ESTONIAN ELECTRICITY SYSTEM SECURITY OF SUPPLY REPORT 2019

Tallinn 2019

FOREWORD

Where will electricity come from in Estonia in 2030?

I have recently often been asked where electricity will come from if the Narva power plants are closed. It is clear that transmission lines do not generate electricity and, to generate electricity, there has to be a power plant somewhere on the same electricity market. In addition, sufficient connections from the power plant to consumption have to be built to transport electricity from and to consumers. Let it immediately be said that the Estonian electricity system has for a long time already no longer only been based on the Narva power plants and, bearing in mind our climate goals, the future of the security of electricity supply in Estonia is not oil shale-fired power plants. Even if the regrettable malfunction at the Balti substation near Narva in May had had an impact on the operation of the power plants of Eesti Energia, it did not pose any risk to the operation of the Estonian electricity system as a whole. The risk of one producer, one power plant, to the security of electricity supply in Estonia has reduced to an acceptable level by today. In Estonia, the consumption has recently been near 800 MW, of which that generated in Narva accounts for approximately 400 MW.

Thus, the Estonian consumer's security of electricity supply has to be analysed considering a more comprehensive picture of electricity generation and transmission lines than only Eesti Energia's power plants or Estonia. We do that in everyday close cooperation with other electricity suppliers in Europe. The probabilistic and deterministic analysis performed in cooperation indicates an acceptable level of the security of supply in Estonia up to 2025. A power plant and wires somewhere in Europe are thick enough in order for electricity to reach the Estonian consumer. Even in the case of conservative presumptions (all old units of the Narva power plants are non-functional), the level of the security of supply in Estonia will meet the standards widespread in Europe. There may be emotions, but analyses produce clear results. In the electricity system, excessive investments have simply historically been made in the generation of electricity. Within the last 10 years, now this "excessive fat" has substantially run off in the system. This is good news for the consumer as the consumer has always paid it up either directly or indirectly.

The new security of electricity supply analysis that is binding on Member States and is to be performed on the basis of the Clean Energy Package on which agreements were reached mostly during the Estonian Presidency will be completed in 2020 and then we can say our best knowledge about 2030 and, if necessary, implement additional measures if only energy-based electricity market does not ensure adequate security of the supply level for the Estonian consumer. There is no reason to rule out any solution, let it be the formation of a strategic reserve or the capacity market. However, when considering the options, it must be taken into account that the consumer has to pay the invoice for these additional measures.

Two sides of the same medal: higher security of supply, higher price

The first question, when talking about the electricity supply of Estonian electricity consumers, is whether the power plant supplying Estonian consumers has to be in Estonia or whether it may be in Latvia. In the case of the supply with foodstuffs, we are ready to accept a situation where the supply of Estonia with food is based on a global foodstuffs market, because it is more reasonable this way. The same also applies in the case of electricity. The smaller the electricity system, the less efficient investments in the generation of electricity are, considering the consumption load of a specific country only. Over the period of the last four years, the consumption load in the Estonian electricity system has been in the case of on average only 12 percent of hours of the year higher than 1,200 megawatts. Approximately 600 MW of the generation capacity with the estimated cost of less than half a billion euros would find a use only during 1,100 hours or less out of the 8,760 hours of the year. Thus, this is an important issue of high-price choice for Estonia. Whether we will continue with the strategy according to which it is great to own an integrated market and connections, but we should have the entire generation capacity in our own "backyard", just in case. In the event of such an approach, the consumer would pay approximately half a billion euros more, compared to market-based investments. This would be the case in a situation where a power plant in Latvia ensures better security of supply for a consumer in Valga, because the main bottleneck in the Estonian-Latvian electricity system up to 2025 is altogether located between Narva and Tartu.

Elering is responsible for ensuring consumer's security of supply at a reasonable price. The smaller the area, the greater the security that we want, the more expensive it will be for the consumer. Every medal has two sides and we have to talk about them in conjunction. Whatever we want to do here in Estonia, which is not economically rational on the common European energy market, our customer has to pay it up. It is impossible to build a power plant that is economically not rational on the energy market and say that we want an electricity price that supports economic development at the same time. Or we as a society have to solidarily pay this inefficiency up instead of the industry. Thus, the security of supply standard is a balancing act between a reasonable security of supply level and cost for the society. Every socio-economic analysis certainly says that low electricity price is more useful for the Estonian society than the expensive one, because most of the additional expenses that we would pay for more expensive electricity would not remain in Estonia, but would move out of Estonia.

According to the economic reasonableness described above, we have said that Member States of the European Union and the European Economic Community are acceptable from the standpoint of the Estonian consumer's security of electricity supply. We have invested hundreds of millions in building connections between countries and integrated our own electricity market with the European electricity market. For example, at the moment we are working on investments in the electricity system in the Latvian direction in the amount of approximately 400 million. However, at the same time we are making a very clear choice – Russian electricity is not acceptable. The impact, including trade impact, of Russia in our electricity sector has to end. For this purpose, we have agreed on synchronising the electricity system of the Baltic States with continental Europe. According to the current agreement, there will be no electrical connections with Russia and Belarus after the synchronisation with continental Europe. Why? Because we see no outlook for setting the electricity markets of the European Union and Russia-Belarus into operation on the basis of the same rules. If no trade exists, there is also no need to build any connections. This is also the reason why today trade with Russia will have to last up to 2025, even if Russian electricity causes unfair competition on the Baltic electricity market. I have no doubt that today Russia is also looking at the existing lines using the same logic – if no trade exists, there is also no need for lines.

The year 2025 will put an end to unfair competition by Russian/Belarusian producers. Until then we have to put up with the idea that Russia provides us with electricity. The impact thereof has, however, been very much overestimated. If in 2018 the Baltic and Nordic countries generated approximately 420 TWh of electricity, then 13.3 TWh, i.e. about 3%, were imported from third countries (via Lithuania and Finland). Therefore, the cessation of this import would not have a very noticeable impact on the market price of electricity of the Baltic and Nordic countries.

The factor behind the closure of Estonian power plants is not unfair competition from Russia (which is certainly not acceptable), but the inability of those plants to operate on the energy market the rules of which have been created for achieving our own climate goals of 2030/2050. And this provides a starting point for the future – Elering looks at the Estonian energy market and energy system according to the goals set in the Estonian National Energy and Climate Plan. Energy policy is not value-free and the goals of the climate policy are something that we will take into account when planning the operation of the future energy system to reduce the carbon footprint of the Estonian energy system.

Market-based solutions

The more market-based power plants Estonia has, the better. We have always worked with the aim of making the process of connecting to the Elering network easier, cheaper and faster for power plants via flexible connection and buying standard connection equipment in advance. We understand that electricity is generated by power plants, not by power lines. The best power plants are those built on the market-based principle. Today, nobody prohibits building power plants in Estonia. There is no need to obtain a permit from the Planning Committee for building a power plant. On the contrary, go ahead and build! But do not ask for any subsidies. The Estonian consumer is unable to pay up the capacities that would result in a significant change in the generation/consumption balance on the European Union energy market. We could consider that connections and integration of markets will not create for us import capability, but export capability. And the active entry of Eesti Energia, Eesti Gaas, Alexela and other market participants to the energy market of the region is a good and the only possible strategy that has to be supported. We see the energy sector as an export sector of strong growth potential in Estonia, which creates jobs and welfare much more than it could ever be done based on the domestic demand. And this is the case when either simply selling energy or offering altogether technological solutions and selling the added value arising from the use of renewable sources.

I have heard lots of rhetoric that future electricity prices in Estonia will be high and the electricity demand will be higher than the supply. I don't know that. However, if anybody believes it, then this is the right place to invest in. The best output for confirming the strength of one's belief is to invest one's money against it. And it seems that there is such belief outside of Estonia. In the Nordic countries, market-based investments seem to be made in terms of gigawatts in wind and solar plants substantially with no support (the last auctions in the Nordic countries have brought solar/wind supports to the level of €2-3/MWh). Let it be said that the peak consumption in Estonia is 1.6 GW.

Alternative electricity supply scenarios

Elering does not see any probabilistic events that could lead to the collapse of the European electricity system and market. Despite that, in addition to the conventional pan-European generation and network adequacy analysis, we will also look at supplementary electricity supply scenarios in Estonia, should anything improbable happen, and prepare the Estonian electricity system for coping with them.

First, we have considered the scenario of emergence of a separate Baltic synchronous area. The synchronous operation of the Baltic States with the Russian unified energy system has ended fast and without agreement. In such a situation, the entire Baltic electricity system has to continue its operation in the present form and the electricity supply of all consumers has to be covered. Such a situation cannot be ruled out.

Second, the Baltic emergency continuity scenario – the Baltic States will operate as a separate synchronous area and due to an attack or another similar event we will also lose all direct current (DC) connections with other regions (Estonia-Finland, Lithuania-Poland and Lithuania-Sweden connections). In such a situation, domestic consumption as well as the consumption of vital service and general-interest service must be covered. The coverage of industrial consumption will not be ensured. Such a scenario is rather unlikely.

Third, the Estonian vital service scenario – Estonia has remained completely alone. In addition to the interruption in connections with Finland (2 EstLink connections) and Russia (3 alternating current (AC) connections), connections with Latvia (2+1 AC connections) have also been interrupted. In such a case, we will not ensure the possibility of switching on an electric sauna heater at home at any time. Such a scenario is not likely.

Based on the performed analysis, the security of supply will also be ensured in the case of all the three unlikely scenarios up to 2029.

Security of supply standard

It is all the same to the customer whether the reason behind the interrupted electricity supply at home is the lack of a power plant or no proper operation of the transmission system or distribution network. The purpose of electricity supply is to keep the lights on in our consumers' homes. Thus, it is important to ensure the operation of the electricity system as a whole in the manner that keeps the lights on in our consumers' homes at any moment of time.

Why is it important? To the same extent as for example a solution consists in new generation capacities, a solution can also be consumption management or storage technologies. Why aren't I a fan of a capacity market? This is because a capacity market is, as for its nature, the same support scheme as the renewable energy support, which we collect from consumers in the amount of 80 million euros a year in order to pay to producers, is at the moment. Granting such a subsidy to conventional power plants deprives effective new technologies and business models of the opportunity to enter the energy market. But let it in conclusion still be restated that if we establish a security of supply standard and the pan-European generation and network analysis to be performed in 2020 indicates that the possible number of hours where even 1 MW is missing to cover the total consumption, the possibility of making additional investments in flexible resources, such as managed generation capacities, managed consumption or storage capacities, has to be considered. It would be nonsense to rule out such solutions.

Taavi Veskimägi
Chairman of the Elering management board

SUMMARY

The Security of Supply Report 2019 assesses the security of supply in the entire electricity value chain view:

<table>
<tr><th>System reliability</th><th>Network adequacy</th><th>Generation adequacy</th><th>Cybersecurity</th></tr>
<tr><td>The capability to keep the electricity system as a whole together and operational and to cope with various disruptions and malfunctions</td><td>Adequate transmission capacities and connections with neighbouring systems ensure the functioning of the market and, in the case of major malfunctions or domestic deficit, import capability. The transmission network ensures that electricity reaches consumption centres. The distribution network takes care that electricity reaches the end user.</td><td>Adequate electricity generation ensures that generation and consumption are in balance in the electricity system at any moment of time. The generation adequacy assessment is based on various scenarios that are used to analyse possible situations and the state of generation adequacy in those situations.</td><td>System management becomes more and more complex and dependent on information technology systems. Against this background, cybersecurity is an important pillar for ensuring secure operation of the system.</td></tr>
<tr><td colspan="4" align="center">Consumption</td></tr>
<tr><td colspan="4" align="center">Directing customers’ consumption habits (e.g. the market platform of flexibility services) allows increasing the involvement of consumers on the electricity market. Flexibility services allow consumers to offer their consumption capability on the market as equivalent service to the generation of electricity.</td></tr>
</table>

Scenarios	**Consumption**	**Generation**	**Network connections [1]**	**Estimated probability [2]**
European energy market scenario (5.1.1)	Covering entire peak consumption	Generation used by Europe as a whole	European transmission capacities used	>90% (expected)
Baltic synchronous area scenario (5.1.3)	Covering entire peak consumption	Generation used by the Baltic States as a whole	AC connections in operation; DC connections in reduced volume	<10% (possible)
Baltic emergency continuity scenario (5.1.4)	Covering reduced peak consumption	Generation used by the Baltic States as a whole	AC connections in operation; no DC connections available	<1% (rather unlikely)
Estonian vital service continuity scenario (5.1.5)	Covering the consumption of vital service and general-interest service	Generation used by Estonia as a whole	No AC connections available; no DC connections available	<0.1% (not likely)

According to the security of supply analysis, the security of supply in Estonia will also be ensured up to 2025 if the Narva units are partially closed down (see clause 5.5.1). There are open risks in the case of more long-term security of supply in respect of which sufficient measures will have to be implemented, if necessary.

[1] *Network connections with third countries are not taken into account.*
[2] *Expert assessment.*

MORE IMPORTANT CONCLUSIONS OF 2019

Based on the analysis of this Security of Supply Report, the security of supply of the electricity system of Estonia and the Baltics is ensured. Due to the fast-changing environment, constant development of the electricity system and energy markets will also have to be continued to ensure the security of supply in the future.

System reliability

Due to the developments in the Unified Power System of Russia (hereinafter IPS/UPS), a systemic risk has emerged to date, the most severe form of which is separation into a separate synchronous area of the Baltic States. To reduce the risks and ensure the stability and reliability of the electricity system, we will carry out the project for synchronising the Baltic States with the continental European frequency area. Within the framework of the project:

1. We will develop the capability of the Baltic synchronous area – the capability to cope with an unexpected islanding in the Baltics exists already today, but, to maintain the stability of the system, short-term large-scale automatic restriction of consumers will have to be imposed on island mode operation in the case of major malfunctions. Through additional developments and measures we will achieve capability for a long-term synchronous operation in an N-1 (switch-off of any one element) situation without imposing any automatic restrictions on consumers. The most important measures are:
   - Ensuring adequate inertia – this ensures the maintenance of the stability of the system in the case of malfunctions and better frequency stability in an ordinary situation. To synchronise the electricity system of the Baltic States with the continental European electricity system, it is necessary to ensure that there is an adequate quantity (17,100 MWs) of inertia in the system of the Baltic States at any moment of time. After partial closure of larger power plants in Estonia, it is already earlier necessary to replace some capacities with equipment that provides the system with inertia in order to ensure the reliability of the system for limiting frequency deviations following malfunctions.
   - Development and implementation of the system services framework – system services include power management and voltage control reserves of different levels.
   - Fast emergency reserves through the existing HVDC submarine cables between the Baltic and Nordic countries as well as those to be established between Lithuania and Poland.
2. The currently implemented synchronisation solution, connecting to the continental European synchronous area along with the planned investments, will not limit the transmission capacities within the Baltic countries or in the direction from the Baltic to the Nordic as well as continental European electricity systems. Thus, the trading opportunities of market participants inside the European Union will not deteriorate.
3. Thanks to the European cofinancing, synchronisation with continental Europe, compared to the situation where the Baltic electricity system was connected to the IPS/UPS system, will not increase the transmission rate.

Network adequacy

The current situation concerning the transmission network adequacy is good:

- Thanks to the systemic maintenance of line routes and the 'Making lines tree-free' programme, the quantity of electricity not served due to the transmission network failures has significantly been reduced. In 2018, the energy not served due to the transmission network failures accounted only for 18 MWh (the annual electricity consumption of an average household is approximately 10 MWh).
- High usability of HVDC submarine cables: EstLink 1 – 92.66% and EstLink 2 – 98.45% (in 2018).
- The need for restrictions in respect of management of the domestic transmission network loads has been minimum, practically close to none.

To ensure long-term reliability and minimise the energy not served due the non-functioning transmission network, we will carry out the following developments and activities:

- To ensure adequate capacities in the Latvian direction, the third Estonia-Latvia connection will be

completed in 2020.
- Within the framework of the synchronisation project, we will reconstruct the 1st and 2nd Latvian-direction existing 330 kV overhead transmission lines (Narva-Valmiera).
- We will further develop the condition and risk-based system for the maintenance and replacement of equipment in order to minimise the energy not served due to failures of equipment or network parts even more efficiently.

We will update the long-term network development plan in cooperation with distribution network operators for the purpose of (read more in the 'Electricity Network Developments' Chapter):

- finding optimal investment alternatives considering the lowest cost to society;
- ensuring an increase in the security of supply as well as the management of electricity supply risks in major consumption regions; and
- reducing variable expenses.

Generation adequacy

Estonia is a part of the European electricity market and therefore the generation adequacy assessment is primarily based on a pan-European generation adequacy analysis (Mid-term Adequacy Forecast – MAF) prepared by ENTSO-E. The MAF probabilistic generation adequacy analysis, which was published in autumn 2018 and where calculations were made, as estimates, in respect of approx. 130 different years, has set out two scenarios up to 2025. As a result of both of the scenarios, the annual average Expected Energy Not Served (EENS) was calculated along with the average Loss of Load Expectation (LOLE).

- baseline scenario (LOLE 0 h/y; EENS 0 MWh/y),
- low carbon scenario (LOLE 2 h/y; EENS 500 MWh/y).

Based on the MAF analysis, it can be concluded that **in 2025 there will be no security of supply problem arising from generation adequacy in Estonia.**

The pan-European generation adequacy analysis requires a functioning European electricity market and does not take into account possible events of low probability. For the aforementioned reasons, Elering also analyses, in addition to the pan-European MAF analysis, supplementary continuity scenarios:

- **Baltic synchronous area scenario** – the synchronous operation of the Baltic States with the IPS/UPS unified energy system has ended fast and without agreement. All the consumption has to be covered.
- **Baltic emergency continuity scenario** – the Baltic electricity system has fallen into island mode operation and has also lost all DC connections with other regions. Domestic consumption as well as the consumption of vital service and general-interest service has to be covered.
- **Estonian vital service scenario** – the Estonian electricity system has extraordinarily remained in island mode operation and all 5-7 electrical connections with other countries have been interrupted. The consumption of vital service and general-interest service has to be covered.

The security of supply will be ensured in the case of all the analysed continuity scenarios up to 2029. (For further analysis, read Chapter 3.)

To improve ensuring long-term generation adequacy, the following activities will have to be carried out:

- To assess the conformity of the generation adequacy level of Estonia, it is necessary to develop, in cooperation with responsible ministries and the Competition Authority, **the security of supply standard.**
- To obtain reserves necessary for synchronising with the continental European electricity system, we will develop **market mechanisms for system services**. System services markets make it possible, on the one hand, to ensure a functioning electricity system and, on the other hand, provide market participants with an opportunity to earn additional income. New system services markets constitute, in addition to the existing manual frequency restoration reserve (mFRR), also an automatic frequency restoration reserve (aFRR) and frequency containment reserve (FCR).
- **The impact of market disruptions will have to be reduced** on the European electricity market. Various

market disruptions and activities can be examined in Elering's electricity market vision. [3]

- To ensure secure electricity supply for the consumption of vital service and general-interest service, a detailed assessment of the respective consumption volume will have to be carried out and the electricity supply for such consumption will have to be ensured in crisis situations.

[3] *Published in the Security of Supply Report 2018 – can be found on the website of Elering.*

Cybersecurity

In 2018, no such cybersecurity incidents occurred in transmission networks, due to which electricity was not transmitted to consumers. The increasing dependence of the electricity system on IT requires from critical ICT (information and communications technology) systems high reliability and focus on external risks.

Cybersecurity of the energy sector is a field that develops fast, due to which in the near future Elering will face several challenges to guarantee reliability and security of the electricity system management in order to be able to continue the digitalisation of the electricity system. To maintain the level of cybersecurity, we apply the following:

- Constant and systemic assessment of cybersecurity risks, involving various parties in order to ensure a uniform overview of risks.
- Vital service continuity risk analysis and plan comprise the cybersecurity component.
- We participate in practical training exercises and practice the resolution of incidents in order to be ready for various situations.
- New cyberthreats bring along the need to invest in the existing and new security solutions.
- It is necessary to train the existing management system specialists and find employees who specialise in the security of management systems.

1 Assessment of security of supply

- ***Ensuring the security of supply is a regional challenge. The solutions are also regional.***
- ***Based on the pan-European assessment, the security of supply in Estonia and the region will be ensured through the combined effect of generation and transmission capacities up to 2025.***
- ***To ensure the security of supply for the longer term, a functioning electricity market must be guaranteed, as it will draw investments in new generation capacities or the consumption management capability.***
- ***The existing generation and transmission capacities also serve as a good basis for coping with various crisis scenarios.***

3.1 REGIONAL SECURITY OF SUPPLY UP TO 2034

Based on the long-term nature of planning the energy sector and pursuant to the specifications of subsection 39 (7) of the Electricity Market Act, Elering takes a 5 to 15-year view of long-term security of supply. In conditions where Europe has an energy union and a single electricity market, Elering takes a pan-European and regional-level view of long-term security of supply. The analysis of long-term security of supply is threefold. First of all, the security of supply situation is viewed in Europe as a whole on the basis of the ENTSO-E analysis. Then, the analysis assesses the Baltic and Finnish regional security of supply and Estonian consumption and generation developments in more detail. The security of supply analyses has been completed in cooperation between Elering and TalTech experts.

3.1.1 European security of supply based on ENTSO-E MAF

Every year ENTSO-E prepares a pan-European generation adequacy report (Mid-term Adequacy Forecast – MAF)[4]. The report is based on the data provided by European system operators about the generation capacities of every country and the Pan-European Market Modelling Database (PEMMDB) comprising the collected data. The report covers the period of up to 2025 and the results include the generation adequacy indicators of all European countries. The analyses of the next years will be based on the data set out in the national energy and climate plans to be submitted by all EU countries.

The generation adequacy is assessed using the probabilistic method. The methodology is based on the Monte Carlo method, which involves a simulation of a large number of years, taking into account changes in consumption, wind generation, solar generation, hydrological situation and malfunctions in system elements. In this analysis, 136 different years were used. Each year has 8,760 hours, which have values for consumption, wind generation, solar generation, hydrological situation and malfunctions. When a very large number of simulations are performed, extreme situations are covered besides an ordinary situation. An example of an extreme situation is where several large power plants suffer a malfunction simultaneously at peak consumption at a time when the renewable energy generation happens to be low.

Year analysed				2025		
		Climatic year 1980		Climatic year 1981	…	Climatic year 2014
35 climatic years (1980-2014)						
Data for wind, solar, hydrology and consumption	Malfunctions A	Malfunctions B	Malfunctions C	…		…
Probabilistic malfunctions for relevant power plants and transmission lines						

Figure 3.1 Diagram of Monte Carlo scenarios

Such an analysis makes it possible to assess the probability of deficits in generation adequacy. As a result of the simulations, the annual average Expected Energy Not Served (EENS) is calculated along with the average Loss of Load Expectation (LOLE). To read in more detail about the methodology developed by ENTSO-E, see the latest MAF.

The analysis has developed the EENS and LOLE indicators in European countries for 2020 and 2025 in the Baseline Scenario, which includes the development of generation capacities in European countries to the best of the current knowledge. As a more Conservative Scenario, the results for 2025 have also been indicated based on the low-carbon sensitivity scenario. A specific precondition for the low-carbon sensitivity scenario, compared to the Baseline Scenario, is exit from the market of a larger quantity of conventional generation capacities based on fossil fuel due to a more aggressive climate policy all over Europe. The preconditions for the closure of power plants based on fossil fuels were set taking into account the power plants that face the risk of closure thanks to more severe environmental restrictions (e.g. coal-fired plants) and plants that face the risk of making a loss due to the changing market situation and, thus, close before the end of lifespan for economic reasons. Data about the power plants to be potentially closed were collected from system operators and, in the case of the Conservative Scenario, the total quantity of conventional generation capacities studied in the system in 2025 is approximately 23 GW less than those studied in the case of the Baseline Scenario.

The LOLE indicators found in the analysis for 2020 are set out in terms of countries in Figure 3.2.

[4] https://www.entsoe.eu/outlooks/midterm/

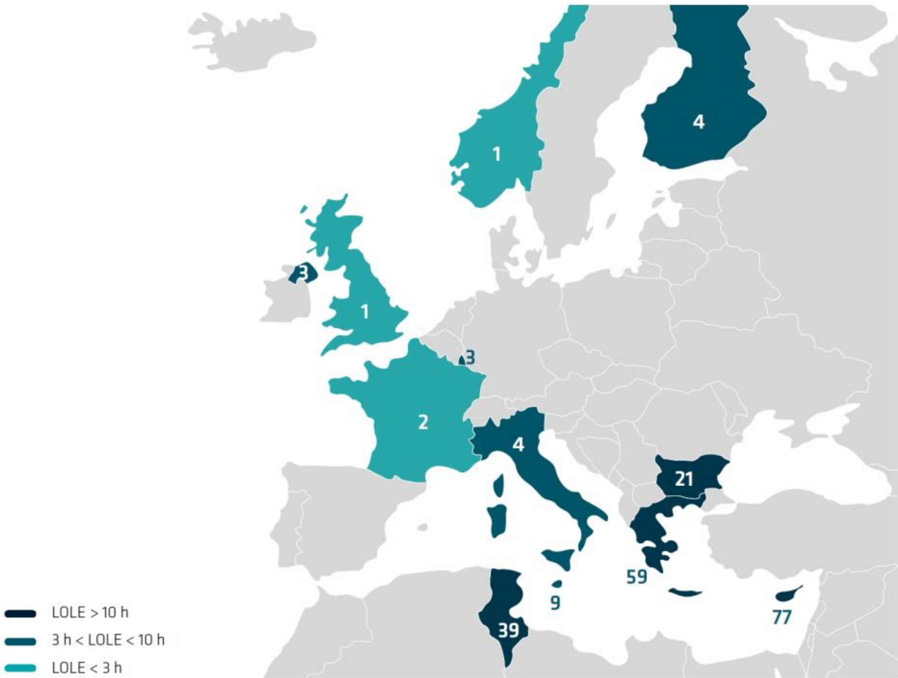

Figure 3.2 Average LOLE in European countries in 2020 received as a result of the probabilistic analysis of the Baseline Scenario of ENTSO-E

Figure 3.2 illustrates the results of the probabilistic analysis in the case of the Baseline scenario. To assess the results, it is useful to know that the widespread value for LOLE in European countries is three hours a year. This means countries consider the security of supply situation adequate if the long-term average is three hours of downtime or less per year. It is important to note that LOLE does not mean that service is interrupted for all consumers, but for the most part only to a small share of consumers – i.e. in the extent of the last megawatts that cannot be guaranteed in the given situation.

In the case of the Baseline Scenario, Estonia lacks EENS and LOLE. This means is that in none of the simulated 136 years there was, in any hour, a deficit of electricity. It can also be admitted that although as an average result of the simulations there were four LOLE hours in Finland per year, the generation adequacy situation in Northern Europe as a whole is very good.

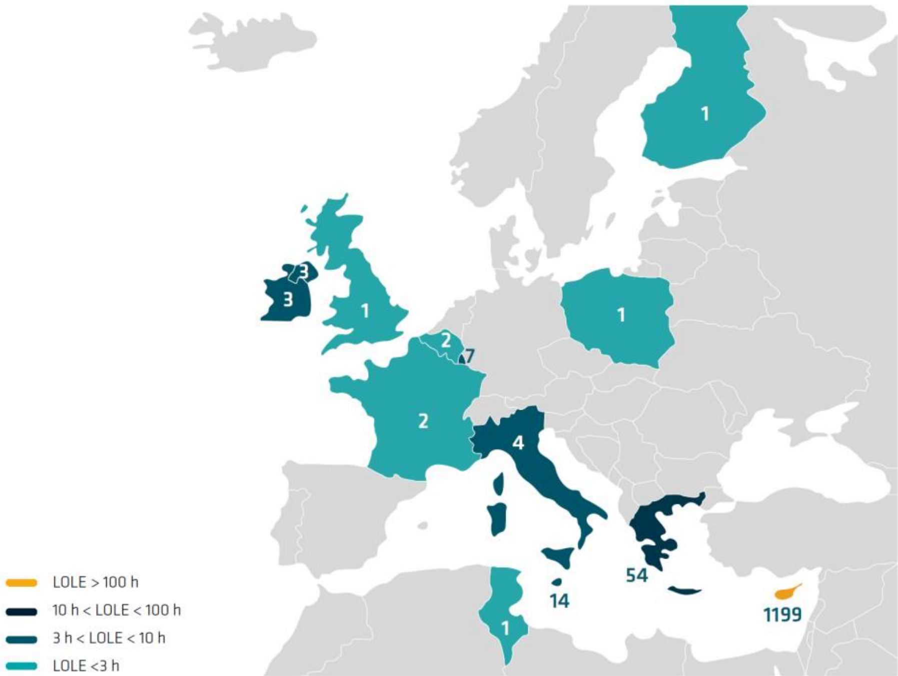

Figure 3.3 Average LOLE in Europe in 2025 received as a result of the probabilistic analysis of the Baseline Scenario of ENTSO-E

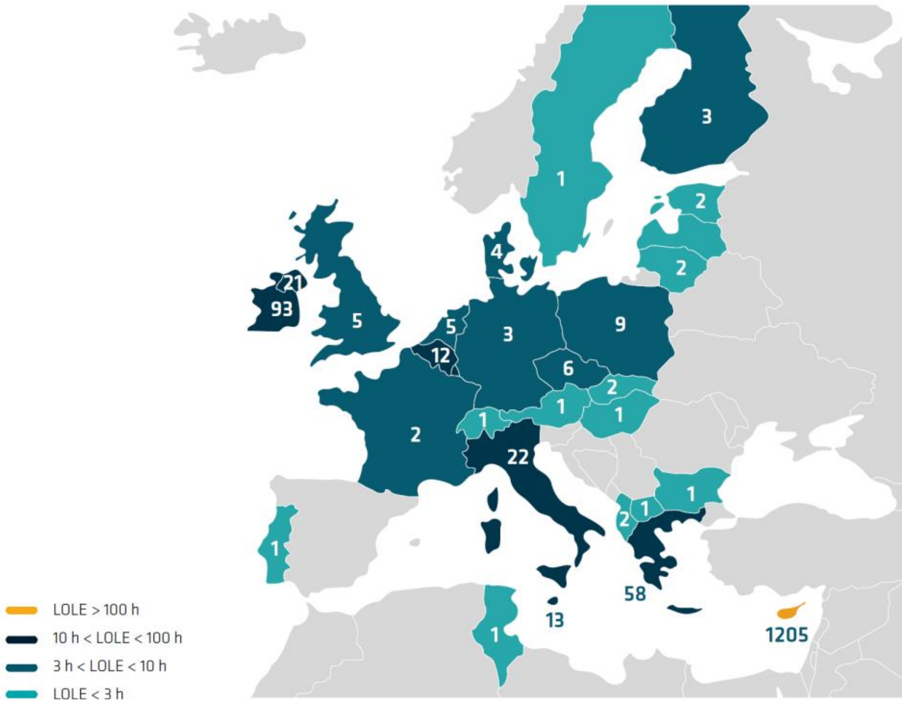

Figure 3.4 Average LOLE in Europe in 2025 received as a result of the probabilistic analysis of the Conservative Scenario of ENTSO-E

Figure 3.3 and Figure 3.4 visualise the European generation adequacy indicator LOLE in 2025 for both the Baseline and Conservative Scenario.

Figure 3.3 refers to the fact that in 2025 the pan-European generation adequacy situation will also be satisfactory and in Northern Europe very good. Figure 3.4 illustrates that, as expected, the generation adequacy situation of Europe as a whole has somewhat deteriorated provided that a larger quantity of conventional generation capacity exits the system. However, we see that even in such a case LOLE in Estonia and nearby countries is low, remaining mostly within the standard of many European countries, i.e. three hours of downtime.

To obtain a more in-depth overview of the regional generation adequacy, Figure 3.5 below studies in more detail both LOLE and the quantities of EENS in the countries of the Baltic Sea region.

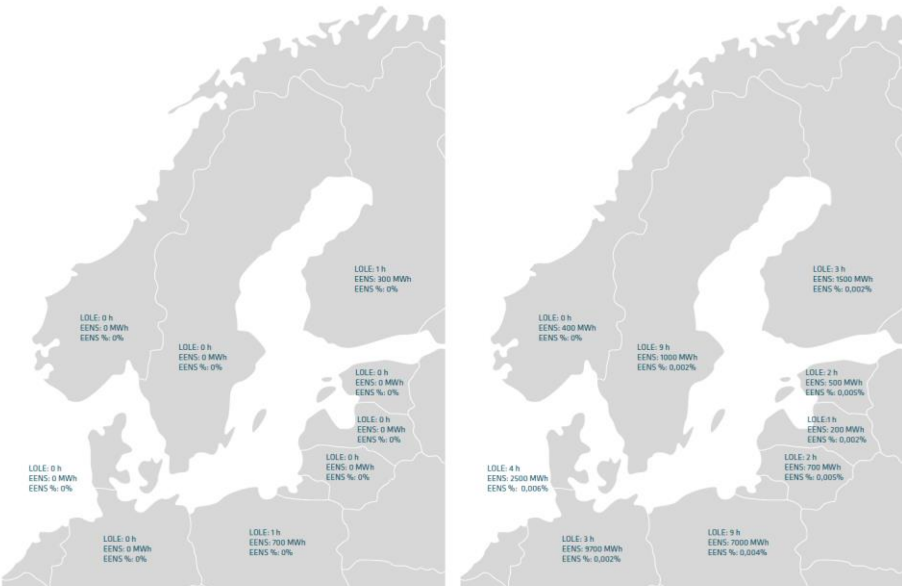

Figure 3.5 The LOLE and EENS generation adequacy indicators of the Baltic Sea region and the share of unconsumed energy out of the total consumption in 2025 in the case of the Baseline Scenario (on the left) and Conservative Scenario (on the right) of ENTSO-E

The results indicate that, in the case of the Baseline Scenario, Estonia lacks LOLE. In the case of the Conservative Scenario, there were an average of 2 LOLE hours per year and 500 MWh of EENS per year in Estonia. As a result of the analysis, it can be said that in 2025 Estonia’s generation adequacy will be ensured in the case of the Baseline Scenario and that indicators will be good even in the case of the Conservative Scenario for development of generation capacities. Even in the case of the Conservative Scenario, the value of LOLE will be below the level of three hours a year, the widespread standard in Europe. The figure also sets out the percentage of energy not consumed due to the deficit of generation capacities. The figures show that if LOLE is low, the share of unconsumed energy out of the entire energy quantity is small. This is due to the fact that, in the case of deficit of generation adequacy, interruptions occur not in the whole country, but only to the extent of the last, missing megawatts. Elering believes that the realisation of the Conservative Scenario by 2025 is unlikely, but even in such a situation the security of supply in Estonia will be within the limits of internationally widespread standards.

3.1.2 Regional security of supply

In cooperation with system operators from neighbouring countries – Fingrid, AST and Litgrid – Elering has used in addition to the probabilistic method also deterministic method to assess the security of supply. The deterministic method collates visually the presumed generation capacities to be used with the quantity of the electricity demand and necessary reserves forecast in the studied countries. The advantage of the method is its simplicity, annual resolution and visual effectiveness.

The deterministic analysis also uses two scenarios, the Baseline Scenario and the Conservative Scenario. The Baseline Scenario and the Conservative Scenario differ from one another mainly when it comes to the assessments of closing and adding generation capacities. The closure of generation capacities and the construction of new capacities depend above all on the market situation, which is extremely difficult to forecast accurately. That is why the system operators have prepared two scenarios to cover potential future situations. The Baseline Scenario is based foremost on assessments from electricity producers and on the closure of their old power plants or construction of new ones. The Conservative Scenario is based on the most conservative estimates from system operators where, based on the market situation, old power plants are closed earlier and the construction of new ones is deferred further into the future. It is presumed in the case of both of the Scenarios that the electricity market functions as a whole.

Figure 3.6 depicts, to the best of the knowledge of Baltic and Finnish system operators, the generation and transmission capacities to be used during the period of 2019-2034 in the Baseline Scenario in Estonia, Latvia, Lithuania and Finland. The same figure also depicts peak consumption and reserve need forecasts of the period, assuming that synchronisation with Central Europe will take place in 2025[5]. It is important to note that the peak consumption forecast does not reflect the consumption management potential in the Baltics, which may be considerable in periods with high electricity prices[6].

The analysis shows that today the Baltics and Finland already depend on the possibilities of import to cover peak consumption and reserve needs. At the same time, the region is already well connected to other regions and the import potential extends up to 4,800 MW[7].

[5] *The needs for reserves are estimated and are based on preliminary studies. In general, three types of reserves are maintained for the functioning of the electricity system. Primary reserves and secondary reserves restore the operation of the electricity system after a malfunction. Tertiary reserves are thereafter used to replenish the primary and secondary reserves for the event of the next malfunction.*

[6] *Price sensitivity of consumption and therefore also consumption management are related to a very large extent to the price of electricity. With today’s relatively low electricity prices, the reduction or shifting of consumption is not widespread as the economic benefit stemming from it is low. In the case of greater volatility of electricity prices, which a reduction in generation adequacy can cause, the economic benefit from the management of consumption increases as well, as does the motivation to manage consumption.*

[7] *From the standpoint of the security of supply, the possibility of the Baltics importing electricity from Russia has not been taken into account as a result of the different market system, which will curtail free movement of electricity.*

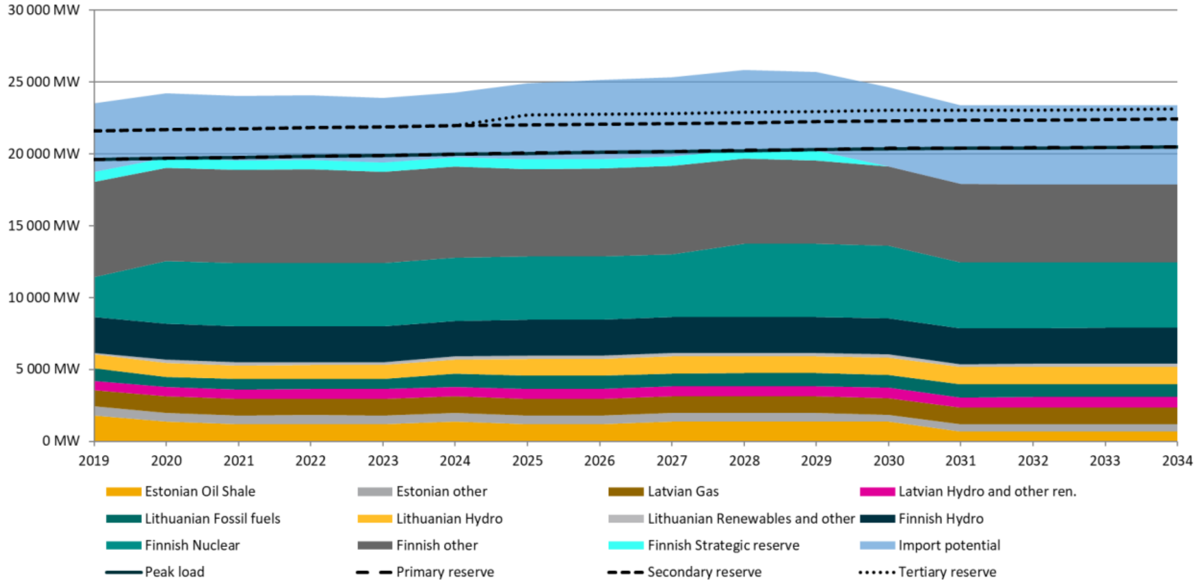

Figure 3.6 Generation and transmission capacities used in the Baltics and Finland in the period of 2019-2034

Figure 3.7 shows Baltic security of supply in a severe N-2 disruption situation. An N-2 disruption situation is used as the security of supply standard in the deterministic analysis. This means that system must be ready for the two biggest elements being non-operational during peak consumption. It also means that after an N-2 situation occurs, there is no longer the assumption that additional reserves will be kept for the subsequent (N-3 or N-4). The two biggest elements of the Baltic and Finnish electricity systems are the two units of the Finnish nuclear power plant, meaning that the most severe N-2 situation would be simultaneous downtime at two nuclear power plant units. Up to 2025, as we see in the figure, reserves will be maintained in an N-2 situation as well based on current agreements between the Baltics, Russia and Belarus. The figure also includes the forecasted peak consumption in the Baltics and Finland and the need for reserves up to 2034[8].

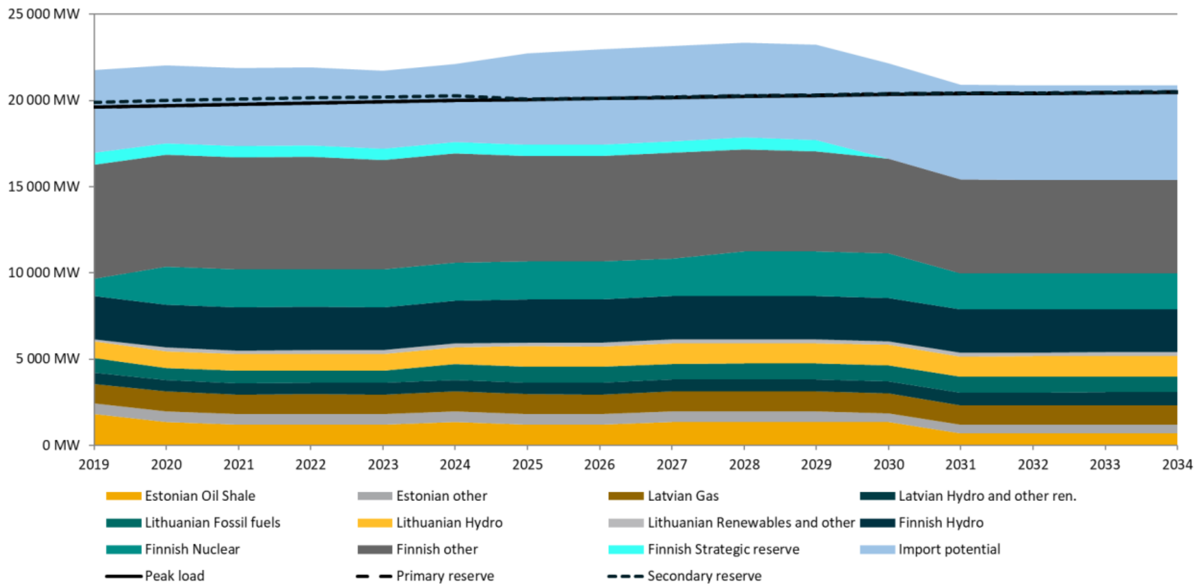

Figure 3.7 Baltic and Finnish security of supply in an N-2 situation given known generation and transmission capacities

The exact figures concerning the situation for 2030 as set out in Figure 3.6 and Figure 3.7 are depicted in Table 3.1.

[8] *The forecasts from Baltic and Finnish system operators are used to project peak consumption and need for reserves.*

Capacity in 2030	Value in an ordinary situation, MW	Value in an N-2 situation, MW
Estonian oil shale	1,363	1,363
Estonian renewable and other	605	605
Latvian natural gas	1,149	1,149
Latvian hydro and other renewable	726	726
Lithuanian fossil fuels	910	910
Lithuanian hydro	1,185	1,185
Lithuanian renewable sources and other	224	224
Finnish hydro	2,500	2,500
Finnish nuclear energy	5,087	2,587
Finnish renewable sources and other	5,501	5,501
Finnish strategic reserve	0	0
Import capability	5,500	5,500
Peak consumption	20,359	20,359
Primary reserve	33	33
Secondary reserve	1,930	0
Tertiary reserve	700	0

Table 3.1 Comparison of generation and consumption capacities at regional level in 2030 in the Baseline Scenario

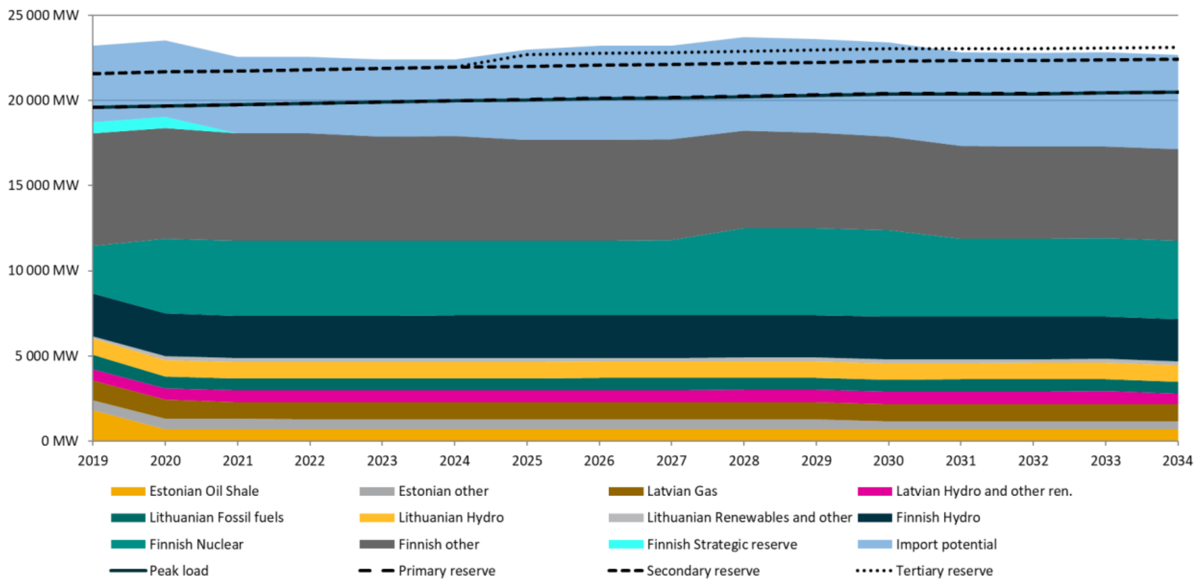

Figure 3.8 Baltic and Finnish security of supply in an ordinary situation in the case of the Conservative Scenario

Figures 3.8 and 3.9 depict an ordinary situation and an N-2 situation also in the Conservative Scenario. As mentioned earlier, the Conservative Scenario presumes a faster closure of old power plants and the postponement of new planned power plant construction.

Figure 3.8 and Figure 3.9 indicate that, in the case of the Conservative Scenario, as of 2031 deficit may arise in respect of covering the security of supply reserve in full – the sum of the consumption demand and reserve demand exceeds the quantity of the generation capacities to be used in the system. In an ordinary situation, the consumption demand as well as the need for the primary and secondary reserve are covered, but deficit may arise in ensuring the tertiary reserve. It is important to emphasise that if such a situation arises, it will not yet entail any limitations on consumption, but limitations on the maintenance of reserves, which nevertheless means a situation of somewhat lower security of supply.

The state in the Conservative Scenario in 2030 as depicted in Figure 3.8 and Figure 3.9 has been set out in more detail in Table 3.2.

Capacity in 2030	Value in an ordinary situation, MW	Value in an N-2 situation, MW
Estonian oil shale	691	691
Estonian renewable and other	605	605
Latvian natural gas	1,009	1,009
Latvian hydro and other renewable	726	726
Lithuanian fossil fuels	710	710
Lithuanian hydro	961	961
Lithuanian renewable sources and other	224	224
Finnish hydro	2,500	2,500
Finnish nuclear energy	5,087	2,587
Finnish renewable sources and other	5,501	5,501
Finnish strategic reserve	0	0
Import capability	5,500	5,500
Peak consumption	20,364	20,364
Primary reserve	33	33
Secondary reserve	1,930	0
Tertiary reserve	700	0

Table 3.2 Comparison of generation and consumption capacities at regional level in 2030 in the Conservative Scenario

In the case of the Conservative Scenario, in 2023 and 2024 a need for limiting reserves may also arise in an N-2 situation. As of 2031, the consumption demand will exceed, in the case of the Conservative Scenario, the sum of the annual generation and import capacities used in the region. Such a situation means limiting the consumption of electricity in a quantity that exceeds the quantity of electricity covered by generation capacities. To sum up, Elering thinks that the realisation of the Conservative Scenario is unlikely and that the total generation capacity will be exceeded in a small volume.

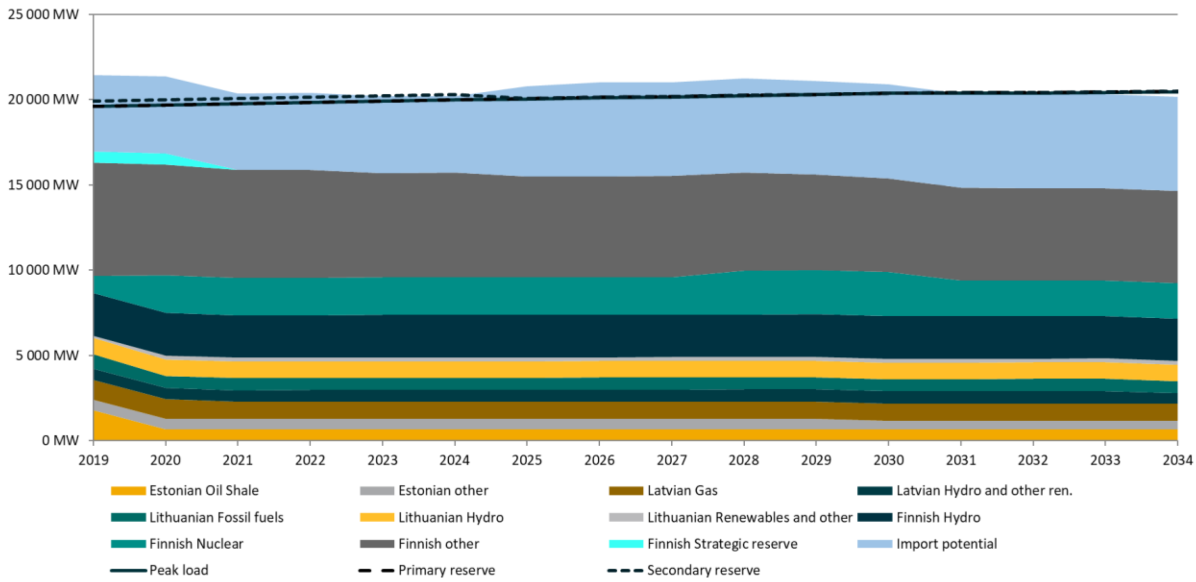

Figure 3.9 Baltic security of supply in an N-2 situation amidst market conditions favouring generation capacities

From the standpoint of Baltic and Finnish security of supply, the most important question is the desynchronisation of the Baltics from the IPS/UPS system, the timetables for closure of old power plants and the development of new power plants projects. The usability of power plants depends on the investments made to upgrade plants, where investments and change of equipment may significantly extend the lifespan of power plants. Making investments in power plants is a question of economic profitability and depends on whether prices on the electricity market will pay back the investments. As to Baltic and Finnish generation capacities, the question of closure is relevant at the Narva power plants, Lithuania’s Elektrenai power plant and Finland’s coal-fired power plants. As regards new projects, the important ones are Kaunas and Vilnius combined heat and power plants, where no decision has been made regarding construction, and the Hanhikivi nuclear power plant in Finland, where the completion date has not been decided.

Elering sees this deterministic analysis as very conservative and, as a result, the likelihood that consumption will have to be limited is very low in the period in question. The analysis is conservative because it views a situation where two of the largest elements in the Baltic and Finnish electricity system are offline simultaneously with peak consumption, no generation from wind turbines and solar panels takes place, and import from Russia to the Baltics is not possible.

In accordance with the pan-European generation adequacy assessment (MAF) prepared by ENTSO-E, Estonia is in compliance with the security of supply standard widespread in Europe, but MAF requires a functioning European electricity market and does not take into account possible events of very low probability. In addition, the European energy-based electricity market is sensitive to several market disruptions, due to which several European countries have cast doubt on the market-based generation of investments necessary for the security of supply. For those reasons, Elering has also analysed additional continuity scenarios. To visualise the low probability of continuity scenarios different from the market scenario, a figure based on the Elering's assessment of the scenario probabilities has been prepared.

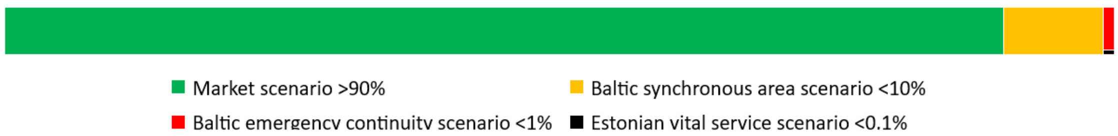

Figure 3.10 Estimated probability of occurrence of scenarios

3.1.3 Baltic synchronous area scenario

Presumptions of the scenario:

- Up to 2025 – the synchronous operation of the Baltic States with the IPS/UPS energy system has ended fast and without agreement. The Baltic States have remained in island mode operation and form a separate Baltic synchronous area. Fast synchronisation with the IPS/UPS system is not possible, it is necessary to have the capability to operate up to 12 months independently until extraordinary synchronisation with continental Europe.
- After 2025 – the Lithuania-Poland AC connection has been interrupted and the Baltic countries will have to be able to cope on their own until the AC connection has been restored.
- DC connections with the Nordic countries and Poland are usable, but in the reduced volume, taking into account the restriction of 400 MW imposed on the largest element.
- It is based on the conservative generation equipment scenario. In addition, it has been presumed that eight units (1,291 MW) of the Narva power plants, including four units with desulphurisation equipment (672 MW) will be closed in 2020.
- N-1 situation means the switch-off of one more DC cable.
- In such a situation the Baltic States depend in respect of fast frequency reserves on DC connections with neighbouring systems.

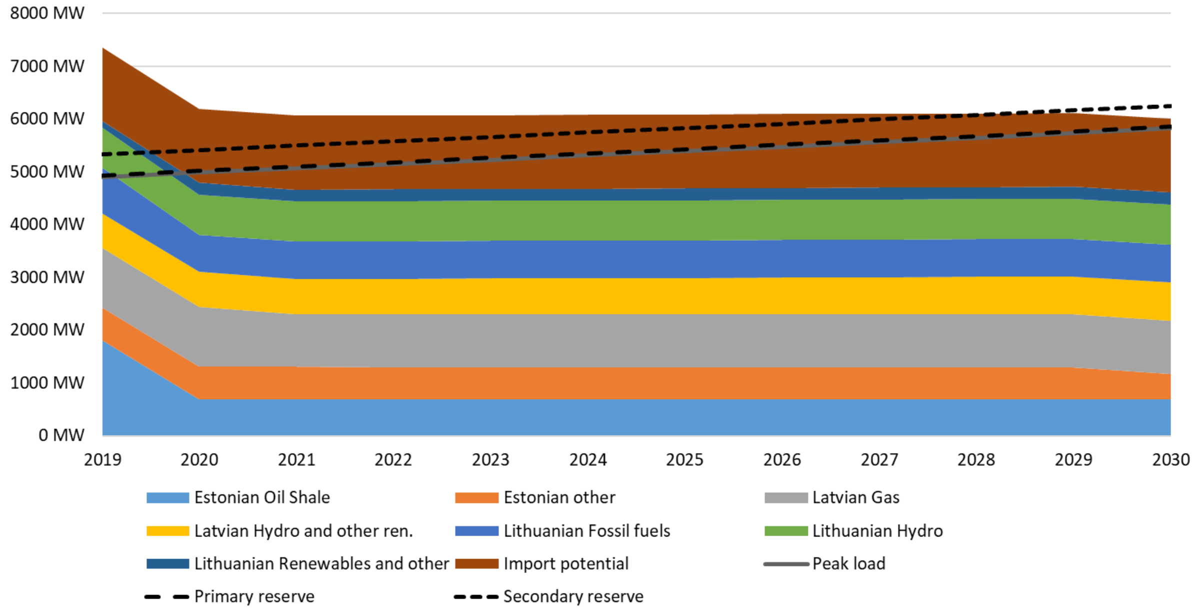

Figure 3.11 Security of supply of Baltic synchronous area

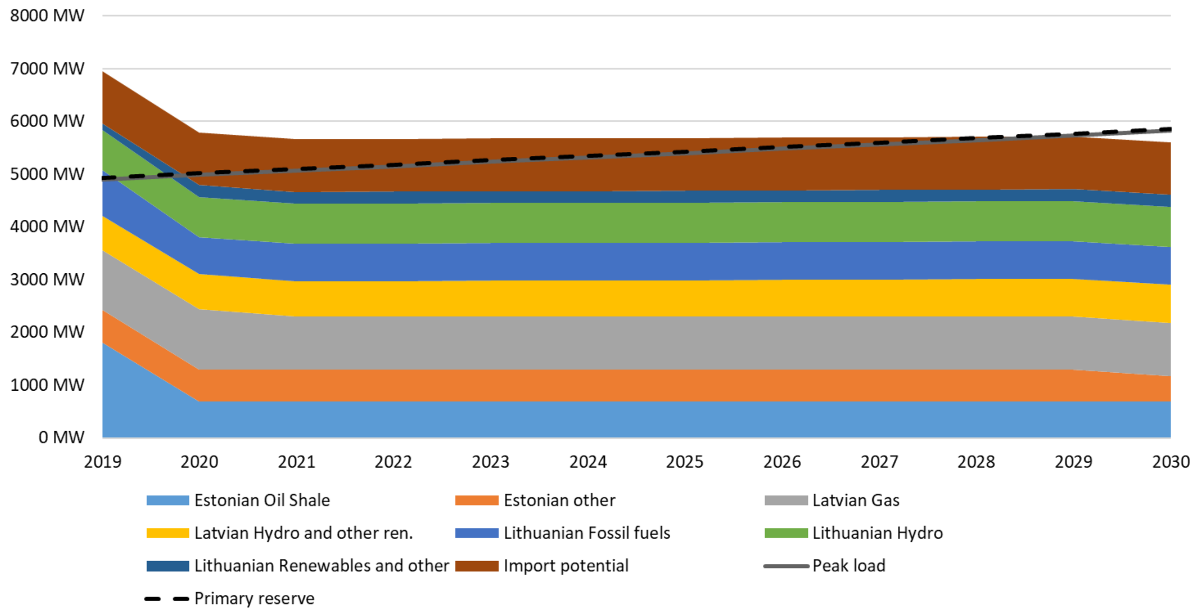

Figure 3.12 Security of supply of Baltic synchronous area in N-1 situation

The result of the analysis of the scenario visible in Figure 3.11 and Figure 3.12 indicates that the generation adequacy will be covered with the known generation capacities and transmission capacities up to 2029. In 2029, such situations may occur where it is not possible to maintain the reserve in an adequate quantity in the peak consumption period and there may be deficit of generation capacities in an N-1 situation. Readiness for operating in island mode is created with the investments that have been prescribed for the synchronisation process and are set out in Table 3.1. The investments to be made within the framework of the synchronisation project will reduce, over time, the impact that the risk of the Baltic countries' remaining in island mode operation will pose to the stability of our electricity system.

3.1.4 Baltic emergency continuity scenario

Presumptions of the scenario:

- Up to 2025 – the Baltic States have remained in island mode operation from the IPS/UPS energy system and form a separate Baltic synchronous area.
- After 2025 – the Baltic States have remained in island mode operation from the European energy system and form a separate Baltic synchronous area.
- There are no DC connections with other regions.
- It is based on the conservative generation equipment scenario. In addition, it has been presumed that eight units (1,291 MW) of the Narva power plants, including four units with desulphurisation equipment (672 MW) will be closed in 2020.
- The estimated duration of the scenario is two months during which it would potentially be possible to restore at least one DC connection.
- The consumption data of the sectors have been found from the databases of statistical offices of the Baltic countries, through which the share of the sector in the total final consumption has been found and it has been presumed that the share of the sector will also remain the same during peak consumption.

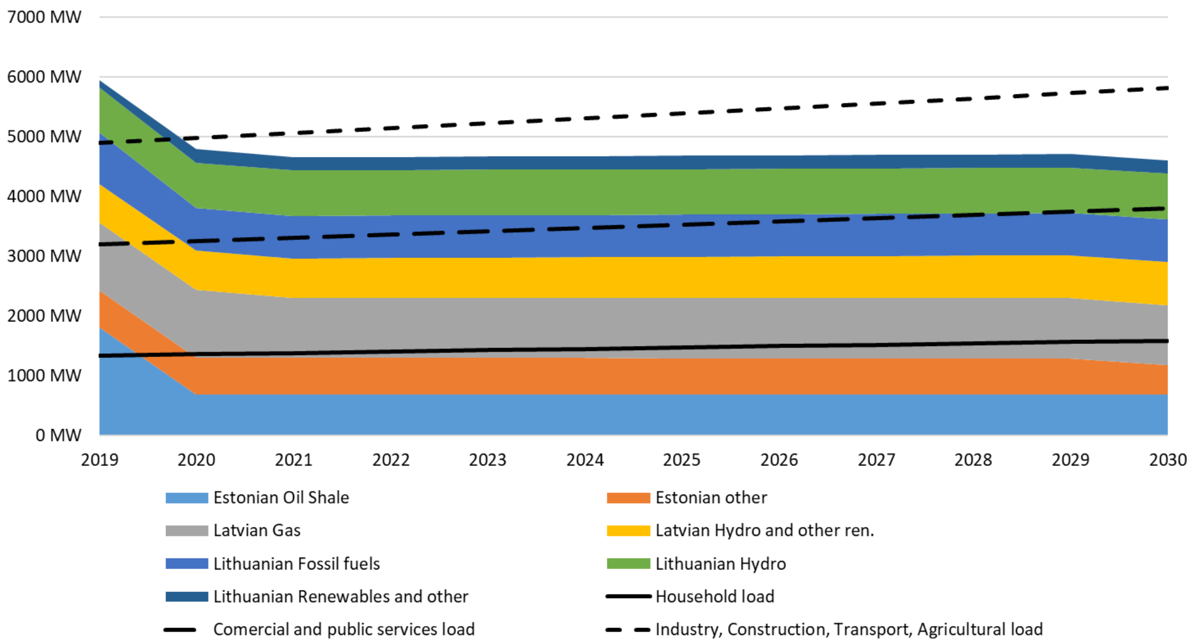

Figure 3.13 Baltic emergency continuity scenario

The analysis of the scenario set out in Figure 3.13 indicates that in the case of no available DC connections it would certainly be possible, from the standpoint of generation adequacy, to ensure electricity supply of households as well as the business and public service sector in the Baltic States while the electricity supply of other sectors should be limited, if necessary. Due to the increasing electricity consumption, the electricity supply of the industrial sector should be more and more limited if this scenario is realised. Moreover, it should also be taken into account in the case of such a scenario that the electricity supply quality will be significantly affected. Without transmission capacities, it is not possible today for the Baltic States to ensure adequate fast frequency reserves, due to which additional malfunctions may result in additional automatic phase-out of consumption. Frequency reserves are obtained within the framework of the synchronisation project.

3.1.5 Estonian vital service scenario

Presumptions of the scenario:

- Estonia has extraordinarily remained in island mode operation.
- There are no electrical connections with other countries.
- The electricity system must be ready to function over an unlimited period of time.
- The electricity system must be able to constantly cover the consumption of vital service and the consumption of general-interest service.
- The estimated maximum consumption of vital service and general-interest service is 200 MW. It is important to note that this is an estimate and Elering along with related parties will carry out activities to specify this estimate. However, Elering considers that this estimate is higher than the actual situation and that this presumption is a conservative one from the standpoint of the security of supply.
- It is based on the conservative generation equipment scenario. In addition, it has been presumed that eight units (1,291 MW) of the Narva power plants, including four units with desulphurisation equipment (672 MW) will be closed in 2020.

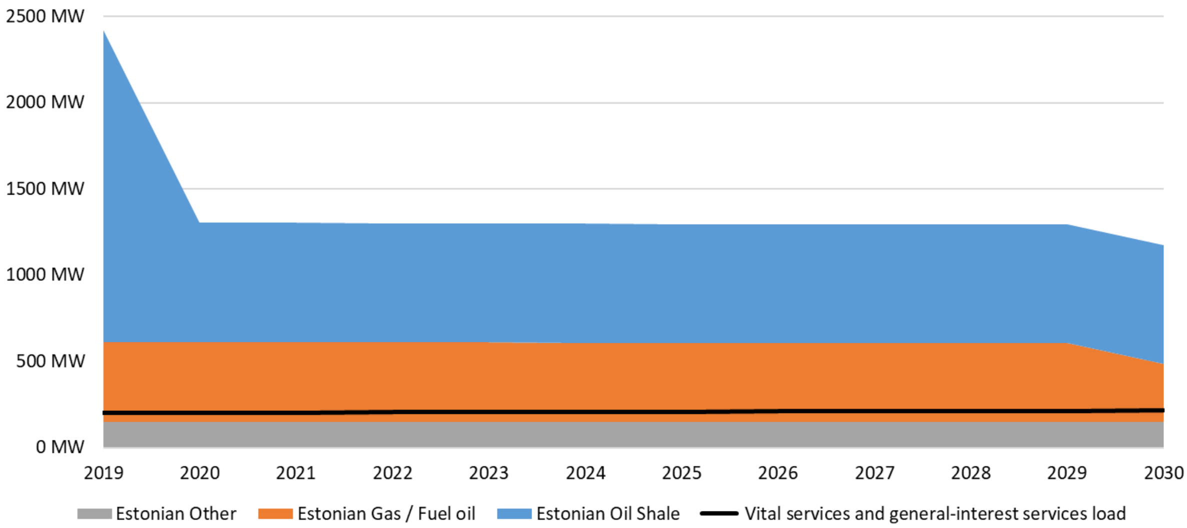

Figure 3.14 Estonian vital service scenario

As Figure 3.14 indicates, the electricity consumption of Estonian vital service and general-interest service can be covered with the existing generation capacity. Furthermore, this consumption can also be covered without oil share-fired power plants. One of the major challenges in the case of this scenario would be the stability of the electricity system as, in the event of a malfunction of larger elements, a part of the consumption would automatically be phased out similarly to the previous scenario.

3.1.2 Assessment

To sum up, the security of supply in Estonia and the region will be ensured, to the best of the current knowledge, in an ordinary situation up to 2025 through the combined effect of generation and transmission capacities. To ensure the security of supply in the longer term, additional power plants will have to be constructed in the region as compared to today's known capacities, or the consumption management potential will have to be increased. Throughout the period, in Estonia, the Baltics and Europe as a whole, the security of supply reserve will be decreasing and Elering is actively analysing further developments.

In Elering's view, the likelihood of electricity deficits in Estonia and the region will be low even after 2025. Analyses indicate a certain deficit of generation adequacy necessary for the consumption demand at the regional level only after 2030 in the case of more conservative presumptions. In the case of continuity scenarios, the deficit of generation capacity necessary for peak consumption may arrive earlier. Transmission capacities with other regions play an important role here and, consequently, the level of the security of supply in Europe as a whole must be adequate. For instance, a Finnish deficit could spread to neighbouring countries, including to Estonia. As a result, the question of the security of supply has become salient for all of the Energy Union; either the question cannot be resolved by local measures or such solutions will be inefficient. In Elering's view, the design of the electricity market will have to be developed so it sends out precise price signals for investment decisions and thereby ensure the security of supply. Work is taking place in this direction and the European Commission is resolving the issue with a Clean Energy Package to be implemented in 2020.

Elering follows trends when it comes to generation capacities and consumption to ensure the security of supply to Estonian consumers in the long term. For its part, Elering contributes actively to simplifying the process of connecting to the electricity system and increasing the consumption management capability. The price sensitivity of consumption allows the generation/consumption balance to be achieved through market-based signals and prevents the need for administrative restrictions on consumption.

In accordance with the Electricity Market Act, the Competition Authority has the right, based on a security of supply report, to request that Elering obtain additional generation capacities by way of competition. Elering believes that for the single European energy market, the security of supply is an issue that spans borders and developments in the region and in Europe as a whole are relevant. In Estonia, it is not possible to make investments in power plants on a scale that would guarantee generation adequacy throughout the region. That is why pan-European measures are important for ensuring the necessary investments in generation and transmission capacities. Pan-European measures include, above all, improvement of the design of the energy market such that the value for the generation capacities market would be fairly priced and consumers would be able to participate on the market on equal terms. With the Clean Energy Package, Europe has taken an important step toward developing the design of the energy market. Elering considers it very important to develop the electricity market and has brought out its suggestions in the Elering vision of the electricity market.

The analysis has pointed out several activities necessary for improving the generation adequacy. To assess the level of generation adequacy of Estonia, **the security of supply standard** is required. It must be developed in cooperation with responsible ministries and the Competition Authority.

To obtain reserves necessary for synchronising with the Central Europe, **market mechanisms for system services** will have to be developed. System services markets make it possible, on the one hand, to ensure a functioning electricity system and, on the other hand, provide market participants with an opportunity to earn additional income. New system services markets constitute, in addition to the existing manual frequency restoration reserve (mFRR), also an automatic frequency restoration reserve (aFRR) and frequency containment reserve (FCR).

The impact of market disruptions will have to be reduced on the European electricity market. Various market disruptions and activities can be examined in Elering's electricity market vision[9].

To ensure secure electricity supply for the consumption of vital service and general-interest service, a detailed assessment of the respective consumption volume will have to be carried out and the electricity supply for such consumption will have to be ensured in crisis situations.

3.2 FORECAST OF ELECTRICITY CONSUMPTION UP TO 2034

The following section gives an overview of the forecasted consumption in the Estonian electricity system as well as factors and preconditions that could potentially influence consumption. Elering's forecast of consumption has remained unchanged in recent years. The forecast will be fine-tuned based on updated statistics and the results of the completed studies.

3.2.1 Economic development[10]

Growth in the European economy was curtailed in the third quarter primarily by a temporary shock to car

[9] *Published in the Security of Supply Report 2018.*
[10] *Source: https://www.eestipank.ee/publikatsioon/rahapoliitika-ja-majandus/2018/rahapoliitika-ja-majandus-42018*

manufacturing, though even without that it was slowing in the European economy. Growth has been faster in the past four years than it has this century on average, and the reserves of strength that have allowed the growth spurt have become exhausted. Labour shortages are becoming ever more restrictive for companies and additional growth in export orders is declining as demand is softening around the world.

Given the size of the single market, a small country like Estonia does not necessarily feel a one-to-one direct relationship with the slower European growth. In the years ahead growth in the Estonian economy will be held back more by the labour market reaching its capacity limits and an end to the rise in employment, which has been a major contributor to the economic success of earlier years. The combined impact of labour limits, weaker foreign markets, and modest investment will be that growth will slow from the 4.9% seen in 2017 to 2.2% in 2021.

Latvian economy increased by 4.7% in the third quarter of 2018 with a very strong quarterly growth of 1.7%. The annual growth in the Lithuanian economy weakened in the third quarter though to 2.4%. The annual GDP growth in Finland picked up to 2.4% in the third quarter and the economy also continued to grow over the previous quarter. Growth in the Swedish economy slowed to 1.6% over the year in the third quarter, and was 0.2% less than in the second quarter.

Growth is slowing in the Estonian economy and the GDP gap will start to narrow during the forecast horizon. In 2019, the economy will grow at a similar rate to that of 2018, but after that growth will fall below 3%. The forecast is for growth of 3.2% in 2019, 2.3% in 2020 and 2.2% in 2021.

The economy is currently running at full steam and there is a shortage of available resources. In consequence, any further rapid growth in the economy will be hindered by supply-side limits such as difficulties in finding labour and technical limits on the use of equipment. At the same time demand-side factors will weaken, most notably the growth in foreign demand.

3.2.2 Forecast of electricity consumption up to 2034

In previous Security of Supply Reports, a growth rate of 1% per year was used to estimate the growth of consumption. For a more detailed forecast, Elering AS commissioned a load forecast study from the Tallinn University of Technology in 2017. To forecast the loads, a model based on an Excel spreadsheet was devised. It can be used to find the estimated load on various levels: the substation level, regional level, and the entirety of the Estonian electricity network. Three different scenarios were developed using this model: medium (baseline), rapid and slow development. Table 3.3 describes consumption using two indicators: annual consumption and peak load. In the consumption forecast view, the basis is the medium scenario in the abovementioned load forecast study.

Table 3.3 Summary of statistics and forecast for total consumption and peak load up to 2034

Consumption statistics		
Year	**Annual consumption, TWh**	**Peak load, MW**
2005	7.2	1,331
2006	7.8	1,555
2007	8.2	1,526
2008	8.3	1,525
2009	7.8	1,513
2010	8.2	1,587
2011	7.9	1,572
2012	8.1	1,433
2013	7.9	1,510
2014	7.8	1,423
2015	7.9	1,553
2016	8.2	1,472
2017	8.3	1,474
2018	8.4	1,544

Consumption forecast		
Year	Annual consumption, TWh	Peak load, MW
2019	8.6	1,555
2020	8.7	1,564
2021	8.9	1,594
2022	9.0	1,609
2023	9.1	1,623
2024	9.2	1,636
2025	9.2	1,649
2026	9.3	1,661
2027	9.4	1,674
2028	9.4	1,680
2029	9.4	1,685
2030	9.5	1,690
2031	9.5	1,695
2032	9.5	1,701
2033	9.5	1,706
2034	9.6	1,711

To this point, overall electricity consumption is showing a growth trend, but the peak loads on the electricity system have remained essentially unchanged in the last decade – between 1,313 and 1,544 MW. It should nevertheless be considered that there will be some peak load growth due to rising consumption in the next 10 years and subsequent decrease in the annual consumption growth rate. The forecast of peak loads at Elering up to 2034 is laid out in the figure below (see Figure 3.15).

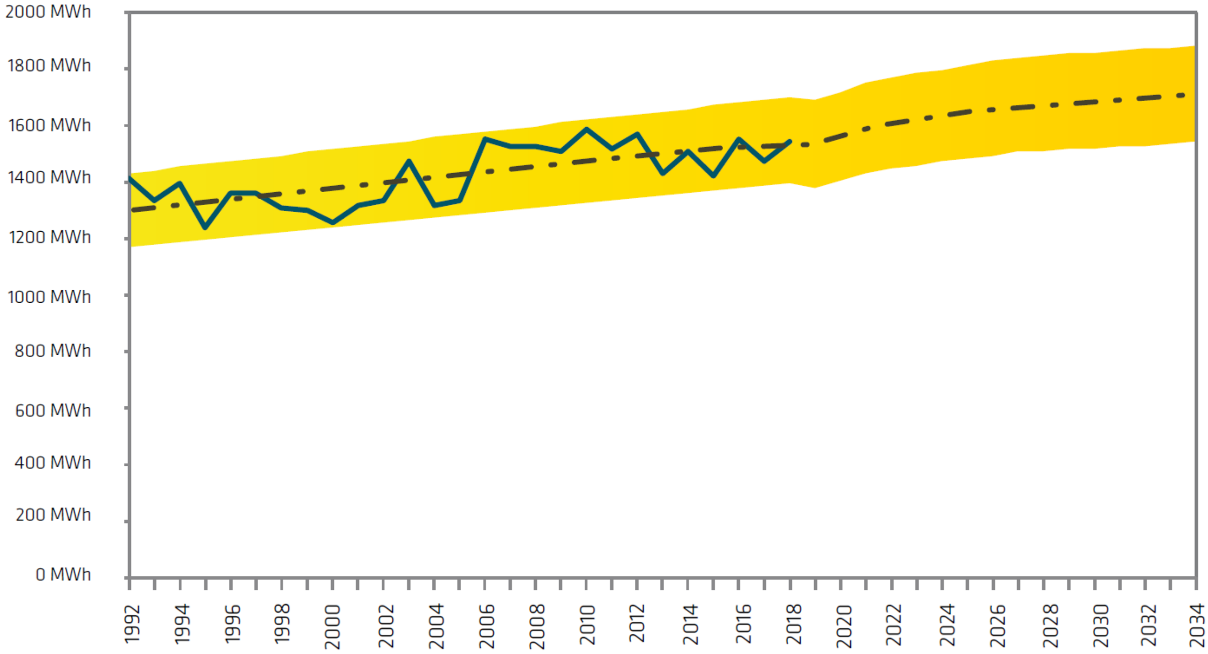

Figure 3.15 Statistics and forecast for peak loads up to 2034

Figure 3.15 describes that the actual peak load fluctuates between the standardised peak load and in a ±10% interval. According to this forecast, peak load will also be 1,600 MW or less in 2021, although it will already have grown to over the level of 1,700 MW by 2032.

According to the load forecast made by the Tallinn University of Technology, the growth in average peak load will be on the order of 1.14% in the period of 2020-2022, but after that it will start to decrease and from 2028 it will grow by 0.31% per year.

The changes in peak load over the years will be significantly affected by weather patterns. Changeable weather means that actual peak loads may also temporarily go beyond the forecast range. A recurrence of the warm winters of recent years may also affect the growth rate of peak loads in the future.

New large projects and consumer connections have not been taken into account in the general forecast, as connecting such capacity (the metal industry, electric railway and, in recent years, server farms) that would have a material effect on consumption is an occurrence to be viewed separately.

3.2.3 Distribution networks

In accordance with subsection 66 (2) of the Electricity Market Act, each year distribution network operators must submit to the Competition Authority a written assessment of the expected total consumption capacity demand within their service areas for each of the seven years following the submission of the assessment.

Subsection 66 (3) of the Electricity Market Act provides that by 15 June each year the transmission network operator submits to the Competition Authority a written assessment, which is as precise as possible, of the expected total consumption capacity demand in the transmission network for each of the seven years following the submission of the assessment. The transmission network operator also indicates the presumptions on which its assessment is based.

The table below sets out the data submitted by distribution network operators in 2019. Pursuant to their consumption capacities, the total consumption capacity demand should remain in the range of 1,736 to 1,837 MW in the period of 2019-2025. Taking also into account possible cold winters (10% reserve), actual demand in distribution networks could be in the range of 1,910-2,020 MW (see Table 3.4).

Table 3.4 Distribution networks' estimate of total demand for consumption capacity in 2019-2025

Year	Total demand for distribution network consumption capacity, MW	Total demand for distribution network consumption capacity with 10% reserve, MW
2019	1,736	1,910
2020	1,764	1,940
2021	1,788	1,967
2022	1,804	1,984
2023	1,818	1,999
2024	1,827	2,009
2025	1,837	2,020

The forecasted consumption capacities submitted by distribution networks can be covered by Elering in full, even factoring in the 10% winter reserve. The generation capacities to be used in 2019 amount to 2,737 MW and in 2025 the respective capacity will be 2,560 MW.

Similarly to the load forecast for the transmission network set out above, new and energy-intensive projects will be treated separately and Elering will not take such connections into account in this forecast.

In addition, in the case of the data submitted by distribution networks, Elering does not take into account the fact that the consumption capacity forecasted in some distribution network will be covered in this network locally and the capacity to be taken from the transmission network will only be used in the event of repairs and emergencies.

3.3 GENERATION EQUIPMENT CONNECTED TO THE ESTONIAN ELECTRICITY SYSTEM IN 2018

Based on data obtained from producers as of March 2019, the total installed net generating capacity is 2,886 MW, of which the capacity used during peak periods accounts for 2,214 MW. An overview of the generation equipment connected to the Estonian electricity system in March 2019 is provided in the following table (see Table 3.5).

Table 3.5 Generation equipment connected to the Estonian electricity system in 2019

Power plant	Installed net capacity, MW	Possible generating capacity, MW

Eesti Power Plant	1,355	1,021
Balti Power Plant	322	224
Auvere Power Plant	274	252
Iru Power Plant	111	111
Kiisa Emergency Reserve Power Plant	250	250
Põhja Thermal Power Plant	78	78
Lõuna Thermal Power Plant	0	0
Sillamäe Thermal Power Plant	16	8
Tallinn Power Plant	39	39
Tartu Power Plant	22	22
Pärnu Power Plant	20.5	20.5
Enefit	10	9
Industrial CHPPs and mini-CHPPs	83	60
Hydropower plants	7.6	4
Wind farms	312	0
Solar power plants	37.9	0
Microproducers	7.6	0
Total	**2,946**	**2,098**

The data set out in Table 3.5 are based on the data submitted by possessors of the generation equipment and no distinction has been made in the table between the generation equipment already in operation and the generation equipment not yet generating electricity.

Microproducers and miniproducers under 15 kW capacity in the Estonian system, taking also into account generation equipment connected in previous years, in the period of 2012-2018:

- Electric wind turbines 221.7 kW;
- Solar panels 11,395 kW;
- Hydropower plants 32.5 kW.

Starting 1 March 2018, the following were connected to the transmission network or expected to be connected in 2019:

- in 2018: Tuuleenergia OÜ, Lõpe wind farm, 1 MW was added, in total 17 MW (wind turbines);
- Aidu Wind Farm, 6.8 MW;
- Varja wind farm, 10 MW (Püssi substation);
- Iru PV-plant, 0.7 MW (Iru substation);
- Raadi PV-park, 50 MW (Ülejõe substation);
- Elektrilevi OÜ, Leisi substation, 6 MW;
- Elektrilevi OÜ, Viljandi substation, 5.94 MW;
- Elektrilevi OÜ, Rakvere substation, 4.34 MW.
- Eesti Energia, Tootsi wind farm, 138 MW (Sopi substation);

Starting 1 March 2018, the following were connected to the distribution network or expected to be connected in 2019:

- in 2019 the 7.1 MW generator of Silpower AS will be connected to the Sillamäe distribution network;
- in 2018: ELV end customer 4E, Kunda substation, 6.9 MW wind turbines;
- in 2019: Mustamäe CHPP, 10 MW, Kadaka substation;
- VKG Soojus AS Ahtme Thermal Power Plant 8 MW (Ahtme substation);
- Elektrilevi OÜ, Videviku PV, 1.2 MW (Anne substation);
- Elektrilevi OÜ, Tallinna prügilagaas OÜ, 1.053 MW, Kallavere substation;
- Elektrilevi OÜ, Pärnu Solar Park 4 MW, Metsakombinaadi substation.

3.4 CHANGES IN GENERATION EQUIPMENT 2019-2029 AS NOTIFIED BY ELECTRICITY PRODUCERS

In accordance with the amendment (16 February 2016) to section 132 of the Grid Code, “Generation reserve necessary for satisfying consumption demand”, all electricity producers must submit to the system operator Elering AS by 1 February of each year, the data set out in Annex 3 to the Grid Code for the next 10 years in order to assess the adequacy of the electricity system’s reserves. This year, all of the major electricity producers and most smaller electricity producers submitted the data. In the case of some of the smaller power plants, the data filed in previous years concerning the planned closure of electricity generation and/or generation equipment were taken into account.

As of the current time, Elering has been notified for 2019-2029 of an increase of up to 28 MW of generation capacity with a pre-planned production cycle; at the same time, a reduction of capacities by up to 623.8 MW is planned.

3.4.1 Changes with respect to 2018

Compared to the previous Security of Supply Report published in 2018, electricity producers have notified of the following biggest changes:

Enefit Energiatootmine AS:
- At Eesti Power Plant, scheduled switch-off (start-up time ~72 h[11]) will take place in the case of a number of units with a total capacity of up to 672 MW in summers of 2019-2023;
- Eesti Power Plant foresees no generation capacity for three units after 2019 with a total capacity of 489 MW.
- Balti Power Plant foresees no generation capacity for TG12 unit with a capacity of 130 MW after 2023; Auvere unit with a capacity of 272 MW will be in scheduled repair in the summer period during 2019-2029 and this power plant will lack potential generating capacity during the summer;
- Enefit Power Plant’s Enefit 280 equipment will be undergoing scheduled repairs in the summer period during 2021-2022 and this power plant lacks potential summer generating capacity.

Hydropower plants:
- Decrease in capacity by 330 kW, which derives from the conserving of depreciated hydropower plants and updating of data.

Wind farms:
- The increase in capacity is 145 MW, which stems from changes in the forecasts submitted by producers and specification of data.

The data submitted by electricity producers in 2019 are set out in Annex 1.

3.4.2 Generation equipment to be closed and reduction in capacity of existing generation equipment

Elering currently has been notified of the following closures of generation capacities, capacity reductions and conservations of generation equipment:

- 2020-2024 restrictions on old units operating on the basis of IED derogation – 619 MW;

or, to be more specific:
- 2024 Closure of the Eesti Power Plant units, 489 MW;
- 2024 Closure of the Baltic Power Plant unit, 130 MW;

Total generation capacity to be closed by 2024: 619* MW.
* the capacity to be closed includes capacity to be used with restrictions

3.4.3 Power plants, planned and under construction

Elering currently has been notified of the following major additions of generation capacities:

[11] *According to the information provided by Enefit Energiatootmine AS.*

- 2019 Fortum Tartu Raadi PV-park, 50 MW;
- 2019 Tootsi Wind Farm, 138 MW.

TOTAL: 188 MW

Electricity generating equipment, the construction of which has been reported to the system operator, but which cannot be taken into consideration as a definite project, is the following:

- 2019-2029 – other new plants (mainly wind farms) up to 910.7 MW.

TOTAL: 910.7 MW

All of this electricity generating equipment, the construction intention of which has been reported to the system operator, cannot be taken into consideration as definite decisions to construct power generation equipment. Some projects are already in the construction phase, and some are also in the planning phase, without a final investment decision having been made. At the same time, it can be assumed that not all of the generation equipment in the planning phase will reach an investment decision and that, in addition, it is not certain which years these projects will actually be completed in.

3.5 ASSESSMENT REGARDING THE GENERATION RESERVE NECESSARY FOR SATISFYING CONSUMPTION DEMAND UP TO 2029

The assessment in this Report as to the generation reserve needed to satisfy the consumption demand was put together in light of what Elering sees as the most likely development trends governing generation capacities as not all of the source data submitted to the system operator can be taken into account as projects certain to be realised in the future.

3.5.1 Assessment of adequacy of generation capacity in winter

The projected scenario takes into account new power plants that are currently being built or where a firm investment decision or closing date has been communicated to the system operator.

Starting 1 January 2016, the Eesti Power Plant's 1st, 2nd and 7th unit and the Balti Power Plant's 12th unit will be operated based on Article 33(1) of the Industrial Emissions Directive (limited life time derogation), according to which an operator is allowed to operate these energy units during the period from 1 January 2016 to 31 December 2023 not more than 17,500 operating hours. According to Eesti Energia, three units will be closed in Eesti Power Plant in 2019 and the Balti Power Plant's unit will be closed in 2023. As the actual use of the operating hours set out in the limited life time derogation depends on the price levels that will take shape on the electricity wholesale market, it is not possible to announce the exact time for the planned closure of the energy generating units. This will be done as soon as possible after the management board of the company has made the relevant decision and the information has been sent to the power exchange for publication.

As of 25 October 2021, the environmental requirements of oil shale-fired power plants will be regulated by the Use of Oil Shale Energy BAT Conclusions Document. The existing generation equipment (except for the generation equipment operating on the basis of the IED limited life time derogation) of Eesti Power Plant, Auvere Power Plant and Balti Power Plant are in compliance with the requirements arising from the aforementioned legislation. The requirements set out in the aforementioned BAT document will presumably remain in effect until approx. 2030 (after which they will probably be made more stringent).

In 2018, Eesti Energia's Narva Power Plants (Balti, Eesti and Auvere) have, along with the six units furnished with desulphurisation equipment (1,058 MW), four existing limited-operating-hour units (619 MW) and one unit launched in Auvere in 2015 (272 MW), a total of 1,949 MW.

In the winter period in 2029, the forecasted peak load based on the projected load scenario is 1,685 MW and the usable generation capacity is 2,552 MW. Considering the data sent by the producers and the information known to Elering, the generation reserve necessary for satisfying the consumption demand will be adequate up to 2020 – even factoring in the 10% reserve for extraordinarily cold winters. Taking into account the electrical connections and generation capacity on the regional electricity market, there are adequate generation capacities for Estonia for the next ten years. Domestic generation capacity used on the electricity market covers the consumption demand during the peak winter period. In case of a malfunction in international connections, the capacity of Elering's emergency reserve power plants can be used; factoring these in, the domestic consumption capacity is covered by domestic generation capacities during peak periods. The forecast for generation capacities used on the electricity market is set out in the figure below (see Figure 3.16). For more information on the security of supply in Estonia, the Baltics and the Baltic Sea region up to the year 2034, see Chapter 3.5.3.

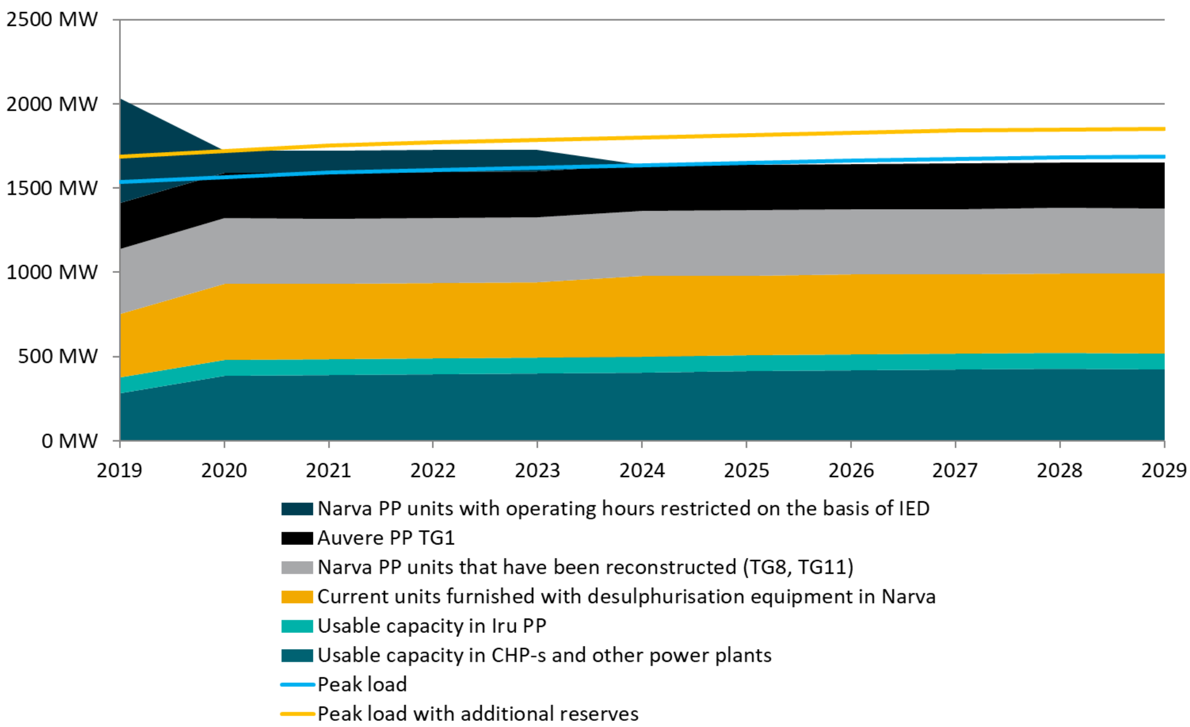

Figure 3.16 Expected forecast for generation capacities to be used and peak demand in winter

In addition to the above forecast, the electricity generation capacities of other countries in the Baltic Sea region can be counted on for covering peak load, based on the difference in the peak load period and the possibility of using cross-border electrical connections. Thanks to the third Estonia-Latvia connection to be completed in 2020, the capacity on the Estonian-Latvian border will increase from 750 MW to 1,050 MW. Elering believes that the cross-border connections and generation capacities in neighbouring systems are sufficient to ensure the functioning of the Estonian electricity system in the years ahead, even in a situation where consumption outstrips forecasts or the existing generation equipment is closed before the currently forecasted closure date. The precondition for use of neighbouring systems' generation reserves is a functioning regional electricity market and reliable international connections with Finland and Latvia.

3.5.2 Assessment regarding the generation reserve necessary for satisfying consumption demand during the summer period

According to the data submitted by the power plants, the capacity not used in the 2019 summer period includes 2,173 MW of generation capacities. The non-used capacity includes conserved generation units (1,024 MW), other restrictions (37 MW), generation units with a non-plannable production cycle (all renewable plants except for hydropower plants – 500 MW), all microproducers (11.6 MW) and the capacity not supplied by industrial and mini-CHPPs in the summer period (13.8 MW). In addition, until the closure year (2023) the units with operating hours restricted on the basis of the IED at Narva Power Plants will not be taken into account; these have a total capacity of 619 MW.

Figure 3.17 describes the forecast for generation capacities and peak demand during the summer period. According to the data submitted by Enefit Energiatootmise AS, the generation units furnished with desulphurisation equipment will be conserved in the summer period of the next ten years and, therefore, they have not been set out in the figure below with the capacity that they offer.

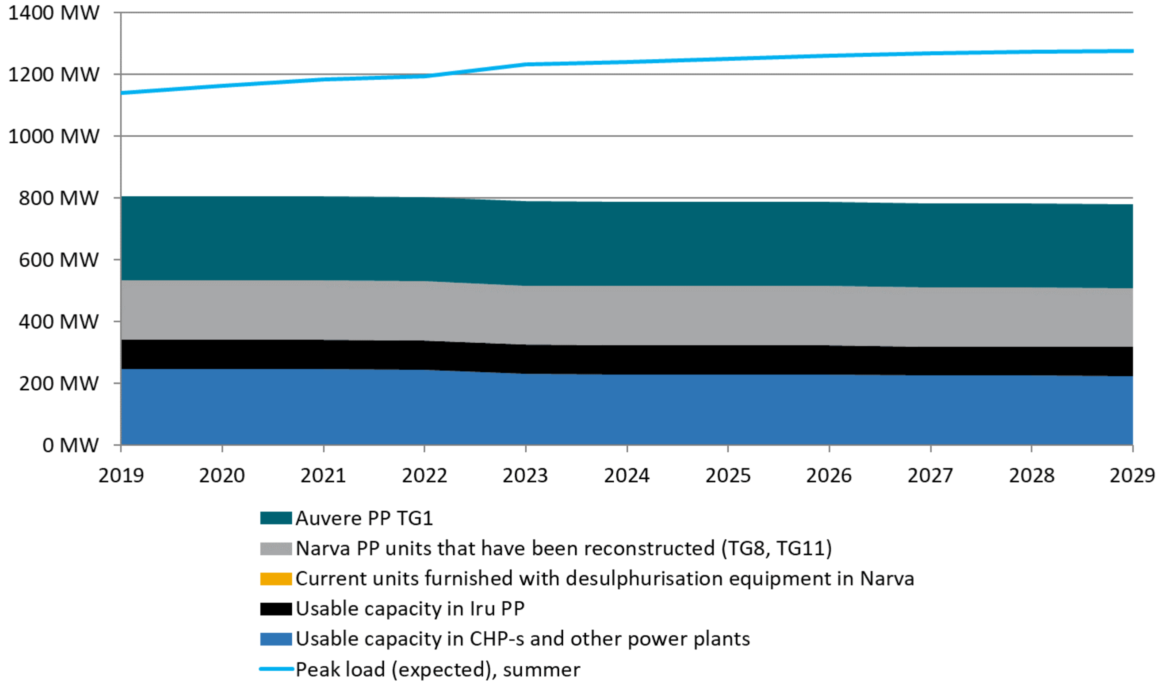

Figure 3.17 Forecast for generation capacities to be used and peak demand during the minimum consumption period (summer)

3.5.3 Estonian security of supply up to 2034

The following analyses the Estonian security of supply up to 15 years into the future. In the conditions of a European single energy market, Elering views the Estonian security of supply in the regional perspective, as a combination of local generation capacities and transmission capacities. Elering's analysis views severe situations from the standpoint of the security of supply and does not express how power plants are used in ordinary market conditions.

Figure 3.18 expresses Elering's assessment regarding the developments of the currently known and usable generation capacities in Estonia up to 2034. Here, proceeding from the conservative position, it is presumed that some of the closures of power plants will be expedited compared to the data submitted by producers upon assessing the generation reserve necessary for satisfying the consumption demand in the Estonian electricity system. Unlike the data from producers, downtime has not been factored in here. The possibility of malfunctions is taken into account in an N-1-1 situation (see Figure 3.19). It is presumed that the Narva Power Plants' units that fall under the Industrial Emissions Directive (IED) derogation will be phased out in 2019. In reality, these units are permitted to use 17,500 operating hours from early 2016 to end 2023. This means that, as market conditions permit, the said generation capacities may be available for a longer period of time than presumed in the analysis. In addition, the closure of the Narva Power Plants' units equipped with deSOx filters is assumed to occur in 2020. This is a conservative presumption, as these units could be in operation longer judging by environmental restrictions and their technical condition. In reality, the duration for which the old power plants will be kept in operation depends on market conditions – whether the costs of maintenance of and the necessary investments in the power plant can be recouped on the electricity market. Elering's task here is to consider severe security of supply situations and, as a result, this analysis relies on conservative presumptions regarding the closure of power plants.

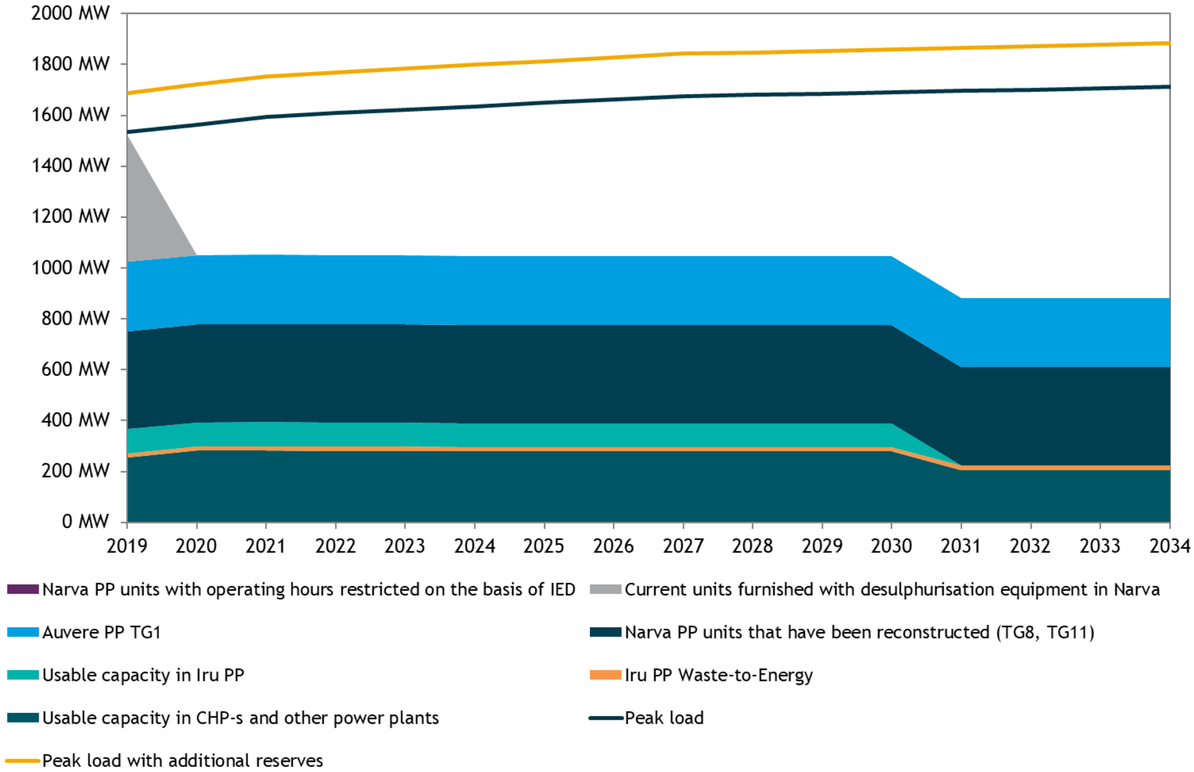

Figure 3.18 Assessment regarding the structure of generation capacities to be used up to 2034

Starting in 2020, Estonia will have, according to current plans, over 2,000 MW of international connections[12]. That means greater import capability than Estonian peak consumption forecasted for this period and, as a result, the potential closure of local generation capacities will not cause problems for the security of supply in an ordinary situation.

As regards the security of supply, it is important to consider emergency situations in the system as well. This analysis views the disruption situation N-1-1[13], where the two biggest elements of the system are non-functional. In the period of up to 2034, to the best of the current knowledge, the two biggest elements in the Estonian system will be the submarine cable EstLink 2 and one of the transmission lines between Estonia and Latvia. In such a situation, the capacity of Estonian international connections will decline in the period of 2020-2034 and, as a result, the import capacity will drop to 1,050 MW – 700 MW from Latvia and 350 MW from Finland. In the event of the scenario described, Estonia will have enough generation and transmission capacity for the entire period in question. In addition, a 10% reserve is ensured for satisfying higher growth of demand. Figure 3.19 illustrates the security of supply in an N-1-1 situation, where the two biggest elements of the electricity system are non-functional. The figure does not show Elering's emergency reserve power plants as in an ordinary situation they do not participate in the electricity market and in covering the consumption demand.

[12] *A new Estonia-Latvia transmission line (Kilingi-Nõmme–Riga) has been factored in here. It is planned to be completed in 2020. From the standpoint of the security of supply, the possibility of importing electricity from Russia has not been taken into account as a result of the different market system, which will curtail free movement of electricity.*

[13] *An N-1-1 situation is the unscheduled switch-off of one element where an element with a significant impact on the operation of the system is undergoing maintenance.*

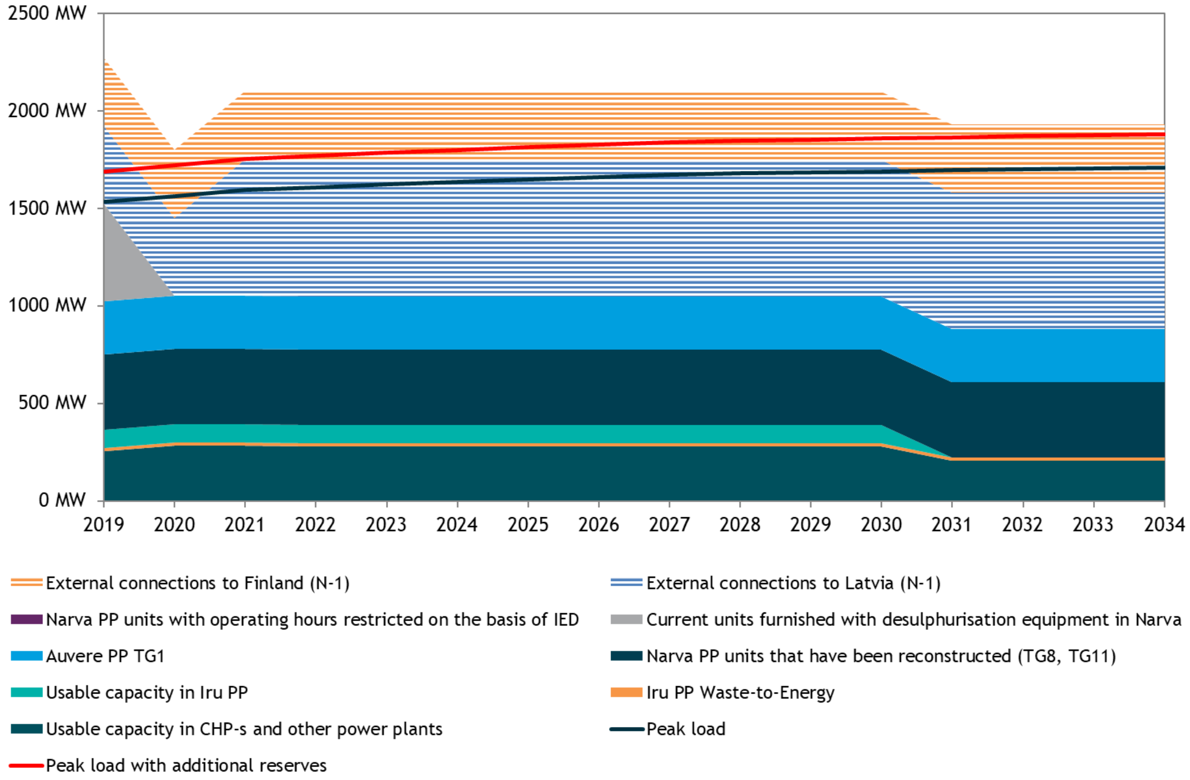

Figure 3.19 Security of electricity supply in Estonia in an N-1-1 situation up to 2034

The analysis shows that through the combination of generation capacities and transmission capacities, it is possible to generate enough electricity to cover peak consumption and to import electricity even in severe emergency situations. The 10% peak consumption reserve for unexpected peak load changes is also ensured.