority), Riina Heinimäki (Finnish Energy), Toivo Hurme (Local Power), Pertti Järventausta (Tampere University of Technology), Kaisa Kettunen (Finnish Real Estate Federation), Pasi Kuokkanen (Suomen sähkönkäyttäjät ry), Risto Lindroos (Fingrid Oyj), Juha Marjeta (Finnish Clean Energy Association), Jarmo Partanen (Lappeenranta University of Technology) and Kaija Savolainen (Finnish House Owners' Association).

The following people were appointed as permanent experts to the working group: Johanna Haverinen (Keravan Energia Oy), Malkus Lindroos (Vattenfall Oy), Markku Hyvärinen (Helen Electricity Network Ltd), Lasse Kontinen (Caruna Oy), Jouni Pylvänäinen (Elenia Oy) and Marko Silokoski (Rauman Energia Oy). Heidi Uimonen from Fingrid Oyj and Ville Väre from the Energy Authority served as the secretaries of the working group.

During its term, the working group consulted a total of 59 experts and commissioned a total of 15 reports to support its work. The working group convened 27 times. The working group hereby respectfully submits its report to the Ministry of Economic Affairs and Employment. A dissenting opinion from the Finnish Clean Energy Association is appended to the report.

By reforming the structures of the electricity market, the energy transition will be implemented cost-effectively, the creation of new services for customers and market actors will be promoted and their opportunities to participate in the building of a smart electricity system will be enhanced.

This is an translation of the original Finnish report published in 24.10.2018. If any discrepancies are found between the two versions, the Finnish version should be followed. The Finnish version can be found in: https://tem.fi/julkaisu?pubid=URN:ISBN:978-952-327-346-7

2 Smart grid vision

The Smart Grid Working Group had the important task of creating a **vision of the smart electricity system of the future** at the very beginning of its term. The smart grid vision for 2025[1] **put the customer to the centre of the vision.** The smart electricity system will work as a service platform in the transition towards a more distributed and low carbon electricity system. It will give customers better opportunities to participate in the electricity market, improve security of supply and cost-effectively create new business opportunities for companies. In the vision, the opportunities provided by the smart electricity system are examined from the viewpoints of the most important stakeholders. A more detailed description of the vision is presented below.

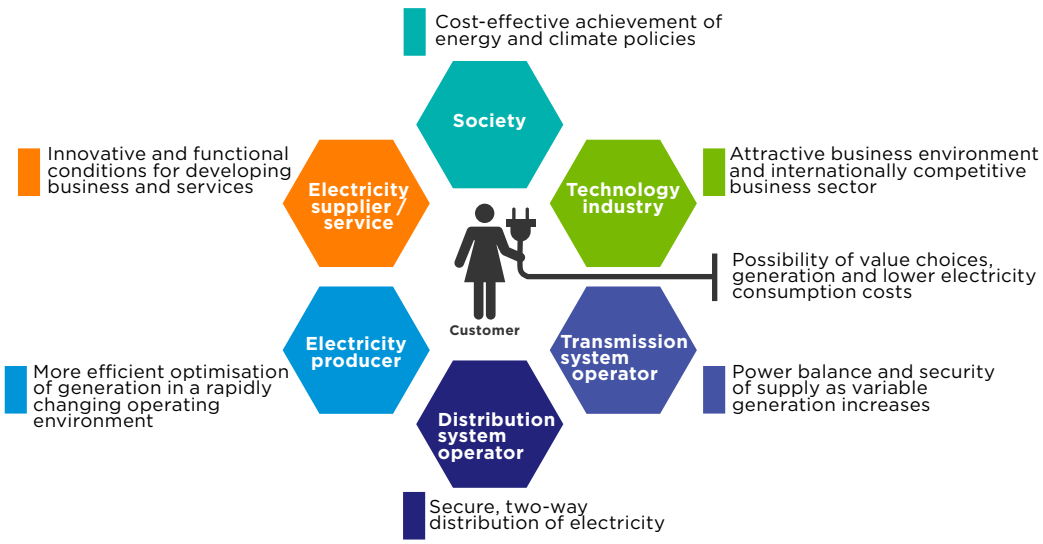


Figure 1. Smart grid

1 Ministry of Economic Affairs and Employment, Finnish smart grid vision, 31 October 2016. available in Finnish https://tem.fi/documents/1410877/3481825/%C3%-84lyverkkovisio+final/9ddc2545-586e-4574-8195-ef9987a07151/%C3%84lyverkkovisio+final.pdf

3 The working group's proposals for the creation of a smart electricity system

In accordance with the working group's mandate, the guiding principle in the measures proposed by the group was to increase the opportunities for customers to participate and to improve the security of electricity supply. The working group's proposals are divided under four main themes:

- The roles and rules in the electricity market will be clarified
- Market-driven incentives will be enabled
- Sufficient technical preconditions will be created
- Cooperation across sectoral boundaries will be increased

This chapter will introduce the working group's proposals at a general level. Further details on the working group's proposals and their background can be found in Appendix 1 of this report[2] (in Finnish only). This summary report and the appendix to the report form an inseparable entity.

3.1 The roles and rules in the electricity market will be clarified

An efficiently working electricity market is based on clear roles and responsibilities of different actors as well as rules that ensure fairness. The rules of the electricity

2 http://urn.fi/URN:ISBN:978-952-327-346-7

market should be specified and the roles clarified to promote new business models and the provision of innovative products and services to customers and to enable a reduction in the overall costs of electricity use for customers.

3.1.1 The roles of market actors and network companies

It is essential to make a distinction between a regulated monopoly and competitive, market-based activities in the electricity market. Electricity network operations are considered to be a natural monopoly, separated from the production and sales of electricity, which are competitive business activities. Network companies must guarantee a sufficiently good quality of electricity and serve as neutral facilitators for the operation of the electricity market. As regards some of the new services and functionalities entering the electricity market, it has been unclear whether they are part of network operations or competitive activities.

The Smart Grid Working Group is of the opinion that customers should have the opportunity to participate in demand flexibility themselves or with the help of a market actor. The working group proposes that demand flexibility services, the storage of electricity and the provision of new services to customers be considered as competitive business activity as competition will ensure customer-driven and needs-based development of products and services as well as efficiency.

Demand flexibility based on market terms

For historical reasons, a considerable part of consumer-customers' electricity consumption that would be suitable for demand-side management currently falls within distribution network companies' load control linked to the time of the day. This kind of control of electricity consumption is generally referred to as night-and-day control. Some companies also use time-of-the-year control, which is linked to the calendar.

The Smart Grid Working Group proposes that the load control by distribution network companies shall be phased out in a controlled manner and that a transition to market-based, more dynamic control of consumption be made at the latest on 30 April 2021. When the control by network companies is phased out, security of supply as well as the customer point of view must be taken into consideration, which is why the transition must be carried out in a controlled manner. Market-based con-

trol enables in a more flexible way the practices that are best suited for the earning opportunities available to customers on the market.

If the aim is to continue the static night-day control, the service provider can choose the way it informs the customer about this possibility and the ways in which it will agree on this with the customer and the network company. The clearest way to do this would be to notify the customer of the change well in advance and agree with network companies on continuing the current control practice for those customers for whom it is considered a suitable option. the supplier may for example choose to inform its customers that load control will continue without any required measures. If the customer's service provider does not agree with the network company on continuing the control, the control service will end at the latest on 30 April 2021.

Phasing out the time-of-the-day or time-of-the-year control of electricity consumption will create opportunities for providers of demand-side management services when the control of electricity consumption, which has previously been in the hands of network companies, is made the responsibility of customers' electricity suppliers and other market actors. The load control functionality proposed by the working group for next-generation smart meters provides an additional option for implementing demand-side management for a large number of customers. The number of market-based control options has increased rapidly over the past few years and their features have become more diverse, improving customers' possibilities to choose the demand-side management service suitable for their needs. The development of services and products is expected to continue. New technologies enable extremely fast controls that react to almost real-time price signals from the market. Faster controls may require investments from the customer.

Network companies can continue to buy demand-side management services for network control from the market on an equal basis and without discrimination. In future, network companies may need flexibility for example to manage bottlenecks in the network.

Electricity storages

Electricity storages are a new component in the electricity market and in the electricity system. Electricity storages have versatile functionalities and they can be

used for several purposes. Electricity storages provide customers with opportunities for influencing the costs of their electricity consumption and customers can offer the services of their electricity storages to the market. For example, by using the storages, it is possible to take advantage of the variations in the market price by timing the intake of electricity from the network to the hours when electricity is cheap and by using the stored energy from the battery during expensive hours. The storage can also be used to maximise the benefits of own electricity consumption and production by storing self-generated energy instead of feeding it into the network. Furthermore, customers can use the electricity storage to influence the size of the possible power-based tariffs. Thanks to the capability to react rapidly, the storage can be used to participate in the frequency control, in controlling the national power balance and in the management of local distribution networks. Electricity storages increase the flexibility of the electricity network, improve the security of supply and have an important role in an electricity system that is based on clean energy. For example, electric cars will in future provide a significant opportunity for storage and flexibility. The profitability of storages improves if they are utilised as diversely as possible. The principles of using and owning electricity storages should be specified so that full advantage can be taken of them.

The Smart Grid Working Group is of the view that in principle, owning and using electricity storages is competitive business activity. According to network companies' role as a neutral market facilitator and according to their general monopoly unbundling obligations, network companies should not influence the market or participate in market activities in the role of providers of storage services. For this reason, network companies should in principle not own or use storages themselves; instead, owning and using electricity storages should be considered market-based activity. Network companies may acquire the services of electricity storages from the market in accordance with open and non-discriminatory principles for purposes such as ensuring security of supply. If an electricity storage service suitable for the network operator's needs is not available on the market, distribution network companies may exceptionally own and use electricity storages for separately determined needs in network operations. This topic is discussed in the EU legislation that is currently being drafted. Once completed, the EU legislation may affect the implementation of the details of this matter.

A customer-driven retail market model

The electricity retail market model plays a key role in the provision of electricity-related services to customers and the model should support the changes underway in the electricity market. The Smart Grid Working Group considers it important that competition in the retail market remains at a high level, that customers can themselves choose their invoicing methods and remain in contact with the network company.

As the electricity market and the network charges change, it may be difficult for customers to fully understand the possibilities offered by the electricity market. It may be straightforward from the customer's point of view to have one party chosen by the customer coordinating the services related to the customer's use and production of electricity and building a clear and effortless package based on these services for the customer. The most comprehensive service to meet the needs of customers can be provided by a party that operates in the competitive market and to which competition is an incentive to improve its services to customers.

The working group considers that customers should be able to choose one combined or two separate invoices for their electricity supply and distribution. If they wish, customers should therefore have the possibility to receive a single invoice for electrical energy and electricity distribution delivered to them by the supplier. For this to happen, distribution network companies are required to give all suppliers of electricity equal and non-discriminatory possibilities to provide their customers with a combined invoice for the electrical power and the distribution of electricity. Offering a combined invoicing is voluntary for the supplier. Combined invoicing is currently not possible in the operating areas of all network companies and suppliers do not generally offer this possibility to their customers. Enabling combined invoicing in the entire country harmonises the operating models of distribution network companies and puts different electricity suppliers to an equal position. The possibility to create new products and more comprehensive energy services will open up to electricity suppliers. The working group considers it important that the information required for the billing of distribution network service to be available to suppliers through the Datahub.

The Smart Grid Working Group is of the view that, because of liability issues, customers should continue to have a separate network service contract with the network company. When necessary, customers should be able to easily contact their

network company regarding technical issues such as power outages, the quality of electricity and electricity connections.

On the other hand, some customers may want separate invoices for network services and energy also in future and there is no need to limit such freedom of choice. This option should also be made possible by the network company.

The Smart Grid Working Group considers that the retail market model used in Finland should be as compatible as possible with the models chosen by the other Nordic countries. Large electricity retail markets and harmonised operating models lower the threshold for entering the market and reduce the prices of different service and technology solutions as there is less need for country-specific and network company-specific tailoring. Lower costs benefit customers and lower the threshold for participation in demand flexibility. Participation in demand flexibility by a large number of customers promotes the maintenance of security of supply in a cost-effective manner. Solutions that have been developed in a more harmonised retail market in Finland are easier to export.

3.1.2 Providers of flexibility services (aggregators)

An aggregator means a market participant that combines the consumption, production and storages of several customers into a larger entity and takes care of the technical implementation in order to use these resources for trading in different electricity market places. This also makes it possible for a small customer to participate in the electricity market. It is possible to reduce consumption during peak hours through the operation of an aggregator serving as a provider of demand flexibility management services when the price is higher or, alternatively, to increase consumption when there is a lot of availability and the price is low. At the same time, both the security of supply and the efficiency of the system will improve and the costs incurred by the users of electricity will go down.

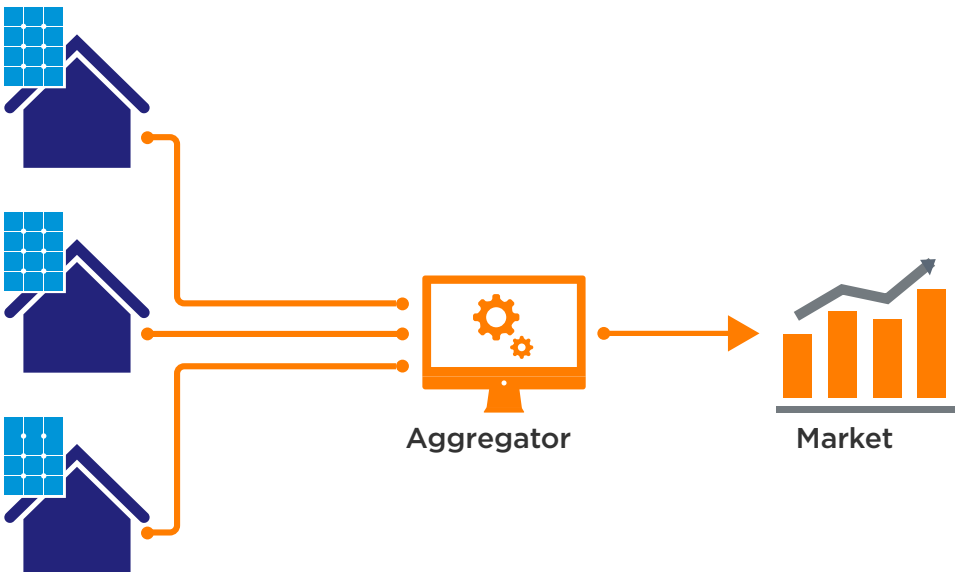


Figure 2. An aggregator means a market participant that combines the consumption, production and storages of several customers into a larger entity and takes it to different electricity market places

An independent aggregator means an actor that is not the customer's electricity supplier or balance responsible party and does not need a contract with the customer's supplier or balance responsible party when operating in the market. An independent aggregator entering into the electricity market increases the choices available to customers through new technologies and increases the number of earning methods in the electricity market. The operation of independent aggregators currently involves a lot of open questions regarding the effects of an independent aggregator on the other actors.

Balance responsibility is a central principle in the electricity market. Each balance responsible party should balance the electricity supply and electricity consumption of its customers during each imbalance settlement period. If the balance responsible party is not in balance, adjustments are necessary in the electricity system (increase or reduction in production or consumption) in order to balance consumption and production. The costs are invoiced to balance responsible parties according to the principle that the party responsible pays the costs. The imbalance settlement is based on metering and the electricity sales carried out by the balance responsible party. The actions of an independent aggregator during the imbalance settlement period may affect the liabilities and costs of the balance responsible party. There-

fore, the effects and fairness between the different parties should be weighed in the model of independent aggregators.

The working group has a positive view on the opportunities aggregators provide to customers. An independent aggregator may work in all market places as long as equal treatment of all actors is ensured. Different market places may have different operating models. The working group considers that all aggregators, including independent ones, should bear the responsibility for the imbalance they cause according to the balancing rules and the implementation must be verifiable. A study commissioned by the working group[3] describes the different alternative models in more detail. The working group's proposal for the models to be applied in different market places have been described in Appendix 1 (in Finnish only) of this report.

3.1.3 Energy communities

Energy communities can be regarded as one form of the sharing economy in which the members of the community share the benefits of the generation and purchase of electricity with one another. Enabling these increases customers' options in participating in the electricity market and generating at least some of the electric power they use in the way they want. By participating in an energy community, customers may receive direct financial benefits. On the other hand, a community makes different value-based choices related to energy possible as it provides the opportunity to influence the environmental effects of one's electricity consumption and generation and the generation method. For example, it will be possible also for individual customers to invest in and utilise larger solar power plants or electricity storages as unit costs fall. The energy community may also through its operation strive to offer better local security of supply to its members than what is generally available, for example, by keeping the power on in the energy community during disturbances in the distribution network.

The energy community may be a distributed energy community or a local energy community. There are two kinds of local energy communities: energy communities within housing companies or energy communities crossing property boundaries.

3 Pöyry Management Consulting, Independent aggregator models, 26 June 2018. available https://tem.fi/documents/1410877/3481825/Itsenäisen+aggregaattorin+mallit+26.6.2018/f63589df-49ea-4232-b39a-bb6973407fe2/Itsenäisen+aggregaattorin+mallit+26.6.2018.pdf

The working group has looked at energy communities mainly from the viewpoint of small-scale generation. Value added tax legislation should also be considered when implementing the working group's proposals.

The working group has a positive view on energy communities and the opportunities they provide to the members of the community and consequently also to service providers and technology providers. The general principle in all energy communities should be that the members can choose their own electricity supplier. It must be possible to resign from the energy community in accordance with the agreements that have been concluded.

Energy community within a housing company

Parties living or operating in the same property, such as stakeholders of housing companies, may be interested in common energy choices, such as generation or other energy solutions in their property. They may then form an energy community within the housing company. At the moment, almost all metering points within housing companies have been equipped with an own electricity meter. .Distribution charges and taxes are paid on the energy running through the meter regardless of whether the energy consumed comes from the distribution network or is produced within the property itself.

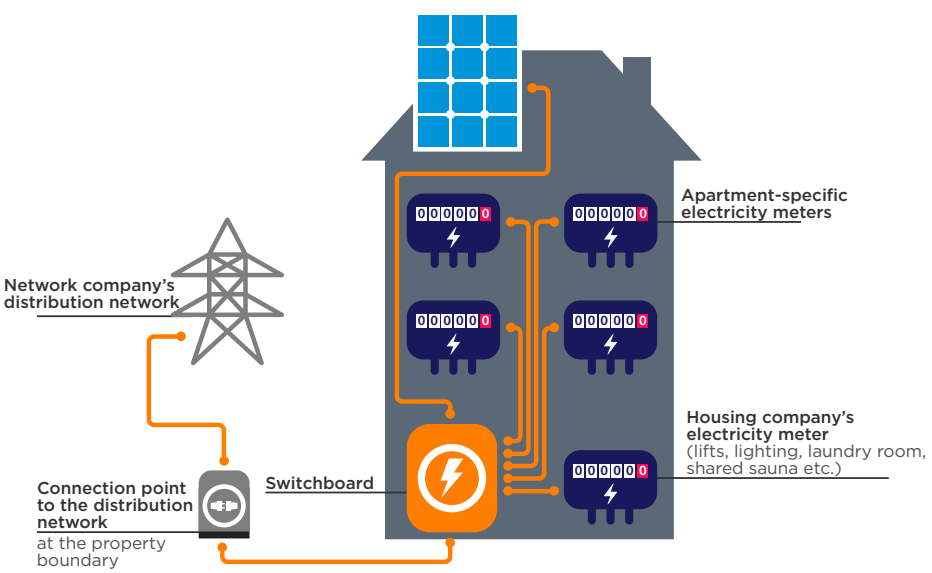


Figure 3. Energy community within a housing company

The working group considers that, to enable the members of the community benefit from their energy resource fairly, no network service charge should be paid to the distribution network company for energy generated and consumed within the property if it does not cross the access point to the distribution network and consequently does not pass through the distribution network. It must be possible to computationally separate the electricity transmitted to the energy community via the distribution network company from the electricity generated by the energy community itself. This may require that the Measuring Instruments Directive or at least its interpretation be changed. Electricity taxation will be implemented according to current taxation practices. At the moment, no electricity tax needs to be paid on small-scale electricity generation that is consumed by the producers themselves. The change proposed by the working group would make this tax benefit possible for communities such as housing companies.

The boundary conditions provided by the Limited Liability Housing Companies Act, the articles of association of the hosing company and other agreements must be considered in the establishment, operation and termination of an energy community within a housing company. Energy communities within housing companies decide on and are responsible for dividing the benefits and costs within the community.

Energy community crossing property boundaries

Under current legislation, a licence is required for the construction of electricity networks and transmitting electricity across the boundaries of real-estate properties or groups of properties. This principle is important as the construction of parallel networks is not cost-effective from society's point of view. However, the most convenient places for small-scale generation are often not found within the customer's own real estate property but in places such as the sunny field owned by a neighbour. The neighbours may then decide that they should build a mutual electricity network of their own in which they would utilise the small-scale generation built together and share the benefits.

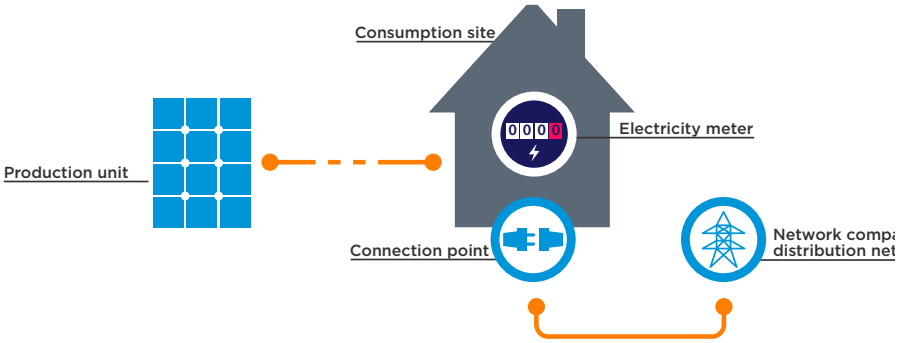


Figure 4. Energy community crossing the property boundary

To explore the possibilities, the Energy Authority investigated the matter from a judicial point of view[4]. To make it possible to establish energy communities crossing property boundaries, the working group proposes that the construction of a power line across the property boundary to connect a small-scale generation site to the consumption site be allowed without permission from the distribution network company and without a electricity network licence. The customer is responsible for the quality of the electricity and the electrical safety beyond the access point for the accounting point also in this situation. To ensure electrical safety and fair treatment of customers, the connecting line must not coonect accounting points to each other and it must also not form a circular network parallel to the distribution network.

Distributed energy communities

Customers may also have production elsewhere than within their own real-estate property or in its immediate vicinity, in which case the customer may want to utilise the electricity it has generated elsewhere at another location. A distributed energy community makes it possible to locate energy resources to a more suitable place. A distributed energy community utilises an existing distribution and transmission network to transfer the production. For example, electricity generated with solar panels at the summer cottage may thus be used by the consumer in his or her actual residence. This also enables

4 Energy Authority, Legal preconditions for energy communities from the viewpoint of the EU's and Finland's regulation on networks, 5 September 2017. available in Finnish http://www.energiavirasto.fi/documents/10191/0/Energiaviraston+selvitys-+5.9.2017+TEMlle+energiayhteist%C3%B6jen+oikeudellisista+edellytyksist%C3%A4.pdf/76a0bebc-af95-4c99-b3e5-9070f18c236c

larger unit sizes which as investments may be proportionally more affordable to the members of the community.

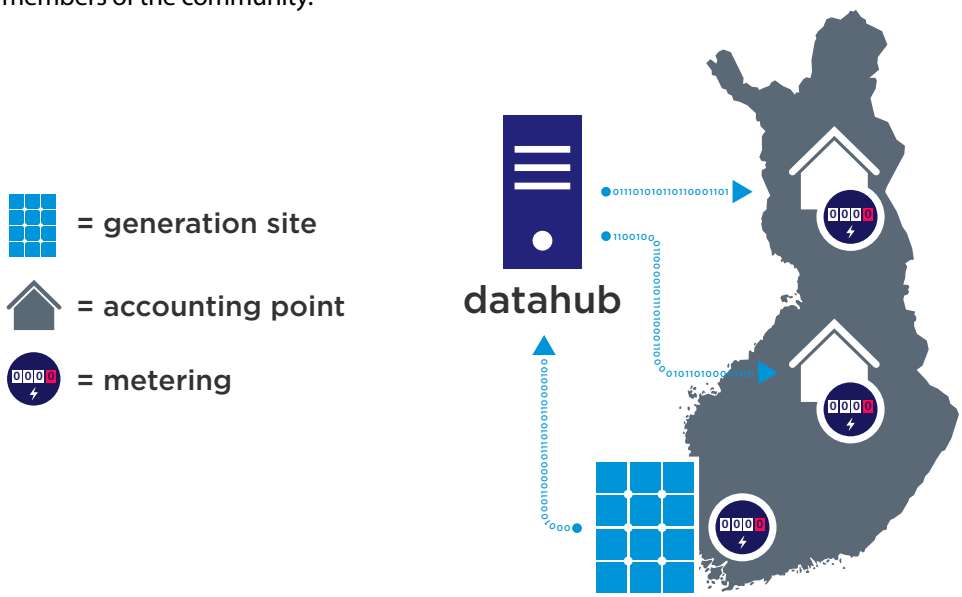


Figure 5. Distributed energy communities

The electricity production equipment, electricity storages and consumption sites of distributed energy communities are measured separately by metering point and the distribution of energy between the use metering points is carried out computationally. Each generation or consumption site of a distributed energy community needs its own network service contract with the local distribution network company. Because such communities use the general power network, they should pay on the use of the network according to the general principles. Similarly, electricity taxation is carried out according to the current taxation practices.

3.2 Market-driven incentives will be enabled

The demand and supply of electricity find a balance most efficiently in a free electricity market as the prices and distribution network charges of different market places steer the short-term decisions made by market actors and customers on consumption, production and storage as well as investment decisions made for

the long term. It is important to ensure that pricing encourages customers to market-based demand flexibility, within the physical limits of the electricity network.

3.2.1 Distribution network tariffs

For historical reasons, most of the network companies currently base their distribution network tariffs for smaller customers on two components: an energy-based variable part (cents per kWh) and a fixed monthly basic charge (euros per month). The basic charge may be adjusted according to the dimension of the main fuse and the components may have different time-of-use tariff principles (e.g. night-day division). The costs of network companies are largely costs incurred from fixed investments and capital commitments, which are not dependent on the amount of energy transferred. Many companies have therefore increased the share of the fixed charge in the distribution network bill. At the same time, the share of the energy-based charge has fallen. Increasing the fixed charge and reducing the energy component make distribution network tariffs more cost-reflective from the network company's point of view, but reduce customers' possibilities to influence their distribution network bill.

Power-based distribution network tariffs is aimed at directing customers to reduce their peak consumption so that investments in distribution networks can be postponed or avoided, the security of supply of the electricity system improved and customers activated to participate in demand flexibility. It may also be possible to use the power component to influence the dimensioning of the network. At least three distribution network companies have recently introduced a power-based price component for smaller customers as well.

The working group has a positive view on replacing the fixed charge with a power component that provides customers with better opportunities for influencing their distribution network bills. The introduction of the power component will have significant customer impacts and the suitability of the component for different customer groups should therefore be investigated before introducing it. At the same time, active, customer-oriented and timely communication and advice must be ensured.

If there are a wide variety of distribution network charges, the charges paid by customers may become more difficult to understand and a comparison of network

charges may become more complicated especially if distribution network companies more widely introduce differing principles for power-based distribution network tariffs. Communicating information about foreseeable changes to customers may also become more difficult if there are distribution network tariff structures and their principles differ significantly between companies. From the point of view of flexibility service providers and customers, the clearest situation would be one in which certain parts of distribution network tariff structures were harmonised throughout Finland. The working group considers that the general distribution tariff structures of distribution networks and the transition periods for the changes should be harmonised through legislation or regulations by the authorities. Tariff structures should enable the operating preconditions for distribution network companies operating in different environments also in the future. Each network company will decide on its pricing level independently also in the future.

3.2.2 Proportional electricity tax

Electricity tax is one of the excise duties levied on energy. Energy taxation is regulated at the level of the EU through directives[5] laying down provisions on the minimum level of the tax and the sustainability criteria for biofuels. Electricity tax is paid on electricity supplied for consumption from the electricity network. The amount of tax paidis thus determined according to the consumed electricity and it is collected by the power network company in connection with the power network charge. Value added tax to the amount of 24 per cent according to the general tax rate is also paid on electricity tax. The share of electricity tax and value added tax of the total costs of purchasing electricity (distribution + electric power + taxes) accounts for about one third of the retail customer's electricity bill.

A fixed electricity tax based on the amount of consumed energy steers towards energy efficiency. However, a fixed tax based on energy consumption does not direct consumers to act according to the price signals from the electricity market, which would be more efficient from the point of view of the electricity system. In the model of proportional electricity tax, electricity tax would depend on the price of

5 Council Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity, and Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources

electricity, which means that the amount of tax paid would be higher during high electricity prices than during lower electricity prices. This would artificially strengthen price variation for the customer.

The model would primarily be aimed at increasing interest in demand-side management and the products and services related to it. A variable electricity tax would be a significant change for customers and involves a large number of open questions. For example, how is the change in taxation allocated to different customer groups? How could different kinds of customers protect themselves from changes in the electricity tax? What market price would the tax be tied to in order to make it fair for everyone? Who would collect the tax? How can variable taxation be planned so as not to increase the tax income and, consequently, customers' tax burden? A proportional electricity tax may also have different kinds of knock-on effects on the derivatives market.

According to a report commissioned by the working group[6], the Energy Tax Directive would seem to enable the introduction of proportional electricity tax, but this interpretation is not completely unambiguous. Another report commissioned by the working group examined models through which the proportional electricity tax could be implemented and the effect of these models on customers[7]. Based on this report, proportional electricity tax could reduce the tax burden of customers who can be flexible. On the other hand, especially the tax burden of smaller customers who cannot be flexible would grow. Before the implementation of load control through a smart meter as proposed by the working group, customers would be required to invest in flexible solutions. According to the report, the initial investment is currently around EUR 1,000 for smaller customers. Linking the tax to the price of the day-ahead market would tie demand flexibility to this market place while reducing the flexibility offered to other market places. The model would require a com-

6 Borenius Attorneys Ltd, Reform of excise duty on electricity from the point of view of EU regulation, 1 March 2017. available in Finnish https://tem.fi/documents/1410877/3481825/S%C3%A4hk%C3%B6veroselvitys+Borenius+ 1.3.2017/4d0c10ca-7ae1-4f29-bad6-e820323462de/S%C3%A4hk%C3%B6veroselvitys+Borenius+1.3.2017.pdf

7 Pöyry Management Consulting Oy, Effects of a proportional electricity tax, 16 May 2018. available in Finnish https://tem.fi/documents/1410877/3481825/Suhteellinen+s%C3%A4hk%C3%B6vero+loppuraportti+16.5.2018/3686caca-e3a0-4ad9-ad75-75869689490e/Suhteellinen+s%C3%A4hk%C3%B6vero+loppuraportti+16.5.2018.pdf

prehensive reform of the tax system, make predicting the tax income more difficult and complicate processes in taxation. According to the report, the model involves a number of challenges related to fairness, predictability and complexity.

The working group considers it a key principle that the incentive for demand flexibility comes from the market. The working group considers that a proportional electricity tax artificially strengthens the electricity price signal, complicates the supply of electricity for customers, increases the price risk and costs for suppliers and customers, and may lock flexibility to a certain market place. A tax tied to a certain market place may also reduce users' interest in the market place concerned and thus reduce the efficiency of this market place. For these reasons, the working group is not in favour of introducing a proportional electricity tax.

3.2.2 Taxation of electricity storages

Electricity tax is levied on electricity supplied for consumption from the electricity network. Currently, electricity tax is also paid on electricity used to charge an electricity storage. As a result, stored electricity is taxed twice: both when stored and when supplied again for consumption. Storage of electricity is not consumption. Instead, electricity storages may be used to optimise the electricity sales, electricity supply or the use of the network by shifting electricity consumption from one moment in time to another. Therefore, storage of electricity should not be taxed. This may set requirements for the owner of the electricity storage and the measuring of the consumption of the storage in order to sufficiently verify the proportion of the electricity eligible for tax-free treatment.

The Ministry of Finance is currently reviewing the legislation concerning the excise duty on electricity to remove the double taxation of electricity storages[8]. When this report was drawn up, the government proposal concerning the matter was being circulated for comments[9]. According to the Ministry's announcement, electricity

8 Government, Changes to energy taxation from the beginning of 2019 [article], 25 May 2018. available in Finnish https://valtioneuvosto.fi/artikkeli/-/asset_publisher/10623/energiaverotukseen-muutoksia-vuoden-2019-alusta

9 Ministry of Finance, change project on energy taxation (in Finnish) VM130:00/2018 https://vm.fi/hanke/-/hankesivu/hanke?tunnus=VM130%3A00%2F2018

taxation will be developed so that in the first stage, double taxation of electricity is eliminated at least for large batteries. In a later stage, it will be investigated whether it would also possible to phase out double taxation in the case of small batteries, for example, in situations in which the batteries of electric cars would be used for interim storage. The initial changes are due to enter into force as of the beginning of 2019.

3.2.3 Regulation of network companies to support flexibility

As customers acquire small-scale generation, electric cars, electricity storages and technology that controls consumption, the load in the distribution networks changes and the transmission of electricity becomes bi-directional. This may complicate the management of distribution networks. In this situation, new kinds of cost-effective approaches are needed in the planning and operating of the networks, including the management of bottlenecks, fault situations, voltages and reactive power.

The customer should allowed to offer its flexibility in addition to the electricity market also for network management. It should be possible to utilise flexibility for a variety of purposes so that more value can be provided with the existing resources to customers that offer flexibility. Regulation should direct network companies to implement solutions that are optimal from the viewpoint of customers and society.

In certain situations, it could be more cost-effective to use other measures than investments in the electricity network to maintain security of supply and manage the load in the network. According to the current monitoring methods[10], the network company's investments and purchased services are handled in different ways, so they are not directly comparable. A central challenge in the comparison of different options is the valuation over their entire life cycle so that it is possible to assess the long-term effects of flexibility services that replace traditional investments in networks. It is important that regulation enables companies to use smarter solutions in an equal and technology-neutral manner so that all customers benefit. A study con-

10 Energy Authority, Regulation methods 2016–2023. available https://www.energiavirasto.fi/valvontamenetelmat-2016-20231

cerning the use of flexibility in network operation was implemented[11] in connection with this topic.

All customers benefit from the utilisation of flexibility as investments in the network can be avoided. It is essential to make the network company's flexibility needs sufficiently transparent for the market so that the market can offer alternative and more cost-effective network management solutions. The Smart Grid Working Group considers that network companies should utilise flexibility in their network operations if it benefits customers and society. Regulation should enable this and steer towards it. Network companies operating as natural monopolies should act in a fair and neutral manner when they acquire flexibility services from the market.

3.3 Sufficient technical preconditions will be created

A smart electricity system and customers' participation in the electricity market require new kinds of technical implementations in the customer interface and in the *processes of the electricity market*. *As the electricity system is becoming more decentralised and the electricity market increasingly takes place in real time, metering and the information exchange between the parties must be improved.*

3.3.1 Next-generation smart meters

Through smart metering, it is possible to provide customers with better information on their electricity consumption, efficiently monitor the information related to the electricity supply and quality, enable customers to sell their own electricity production to the market and, for example, enable customers' participation in demand-side management.

11 Ernst & Young Oy, Regulation methods supporting demand flexibility in electricity distribution network operations, 13 April 2018. available in Finnish http://www.energiavirasto.fi/documents/10191/0/Kysynt%C3%A4joustoa+tukevat+k-v+valvontamenetelm%C3%A4t+loppuraportti.pdf/3baf0cb9-3d9d-44f9-bcf1-51e11e9ba7b5

Smart meters can therefore be used to contribute to increasing choices for customers and to the security of electricity supply. Next-generation smart meters will largely be installed in the 2020s, the first ones even before that. The functionalities of next-generation smart meters must therefore be determined well in advance. Bearing this in mind, the working group carried out a study on the minimum requirements for next-generation smart meters.[12]

The Smart Grid Working Group proposes that the load control functionality should be integrated in the next-generation smart meters for those customers who have considerable loads. This way, the majority of customers currently within night-and-day control (e.g. customers using electric heating) can cost-effectively and easily be included in demand-side management. This will improve the security of supply along with the increase in demand flexibility, for example. The additional costs of load control with a smart meter are reasonable as regards the actual meter when large numbers of meters are purchased at the same time. According to the working group's estimation[13], the load that can be controlled through current meters is currently about 1,800 MW.

The Smart Grid Working Group considers that the role of the distribution network company is to create a technical platform and that service providers should form the actual control commands with the help of the interface created by the network companies. When all distribution network companies provide a standardised interface for the control, a clear and uniform opportunity to create demand-side management services benefitting customers will be available to electricity suppliers and service providers. It should be possible to update the control commands for the meter several times a day. A control platform that treats different actors equally makes the pro-

12 Pöyry Management Consulting, Minimum functionalities of next-generation smart electricity meters, 15 December 2017. available in Finnish https://tem.fi/documents/1410877/3481825/AMR+2.0+loppuraportti+15.12.2017/6a2df7e6-a963-40c0-b4d8-d2533fbca488/AMR+2.0+loppuraportti+15.12.2017.pdf

13 Sub-group of the Smart Grid Working Group, Utilisation of installed remotely readable meters in demand-side management 22 May 2017, available in Finnish https://tem.fi/documents/1410877/3481825/Asennettujen+et%C3%A-4luettavien+mittareiden+hy%C3%B6dynt%C3%A4minen+kysynt%C3%A-4joustossa%2C+22.5.2017/ 3968fe7d-ab5f-420f-b7fc-b0d64a5b9b1d/Asennettujen+et%C3%A4luettavien+mittareiden+hy%C3%B-6dynt%C3%A4minen+kysynt%C3%A4joustossa%2C+22.5.2017.pdf

cess of switching flexibility service providers smooth. Several options for the implementation of the interface have been investigated in the working group's report.[14]

It should be taken into consideration that customers who do not use the control service available in the meter unavoidably subsidise in their distribution network charges the customers who use the service. As actual automation systems provide customers with wider benefits than control carried out through meters, a direct comparison of the viability of the services is difficult. For example, living comfort and other factors valued by customers can be better taken into account in services available in the market than in control carried out through meters. Controls already take place through market-based service solutions and technological solutions and as a result of competition, different smart home solutions are expected to become an even more versatile and common option.

The working group has also assessed other technical requirements for the meter. The working group proposes that next-generation meters should have the capability to measure a larger number of variables more frequently. This supports the transition of electricity trade to be carried out closer to real-time. As the market changes, it is important to be able to remotely update the features of the meters. With the help of the local physical data exchange interface, customers can take advantage of its other measurement variables, such as voltage and the duration of outages, in addition to real-time data on consumption. Appropriate data security and privacy must be ensured as metering data may contain personal information on the customer and the load control and remote connecting functionalities may directly affect the customer's supply of electricity. Further details of the minimum functionalities of next-generation smart meters can be found in Appendix 1 of this report (in Finnish only).

The working group proposes that Finland should in cooperation with other European countries promote the modernisation of both the legislation on metering and its interpretation as regards remotely readable meters. For example, the working group regards the requirement concerning the display of the metering device as

14 Sub-group of the Smart Grid Working Group, Load control interface for control implemented through AMR meters, 4 September 2018. available in Finnish https://tem.fi/documents/1410877/3481825/•%-09Kuormanohjausrajapinta+AMR-mittarin+kautta+toteutettaviin+ohjauksiin+4.9.2018/eae9b3c1-9773-4e07-aa00-5e144f78e55f/•%-09Kuormanohjausrajapinta+AMR-mittarin+kautta+toteutettaviin+ohjauksiin+4.9.2018.pdf

unnecessary and expensive as technology evolves. Consumer protection should be ensured in other ways.

3.3.2 Building regulations

In addition to the total energy consumption of buildings, the importance of taking into account the instantaneous power consumption of buildings is becoming more important. For example, the wider spread of charging points for electrical cars will significantly affect the electricity use in buildings. In the future, in addition to energy efficiency, it will be important to also take into account the possibilities to control electric power in building design.

Cooperation between different administrative branches should be intensified so that factors related to the use of electricity could be taken into consideration comprehensively. With the energy transition taking place, buildings and properties should be identified as active operators in the electricity market where as they have previously been regarded more as consumption sites.

Compatible plans for electrical wiring, HVAC and plumbing and automation are essential in enabling the controllability of the consumption of electricity and other kinds of energy. **The Smart Grid Working Group is in favour of cost-effective building regulation that supports demand-side management and smart charging of electric cars.** The cheapest way to enable demand flexibility in buildings is to already take it into account in the construction stage. The Smart Grid Working Group considers that, once the building has been completed, **customers should be given the up-to-date planning documents for the building technology systems**, including the final drawings of the electrical wiring, HVAC and plumbing and automation systems, so that the implementation of further installations enabling demand-side management will be as easy, safe and cost-effective as possible. Closer examination is needed on what parts of these plans should be defined compulsory for new buildings in the building regulations.

3.4 Cooperation across sectoral boundaries will be increased

The energy transition will not affect only the operators in the electricity sector but will have a wide-ranging effect on several sectors. Digitalisation brings a large number of opportunities to improve resource efficiency, among other things. On the other hand, it also brings new kinds of threats to which can be prepared by cooperating across organisational and sectoral boundaries.

3.4.1 Cyber security

The cyber security of a smart electricity system should be at a level that ensures all parties trust the functioning of the energy system while still not endangering the balanced development of the smart energy system. The cyber security perspective of the systems and the required data connections of electricity market participants should be taken into account from the beginning of the planning. The increasing decentralisation of the electricity system changes the risks related to the electricity system, as a larger number of remotely controlled devices will be participating in the electricity market and the maintenance of the power balance. Connecting devices to the internet may be a considerable risk if the sufficient level of data security has not been ensured. Damages may occur not only to customers, but also to the actors in the electricity market and, at worst, to society as a whole if data security in the exchange of information and control of devices is not appropriately taken care of.

In addition to controllable electrical devices and well-functioning communications, special attention should also be paid to the data security of the electricity market places as the decisions made by the electricity market actors are based on realistic and real-time information. As real-time operations and automation increase, market actors should continue to be able to trust the functioning of the market. The critical operative systems of market place owners, market actors and network companies should be appropriately secured.

It must be ensured that cooperation across sectoral and organisational boundaries is expanded to explore and prevent cyber security threats and to recover from them. It must be ensured that the authorities and companies have clear roles, responsibilities and operating practices and sufficient powers to act in challenging

situations. The working group recommends that Finnish authorities and the operators in the field deepen international cooperation concerning cyber security and actively contribute to the creation of the EU's cyber security regulations.

3.4.2 Synergies of energy systems

In addition to the electricity system, the emissions from other energy systems should also be reduced to mitigate climate change. Through intensified cooperation energy systems such as electricity, heating and gas systems and the transport system can offer one another opportunities to balance the variation in the availability of different energy sources. This can be promoted by making use of smart and flexible solutions.

The Smart Grid Working Group considers that different energy systems should support one another in a market-driven manner. The synergy of different energy systems should support customers' freedom of choice and promote cost-effectiveness. For example, this may mean market-based sales of self-generated energy to different systems when doing it is technically possible and cost-effective.

Customers should have freedom of choice regarding the purchase of services related to the production and use of energy and their management. The Smart Grid Working Group proposes that energy measurement data should be available to customers and the service providers authorised by customers as easily and as uniformly as possible to enable the development of services. More detailed information on energy consumption helps customers influence the costs of their energy use as a whole and enables different choices based on values. The availability of data enhances service providers' possibilities to create services and technologies suitable for the needs of customers and energy systems. The working group encourages companies in the energy sector to investigate what kind of pricing and operating models could be offered to customers to steer consumption and production to increase the efficiency of energy systems and reduce their emissions in cooperation with customers.

3.5 Impacts of the proposals

The working group commissioned a sudy to assess the magnitude of the impacts of the measures proposed by it on different customer groups[15]. The impacts were assessed in terms of both quality and quantity, based on a desktop study, on supplementary example calculations carried out by the consultant and on the consultant's view. The study does not discuss the impacts of the measures on the security of supply in the electricity system, which are regarded as positive by the working group.

In the report, the measures as a whole were considered to increase customers' possibilities to operate in the electricity market. Especially in the case of smaller customers, the impacts of the proposed measures are affected essentially by customers' activity and their possibility, ability and willingness to change their behaviour. As an example, the impact of eliminating the load control by distribution network companies may be significantly negative on those who use electricity for heating unless it is possible for the customer to replace the service with a new one that controls the heating of household water to take place during the cheapest hours. On the other hand, by changing their behaviour or by adopting a new, smarter control, the same customer group may benefit from the elimination of load control by distribution network companies and make savings in their electricity bill. This control can be implemented through the smart meters of distribution network companies. Alternatively, it can be implemented by investing in smart control that also provides the customer with more diverse opportunities to optimise their use of electricity and their costs. The costs of investments in smart control systems have over the past few years gone down and are currently at the level of about EUR 1,000. Service providers offer different service concepts in which the customer may receive the control devices without an initial investment by paying a service charge.

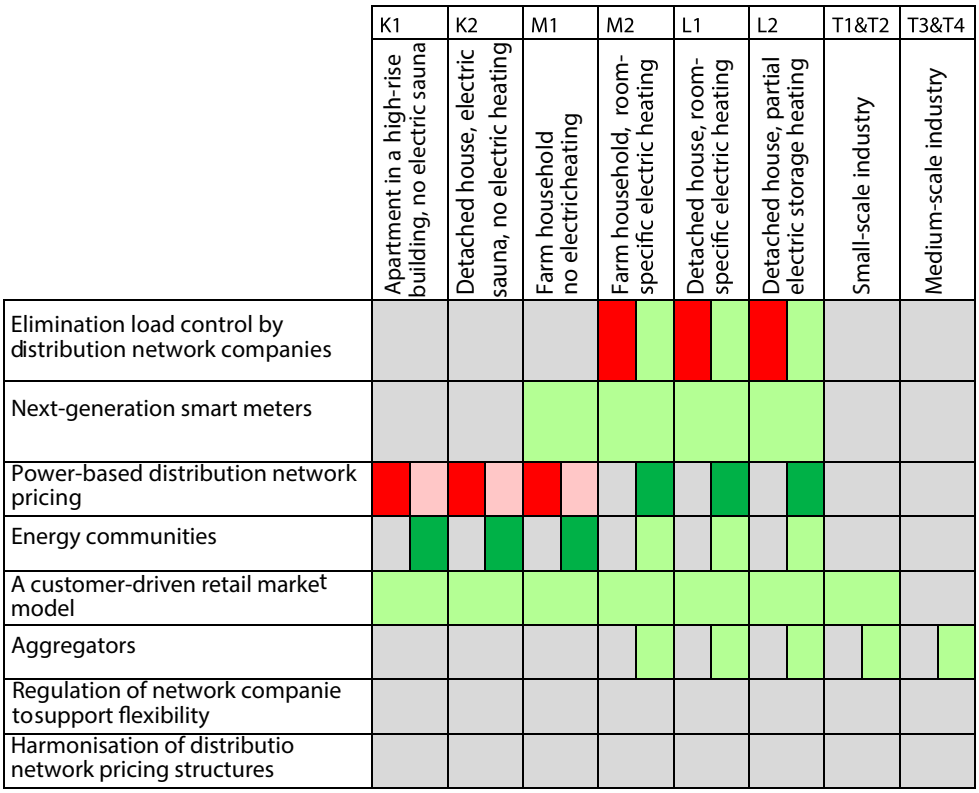
Replacing a fixed basic charge with a power-based component increases customers' possibilities to influence their distribution network charge. In comparison with the current situation, power-based distribution network traiffs would have a clearly

15 Gaia Consulting Oy, Assessment of the impacts of the measures proposed by the Smart Grid Working Group set by the Ministry of Economic Affairs and Employment 8 October 2018, https://tem.fi/documents/1410877/3481825/Vaikutustenarvio+%C3%A4lyverkko-ty%C3%B6ryhm%C3%A4n+esitt%C3%A4mist%C3%A4+toimista%2C+8.10.2018/0452e52f-ec04-4e42-98f2-66cb6b0b79b9/Vaikutustenarvio+%C3%A4lyverkkoty%C3%B6ryhm%C3%A4n+esitt%C3%A4mis-t%C3%A4+toimista%2C+8.10.2018.pdf

negative effect on the costs for those smaller consumers who do not use electricity for heating. The introduction of a proportional electricity tax, which the working group does not support, would have the same effect. It is often difficult for the customer groups in question to change their consumption profile, which exposes them to the risks of the measures. This customer group mainly consists of apartments in high-rise buildings and of detached houses that do not have electric heating. In addition, farms without electric heating were assumed to belong to this group. According to the study, power-based distribution network tariffs are not likely to apply to apartments in high-rise buildings and detached houses with no electric heating. The negative effects of the proposed measures would then be avoided.

The table below describes a summary of the effects on different customer groups of the different measures proposed by the working group.

Table 1. A summary of the effectiveness of the proposed measures (grey=normal effect no effect, light green=mild positive effect, dark green=significant positive effect, pink=-mild negative effect, red=significant negative effect. The colour on the left side of the cell describes passive customers who do not change their behaviour as a result of the measures and the right side of the cell describes active customers who adopt their activities to the new situation.) (Gaia 2018)



The measures proposed by the Smart Grid Working Group are in many respects interlinked and therefore affect the impact assessment. An example would be phasing out the load control carried out by distribution network companies, which is closely linked to next-generation smart meters through the available load control opportunities, to power-based distribution tariffs through the peak load caused by heating control and to the harmonisation of distribution network pricing structures through substituting distribution products. This makes it challenging to estimate

the overall impacts of all measures. The proposals of the Smart Grid Working Group form an entity, the overall impacts of which on different customer groups and security of supply should be assessed in greater detail when the legislation is being drafted.

4 Road map for the implementation of the proposals

The policy outlines proposed by the working group and the subsequent needs for changes are in many respects strongly linked to one another and some of the changes result in significant changes to current practices for the customer. The Smart Grid Working Group finds it important that the changes be implemented smoothly and cost-effectively without unreasonable harm and costs to customers. On the other hand, other changes affecting the implementation schedule of the working group's proposals will also take place in the electricity market and electricity system. For example, the centralised information exchange solution, the Datahub, will have a significant impact on the proposals related to the retail market and the exchange of information and their cost-effectiveness. The Datahub is due to be introduced into use in April 2021[16]. Transitions should be planned and coordinated carefully as the changes resulting from them have considerable effects on one another. The most cost-effective way to implement the changes required in the market actors' information systems would be to bundle them together. The coordination of the changes and understanding the schedule will also help in customer communication and the allocation of the resources.

A public consultation of the proposals will be launched in connection with the publication of this report. After the consultation, legislative drafting will begin in the Ministry of Economic Affairs and Employment. Consultation of the key stakeholders and assessment of the effects is an essential part of legislative work. The implemen-

16 Fingrid, Fingrid Datahub Oy procures Finnish Datahub system from CGI Finland [press release]. available https://www.fingrid.fi/en/pages/news/news/2018/fingrid-datahub-oy-procures-finnish-datahub-system-from-cgi-finland/

tation of the Clean Energy Package proposed by the Commission, due to begin in many places at the beginning of 2019, will have a considerable effect on the drafting. The EU's Clean Energy Package[17] lays down provisions on energy communities and aggregation in detail. Because the number of proposals and needs for changes is high, the proposals will be taken further step by step. During the legislative process, changes that are considered politically important may be made to the proposals. The time point for the implementation of the proposals will also be affected by changes taking place in the market.

The figure below presents a draft of the order of implementing the working group's proposals. The schedule of the working group's proposals is presented in the top half of the picture and changes taking place in the electricity system and the electricity market in the bottom half. The location of the boxes in the timeline describes the implementation of the proposal concerned. Legislative drafting and other preparatory measures have already been carried out prior to this. The blue colour describes the changes implemented at the Ministry of Economic Affairs and the green colour changes implemented by other ministries. Cyber security is a matter that has to be paid attention to in all situations. Similarly, communication and advice are important throughout and after the changes. In the presentation, they have therefore been distributed over the entire time period.

17 "Clean Energy Package", the European Commission's proposal for a legislation package. available https://ec.europa.eu/energy/en/ news/commission-proposes-new-rules-consumer-centred-clean-energy-transition

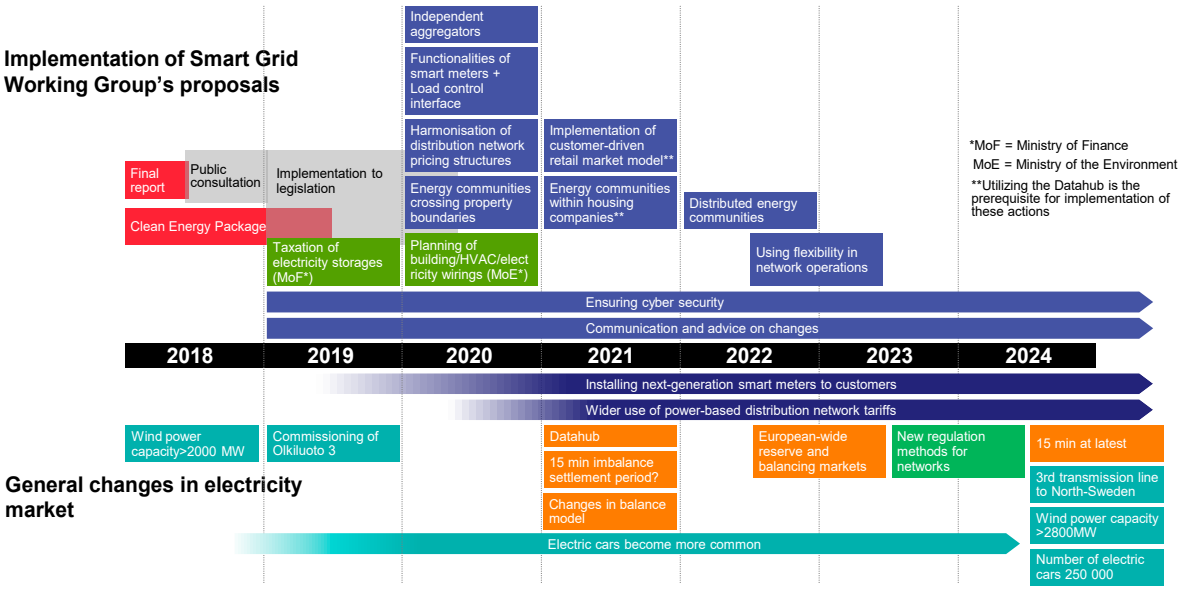


Figure 6. Order of implementing the working group's proposals

The Smart Grid Working Group's proposals for improving customers' opportunities for participation change the operating models both in the energy sector and in the customer interface. The key to the flexible implementation of these changes is clear, uniform and continuous communication both within the sector and to consumers. Many of the changes may be difficult for customers to understand fully. In the short term, the costs may increase for some of the stakeholders, while they may decrease for others. Clear, open and honest communication linking the necessity of the changes to the mitigation of climate change and concretely opening up new opportunities for influencing makes the changes more acceptable. Energy advice for consumers is provided especially by Motiva, but also by other parties who are in contact with customers.

The Smart Grid Working Group proposes that a communications steering group be established for the coordination of consumer communications. In this steering group, the main organisations representing the sector and consumers would plan how communications and advisory resources could be allocated efficiently. The Smart Grid Working Group also encourages the actors of the energy sector to utilise the materials prepared by communication professionals in connection with the working group and to use consistent terminology to facilitate communication.

The change in customers' behaviour, the development of technology and their effects on the electricity system will continue. New services and digitalisation may bring previously unknown operating practices within the reach of customers at a very fast pace. An example of this are the new market places for distributed flexibility and the opportunities provided by blockchain technology. Also, topics for further studies, such as the data exchange in the electricity system and the electricity market, cooperation between the transmission system operators and distribution network companies and the development of the electricity supply obligation, have already emerged in the discussions of the Smart grid working group. The developments in the operating environment and technology should be monitored and, as necessary, new operating practices that benefit customers should be enabled as a response to changes.

5 Summary

In autumn 2016, the Ministry of Economic Affairs and Employment established the Smart Grid Working Group for a term of two years to explore the potential of smart grids in the electricity markets. The aim of the Smart Grid Working Group was to create a shared view of the smart electricity system of the future. Its task was to explore and propose concrete measures through which a smart electricity system could facilitate the ability of customers to actively participate in the electricity markets and promote the maintenance of security of supply. This report describes the measures proposed by the working group to achieve the set targets. The goal is a smart electricity system that serves as a cost-effective platform enabling the actors in the electricity markets, service providers, suppliers of technology and network operators to meet the needs of customers and society.

The working group proposes that demand flexibility services, the storage of electricity and the provision of new services to customers be considered as competitive business activity

The working group considers as a key principle that control of customers' electricity consumption must be competitive business activity as the decisions on electricity consumption and production are made most efficiently based on the prices in the markets. Therefore, load control by distribution network companies and the mandatory time-of-use pricing will be eliminated in a controlled manner. Owning and operating storages should also be primarily a task of market parties, not monopolies. However, it should be possible for network companies to obtain flexibility from the market instead of investing in the infrastructure when this is cost-effective. Enabling combined invoicing for the distribution and energy to all suppliers increases customers' options in the electricity market.

Different energy communities provide customers with concrete opportunities to influence their electricity bill and the environmental effects of their supply of electricity. The working group has a positive view on energy communities. The benefits created by aggregators of customers' electricity production, consumption and reserves are also regarded positively. Both the energy communities and aggregators independent of electricity suppliers are new actors in the electricity market. The aim is that these new actors participate in the electricity market in an equal and market-driven manner.

Recently, at least three electricity distribution companies have introduced a power-based tariff component also to smaller customers. The working group has a positive view on replacing the fixed fee in the bills with a power component that provides customers with better opportunities for influencing their distribution network charges. Harmonising the pricing structures of distribution network service charges could bring clarity to the situation at the transition stage. From the point of view of cost-effective utilisation of demand-side management, it is important for customers that the electrical, HVAC and plumbing and automation systems of buildings have been built in a manner that supports flexibility. Building regulations play an important part in ensuring this. Electricity tax that varies according to the market price of electricity was found problematic from the points of view of fairness, predictability and complexity and the working group does not support the introduction of a proportional electricity tax.

Current smart meters are reaching the point in their lifespan where some of them have to be replaced now while majority will be changed during the first half of the 2020s. The functionalities required from the meters will have to be determined well in advance. The load control functionality proposed for the next-generation smart meters enables large number of customers to engage in demand response cost-effectively. As the smartness of the electricity network increases, it is essential to prepare for data security threats and ensure the high level of cyber security in the entire electricity system and in the devices and services connected to it.

The proposals of the working group and the subsequent needs for change are in many respects strongly linked to one another and on the other hand also to other changes in the electricity market. Some of the changes result in significant changes to current practices for the customer. The schedule for the changes must therefore be planned carefully. Communication and advice are considered to be vital at the transition stage.

Flexible and customer-centred electricity system; Final report of the Smart Grid Working Group

The smart grid working group was commissioned to review and present concrete actions that would improve consumers' opportunities to participate in the electricity market and that would promote security of supply. The working group considers demand response to be a competitive business, thusload control by distribution network operators should be dismantled in a controlled manner. Market participants would own and use energy storages. Voluntary single invoice covering both grid fees and energy sale would create more options for consumers. The working group welcomes energy communities and aggregators that combine small-scale consumption and generation into larger flexible units. The goal is to enable new participants to join the electricity markets on equal and market-based terms. The working group agrees that the fixed distribution charge could be replaced with a power component to give consumers better chances of influencing their distribution costs. Harmonised structures for distribution charges would increase transparency. The working group does not support the adoption of a proportional electricity tax due to its many problems. The load control capability for the new smart meters would introduce demand response to a great number of consumers. Technical systems in buildings should be designed to support demand response. A sufficient level of cyber security should be ensured in light of the increasing number of smart devices in use. The proposal would introduce many changes to the customers making communication and advice essential. The proposed measures would mean significant changes for the customers, and it would be important to provide information and guidance.

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