Energiateollisuus

PRINCIPLES OF ELECTRICITY METERING

2022

These instructions are a translation of the corresponding instructions in Finnish. In any cases of ambiguity in interpretation, the Finnish-language instructions shall be complied with.

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Introduction

This instruction deals with the implementation of electricity metering in the distribution networks as required by the legislation on the electricity market and measuring instruments. The instruction reviews the legal requirements and provides guidelines and recommendations that clarify the interpretation of legislation concerning the implementation of electricity metering and the processing and transmission of metering data. The objective of the instruction is to harmonise industry practices on the metering of electricity and the transmission of metering data.

This instruction mainly applies to the distribution network, unless otherwise mentioned. The instruction does not deal with the implementation of MGA exchange metering.

This instruction is based on metering legislation, the practical procedures in the industry and commonly agreed policies in the industry. The instruction is based on the previous metering recommendations of Finnish Energy, especially the recommendation Principles of Hourly Metering, where applicable.

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Definitions

Timestamp	Time reference entry for metering data, indicating the time period of data provided.
Datahub	A centralised solution for information exchange in the electricity retail market maintained by Fingrid Datahub Oy, through which the exchange and management of information required by the market processes of electricity trade conducted in the distribution systems, as well as the imbalance settlement of distribution systems, are managed.
Energy data	Energy registered by the metering device by metering period.
eSett	Imbalance settlement unit. A service company owned by Fingrid, Statnett and Svenska Krafnät. Responsible for the operational activities of the common Nordic imbalance settlement model.
Remote metering equipment	Metering equipment for metering and registering of electricity consumption or feed to the network in the memory of the equipment by a specified period (e.g. hour or 15 minutes). The data registered by this equipment may be read from the memory of the equipment via the data transmission network.
Distribution network	An electricity network with a nominal voltage of lower than 110 kilovolts.
Distribution system operator	An organisation or enterprise in possession of a distribution network and engaged in licensed operation thereof.
Cumulative reading	A continuously growing value of a metered quantity.
Load curve procedure	The type load curve procedure means a nationwide calculation model used for calculating the hourly energies of an electricity user for imbalance settlement using the annual consumption estimate based on the previous year's electricity use drawn up by the distribution system operator.
Reading system	A system for collecting metering data and maintaining the settings of the metering device.
Reading	Cumulative reading metered and registered by the metering device for a certain moment that does not take account of, e.g. two separate readings of two-rate products. Depending on the specified period of registration, this refers to, e.g., either hourly reading or 15-minute reading.
Metering device	A general term for a meter at a metering point, used for energy metering.
Metering grid area, MGA	A metering area means the transmission grid, a high-voltage distribution network, a distribution network, a closed distribution network, and their part, or an internal electricity network of a real estate or a corresponding group of real estates, which forms its own settlement area in imbalance settlement.
Metering equipment	An entity consisting of the metering device and the data transmission connection.
Metering circuit	Separate metering circuits, through which the amount of energy consumed/produced is metered and transmitted to be registered by the metering device.

Metering point — A point in the electricity network, to which the current transformer or meter of the metering equipment at the delivery point is connected.

Metering data — A general term meaning either power, energy or reading (hour or 15 minutes).

Metering data management system — A system used in the recording and processing of data gathered from the metering device. Inspection of metering data, correction of statuses and forwarding of hourly data take place in the metering data management system.

Metering data status — The status recorded for the metering data describes the reliability of the data to its recipient.

MGA exchange point — A point at the exchange of two Metering Grid areas (MGA) where the electricity distribution between the metering areas is metered or otherwise determined. MGA exchange point metering means metering between these two metering grid areas for metering the electricity flows between Metering Grid Areas.

Imbalance window — Period from the supply of electricity to the closing of the balances of the distribution network. The imbalance window is 11 days from supply.

Data transmission protocol — A set of rules, which the devices must comply with to enable data transmission (data transmission frame).

Point of delivery — A point in the electricity network where electric energy is transmitted from one party to another.

Hourly energy — Energy consumed during each hour. This may be calculated as a difference of two consecutive hourly readings.

Hourly metering — Hourly metering of the amount of electricity and the registration of this metering data in the memory of the metering equipment (see also 15-minute metering).

Hourly metering equipment — Metering equipment for metering and registering in the memory of the equipment of electricity consumption or feed to the network. The data registered by this equipment may be read from the memory of the equipment via the data transmission network (=hourly meter). According to the policy of the Energy Authority, the following requirements must also be met for the equipment to be regarded as hourly metering equipment:

- The hourly meter has a data transmission connection for transmitting the hourly data on a daily basis, and the reading system is in such condition that it can be used for daily reading of the hourly data of all sites equipped with an hourly meter.
- The definition of hourly metering equipment does not include the readiness of the metering data management system for processing hourly metering data.

Hourly load — Average hourly load for each hour. This may be calculated as a difference of two consecutive hourly readings.

New remote metering equipment

	Remote metering equipment that meets the requirements of the metering decree issued on 1 November 2021 (see section 1.6.4)
15-minute energy	Energy consumed during each 15-minute period. This can be calculated as a difference of two consecutive 15-minute readings.
15-minute metering	Metering of the amount of electricity every 15 minutes and the registration of this metering data in the memory of the metering equipment (also see hourly metering).
15-minute metering equipment	
	Hourly metering equipment that is remote-programmed into 15-minute metering equipment. The requirement is that 15-minute metering data can be read at least daily and that it is possible to record 15-minute metering data in the metering equipment for a period of at least 11 days.
15-minute load	Average load for each 15-minute period. This can be calculated by multiplying the difference of two consecutive 15-minute readings by four.
Official time	The current local time in Finland. The time is determined with respect to the Coordinated Universal Time (UTC). Finnish winter time (= standard time) is two hours ahead of this, i.e. UTC+2, and summer time is three hours ahead, i.e. UTC+3.

1. On metering in general

The instruction is primarily meant for distribution system operators (DSOs) and personnel responsible for metering operations, but also for other parties related to metering and the processing, transmission and reception of metering data. As a rule, the instruction only deals with metering on the distribution network.

The instruction reviews the principles and procedures of metering and the processing and transmission of metering data. The instruction addresses the legal requirements for electricity metering and gives recommendations on the properties of metering devices and systems.

1.1 Legislative obligations on metering

1.1.1 Electricity Market Act (Sähkömarkkinalaki 588/2013)

According to Section 22 of the Electricity Market Act, the DSO must arrange for the metering of electricity supplies in its electricity network, which is the basis for imbalance settlement and invoicing, as well as for the registration and reporting of metering data to the electricity market participants. The metering data required in imbalance settlement and invoicing must be reported per each consumption or metering point.

According to Section 22, the DSO must take care of appropriate cyber security of its metering systems and data transmission of the metering data. In order to ensure high level of cyber security of its metering systems and the data transmission of the metering data, the DSO must take appropriate account of the best available technology in relation to the costs incurred from the acquisition and use of the systems.

Further, according to Section 22, when arranging the metering service, the DSO must aim to promote efficient and frugal electricity consumption by the network users and the utilisation of the options of controlling electricity consumption. Before installing the metering equipment, the end users must be given appropriate guidance and information about the utilisation of the metering equipment and the collection and processing of personal data.

According to Section 22, the DSO can provide the metering service as either its own work or as an outsourced service. Thus, the service can also be acquired from another electricity market participant.

Section 22 also states that if the network user or owner of an electricity storage facility orders from the DSO a metering service that exceeds the prescribed requirements, the DSO may charge reasonable costs incurred from such a metering service to the party ordering the service.

In addition, according to section 22, more detailed provisions on the metering of electricity supplies in electricity networks are provided for with the Government decree.

Section 74 of the Electricity Market Act gives a brief statement of imbalance settlement: it shall be based on electricity metering or on a combination of metering and type-loading curves, as well as on supply reports, and further provisions are provided for by a separate Government decree.

The section also states that imbalance settlement services must be offered on equitable and non-discriminatory terms to the electricity market participants. The imbalance settlement services offered may not include any conditions or limitations that would be unfounded or that would obviously restrict competition.

The supply of metering data to customers is prescribed in section 75 e of the Electricity Market Act. This is dealt with in further detail in section 9.

1.1.2 Government decree on the settlement and metering of electricity deliveries (Valtioneuvoston asetus sähköntoimituksen selvityksestä ja mittaamisesta 767/2021)

The most important regulation concerning metering is the Government decree on the settlement and metering of electricity deliveries (metering decree) issued by virtue of the Electricity Market Act. The first metering decree was issued in 2009, after which amendments have been made to the decree over time. In November 2021, the new metering decree entered into force, containing the majority of requirements concerning the metering of electricity. However, remotely read meters installed before the new metering decree entered into force are still subject to the requirements of the previous metering decree, where applicable.

The metering decree provides for the DSO's tasks in imbalance settlement and metering.

The DSO's obligations include the metering of electricity consumption and production, the installation of necessary metering devices, reading of the meters and the processing and forwarding of metering data in the way prescribed in the decree.

The metering decree also states the minimum obligations regarding the properties of the metering equipment and the obligations to store metering data. These are discussed in further detail in chapters 1.6 and 6.5.

The metering decree also states obligations on the transmission of metering data. This matter is also prescribed in the decree by the Ministry of Economic Affairs and Employment on the exchange of information related to the settlement of electricity deliveries (työ- ja elinkeinoministeriön asetus sähköntoimitusten selvitykseen liittyvästä tiedonvaihdosta), which is dealt with in further detail in the next chapter. Transmission of data is dealt with in further detail in chapter 8.

1.1.3 Decree of the Ministry of Economic Affairs and Employment on the exchange of information related to the settlement of electricity deliveries (Työ- ja elinkeinoministeriön asetus sähköntoimituksen selvitykseen liittyvästä tiedonvaihdosta 839/2021)

In addition to the metering decree, the decree of the Ministry of Economic Affairs and Employment on the exchange of information related to the settlement of electricity deliveries (information exchange decree) has also been prescribed by virtue of the Electricity Market Act.

In accordance with the information exchange decree, the DSO must send to the datahub a preliminary report of the electricity supplies pertaining to hourly and 15-minute metering, calculated according to the type load curve procedure in its metering area in terms of each metering point and metering event at the latest by 12 midnight on the day following the day of supply. Final reports of the electricity supplies must be made to the datahub within the next 11 days of the delivery date by 12 midnight at the latest. The transmission of the data to the datahub is described in further detail in the datahub instructions. Furthermore, it has been prescribed as an obligation for the datahub to forward this data to the suppliers and for imbalance settlement.

1.1.4 The Energy Authority's regulation on the itemisation of invoices concerning the sale of electricity and electricity distribution (Energiaviraston määräys sähkön myyntiä ja sähkön jakelua koskevien laskujen erittelystä 1097/002/2013).

The Energy Authority's regulation on the itemisation of invoices concerning the sale of electricity and electricity distribution (electricity bill regulation) must also be taken into account when determining the principles related to hourly metering. Section 7 of the regulation also states, e.g. that meter readings must be reported in the balancing invoice or its appendix, if these readings are available.

1.1.5 The Measuring Instruments Act (Mittauslaitelaki 17.6.2011/707) and the Government Decree on Essential Requirements, Demonstration of Compliance and Specific Technical Requirements of Measuring Instruments (Valtioneuvoston asetus mittauslaitteiden olennaisista vaatimuksista, vaatimustenmukaisuuden osoittamisesta ja teknisistä erityisvaatimuksista 21.12.2016/1432)

The use and properties of electricity meters are regulated by the Measuring Instruments Act and the Government Decree on Essential Requirements, Demonstration of Compliance and Specific Technical Requirements of Measuring Instruments (Measuring Instruments Decree) with their appendices. Some of the regulations are found in the appendices to the Measuring Instruments Directive[1].

[1] Finnish translation of the Measuring Instruments Directive: https://eur-lex.europa.eu/legal-content/FI/TXT/HTML/?uri=CELEX:02014L0032-20150127&from=EN
Electricity meters are dealt with especially in Annexes I and V

The purpose of the measuring instruments legislation is to safeguard the reliability of operation, metering methods and metering results of the measuring instruments. The regulations provide instructions on, e.g. the errors, operating conditions and display of results of metering devices, as well as the inspection of metering devices before and during their deployment.

It is most likely that separate decrees will be drawn up on the characteristics and inspections of metering devices during their use, although there is not much information about more detailed contents of these at the time of drawing up this instruction. Therefore, at the time of drawing up the instruction, there are no regulations of further detail available concerning the inspection of metering devices during their use.

Inspections taking place before deployment

According to the Measuring Instruments Act, a metering device must not be taken into use before demonstrating its compliance and ensuring its reliability. When a meter is used in a business activity in order to determine the price of a product or service or another economic advantage on the basis of the metering results, the reliability of the metering device shall be verified by a notefied body or inspection body before the deployment. The device manufacturer may verify the reliability of the device if the manufacturer has a procedure corresponding with its impacts, which is approved and supervised by the notified body or inspection body.

The Finnish Safety and Chemicals Agency (TUKES) approves the lawful inspection bodies. Verification of the reliability of the metering device before its deployment includes inspection of the structure and operation of the device, as well as comparison of metering results in an applicable way within the maximum permissible errors.

Inspections during use

According to the Measuring Instruments Act, the operator is responsible for ensuring that the metering device in use is suitable for its intended use and environment, that it functions reliably at all times, and its use meets the legal requirements, and the verification is carried out at prescribed intervals and whenever necessary. Therefore, the operator must ensure that the reliability of the metering device in use is verified at specified intervals. However, so far there is no separate provision on the verification of electricity meters during use, and the decree concerning this may be provided at a later date, if necessary, by virtue of the Measuring Instruments Act. Due to the lack of a provision, it is not possible to provide detailed instructions in this instruction concerning verification during use, and the DSO must agree on the implementation separately with its own metering device and service providers.

Reliable operation of a serviced metering device must be verified before taking it into use again at a later date.

If the operator neglects the verification of the metering device during use or the metering device does not otherwise meet the requirements, the supervisory authority may prohibit or restrict the use of the device.

1.2 Metering of electricity consumption

According to the Metering Decree, the metering of electricity consumption must be based on 15-minute metering and remote reading of metering equipment as from 22 May 2023 (15-minute metering obligation). Before that, remotely read metering points are subject to hourly metering, although metering equipment may be moved to 15-minute metering in advance, taking into account the limitations presented in section 1.6.5.

Even after 22 May 2023, some remotely read metering points may be subject to hourly metering until 31 December 2028 at the latest. These include metering points in the low-voltage network, equipped with a main fuse of under 3x200 A, which are subject to hourly metering on 1 November 2021 and which cannot be remotely programmed to 15-minute metering.

The transition periods and specifications concerning metering are dealt with in further detail in section 1.6.5.

Metering points where no hourly metering equipment has been installed by 1 November 2021 can be left completely outside remote metering (15-minute or hourly metering). This kind of metering point can be metered with so-called standard metering equipment if the metering point is equipped with main fuses of a maximum of 3x25 A or which are subject to delivery obligation in accordance with section 67 of the Electricity Market Act and the maximum annual consumption of which is 5,000 kWh.

Metering points with a main fuse of a maximum of 3 x 25 amperes and where electricity consumption can be estimated sufficiently accurately (so-called standard consumption sites) can be left completely without metering.

In practice, almost 100 per cent of the DSO's metering points are remotely metered and the DSOs aim to a full coverage of remote metering.

1.2.1 Sites with no metering

DSOs still have a small number of sites with no metering. These may include, e.g. distribution cabinets for cable-TV amplifiers and other similar sites. Invoicing has been based on standard power and usage times. The sites' connected load to the electricity network is very small, ranging from a few watts to about 1 kW.

According to the metering decree, it is not compulsory to have metering equipment at the DSO's electrical equipment connected to the electricity network or at a metering point with a main fuse of under 3 x 25 A if electricity consumption at the metering point can be estimated with sufficient accuracy. In outdoor lighting networks installed before 1 March 2009, an exemption can be made to the metering requirement until the outdoor lighting centre is replaced even when the main fuse of the outdoor lighting network is higher than 3 x 25 A.

According to the Electricity Market Act, imbalance settlement must be based on electricity metering or the combination of metering and the type load curve, as well as on supply reports, as prescribed by the decree.

These non-metered sites can be processed in the electricity market in two ways.

1. Metering is arranged at the sites. If the meter is a standard meter (not an hourly metered equipment, 15-minute metering equipment or new remote metering equipment), the site is processed according to chapter 7.
2. If it is technically impossible to arrange metering or the cost of metering at the site makes it an expensive solution in view of the electricity consumption (with the costs equalling more than 10 years' electricity consumption at the site), it is possible to act as follows.

The sites meet the characteristics of energy metering per imbalance settlement period and the registering referred to in the government decree on the settlement and metering of electricity supply if all of the following requirements are met:

1. The connected load can be determined in a reliable way
2. The hours of consumption can be determined in a reliable way
3. Energy consumption can be registered in a reliable way so that it is possible to carry out imbalance settlement in the way required by the electricity market legislation.

Section 3 can be implemented so that metering data per imbalance settlement period is calculated of the site's connected load and hours of usage, which is processed in the same way as other remotely metered metering points. The metering data thus produced is marked according to the sections 8.3, 8.5 and 8.7. of the instruction.

1.3 Metering of production

Electricity generation equipment that feeds electricity into the electricity network for distribution must be equipped with metering equipment.

However, if the maximum nominal rated capacity of the generation equipment is 100 kVA, it need not be equipped with separate metering equipment if the metering point where the generation equipment is located is fitted with remote reading equipment that meters both network input and output. Network input and output must not be netted, but the metering device must have separate registers for these.

Separate metering of the generation plant is needed in order to determine liability for electricity tax[2]. Generation equipment of a maximum of 100 kVA is exempt from liability for electricity tax, and therefore it is not necessary to meter these generation plants separately. In terms of generation plants of over 100 kVA, the generation plant's production must also be metered separately in order to be able to determine consumption of own generation on which the payment of electricity tax is based. This information is needed only to determine the liability to pay electricity tax.

Consumption of own generation is obtained by deducting from the generated electricity the production plant's electricity for own use and the electricity fed into the network (network output). Electricity for own use is electricity consumed by the generation installation system itself.

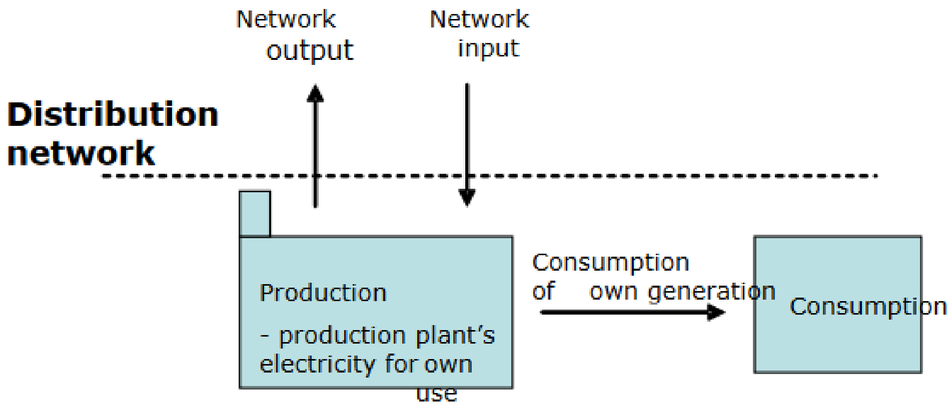

Figure 1. An example of metering of production

If the consumption of own production is needed only for determining electricity tax liability, the producer is responsible for organising metering of the consumption of own production. The Electricity Market Act requires that the DSO organises metering in its electricity network that acts as a basis for imbalance settlement and billing. However, this is not the case when the production equipment is connected to the real estate's internal electricity network and the metering data is used only to determine electricity tax liability. According to the legislative history of the Electricity Market Act (HE 116/2021), the DSO's responsibility for organising metering would not be extended to situations where electricity delivery would take place via an electricity network within a real estate or a corresponding group of real estates.

However, upon its customer's separate order, the DSO must offer for the customer's use new remote metering equipment for separate metering of the amount of electricity production in the electricity generation equipment or power plant that are not required to have separate metering equipment. A separate metering point must be established on this kind of metering for the purpose of imbalance settlement. The DSO shall have the right to charge reasonable metering and measurement fees for this service.

A separate metering grid area shall be established on larger production sites (1 MW and higher). According to the Electricity Market Act, if a separate metering grid area is established with a production site, the DSO and the prosessor of the production plant (the term occupier of the real estate is used in section 71 of the Electricity Market Act) can agree that the occupier of the production plant arranges exchange point metering between the metering areas. The metering of

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[2] Link to the Tax Administration's website: https://www.vero.fi/yritykset-ja-yhteisot/verot-ja-maksut/valmisteverotus/sahko-ja-eraat-polttoaineet/

metering areas and the transmission of metering data have not been dealt with in further detail in this instruction. Further information is available in the Handbook of Nordic Imbalance Settlement, which is available on the eSett website at https://www.esett.com/handbook/.

1.4 Metering of real estate systems

According to the metering decree, separate living and business quarters of a new building must be fitted with metering devices even if the electricity is sold through a real estate system. Apartment-specific metering must also be arranged when the electricity system inside the real estate is altered so that electricity is sold through the real estate system after the alteration.

Metering shall be arranged so that apartment-specific consumption can easily be added to the real estate’s consumption or separated from it if the electricity user wishes to switch the supplier.

The real estate system operator is responsible for the necessary alterations to the system to enable apartment-specific metering.

In addition, in accordance with section 72 of the Electricity Market Act, if the user of electricity has purchased their electricity through the real estate’s internal electricity system, they shall pay back the costs arising from the modification works related to the metering of electricity to the real estate system operator when switching to purchase their electricity through the distribution system of a distribution system operator.

1.4.1 Arrangement of sub-metering

Sub-metering means a metering arrangement where the meter at the metering point is physically connected to the electricity equipment or electricity system of another metering point and the actual electricity consumption of both metering points is calculated from the metering data of these two (or more) meters.

The DSOs should avoid such sub-metering solutions, due to which it is not possible to disconnect the electricity supply to an individual metering point without disconnecting the other metering point at the same time.

However, the DSO may have sites where sub-metering is practically the only possible way to arrange competitive tendering (separate electricity contracts for electricity users). For example, there may be this kind of a situation in medium-voltage connections.

If the DSO allows a sub-metering arrangement, it must be contractually ensured that the DSO will still be able to disconnect the electricity at the main metering point for a reason attributable to the user or supplier of the main metering point.

By law, it is not possible to agree with a consumer on the requirements of disconnection extensively, and in the case of a consumer customer these kinds of sub-metering arrangements should not be used or accepted.

In terms of business customers, it is possible to agree on the responsibilities of sub-metering under certain limits. The DSO’s right to suspend electricity supply to the sub-metering point if electricity is disconnected at the main metering point for a reason attributable to the user of the main metering point or to their supplier should be recorded in the contract between the customer of the sub-metering point and the DSO. The DSO shall notify of the disconnection to the customer of the sub-metering point before disconnection.

Based on the contract between the DSO and the customer of the sub-metering point, there is therefore no error in the network service and the DSO shall therefore not pay damages or give a discount on the price if the suspension of electricity supply to the customer of the sub-metering point is due to the fact that the electricity supply to the main metering point has been disconnected for a reason attributable to the user of the main metering point or their supplier (e.g. user’s breach of contract or a period with no valid contract).

However, it must be taken into account that standard compensation rules cannot be deviated from to the detriment of the user, i.e. standard compensation must be paid to the customer of the sub-metering point also when the suspension has been due to a breach of contract or a period of no contract at the main metering point.

It is advisable to enter a clear disclaimer in the contract between the customer of the sub-metering point and the real estate system operator. The network company does not draw up these contracts, but it may remind the customer of the sub-metering point and the real estate system operator of the matter.

1.5 Responsibilities related to metering

1.5.1 System operator's responsibilities

The DSO is responsible for organising metering required by the electricity market legislation, and for reading and validating the metering data. The DSO is also responsible for the metering equipment, including its data transmission connections. According to previous electricity market legislation, customers had the right to acquire their own hourly metering equipment. The customer's right to own the hourly metering equipment was withdrawn at the beginning of 2014.

The DSO is responsible for delivering the metering data of the distribution network to the datahub. The DSO is also responsible for reporting the metering data to the customers. After the deployment of the datahub, the DSO can designate the datahub as the body disclosing the data.

The DSO may manage these tasks itself or purchase them as a service. When outsourcing metering operations, the responsibility for the metering devices and metering remains with the DSO, which must be taken into account in contracts drawn up with the service provider.

The DSO is also responsible for the data protection related to meter reading and the recording and transmission of metering data. Metering data must be processed in the same way as personal data, starting from the metering device. The customer and the body authorised by the customer are entitled to have access to the metering data. The electricity market participants and the datahub are given the information they need, e.g. for meeting the balance responsibility and for invoicing.

The metering grid area is the settlement area of imbalance settlement. There must be exchange point metering at the point of the electricity network where electricity is transferred from one metering grid area to another. The DSO's electricity network constitutes a metering grid area[3]. The DSO may also form several metering grid areas from its electricity system. The metering grid area must be registered in the imbalance settlement unit.

From chapter **Virhe. Viitteen lähdettä ei löytynyt.** onwards, the instruction deals with tasks that are the DSO's responsibility unless otherwise mentioned.

1.5.2 Electricity supplier's responsibilities

The electricity supplier's responsibility in the metering of electricity supply is mainly related to the reception of metering data from the datahub and its use in invoicing, as well as to transmission of information having an impact on metering to the datahub.

The supplier must be able to receive the data from the datahub. The supplier shall not be responsible for the accuracy of the data as this is the responsibility of the DSO and the datahub in accordance with their obligations. However, the supplier must ensure that even corrected data is recorded correctly in the systems. Moreover, the supplier shall notify the datahub of any errors it has detected in the data it receives.

The supplier must comply with the datahub instructions in delivering and processing the corresponding data.

1.5.3 Datahub's responsibilities

It is the datahub's responsibility to receive the metering data sent by the DSO and forward it to the correct electricity market participants and customers. The datahub calculates the imbalance settlement of the distribution system on the basis of the data. It is the responsibility of the

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[3] An occupier of a real estate or a corresponding real estate group, or a balance responsible party managing such an electricity network, may also form a metering grid area under certain conditions prescribed in legislation. See also sections 1.4 and 1.5.6

datahub to store and process the data, retaining its integrity and taking care of information security.

Link to the datahub instructions: https://palvelut.datahub.fi/fi/datahub/dokumentaatio-ja-materiaalit

1.5.4 Electricity user's responsibilities

A customer with a contractual relationship with a system operator or a supplier with a delivery obligation, i.e. the electricity user, is responsible for keeping their own electricity devices and equipment in the condition required by the regulations and guidelines. The electricity user must ensure that the their own electricity switchboard is in the condition required by metering. The electricity user is primarily responsible for the instrument transformers required by indirect metering. If it so wishes, the DSO may take over the responsibility for instrument transformers.

If the electricity user and the DSO have agreed on the load control, for example, directing night-time loads, the electricity user is responsible for the related connections and wiring of their own switchboard. Connections made to the meter requiring opening the seal may only be implemented by the DSO.

The above also applies to a customer whose electricity storage facility takes electricity from the electricity network.

1.5.5 Electricity producer's responsibilities

The electricity producer has the same responsibilities as electricity users with regard to metering in accordance with the previous section.

The electricity producer is also responsible for arranging for metering that the DSO does not need in order to meet its own obligations, but which may be required, e.g. for tax reasons. If separate metering of production within an electricity network in a real estate is only needed for meeting the obligations of tax legislation, and the DSO does not need the metering data in question, the electricity producer shall be responsible for arranging this metering. According to the legislative history of the Electricity Market Act (HE 116/2021), the DSO's responsibility for organising metering would not be extended to situations where the electricity supply would take place via an electricity network within a real estate or a corresponding group of real estates.

However, in accordance with section 1.3, the DSO must offer for the customer's use at the customer's separate order new remote metering equipment for separate metering of the amount of electricity production in the electricity generation equipment or power plant that are not required to have separate metering equipment. A separate metering point must be established on this kind of metering for the purpose of imbalance settlement. The DSO shall have the right to charge reasonable metering and measurement fees for this service. The electricity producer shall always notify the tax administration the information required for tax purposes.

The customer is always under obligation to notify the DSO of electricity generation to be connected to the metering point so that the DSO can ensure the safety and operational reliability of network use and to organise metering for the site in accordance with the electricity market legislation.

The above also applies to a customer whose electricity storage facility feeds electricity into the electricity network.

1.5.6 Responsibilities of the real estate system operator

The real estate system operator is responsible for arranging for metering inside the real estate system in accordance with section **Virhe. Viitteen lähdettä ei löytynyt.**.

1.5.7 Responsibilities related to separate inspection of the metering equipment

In addition to inspections related to standard maintenance measures, the customer may demand the DSO to have the metering equipment inspected.

If the inspection proves to be unfounded, the inspection will be paid by the party requesting it. Otherwise, it shall be paid by the owner of the inspected metering equipment. The amount of any rectification will be determined or estimated on the basis of available metering data or, if necessary, with the aid of an impartial expert statement in accordance with the Terms of Network Service.

1.6 Requirements of the metering decree on metering equipment

The metering decree specifies four different types of metering equipment: standard meter, hourly metering equipment, 15-minute metering equipment and the new remote metering equipment.

1.6.1 Standard meter

A standard meter refers to analogue meters and digital meters that are not remotely readable.

1.6.2 Hourly metering equipment

Hourly metering equipment refers to equipment or a combination of equipment that meters and registers electricity consumption or feed into the network into the memory of the equipment on an hourly basis. The data registered by this equipment may be read from the memory of the equipment via the data transmission network.

The information system handling the metering data of the hourly-metering equipment and of the DSO must include at least the requirements presented in the following.

- The data registered by the metering equipment must be readable from the memory of the equipment via the communications network (remote readability).
- The metering equipment must register the starting and ending times of voltage-free period of over three minutes
- The metering equipment must be able to receive load control commands sent via the communications network, and it must have at least one control device available for load control, and this control device may not be reserved for any other use
- Metering data and the data concerning voltage-free period must be recorded in the DSO's data system that processes metering data. In the data system, the metering data must be stored for a minimum period of six years and the data concerning voltage-free periods for a minimum period of two years
- The data protection of the metering equipment and the data system processing the system operator' metering data must be verified in an appropriate way.
- Moreover, the system operator must offer hourly-metering equipment for the use of its customer at the customer's separate order, including a standardised connection for real-time monitoring of electricity consumption.

1.6.3 15-minute metering equipment

15-minute metering equipment refers to hourly metering equipment that is remote-programmed into 15-minute metering equipment. The requirement is that 15-minute metering data can be read at least daily and that it is possible to record 15-minute metering data in the metering equipment for a period of at least 11 days.

1.6.4 New remote metering equipment

The new remote metering equipment refers to new meters complying with the metering decree of 1 November 2021, meeting the following requirements:

- The data registered by the metering equipment must be readable from the memory of the equipment via the communications network (remote readability).
- With respect to electricity fed into the electricity network and that taken from it, the metering equipment must record at least the active and reactive energy, on which invoicing is based, for each phase and register the active and reactive energy, on which invoicing is based, for each imbalance settlement period with respect to electricity fed into and taken out of the electricity network without carrying out netting.
- Other than voltage transformer metering equipment must have a customer interface equipped with a voltage output that enables one-way data transmission for the end user,

based on an open and updatable European standard that is also used in another EU member state.

- The metering equipment must register the starting time and duration or the starting and ending times of a voltage-free period.
- Other than a single-phase metering equipment must be capable of observing a voltage imbalance caused by disconnected neutral situation of the feeding electricity network when there is electricity consumption at the metering point.
- It must be possible to update the software and settings determining the functionality of the metering equipment and the registering frequency of the metering data with remote connection without a visit to the metering point.
- Other than current and voltage transformer metering equipment must have a remote disconnection and connection functionality.
- The metering equipment has a load control relay if the metering point is a maximum of 3x63A and it is not located in an office, retail, industrial or storage building or in a residential building of more than two dwellings.

1.6.5 Transition periods for installation and use of different types of metering devices

Transition periods concerning new remote metering equipment

New meters to be installed must be new remote metering equipment as from 1 May 2023. It is possible to deviate from this in individual cases until 30 June 2025 when the meter at the metering point has to be replaced due to a fault and the DSO has not yet started to replace current meters with new remote metering equipment.

The DSO must install for the customer upon a separate order new remote metering equipment or new remote metering equipment with a load control relay within four months of the customer's order. This requirement will be effective as from 1 May 2023.

All remote meters must be new remote metering equipment complying with the metering decree by 4 July 2031 at the latest.

Transition periods concerning 15-minute metering

15-minute imbalance settlement will be deployed in Finland on 22 May 2023. 15-minute metering will be introduced in phases so that all of the following types of metering will be subject to 15-minute metering on the day of deployment of 15-minute imbalance settlement:

- Exchange point metering
- Metering of production over 1 MVA
- Metering of metering points equipped with a main fuse of 3x200 amperes or higher
- Metering of metering points in networks other than a low-voltage network
- Metering of a metering point with metering equipment that can be programmed into 15-minute metering equipment with remote connection without visiting the site.

Metering equipment may be converted to 15-minute metering in advance as from the entry into force of the decree, however, taking into account that the datahub will not accept 15-minute metering until on 1 January 2023 at the earliest and eSett will accept 15-minute metering in accordance with its own transition plans concerning 15-minute metering (https://www.esett.com/projects/15-minute-settlement/).

All the remaining hourly metering equipment must be replaced (or otherwise be brought under 15-minute metering) as from 1 January 2029 at the latest.

The transition periods are also described on a timeline in Appendix 5 of the instruction (in Finnish).

1.6.6 Customer's right to obtain a meter upon separate order

According to the metering decree, in addition to organising metering in the way described in this instruction, the DSO must offer for the customer's use upon the separate order of the customer new remote metering equipment of the kind described in this instruction to the customer's metering point within four months at the latest in the following cases:

- if the DSO is not by virtue of the decree otherwise obliged to install new remote metering equipment for the customer;
- for separate metering of the amount of electricity production in an electricity generation equipment or power plant, the fitting of which with separate metering equipment is not compulsory;
- new remote metering equipment for separate metering of electricity supply at an electric vehicle charging point.

In addition, the DSO must offer the customer new remote metering equipment fitted with a load control relay if the DSO is not otherwise obliged to install metering equipment fitted with a load control relay at the customer's metering point. The load control properties of metering equipment is dealt with in further detail in section 2.14.

In the case of an electric vehicle charging point or in the event of separate metering of the amount of production, a separate metering point is established of the sites for the purpose of imbalance settlement.

The DSO shall have the right to charge reasonable metering and measurement fees for the installation of a meter ordered separately.

1.7 Metering and data transmission chain

Figure 2 presents the metering and data transmission chain of remote reading, starting from the collection device and ending with the parties requiring the data. The figure applies to a situation where the datahub is in use.

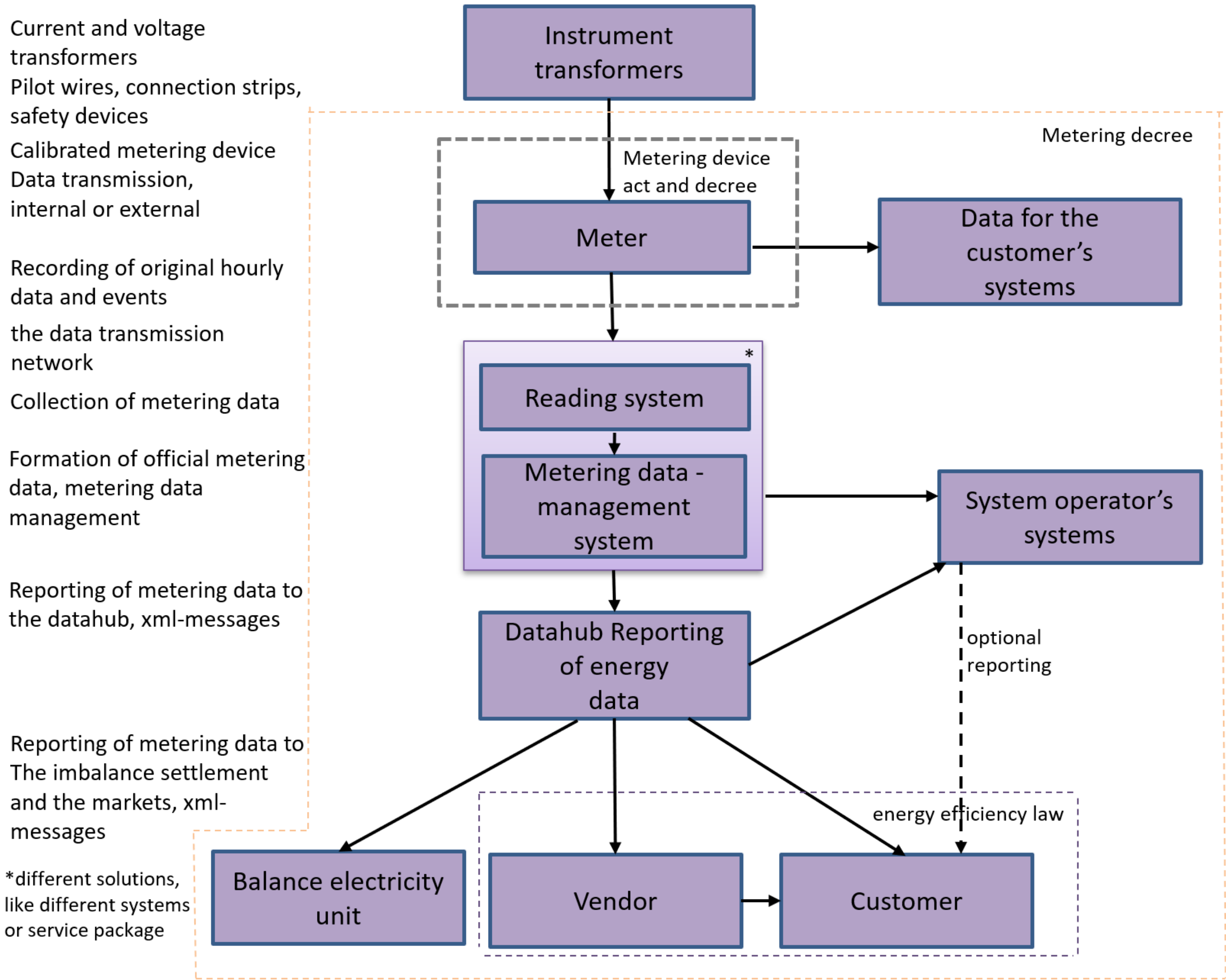


Figure 2. Metering and data transmission chain

The obligations of the acts and the decree referred to above and the sections of the metering and data transmission chain they apply to are marked in the figure. Many of the definitions in the first part of the chain also have an impact on the contents of messages to be transmitted. These include, e.g. recommendations on periods of time and the statuses of hourly data.

The figure illustrates the implementation of remote metering. In terms of standard meters and non-metered metering points, the figure is applicable starting from the transmission of metering data created by the DSO to the datahub.

2. Characteristics and connection of remotely read metering devices

In this instruction, remote metering devices refer to hourly metering equipment, 15-minute metering equipment and new remote metering equipment. Remote metering devices meter active energy, reactive energy, power data and certain quality features of electricity, depending on the type of meter in question. The characteristics of the metering and registering of metering data are dealt with in sections 2.2-2.3. The metering and registering of characteristics related to the quality of electricity are dealt with in chapter 3.

The metering decree, the Measuring Instruments Act and the decrees prescribed by virtue of it provide the minimum requirements for remote metering equipment. The minimum requirements of the metering decree are dealt with, e.g. in section **Virhe. Viitteen lähdettä ei löytynyt.**.

2.1 Accuracy requirements and operating limits of metering equipment

The accuracy requirements for electrical energy meters intended for residential, commercial and light industrial use are prescribed in the appendix of the Measuring Instruments Decree (available in the Finnish-language translation of Annex V (MI-003) of the Measurement Instruments Directive[4]). These requirements are presented in the enclosed table (meter classes A, B, C). The requirements apply to the metering of active energy. The accuracy requirements only apply to electrical energy meters, not instrument transformers. The meter requirements are deal with in further detail in the following standards: SFS-EN 62053-21:2003/A1:2018, SFS-EN 62053-22:2003/A1:2018, SFS-EN 62053-23:2003/A1:2018 and SFS-EN 62053-24:2003/A1:2018.

Table 1. Maximum permissible errors as percentage when the meter is operating under varying-load current.

MPEs in percent at rated operating conditions and defined load current levels and operating temperature

	Operating temperatures			Operating temperatures			Operating temperatures			Operating temperatures		
	+ 5 °C ... + 30 °C			– 10 °C ... + 5 °C or + 30 °C ... + 40 °C			– 25 °C ... – 10 °C or + 40 °C ... + 55 °C			– 40 °C ... – 25 °C or + 55 °C ... + 70 °C		
Meter class	A	B	C	A	B	C	A	B	C	A	B	C
Single phase meter; polyphase meter if operating with balanced loads												
$I_{min} \leq I < I_{tr}$	3,5	2	1	5	2,5	1,3	7	3,5	1,7	9	4	2
$I_{tr} \leq I \leq I_{max}$	3,5	2	0,7	4,5	2,5	1	7	3,5	1,3	9	4	1,5
Polyphase meter if operating with single phase load												
$I_{tr} \leq I \leq I_{max}$, see exception below	4	2,5	1	5	3	1,3	7	4	1,7	9	4,5	2
For electromechanical polyphase meters the current range for single-phase load is limited to $5I_{tr} \leq I \leq I_{max}$												

When a meter operates in different temperature ranges the relevant MPE values shall apply.

I = the electrical current flowing through the meter
I_{min} = the value of I above which the error lies with maximum permissible errors (MPEs) (polyphase meters with balanced load)

[4] Direct link to the Finnish-language annex https://eur-lex.europa.eu/legal-content/FI/TXT/HTML/?uri=CELEX:02014L0032-20150127&from=EN#tocId136

I_{tr}= the value of I above which the error lies within the smallest MPE corresponding to the class index of the meter
I_{max} = the maximum value of I for which the error lies within the MPEs
U = the voltage of the electricity supplied to the meter
U_n = the specified reference voltage
f = the frequency of the voltage supplied to the meter
f_n = the specified reference frequency

The requirements concerning the maximum permissible errors defined in the table are in force in the voltage range $0.9x\ U_n \leq U \leq 1.1x\ U_n$ and in the frequency range $0.98xf_n \leq f \leq 1.02xf_n$. The power factor range must be at least between cosφ = 0.5 inductive and cosφ = 0.8 capacitive.

Below the rated operating voltage the positive error of the meter shall not exceed 10%.

The recommendations on accuracy classes apply to new and renovated permanent metering connections. Less accurate measurements may be used temporarily, e.g. in maintenance situations or similar.

According to Annex V (MI-003) of the Measuring Instruments Decree, single-phase energy metering in indoor areas in a residential environment can be carried out with a meter pertaining to class A, B or C. In a residential environment, 3-phase energy metering or the metering of electric energy in outdoor areas can be carried out with a meter pertaining to class B or C. In commercial buildings and/or light industrial buildings, energy metering can be carried out indoors with a meter pertaining to class B or C. In outdoor areas, energy metering is carried out with a meter pertaining to class C.

DSOs should pay attention to the fact that the accuracy requirements for meters in accordance with the Annex are less strict than the accuracy requirements for meters traditionally used at these sites (meter classes 1 and 2), which are specified in standards SFS-EN 62052-11:2003/A1:2018:en and SFS-EN 62053-21:2003/A1:2018. In order to ensure the reliability of metering, the DSO may acquire more accurate meters than those in the accuracy requirement of the Annex of the decree.

Metering of active power in accordance with standard SFS-EN 62053-22:2003/A1:2018 (classes 0,2S and 0,5S) is still used for the metering of larger sites. The accuracy of the metering of reactive power is specified in standard EN 62053-23:2003/A1:2018. The required accuracy of both direct and indirect metering of reactive power is accuracy class 2 in accordance with the standard.

The total error is crucial with respect to the correct measurement; total error is affected by, e.g. the selected instrument transformers and testing wires, which are dealt with in further detail in section 2.16. Annex 1 includes practical instructions for establishing the total error at the installation site.

2.2 Data metered and registered by a remotely read metering device

In terms of energy data, the metering device must *meter* and *register* in the metering device memory at least with the frequency of the imbalance settlement periods[5] *cumulative readings (hourly or 15-minute reading) or the amount of energy (hourly or 15-minute energy),* which is read further into the reading system.

A cumulative reading registered with the frequency of each imbalance settlement period, i.e. hourly or 15-minute reading, is one uninterrupted total reading that does not take account of, e.g. the two separate readings of two-rate products. The total reading registered per imbalance settlement period usually, but not always, corresponds to the reading in accordance with the single-rate product, which can be seen on the metering device.

Therefore, metering data for each imbalance settlement period in hourly metering means metering data registered every hour on the hour, 1:00, 2:00, 3:00 etc. and, correspondingly, in

[5] See the transition periods for 15-minute metering under **Virhe. Viitteen lähdettä ei löytynyt.**

15-minute metering it means metering data registered after every 15-minute period, at 1:00, 1:15, 1:30, etc.

In the case of indirect metering, it is important to take into account the metering coefficient. The metering coefficient can be recorded either on the metering device or in the information systems. When setting the metering coefficient, it is important to ensure that the coefficient is recorded correctly and that the data is processed in a secure way. If values are shown in the meter display without a coefficient, it must be ensured that there is a separate rating plate notifying about the matter and stating the values by which the metering data must be multiplied so that they correspond to actual consumption. The coefficient must be presented in an appropriate place (e.g. on the rating plate or on the meter display). Correspondingly, in terms of data obtained via the local open customer interface of the metering device, the customer must be told if the data must be multiplied and by which value.

2.3 Registering of network input and output

The metering device must register network input and output separately. The metering device must not add up network input and output taking place during a single hour (netting), but network input and output taking place during one hour must be registered in different registers.

Based on an interpretation of the pervious metering decree concerning hourly metering devices, some hourly metering devices (and some 15-minute metering devices after programming) net between the phases of network input and output taking place at the same time.

The new remote metering device must register the active and reactive energies used as the basis for invoicing for each imbalance settlement period in terms of electricity fed into and taken out of the electricity network without netting. Therefore, momentary netting between phases is not permitted in the new remote metering equipment.

In the data registered by the metering device, the direction of electric energy transmitted is marked with a sign. Network input (import) has a positive (+) sign and network output (export) has a negative (-) sign. Correspondingly, in terms of reactive energy, import reactive has a positive (+) sign and export reactive is negative (-).

2.4 Accuracy requirements and rounding off metering data

Metering data must be recorded with an accuracy of at least 10Wh at sites of up to 3x63A. Data for sites larger than this are recorded with an accuracy of at least 1 kWh. When rounding off the metering data, truncating rounding is used, and the remaining energy is transferred to the next metering period.

2.5 Time stamps and statuses of metering data

A remotely read metering device must equip the metering data (hourly/15-minute readings or hourly/15-minute energies) and other possible readings registered by the metering device with time stamps. Moreover, the metering data is given statuses, which can be used for detecting any factors of uncertainty having an impact on the validity of the data.

With cumulative readings (hourly/15-minute reading) the time stamp is the moment of registering the reading. On the other hand, hourly/15-minute energies are usually given a time stamp for the start of the period in question (hour or 15 minutes). The meanings of the time stamps must be taken into account when forming energy time series for each day in the metering data management system.

The remotely read metering device must enter statuses for the metering data to indicate whether the data is reliable or whether there is a possibility of an error. The statuses entered for the metering data of metering devices on the market vary by metering device. These statuses are mainly information meant for the use of the system operator for monitoring the operation of the metering equipment. The statuses of metering data are converted to a commonly agreed form in the metering data management before the data is transmitted to other market participants. This is dealt with in further detail in sections 6.3, 8.3, 8.5 and 8.7.

2.6 Recording capacity of a remotely read metering device

According to ET's previous instruction "Principles of hourly metering", the memory of the hourly metering device must accommodate the energy data at least for the period of the imbalance window. According to the metering decree, the memory of the 15-minute metering equipment must accommodate the 15-minute metering data for a period of at least 11 days.

In terms of new remote metering equipment, the recording capacity of the metering device has not been directly determined in legislation. However, the decree refers to the Measuring Instruments Act and the provisions issued by virtue of it with regard to the display of metering results on the metering device. This has been dealt with in further detail under section concerning the display of the metering device.

It is worth noting that when the remote reading connection is out of order, the memory must retain the recorded data (including interruption data) at least for a period long enough to have time to retrieve the data from the meter and, if necessary, to replace the meter.

2.7 Functioning of a remotely read metering device during a power cut

The clock of a remotely read metering device must show the right time during a power cut, and the data in the memory of the meter must remain correct in the memory. The programme and metering data of the metering device should be retained in the metering device even for years without power. According to the measuring instruments legislation, in the event of loss of electricity in the circuit, the amounts of electrical energy measured shall remain available for reading during a period of at least four months.

It is recommended that the clock of the metering devices keeps time for at least 7 days.

The metering device must be able to register the start and end time of a power cut in accordance with section 3.1.

2.8 The clock of the metering device and inspection of the clock's accuracy

When moving to a shorter metering period, the requirements of the accuracy of the clock of the metering device is emphasised. It must be actively ensured that the clock of the metering device keeps accurate time and, if necessary, the clock must be set to the correct time. If necessary, the values of the time series must also be corrected as required by the error.

Resetting of the clock must be available as a remote function.

The time of the clock shown on the display is dealt with in further detail in the following section.

2.9 Display of the metering device

According to the Measuring Instruments Decree, the metering device must meet its essential requirements set out in Annex I of the Measuring Instruments Directive. According to the Annex, "whether or not a measuring instrument intended for utility measurement purposes can be remotely read it shall in any case be fitted with a metrologically controlled display accessible without tools to the consumer. The reading of this display is the measurement result that serves as the basis for the price to pay."

Therefore, measuring instrument legislation requires that metrologically controlled metering data is displayed to the customer either on the display of the metering equipment or possibly via a user interface that meets the requirements of the measuring instrument legislation. However, it has not been possible to interpret that the DSO's online service or a similar web service is such a user interface, and at the time of writing this instruction, a display physically attached to the meter is deemed as the only way in use to meet the display requirements set out in the measurement instrument legislation.

According to the Annex of the directive, the reading of this display is the measurement result that serves as the basis for the price to pay. However, the legislation or official regulations do not clearly describe which data must be shown on the display of the metering device and for how long a period.

However, when interpreting the requirement concerning the display, the following viewpoints can be taken into account:

- In metering points fitted with a remotely read metering device, invoicing of electricity is based on hourly or 15-minute data registered by the metering device, and the DSO reads this data and delivers it to the datahub. The supplier and the DSO send a separate invoice to the customer, and the operators' invoicing principles may differ from one another (e.g. sales contract with hourly pricing and two-rate network product).
- In addition to hourly or 15-minute data, it would be clear to the customer that the cumulative energy data for each moment is shown on the display of the metering device (one cumulative total reading). The customer has the option of making a note of the cumulative reading data, for example, once on two separate occasions, and compare the difference of this data with the data of the reporting service provided free of charge by the DSO or the datahub. In addition, the cumulative reading data is not the customer's personal data, which enables operations that comply with the information security regulations in terms of the metering device with reasonable costs.
- At the time of drawing up this instruction, the DSO and the supplier must carry out invoicing based on verified consumption at least four times a year.
- According to the draft of the explanatory memorandum concerning the metering decree of the Ministry of Economic Affairs and Employment, dated 17 May (however, not the final explanatory memorandum), the customer should be able to read, for example, metering data registered by the metering equipment for each imbalance settlement period per invoicing period. It also states that the displaying of metering data for the previous four months would ensure that the supplier or the DSO would not need to apply an invoicing period shorter than this and that the customer would have the opportunity to verify the data on the invoice after receiving it.

In accordance with Annex I of the Measuring Instruments Directive, it must not be possible to reset the display of the metering equipment to zero during use.

The electrical energy measured must be displayed in accordance with the Measuring Instruments Directive either in kilowatt-hours or in megawatt-hours, depending on the size of the site.

It is recommended that the display of the metering device shows the date and time. The clock shown on the display must be in official Finnish time, i.e. complying with winter and summer time. If the official time is deviated from, the customer must be notified of this separately, for example, with a sign or sticker attached to the meter case or device, or in the meter reading instructions.

2.10 Programming features of a remotely read metering device

It must be possible to program a remotely read metering device, and it must be possible to carry out the programming primarily as a remote function. It must be possible to update the software and settings determining the functionality of new remote metering equipment and the registering frequency of the metering data with remote connection without a visit to the metering point in accordance with the metering decree.

The DSO is responsible for the programming, and programming is only permitted to be carried out by the DSO or a body authorised by the DSO. It must not be possible to change the settings without sufficient safety measures through the data transmission connection.

Similarly, it must be possible to programme the clock of the metering device via the remote connection. Furthermore, it must be able to remotely programme the control delays of night loads, control times and any control functions serving demand flexibility, where necessary. The DSO's information systems must enable the implementation of the load control function forwarded or given by the DSO within six hours of giving the control command with new remote metering equipment as from 1 January 2026.

In the case of indirect metering, it is recommended that it is possible to programme a metering coefficient for the metering device, in which case the metering device will record the final coefficient values. Alternatively, the coefficient can be recorded in the DSO's information system where the metering data is processed.

2.11 Remote disconnection and reconnection feature

New remote metering equipment must be fitted with a remote disconnection and connection function.

The remote connection device must not be used as an isolating device when the electricity is disconnected due to electrical works. The remote connection device does not have an air clearance in accordance with the electrical safety regulations, nor does it have a visible locking of the 'open' position.

The metering device can also be fitted with so-called approval button. By pressing this button, the customer can reconnect the electricity to the site after the DSO has first enabled the connection. However, in this respect, the DSO must pay attention to sites where the customer has no access to the meter. With some metering devices, the approval button can be bypassed.

It is not compulsory to fit hourly or 15-minute metering equipment with the remote disconnection and reconnection function.

2.12 Reading of metering data during a connection failure

It is recommended that the DSO can read the metering device also locally via a data transmission connection if the remote reading of the metering device is not successful for some reason. This must be carried out in a secure way.

2.13 Inputs and outputs of the metering device, and data transmission to other systems

The metering devices may have other inputs and outputs, but they must not have an impact on the reliability, hourly registering and data transmission of invoiced metering.

Requirements concerning the customer interface of hourly and 15-minute metering equipment

According to the metering decree, the DSO must offer for hourly and 15-minute metering equipment a standardised connection selected by the DSO for real-time monitoring of electrical energy consumption, if the customer places a separate order for such an equipment. If for this reason an existing meter needs to be replaced before the DSO would be obliged to replace the meter according to the metering decree, the DSO has the right to charge the customer for the costs of installing and commissioning of the meter.

Requirements concerning the customer interface of new remote metering equipment

According to the metering decree, new remote metering equipment (with the exception of voltage transformer metering equipment) must have a customer interface fitted with a voltage output that enables one-way data transmission for the end user, based on an open and updatable European standard that is also used in another EU member state.

The root-mean-square values of at least the current, active power, reactive power and voltage of the electricity fed into the electricity network and electricity acquired from the electricity network must be obtained from the customer interface every 10 seconds or more frequently phase-specifically, as well as the cumulative electric energy reading of the metering equipment every minute or more frequently via an RJ12 connector complying with data transmission using ASCII characters.

The most essential data describing the customer's electricity use is active power, reactive power, voltage and current, and whether electricity is obtained from or fed into the electricity network. From the customer's point of view, it is also significant how the load is distributed for each phase. For this reason, the data should be metered phase-specifically. The customer must be able to read this data via the customer interface, which is updated every 10 seconds or more frequently.

In addition, the customer must obtain a cumulative electric energy reading of the metering equipment from the interface every minute or more frequently. In practice, the cumulative electric energy reading would not necessarily correspond to the exact time stamp of the data due to delays in the internal data transmission of the metering equipment. Due to the nature of the interface, it must be noted that during the software updates of the metering equipment, the metering equipment is not necessarily capable of sending the data referred to in the section via the interface in real time.

There should be an option of feeding the voltage to the device to be connected via the connector, in which case there would be no need for a network interface controller for the device itself.

For the sake of information security, the interface must be unidirectional.

The DSO must activate the interface at the end user's request. In order to protect the end user's metering data (personal data), the prescribed data must not be obtained from the interface until the customer interface has been activated at the end user's request. No extra costs must be charged to the customer for the activation.

SESKO has published a recommendation on the implementation of the interface, which is found on the SESKO committee SK13 website:
https://www.sesko.fi/osallistuminen/komiteaesittelyt/sk_13_sahkoenergian_mittaus.

2.14 Load control features of a remotely read metering device

In compliance with the metering decree, hourly and 15-minute metering equipment must be able to receive and implement or forward load control commands to be sent via the communication network.

New remote metering equipment must be fitted with a load control relay if the meter is installed at in a metering point other than of over 3x63A or located in a residential building of more than two dwellings or in an office, commercial, industrial or storage building. In practice, the requirement to fit remote metering equipment with a load control relay therefore applies to detached homes, semi-detached homes and holiday homes.

The DSO must offer the customer new remote metering equipment with a load control relay also at the customer's separate order (also see section 1.6.6).

It is recommended to build the metering systems so that the load control features enable site-specific load control. This should be taken into account especially when building and renovating multimeter distribution boards.

It is recommended that DSOs maintain the control possibilities (e.g. load shedding, night-time load) while doing meter replacements.

2.14.1 Implementation of load controls with new remote metering equipment

The DSO's information systems must enable the implementation of the load control function forwarded or given by the DSO within six hours of giving the control command.[6]

This functionality must be available by 1 January 2026 at the latest.

2.14.2 Implementation of load controls with hourly and 15-minute metering equipment

According to the metering decree, the metering device must be able to receive and transmit load control commands. The purpose of the decree paragraph is to promote, e.g. introduction of demand response controls and management of power shortages.

The decree does not impose obligations on the technical implementation of controls.

The DSOs use load controls based on the network service tariff, such as, e.g. night-time load controls tied to the night-time/daytime tariff.

These load controls should not be tied to the start time of tariff control, i.e. night-time load can be switched on at a later time after the start of night-time tariff period. Fingrid has previously provided instructions for the DSOs to have staggered switch-on of their customers' night-time loads in order to be able to moderate the power peak at 22.00 hours. It is recommended that the

[6] The implementation of this requirement is clarified in further detail in the project The definition of the demand response interface (Kuormanohjausrajapinnan määrittely) funded by the Electricity Research Pool:
https://energia.fi/uutishuone/materiaalipankki/kuormanohjausrajapinnan_maarittely_-_sahkotutkimuspoolin_julkaisu.html#material-view

staggering takes place over a sufficiently long period, at least one hour. The DSO may determine the method of implementing the control delay, i.e. the delay may be either occasional or standard, depending on the metering point.

The customer may also control their own loads to be switched on or off with their own automation equipment or timer switch unless otherwise agreed with the customer.

2.15 Location of the metering point

Primarily, efforts are made to locate the metering point at the point of energy delivery. In some special cases, the metering point and the point of delivery differ from one another (e.g. instrument transformers and the point of delivery are on different sides of the distribution substation). In practice, this may become an issue when, for example, the metering of a medium-voltage connection is located on the low-voltage side of a transformer substation. In these cases, the DSO shall calculate the losses using a formula derived from the electrical values of the cables and transformer, as well as the metered data. Metering data can be corrected on the basis of the calculated loss data. This can be carried out on the metering data management side. On the market, there are also metering devices with an opportunity for internal calculation in order to take transformer losses into account. The use of this function will naturally require programming of the correct parameters in the metering device.

The DSO and the customer should also account for the location of reactive power metering in view of the compensation.

2.16 Metering connections

When connecting a remote metering device, it is essential to take into account whether the data transmission connection to the device is working after the electricity has been switched off from the main switch of the low-voltage switchboard. The devices used in the metering must be selected and installed so that they operate and withstand the environmental conditions of the place of installation.

2.16.1 Size of the metering device and structure of the switchboard

The DSO must ensure that the metering device fits into the switchboard structures in accordance with the effective standards. This matter is dealt with, e.g. in standard SFS 5601 Space for electrical energy meters. Also in other respects, it is advisable for the DSO to choose the size of the metering device so that it will fit into the majority of electrical centres in the metering points of its network area.

The size and structure of the customer’s switchboard must comply with the standards.

2.16.2 Connection of the metering device in the switchboard

The metering device must be installed between the main fuses and the main switch whenever possible. Thus, the metering device must be fitted with appropriate warning signs indicating that the voltage of the metering device is not disconnected from the main switch. New switchboard are built according to this principle, but a modification of old switchboards may be difficult. When the metering device cannot be installed in the above-mentioned way, it is worth finding out whether it is possible to arrange auxiliary supply to the metering device before the main switch. The auxiliary voltage feed must be protected with labelled over-current protection, which must be able to be sealed.

If it is decided that the connections of also old centres are modified so that the metering device is located between the main fuses and the main switch, or if auxiliary voltage is connected to the metering device, this must be recorded in the document concerning the technical requirements of the DSO’s metering or in the design instructions. The customer will not be charged separately for the modifications.

Centre structures are dealt with in Sähköinfo’s ST cards and the effective standards regarding metering centres.

2.16.3 Connections of indirect metering

The cross section of testing wires must be at least 2.5 mm^2. When using thicker cross sections, especially the load of the current transformers must be taken into account. The design of instrument transformers is dealt with in further detail in Appendices 2 and 3.

In indirect measurements, connection strips with a switching facility and fitted with plug cases must be fitted to both the voltage and circuit as close to the instrument transformers and meters as possible. Separate secondary cabling, protected with a fuse or residual current circuit breaker, is recommended for the voltages of invoiced metering. The connection strips must be installed in a space that can be sealed or the connection strips must be able to be sealed.

2.16.4 Instrument transformers

The properties of instrument transformers are defined in standard SFS 3381 Metering of alternating current energy, metering equipment (includes in SFS manual 640).

According to standard SFS 3381, the instrument transformers used must comply with the standards SFS-EN 61869-1, -2, -3 and -5. According to standard SFS 3381, the accuracy class requirement of current transformers is 0.2S and that of voltage transformers is 0.2, covering all capacity ranges.

Instrument transformers are installed in all phases. The secondary current recommendation for current transformers is 5A. The current transformer should correspond with the actual operating area as far as possible. The current transformer must be selected so that the metered current corresponds with 5–120% of the rated current of the primary of the current transformer. All phases must have their own return current wires.

It is recommended to use only voltage transformers with single-pole insulation. The secondary voltage of a voltage transformer is 58 V.

For the instrument transformers to keep within their accuracy class, the devices and wires in the secondary circuit must be selected so that they form a load, which is 25-100% of the rated load of the secondary of the instrument transformers.

This must be taken into account especially in the circuit of the current transformer when using static meters (also changing the induction meter into a static one). The problem is emphasised when the secondary current of instrument transformers is below 5 A or when the load of the current transformers is high (often with old current transformers). If necessary, the instrument transformers are replaced with ones with a smaller rated load or extra load is installed in the secondary circuit (e.g. separate return wires and/or a necessary length of 2.5 mm2 extra wire).

Calculation examples of taking account of the instrument transformer load and a table of the design of current transformers in a low-voltage network are presented in Appendices 2 and 3.

Current transformers fitted with one metering circuit must not, as a rule, be used for anything other than invoice metering of energy. If the current transformers are fitted with more than one metering circuit, a metering circuit used for other than invoice metering may be used for another purpose. Utilisation of metering circuits for a purpose other than invoice metering must always be agreed with the network company and their utilisation must not jeopardise the metering accuracy of invoice metering.

2.17 Data communication features of the metering device

An individual metering device is usually capable of utilising only one data transmission technology. However, it is recommended that the DSO has an opportunity to use different data transmission technologies (typically different kinds of meters) in its network. It is advisable to consider the life expectancy of the data transmission technology used.

If the network company wants to receive automatic alarms from the metering device, e.g. in relation to interruptions, the metering device must be able to send the alarms without excitation from the reading system.

It is advisable for the DSO to aim to take account of challenging metering points in terms of their data communication properties already before actual installation of the meter. For example, installers can be instructed in the DSO’s contractor instructions to ensure the necessary data communication reception. The instructions can include, e.g. a requirement to arrange sufficient signal strength in the meter cabinets and the main distribution facility and, if this is not possible, a lead-through out of the facility for aerial cable required for an extra aerial must be arranged. The connecting party may be obliged to present a plan for the implementation of the aerial route in order to implement remote reading of metering centres located underground or in deep within of structures.

3. Metering features of outage data and the quality of voltage

Remotely read metering devices can be utilised, e.g. in the monitoring of voltage quality. However, metering of voltage with remotely read metering devices is not seamless, and the frequencies of sampling of the voltage vary between meters. Remotely read metering devices are not comprehensive electricity quality meters, but they can be used for obtaining information in support of network operation.

The metering decree requires that all remotely read meters observe and register outages and that new remotely read metering equipment observes loss of neutral faults.

3.1 Characteristics of outage registration

The metering decree requires that an hourly and 15-minute metering device must register outages lasting more than three minutes.

New remote metering equipment must also register outages shorter than that. New remote metering equipment must register all customer's power cuts observed by the metering equipment phase-specifically. New remote metering equipment must register all outages that the meter is capable of observing, but the explanatory memorandum of the decree states that it is not always possible to observe very short outages and this is permitted (e.g. high-speed automatic reclosing).

The following features must be taken into account when examining the outage data registered by the metering device:

- Sampling frequency: are all voltage dips and short outages registered
- Long outages: registers the start and end time of the outage or the duration of the outage and the ending time or starting time of the outage
- Short outages: registers the numbers and possibly the times
- Set value of the outage: the results are affected by the setting of the residual voltage (10%*Un / 5%*Un[7]).

3.2 Observing of loss of neutral faults

The metering decree requires that new remote metering equipment must observe a voltage imbalance caused by a loss of neutral fault in the feeding electricity network when there is electricity consumption at the metering point. The requirement concerns three-phased meters. After observing a loss of neutral fault, the DSO must take appropriate measures to ensure electrical safety.

3.3 Characteristics of voltage-level metering

The metering devices have different ways of metering and registering voltage. The voltage data obtained from the meters may be the root-mean-square value or the average root-mean-square value for a certain period, e.g. 1, 3 or 10 minutes. From the viewpoint of the quality of electricity, the average root-mean-square value for 10 minutes is interesting because, according to the power quality standards (EN 50160, EN 61000-4-30), slow voltage variations are examined specifically over a 10-minute metering period. In addition, it would be beneficial to obtain information about a few highest and lowest root-mean-square values over a period of the past week.

New remote metering equipment must meter the voltage for all phases. This is also recommended for hourly and 15-minute metering equipment.

It is also recommended that the over- and undervoltage limits can be determined by the DSO.

3.4 Operational functions

In addition to the features required by legislation, the metering device may also have other features selected by the DSO, which can be utilised in the DSO's operational functions. These

[7] EN 50160

kinds of new extra features are constantly developed, and every DSO must select from the range of options the suitable solutions for their own needs.

The previous ET’s principles of hourly metering recommended certain extra functionalities, such as:

- It should be possible to program the metering device to indicate and raise the alarm as a result of outages and voltage variations according to the adjustable limit values.
- In terms of alarms/indications, the following operating categories should be available to choose from: 1) out of use, 2) recording into the event log, and 3) recording into the event log and alarm.
- There should be prioritisation/locking possibilities between various alarms, in which case only the most important data is sent to control in case of several simultaneous indications.
- It should be possible to freely set the indications and alarm limits, e.g. Un – X% for a certain duration. The limits should be determined at least for over- and undervoltage. With suitable limit values of over- and undervoltage, it is also possible to detect a zero fault, phase discontinuity, lack of one phase in the low-voltage network, lack of two phases in the low-voltage network.
- In practice, it is enough that the alarm functions are taken into use from behind the transformer only with respect to one or two metering devices. Three-phase faults are usually faults in the medium-voltage network, and therefore they do not necessarily need an alarm.
- The meter must keep an event log of the alarms and indications with respect to each matter: e.g. of the last five events including their time stamps.
- It would be beneficial to be able to examine the voltage data for the metering point in real time with the remote connection.

3.5 Recording of outages and voltage quality data

The decree obliges to record outage data for a minimum period of two years. For this period, the data must be recorded in an appropriate system of the DSO. The data can be recorded in the reading system if it has sufficient capacity. The data can also be recorded on the side of the metering data management system or in a separate power outage/quality data system of the DSO. It is essential that the data is available in the calculation system where the outage statistics and any monitoring of long outages take place. This can be a network operation support application.

Meter recording ability and registered events

It must also be possible to record outage data for at least for a period long enough to enable reading it from the meter also in potential connection failures. It is recommended that the DSO can also read the connection failure data locally via a data transmission connector if the remote reading of the metering device is not successful for some reason. It must be possible to read the outage data and voltage quality data, such as the energy data, locally directly from the meter if remote reading is not successful.

In terms of the registering ability, it is advisable to establish the number of registered events for various quantities and whether the metering device has a common or separate registers for different quantities.

Reading of outage data from new remote metering equipment

In accordance with the decree, the DSO’s information system that processes metering data must collect registered metering data (incl. outage data) from the new remote metering equipment into the metering data reading system at least every six hours (from 1 January 2026 at the latest).

The reading of meters is dealt with in further detail in section 5.4.

4. Inspection of the metering equipment

This chapter deals with the inspection of metering devices and related connections, and data transmission connections. Chapters 5.6, 6.6 and 8.6, on the other hand, deal with the inspection of metering data and continuous fault monitoring. Verification of metering devices upon commissioning is regulated by virtue of the Measuring Instruments Act and Decree, which is dealt with in further detail in section 1.1.5. Regulation concerning in-service verification of metering devices is being prepared at the time of updating the instruction.

4.1 Inspections during the installation phase

In the installation phase, the following matters are usually inspected:

- Validity of metering connections; e.g. correct connection of phases, i.e. incoming and outgoing wires are connected in the correct way
- Correct direction of rotation of the electrical field in the case of reactive power metering
- Functioning of the data transmission connection; for example, the intensity of the GSM field at the time of installation, which can be used for estimating the need for extra antennae
- Sealings
- The energy and power readings of the meter (e.g. validity of the magnitude of power)
- Meter data (incl. pulse data)
- Operating couplings

Moreover, the fitter should report the condition of the main switch for later reference as regards to the reason why the reading may not be successful.

In the inspection, it is recommended to use, e.g. dummy loads if the site has no load at the time of inspection, if necessary.

4.2 Further inspections of indirect metering points

After installation, the following can be inspected in addition to the previous section:

- Total metering error
- Condition, functioning and conversion ratio of current and voltage transformers
- Integrity and load of the induced wire
- Meter accuracy
- Phase-specific currents, voltages and loads of the secondary side

In the inspections, the load situation at the metering point and its impact on the success and correctness of inspections must be taken into account.

The calculation examples of taking account of the instrument transformer load and a table of the design of current transformers in a low-voltage network are presented in Appendices 2 and 3.

4.3 Self-diagnostics of remotely read metering equipment

Remotely read metering equipment may perform internal self-tests at the time of installation and continuously during use. It is also possible to record in the metering equipment various events and alarms concerning exceptional situations in the power supply.

At the time of installation, depending on the type of metering device, the meter may observe, for example:

- Whether the meter has reverse current. Reverse current usually indicates an incorrect connection if there is no electricity generation equipment at the metering point.
- In which meter phases there is electricity. If one of the three phases is missing, the meter may give an incorrect reading.

During service, the meter can constantly perform various internal tests depending on the type of metering device. If the meter detects a problem in an internal test, the observation must be recorded, and it is dealt with in an appropriate way. Errors can be divided according to their degree of criticality, for example, into the following categories:

- Critical errors. The device has a serious problem. The device is still able to function, but the metered data and data recorded in the meter may be incorrect.
- Data transmission errors. Brief errors in data transmission, which are removed automatically when the data transmission connection is restored. However, the errors are recorded in the meter memory. Data transmission errors do not usually require meter replacement.
- Other errors. Other possible errors are recorded in the register of the meter. Usually the meter can continue functioning as normal, and there is usually no need to replace it.

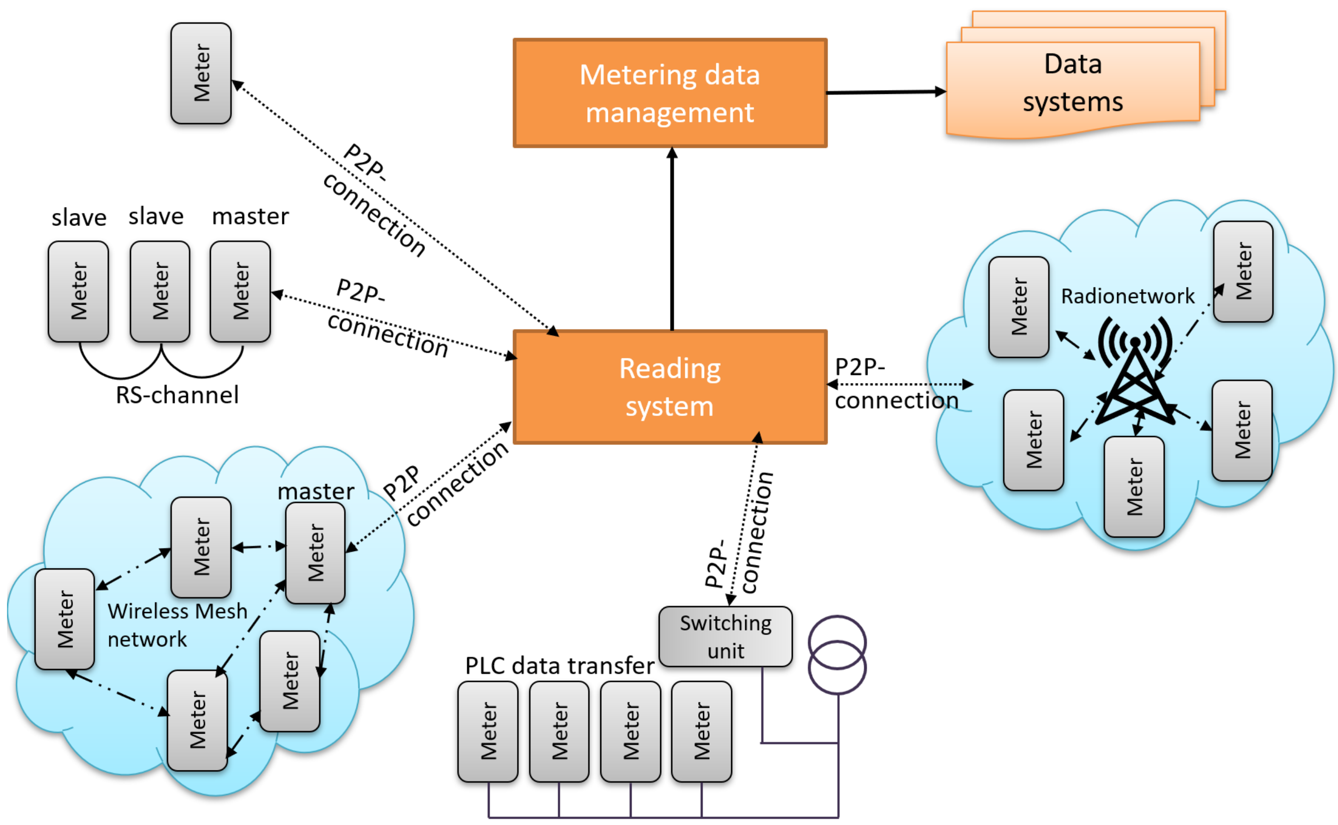
4.4 Inspection of metering equipment on separate request

In addition to inspections related to standard maintenance measures, the customer may demand the DSO to have the metering equipment inspected. If the inspection proves to be unfounded, the customer will have to pay for the inspection. Otherwise, the owner of the defective metering device will pay for the inspection. The extent of any rectification of a metering error will be determined or estimated on the basis of the available metering data or, if necessary, with the aid of an impartial expert statement in accordance with the Terms of Network Service.

5. Reading and data transmission connection of remotely read metering devices

The requirements for the data transmission and reading system of remotely read metering data are described in the following. It should also be taken into account that the same requirements for functionality, availability, information security and data protection also apply to the reading service purchased by the DSO.

The enclosed Virhe. Viitteen lähdettä ei löytynyt. presents a few data transmission alternatives from a remotely read meter to a reading system.



Examples of P2P-technologies: 3G, 4G, 5G NB-IoT ja LTE-M
Example of Mesh-network: RF-Mesh
Examples of PLC-technologies: OSGP, 3G-PLC, PRIME, Meters and More
Examples of radionetworks: LoRa, WizeAlliace, Wi-SUN alliance and different LTE-networks

Figure 3. Principles of the data transmission of energy meters.

5.1 Characteristics required of the data transmission connection

The data transmission connection must be a two-way system. It must be able to transmit at least the data specified in this instruction.

It is recommended that the data transmission connection of a metering device is selected so that data transmission is successful at all times of the day and night. The DSO must be able to read the data registered by the metering device and to implement the functionality required of the meter by law, such as remote connections and disconnections and the transmission of load control commands, at any moment of time.

It should be taken into account in the selection of data transmission connections and systems that the meter is capable of transmitting, e.g. alarms to the DSO’s system and controls from the DSO’s system to the metering device with the desired response time.

The DSO should set a minimum level for successful reading. The requirements may be set separately for data transmission and the reading system. In terms of data transmission, any technical restrictions related to the selected data transmission technology and the life cycle of the data transmission channel should be taken into account. The prerequisites and requirements for data transmission should be carefully written into any contracts to be signed with co-operation partners.

5.2 Data transmission protocol and openness of systems

It is advisable that the data transmission protocol is based on a public standard (e.g. DLMS/COSEM) or to otherwise ensure the compatibility of functionalities and the requirements of legislation. It is advisable to require openness of the systems so that metering devices of different meter providers can be matched to the same systems. Compatibility can also be managed with agreements. On the other hand, with respect to the transmission and recording of metering data, it must be ensured that access to the data by unauthorised persons is prevented.

The data transmission protocol must ensure that no data will be altered in data transmission without it being detected in the reading system. This error detection method must be public.

5.3 Characteristics required of the reading system

The metering device, data transmission connection and reading system should be selected so that the data registered by the meter can be read by both separate command and automatically. The metering device can also automatically send data to the reading system.

It must be possible to verify the individual code of the metering device and the time on the clock in the metering device through the data transmission connection, and it must also be possible to individualise every metering device in the reading system.

The reading of the metering device must not destroy or alter the metering or event data of the metering device.

The reading system must detect any errors and unsuccessful readings showing from the data transmission and report these.

It is recommended that the DSO empirically determines the longest time during which a temporary fault in the connection should correct itself. Outages longer than this time will launch remedial actions in order to restore the connection.

It is advisable that the DSO sets a minimum level for successful reading. The requirements may be set separately for data transmission and for the availability of the reading system. The requirements may be set separately for first reading and for re-reading taking place after a certain length of time, for example, 3 days.

5.4 Data read by the reading system, and recording of the data

The reading system must read from the meter new and missing data registered by the meter, including time stamps and the statuses given by the meter. The data to be read is dealt with in further detail in sections 2.2-2.3 and outage data in section 3.

According to the metering decree, hourly and 15-minute metering equipment must be read at least once every 24 hours. New remote metering equipment must be read at least every six hours (as from 1 January 2026).

5.5 Time base of the reading system and inspection of the meter clock

The time base of the reading system is not restricted, nor is the time base of the time stamps for hourly data. However, in terms of the time spent, it is important to take account of the obligations related to the use of the official Finnish time (summer/winter time). In terms of reading, it must be ensured that the DSO is able to send the metering time series required by the decree to the datahub according to the official time, i.e. watch time. Other metering data is also always transmitted according to the official time. In addition, the display of the metering device must operate in the official Finnish time.

The time of the reading system may differ from the correct time by a maximum of +/- 2 s (at the time of setting the time of the metering devices).

The clock of the metering device is inspected against the time of the reading system in connection with every reading and, when necessary, the clock of the metering device must be set to the correct time after reading. This is dealt with in further detail in section 2.8.

5.6 Inspections when connecting the metering device to the reading system

When using the GSM network, the system should verify the meter identification data and the SIM card identifier, and compare whether they correspond with the data established in the database. If the data of the metering device and the SIM card do not match, no connection is usually made to the meter.

In terms of the current transformer measurements, it is also advisable to check the current transformer coefficient if it has been set for the meter. This can usually be made as remote reading from the meter register.

5.7 Requirements of load control for data transmission

The information systems and the data transmission connection must enable the implementation of the load control function forwarded or given by the DSO for new remote metering equipment at the least within six hours of giving the control command (as from 1 January 2026).

5.8 Information security

The remote reading system must have comprehensive information security. Information security consists of, e.g. personnel security, document security (backup and safe copying), physical security, hardware security, software security, telecommunications security and operating security (malware protection). Further information about information security is available, e.g. on the website of the National Cyber Security Centre https://www.kyberturvallisuuskeskus.fi/fi.

From information security point of view, data transmission should also be based on a well-known data transmission protocol (e.g. DLMS/COSEM). With respect to the transmission and recording of metering data, it must be ensured that access to the data by unauthorised persons is blocked. Remote reading and programming of the metering device should only be possible by the DSO or a body authorised by the DSO. It must be possible to update the information security features remotely so that the new features can be commissioned and vulnerabilities fixed with remote updates.

The reading system must detect errors that have taken place in data transmission.

The DSO should also take account of storage of data and information security in situations where the reading system develops a fault.

If remote reading is purchased as a service, the management of and responsibilities for information security must be agreed on in the service contracts.

6. Managing the metering data of remotely read metering devices

This chapter deals with the energy data recorded in the metering data management system and the measures required for verifying its validity. The chapter deals with metering data collected by remotely read metering devices. The reading of non-remotely read meters and the processing of metering data are described in chapter 7.

The DSO must carry out the inspections and any processing that may be required, which are described in this chapter, after which the data is ready for distributing for market user (= hourly/15-minute energies equipped with general statuses).

6.1 Calculation of hourly/15-minute energies from hourly/15-minute readings

If cumulative readings are read from the metering device, the hourly/15-minute energies forwarded to the datahub and used in imbalance calculation are calculated from them in the metering data management system. When calculating energies from cumulative readings, particular attention should be paid to the fact that the time stamps for the metering data are recorded correctly. The meters record the time of registering as the time stamp for cumulative readings. The meter usually stamps hourly/15-minute energies with the time stamp of the start time of the period in question.

6.2 Recording of metering data

Metering data must be recorded in the metering data management system so that the original and any modified data with their statuses can be traced at a later date.

Further information about the storage times of hourly/15-minute data is available in section 6.5 In practice, the hourly/15-minute time series may be distributed between different metering data management systems (in the systems of both the DSO and the service provider).

It is recommended that an accuracy of maximum 1 Wh is used in the recording of metering data in the metering data management system. The recording of more accurate data increases the risk of rounding errors in data transmission. In forwarding data to other parties and systems, it is important that the DSO ensures that the metering data is processed with the same accuracy in all situations and deliveries and that there are no rounding errors. Therefore, in the entire process from the metering data management system to the invoicing system, the accuracy of metering data must remain the same as when it has been transmitted to the other electricity market participants. The accuracy used in the transmission of metering data is described in further detail in section 8.2.

In the metering data management system, network input (consumption) and network output (production) must be separated.

Metering data must be transmitted to the electricity market participants with a resolution according to the imbalance settlement period with the exception of the transmission of hourly data to the datahub after the introduction of 15-minute metering from sites that are not required by law to have 15-minute metering. If the DSO reads the metering data of a metering or production site with a resolution that is shorter than the imbalance settlement period, the DSO must in its own systems change the metering data to comply with the imbalance settlement period before transmitting it to the electricity market participants.

6.3 Statuses of remote metering data

The statuses entered for the metering data of remotely read metering devices on the market vary by metering device. These statuses are mainly meant for the DSO’s use. When data registered by the meter is processed in the metering data management system, the statuses of the metering data are changed in to general statuses to be used in the datahub.

The statuses used in the datahub are:

- Missing
- Uncertain
- Estimated
- OK
- Corrected OK

The use of statuses and the replacement of a weaker status with a stronger one are described in further detail in the guidelines on datahub business processes[8] and in sections 8.3 and 8.4 of this instruction.

6.4 Processing of missing data

It is the DSO's task to estimate the missing data. The supplier may not estimate data for the use of the customer processes (e.g. invoicing, reporting).

If it is not possible to obtain metered data from the meter, the missing active energy data for the consumption metering point must be estimated within 5 days of the delivery day at the latest. However, the estimation procedure for missing metering data depends on the situation that causes the lack of data. Therefore, the network meter reading process should be able to give to metering data management the reasons for missing data.

- If the data is received within 5 days, i.e. it is a case of, e.g. a connection problem, there is no need to estimate the missing metering data.
- However, if it takes longer to receive the data, but it can be assumed that the missing data will be received later from the meter, i.e. it is a case of, e.g. a data communication fault (permanently poor connection, data communication module out of order), the missing data must be estimated. In such a case, the status of the estimated data will be marked as uncertain.

If it is known that the missing data will not be received, i.e. it is a case of, e.g. a fault in the metering device resulting in metering errors, or if the registering of data has been completely unsuccessful, the metering data must always be estimated. In such as case, the status will be marked as estimated. When estimating missing metering data, any available cumulative readings must always be utilised. The missing use is entered for the gap hours on the basis of the previous consumption profile for the site. The estimate is based on consumption during similar periods, taking weekdays and holidays into account.

In the estimate, any power peaks are removed and any temperature impacts are taken into account, i.e., for example, estimates for a site with electrical heating will not be made directly on the basis of consumption during a colder period.

When consumption for only one or two imbalance settlement periods is missing, the gap may be filled on the basis of metering data on either side of the gap. Even here, primarily the cumulative readings will be utilised. Even an isolated gap must be estimated with discretion especially if no cumulative readings are available so that, e.g. the consumption during tariff-change periods in two-rate tariff sites will be correctly estimated.

If there is no data available for the previous consumption behaviour of the site, the data of a longer outage may be estimated using the load curve method.

The DSO should pay attention to sites where the main switch is switched on/off from time to time (summer cottages). The missing metering data for these sites should be estimated as zero because with the lack of data it is probable that the customer has switched off the power feed of the site from the main switch and therefore there is no consumption at the site. Therefore, the DSO will forward the lacking data for a site known to be a main switch site as zero data with an Estimated status.

Further information about the estimating methods of missing readings (active energy data of consumption metering points) is presented in Appendix 4 of this instruction and about data transmission in section 8.4 of this instruction.

Allocation of consumption without a time stamp at main switch sites:

[8] See link to datahub instructions under 1.5.3 Datahub's responsibilities. The matter is dealt with in section 3.3.2.3 Status processing of the Business Process instruction

- Sudden, extremely high individual registered metering data (spikes in consumption) may be problematic in terms of the electricity supplier or customer. The DSO's validations and the estimation procedures for missing readings must prevent any unfounded spikes remaining in the time series to be sent to the datahub.
- However, in certain situations that mainly concern main switch sites, spike use may be the best alternative to estimating missing readings.
- When a meter is primarily without power, for example, over a winter period, the systems usually estimate zero consumption at the main switch site. The meter clock will be set to zero during a long period without power. However, there may be short periods of electricity use at some stage during the winter, for example, at Christmas. If during this short period it has not been possible to contact the meter, the energy consumed during this time will have no time stamp at all.
- In this kind of situation when it is not possible allocate consumption during a short period without a time stamp to the correct time of use, all electricity metered without a time stamp during the winter will be recorded for the first commencing metering period next time when it is possible to contact the meter. This will avoid a correction of imbalance errors.
- This procedure can be used only in these kinds of special cases when for technical reasons it is not possible to obtain a correct time stamp for the metering data, and the metering data cannot be allocated correctly to the time of consumption and the amount of consumption without a time stamp is low.
- If consumption without a time stamp over a short period has been high, the situation must be estimated separately.

In addition, when starting to use the datahub, it must be taken into account that if the energy amount recorded for the first imbalance settlement period is so high that the validation of the datahub does not permit recording of the data, the energy must be distributed to several of the first imbalance settlement periods, if necessary.

6.5 Storage time for metering data

According to the Electricity Market Act, an electricity company must retain the metering data for six years from the event the metering data applies to. Further, according to the Electricity Market Act, the DSO may determine the datahub as the storage place of metering data. Therefore, the datahub has an obligation to retain the metering data as prescribed in the Electricity Market Act.

Invoicing data must be stored for 6 years as prescribed by the Accounting Act and the Electricity Market Act.

When considering the storage time for metering and invoicing data, it should be remembered that, according to the Terms of Contract, the contracting parties may, in principle, present a claim for their receivables based on invoicing, metering and meter reading errors for a period of three years, but the consumer may present a claim for their receivables for a maximum of 10 years if it is possible to afterwards verify the time when the error occurred and the impact of the error on invoicing.

6.6 Inspection of metering data

The DSO is responsible for the task of ensuring the accuracy of metering data. However, the supplier must notify the DSO of any errors detected in the received data. Inspections of metering data can be made either in the metering data management system or the reading system.

As hourly/15-minute energies are transmitted to the electricity market, the inspection of energy series in particular will be focused on in the following. The inspection aims to produce an uninterrupted time series for the electricity market, equipped with the correct time stamps and values and approved statuses. The measures described in the following may also be adapted to the cumulative reading series. It must be noted that the measures described in the following are examples and the DSO may also carry out inspections that deviate from these.

Verifying missing data

Metering data management must have procedures for detecting missing data from the time series. Based on the detected faults, measures must be launched in order to establish the missing values, as presented in section 6.4.

Inspection of excessively high values

As the impact of even one value on total consumption may be significant, metering data management must have procedures for the inspection of excessively high values. The main fuse of the metering point is meant to act as overload protection and, that way, to set a limit for the maximum value of electricity consumption. However, in the cold conditions of Finland, the fuse transmission coefficient in extreme conditions may be 2-2.5 times the rated current.

Inspection of average hourly/15-minute loads based on fuses can, therefore, be carried out with a simple maximum inspection based on the maximum value of the fuse size permitted for the metering point, taking the above coefficient into account. If the maximum value is exceeded, the DSO must inspect and, if necessary, correct the hourly/15-minute data. Before inspection, an oversized value may not be transmitted further.

Inspection of negative values

If the energies are calculated from cumulative figures, it is possible that the energy will be a negative figure. This situation may arise from a metering error, but it is also possible in connection with meter replacement.

Metering data management must have procedures for the inspection and correction of negative values. A negative value may not be transmitted onward by the DSO.

Inspection of statuses

Metering data management must have procedures for detecting the metering values, for which the meter has entered an error status. Based on the detected errors, measures must be launched in order to restore the statuses to approved ones in accordance with section 6.3.

Long series of zero values

A zero value for consumption is possible as such, but is usually an abnormal situation especially if the zero series is longer-lasting. As a result, it is recommended to implement observation of long zero series (e.g. 7 days).

However, as the zero value is possible, there is no reason to automatically change the statuses for the time series to Uncertain before the situation has been inspected at the metering site or the log data of the meter has been examined.

It is also possible to use a deduction mechanism on the nature of the metering site (e.g. summer cottage in the winter), on the basis of which it is possible to accept even longer zero series.

Inspection of total consumption

The objective of the inspection carried out on the basis of the annual consumption estimate for the metering point is to reveal a systematic metering error. This may arise, for example, from a coefficient error of indirect meterings or an undetected fault in the metering device.

It is recommended that this kind of an inspection is carried out on the measurements at least once a year. This inspection is particularly necessary if changes have been made to the metering procedure.

Inspections of metering data carried out by the datahub

In addition to inspections carried out by the DSO, the datahub will perform some inspections on metering data after its commissioning. Further information about inspections carried out by the datahub is available in the datahub instructions[9].

6.7 Netting and credit calculation within an imbalance settlement period

In accordance with the Government decree on the settlement and metering of electricity deliveries (767/2021), the DSO is entitled to implement for its customers netting of microgeneration within the imbalance settlement period, as well as a credit calculation service of an energy community within a real estate as described in Chapter 4, section 1a and 1b of the decree.

6.7.1 Netting within an imbalance settlement period

In netting within an imbalance settlement period (netting), electricity input and output, metered with the same metering equipment of the DSO, is added up with respect to each imbalance settlement period. This aggregated data is used in both imbalance settlement and customer invoicing. The requirement for the netting is that both network input and output are metered with the same metering equipment and that the maximum size of the electricity generating equipment is 100 kVA. Netting must be implemented so that, in terms of each imbalance settlement period, the sum of electricity amounts with network input and output during the electricity metering point's imbalance settlement in question becomes the data that is utilised in imbalance settlement and invoicing[10]. Separate metering time series are formed for both network input and output, and the value obtained as a result of netting is recorded in the metering time series of either electricity consumption or electricity production, depending on whether the end result of the sum calculation is attributable to network input or output.

The DSO may implement netting to its customers until 1 January 2023 when the datahub will start netting with respect to all microgeneration metering points.

6.7.2 Credit calculation of an energy community within a real estate

In credit calculation (credit calculation) of a local energy community or a group of active customers within a real estate, electricity fed into the network from electricity generation equipment or electricity storage facility, metered with the DSO's meter, is divided between the community's metering points as a calculated value with shares notified in advance by the community. The nominal rated output of the production plant or electricity storage must be below 1 MVA.

The division is made so that the amount of electricity drawn from the distribution network to the electricity metering point of a member of the community and the share of the electricity fed by the community into the network allocated to the same member of the community in accordance with the community's notification are added together during each imbalance settlement period (credit calculation).

If the share of the electricity subject to credit calculation, pertaining to the electricity metering point, exceeds the consumption of the metering point during the imbalance settlement period in question, the exceeding proportion will be fed into the distribution network for transmission. The community shall decide whether the electricity fed into the network after credit calculation will remain at each electricity metering point of each member of the community or in full at the electricity metering point where the electricity generation equipment or electricity storage is located.

If electricity distribution or supply has been suspended at an electricity metering point that is a member in the community, the share of the metering point in question shall be allocated in credit calculation to the metering point where the production equipment or electricity storage is located.

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[9] See link to datahub instructions under 1.5.3 Datahub's responsibilities. The matter is dealt with in section 3.3.2.2 Metering data validation of the Business Process instruction.

[10] Taking the signs into account. The sign rules are described in section 2.3.

Netting is carried out for the electricity metering point before credit calculation.

The production and consumption time series produced as a result of credit calculation shall be used in imbalance settlement and invoicing.

The DSO may provide the credit calculation as a service to its customers until 30 June 2023 at the latest. As from 1 January 2023, the datahub will implement the credit calculation for all interested customers.

7. Reading of standard meters and management of metering data

This chapter deals with the reading of a so-called standard meter and processing of metering data in accordance with section 1.6.1. A standard meter refers to a meter that does not meet the definitions for remotely read (hourly metering equipment, 15-minute metering equipment or new remote metering equipment) meters in accordance with the metering decree.

The number of standard meters in Finland is very low because Finland is a forerunner in remote metering and almost all metering points are covered by remote metering.

The accuracy requirements and operating limits of metering equipment described in section 2.1 of this instruction also apply to standard meters.

Imbalance settlement of metering points metered with a standard meter is based on a combination of a metering method with a type load curve and standard meter (type load curve procedure).

7.1 Continuous reading of a standard meter

A standard meter must be read at least four times a year. The DSO is responsible for at least one reading of a standard meter per year. Therefore, if the customer does not provide the other three readings after the DSO has requested them, the DSO may estimate the reading.

The DSO may carry out regular meter reading by utilising remote reading or visiting (itself or using a subcontractor) on site to read the meter. Metering data other than that read by the DSO itself at least once a year can be collected with the customer’s self-reading card or metering data reported by the customer in another way.

7.2 Reading of a standard meter in change situations of metering points

The DSO must read a standard meter in relation to the change of supplier or customer at the metering point. The reading is carried out within +/- 5 working days of the start/end time of the contract. Then, the error in the energies is so small that there is no need for separate adjustment of readings. The reading data must be recorded for the start/end time of the contract.

In supplier switching, the DSO may estimate the metering data if the customer has not submitted the metering data within a reasonable time set by the DSO after the DSO has requested it from the customer, or if the metering equipment is located in a place where the customer has no access to.

In moving situations (customer changes), the metering data is always recorded for the day of move. The customer may also read the meter if they have an opportunity to do so. The reading submitted by the customer must be used unless there is reason to suspect that there has been a reading error. If the customer does not submit a meter reading within the time limit despite requesting them to do so and the DSO has no access to the meter, the use of estimated readings is possible in these exceptional situations. The possibility of estimating the reading must be limited only to exceptional situations where, despite effort, it has not been possible to obtain a reading.

7.3 Imbalance settlement of the metering data of a standard meter

The imbalance settlement of metering points metered with a standard meter is based on the type load curve procedure.

7.4 Transmission of metering data of a standard meter to the datahub

Starting from the deployment of the datahub, the DSO must calculate the hourly energy for each electricity metering point pertaining to the type load curve procedure for each hour by multiplying the value of the reference curve by the ratio of the annual energy estimate of the electricity metering point expressed in kilowatt-hours and 10,000 kilowatt-hours. The reference curve is applied on the basis of the annual energy estimate for each time zone. The DSO notifies the hourly energy data to the datahub.

When a standard meter has been metered, the DSO must calculate final hourly energies for each electricity metering point pertaining to the type load curve procedure on the basis of data metered at the electricity metering point. The DSO must notify the final hourly energy data to the datahub to be taken into account in the balancing calculation.

Information exchange concerning the datahub is described in further detail in the datahub process descriptions[11].

[11] See link to datahub instructions in section **Virhe. Viitteen lähdettä ei löytynyt.** Datahub's responsibilities.

8. Transmission of metering data

This chapter deals with the transmission of metering data to the datahub for the purpose of invoicing and imbalance settlement.

Further information about data transmission is available in the datahub instructions gathered in the Datahub Services portal[12].

8.1 Transmission of metering data to the datahub

Metering data must be transmitted in accordance with the message traffic decree (tiedonvaihtoasetus) and the datahub instructions. Metering data must be transmitted provisionally to the datahub by 12 midnight on the day after the delivery date at the latest. Final notifications must be made within 11 days of the delivery date (=imbalance window).

The metering data to be transmitted shall be marked with jointly agreed statuses. The statuses and their use are presented in further detail in chapters 8.3 and 8.4.

The basic principle is that only new and changed data is transmitted to the datahub on a daily basis.

The transmission of metering time series observes the Finnish official time. The DSO sends the metering time series for a full 24-hour period according to the official Finnish time to the datahub. At the start of the summer time, the length of a 24-hour period is 23 hours and at the start of the winter time it is 25 hours.

If the site has production and consumption, separate metering points are established for network input and network output with separate time series, which are transmitted to the datahub.

8.2 Accuracy of metering data and rounding-off rules

Metering data is transmitted to all parties with the same accuracy. Metering time series concerning an individual metering point are transmitted between operators always with the same accuracy. At their most accurate, the data can be transmitted as MWh with six decimals and as kWh with three decimals, i.e. with an accuracy of 1 Wh.

The accuracy of the data must remain unchanged from the DSO's metering data management system to the datahub, i.e. no rounding-off is permitted in the transmission of data. On the invoice, consumption is rounded off, e.g. to kWh with mathematical rounding off. The DSO must ensure in all situations that wherever metering data is sent to from the network systems, the data must be sent with the same accuracy (incl. the DSO’s online service, the DSO’s invoicing, data sent to the datahub). When calculating sum series, the network must ensure that the sums are calculated with the same accuracy as the individual data is forwarded, i.e. the initial data of the sum calculation must be at the same accuracy as the end result is presented. This will ensure that the calculation of sum series will not result in rounding-off errors in the data, and the recipient should reach the same outcome by calculating the sum from their own initial data.

In addition to the metering data, the data transmitted to the datahub must also include the data unit (e.g. kWh/h or MWh/h).

8.3 Use and transmission of metering data statuses

It is important that the operator utilising the metering data knows how reliable the metering data in question is and how likely it is that the data will change later, and whether the data is based on meter data or whether it is estimated. The status of the metering data describes the reliability of the data to its recipient. However, the status processing rules allows that DSOs are able to use the statuses in different ways.

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[12] See link to datahub instructions in section **Virhe. Viitteen lähdettä ei löytynyt.** Datahub’s responsibilities.

The DSO must mark the metering data transmitted to the datahub with statuses in accordance with the datahub instructions. **The statuses used in the datahub are:**

- Missing
- Uncertain
- Estimated
- OK
- Corrected OK

The use of statuses and the replacement of a weaker status with a stronger one are also described in further detail in the datahub instructions[13].

The principles of the following table are applied in the use of statuses. The table shows the order of status from the weaker status to the stronger status.

Table 1. The principles of the use of statuses

Term	**When used**	**Correction**
Missing	• When there is no hourly data, preliminary data can be sent as zero use with the Missing status.	To be corrected with data provided with a same or stronger status.
Uncertain	• When it is suspected that incorrect data has been received from the meter, and it is assumed that more accurate data will be received at a later date. • When the missing data is estimated (within 5 days of transmission of preliminary data at the latest) and it is assumed that more accurate data will be received at a later date.	To be corrected with data provided with a same or stronger status.
Estimated	• When the hourly data is estimated and it is known that no other data will be obtained.	To be corrected with data provided with a same or stronger status.
OK	• When the data has been metered (is reliable). • When the data transmitted with a Missing or Uncertain status is corrected with the metered reading.	To be corrected with data provided with a same or stronger status.
Corrected OK	• When it is necessary to correct data transmitted with an OK or Estimated status. • Can also be used when it is necessary to correct data sent with a Corrected OK status. • Can also be used sites with no metering if sites are not of the load curve procedure.	To be corrected with data provided with a Corrected OK status.

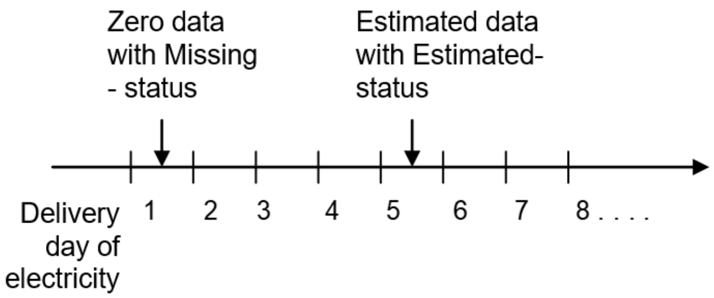
[13] See link to datahub instructions in section **Virhe. Viitteen lähdettä ei löytynyt.** Datahub’s responsibilities. The matter is dealt with in section 3.3.2.3 Status processing of the Business Processes instruction

8.4 Transmission of missing hourly data

If no metering data is obtained from the meter, preliminary data can be sent with a zero value and the *Missing status*. The missing data must be replaced with a stronger status within 5 days of the delivery date at the latest.

In the following, there are a few examples of the use of statuses when some of the data is missing.

1) The data is missing due to a fault in the meter, i.e. the data will not be received at all.



2) The data is missing due to a fault in connection. Metered data will be received at a later date.

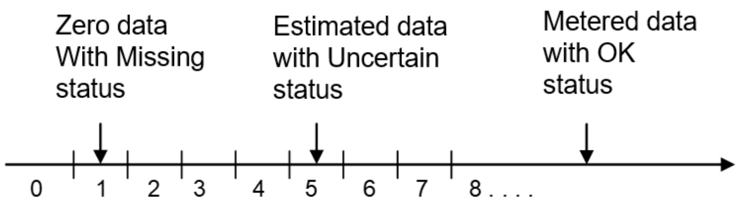


Figure 4. Examples of data transmission and the use of statuses.

It will be at the discretion of the operator whether to use metering data marked with the Uncertain status in its invoicing. Metering data marked with the Estimated status should be taken into account in invoicing because it is presumed that these will not be specified at a later date.

8.5 Transmission of metering data after the closing of the balances

The DSO must take all steps necessary to send the final metering data to the datahub within the imbalance window. This is the primary objective and part of the statutory tasks of the DSO. In exceptional situations, when the metering data changes after the balances have closed, the balances are corrected with a special procedure, for which separate industry guidelines have been provided[14]. Corrections to the metering data must be transmitted to the datahub.

After the imbalance window has closed, the changed metering data (metering data or status data) is sent to the datahub usually immediately when it is available. All metering data marked with an Uncertain status sent by the DSO must always be replaced at a later date either with the OK, Corrected OK or Estimated status.

[14] https://energia.fi/uutishuone/materiaalipankki/tasevirheiden_kasittelyohje_2021.html#material-view

8.6 Verification of the validity of metering data transmission

When sending metering data, it must be taken into account that the DSO is responsible for ensuring that the metering data gets to its destination until the DSO receives a positive acknowledgement from the datahub. If the acknowledgement is negative, the DSO must send the data again, corrected. If the DSO does not receive an acknowledgement from the datahub at all, the DSO must contact the datahub to find out the reason for the problem.

8.7 Transmission of metering data from meters subject to 15-minute metering

It will be possible to transmit 15-minute metering data to the datahub as from 1 January 2023. Before that date, the DSO must transmit the metering data as hourly data. If the DSO reads the metering data of a metering or production site with a resolution that is shorter than an hour (e.g. 15-minute metering), the DSO must in its own systems change the metering data to hourly metering data before transmitting it to the datahub.

When in this kind of case a status is given to the data in accordance with the imbalance settlement period, the following principles are complied with:

- If some of the data forming the metering data in accordance with the imbalance settlement period is missing, the status of the metering data in accordance with the imbalance settlement shall be Uncertain. The Missing status shall be used only if the data is missing for the entire imbalance settlement period.

- If the DSO uses cumulative start and end data for the duration of the imbalance settlement period when forming the metering data in accordance with the imbalance settlement period, the status of the metering data in accordance with the imbalance settlement period shall be OK. If, however, it uses only the energy data, the status is Uncertain even if the start and end data of the metering data in accordance with the imbalance settlement period was known.

8.8 Transmission of metering point data to the datahub

The DSO must transmit to the datahub other data concerning the metering point in accordance with the datahub instructions. This kind of data includes, e.g. information about whether there is controlled load connected to the meter at the metering point. The DSO must maintain metering point-specific data about loads controlled via the meter and about their timings and control restrictions in the way described in the datahub instructions[15].

[15] See link to datahub instructions in section **Virhe. Viitteen lähdettä ei löytynyt.** Datahub's responsibilities. The matter is dealt with in section 3.1.1 of the Business Processes instruction

9. Reporting of metering data to customers

Obligations regarding the reporting of metering data to customers are imposed in the metering decree and the Electricity Market Act.

Delivery of metering and consumption data to the customer

Section 75 e of the Electricity Market Act provides for the reporting of metering data as follows:

> *The DSO must provide the end user and electricity producer or a body appointed by them a copy of the metering and consumption data concerning the end user's or electricity producer's own electricity use and electricity production, which the DSO has collected from the metering equipment of the electricity metering point. The data must be provided with respect to each electricity metering point or metering event in a machine-readable, standard data format that is easy to edit.*

In the legislative history of the Electricity Market Act, it is also stated as follows:

> *The data gathered by the hourly metering equipment should be provided for the customer's use not later than at the same time as it is transferred or completed for transfer to the customer's electricity supplier. Standardisation concerning the format of data transfer should aim for as open a format as possible, being widely compatible with various analysis and control systems. However, the processing of data in a standard format into a suitable format for utilisation from their own perspective would be the responsibility of the end user and the electricity producer. The data could be transferred to the customer, for example, with the aid of the DSO's metering data system or directly from the metering equipment if the customer is using metering equipment suitable for that purpose, or from a centralised data exchange unit of electricity trade.*

According to the Electricity Market Act, the Energy Authority may provide more detailed provisions on the format of the data and on the procedure to be complied with in the transfer of data. At the time of drawing up the instructions, these kinds of provisions have not been issued.

According to the interpretation of Finnish Energy, an Excel/CSV file containing the metering point-specific metering data and downloaded from the DSO's online service constitutes a copy of metering and consumption data issued in a machine-readable, standard data format that is easy to edit, as referred to in the Electricity Market Act.

In connection with the deployment of the datahub, PRODAT and MSCONS message traffic will be terminated in the electricity retail market. The MSCONS message exchange of metering and consumption data to customers and bodies authorised by the customers can also be withdrawn after the deployment of the datahub.

According to section 75 e of the Electricity Market Act, the DSO can appoint the datahub to be the assignor of metering and consumption data. The DSO can provide the metering and consumption data in an online service or assign the datahub as the provider of the data, in which case the customer receives the metering and consumption data from the datahub in accordance with the datahub instructions[16].

According to section 75 e of the Electricity Market Act, the data must be transmitted to the end user without separate compensation.

According to ET's Finnish Energy's interpretation, it is not required by law to offer several alternative methods of data transmission (section 75 e of the Electricity Market Act specifically refers to the standard data format). If the customer or a party authorised by the customer requests the metering and consumption data in a way other than the online service or the datahub, if the DSO has assigned the datahub as the supplier of the data (e.g. as a file to be compiled and sent separately), a fee corresponding to the costs of this kind of tailoring and

[16] See link to datahub instructions in section 1.5.3 Datahub's responsibilities. Customer's access to their own data is dealt with in section 3.12 Customer access to own information in the Business Processes instruction

additional work should, as a rule, be charged due to the equal treatment of customers. Standard online service only includes the transmission of data in standard data format as required by law.

Transmission of metering and consumption data to parties authorised by the customer

Parties authorised by the customer have an equal right to the customer's metering and consumption as the customer themselves. The DSO may assign the datahub as the party transferring the data, in which case the party authorised by the customer will receive the metering and consumption data concerning the authorisation from the datahub. The management of datahub authorisations is described in further detail in the datahub instructions[17].

The service fees concerning service providers acting on the basis of the end user's authorisation and other third parties are subject to the datahub pricing in accordance with section 49 b of the Electricity Market Act (data exchange service fees of the transmission system operator with the system responsibility).

Transmission of real-time metering data

The metering decree also obliges the DSO to offer the customer at the customer's separate request new remote metering equipment that includes a RJ12 connector and real-time interface in accordance with the decree. The customer can utilise this interface for the monitoring of real-time electricity consumption. This is dealt with in further detail in section 2.13.

[17] See link to datahub instructions in section 1.5.3 Datahub's responsibilities. The authorisation processing is described in further detail in section 3.9.1 Authorisations granted by the customer in the Business Processes instruction

APPENDIX 1

DETERMINING TOTAL METERING ERROR

When determining total metering error, the following error factors are taken into account:

- Error of the energy meter
- Ratio errors in instrument transformers, i.e. current and voltage error
- Angle errors of instrument transformers
- Voltage reduction caused by secondary wiring in the voltage transformer (cabling and the transition resistances of auxiliary contacts of connectors, circuit breakers, throw-over relays or disconnectors).
- Angle error caused by voltage cabling (the impact is low)

Total error definition at the installation place is carried out as follows:

Measuring at the installation place is carried out either in a normal operating situation or with power supply devices. The metering devices used must be calibrated.

1. An error in the energy meter is measured with a portable inspection device.

2. In order to define the operating points of current transformers, the terminal voltages and secondary currents of the measuring windings are measured.

3. When measuring with a voltage transformer connection (measurement groups 3-5), in order to define the operating points of transformers, the terminal voltages and secondary currents of the measuring windings, as well as the secondary load, are measured.

4. If the energy metering has separate voltage cabling, the currents and secondary load of the measuring circuits are also measured.

5. The voltage reduction of voltage cabling is measured, when necessary, with a coaxial cable.

6. Errors in the operating points caused by instrument transformers are defined with error curves drawn on the basis of the transformer manufacturer's testing records.

7. The total error is calculated with the formula presented on the next page.

The total error of active energy metering is calculated on the basis of the measurement results as follows:

- $F_{kok} = f_{mitt} + \mathbf{f_{vm}} + f_{jm} + f_{uh} + k\,(\delta vm - \delta jm - \delta uh) \tan \varphi$
- The errors are inserted into the formula with their signs. The errors of instrument transformers are the averages of the components in different phases. The angle is entered as an absolute value.
- Fkok = total error
- fmitt = meter error [%]
- **fvm = ratio error of the current transformer [%] (THE MOST SIGNIFICANT FACTOR)**
- fjm = ratio error of the voltage transformer [%]
- fuh = ratio error due to the wiring of the voltage circuit
- δvm = angle error of the current transformer [min]
- δjm = angle error of the voltage transformer [min]
- δuh = angle error due to the wiring of the voltage circuit
- φ = phase angle
- $k = p / (180^{o}\ 60')\ \ 100\% \approx 0.0291$

As the most significant error factor especially in measurement groups 2-4 is the ratio error resulting from the incorrect design of the current transformers, an example of ensuring the operating load of the current transformer is presented in Appendix 2.

In measurement groups 3-5, the compatibility of the voltage transformers and the loads of the meters used must also be checked.

APPENDIX 2

TAKING THE INSTRUMENT TRANSFORMER LOAD INTO ACCOUNT

Example 1. Replacing an induction meter with a static meter. Is the load suitable? Current transformer 200/5A, rated load 5 VA

Method 1: By calculating

	1. Induction meter + wire 2 x 2.5 m	**2. Static meter + wire 2 x 2.5 m**	**3. Static meter + wire 2 x 3.4 m**
Meter load	0.500 VA	0.010 VA	0.010 VA
Connections	0.075 VA	0.075 VA	0.075 VA
Wire (separate, 2.5 mm2 Cu) load	0.875 VA	0.875 VA	1.190 VA
Load in total	**1,450 VA**	**0.960 VA**	**1.275 VA**
Load % of the rated load of the current transformer	29%	19%	25.5%
Is it within the permitted limits (25-100%)	Valid	**Not valid**	**Valid**

The meter load is stated in the technical specifications of the meter.

The value 0.075 VA can be used as the load of the connections

The load of the wire can be calculated or estimated with Formula 1. The calculation formula is:
$S = I_{SN}^2 \times \rho \times l/A = 5^2 \times 0.0175 \times 5/2.5 = 0.875$ VA, where
S = Load of the wire (VA)
I_{SN} = Rated secondary current (A)
ρ = Rated resistivity of the wire (Ω /mm^2/m), which with copper is
l = Wire length (m)
A = Cross-section of the wire (mm^2)

In this case, it is not appropriate just to replace the inductive meter with a static one, but extra load must be installed in the secondary circuit, **e.g. in accordance with column 3 in the table**, or the instrument transformers must be replaced with ones with a smaller rated load.

Method 2: With the figure and auxiliary table

The load of the wire is estimated on the basis of diagram 1. According to the figure, the load is 0.9 VA.

The circuit of the current transformer:

Rated load of the current transformer 5.00	VA	x	Minimum load (%) 25%	VA	=	Minimum load (VA) + 1.25	VA
Meter load 0.01	VA	+	Wire load (VA) 0.90	VA	=	- Load in total – 0.91	VA
Need for further load if the value is positive					=	+ 0.34	VA

If the value is positive, change into cross-section 2.5 mm2 or

install separate return wires or extra wire (2,5 mm2 Cu) as extra load:

+

2.5 mm2 Cu wire 0.175	VA/m	x	Length of extra wire (m) 2.0	m	=	- - Extra load (VA) – 0.35	VA

Therefore, 2 m of extra wire, i.e. 1 m for either direction, is needed as extra load.

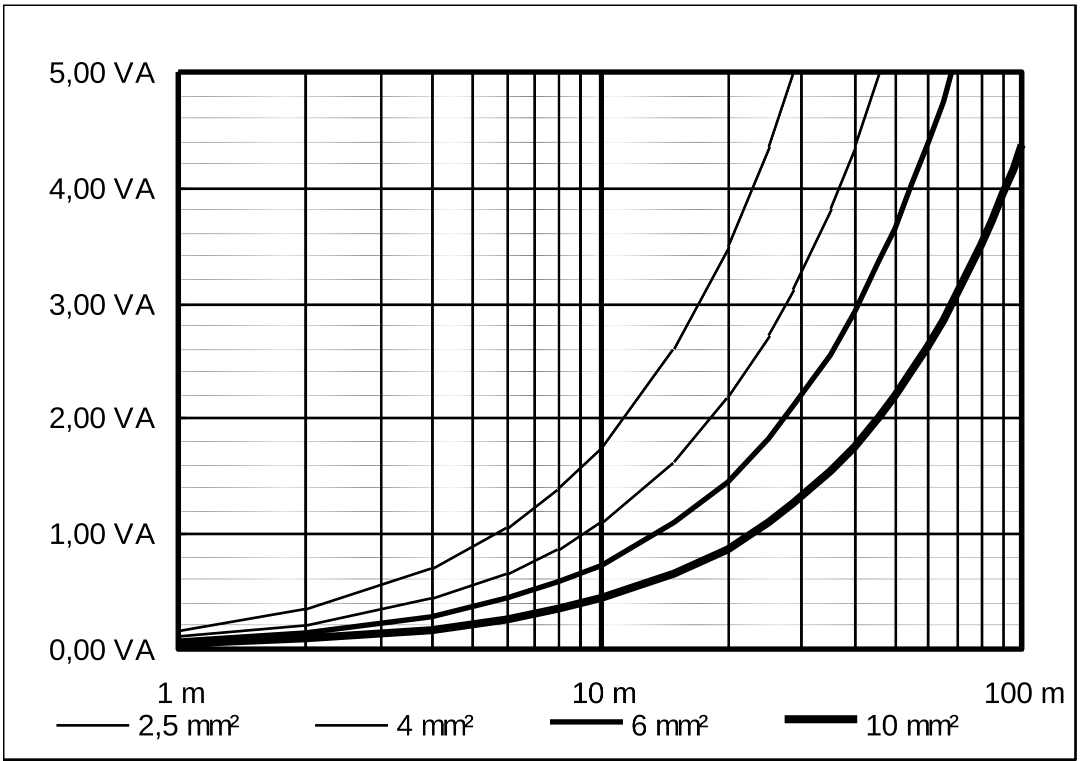


Figure 1. Load of the copper wire in a 5 A rated secondary circuit at different cross-sections (If a common return wire, distance only in one direction)

Inspection record: Carried out by:__________Time: _________

The circuit of the current transformer:

Rated load of the current transformer	VA	x	Minimum load (%) 25%	VA	=	Minimum load (VA) +	VA
Meter load (current side)	VA	+	Wire load (VA)	VA	=	Load in total –	VA
Need for further load if the value is positive					=		VA

If the value is positive, change into cross-section 2.5 mm2 or

install separate return wires or extra wire (2.5 mm2 Cu) as extra load:

+

2.5 mm2 Cu wire 0.175	VA/m	x	Length of extra wire (m)	m	=	- Extra load (VA) –	VA

The circuit of the voltage transformer:

Load of the voltage transformer	VA	x	Minimum load (%) 25%	VA	=	Minimum load (VA) +	VA
Meter load (voltage side)	VA	+	Load of other devices (VA)	VA	=	Load of devices in total –	VA
Change the voltage transformers or meter, if positive					=		VA

APPENDIX 3

INDICATIVE DESIGN FOR CURRENT TRANSFORMERS AT LOW VOLTAGE

Pre-fuse A for metering	Transformation ratio alternatives A/A	Primary punctures	Connected transformation ratio A/A	Coefficient
3 x 50	50/5	1	50/5	10
3 x 63	75/5	1	75/5	15
or	150/5	2	75/5	15
3 x 80	300/5	4	75/5	15
3 x 100	100/5	1	100/5	20
	200/5	2	100/5	20
	300/5	3	100/5	20
3 x 125	125/5	1	125/5	25
	250/5	2	125/5	25
3 x 160	150/5	1	150/5	30
	300/5	2	150/5	30
3 x 200	200/5	1	200/5	40
	400/5	2	200/5	40
3 x 250	250/5	1	250/5	50
3 x 315	300/5	1	300/5	60
3 x 400	400/5	1	400/5	80
3 x 500	500/5	1	500/5	100
3 x 630	600/5	1	600/5	120
3 x 750	800/5	1	800/5	160
3 x 800	800/5	1	800/5	160
3 x 945	1,000/5	1	1,000/5	200
3 x 1,000	1,000/5	1	1,000/5	200
3 x 1,250	1,200/5	1	1,200/5	240

Accuracy class	0,2S
Load	2.5 VA, the volt ampere amounts can be deviated from if it is indicated with an imputed value that the load is in the region of 0.25-1.0 of the rated load. If the total length of the secondary wiring between the metering device and the instrument transformer (supply+return wire) is over 6m, the design is established separately in each case.
Voltage circuits	2.5 mm^2
Circuit wires	2.5 mm^2
Terminal blocks	In accordance with SFS 3381
Voltage fuses	3 x 10 A plug fuse or residual current circuit breaker
Fuse of the control device	1 x 10 A plug fuse or residual current circuit breaker

APPENDIX 4

METHODS OF ESTIMATING MISSING METERING DATA

This appendix specifies the boundary conditions for estimating missing metering data by determining detailed methods for estimating missing metering data in various situations.

The estimation of missing metering data is the responsibility of the DSO. The calculation usually takes place in the metering data management system. The lack of metering data may be due to several different reasons, which also has an impact on the necessity of estimation and the method used. The missing metering data can often be retrieved from the meter register at a later date when, for example, a data communication connection problem has been resolved. However, sometimes the registering of data has completely failed, and in such a situation the data must be estimated also for the final balance data. The estimation must be made at the latest within 5 days of the time when the data is missing even if it was known that the correct metered data will be obtained from the meter register at a later date. Estimated data will always be replaced with the correct data obtained afterwards.

The imbalance settlement period will change from one hour to 15 minutes on 22 May 2023. The DSO may apply corresponding estimation methods when estimating hourly and 15-minute data as long as the estimation tool can take into account the imbalance settlement period used in each calculation.

The history data of the metering point must be utilised in the estimation whenever possible. It is also possible to utilise the readings of the cumulative metering data register in the estimation if they are available for the time before and after the outage. The total energy for the missing period can be calculated accurately as the difference of the cumulative readings.

In estimations, the status entered for the metering data depends on the reason for the lack of data.

- *Uncertain* status is used if it is possible that the metered values can still be obtained from the meter.
- *Estimated* status is not used until it is certain that the original metering data will not be obtained, for example, due to meter malfunction.

In practice, the data is usually estimated within 5 days with the status *Uncertain*, and the status will be changed later to *Estimated* if the actual metered values are not obtained.

All the statuses referred to in this appendix mean the general statuses determined in the chapter 8 and the datahub instructions for business processes[18], which are used in information exchange with other parties concerning metering point-specific metering data. In addition to these, the DSO may also have other statuses in its internal use.

This appendix deals only with the estimation of active energy in consumption metering points. The DSOs can implement production estimation methods in the way they deem appropriate if they so wish. Reactive energy has no impact on imbalance settlement or supplier invoicing, and therefore the DSOs can implement any methods of estimating reactive energy themselves if they so wish.

ESTIMATING METHODS

The most accurate estimation is reached when both the total energy for the missing period calculated from cumulative readings and history data from the previous consumption profile of the metering place are available. If total energy is not available, the estimation must primarily be made with the aid of history data alone.

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[18] Link to the instruction in section **Virhe. Kirjanmerkkiä ei ole määritetty.**1.5.3

History data is used for creating a metering point-specific profile based on the previous weeks' consumption. With the profile, it is possible to estimate the metering data of the missing period more reliably than, for example, using the generally determined load curve.

The metering point-specific profile is calculated for each imbalance settlement period using the average of the corresponding metering data for the previous weeks. I.e. a certain default value is calculated for each imbalance settlement period of the missing period on the basis of the corresponding imbalance settlement periods of the previous weeks. Periods matching the official time are always used in the calculation. Three previous effective values are included in the calculation as reference values. The values of the closest three weeks are not always available because there may have been, for example, a midweek holiday during the period in question. In such a case, values corresponding to the three closest previous weeks shall be used in as far as they are valid for use. Only two (and in extreme exceptional cases one) history data values can be used when it is not possible to obtain three values over a reasonable period from a time preceding the missing period. In the exceptional case when the missing period is exceptionally long (several weeks) or no useful reference values can be obtained from several previous weeks, the values of a corresponding period one year ago can also be used for calculating the profile.

If the customer of the metering point has recently changed, it is possible to use, for example, a general reference profile created by the DSO, based on, for example, the history data of other customers. Using the history data of the previous customer as such does not necessarily meet the requirements of the General Data Protection Regulation.

At sites from which there is no history data available at all, it is possible to utilise the DSO's experience of similar users when estimating the missing data. Alternatively, it is possible, e.g. to utilise the customer's annual consumption estimate (vuosikäyttöarvio, VKA) and the reference curve created by the DSO. However, these kinds of sites should not exist because the DSOs must ensure that the meter and the data transmission connection are fully functional before starting the transmission of metering data.

If the metering data is missing from a site with significant consumption over the missing period, case-specific discretion must be used in addition to the estimation methods presented in this instruction. It may be necessary to request the customer for further information about consumption during the missing period and utilise this information in the estimation.

The same level of accuracy is always used in the calculation by the DSO when transmitting the metering data to the datahub.

1. ESTIMATION WHEN CONSUMPTION DURING THE MISSING PERIOD IS KNOWN (INTERPOLATION)

When accurate consumption of the metering point can be calculated for a period with lacking metering data using cumulative readings, the consumption profile created with history data must be scaled for the missing period according to this determined consumption. That way, the correct metered consumption is obtained for the missing period, divided for imbalance settlement periods in accordance with the metering point-specific profile determined with history data.

Thus, the consumption of an individual imbalance settlement period is calculated according to the following formula:

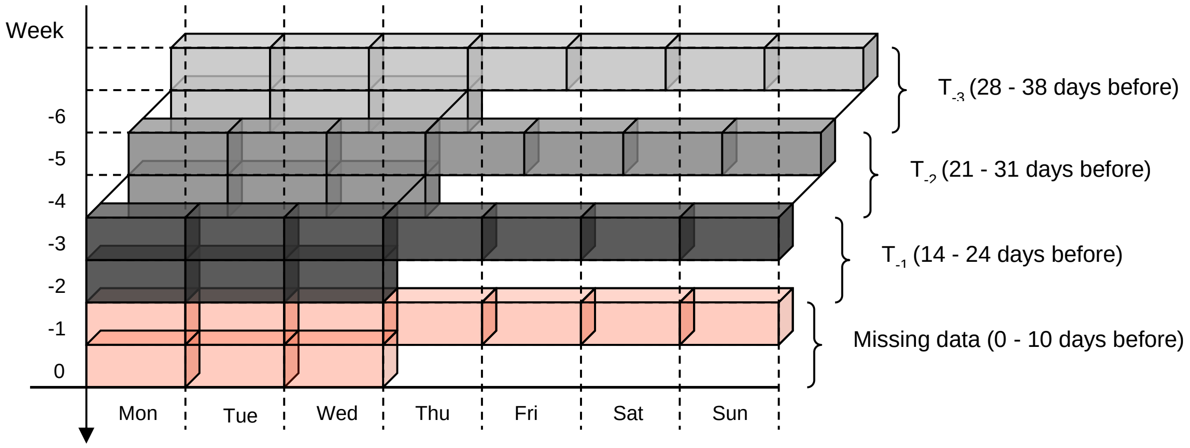
where W_{T0} is the consumption for the estimated imbalance settlement period and W_{T-1} is the consumption for the corresponding imbalance settlement period in the previous week, etc. W_{PKE} is the missing total energy, i.e. the total consumption for the missing interval

$$W_{T_0} = \frac{W_{PKE}}{W_{PKE_{T-1}} + W_{PKE_{T-2}} + W_{PKE_{T-3}}} \times \left(W_{T_{-1}} + W_{T_{-2}} + W_{T_{-3}} \right)$$

calculated from the cumulative readings. Correspondingly, $W_{PKE\ T-1}$ represents consumption for the corresponding period in the previous week, etc.

Only data for corresponding days is used in the calculation of the mean. I.e. if, for example, in the calculation of a weekday, the corresponding day in the previous week is a midweek holiday, the metering data for the day in question must not be taken into account when calculating the average, but the weeks included in the calculation of the average must be brought forward by one week. I.e. in the example case, when the midweek holiday takes place in week T_{-1}, weeks T_{-2} - T_{-4} are selected as the history data. More detailed instructions about estimating missing metering data for midweek holidays are presented later in this instruction.

If the length of the missing period is longer than one week, the above formula is applied so that the total energies missing from the previous corresponding periods included in the calculation start from the first possible moment from which it is possible to obtain the energy corresponding to the missing period. Thus, the periods may partly overlap as described in the following image. I.e. when the missing interval is, for example, 10 days long, the interval of $W_{PKE\ T-1}$ is 14–24 days before the end of the missing period. Correspondingly, the interval of $W_{PKE\ T-2}$ is 21–31 days before the end of the missing period.



2. ESTIMATION WITH HISTORY DATA ONLY (EXTRAPOLATION)

When accurate consumption of the metering point for the missing period is not available, for example, when the meter records only power or energy time series, the estimate must be made by imbalance settlement period in accordance with the profile calculated for the metering point with the metering data for the previous weeks.

Therefore, an individual metering data is estimated according to the following formula:

$$W_{T_0} = \frac{W_{T_{-1}} + W_{T_{-2}} + W_{T_{-3}}}{3}$$

where W_{T0} is the consumption for the estimated imbalance settlement period and W_{T-1} is the consumption for the corresponding imbalance settlement period in the previous week, etc.

With the extrapolation method, too, only the corresponding days must be used as history day, i.e. for example, midweek holidays must not be included in history data when estimating a normal weekday. With extrapolation, history data transmitted with the *Uncertain* status must not be used because the total energy for the missing period is not known and therefore that estimated energy may be incorrect when using uncertain history data. If this kind of a value turns up in the history data, the weeks included in the calculation of the mean must be brought forward by one week in the same way as in the previously mentioned midweek holiday case.

3. ESTIMATION OF SHORT PERIODS

If the metering data is missing only for a very short time (5 hours or less), the energy calculated from cumulative readings can be divided equally for the missing imbalance settlement periods.

However, in these cases, too, it is recommended to utilise the metering point-specific consumption curve calculated from the history data.

4. ESTIMATION OF MIDWEEK HOLIDAYS AND EVES OF HOLIDAYS

It is not possible to apply exactly the same estimation method for midweek holidays as for normal weekdays. When estimating metering data for a midweek holiday, weekdays according to the following table, or previous midweek holidays if they occur in the reference period, shall be applied as a reference point. Otherwise the calculation shall be made in the same way as in a normal case.

Midweek holiday	**Reference day to be applied**
Epiphany	Sunday
Good Friday	Sunday
Easter Monday	Sunday
May Day	Sunday
Ascension Day	Sunday
Midsummer Eve	Saturday
Midsummer Day	Sunday
All Saints' Day	Sunday
Independence day	Sunday
Christmas Eve	Saturday
Christmas Day	Sunday
Boxing Day	Sunday
New Year's Day	Sunday

The use of midweek holidays also works in the other direction, i.e. when estimating missing data for Saturdays and Sundays, the midweek holidays that occur during the reference period for the missing period can be used as history data.

5. SITES WITH A METERING DEVICE WITHOUT POWER

To avoid situations where the connection between the reading system and the meter is cut off when the customer switches on/off the main switch of the metering, it is recommended that remotely read meters are always connected so that the internal voltage of the meter remains even when the main switch is switched on. In such a case, the meter is able to send metering data according to zero consumption instead of a complete lack of metering data.

5.1. Sites not known to be main switch sites

The DSOs cannot know all so-called main switch sites, i.e. sites where the data transmission connection to the meter is cut off when the customer switches on/off the main switch. These sites may include, for example, summer cottages. When there is reason to suspect that the customer has caused the lack of metering data by switching off the meter voltage, the following procedure must be followed. First, the missing data is marked as zero with the status *Missing*. Within 5 days, the data is estimated in accordance with the principles presented above, and marked with the status *Uncertain*. Finally, when it is known that the site is a so-called main switch site, the metering data is changed to zero and the status is entered as *Estimated*.

5.2. Sites that are known to be main switch sites

In terms of sites that the DSO knows to be main switch sites, the estimation methods presented above are not applied, but the missing energies can be estimated directly as zero with the status of *Estimated* already within 5 days. The same procedure is used with sites, in terms of which the DSO knows that their voltages are cut due to repair works, faults or other similar reason.

EXAMPLES

EXTRAPOLATION (TOTAL ENERGY FOR MISSING INTERVAL IS NOT KNOWN)

When the total consumption of a missing period of time is not known, the consumption of an individual imbalance settlement period will simply be calculated as the average of corresponding imbalance settlement periods in the history data according to the following formula:

$$W_{T_0} = \frac{W_{T_{-1}} + W_{T_{-2}} + W_{T_{-3}}}{3}$$

where W_{T0} is the consumption for the estimated imbalance settlement period and W_{T-1} is the consumption for the corresponding imbalance settlement period in the previous week, etc.

Example 1, metering point with hourly metering: Hourly data is missing for the period 1.12.2010 on Wednesday at 10am – 8pm Finnish time, i.e. the data is missing for time stamps 1.12.2010 10.00 – 1.12.2010 19.00. In the example, hourly energy is calculated for the time stamp 1.12.2010 11:00, which therefore tells the consumption at 11 – 12. (N.B. the hourly energy time stamp is usually the starting moment of the hour in question)

The history data values of the metering point for the corresponding periods over the previous weeks are presented in the following:

Time stamp		Value [kWh]	Status
24.11.2010 10:00	W_{T-1}	1.34	OK
24.11.2010 11:00		1.70	OK
24.11.2010 12:00		1.45	OK
…			
17.11.2010 10:00	W_{T-2}	1.45	OK
17.11.2010 11:00		1.34	OK
17.11.2010 12:00		1.53	OK
…			
10.11.2010 10:00	W_{T-3}	1.23	OK
10.11.2010 11:00		1.22	OK
10.11.2010 12:00		1.11	OK

An individual hour is estimated as follows:

$$W_{T_0} = \frac{1.70 + 1.34 + 1.22}{3} = 1.42 kWh$$

The calculation must be made separately for all hours of the missing period.

Example 2, metering point with hourly metering: The hourly energies are missing for the period 1 December 2010 on Wednesday at 10am – 8pm Finnish time. In the example, the hourly energy is calculated for the time stamp 1.12.2010 11:00. In this example, one of the weeks in the history data has a weak status, and therefore it cannot be used.

The history data values of the metering point for the corresponding periods over the previous weeks are presented in the following:

Time stamp		Value [kWh]	Status
24.11.2010 10:00	W_{T-1}	1.04	OK
24.11.2010 11:00		1.70	OK
24.11.2010 12:00		1.41	OK
…			
17.11.2010 10:00	W_{T-2}	1.23	OK
17.11.2010 11:00		1.22	OK
17.11.2010 12:00		1.11	OK
…			
10.11.2010 10:00	Cannot be used	1.45	Uncertain
10.11.2010 11:00		1.34	Uncertain
10.11.2010 12:00		1.53	Uncertain
...			
3.11.2010 10:00	W_{T-3}	1.04	OK
3.11.2010 11:00		1.18	OK
3.11.2010 12:00		1.41	OK

An individual hour is estimated according to the following formula:

$$W_{T_0} = \frac{1.70 + 1.22 + 1.18}{3} = 1.37 kWh$$

Example 3, metering point with 15-minute metering: 15-minute data is missing for the period 5.12.2023 on Tuesday at 10am – 8pm Finnish time, i.e. the data is missing for time stamps 5.12.2023 10.00 – 5.12.2023 19.45. In the example, 15-minute energy is calculated for the time stamp 5.12.2023 11:30, which therefore tells the consumption at 11:30 – 11.45. (N.B. the 15-minute energy time stamp is usually the starting moment of the 15-minute period in question)

The history data values of the metering point for the corresponding periods over the previous weeks are presented in the following:

Time stamp		Value [kWh]	Status
28.11.2023 11:15	W_{T-1}	1.34	OK
28.11.2023 11:30		1.70	OK
28.11.2023 11:45		1.45	OK
…			

21.11.2023 11:15	W_{T-2}	1.45	OK
21.11.2023 11:30		1.34	OK
21.11.2023 11:45		1.53	OK
…			
14.11.2023 11:15	W_{T-3}	1.23	OK
14.11.2023 11:30		1.22	OK
14.11.2023 11:45		1.11	OK

An individual 15-minute period is estimated as follows:

$$W_{T_0} = \frac{1.70 + 1.34 + 1.22}{3} = 1.42 kWh$$

The calculation must be made separately for all 15-minute periods of the missing period.

INTERPOLATION (TOTAL ENERGY FOR MISSING INTERVAL IS KNOWN)

When the total consumption of a missing period is known with the aid of cumulative readings, the consumption of an individual imbalance settlement period is calculated according to the following formula:

$$W_{T_0} = \frac{W_{PKE}}{W_{PKE_{T-1}} + W_{PKE_{T-2}} + W_{PKE_{T-3}}} \times \left(W_{T_{-1}} + W_{T_{-2}} + W_{T_{-3}}\right)$$

Where W_{PKE} is the missing total energy, i.e. the total consumption for the missing interval calculated from the cumulative readings. Correspondingly, $W_{PKE\ T-1}$ represents consumption of the corresponding period in the previous week, etc.

<u>**Example 4, metering point with hourly metering:**</u> Hourly energies are missing for the period 1.12.2010 on Wednesday at 10am – 8pm Finnish time, i.e. the data is missing for the time stamps 1.12.2010 10.00 – 1.12.2010 19.00. In this example, the meter also records cumulative readings. (N.B. the time stamp for cumulative readings is the moment of registering the metering, and therefore the time stamps for hourly energies and the readings must not be mixed up. In the example, the hourly energy for the time stamp 1.12.2010 11:00 is calculated.

The cumulative readings recorded by the meter for the missing period and for the corresponding periods of history data are presented in the following:

Time stamp		Value [kWh]	Status
1.12.2010 10:00	W_{PKE}	9751.32	OK
1.12.2010 20:00		9766.32	OK
…			
24.11.2010 10:00	$W_{PKE\ T-1}$	9524.34	OK
24.11.2010 20:00		9540.34	OK
…			
17.11.2010 10:00	$W_{PKE\ T-2}$	9320.45	OK
17.11.2010 20:00		9334.45	OK

...			
10.11.2010 10:00	$W_{PKE\ T-3}$	9100.23	OK
10.11.2010 20:00		9112.23	OK

The total energy (1.12. at 10-20) for the missing period calculated from the cumulative readings is **15 kWh**. The total energies of the three previous corresponding periods are (24.11. at 10-20) **16 kWh**, (17.11. at 10-20) **14 kWh** and (10.11. at 10-20) **12 kWh**.

The hourly energies of the history data of the metering point for periods corresponding to the estimated hour are presented in the following:

Time stamp		Value [kWh]	Status
24.11.2010 10:00	W_{T-1}	1.34	OK
24.11.2010 11:00		1.70	OK
24.11.2010 12:00		1.45	OK
…			
17.11.2010 10:00	W_{T-2}	1.45	OK
17.11.2010 11:00		1.34	OK
17.11.2010 12:00		1.53	OK
…			
10.11.2010 10:00	W_{T-3}	1.23	OK
10.11.2010 11:00		1.22	OK
10.11.2010 12:00		1.11	OK

Thus, the hourly energy of the time stamp 1.12.2010 11:00 is calculated as follows:

$$W_{T_0} = \frac{15}{16+14+12} \times (1.70+1.34+1.22) \approx 1{,}52 \text{ kWh}$$

<u>Example 5, metering point with 15-minute metering:</u> 15-minute data is missing for the period 5.12.2023 on Tuesday at 10am – 8pm Finnish time, i.e. the data is missing for the time stamps 5.12.2023 10.00 – 5.12.2023 19.45. In this example, the meter also records cumulative readings. (N.B. the time stamp for cumulative readings is the moment of registering the metering, and therefore the time stamps for 15-minute energies and the readings must not be mixed up.) In the example, the 15-minute energy for the time stamp 5.12.2023 11:30 is calculated, which tells consumption at 11:30 – 11.45.

The cumulative readings recorded by the meter for the missing period and for the corresponding periods of history data are presented in the following:

Time stamp		Value [kWh]	Status
5.12.2023 10:00	W_{PKE}	9751.32	OK
5.12.2023 20:00		9766.32	OK
…			
28.11.2023 10:00		9524.34	OK

28.11.2023 20:00	$W_{PKE\ T-1}$	9540.34	OK
…			
21.11.2023 10:00	$W_{PKE\ T-2}$	9320.45	OK
21.11.2023 20:00		9334.45	OK
...			
14.11.2023 10:00	$W_{PKE\ T-3}$	9100.23	OK
14.11.2023 20:00		9112.23	OK

The total energy (5.12. at 10-20) for the missing period calculated from the cumulative readings is **15 kWh.** The total energies of the three previous corresponding periods are (28.11. at 10-20) **16 kWh**, (21.11. at 10-20) **14 kWh** and (14.11. at 10-20) **12 kWh**.

The 15-minute energies of the history data of the metering point for the periods corresponding to the 15-minute period to be estimated are presented in the following:

Time stamp		Value [kWh]	Status
28.11.2023 11:15	W_{T-1}	1.34	OK
28.11.2023 11:30		1.70	OK
28.11.2023 11:45		1.45	OK
…			
21.11.2023 11:15	W_{T-2}	1.45	OK
21.11.2023 11:30		1.34	OK
21.11.2023 11:45		1.53	OK
…			
14.11.2023 11:15	W_{T-3}	1.23	OK
14.11.2023 11:30		1.22	OK
14.11.2023 11:45		1.11	OK

Thus, the 15-minute energy of the time stamp 5.12.2023 11:30 is calculated as follows:

$$W_{T_0} = \frac{15}{16+14+12} \times (1.70+1.34+1.22) \approx 1{,}52 \text{ kWh}$$

MIDWEEK HOLIDAY

The three previous Sundays or midweek holidays are selected as the history data of missing metering data on a midweek holiday. Midsummer Eve and Christmas Eve are compared to Saturdays.

Example 6, metering point with hourly metering: The hourly data is missing for Epiphany 6.1.2011 at 00 - 24. Epiphany is a midweek holiday, and there are also several other midweek holidays in the weeks preceding it. The three previous corresponding days are the previous Sunday (2.1.2011), New Year’s Day (1.1.2011) and Boxing Day (26.12.2011). In the example, hourly energy is calculated for the time stamp 6.1.211 01:00 (i.e. 01:00 – 02:00).

The cumulative readings from the metering device:

Time stamp		Value [kWh]	Status	
6.1.2011 00:00	W_{PKE}	4711.40	OK	Epiphany
7.1.2011 00:00		4721.40	OK	
...				
2.1.2011 00:00	$W_{PKE\ T-1}$	4637.10	OK	Sunday
3.1.2011 00:00		4649.60	OK	
...				
1.1.2011 00:00	$W_{PKE\ T-2}$	4628.10	OK	New Year's Day
2.1.2011 00:00		4637.10	OK	
26.12.2010 00:00	$W_{PKE\ T-3}$	4561.55	OK	Boxing Day / Sunday
27.12.2010 00:00		4574.55	OK	

The total energy (6.1. at 00-24) for the missing period calculated from the cumulative readings is **10 kWh.** The total energies of the three previous corresponding periods were (2.1. at 00-24) **12.50 kWh**, (1.1. at 00-24) **9.00 kWh** and (26.12. at 00-24) **13.00 kWh**.

The hourly energies of the three previous corresponding periods of the metering point:

Time stamp		Value [kWh]	Status
2.1.2011 01:00	W_{T-1}	0.40	OK
...			
1.1.2011 01:00	W_{T-2}	1.07	OK
...			
26.12.2010 01:00	W_{T-3}	0.65	OK

Thus, the hourly energy of the time stamp 6.1.2011 01:00 is calculated as follows:

$$W_{T_0} = \frac{10.00}{12.50 + 9.00 + 13.00} \times (0.40 + 1.07 + 0.65) \approx 0.61$$

CHANGE IN SUMMER AND WINTER TIME

The change from summer time to winter time and vice versa causes a special situation in the estimation of metering data because in the 24-hour periods in question there are a total of either 25 or 23 hourly energies and either 100 or 92 15-minute values. However, the impact of the deviating number of the hours or 15-minute periods in the 24-hour period depends on the time system used in the meters and the metering database, which include, e.g. UTC time, normal time (UTC+2) and official time (winter and summer time used in Finland).

If the metering data is recorded in the metering database without a change in the summer/winter time, i.e., e.g. in normal time, it is not necessary to take the change into account and the data in the database can be used directly as history data in the normal way. On the other hand, in such a case, in connection with the time of change, the time stamps of the metering data of the history data do not fully match with the official time, but any error that may be caused is minor. However, the time stamps of metering data sent to the suppliers must always be changed so that they correspond to the official time.

If the metering data is recorded in the system according to the official time, the amount of data is deviating on two days a year. In such a case, the procedure according to the following examples shall be complied with.

Example 7, metering point with hourly metering: The hourly data is missing on 30.10.2011 at 02.00 – 06.00, at which time the summer time turns into winter time and the clocks will go back by one hour at 04.00 at night. Therefore, the 24-hour period includes two hourly energies with a time stamp of 03.00, which means that there are a total of 25 hours in the 24-hour period. The hourly energy is estimated for the time stamp 30.10.211 03:00.

For the sake of simplicity, in this example the total energy for the missing time is not known, and therefore the hourly energies are calculated by extrapolation.

The hourly energies of the missing time period of the metering point and the corresponding preceding periods:

Time stamp		Value [kWh]	Status
30.10.2011 02:00	W_{T0}	-	Missing
30.10.2011 03:00		-	Missing
30.10.2011 03:00		-	Missing
30.10.2011 04:00		-	Missing
…			
23.10.2011 02:00	W_{T-1}	0.48	OK
23.10.2011 03:00		0.81	OK
23.10.2011 04:00		0.52	OK
…			
16.10.2011 02:00	W_{T-2}	0.29	OK
16.10.2011 03:00		0.34	OK
16.10.2011 04:00		0.50	OK
...			
9.10.2011 02:00	W_{T-3}	0.85	OK
9.10.2011 03:00		0.93	OK
9.10.2011 04:00		1.02	OK

Both of the missing hourly data values with a time stamp of 30.10.2011 are estimated on the basis of the same hours in the history data, and therefore the values are the same:

$$W_{T_0} = \frac{0.93 + 0.34 + 0.81}{3} = 0{,}69 kWh$$

In a case where the hourly data would be missing 6.11.2011 03:00, i.e. the previous value in the history data would fall on the change of summer and winter time, only one of these two hourly data values marked with the same time stamp will be used, and the other two reference values of the estimation will be obtained from the previous weeks.

Example 8, metering point with hourly metering: The hourly data is missing 10.4.2011 00:00 – 08:00. Winter time changes to summer time on 27 March 2011, which is one of the reference times of the history data of the missing hourly data. Thus, the clock is moved forward by 03:00 hours, and therefore there is no hourly energy at all with the time stamp 27.3.2011 03:00. The hourly energy for time stamps 10.4.2011 03:00 and 10.4.2011 04:00 is estimated.

The complete lack of one hourly data value makes it more difficult to use the interpolation method because it is not possible to directly calculate the total energy of the history data corresponding to the total energy of the missing period for the period in question as a difference of the cumulative readings. In that kind of situation, therefore, when calculating the total energy, the energy of the hour preceding the hourly energy that is missing due to the move to summer time must be added to the $W_{PKE\ T-2}$ value calculated from the cumulative readings. That way, $W_{PKE\ T-2}$ includes the same amount of hourly data as the total energy for the missing period.

The hourly energies of the three previous corresponding periods of the metering point:

Time stamp		Value [kWh]	Status
10.4.2011 02:00	W_{T0}	-	Missing
10.4.2011 03:00		-	Missing
10.4.2011 04:00		-	Missing
…			
3.4.2011 02:00	W_{T-1}	0.48	OK
3.4.2011 03:00		0.81	OK
3.4.2011 04:00		0.52	OK
…			
27.3.2011 02:00	W_{T-2} (*)	0.29	OK
27.3.2011 03:00		-	-
27.3.2011 04:00		0.50	OK
…			
20.3.2011 02:00	W_{T-2} / W_{T-3} (*)	0.85	OK
20.3.2011 03:00		0.93	OK
20.3.2011 04:00		1.02	OK
…			
13.3.2011 02:00	W_{T-3} (*)	0.56	OK
13.3.2011 03:00		0.64	OK
13.3.2011 04:00		0.60	OK

(*)A value with the time stamp 27.3.2011 03:00 of the history data cannot be used for the time stamp 10.4.2011 03:00 because it doesn't exist. For this reason, the previous week's data is used in estimating the hour in question instead.

The cumulative readings from the metering device:

Time stamp		Value [kWh]	Status
10.4.2011 00:00	W_{T0}	3422.00	OK
10.4.2011 08:00		3429.00	OK
...			
3.4.2011 00:00	W_{T-1}	3366.00	OK
3.4.2011 08:00		3370.00	OK
...			
27.3.2011 00:00	W_{T-2}	3272.00	OK
27.3.2011 08:00		3280.00	OK
...			
20.3.2011 00:00	W_{T-2} / W_{T-3}	3190.00	OK
20.3.2011 08:00		3198.00	OK
...			
13.3.2011 00:00	W_{T-3}	3100.00	OK
13.3.2011 08:00		3105.00	OK

The total energy (10.4. at 00-08) for the missing period calculated from the cumulative readings is **7 kWh.** Correspondingly, the total energies for the previous periods corresponding to the missing period are (3.4.2011 00 – 08) **4.00 kWh**, (27.3. 00 - 08) **8.00 + 0.29 kWh**, (20.3. 00 - 08) **8.00 kWh** and (13.3. 00 - 08) **5.00 kWh**.

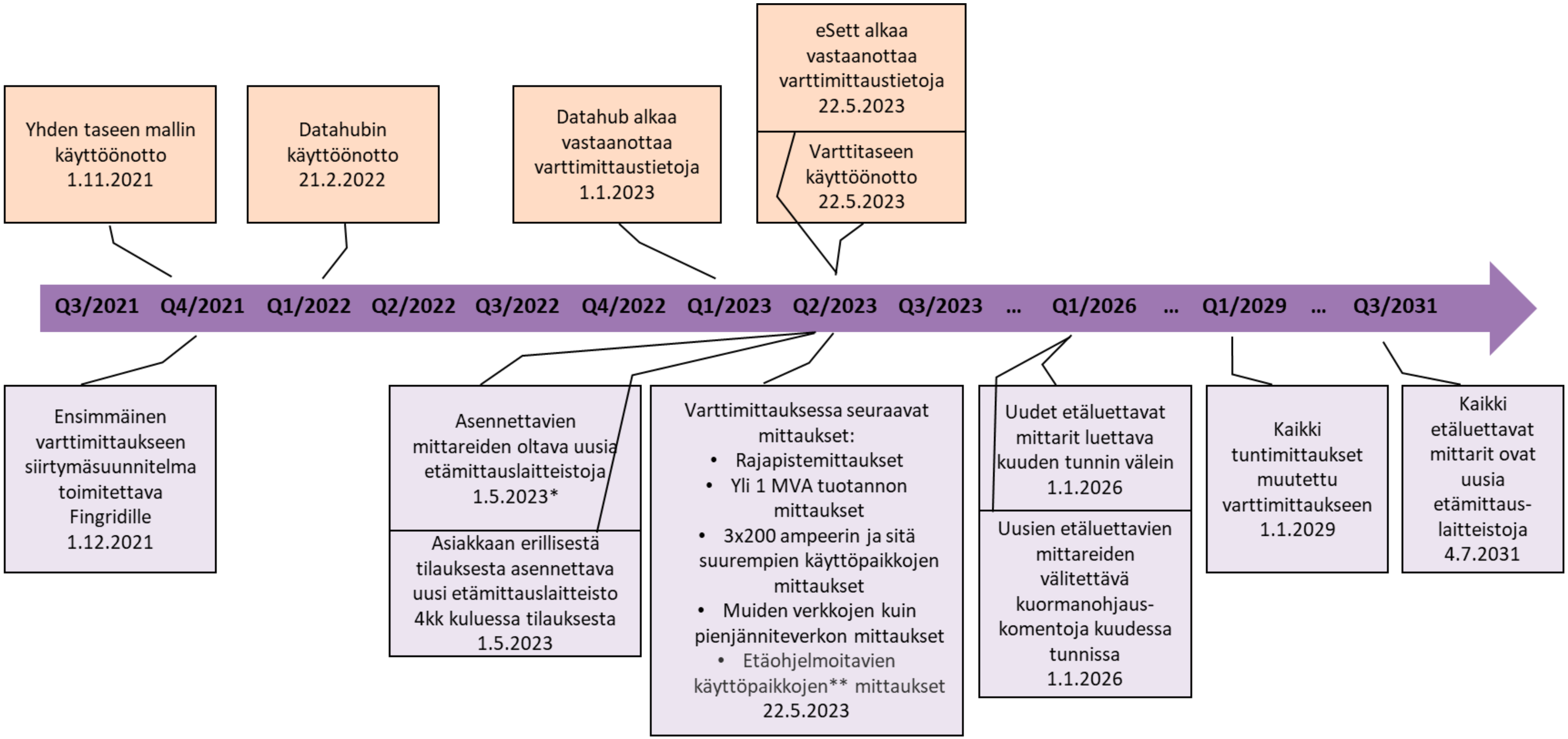
The hourly energy of the time stamp 10.4.2011 **03:00** is calculated as follows:

$$W_{T_0} = \frac{7.00}{4.00 + 8.00 + 5.00} \times \left(0.81 + 0.93 + 0.64\right) \approx 0.98 kWh$$

The hourly energy of the time stamp 10.4.2011 **04:00** is calculated as follows:

$$W_{T_0} = \frac{7.00}{4.00 + 8.29 + 8.00} \times \left(0.52 + 0.50 + 1.02\right) \approx 0.70 kWh$$

APPENDIX 5
TRANSITION PERIODS IN ACCORDANCE WITH THE METERING DECREE



*Mahdollisuus poiketa yksittäistapauksissa 30.6.2025 asti, silloin kun käyttöpaikan mittari joudutaan vaihtamaan vikaantumisen takia, eikä verkonhaltija ole vielä aloittanut nykyisten mittareiden korvaamista uusilla etämittauslaitteistoilla.

**Sellaisen käyttöpaikan mittaus, jonka mittauslaitteisto voidaan etäyhteyksin (käymättä paikan päällä) ohjelmoida varttimittauslaitteistoksi (varttimittauslaitteisto = varttitiedot tulee voida lukea päivittäin ja ne tulee tallettaa mittarin muistiin vähintään 11 vuorokauden ajan)