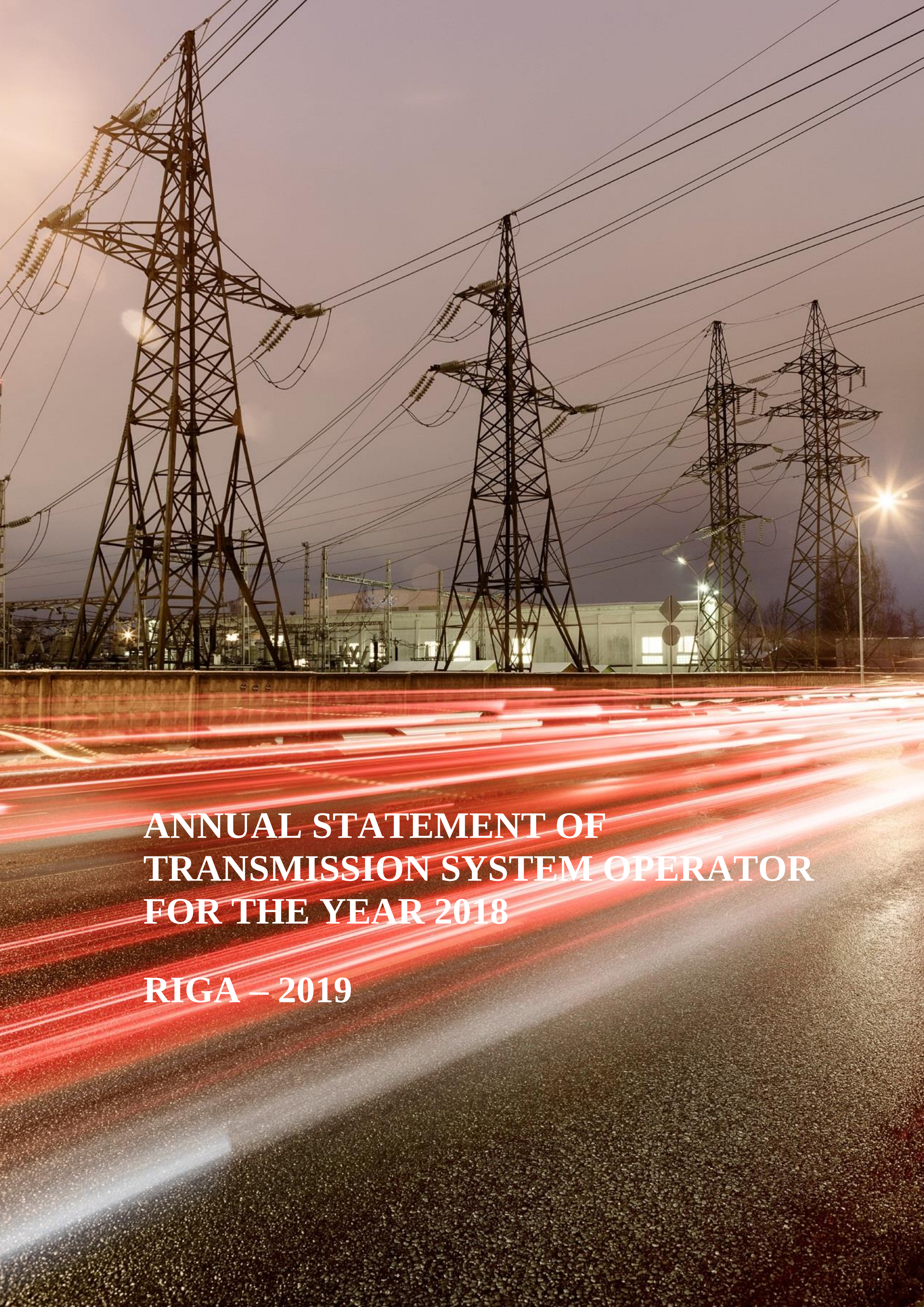


ANNUAL STATEMENT OF TRANSMISSION SYSTEM OPERATOR FOR THE YEAR 2018

RIGA – 2019

CONTENT

The Report is prepared in accordance with the Regulation No. 322 "Regulations on the TSO's annual statement" by Latvian Cabinet of Ministers from April 25, 2006, taking into account "Energy Development Guidelines for years 2016-2020 in Latvia" approved by the Latvian Cabinet of Ministers (Order No. 129) on February 9, 2016, as well as taking into account informative report on Long Term Energy Strategy for year 2030.

1. Electricity and power demand in the country last year

1.1. Electricity consumption (net) (including losses) by week for year 2018

Total annual energy consumption including losses equals 7 410 214 MWh.

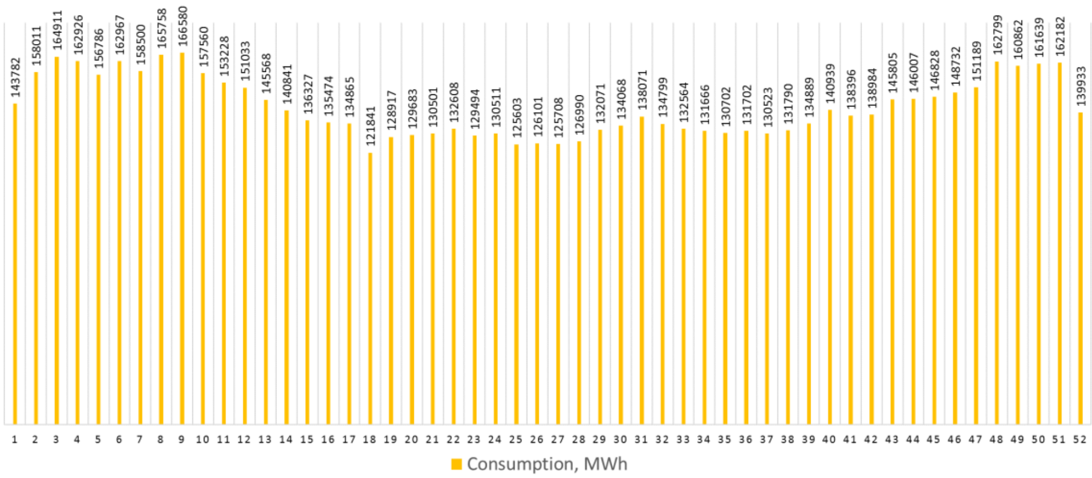
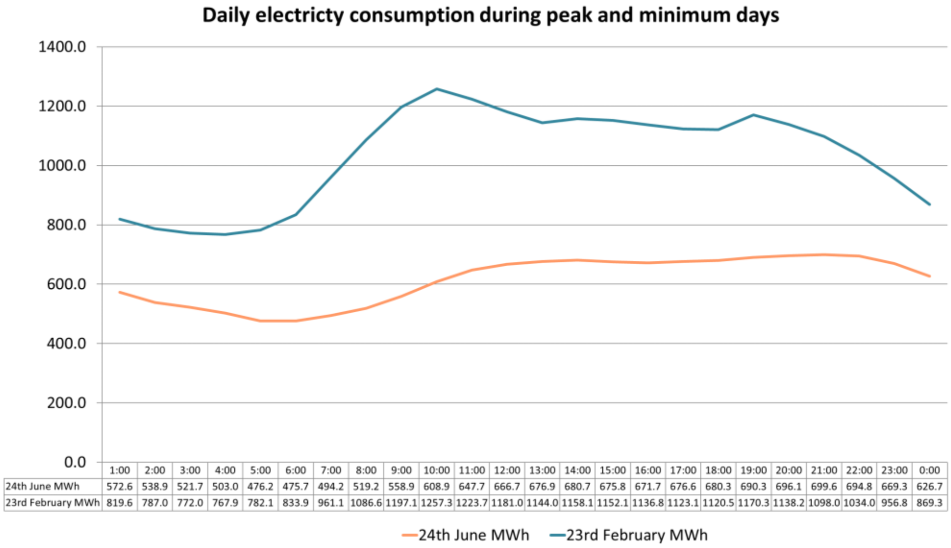


Fig. 1. Weekly electricity consumption (net) in Latvia.

1.2. Maximum winter peak load and minimum summer load (control-measurement data, MWh/h).

Minimum load:	476 MW	24.06.2018.g.	06.00
Maximum load:	1257 MW	23.02.2018.g.	10.00

1.3. System load in control measurement days (24 hours)



	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00
24th June MWh	572.6	538.9	521.7	503.0	476.2	475.7	494.2	519.2	558.9	608.9	647.7	666.7
23rd February MWh	819.6	787.0	772.0	767.9	782.1	833.9	961.1	1086.6	1197.1	1257.3	1223.7	1181.0

	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
24th June MWh	676.9	680.7	675.8	671.7	676.6	680.3	690.3	696.1	699.6	694.8	669.3	626.7
23rd February MWh	1144.0	1158.1	1152.1	1136.8	1123.1	1120.5	1170.3	1138.2	1098.0	1034.0	956.8	869.3

Fig. 2. System load during 24 hours

2. Electricity and power demand in the coming years (minimum forecast period - 10 years), including the annual electricity consumption and peak loads by scenarios.

Maximum power system load is calculated (normalized) based on GDP growth forecast submitted by the Latvian Ministry of Economics at the average regulated ambient temperature during winter period (December-February) -3.5°C (Table 3). Changes in outdoor temperature also affect changes to the maximum load. Electricity consumption of the system is forecasted for three scenarios – Conservative (A), Base (B) and Optimistic (EU2030).

Table 1

Year	Annual consumption for Conservative scenario (A)	Annual consumption for Base scenario (B)	Annual consumption for Optimistic scenario (EU2030)	Peak load
	GWh	GWh	GWh	MW
2019	7362	7589	7741	1287
2020	7406	7648	7836	1314
2021	7457	7714	7939	1342
2022	7496	7768	8030	1369
2023	7541	7830	8132	1398
2024	7578	7883	8226	1426
2025	7615	7937	8323	1456
2026	7650	7990	8420	1485
2027	7688	8046	8522	1516
2028	7716	8093	8617	1547
2029	7743	8138	8712	1578

3. Supply and consumption compliance rating during the reporting period and forecast for the future years (minimum forecast period - 10 years)

3.1. Annual power consumption and possible sources of power supplies.

The electric energy and power balance forecast, as well as the electricity consumption forecast, have been developed for three scenarios, where all three scenarios include synchronization of the Baltic States with continental Europe from year 2025. The detailed analysis of the scenarios is based on the Political Roadmap signed on June 28, 2018 by European Commission, Baltic States and Poland on the synchronization of the Baltic electricity transmission grids with the electricity grid of Continental Europe.

A detailed description of the scenarios is following:

- **Scenario A "Conservative development"**: The forecast of the electricity system load is based on the information provided by the Latvian distribution system operators regarding the development of load and electricity consumption. The forecast of the development of generating capacities is developed taking into account the operation of the gas power plants in the electricity market conditions, mainly working in the cogeneration mode only during the winter period. In the conservative scenario, the development of wind farms, biomass and biogas plants, small gas co-generation plants and solar power plants is planned, provided that the pace of development of each source in Latvia can be affected by possible changes in the governmental support schemes. Due to the possible changes of support scheme and based on the electricity producers previous years submitted information for cogeneration power plants operated by natural gas starting from the year 2021 Riga CHP-1 is being shut down and is not taking part in energy balance, in similar way in 2021 it is planned to stop the operation of Imanta CHP.

- **Scenario B "Base scenario"** Electricity system load forecast is based on GDP growth forecast for Latvia, supplied by Ministry of Economics of Latvia, by users of energy sector in Latvia, as well as based on the information on the load and electricity consumption forecast, supplied by distribution system operators. Forecast of generation development takes into account power stations planned for commissioning or de-commissioning based on the information supplied by all power system users to the TSO. In Base scenario (B) production of the Daugava HPP cascade and both of Riga CHP's is planned based on the annual average production. Development of the wind power stations, bio-mass and bio-gas stations, small gas co-generation stations and solar power stations is based on historical development temps data for each type of generation in Latvia at moderate economy development temps in the country.

- **Scenario EU2030 "Optimistic development"** Generation development forecast and electricity system load increase are based on GDP increase forecast for Latvia, submitted by the Ministry of Economics, taking into account planned generation and load increase plans necessary to achieve the development of EU goals for 2030, based on "Energy Development Guidelines for years 2016-2020 in Latvia" approved by the Latvian Cabinet of Ministers (Order No. 129) on February 9, 2016 and based on informative report on Latvian long term energy strategy for year 2030. In this scenario, in addition to the development plans from scenarios A and B, possible future power stations are taken into account, commissioning of which are deemed possible based on the information available at TSO. The scenario assumes that Imanta CHP and Riga CHP-1 will retain their ability to participate in the covering of peak load. In this scenario forecasted development of wind, solar, bio-mass and bio-gas power stations is much faster, due to stronger governmental support and wider transmission system infrastructure development.

Note: *Power plants output in the tables is shown in net values and takes into account the power plant planned annual maintenance schedules.*

Assumptions and explanations for the tables:

1) Daugava cascade hydropower plants (hereinafter - the Daugava HPP) multi-annual average net output according to the statistical data are 2700 GWh per year.

2) In 2010, a five-party agreement of BRELL ring between the Estonian, Latvian, Lithuanian, Russian and Belarusian TSO provides for the mutual provision of emergency reserves from the beginning of the realization and up to 12 hours. Emergency reserve for Latvia provides BRELL five-party agreement on common emergency reserve maintenance for each of the parties involved, maintaining 100 MW each, which consists of the sum of 500 MW. Taking into consideration the largest generating unit load in Latvia, Latvian power system needs of the emergency reserve is ensured according to the maximum generating units planned load, i.e. up to 440 MW (Riga CHP-2 largest unit). The available power reserves in Latvia is 100 MW, and other missing power amount 340 MW from neighboring power systems can be received only 12 hours. After 2025, when the power systems of the Baltic States will operate synchronously with the power system of Continental Europe, the Latvian power system should provide the necessary power reserve for the operational security of the power system. According to AST estimates these reserves could reach up to 225 MW, including a frequency containment reserve

of ~10 MW, automatic frequency restoration reserve of ~ 30 MW and a manual frequency restoration reserve of up to 185 MW.

3) Necessary power reserve for provision of Latvian power system operational security according to planned load and generation development scenarios.

4) Power system regulation reserve assessed as 6% of the system peak load and 10% of the installed wind power station capacity for winter day peak load.

5) For power balance monthly assessment it is necessary to account water inflow for Daugava HPPs in river Daugava. For “Conservative scenario” (A) January least average inflow since 2000 has been in 2003 (150 m^3/s, which corresponds to 270 MW of power for covering peak demand). In “Base scenario” (B) inflow for Daugava HPPs is assumed 200 m^3/s, which corresponds to 350 MW power equivalent. In “Optimistic scenario” (EU2030) inflow for Daugava HPPs is assumed 230 m^3/s, which corresponds to 400 MW power equivalent. For coverage of minimum load during the June the same inflow values are assumed for each scenario respectively.

6) Installed capacities of power stations in the tables are presented, including their own self-consumption (gross), but the rest of the tables are shown excluding self-consumption (net). Gross output is the total capacity of the power station developed by all main generator units and generators for self-consumption. Net power output is gross output minus the power of the self-consumption equipment required for feeding power and power losses in transformers.

7) Wind power installed capacity and net capacity for Conservative scenario (A) and Base Scenario (B) has been assumed on the basis of the information report "Action of Latvian Republic in the field of renewable energy subject to Directive 2009/28/EC of the European Parliament and the Council of April 23, 2009 on the promotion of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC to be introduced by year 2020", in the Optimistic Scenario (EU 2030) – based on the Forecast of development of large scale wind parks, submitted by the Ministry of Economy of Latvia and technical requirements for producers issued by Latvians transmission system operator AS "Augstsprieguma tikls" and Latvian distribution system operator AS "Sadales tikls".

8) In the Conservative scenario (A) and in Base scenario (B), bio-mass and bio-gas power plant capacity assessed on the basis of the information presented in the report "Latvian Republic Action for renewable energy in the European Parliament and of the Council of 23 April 2009 Directive 2009/28/EC on the promotion of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC by 2020", but in the Optimistic scenario (EU 2030) – based on technical requirements for producers issued by AS "Augstsprieguma tikls" and AS "Sadales tikls".

9) In electricity balance tables for Conservative scenario (A) Riga CHP-1, Riga CHP-2 and Imanta CHP power generation is assessed based on market situation in the market area of “Nord Pool”. In Base scenario (B) power generation in Riga CHP-1, Riga CHP-2 and Imanta CHP is assumed as long term annual average. In Optimistic scenario (EU) production of Riga CHP-1, Riga CHP-2 and Imanta CHP is assessed as maximum possible, irrelevant to the “NordPool” market situation, developing the maximum possible amount of electricity in annual terms. For possibility of co-generation stations to receive compulsory payment for installed capacity according to Cabinet of Ministers Regulations No 221 "Regulations on electricity production and pricing with cogeneration stations" the utilization time of co-generation power stations or separate equipment installed in them must be at least 1200 hours per year.

10) In the hourly load demand tables production in the power stations of Latvia is shown with not inclusion possible power reserves (assumption 3). Power reserves for the needs of Latvian power system will be provided via market based reserve purchases from the participants of Latvian or Baltic power systems.

11) For conservative scenario (A) it is assumed that Riga CHP-2 can operate in co-generation mode only, when its output power reaches 803 MW net. In Base scenario (B) and Optimistic scenario

(EU 2030) it is assumed that Riga CHP-2 maximum net production can reach up to 850 MW with power plant operating in condensing mode.

12) On June 28, 2018, a political decision has been made on the synchronization of the Baltic States with Continental Europe and the disconnection (desynchronization) from the Russian power system. These measures will be implemented by year 2025. Due to this, the Latvian transmission system operator in this report evaluate possible synchronous operation of the Baltic States with continental Europe in the regional capacity adequacy analysis.

13) In conservative scenario (A), according to previous years information provided by AS Latvenergo, it is assumed that the operation of the Riga CHP-1 will stop after 2020, and it is planned to stop the operation of Imanta CHP in mid of 2021, due to the possible change of support scheme program. Staring from year 2021 capacity of Riga CHP-1 (144 MW) and from year 2022 capacity of Imanta CHP are not included in the adequacy analysis.

MW Installed capacities (gross) of power stations, MW

Table 2

Years		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Power stations with installed capacity above 40 MW [6)]	**1**	**2630**	**2644**	**2666**	**2674**	**2674**	**2674**	**2674**	**2674**	**2674**	**2674**	**2674**
Including: Daugava HPPs	*1.1*	*1558*	*1558*	*1580*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*
Riga CHP-1 [13)]	*1.2*	*144*	*158*	*0/158*	*0/158*	*0/158*	*0/158*	*0/158*	*0/158*	*0/158*	*0/158*	*0/158*
Riga CHP-2	*1.3*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*
Imanta CHP [13)]	*1.4*	*48*	*48*	*48*	*0/48*	*0/48*	*0/48*	*0/48*	*0/48*	*0/48*	*0/48*	*0/48*
Installed capacity of small power stations (conservative scenario A)	**2**	**375**	**383**	**392**	**400**	**428**	**443**	**457**	**472**	**487**	**501**	**516**
Including: Natural gas co-generation stations	*2.1*	*113*	*112*	*111*	*110*	*109*	*108*	*106*	*105*	*104*	*103*	*102*
Hydro power stations	*2.2*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*
Wind power stations [7)]	*2.3*	*78*	*82*	*85*	*89*	*112*	*122*	*132*	*141*	*151*	*161*	*171*
On-shore	*2.3.1.*	*78*	*82*	*85*	*89*	*92*	*96*	*99*	*103*	*106*	*110*	*113*
Off-shore	*2.3.2.*	*0*	*0*	*0*	*0*	*20*	*26*	*33*	*39*	*45*	*51*	*58*
Biomass power stations [8)]	*2.4*	*89*	*91*	*94*	*96*	*99*	*102*	*104*	*107*	*110*	*112*	*115*
Biogas power stations [8)]	*2.5*	*63*	*66*	*69*	*72*	*75*	*78*	*82*	*85*	*88*	*91*	*94*
Solar power stations	*2.6*	*2.25*	*2.48*	*2.71*	*2.94*	*3.17*	*3.40*	*3.63*	*3.86*	*4.08*	*4.31*	*4.54*
Installed capacity of small power stations (base scenario B)	**3**	**389**	**411**	**433**	**455**	**502**	**537**	**572**	**607**	**642**	**678**	**713**
Including: Natural gas co-generation stations	*3.1*	*114*	*114*	*114*	*114*	*114*	*114*	*115*	*115*	*115*	*115*	*115*
Hydro power stations	*3.2*	*30*	*30*	*30*	*31*	*31*	*31*	*31*	*32*	*32*	*32*	*32*
Wind power stations [7)]	*3.3*	*85*	*94*	*104*	*113*	*148*	*171*	*194*	*216*	*239*	*262*	*285*
On-shore	*3.3.1.*	*85*	*94*	*104*	*113*	*123*	*133*	*142*	*152*	*162*	*171*	*181*
Off-shore	*3.3.2.*	*0*	*0*	*0*	*0*	*25*	*38*	*51*	*64*	*78*	*91*	*104*
Biomass power stations [8)]	*3.4*	*91*	*95*	*100*	*104*	*109*	*113*	*118*	*122*	*127*	*131*	*136*
Biogas power stations [8)]	*3.5*	*67*	*74*	*81*	*88*	*95*	*102*	*109*	*115*	*122*	*129*	*136*
Solar power stations	*3.6*	*2.64*	*3.25*	*3.86*	*4.48*	*5.09*	*5.71*	*6.32*	*6.93*	*7.55*	*8.16*	*8.77*
Installed capacity of small power stations (optimistic scenario EU2030)	**4**	**406**	**444**	**483**	**522**	**601**	**659**	**718**	**777**	**836**	**895**	**953**
Including: Natural gas co-generation stations	*4.1*	*115*	*116*	*118*	*119*	*120*	*121*	*123*	*124*	*125*	*126*	*128*
Hydro power stations	*4.2*	*30*	*31*	*31*	*32*	*32*	*33*	*33*	*34*	*34*	*35*	*35*
Wind power stations [7)]	*4.3*	*92*	*110*	*127*	*144*	*202*	*239*	*276*	*313*	*351*	*388*	*425*
On-shore	*4.3.1.*	*92*	*110*	*127*	*144*	*162*	*179*	*196*	*213*	*231*	*248*	*265*

Off-shore	*4.3.2.*	*0*	*0*	*0*	*0*	*40*	*60*	*80*	*100*	*120*	*140*	*160*
Biomass power stations [8)]	*4.4*	*94*	*102*	*110*	*118*	*126*	*134*	*142*	*150*	*158*	*166*	*174*
Biogas power stations [8)]	*4.5*	*71*	*82*	*92*	*103*	*114*	*125*	*135*	*146*	*157*	*168*	*178*
Solar power stations	*4.6*	*3.02*	*4.02*	*5.02*	*6.02*	*7.01*	*8.01*	*9.01*	*10.01*	*11.01*	*12.01*	*13.00*

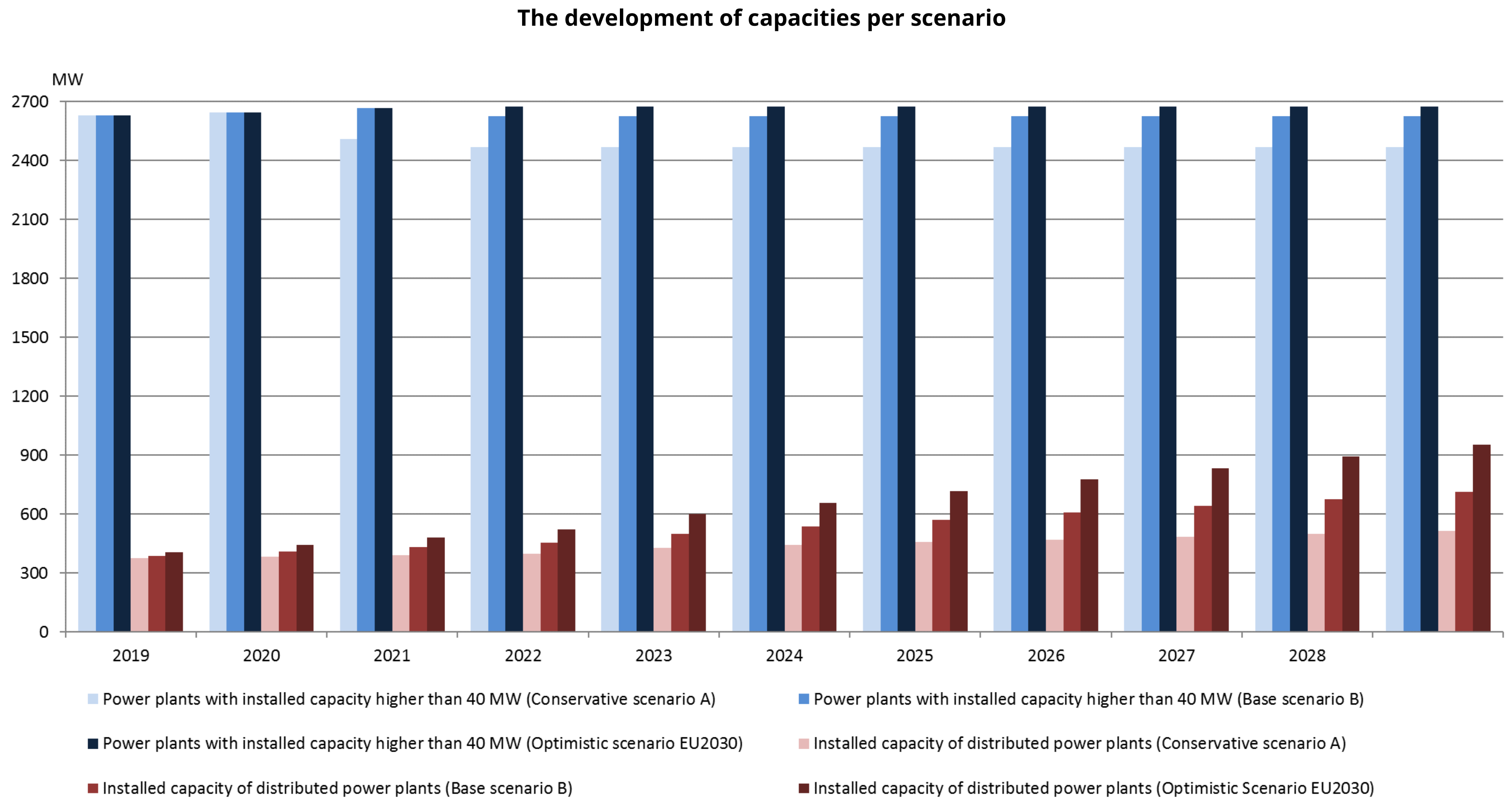


Fig.3. Development of installed capacities in power stations MW (gross) for different development scenarios.

Latvian power system balance for Scenario A winter peak load hours, MW (net)

Table 3

Years		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Maximum load	**1**	**1287**	**1314**	**1342**	**1369**	**1398**	**1426**	**1456**	**1485**	**1516**	**1547**	**1578**
Power stations with installed capacity above 40 MW	**2**	**2534**	**2548**	**2417**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**
Including: Daugava HPPs	*2.1*	*1550*	*1550*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*139*	*153*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Riga CHP-2	*2.3*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*
Imanta CHP	*2.4*	*42*	*42*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**348**	**356**	**364**	**372**	**400**	**414**	**428**	**442**	**456**	**470**	**484**
Including: Natural gas co-generation power stations	*3.1*	*103*	*102*	*101*	*100*	*99*	*98*	*97*	*96*	*95*	*94*	*93*
Hydro power stations	*3.2*	*28*	*28*	*28*	*28*	*28*	*28*	*28*	*28*	*28*	*28*	*29*
Wind power stations	*3.3*	*78*	*81*	*85*	*88*	*111*	*121*	*130*	*140*	*150*	*159*	*169*
Onshore	*3.3.1.*	*78*	*81*	*85*	*88*	*91*	*95*	*98*	*102*	*105*	*109*	*112*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*20*	*26*	*32*	*38*	*45*	*51*	*57*
Biomass power stations	*3.4*	*81*	*83*	*85*	*88*	*90*	*92*	*95*	*97*	*100*	*102*	*104*
Biogas power stations	*3.5*	*57*	*60*	*63*	*66*	*69*	*71*	*74*	*77*	*80*	*83*	*85*
Solar power stations	*3.6*	*2.03*	*2.23*	*2.44*	*2.65*	*2.85*	*3.06*	*3.26*	*3.47*	*3.68*	*3.88*	*4.09*
Available capacities for peak load and reserve guaranteeing	**4**	**1437**	**1454**	**1305**	**1266**	**1271**	**1275**	**1279**	**1283**	**1287**	**1291**	**1295**
Including: Daugava HPPs [5)]	*4.01*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*
Riga CHP-1	*4.02*	*139*	*153*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Riga CHP-2	*4.03*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*
Imanta CHP	*4.04*	*42*	*42*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Natural gas co-generation power stations	*4.05*	*72*	*71*	*70*	*70*	*69*	*68*	*68*	*67*	*66*	*66*	*65*
Hydro power stations	*4.06*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Wind power stations	*4.07*	*8*	*8*	*8*	*9*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
Biomass power stations	*4.08*	*56*	*58*	*60*	*61*	*63*	*65*	*66*	*68*	*70*	*71*	*73*
Biogas power stations	*4.09*	*40*	*42*	*44*	*46*	*48*	*50*	*52*	*54*	*56*	*58*	*60*
Solar power stations	*4.10*	*0.81*	*0.89*	*0.98*	*1.06*	*1.14*	*1.22*	*1.31*	*1.39*	*1.47*	*1.55*	*1.64*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**85**	**87**	**89**	**91**	**95**	**98**	**100**	**103**	**106**	**109**	**112**
Total reserve in Latvia[3)]	**7=5+6**	**185**	**187**	**189**	**191**	**195**	**198**	**325**	**328**	**331**	**334**	**337**
Power surplus (+), deficit (-)	**8=4-1**	**-35**	**-47**	**-226**	**-294**	**-322**	**-349**	**-501**	**-530**	**-560**	**-589**	**-619**
Power adequacy	**9=4/1**	**97%**	**96%**	**83%**	**79%**	**77%**	**76%**	**66%**	**64%**	**63%**	**62%**	**61%**

Latvian power system balance for Scenario B winter peak load hours, MW (net)

Table 4

Years		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Maximum load	**1**	**1287**	**1314**	**1342**	**1369**	**1398**	**1426**	**1456**	**1485**	**1516**	**1547**	**1578**
Power stations with installed capacity above 40 MW	**2**	**2534**	**2548**	**2417**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**
Including: Daugava HPPs	*2.1*	*1550*	*1550*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*139*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*
Riga CHP-2	*2.3*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*
Imanta CHP	*2.4*	*42*	*42*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**362**	**382**	**403**	**424**	**470**	**503**	**537**	**571**	**605**	**638**	**672**
Including: Natural gas co-generation power stations	*3.1*	*104*	*104*	*104*	*104*	*104*	*104*	*104*	*104*	*104*	*104*	*104*
Hydro power stations	*3.2*	*28*	*29*	*29*	*29*	*29*	*30*	*30*	*30*	*30*	*31*	*31*
Wind power stations	*3.3*	*84*	*93*	*103*	*112*	*147*	*169*	*192*	*214*	*237*	*259*	*282*
Onshore	*3.3.1.*	*84*	*93*	*103*	*112*	*122*	*131*	*141*	*150*	*160*	*169*	*179*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*25*	*38*	*51*	*64*	*77*	*90*	*103*
Biomass power stations	*3.4*	*82*	*86*	*91*	*95*	*99*	*103*	*107*	*111*	*115*	*119*	*124*
Biogas power stations	*3.5*	*61*	*67*	*74*	*80*	*86*	*92*	*99*	*105*	*111*	*118*	*124*
Solar power stations	*3.6*	*2.37*	*2.93*	*3.48*	*4.03*	*4.58*	*5.13*	*5.69*	*6.24*	*6.79*	*7.34*	*7.90*
Available capacities for peak load and reserve guaranteeing	**4**	**1569**	**1590**	**1598**	**1563**	**1574**	**1583**	**1592**	**1601**	**1610**	**1619**	**1628**
Including: Daugava HPPs 5)	*4.01*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*
Riga CHP-1	*4.02*	*139*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*
Riga CHP-2	*4.03*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*
Imanta CHP	*4.04*	*42*	*42*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Natural gas co-generation power stations	*4.05*	*72*	*71*	*70*	*70*	*69*	*68*	*68*	*67*	*66*	*66*	*65*
Hydro power stations	*4.06*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Wind power stations	*4.07*	*8*	*9*	*10*	*11*	*15*	*17*	*19*	*21*	*24*	*26*	*28*
Biomass power stations	*4.08*	*58*	*61*	*63*	*66*	*69*	*72*	*75*	*78*	*81*	*84*	*86*
Biogas power stations	*4.09*	*43*	*47*	*51*	*56*	*60*	*65*	*69*	*73*	*78*	*82*	*87*
Solar power stations	*4.10*	*0.95*	*1.17*	*1.39*	*1.61*	*1.83*	*2.05*	*2.27*	*2.50*	*2.72*	*2.94*	*3.16*
Power system emergency reserve 2)	**5**	**100**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**	**225**
Power system regulating reserve 4)	**6**	**86**	**88**	**91**	**93**	**99**	**102**	**106**	**111**	**115**	**119**	**123**
Total reserve in Latvia3)	**7=5+6**	**186**	**188**	**191**	**193**	**199**	**202**	**331**	**336**	**340**	**344**	**348**
Power surplus (+), deficit (-)	**8=4-1**	**95**	**88**	**65**	**1**	**-23**	**-46**	**-195**	**-220**	**-246**	**-272**	**-297**
Power adequacy	**9=4/1**	**107%**	**107%**	**105%**	**100%**	**98%**	**97%**	**87%**	**85%**	**84%**	**82%**	**81%**

Latvian power system balance for Scenario EU2030 winter peak load hours, MW (net)

Table 5

Years		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Maximum load	**1**	**1287**	**1314**	**1342**	**1369**	**1398**	**1426**	**1456**	**1485**	**1516**	**1547**	**1578**
Power stations with installed capacity above 40 MW	**2**	**2534**	**2548**	**2417**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**
Including: Daugava HPPs	*2.1*	*1550*	*1550*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*139*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*
Riga CHP-2	*2.3*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*
Imanta CHP	*2.4*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*
Small power stations	**3**	**376**	**412**	**447**	**482**	**557**	**613**	**668**	**723**	**778**	**833**	**889**
Including: Natural gas co-generation power stations	*3.1*	*104*	*104*	*104*	*104*	*104*	*104*	*104*	*104*	*104*	*104*	*104*
Hydro power stations	*3.2*	*28*	*29*	*29*	*29*	*29*	*30*	*30*	*30*	*30*	*31*	*31*
Wind power stations	*3.3*	*91*	*109*	*126*	*143*	*200*	*236*	*273*	*310*	*347*	*384*	*421*
Onshore	*3.3.1.*	*91*	*109*	*126*	*143*	*160*	*177*	*194*	*211*	*228*	*246*	*263*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*40*	*59*	*79*	*99*	*119*	*139*	*158*
Biomass power stations	*3.4*	*85*	*93*	*100*	*107*	*115*	*122*	*129*	*136*	*144*	*151*	*158*
Biogas power stations	*3.5*	*64*	*74*	*84*	*94*	*104*	*113*	*123*	*133*	*143*	*152*	*162*
Solar power stations	*3.6*	*2.7*	*3.6*	*4.5*	*5.4*	*6.3*	*7.2*	*8.1*	*9.0*	*9.9*	*10.8*	*11.7*
Available capacities for peak load and reserve guaranteeing	**4**	**1624**	**1651**	**1664**	**1678**	**1695**	**1710**	**1725**	**1741**	**1756**	**1771**	**1787**
Including: Daugava HPPs [5)]	*4.01*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*
Riga CHP-1	*4.02*	*139*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*
Riga CHP-2	*4.03*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*
Imanta CHP	*4.04*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*
Natural gas co-generation power stations	*4.05*	*72*	*71*	*70*	*70*	*69*	*68*	*68*	*67*	*66*	*66*	*65*
Hydro power stations	*4.06*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Wind power stations	*4.07*	*9*	*11*	*13*	*14*	*20*	*24*	*27*	*31*	*35*	*38*	*42*
Biomass power stations	*4.08*	*60*	*65*	*70*	*75*	*80*	*85*	*90*	*95*	*101*	*106*	*111*
Biogas power stations	*4.09*	*45*	*52*	*59*	*66*	*73*	*79*	*86*	*93*	*100*	*107*	*114*
Solar power stations	*4.10*	*1.09*	*1.45*	*1.81*	*2.17*	*2.53*	*2.88*	*3.24*	*3.60*	*3.96*	*4.32*	*4.68*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**86**	**90**	**93**	**96**	**104**	**109**	**115**	**120**	**126**	**131**	**137**
Total reserve in Latvia[3)]	**7=5+6**	**186**	**190**	**193**	**196**	**204**	**209**	**340**	**345**	**351**	**356**	**362**
Power surplus (+), deficit (-)	**8=4-1**	**150**	**147**	**129**	**112**	**93**	**75**	**-70**	**-90**	**-111**	**-132**	**-153**
Power adequacy	**9=4/1**	**112%**	**111%**	**110%**	**108%**	**107%**	**105%**	**95%**	**94%**	**93%**	**91%**	**90%**

Possible power balance for Scenario A (annual values), GWh

Table 6

Years		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Energy demand	**1**	**7362**	**7406**	**7457**	**7496**	**7541**	**7578**	**7615**	**7650**	**7688**	**7716**	**7743**
Output in power stations with installed capacity above 40 MW	**2**	**5120**	**4169**	**3697**	**3839**	**3839**	**3839**	**3839**	**3839**	**3839**	**3839**	**3839**
Including: Daugava HPPs [1)]	*2.1*	*1851*	*2800*	*2817*	*2864*	*2864*	*2864*	*2864*	*2864*	*2864*	*2864*	*2864*
Riga CHP-1 [9), 13)]	*2.2*	*570*	*489*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Riga CHP-2 [9)]	*2.3*	*2639*	*820*	*820*	*975*	*975*	*975*	*975*	*975*	*975*	*975*	*975*
Imanta CHP	*2.4*	*60*	*60*	*60*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**1624**	**1656**	**1688**	**1720**	**1801**	**1848**	**1895**	**1943**	**1990**	**2037**	**2084**
Including: Natural gas co-generation power stations	*3.1*	*616*	*610*	*604*	*598*	*592*	*587*	*581*	*575*	*569*	*563*	*557*
Hydro power stations	*3.2*	*77*	*77*	*78*	*79*	*79*	*80*	*81*	*81*	*82*	*83*	*83*
Wind power stations	*3.3*	*155*	*162*	*169*	*176*	*232*	*255*	*277*	*299*	*322*	*344*	*366*
Onshore	*3.3.1.*	*155*	*162*	*169*	*176*	*183*	*190*	*196*	*203*	*210*	*217*	*224*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*50*	*65*	*80*	*96*	*111*	*127*	*142*
Biomass power stations	*3.4*	*403*	*415*	*427*	*438*	*450*	*462*	*474*	*486*	*498*	*510*	*522*
Biogas power stations	*3.5*	*373*	*391*	*409*	*427*	*445*	*464*	*482*	*500*	*518*	*536*	*555*
Solar power stations	*3.6*	*0.61*	*0.67*	*0.73*	*0.79*	*0.86*	*0.9*	*1.0*	*1.0*	*1.1*	*1.2*	*1.2*
Possible annual export/import	**4=(2+3)-1**	**-617**	**-1581**	**-2072**	**-1937**	**-1901**	**-1890**	**-1880**	**-1868**	**-1859**	**-1840**	**-1819**
Annual adequacy	**5=(2+3)/1**	**92%**	**79%**	**72%**	**74%**	**75%**	**75%**	**75%**	**76%**	**76%**	**76%**	**77%**

Possible power balance for Scenario B (annual values), GWh

Table 7

Years		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Energy demand	**1**	**7589**	**7648**	**7714**	**7768**	**7830**	**7883**	**7937**	**7990**	**8046**	**8093**	**8138**
Output in power stations with installed capacity above 40 MW	**2**	**3981**	**4849**	**4866**	**4853**	**4853**	**4853**	**4853**	**4853**	**4853**	**4853**	**4853**
Including: Daugava HPPs [1]	*2.1*	*1851*	*2800*	*2817*	*2864*	*2864*	*2864*	*2864*	*2864*	*2864*	*2864*	*2864*
Riga CHP-1 [9), 13)]	*2.2*	*570*	*489*	*489*	*489*	*489*	*489*	*489*	*489*	*489*	*489*	*489*
Riga CHP-2 [9]	*2.3*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*
Imanta CHP	*2.4*	*60*	*60*	*60*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**1669**	**1744**	**1820**	**1895**	**2033**	**2141**	**2249**	**2356**	**2464**	**2572**	**2680**
Including: Natural gas co-generation power stations	*3.1*	*616*	*610*	*604*	*598*	*592*	*587*	*581*	*575*	*569*	*563*	*557*
Hydro power stations	*3.2*	*77*	*77*	*78*	*79*	*79*	*80*	*81*	*81*	*82*	*83*	*83*
Wind power stations	*3.3*	*168*	*187*	*206*	*225*	*306*	*357*	*409*	*460*	*512*	*563*	*615*
Onshore	*3.3.1.*	*168*	*187*	*206*	*225*	*244*	*263*	*282*	*301*	*320*	*339*	*358*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*62*	*94*	*127*	*159*	*192*	*224*	*257*
Biomass power stations	*3.4*	*412*	*432*	*453*	*473*	*494*	*515*	*535*	*556*	*577*	*597*	*618*
Biogas power stations	*3.5*	*396*	*437*	*478*	*519*	*560*	*601*	*641*	*682*	*723*	*764*	*805*
Solar power stations	*3.6*	*0.7*	*0.9*	*1.0*	*1.2*	*1.4*	*1.5*	*1.7*	*1.9*	*2.0*	*2.2*	*2.4*
Possible annual export/import	**4=(2+3)-1**	**-1939**	**-1055**	**-1029**	**-1020**	**-944**	**-889**	**-835**	**-780**	**-728**	**-667**	**-605**
Annual adequacy	**5=(2+3)/1**	**74%**	**86%**	**87%**	**87%**	**88%**	**89%**	**89%**	**90%**	**91%**	**92%**	**93%**

Possible power balance for Scenario EU2030 (annual values), GWh

Table 8

Years		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Energy demand	**1**	**7741**	**7836**	**7939**	**8030**	**8132**	**8226**	**8323**	**8420**	**8522**	**8617**	**8712**
Output in power stations with installed capacity above 40 MW	**2**	**9253**	**10202**	**10219**	**10266**	**10266**	**10266**	**10266**	**10266**	**10266**	**10266**	**10266**
Including: Daugava HPPs [1)]	*2.1*	*1851*	*2800*	*2817*	*2864*	*2864*	*2864*	*2864*	*2864*	*2864*	*2864*	*2864*
Riga CHP-1 [9), 13)]	*2.2*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*
Riga CHP-2 [9)]	*2.3*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*
Imanta CHP	*2.4*	*336*	*336*	*336*	*336*	*336*	*336*	*336*	*336*	*336*	*336*	*336*
Small power stations	**3**	**1733**	**1861**	**1989**	**2177**	**2334**	**2492**	**2650**	**2807**	**2965**	**3123**	**3310**
Including: Natural gas co-generation power stations	*3.1*	*616*	*610*	*604*	*598*	*592*	*587*	*581*	*575*	*569*	*563*	*557*
Hydro power stations	*3.2*	*77*	*77*	*78*	*79*	*79*	*80*	*81*	*81*	*82*	*83*	*83*
Wind power stations	*3.3*	*183*	*217*	*251*	*345*	*409*	*473*	*537*	*601*	*665*	*729*	*823*
Onshore	*3.3.1.*	*183*	*217*	*251*	*286*	*320*	*354*	*388*	*423*	*457*	*491*	*526*
Offshore	*3.3.2.*	*0*	*0*	*0*	*59*	*89*	*119*	*149*	*178*	*208*	*238*	*297*
Biomass power stations	*3.4*	*470*	*510*	*550*	*590*	*630*	*670*	*710*	*750*	*790*	*830*	*870*
Biogas power stations	*3.5*	*387*	*446*	*504*	*563*	*622*	*680*	*739*	*798*	*856*	*915*	*974*
Solar power stations	*3.6*	*0.8*	*1.1*	*1.4*	*1.6*	*1.9*	*2.2*	*2.4*	*2.7*	*3.0*	*3.2*	*3.5*
Possible annual export/import	**4=(2+3)-1**	**3245**	**4227**	**4269**	**4412**	**4468**	**4532**	**4593**	**4653**	**4709**	**4772**	**4865**
Annual adequacy	**5=(2+3)/1**	**142%**	**154%**	**154%**	**155%**	**155%**	**155%**	**155%**	**155%**	**155%**	**155%**	**156%**

Power demand and possible sources of guaranteeing, hourly balance for Scenario A (peak load), MW

Power demand and possible sources for guaranteeing, hourly values.
Scenario A

Year 2019. January (Working day, Wednesday of the third week, Peak load) *Table 9*

Hour	Riga CHP-1	Riga CHP-2 11)	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
01:00	139	450	42	56	40	72	6	8	0	26	0	839
02:00	139	428	42	56	40	72	6	8	0	15	0	806
03:00	139	407	42	56	40	72	6	8	0	21	0	790
04:00	139	397	42	56	40	72	6	8	0	27	0	786
05:00	139	404	42	56	40	72	6	8	0	34	0	801
06:00	139	444	42	56	40	72	6	8	0	47	0	854
07:00	139	499	42	56	40	72	6	8	0	122	0	984
08:00	139	560	42	56	40	72	6	8	0	190	0	1113
09:00	139	602	42	56	40	72	6	8	0	261	0	1226
10:00	139	655	42	56	40	72	6	8	0	270	0	1287
11:00	139	662	42	56	40	72	6	8	0.81	227	0	1253
12:00	139	653	42	56	40	72	6	8	0.81	192	0	1209
13:00	139	623	42	56	40	72	6	8	0.81	185	0	1171
14:00	139	630	42	56	40	72	6	8	0.81	192	0	1186
15:00	139	601	42	56	40	72	6	8	0.81	215	0	1180
16:00	139	577	42	56	40	72	6	8	0.81	223	0	1164
17:00	139	539	42	56	40	72	6	8	0	249	0	1150
18:00	139	516	42	56	40	72	6	8	0	269	0	1147
19:00	139	572	42	56	40	72	6	8	0	263	0	1198
20:00	139	598	42	56	40	72	6	8	0	205	0	1165
21:00	139	617	42	56	40	72	6	8	0	145	0	1124
22:00	139	570	42	56	40	72	6	8	0	126	0	1059
23:00	139	534	42	56	40	72	6	8	0	83	0	980
00:00	139	477	42	56	40	72	6	8	0	50	0	890

Power demand and possible sources for guaranteeing, hourly values.

Scenario A

Year 2024. January (Working day, Wednesday of the third week, Peak load) *Table 10*

Hour	Riga CHP-1	Riga CHP-2 11)	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
01:00	0	703	0	65	50	68	6	12	0	26	0	930
02:00	0	677	0	65	50	68	6	12	0	15	0	893
03:00	0	654	0	65	50	68	6	12	0	21	0	876
04:00	0	644	0	65	50	68	6	12	0	27	0	871
05:00	0	652	0	65	50	68	6	12	0	34	0	887
06:00	0	698	0	65	50	68	6	12	0	47	0	946
07:00	0	767	0	65	50	68	6	12	0	122	0	1090
08:00	0	803	0	65	50	68	6	12	0	190	39	1233
09:00	0	803	0	65	50	68	6	12	0	261	93	1358
10:00	0	803	0	65	50	68	6	12	0	270	152	1426
11:00	0	803	0	65	50	68	6	12	1.22	227	156	1388
12:00	0	803	0	65	50	68	6	12	1.22	192	142	1340
13:00	0	803	0	65	50	68	6	12	1.22	185	108	1298
14:00	0	803	0	65	50	68	6	12	1.22	192	116	1314
15:00	0	803	0	65	50	68	6	12	1.22	215	87	1307
16:00	0	803	0	65	50	68	6	12	1.22	223	61	1290
17:00	0	803	0	65	50	68	6	12	0	249	22	1274
18:00	0	802	0	65	50	68	6	12	0	269	0	1271
19:00	0	803	0	65	50	68	6	12	0	263	61	1328
20:00	0	803	0	65	50	68	6	12	0	205	83	1291
21:00	0	803	0	65	50	68	6	12	0	145	97	1246
22:00	0	803	0	65	50	68	6	12	0	126	43	1173
23:00	0	802	0	65	50	68	6	12	0	83	0	1085
00:00	0	735	0	65	50	68	6	12	0	50	0	986

Power demand and possible sources for guaranteeing, hourly values.

Scenario A

Year 2029. January (Working day, Wednesday of the third week, Peak load)

Table 11

Hour	Riga CHP-1	Riga CHP-2 11)	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
01:00	0	782	0	73	60	65	6	17	0	26	0	1028
02:00	0	752	0	73	60	65	6	17	0	15	0	988
03:00	0	727	0	73	60	65	6	17	0	21	0	969
04:00	0	717	0	73	60	65	6	17	0	27	0	964
05:00	0	727	0	73	60	65	6	17	0	34	0	981
06:00	0	779	0	73	60	65	6	17	0	47	0	1046
07:00	0	803	0	73	60	65	6	17	0	122	61	1206
08:00	0	803	0	73	60	65	6	17	0	190	151	1363
09:00	0	803	0	73	60	65	6	17	0	261	218	1502
10:00	0	803	0	73	60	65	6	17	0	270	284	1578
11:00	0	803	0	73	60	65	6	17	1.64	227	283	1536
12:00	0	803	0	73	60	65	6	17	1.64	192	265	1482
13:00	0	803	0	73	60	65	6	17	1.64	185	226	1436
14:00	0	803	0	73	60	65	6	17	1.64	192	236	1453
15:00	0	803	0	73	60	65	6	17	1.64	215	206	1446
16:00	0	803	0	73	60	65	6	17	1.64	223	178	1426
17:00	0	803	0	73	60	65	6	17	0	249	137	1409
18:00	0	803	0	73	60	65	6	17	0	269	114	1406
19:00	0	803	0	73	60	65	6	17	0	263	182	1469
20:00	0	803	0	73	60	65	6	17	0	205	200	1428
21:00	0	803	0	73	60	65	6	17	0	145	210	1378
22:00	0	803	0	73	60	65	6	17	0	126	148	1297
23:00	0	803	0	73	60	65	6	17	0	83	94	1201
00:00	0	803	0	73	60	65	6	17	0	50	17	1091

Power demand and possible sources of guaranteeing, hourly balance for Scenario B (peak load), MW

Power demand and possible sources for guaranteeing, hourly values.
Scenario B
Year 2019. January (Working day, Wednesday of the third week, Peak load)

Table 12

Hour	Riga CHP-1	Riga CHP-2 11)	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
01:00	139	438	42	58	43	72	6	8	0	34	0	839
02:00	139	419	42	58	43	72	6	8	0	19	0	806
03:00	139	396	42	58	43	72	6	8	0	27	0	790
04:00	139	385	42	58	43	72	6	8	0	34	0	786
05:00	139	389	42	58	43	72	6	8	0	44	0	801
06:00	139	426	42	58	43	72	6	8	0	61	0	854
07:00	139	459	42	58	43	72	6	8	0	158	0	984
08:00	139	500	42	58	43	72	6	8	0	246	0	1113
09:00	139	521	42	58	43	72	6	8	0	338	0	1226
10:00	139	570	42	58	43	72	6	8	0	350	0	1287
11:00	139	590	42	58	43	72	6	8	0.95	295	0	1253
12:00	139	592	42	58	43	72	6	8	0.95	249	0	1209
13:00	139	564	42	58	43	72	6	8	0.95	239	0	1171
14:00	139	568	42	58	43	72	6	8	0.95	249	0	1186
15:00	139	533	42	58	43	72	6	8	0.95	279	0	1180
16:00	139	507	42	58	43	72	6	8	0.95	289	0	1164
17:00	139	460	42	58	43	72	6	8	0	322	0	1150
18:00	139	432	42	58	43	72	6	8	0	348	0	1147
19:00	139	490	42	58	43	72	6	8	0	341	0	1198
20:00	139	533	42	58	43	72	6	8	0	265	0	1165
21:00	139	569	42	58	43	72	6	8	0	188	0	1124
22:00	139	528	42	58	43	72	6	8	0	164	0	1059
23:00	139	505	42	58	43	72	6	8	0	107	0	980
00:00	139	458	42	58	43	72	6	8	0	65	0	890

Power demand and possible sources for guaranteeing, hourly values.
Scenario B
Year 2024. January (Working day, Wednesday of the third week, Peak load)

Table 13

Hour	Riga CHP-1	Riga CHP-2[11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
01:00	153	516	0	72	65	68	6	17	0	34	0	930
02:00	153	493	0	72	65	68	6	17	0	19	0	893
03:00	153	468	0	72	65	68	6	17	0	27	0	876
04:00	153	456	0	72	65	68	6	17	0	34	0	871
05:00	153	463	0	72	65	68	6	17	0	44	0	887
06:00	153	505	0	72	65	68	6	17	0	61	0	946
07:00	153	552	0	72	65	68	6	17	0	158	0	1090
08:00	153	607	0	72	65	68	6	17	0	246	0	1233
09:00	153	640	0	72	65	68	6	17	0	338	0	1358
10:00	153	696	0	72	65	68	6	17	0	350	0	1426
11:00	153	711	0	72	65	68	6	17	2.05	295	0	1388
12:00	153	708	0	72	65	68	6	17	2.05	249	0	1340
13:00	153	676	0	72	65	68	6	17	2.05	239	0	1298
14:00	153	682	0	72	65	68	6	17	2.05	249	0	1314
15:00	153	646	0	72	65	68	6	17	2.05	279	0	1307
16:00	153	618	0	72	65	68	6	17	2.05	289	0	1290
17:00	153	571	0	72	65	68	6	17	0	322	0	1274
18:00	153	543	0	72	65	68	6	17	0	348	0	1271
19:00	153	606	0	72	65	68	6	17	0	341	0	1328
20:00	153	646	0	72	65	68	6	17	0	265	0	1291
21:00	153	678	0	72	65	68	6	17	0	188	0	1246
22:00	153	629	0	72	65	68	6	17	0	164	0	1173
23:00	153	598	0	72	65	68	6	17	0	107	0	1085
00:00	153	541	0	72	65	68	6	17	0	65	0	986

Power demand and possible sources for guaranteeing, hourly values.

Scenario B

Year 2029. January (Working day, Wednesday of the third week, Peak load)

Table 14

Hour	Riga CHP-1	Riga CHP-2[11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
01:00	153	570	0	86	87	65	6	28	0	34	0	1028
02:00	153	544	0	86	87	65	6	28	0	19	0	988
03:00	153	517	0	86	87	65	6	28	0	27	0	969
04:00	153	505	0	86	87	65	6	28	0	34	0	964
05:00	153	513	0	86	87	65	6	28	0	44	0	981
06:00	153	561	0	86	87	65	6	28	0	61	0	1046
07:00	153	623	0	86	87	65	6	28	0	158	0	1206
08:00	153	693	0	86	87	65	6	28	0	246	0	1363
09:00	153	740	0	86	87	65	6	28	0	338	0	1502
10:00	153	803	0	86	87	65	6	28	0	350	0	1578
11:00	153	813	0	86	87	65	6	28	3.16	295	0	1536
12:00	153	805	0	86	87	65	6	28	3.16	249	0	1482
13:00	153	769	0	86	87	65	6	28	3.16	239	0	1436
14:00	153	776	0	86	87	65	6	28	3.16	249	0	1453
15:00	153	739	0	86	87	65	6	28	3.16	279	0	1446
16:00	153	710	0	86	87	65	6	28	3.16	289	0	1426
17:00	153	662	0	86	87	65	6	28	0	322	0	1409
18:00	153	633	0	86	87	65	6	28	0	348	0	1406
19:00	153	703	0	86	87	65	6	28	0	341	0	1469
20:00	153	739	0	86	87	65	6	28	0	265	0	1428
21:00	153	766	0	86	87	65	6	28	0	188	0	1378
22:00	153	709	0	86	87	65	6	28	0	164	0	1297
23:00	153	669	0	86	87	65	6	28	0	107	0	1201
00:00	153	601	0	86	87	65	6	28	0	65	0	1091

Power demand and possible sources of guaranteeing, hourly balance for Scenario EU 2030 (peak load), MW

Power demand and possible sources for guaranteeing, hourly values.
Scenario EU2030
<u>Year 2019. January (Working day, Wednesday of the third week, Peak load)</u>

Table 15

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
01:00	139	428	42	60	45	72	6	9	0	39	0	839
02:00	139	411	42	60	45	72	6	9	0	22	0	806
03:00	139	387	42	60	45	72	6	9	0	31	0	790
04:00	139	374	42	60	45	72	6	9	0	39	0	786
05:00	139	378	42	60	45	72	6	9	0	50	0	801
06:00	139	412	42	60	45	72	6	9	0	70	0	854
07:00	139	431	42	60	45	72	6	9	0	181	0	984
08:00	139	459	42	60	45	72	6	9	0	281	0	1113
09:00	139	467	42	60	45	72	6	9	0	386	0	1226
10:00	139	515	42	60	45	72	6	9	0	400	0	1287
11:00	139	543	42	60	45	72	6	9	1.09	337	0	1253
12:00	139	550	42	60	45	72	6	9	1.09	285	0	1209
13:00	139	524	42	60	45	72	6	9	1.09	273	0	1171
14:00	139	527	42	60	45	72	6	9	1.09	285	0	1186
15:00	139	487	42	60	45	72	6	9	1.09	319	0	1180
16:00	139	460	42	60	45	72	6	9	1.09	330	0	1164
17:00	139	409	42	60	45	72	6	9	0	368	0	1150
18:00	139	377	42	60	45	72	6	9	0	398	0	1147
19:00	139	436	42	60	45	72	6	9	0	390	0	1198
20:00	139	490	42	60	45	72	6	9	0	303	0	1165
21:00	139	537	42	60	45	72	6	9	0	215	0	1124
22:00	139	499	42	60	45	72	6	9	0	187	0	1059
23:00	139	484	42	60	45	72	6	9	0	123	0	980
00:00	139	443	42	60	45	72	6	9	0	74	0	890

Power demand and possible sources for guaranteeing, hourly values.
Scenario EU 2030
Year 2024. January (Working day, Wednesday of the third week, Peak load)

Table 16

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
01:00	153	434	42	85	79	68	6	24	0	39	0	930
02:00	153	414	42	85	79	68	6	24	0	22	0	893
03:00	153	388	42	85	79	68	6	24	0	31	0	876
04:00	153	375	42	85	79	68	6	24	0	39	0	871
05:00	153	380	42	85	79	68	6	24	0	50	0	887
06:00	153	419	42	85	79	68	6	24	0	70	0	946
07:00	153	453	42	85	79	68	6	24	0	181	0	1090
08:00	153	495	42	85	79	68	6	24	0	281	0	1233
09:00	153	515	42	85	79	68	6	24	0	386	0	1358
10:00	153	569	42	85	79	68	6	24	0	400	0	1426
11:00	153	592	42	85	79	68	6	24	2.88	337	0	1388
12:00	153	595	42	85	79	68	6	24	2.88	285	0	1340
13:00	153	565	42	85	79	68	6	24	2.88	273	0	1298
14:00	153	569	42	85	79	68	6	24	2.88	285	0	1314
15:00	153	529	42	85	79	68	6	24	2.88	319	0	1307
16:00	153	499	42	85	79	68	6	24	2.88	330	0	1290
17:00	153	449	42	85	79	68	6	24	0	368	0	1274
18:00	153	416	42	85	79	68	6	24	0	398	0	1271
19:00	153	481	42	85	79	68	6	24	0	390	0	1328
20:00	153	531	42	85	79	68	6	24	0	303	0	1291
21:00	153	574	42	85	79	68	6	24	0	215	0	1246
22:00	153	529	42	85	79	68	6	24	0	187	0	1173
23:00	153	506	42	85	79	68	6	24	0	123	0	1085
00:00	153	455	42	85	79	68	6	24	0	74	0	986

Power demand and possible sources for guaranteeing, hourly values.

Scenario EU 2030

Year 2029. January (Working day, Wednesday of the third week, Peak load)

Table 17

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
01:00	153	458	42	111	114	65	6	42	0	39	0	1028
02:00	153	434	42	111	114	65	6	42	0	22	0	988
03:00	153	406	42	111	114	65	6	42	0	31	0	969
04:00	153	393	42	111	114	65	6	42	0	39	0	964
05:00	153	399	42	111	114	65	6	42	0	50	0	981
06:00	153	445	42	111	114	65	6	42	0	70	0	1046
07:00	153	494	42	111	114	65	6	42	0	181	0	1206
08:00	153	551	42	111	114	65	6	42	0	281	0	1363
09:00	153	584	42	111	114	65	6	42	0	386	0	1502
10:00	153	646	42	111	114	65	6	42	0	400	0	1578
11:00	153	663	42	111	114	65	6	42	4.68	337	0	1536
12:00	153	661	42	111	114	65	6	42	4.68	285	0	1482
13:00	153	626	42	111	114	65	6	42	4.68	273	0	1436
14:00	153	632	42	111	114	65	6	42	4.68	285	0	1453
15:00	153	591	42	111	114	65	6	42	4.68	319	0	1446
16:00	153	560	42	111	114	65	6	42	4.68	330	0	1426
17:00	153	509	42	111	114	65	6	42	0	368	0	1409
18:00	153	477	42	111	114	65	6	42	0	398	0	1406
19:00	153	547	42	111	114	65	6	42	0	390	0	1469
20:00	153	594	42	111	114	65	6	42	0	303	0	1428
21:00	153	632	42	111	114	65	6	42	0	215	0	1378
22:00	153	579	42	111	114	65	6	42	0	187	0	1297
23:00	153	546	42	111	114	65	6	42	0	123	0	1201
00:00	153	485	42	111	114	65	6	42	0	74	0	1091

Power demand and possible sources of guaranteeing, hourly balance for Scenario A (minimum load), MW

Scenario A

Year 2019. June – minimum load

Table 18

Hour	Riga CHP-1	Riga CHP-2[11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	342	0	56	40	72	6	8	0	62	0	586
01:00	0	327	0	56	40	72	6	8	0	43	0	552
02:00	0	315	0	56	40	72	6	8	0	38	0	534
03:00	0	309	0	56	40	72	6	8	0	24	0	515
04:00	0	282	0	56	40	72	6	8	0	24	0	488
05:00	0	283	0	56	40	72	6	8	0	22	0	487
06:00	0	273	0	56	40	72	6	8	0	52	0	506
07:00	0	237	0	56	40	72	6	8	0	112	0	532
08:00	0	206	0	56	40	72	6	8	0.97	184	0	572
09:00	0	194	0	56	40	72	6	8	0.97	247	0	623
10:00	0	212	0	56	40	72	6	8	0.97	269	0	663
11:00	0	230	0	56	40	72	6	8	0.97	270	0	683
12:00	0	259	0	56	40	72	6	8	0.97	251	0	693
13:00	0	268	0	56	40	72	6	8	0.97	247	0	697
14:00	0	261	0	56	40	72	6	8	0.97	249	0	692
15:00	0	283	0	56	40	72	6	8	0.97	222	0	688
16:00	0	308	0	56	40	72	6	8	0.97	202	0	693
17:00	0	346	0	56	40	72	6	8	0.97	168	0	697
18:00	0	373	0	56	40	72	6	8	0.97	151	0	707
19:00	0	392	0	56	40	72	6	8	0	139	0	713
20:00	0	394	0	56	40	72	6	8	0	141	0	716
21:00	0	416	0	56	40	72	6	8	0	113	0	711
22:00	0	410	0	56	40	72	6	8	0	94	0	685
23:00	0	381	0	56	40	72	6	8	0	79	0	642

Scenario A
Year 2024. June – minimum load

Table 19

Hour	Riga CHP-1	Riga CHP-2[11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	448	0	65	50	68	6	12	0	62	0	711
01:00	0	406	0	65	50	68	6	12	0	43	0	650
02:00	0	373	0	65	50	68	6	12	0	38	0	611
03:00	0	367	0	65	50	68	6	12	0	24	0	592
04:00	0	346	0	65	50	68	6	12	0	24	0	571
05:00	0	317	0	65	50	68	6	12	0	22	0	540
06:00	0	287	0	65	50	68	6	12	0	52	0	540
07:00	0	247	0	65	50	68	6	12	0	112	0	561
08:00	0	203	0	65	50	68	6	12	1.47	184	0	589
09:00	0	185	0	65	50	68	6	12	1.47	247	0	634
10:00	0	220	0	65	50	68	6	12	1.47	269	0	691
11:00	0	262	0	65	50	68	6	12	1.47	270	0	735
12:00	0	303	0	65	50	68	6	12	1.47	251	0	756
13:00	0	319	0	65	50	68	6	12	1.47	247	0	768
14:00	0	321	0	65	50	68	6	12	1.47	249	0	772
15:00	0	342	0	65	50	68	6	12	1.47	222	0	767
16:00	0	358	0	65	50	68	6	12	1.47	202	0	762
17:00	0	398	0	65	50	68	6	12	1.47	168	0	768
18:00	0	418	0	65	50	68	6	12	1.47	151	0	772
19:00	0	443	0	65	50	68	6	12	0	139	0	783
20:00	0	448	0	65	50	68	6	12	0	141	0	790
21:00	0	480	0	65	50	68	6	12	0	113	0	794
22:00	0	494	0	65	50	68	6	12	0	94	0	788
23:00	0	480	0	65	50	68	6	12	0	79	0	759

Scenario A

Year 2029. June – minimum load

Table 20

Hour	Riga CHP-1	Riga CHP-2[11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	504	0	73	60	65	6	17	0	62	0	786
01:00	0	456	0	73	60	65	6	17	0	43	0	719
02:00	0	418	0	73	60	65	6	17	0	38	0	676
03:00	0	410	0	73	60	65	6	17	0	24	0	655
04:00	0	387	0	73	60	65	6	17	0	24	0	631
05:00	0	355	0	73	60	65	6	17	0	22	0	598
06:00	0	325	0	73	60	65	6	17	0	52	0	597
07:00	0	287	0	73	60	65	6	17	0	112	0	620
08:00	0	246	0	73	60	65	6	17	1.96	184	0	651
09:00	0	232	0	73	60	65	6	17	1.96	247	0	701
10:00	0	273	0	73	60	65	6	17	1.96	269	0	764
11:00	0	320	0	73	60	65	6	17	1.96	270	0	813
12:00	0	363	0	73	60	65	6	17	1.96	251	0	837
13:00	0	380	0	73	60	65	6	17	1.96	247	0	849
14:00	0	383	0	73	60	65	6	17	1.96	249	0	854
15:00	0	404	0	73	60	65	6	17	1.96	222	0	848
16:00	0	419	0	73	60	65	6	17	1.96	202	0	843
17:00	0	459	0	73	60	65	6	17	1.96	168	0	849
18:00	0	480	0	73	60	65	6	17	1.96	151	0	854
19:00	0	506	0	73	60	65	6	17	0	139	0	866
20:00	0	512	0	73	60	65	6	17	0	141	0	874
21:00	0	544	0	73	60	65	6	17	0	113	0	878
22:00	0	558	0	73	60	65	6	17	0	94	0	872
23:00	0	541	0	73	60	65	6	17	0	79	0	840

Power demand and possible sources of guaranteeing, hourly balance for Scenario B (minimum load), MW

Scenario B

Year 2019. June – minimum load

Table 21

Hour	Riga CHP-1	Riga CHP-2[11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	319	0	58	43	72	6	8	0	81	0	586
01:00	0	310	0	58	43	72	6	8	0	55	0	552
02:00	0	299	0	58	43	72	6	8	0	49	0	534
03:00	0	297	0	58	43	72	6	8	0	31	0	515
04:00	0	270	0	58	43	72	6	8	0	31	0	488
05:00	0	272	0	58	43	72	6	8	0	29	0	487
06:00	0	253	0	58	43	72	6	8	0	67	0	506
07:00	0	200	0	58	43	72	6	8	0	146	0	532
08:00	0	170	0	58	43	72	6	8	1.14	238	0	572
09:00	0	170	0	58	43	72	6	8	1.14	320	0	623
10:00	0	170	0	58	43	72	6	8	1.14	349	0	663
11:00	0	170	0	58	43	72	6	8	1.14	350	0	683
12:00	0	180	0	58	43	72	6	8	1.14	325	0	693
13:00	0	190	0	58	43	72	6	8	1.14	320	0	697
14:00	0	183	0	58	43	72	6	8	1.14	322	0	692
15:00	0	212	0	58	43	72	6	8	1.14	288	0	688
16:00	0	244	0	58	43	72	6	8	1.14	262	0	693
17:00	0	292	0	58	43	72	6	8	1.14	217	0	697
18:00	0	324	0	58	43	72	6	8	1.14	196	0	707
19:00	0	346	0	58	43	72	6	8	0	181	0	713
20:00	0	348	0	58	43	72	6	8	0	183	0	716
21:00	0	378	0	58	43	72	6	8	0	147	0	711
22:00	0	378	0	58	43	72	6	8	0	121	0	685
23:00	0	354	0	58	43	72	6	8	0	102	0	642

Scenario B

Year 2024. June – minimum load

Table 22

Hour	Riga CHP-1	Riga CHP-2 [11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	402	0	72	65	68	6	17	0	81	0	711
01:00	0	367	0	72	65	68	6	17	0	55	0	650
02:00	0	335	0	72	65	68	6	17	0	49	0	611
03:00	0	333	0	72	65	68	6	17	0	31	0	592
04:00	0	311	0	72	65	68	6	17	0	31	0	571
05:00	0	284	0	72	65	68	6	17	0	29	0	540
06:00	0	245	0	72	65	68	6	17	0	67	0	540
07:00	0	187	0	72	65	68	6	17	0	146	0	561
08:00	0	170	0	72	65	68	6	17	2.46	238	49	589
09:00	0	170	0	72	65	68	6	17	2.46	320	86	634
10:00	0	170	0	72	65	68	6	17	2.46	349	58	691
11:00	0	170	0	72	65	68	6	17	2.46	350	15	735
12:00	0	201	0	72	65	68	6	17	2.46	325	0	756
13:00	0	218	0	72	65	68	6	17	2.46	320	0	768
14:00	0	220	0	72	65	68	6	17	2.46	322	0	772
15:00	0	248	0	72	65	68	6	17	2.46	288	0	767
16:00	0	270	0	72	65	68	6	17	2.46	262	0	762
17:00	0	320	0	72	65	68	6	17	2.46	217	0	768
18:00	0	346	0	72	65	68	6	17	2.46	196	0	772
19:00	0	375	0	72	65	68	6	17	0	181	0	783
20:00	0	379	0	72	65	68	6	17	0	183	0	790
21:00	0	419	0	72	65	68	6	17	0	147	0	794
22:00	0	439	0	72	65	68	6	17	0	121	0	788
23:00	0	430	0	72	65	68	6	17	0	102	0	759

Scenario B

Year 2029. June – minimum load

Table 23

Hour	Riga CHP-1	Riga CHP-2[11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	434	0	86	87	65	6	28	0	81	0	786
01:00	0	391	0	86	87	65	6	28	0	55	0	719
02:00	0	355	0	86	87	65	6	28	0	49	0	676
03:00	0	351	0	86	87	65	6	28	0	31	0	655
04:00	0	328	0	86	87	65	6	28	0	31	0	631
05:00	0	297	0	86	87	65	6	28	0	29	0	598
06:00	0	258	0	86	87	65	6	28	0	67	0	597
07:00	0	202	0	86	87	65	6	28	0	146	0	620
08:00	0	170	0	86	87	65	6	28	3.79	238	32	651
09:00	0	170	0	86	87	65	6	28	3.79	320	64	701
10:00	0	170	0	86	87	65	6	28	3.79	349	30	764
11:00	0	187	0	86	87	65	6	28	3.79	350	0	813
12:00	0	235	0	86	87	65	6	28	3.79	325	0	837
13:00	0	254	0	86	87	65	6	28	3.79	320	0	849
14:00	0	256	0	86	87	65	6	28	3.79	322	0	854
15:00	0	284	0	86	87	65	6	28	3.79	288	0	848
16:00	0	305	0	86	87	65	6	28	3.79	262	0	843
17:00	0	356	0	86	87	65	6	28	3.79	217	0	849
18:00	0	382	0	86	87	65	6	28	3.79	196	0	854
19:00	0	413	0	86	87	65	6	28	0	181	0	866
20:00	0	419	0	86	87	65	6	28	0	183	0	874
21:00	0	459	0	86	87	65	6	28	0	147	0	878
22:00	0	479	0	86	87	65	6	28	0	121	0	872
23:00	0	466	0	86	87	65	6	28	0	102	0	840

Power demand and possible sources of guaranteeing, hourly balance for Scenario EU2030 (minimum load), MW

Scenario EU 2030

Year 2019. June – minimum load

Table 24

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
00:00	0	302	0	60	45	72	6	9	0	92	0	586
01:00	0	297	0	60	45	72	6	9	0	63	0	552
02:00	0	287	0	60	45	72	6	9	0	56	0	534
03:00	0	287	0	60	45	72	6	9	0	36	0	515
04:00	0	260	0	60	45	72	6	9	0	36	0	488
05:00	0	263	0	60	45	72	6	9	0	33	0	487
06:00	0	238	0	60	45	72	6	9	0	76	0	506
07:00	0	173	0	60	45	72	6	9	0	167	0	532
08:00	0	170	0	60	45	72	6	9	1.31	272	63	572
09:00	0	170	0	60	45	72	6	9	1.31	366	105	623
10:00	0	170	0	60	45	72	6	9	1.31	398	98	663
11:00	0	170	0	60	45	72	6	9	1.31	400	80	683
12:00	0	170	0	60	45	72	6	9	1.31	372	42	693
13:00	0	170	0	60	45	72	6	9	1.31	365	31	697
14:00	0	170	0	60	45	72	6	9	1.31	368	39	692
15:00	0	170	0	60	45	72	6	9	1.31	329	4	688
16:00	0	201	0	60	45	72	6	9	1.31	299	0	693
17:00	0	255	0	60	45	72	6	9	1.31	248	0	697
18:00	0	290	0	60	45	72	6	9	1.31	224	0	707
19:00	0	315	0	60	45	72	6	9	0	207	0	713
20:00	0	316	0	60	45	72	6	9	0	209	0	716
21:00	0	352	0	60	45	72	6	9	0	168	0	711
22:00	0	355	0	60	45	72	6	9	0	139	0	685
23:00	0	334	0	60	45	72	6	9	0	116	0	642

Scenario EU 2030
Year 2024. June – minimum load

Table 25

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
00:00	0	356	0	85	79	68	6	24	0	92	0	711
01:00	0	324	0	85	79	68	6	24	0	63	0	650
02:00	0	293	0	85	79	68	6	24	0	56	0	611
03:00	0	293	0	85	79	68	6	24	0	36	0	592
04:00	0	272	0	85	79	68	6	24	0	36	0	571
05:00	0	245	0	85	79	68	6	24	0	33	0	540
06:00	0	201	0	85	79	68	6	24	0	76	0	540
07:00	0	170	0	85	79	68	6	24	0	167	38	561
08:00	0	170	0	85	79	68	6	24	3.46	272	119	589
09:00	0	170	0	85	79	68	6	24	3.46	366	167	634
10:00	0	170	0	85	79	68	6	24	3.46	398	143	691
11:00	0	170	0	85	79	68	6	24	3.46	400	101	735
12:00	0	170	0	85	79	68	6	24	3.46	372	51	756
13:00	0	170	0	85	79	68	6	24	3.46	365	33	768
14:00	0	170	0	85	79	68	6	24	3.46	368	32	772
15:00	0	172	0	85	79	68	6	24	3.46	329	0	767
16:00	0	197	0	85	79	68	6	24	3.46	299	0	762
17:00	0	253	0	85	79	68	6	24	3.46	248	0	768
18:00	0	282	0	85	79	68	6	24	3.46	224	0	772
19:00	0	314	0	85	79	68	6	24	0	207	0	783
20:00	0	319	0	85	79	68	6	24	0	209	0	790
21:00	0	364	0	85	79	68	6	24	0	168	0	794
22:00	0	387	0	85	79	68	6	24	0	139	0	788
23:00	0	380	0	85	79	68	6	24	0	116	0	759

Scenario EU 2030

Year 2029. June – minimum load

Table 26

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
00:00	0	357	0	111	114	65	6	42	0	92	0	786
01:00	0	318	0	111	114	65	6	42	0	63	0	719
02:00	0	283	0	111	114	65	6	42	0	56	0	676
03:00	0	282	0	111	114	65	6	42	0	36	0	655
04:00	0	258	0	111	114	65	6	42	0	36	0	631
05:00	0	227	0	111	114	65	6	42	0	33	0	598
06:00	0	184	0	111	114	65	6	42	0	76	0	597
07:00	0	170	0	111	114	65	6	42	0	167	54	620
08:00	0	170	0	111	114	65	6	42	5.62	272	133	651
09:00	0	170	0	111	114	65	6	42	5.62	366	177	701
10:00	0	170	0	111	114	65	6	42	5.62	398	147	764
11:00	0	170	0	111	114	65	6	42	5.62	400	100	813
12:00	0	170	0	111	114	65	6	42	5.62	372	48	837
13:00	0	170	0	111	114	65	6	42	5.62	365	29	849
14:00	0	170	0	111	114	65	6	42	5.62	368	27	854
15:00	0	217	0	111	114	65	6	42	5.62	329	41	848
16:00	0	239	0	111	114	65	6	42	5.62	299	37	843
17:00	0	289	0	111	114	65	6	42	5.62	248	31	849
18:00	0	315	0	111	114	65	6	42	5.62	224	28	854
19:00	0	348	0	111	114	65	6	42	0	207	26	866
20:00	0	354	0	111	114	65	6	42	0	209	26	874
21:00	0	394	0	111	114	65	6	42	0	168	21	878
22:00	0	414	0	111	114	65	6	42	0	139	17	872
23:00	0	401	0	111	114	65	6	42	0	116	15	840

3.2. Information on energy cross-border trade amounts for 2017 comparison to 2018.

Table 27

	Amounts of energy trade in 2017 (MWh)	Amounts of energy trade in 2018 (MWh)
Import	4 072 912	5 173 682
Export	4 137 077	4 264 801

Table 27 shows, that in year 2018 electricity imports increased by 21%, in compare with 2017, while the exports from the Latvian electricity system increased slightly by around 3% compared to the previous year. In 2018, the Latvian electricity system imported more and exported more electricity, which indicates that the total electricity balance in 2018 was negative, but electricity imports to Latvia and transit through Latvia to neighboring countries has increased. Latvian electricity system has imported 908 881 MWh (difference between import and export) from neighboring countries, which covered the annual electricity consumption of Latvia.

3.3. TSO evaluation for the time periods of insufficient power adequacy and suggestions for power supply guarantee in forthcoming years (i.e. generation development on certain locations, demand side management, new infrastructure creation).

The Latvian TSO, as the responsible institution in Latvia for the security of the electricity system and supply within the electricity market conditions, working with Estonia and Lithuania in accordance with the Nord Pool principles of the Nordic electricity market, ensures market transactions in the Latvian trading area and provides monitoring and publishing of available interconnection capacities for electricity trade with electricity systems of neighboring countries. Since the adoption of the European Union Energy Action Plan 2050, which requires generation development and national capacity adequacy to be focused on areas with renewable energy potential to stimulate the reduction of CO2 emissions and greenhouse gas effects, as well as to promote the development of more efficient, competitive power plants, sufficiency of base generating capacity within single country is no unequivocal indicator of the generation adequacy, but it must be taken into account in complexity together with the available transmission capacities to/from the country or region.

Under normal operating conditions of the Latvian power system, the transmission capacity of cross-sections with the power systems of neighboring countries is sufficient to ensure the forecasted import/export of electricity. In previous years there has not been a single situation where it would have been necessary to switch off electricity users or regions in Latvia due to insufficient generating capacity or insufficient interconnection capacity with the electricity systems of neighboring countries. So far, the Latvian TSO has been able to ensure the transmission of the requested capacity (consumption) in the Latvian electricity system in all operational modes, independently of the generating units operating in the territory of Latvia. At the same time, analyzing the generating power adequacy at the national and regional level, the generating capacities in the Latvian power system are insufficient to cover the peak load of the Latvian power system and to provide the necessary capacity reserves in the scenarios considered, as well as to ensure the operation of Latvian electricity system irrespective of external circumstances, especially during the emergencies caused by the reduction of inter-area transmission capacity. In view of the above mentioned and considering further progress towards synchronization of the Baltic States with Continental Europe, the TSO considers that the development of generating capacities in Latvia is preferable for the safe operation of the Latvian electricity system.

Analyzing power supply for coming years, in the Conservative scenario (A) power (MW) supply analysis table (Table 3) shows that the generating capacities are insufficient to cover peak load, provide power reserves, and meet system control and reliability requirements for the winter months. throughout the whole study period. The Conservative scenario (A) presumes very slow development of the Latvian power system, a slow economic growth rate, as a result of expected changes in the state support mechanism for renewable energy and cogeneration power plants, therefore operation of natural gas power plants, such as Riga CHP-1 and Riga CHP-2, in a free electricity market environment will be less competitive and less efficient. Due to the possible change or reduction of the state support mechanism for renewable and cogeneration producers under the mandatory procurement component (OIK), according to the information available to TSOs, Riga CHP-1 may be stopped starting from 2021 and will not participate in the provision of the power balance.

A similar situation is with the Imanta CHP, which will be stopped in mid-2021. In the Conservative scenario (A), according to the trend in generation development, the power deficit reaches 24% by 2024 and 39% by 2029. It is planned that by 2029 57 MW of the total net capacity of wind power plants could be covered by off-shore wind farms, actual development of which are currently difficult to forecast. Given the slow pace of wind farm development, the Conservative scenario (A) assumes that the development of offshore wind farms could begin no sooner than year 2023 (minimum construction time for wind farms being 4-6 years, including exploration and state licensing). Throughout the period considered (2019-2029), generation capacity adequacy is in the range of 61% to 97%, indicating that generating capacities are insufficient to cover electricity consumption, and the capacity deficit will increase from 35 MW to 619 MW throughout the study period.

The Conservative scenario (A) clearly shows that it is very important not to lose/reduce the existing Latvian base generation capacities (Daugava HPPs, Riga CHP-1 and Riga CHP-2, Imanta CHP) in order to maintain the electricity balance in the Latvian electricity system. In the Conservative scenario (A), power generation is considered under the condition that Riga CHP-1, Riga CHP-2 and Imanta CHP are operating under electricity market conditions, where the power plants are less efficient and can produce only part of the maximum possible capacity. The electricity balance table (Table 6) shows that the electricity deficit for the Latvian electricity system in the Conservative scenario (A) ranges from 617 GWh to 1819 GWh, which will be possible to import through cross-border interconnections to maintain the electricity balance in the system.

Analyzing the power (MW) adequacy table for the Base scenario (B) (Table 4), it can be seen that the Latvian electricity system is able to cover its peak load from year 2019 to 2022, and during the next years, the power deficit increases from year 2023 (2-19%). Similarly to the Conservative scenario (A), the Base scenario (B) shows that it is important not to lose/reduce the existing Latvian base generation capacities (Daugava HPP, Riga CHP-1, Riga CHP-2 and Imanta CHP). Base scenario (B) assumes that offshore wind farm development could gradually begin starting from year 2023, when the first wind turbines on the Baltic Sea on-shore would be connected to the Kurzeme Ring, as well as development of the wind power plants is expected at a slightly faster pace than planned in the Conservative scenario (A). The electricity balance table (Table 7) shows that in the Base scenario (B), the electricity supply will be insufficient for the whole period under review (74-93%), which means that Latvia will import electricity from neighboring power systems and the cross-border transmission capacity will be sufficient to ensure the electricity balance of Latvia. Base scenario (B) assumes that Riga CHP-1 and Riga CHP-2 are operating under electricity market rules (Nord Pool) and electricity generation is planned based on an average long-term production.

In the Optimistic scenario (EU 2030) power (MW) adequacy table (Table 5) shows that the Latvian electricity system is able to cover the peak load from year 2019 to 2024 (112% to 105%), but from year 2025, when the synchronous operation with continental Europe is planned, the capacity deficit increases from 5% to 10%. Excess capacity from 2019 to 2024 indicates that it is possible to export capacity to neighboring power systems to help cover peak loads of neighboring power systems. The optimistic scenario (EU 2030) assumes that the offshore wind farm development could gradually start in 2023. The electricity balance table (Table 8) shows that in the Optimistic scenario (EU 2030) the electricity supply will be sufficient for the whole reviewed period (142-156%), which means that the electricity balance of Latvia will not require the import of electricity from neighboring countries. Instead, Latvia will be able to provide electricity export to power systems of neighboring countries.

In the Optimistic scenario (EU2030) is assumed that Riga CHP-1, Riga CHP-2 and Imanta CHP are working according electricity market Nord Pool conditions and are able to produce the maximum possible amount of electricity in order to ensure the security of the Latvian electricity system and electricity supply in Latvia, considering the annual repair schedule for each power plant. In the Optimistic scenario (EU), increase of the amount of wind power plants in the Latvian electricity system will increase the necessity for regulation reserve. Cross-border interconnection capacity will be sufficient to export excess capacity and electricity to the electricity systems of neighboring countries.

Analyzing the winter peak load coverage for a 24-hour period, the total reserve of the Latvian electricity system is not included. In the Conservative scenario (A) can conclude that in 2019 Latvian electricity system will be able to cover the daily load graph and power imports will not be needed to cover the daily peak load (Table 9). In the Conservative scenario in 2024, the Latvian power system will need to import power from the neighboring power systems from 22 MW to 156 MW to cover its peak load (Table 10). In 2029 the import amount will increase from 17 MW to 283 MW and the interconnection capacity will be sufficient to import the missing capacity to the Latvian electricity system (Table 11). In the Base scenario (B), Latvian TSO will be able to fully cover their daily load for the years 2019 (Table 12), 2024 (Table 13) and 2029 (Table 14). It is possible to cover the daily load schedule for 100%, because the total system reserve is not included in the tables. In Base scenario (B), power exports to neighboring power systems will be possible, if needed, to help neighboring countries cover their peak load during the winter months, as interconnection capacity allows for export/import of excess capacity. In the Optimistic scenario (EU 2030), Latvian TSO will be able to fully cover their daily load until 2019 (Table 15), 2024 (Table 16) and 2029 (Table 17). It is possible to cover the daily load schedule for 100% as the tables do not include the required total capacity reserve.

To cover the daily minimum load during the summer period in the Conservative scenario (A) Riga CHP-1 and Imanta CHP are stopped (Table 18) and power balance is mainly provided by renewable energy sources - biomass and biogas, wind power stations, Daugava HPPs, solar power plants and small natural gas cogeneration plants, while regulation reserves are provided by Riga CHP-2. Electricity import and export is not planned. Minimum production capacity of Riga CHP-2 is assumed 170 MW. In Conservative scenario (A), by year 2024 biomass and biogas power plants, small hydropower plants, wind and solar power plants, Daugava HPPs, small natural gas cogeneration plants are operating as base power plants and regulation is provided by Riga CHP-2 (Table 19). Minimum production capacity of Riga CHP-2 is assumed 170 MW. In such scenario, electricity export to neighboring power systems is not planned. By the year 2029, the base power plants will remain the same, only due to increase of maximum load, the production of Riga CHP-2 will increase as well (Table 20).

To cover the daily minimum load in Base scenario (B) on 2019 Riga CHP-1 and Imanta CHP are stopped (Table 21) and power balance is mainly provided by renewable energy sources - biomass and biogas, wind power plants, Daugava HPPs, small HPPs, solar power plants, and small natural gas cogeneration plants, and regulation reserves are provided by Riga CHP-2. Minimum generation capacity of Riga CHP-2 is assumed 170 MW. In this scenario, electricity export to neighboring power systems will be in the range of 23 MW to 54 MW. In the Base scenario (B) on year 2024, biomass and biogas power plants, small hydroelectric power stations, wind and solar power plants, Daugava HPPs, small natural gas cogeneration plants are operating as base power plants and regulation is being provided by Riga CHP-2 (Table 22). Minimum generation capacity of Riga TEC-2 is assumed 170 MW. Forced electricity export to neighboring power systems will be from 15 MW to 86 MW. By year 2029 the base power plants shall remain the same, only due to the increase of maximum load only Riga CHP-2 is regulating (Table 23).

To cover the daily minimum load in the Optimistic scenario (EU 2030), when the fastest development of renewable energy is planned, Riga CHP-1 and Imanta CHP are stopped in 2019 (Table 24) and the power balance is mainly provided by renewable energy sources - biomass and biogas , wind power stations, Daugava HPPs, small hydroelectric power stations, solar power plants, and small natural gas CHP plants, and only Riga TEC-2 is providing regulation. Minimum generation level of Riga CHP-2 is assumed 170 MW. The electricity export is planned in the range from 4 MW to 105 MW and the amount of electricity export will be approximately 462 MWh. In the Optimistic scenario (EU2030) on 2024 biomass and biogas power plants, small hydroelectric power plants, wind and solar power plants, Daugava HPPs, small natural gas cogeneration plants are operating as base power plants and regulation is being provided by Riga CHP-2 (Table 25). Minimum generation of Riga TEC-2 is assumed at 170 MW. The export of electricity will be facilitated by interconnection capacity which is adequate and exports will range from 32 MW to 167 MW. About 686 MWh of electric energy will be exported per day. By year 2029 the base power plants remain the same (Table 26), but the amount of exported electric energy increases to 957 MWh. Expected capacity exports will increase from 15 MW to 177 MW and cross-border interconnection capacity will be sufficient to export surplus capacity to neighboring power systems.

3.4. Information on required and available emergency reserve capacities, replacement reserves (MW) and amount of reserve utilization (MWh) in 2018.

Table 28

Month	Max required power reserve	Available power reserve		Realized power reserve
		In Latvia	BRELL agreement, till 12h	
	MW	MW	MW	MWh
January	440	100	340	0
February	440	100	340	0
March	440	100	340	0
April	440	100	340	746.667
May	440	100	340	1738.632
June	440	100	340	8.333
July	440	100	340	239.167
August	440	100	340	2692.501
September	440	100	340	4.167
October	440	100	340	334.633
November	440	100	340	0
December	440	100	340	0

With increase of the production of electricity from renewable energy sources the problems with covering the minimum and maximum daily load is appearing. At minimum load, the power system regulation service requires the operation of highly maneuverable gas-fired generation stations (at the minimum output levels), which then provides coverage of daily load peaks. In this way, in order to ensure system reliability and to fulfill the power balance function, at minimum load modes is necessary to export electricity produced from renewables to the neighboring countries' electricity systems, but at peak load modes it is necessary to maintain additional highly maneuverable gas-fired generation in operation, since it is not possible to cover the daily peak load with renewable energy sources alone.

With the development of renewables, there is a greater need for a rapidly adjustable power reserve capable of adjusting the power balance to meet the demand of the daily load schedule. TSO may purchase such service from existing power plants in Latvia, purchase the service from neighboring power generators, or consider to install the necessary equipment (for instance as Battery Energy Storage Systems) in 110 kV or 330 kV substations. The information of the required and available reserves (MW) and used reserve amounts (MWh) in 2018 are shown in table 28.

3.5. TSO conclusions on generation capacity and power availability for the needs of power supply providing for Latvian consumers.

Energy Development Guidelines 2016-2020 in Latvia define directions of actions, taking into account the following climate and energy policy objectives set out at the European Council of 8 and of 9 March 2007, to be achieved by 2020:

- reduction of Green House Gas (GHG) emissions by 20 % compared to 1990 levels;
- increase of share of renewable energy in the total energy consumption up to 20 %;
- increase of energy efficiency by 20 %.

The capacity adequacy table (Table 3) shows that in the Conservative Development scenario (A) in year 2019 the power (MW) self-sufficiency of the Latvian electricity system will reach 97% and with electric energy (MWh) (Table 7) - 92%. In Conservative scenario (A) is expected to have the largest capacity deficits due to possible changes in the support mechanism for renewable and cogeneration producers and based on information provided by the producers during previous years, the Riga CHP-1 will be shut down starting from 2021 and the Imanta CHP will be shut down from 2022. Due to the end of operation of Riga CHP-1 and Imanta CHP and insufficient generation capacities, especially during the winter period, the power deficit will increase, which will be covered by the transmission capacities of interconnections with the power systems of neighboring countries.

In the Base case scenario (B), the power adequacy level above 100% will be from 2019 to 2022 and starting from 2023 till 2029 there will be a power deficit from 2 to 19%. Missing capacity for peak load coverage will be imported via interconnectors from neighboring power systems. In the Optimistic scenario (EU 2030), the amount of produced electricity from 2019 to 2029 will be about 150%, which indicates that the Latvian power system will be able to cover the electricity consumption balance during whole evaluated time period. In case of maximum electricity production, the Latvian electricity system will be able to ensure the export of electricity to the neighboring power systems. The power adequacy table shows that in Optimistic scenario (EU 2030) the capacities are sufficient from 2019 to 2024, but in case of possible synchronization of the Baltic States with continental Europe, the need for capacity reserves will increase from 2025 therefore there will be a power deficit from 5% to 10%.

According to the AST available information, the commissioning of new big base power plants in Latvia is not planned till 2029 and no decisions have been made on the implementation of big capacity power plant projects in the Baltic States (incl. growth of the base load) for the time period until 2029. At the same time, the Ministry of Economics of the Republic of Latvia, as the Competent Authority responsible for the energy sector in Latvia, points out that considering the fulfillment of EU renewable energy share target by 2030, it is likely that high-capacity wind farms with installed capacity of more than 100 MW might be implemented in Latvia.

The potential future interest from renewable energy producers in Latvia could be mainly related to the potential use of the Baltic Sea offshore wind potential and the construction of wind farms on the Kurzeme coast. Taking into account the experience of previous years, possible construction time of the wind power plant, development trends of wind turbines, introduction of the last stage of the Kurzeme Ring, current situation with AST and ST issued technical requirements for electricity producers, as well as current requirements of Latvian legislation in the field of renewable energy, TSO has no reason to expect that submitted wind park development project applications will be fully implemented. Due to this, TSO considers that the faster development of new wind power plants is expected not earlier than 5-7 years, but no criteria are available which would allow for an objective assessment and control of the planned power plants construction process. Due to the potential development of offshore wind farms in Kurzeme, AS Augstsprieguma tīkls, as an energy field expert, participates in various wind park development projects in the Baltic Sea, incl. Marine Spatial Planning Development Project led by the Ministry of Environmental Protection and Regional Development, assessing the number and potential connection points of offshore wind farms on the Baltic Sea coast of Latvia, as well as other regional projects planning offshore wind farms involving several Baltic Sea region countries.

3.6. Conclusions of the transmission system operator on electricity generation capacity and availability of electricity in the Baltic region and Finland - Latvia, Lithuania, Estonia and Finland

In November 2018, the three Baltic TSOs - AS Augstsprieguma tīkls (Latvia), Elering AS (Estonia) and Litgrid AB (Lithuania), in cooperation with the Finnish TSO Fingrid OYJ, started assessment of the operational reliability and power adequacy of the electricity systems in the Baltic States and Finland. Transmission system operators have prepared a power adequacy data exchange report, which is an internal TSOs document. The report investigated the power adequacy of the Baltic States together with Finland, possible imports/exports to/from the region and peak loads assessment. The regional power adequacy assessment was carried out by the TSOs using a deterministic approach, as probabilistic simulations performed in 2018 showed that the Baltic Sea region is not expected serious power adequacy problems until 2030 (potential annual generation loss for load coverage being less than 3 hours for each country), which eliminates the need to repeat the simulation.

The key method under the deterministic approach is to sum up all available capacities in the region, assess import/export opportunities and compare them with the peak load of the region. Using the deterministic approach, the two power system scenarios of the Baltic States and Finland have been evaluated: normal operating mode (N-0) (all system elements in operation) and unplanned disconnection of two critical elements (two major generation units N-2). The two largest critical elements in the assessment are the largest nuclear power plant units in Finland. The potential interruption capacity of the two largest units varies from 1770 MW to 2500 MW. The power adequacy assessment gives the amount of available reserves for primary, secondary and tertiary reserves. The assessment assumes that there are no transmission capacity restrictions between the Baltic States and Finland. The power adequacy assessment is prepared till year 2034.

3.6.1. Power adequacy assessment of the Baltic States and Finland

This scenario of power adequacy assessment is shown in Figure 4. Taking into account that the Russian power system is currently providing primary frequency control for Baltic power systems, the Baltic States till 2025 have to provide only secondary reserve. The tertiary reserve does not have to be provided either, as it can be obtained from the BRELL members for a limited period. The figure shows that the Baltic electricity systems, together with the Finnish electricity system, will not be able to provide the necessary reserves and power to cover peak loads for the evaluated period until 2034. To cover peak load for the Baltic region and Finland, is necessary to use interconnections with neighboring power systems, which are able to import the missing power from neighbors.

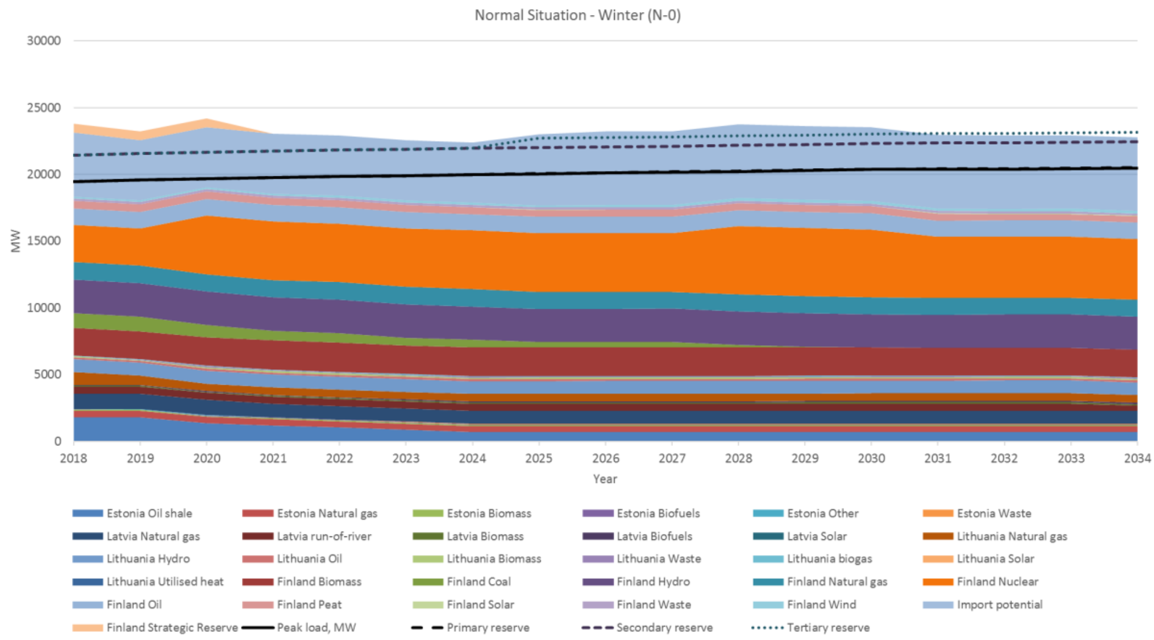


Fig. 4. Power adequacy assessment for the Baltic States and Finland operating synchronously with power systems of Continental Europe after 2025

In this scenario, Baltic States being in synchronous operation with Continental Europe, Finland is expected to maintain a strategic reserve of 667 MW until year 2020. By 2030, the power adequacy will be guaranteed with power import from neighboring power systems. Accordingly, to maintain the necessary reserves till 2030, the power deficit will remain, but the available cross-border transmission capacities (approximately 4,500 MW to 5,500 MW) will be sufficient to import the missing power from neighboring power systems.

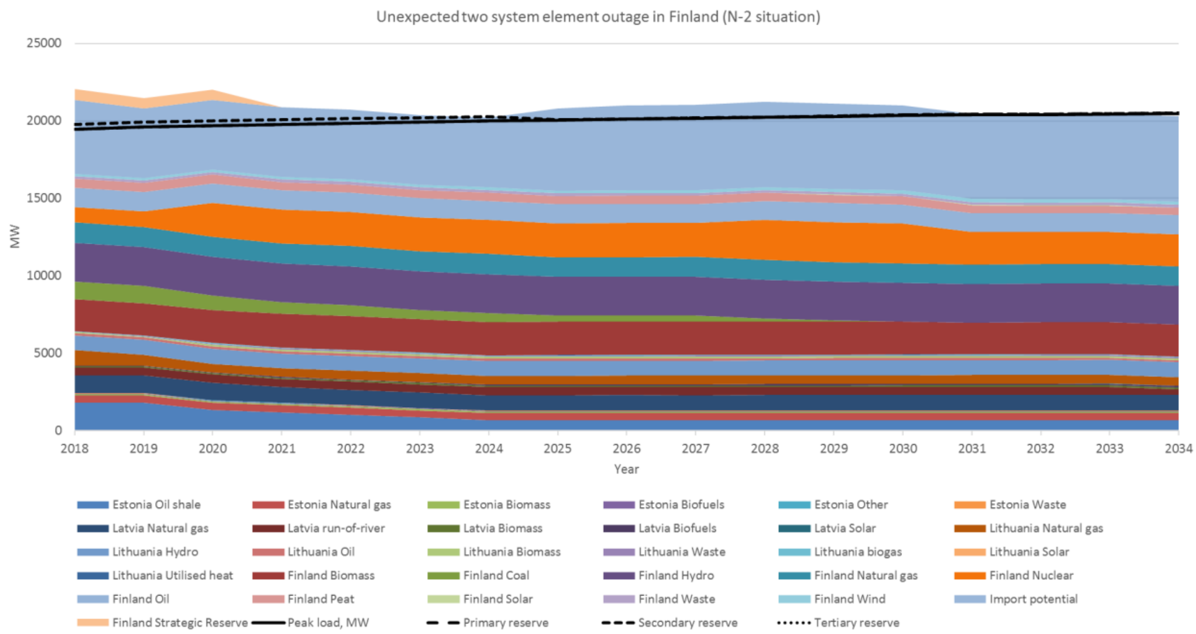


Fig.5. Power adequacy assessment for the Baltic States and Finland operating synchronously with power systems of Continental Europe after 2025

Starting from 2031, the region will have power deficit, that will not be covered by imports from neighboring power systems due to insufficient cross-border capacity with neighboring power systems and the lack of information about power adequacy of neighboring power systems. The power deficit in the Baltic States is expected to be around 90 to 360 MW during period from 2031 till 2034.

In the scenario of the disconnection of the two largest generating units in Finland (N-2) in 2024, there will be problems with available power to cover reserves and load peaks (Figure 5), and the import potential to the region is insufficient to guarantee the power balance. The graph shows that the Baltic States and Finland will provide power balance via power import through interconnections from neighboring power systems, and from 2031 the region will be incapable to cover peak loads and will not be able to import all needed capacity through interconnectors. The capacity deficit will be between 3 and 227 MW.

3.6.2. Power adequacy assessment of the Baltic States in isolated island mode after desynchronization from Russian and Belarusian Power Systems

For the Baltic States working synchronously with the Continental European Power System, the hardest possible mode of operation is to operate in isolated island mode, so the power adequacy of Baltic States for this particular mode has been assessed as well.

Figure 6 shows that the Baltic States have sufficient power adequacy until 2020 to cover the peak load with their own generations and without importing electricity via interconnectors from the neighboring power systems. The generation capacity will be sufficient to cover the peak load until 2020, and after that the Baltic States will use the power import from neighboring electricity systems - Finland, Sweden and Poland. Starting from 2031, generation capacities and import capacities are insufficient to cover peak loads and provide an adequate level of security of supply in the Baltic electricity system. The power deficit ranges from 2 MW to 363 MW.

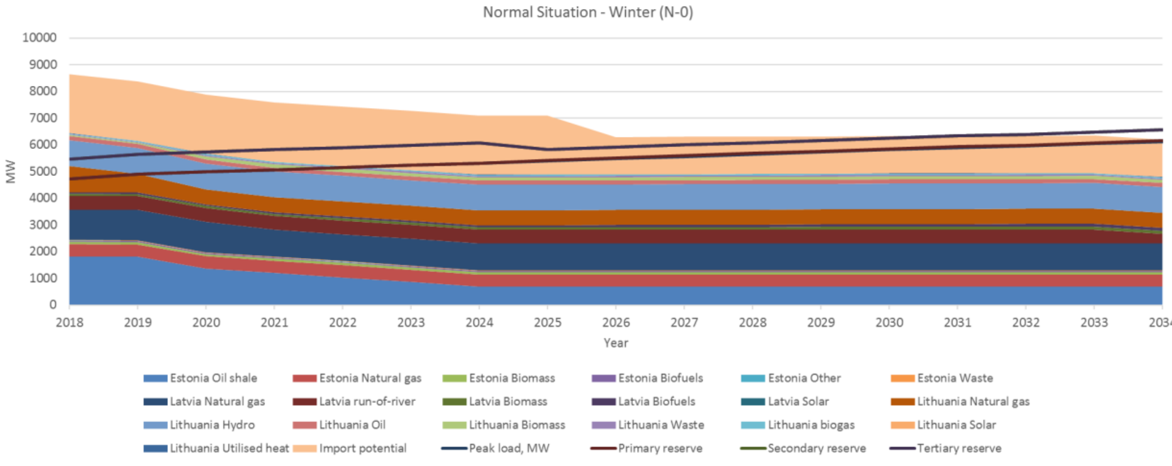


Fig.6. Power adequacy assessment for the Baltic States operating in isolated island mode after 2025

Figure 7 shows a power adequacy assessment for the Baltic States operating in isolated island mode with system emergency and unexpected outage of 700 MW DC link interconnector cable between Lithuania and Sweden (NordBalt) and 650 MW DC link cable between Estonia and Finland (Estlink-2). An assessment of the overall capacity adequacy of the transmission system operators in the Baltic States concludes that a power deficit or problems with peak load capacity could start after 2025, when synchronous operation with Continental Europe power systems is planned. Peak load coverage can be a problem due to shutdown of big base power plants, according to economic and environmental pollution reasons, and due to system reliability (power reserves) providing reasons as well. According to the current generation development forecast, after 2030 the Baltic States will not be able to ensure the secure and reliable operation of the power system and the development of new base power plants in the Baltic States is important and supported.

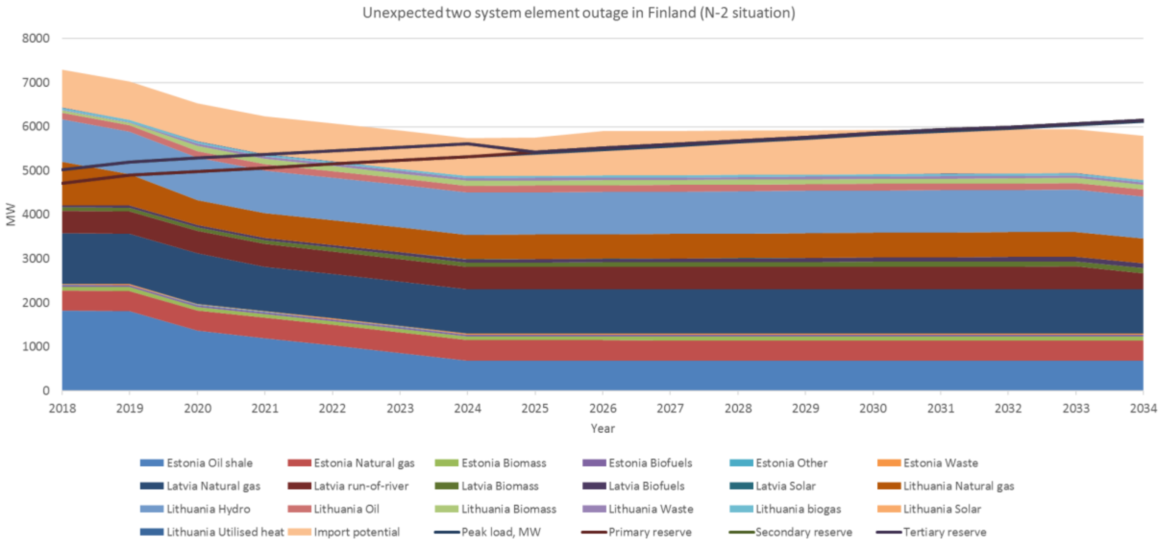


Fig.7 Power adequacy assessment for the Baltic States operating in isolated island mode after 2025, with disconnection of two critical network elements in Baltic countries

4. Transmission system adequacy for demand and maintenance quality

4.1. TSO conclusions on the power transmission system adequacy for the tasks of energy transmission and the ability to provide non-interrupted functioning of the power system in outage of one of the systems units and activities (individually and jointly with other transmission system operators) for the reliable operation of the transmission system for the coming years (minimum forecast period - 10 years).

At present, in some Baltic transmission network operation modes the capacity of the Baltic power transmission grid is reduced at the Latvian-Estonian interconnection due to restrictions enforced by AS Elering (Estonian TSO) on cross-border and internal 330 kV transmission lines. Taking into account the loading of the Baltic interconnection with the Nordic countries and Poland, under the normal operation conditions the Estonia-Latvia interconnection is not overloaded, but in emergency and repair modes it remains the limiting factor creating power congestion. In order to eliminate these shortcomings, the third Estonian-Latvian interconnection, which is in active construction stage now both in Latvia and Estonia, is planned to be commissioned in 2020.

In order to fully eliminate transmission bottlenecks between Estonia and Latvia, after the commissioning of the third Estonia-Latvia interconnection, the existing two interconnections with Estonia from Valmiera (Latvia) to 330 kV substations in Estonia – Tartu and Tsirguliina are planned to reconstruct, while Elering is planning to reconstruct other 330 kV internal lines as well by 2025.

This means that Latvian-Estonian cross-border transmission capacity will remain to be limited by 2025, but less so than before 2020. As a result of this limitations, the power system is not functioning properly in emergency or repair modes, which significantly impedes the ability of Latvia and Lithuania to import electricity from cheaper electricity price areas in the Nordic countries. In 2018 Elering and AST agreed on a time schedule of 330 kV power transmission lines reconstruction until 2025 necessary to strengthen the Baltic power transmission networks as a part of the synchronization project.

Transmission capacity in the Latvian-Lithuanian cross-border is sufficient at present and does not cause additional problems in electricity transit under normal conditions, therefore it does not require additional measures for the improvement of the situation, except in the case of synchronization scenario. Following the approval of the Baltic States synchronization scenario with Continental Europe, which will consist of AC line between Lithuania and Poland, and additional DC interconnections between Lithuania and Poland, future reinforcement of the Latvian-Lithuanian cross-section may be required depending on modes of operation and further development of Baltic network during synchronization project.

The transmission capacity in the Latvian-Russian cross-border is also sufficient now and does not show additional problems for electricity transmission and transit under normal conditions. Due to the possible synchronization of the Baltic States with the electricity system of Continental Europe and the desynchronization of the electricity systems of Russia and Belarus, the development of the Latvian-Russian cross-border is not planned.

4.2. Information about the planned system interconnections and internal power system infrastructure projects of strategic importance (minimum forecast period - 10 years).

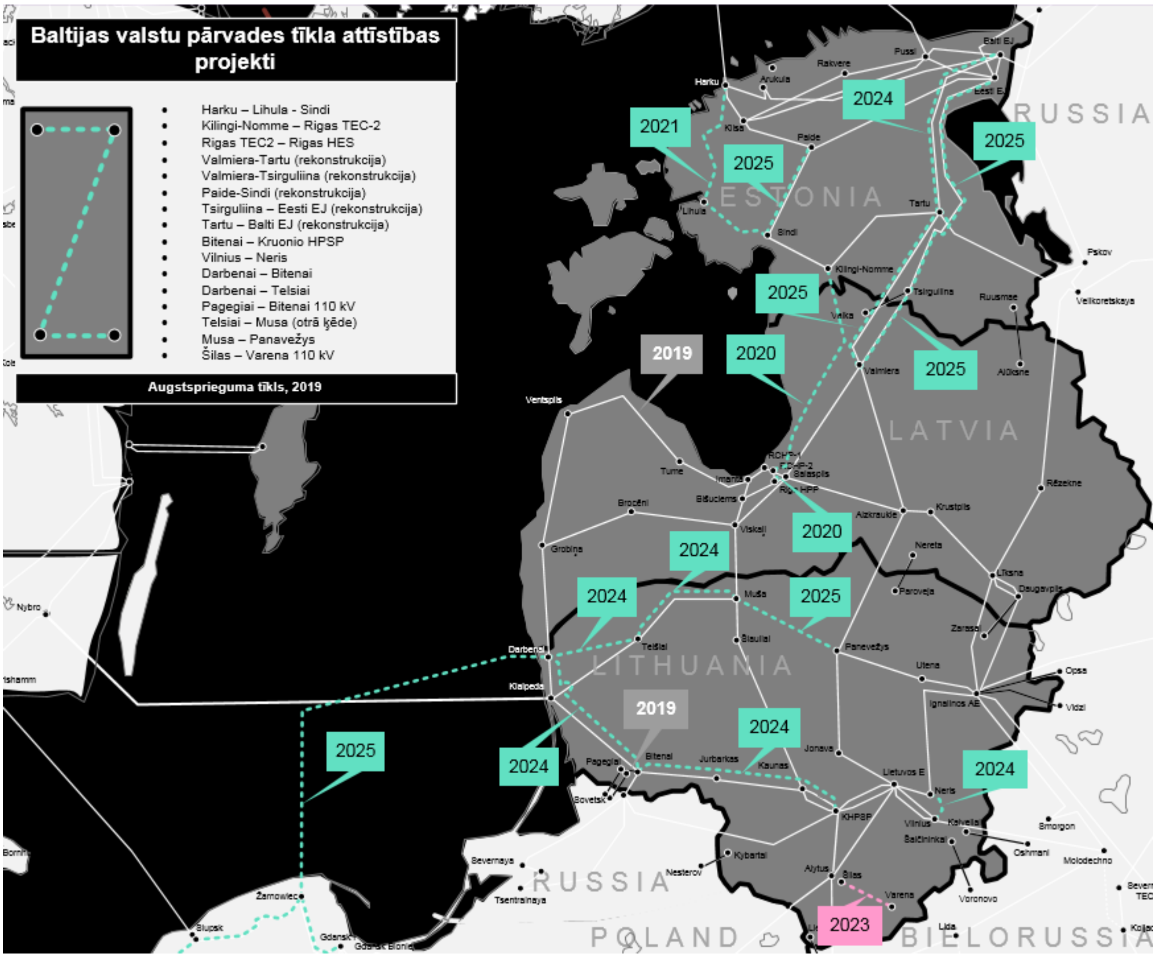


Fig. 8. Transmission infrastructure projects in Baltic countries according to the development plans of Baltic TSOs

4.2.1. Kurzeme Ring 3rd stage "Ventspils-Tume-Imanta"

Co-financed by the European Union
Connecting Europe Facility

During 2018-2019, active work continued on the implementation of Kurzeme Ring Project Stage 3 "Ventspils-Tume-Imanta", a strategically important infrastructure project of the Latvian electricity transmission network, using the 45% co-financing Connecting Europe Facility (CEF) funds. As a result, by September 2019, the project has been completed, the power transmission line has been put into operation and under voltage and on September 11, 2019 the project has been officially and solemnly opened with the participation of AS Augstsprieguma tīkls Chairman of Management Board Mr. Varis Boks, Prime Minister of Republic of Latvia Mr. Krišjānis Kariņš and Mr. Dirk Becker, director of European Innovation and Network Executive Agency. The full commissioning of the project, with the completion of all necessary documentation to the National Institutions and competent authorities involved, is planned by the end of 2019.

Fig. 9. Official opening of Kurzeme Ring project in substation "Tume" on 11 of September 2019.

The whole Kurzeme Ring project from Liepaja to Riga will provides security of supply to the region, provides the necessary infrastructure for the development of wind farms in the Kurzeme region, connect the two largest (Western and Central) production and consumption regions of Latvia, and facilitate a possible increase in Sweden – Lithuania transit flows through the 700 MW DC NordBalt project).

4.2.2. Third electricity interconnection between Estonia and Latvia

Co-financed by the European Union
Connecting Europe Facility

In cooperation with the Estonian TSO – Elering, the third Estonian-Latvian interconnection is being developing between the 330 kV substations Riga CHP-2 in Latvia and Killing-Nomme in Estonia. The project is implementing with 65% co-financing of the total project costs in Latvia and Estonia Connecting Europe Facility (CEF) funds. Such interconnection will increase the available transmission capacity between the Latvian and Estonian power systems and eliminate the bottleneck in the Estonian-Latvian interconnection, which currently limits the volume of electricity trade between the Baltic and Nordic countries. The Estonia-Latvia third Interconnection Project is considered to be one of the most significant projects for the whole Baltic Sea region as it increases the transmission capacity of the Estonia-Latvia cross-border up to 500/600 MW in normal operation conditions and up to 300/500 MW in isolated mode. The third interconnection between Estonia and Latvia is also one of the backbone projects for the Baltic electricity transmission networks synchronisation with the Continental European networks.

The construction of the transmission line route in the territory of Estonia consists of a section between the 330 kV substation Kilingi-Nomme and the Estonian-Latvian border and the 330 kV Harku-Sindi transmission line, which is an internal network reinforcement for safe and stable interconnection operation in Estonia. The Estonian-Latvian border crossing point has been selected and agreed between the two operators, as well as the responsible authorities and border guards of both countries. On the Latvian side, in February 2018, a contract with a constructor was signed for the construction a 330 kV transmission line in Latvian territory, and in June 2018, a contract with a constructor was signed for the extension of the 330 kV substation Riga CHP-2. In February 2018 design of the power transmission line has been started, in February 2019 the construction works of the power transmission line in Latvia were started and in May 2019 the first transmission line pylons in the territory of Latvia were installed. Currently project is under active construction phase in Vidzeme region of Latvia, as well as coordinated design work for the related sections between the third Estonia - Latvia interconnection and the RailBaltica project is ongoing. Implementation of the project in Latvian territory is going along the existing 110 kV electricity line routes and on the stage from Saulkrasti to Riga CHP-2 substation along the common route with the European-wide railway project "RailBaltica" in Latvia. The third Latvian-Estonian interconnection project is expected to be commissioned by the end of 2020.

4.2.3. Electricity transmission line "Riga CHP-2 – Riga HPP"

Co-financed by the European Union

Connecting Europe Facility

In 2018, work on the Latvian power transmission network reinforcement project Riga CHP-2 – Riga HPP was continued. Riga CHP-2 – Riga HPP electricity transmission line project is an reinforcement of the Latvian electricity transmission network of the Riga region, which will provide the full functionality of the Estonian-Latvian third interconnection in repairs and outages modes in the transmission networks of Riga region in Latvia. At regional level, this network reinforcement will play a significant role in increasing North-South transmission capacity in the Baltic region, as the need to reinforce the internal Baltic electricity transmission network for future connection of the Baltic States with Continental Europe power systems.

Taking into account the importance of the project not only for Latvia but also for the whole Europe, the project also received CEF 50% co-financing.

The project route has been selected and is going thorough only one municipality (Salaspils). According to national legislation, an initial environmental impact assessment has been prepared for the project and the Environmental State Service has issued technical requirements for the implementation of the project in compliance with environmental protection requirements and regulations. Taking into account importance of the project for Latvia, Baltic States and Europe, on 16 of August 2017 the Cabinet of Ministers assigned to the project the Status of National Interest status.

In October 2017, a tendering procedure for the project has been announced for transmission line design and construction design and construction and in August 2018 a contract with constructor was signed. In May 2018, contracts were signed with constructors for the reconstruction of the 330 kV substation Riga HPP and in June 2018 - for the extension of the 330 kV substation Riga CHP-2. The design of power transmission lines and substations has been started after signing of the contracts, and in May 2019 the construction of the power transmission line has been started. The project has to be commissioned by the end of 2020, before the commissioning of third interconnection between Estonia and Latvia.

4.2.4. Baltic States synchronization with Continental Europe transmission networks and de-synchronization from Russian power system

Co-financed by the European Union

Connecting Europe Facility

In 2018 and 2019, work on synchronization of the electricity systems of Baltic States with networks of Continental Europe. On 28 of June 2018, the Prime Ministers of the Baltic States and the President of the European Commission signed a synchronization roadmap with selected scenario and recommended further steps for synchronization with Continental Europe and desynchronization from the Russian power system. During 2018, the Baltic TSOs together with Polish TSO and support of ENTSO-E, prepared additional studies on the technical aspects, measures and costs required for the Baltic States' synchronization with continental Europe.

During June-August 2018 the Baltic and Polish TSOs initiated technical study for measures and costs for selected synchronization scenario. Study was prepared by the Polish energy consultant – Gdansk Institute of Energy. The study concluded that, in addition to the frequency control and reserves providing by EU principles, HVDC interconnections should also participate in frequency regulation, and the power systems of the Baltic States should continuously provide sufficient levels of inertia. Based on the conclusions and recommendations of all studies prepared in 2018, on 14 of September 2018, the European Commission supported synchronization of the Baltic States on political level and recommended ENTSO-E to start necessary procedures for further technical steps to initiate the synchronization of the Baltic States with Continental Europe. The synchronization scenario between Lithuania and Poland has been selected and approved as the synchronization option, using the double-circuit AC interconnection Alytus-Elk and additionally constructed DC interconnector in the Baltic Sea between Poland and Lithuania.

In addition to ensure sufficient amount of inertia in the Baltic electricity systems, will be necessary to install synchronous condensers in the Baltic States and, if necessary, install Battery Energy Storage System (BESS) to further frequency containment reserve and frequency restoration reserve providing processes.

On 19 of September 2018, the Baltic States TSOs submitted an application to the Polish TSO for the extension of the Continental Europe synchronous zone with Baltic power systems, and on 21 of September 2018, the Polish TSO submitted an application to the Regional Group Continental Europe for the extension of the European continental synchronous zone.

After the prepared studies in 2018, it became clear that the necessary measures would have to be implemented by 2025, when synchronization of the Baltic States with Continental Europe and desynchronization from the Russian power system is expected. In May 2019, the "Connection Agreement" between the TSOs of the Baltic States and Continental Europe was signed, including annexes with a list of technical measures to be implemented by the Baltic TSOs of the Baltic States before start of synchronous operation.

The synchronization project will be implemented in two phases:

Baltic Synchronization Project Phase 1.

Synchronization phase 1 consists of the reinforcement of the Baltic electricity transmission network, including installation of equipment for providing the necessary amount of inertia and frequency control and management. In 2018, the Baltic TSOs submitted a joint investment request to the Baltic NRAs for Phase 1 of the Baltic Synchronization Project, on the basis of which each NRA issued a cross-border cost allocation decision on project implementation in each country. In September 2018, the Public Utilities Commission issued cross-border cost allocation decision no. 101 on Phase I of the Baltic Synchronization project implemented in the territory of Latvia. In October 2018, the Baltic TSOs submitted an application to Innovation and Network Executive Agency for co-financing for Synchronization Project Phase 1, and in January 2019

European Commission decided to support the Baltic Synchronization Project Phase 1 from CEF funds with 75% co-financing.

In Latvia, during implementation of Synchronization of Phase 1, two existing interconnections between Estonia and Latvia: Valmiera-Tartu and Valmiera-Tsirguliina will be reconstruct and additional equipment will be installed to implement the technical requirements identified by ENTSO-E.

Reconstruction of existing 330kV interconnections Valmiera (LV) – Tartu (EE) and Valmiera (LV) - Tsirgulina (EE) is combined in one activity. These electricity transmission lines were built in the 1960s and 1970s, and their construction standards are not complied with existing operational and maintenance requirements, for example differences in transmission line capacity between winter and summer seasons trouble the optimal and efficient functioning of the electricity market. These lines should be completely replaced with new high transmission capacity lines in order to provide bigger total transmission capacity in the North-South direction of Baltic region, as well as increasing the transmission capacity of the Latvian and Baltic electricity transmission network and hence the security of electricity supply for further synchronization of the Baltic States with electricity transmission networks of Continental Europe.

Due to fact that under synchronization Phase 1 the Estonian TSO is planning to reconstruct the electricity transmission lines to Narva power plants, in order not to reduce the net transfer capacity for the electricity market, the Latvian and Estonian TSOs are planning to reconstruct the existing lines step by step. In the spring of 2018, AST and Elering agreed on a timetable for outages of reconstructed transmission lines. The reconstruction of 330 kV transmission line Valmiera (LV) – Tartu (EE) is foreseen on beginning of 2020, starting with construction design. Construction work is expected to start in 2022 and commissioning of transmission line is expected on 2023. The outage of 330 kV transmission line Valmiera (LV) – Tsirguliina (EE) is planned immediately after the reconstruction of the Valmiera (LV) – Tartu (EE) and the project commissioning is expected by mid of 2024. Both projects are included in the list of projects of common interest, approved by European Commission, as well as in all national and European development documents. At the beginning of 2018, an initial environmental impact assessment in Latvia has been prepared for both projects and in March 2018, the Valmiera Regional Environmental Board of the Environmental State Service decided not to apply full Environmental Impact Assessment procedure for both mentioned lines, and issued technical requirements to be observed during the project implementation.

During synchronization project Phase 1 implementation the equipment, necessary for secure and stable synchronization of the Baltic States should be installed. One of the most important tasks in the preparation of synchronous operation mode is the primary frequency regulation and control of the Latvian power system - the check and, if necessary, modernization of the frequency control systems according to the Continental European power system requirements, because frequency regulation and control is currently providing by the Russian power system. In addition, it is necessary to develop and modernize the power management system and power transmission network management system by installing power control and measurement equipment (PMU - Phasor Measurement Units and WAMS - Wide Area Monitoring System) at all main network nodes. These measures should be implemented by 2025, when the synchronization of the Baltic electricity systems with Continental Europe and the desynchronization of the Russian power system is expected.

In addition to frequency control measures, the Baltic TSOs must provide sufficient amount of inertia during 24 hours a day, estimated for Latvia at 5700 MWs, for stable power system operation in synchronization mode. During Synchronization Phase 1 Project, the installation of synchronous condenser of approximately 200 MVA for provision of inertia services is expected.

Baltic Synchronization Project Phase 2.

Phase 2 of the Baltic Synchronization Project is a continuation of Phase 1, which includes the construction of additional DC interconnection between Poland and Lithuania (Harmony Link).

This project also includes the reinforcement of necessary electricity transmission network infrastructure for the secure and stable operation, installation of additional equipment to ensure the sufficient amount of inertia and installation of the frequency control equipment. The exact number of installed equipment will be known during 2019-2020, when the Baltic States will start implementing the technical requirements issued by ENTSO-E at Catalogue of Measures and start installing mentioned equipment in Baltic power systems. The Baltic Synchronization Project is included in the list of project of common interest and Phase 2, similar with Phase 1, is candidate for European co-financing from the Connecting Europe Facility funds.

AS "Augstsprieguma tīkls", as the responsible institution in Latvia for security of supply and system stability, currently implementing technical measures of Synchronization Phases 1 and 2, plans to develop, purchase and install modern and efficient inertia equipment (synchronous condensers - SC). Taking into account, that after synchronization with Continental Europe and desynchronization from the Russian power system in 2025, AST will need to provide frequency containment and restoration reserves, AST is considering to install a Battery Energy Storage System (BESS). According to AST evaluation, providing this type of service with BESS is more efficient and less costly compared to purchasing this service from existing power plants on the market as well as lower operating and maintenance costs (OPEX), and TSO is not convinced that after 2025 the market will be able to provide the above services 24/7 hours at an adequate price. A specific European Commission regulation (Clean Energy Package - CEP) is currently under development and is being implemented in coming years in each country. Its framework provides to purchase the frequency control services in the electricity market, unless in special situations, derogations could be done, or the national regulatory authority decides otherwise, due to the nature and necessity of the concrete system.

4.3. TSO conclusions on the electricity transmission system reliability and adequacy of all consumers to provide secure power supply in the previous year and the following years (minimum forecast period - 10 years).

Implementation of the projects mentioned in the paragraph 4.2 will provide secure and reliable operation of transmission network, compliance with the increasing electricity consumption, possibilities to connect new power plants, stable operation of the power plants and electricity transit through Latvia and the Baltic States, as well as will claim the interconnection of the Baltic States with the European electricity transmission networks.

The 330 kV and 110 kV transmission network is foreseen to reconstruct, modernized and developed in accordance with the Electricity Transmission System Development Plan of Latvia developed by AST and approved by the PUC, which is published on the AST and PUC websites. In parallel with the 330 kV transmission network, the 110 kV transmission network should be also developed, especially in the places where the N-1 reliability criterion cannot be met. The planned reconstruction of 110 kV substations and planned replacement of aged transformers is planned in the 110 kV network. In addition to the closed 330 kV electricity transmission ring around Riga, it is necessary to reconstruct 110 kV substations and upgrade the 110 kV network in the Riga region in order to increase the security of electricity supply to electricity consumers.

4.4. Existing generation capacities on January 1, 2018, greater than 1 MW.

Latvian power system power plants with installed capacity above 1 MW are shown in the Table 29:

Table 29

Nr.	Station name	Installed capacity (MW)
	Natural gas co-generation plants	

1	BK Enerģija	3.9
2	Daugavpils siltumtīkli PAS	1.455
3	DLRR Enerģija SIA	1.698
4	Energy & Communication, AS	3.9
5	LATNEFTEGAZ SIA	3.986
6	Rēzeknes siltumtīkli SIA	5.572
7	Fortum Latvia, SIA	3.996
8	WINDAU, SIA	3.8
9	Elektro bizness SIA	3.6
10	Mārupes siltumnīcas SIA	1.999
11	Olainfarm enerģija AS	2
12	Olenergo AS	3.12
13	VANGAŽU SILDSPĒKS, SIA	2.746
14	Zaļā dārzniecība SIA	1.999
15	RTU Enerģija SIA	1.56
16	Uni-enerkom, SIA	2.997
17	LIEPĀJAS ENERĢIJA, SIA	4
18	Juglas jauda, SIA	14,9
19	RIGENS, SIA	2.096
20	Krāslavas nami, SIA	1
21	RĪGAS SILTUMS AS (SC Imanta)	47.7
22	RĪGAS SILTUMS AS (SC Ziepniekkalns)	4
23	RĪGAS SILTUMS AS (KM Keramikas 2A)	2.33
24	ENERGY RESOURCES CHP RĒZEKNES SPECIĀLĀS EKONOMISKĀS ZONAS SIA	3.98
25	Dobeles EKO SIA	3.990
26	BALTIC COMMUNICATION NETWORK SIA	1.3
Biomass and biogas power plants		
1	AD Biogāzes stacija, SIA	1.96
2	Agro Iecava, SIA	1.95
3	Conatus BIOenergy, SIA	1.96
4	Bioenerģija-08, SIA	1.98
5	Biodegviela, SIA	2
6	DAILE AGRO, SIA	1
7	Getliņi EKO, BO SIA	5.24
8	Grow Energy, SIA	1.996
9	LIEPĀJAS RAS, SIA	1.1
10	Zaļā Mārupe, SIA	1
11	GRAANUL INVEST, SIA	6.5
12	Liepājas Enerģija, SIA	2.4
13	GAS STREAM SIA	1
14	BIO FUTURE, SIA	1
15	Pampāļi, SIA	1
16	EcoZeta, SIA	1.4
17	Saldus enerģija,SIA	1.862
18	BIOEninvest, SIA	1.25
19	Priekules Bioenerģija, SIA	2.4
20	Piejūras Energy, SIA	1.6
21	Agro Lestene, SIA	1.5

22	OŠUKALNS, SIA	1.4
23	EGG Energy SIA	1.996
24	Fortum Jelgava SIA	23,82
25	Agrofirma Tērvete AS	1.5
26	International Investments SIA	1
27	SM Energo SIA	1.1
28	Enefit power un Heat Valka SIA	2.4
29	Betula Premium SIA	1.9
30	Incukalns Energy SIA	3.999
31	Graanul Pellets Energy SIA	3.99
32	PREIĻU SILTUMS SIA	1.15
33	JE Enerģija SIA	1
34	TUKUMS DH SIA	1.25
35	Technological solutions SIA	3.980
36	DJF SIA	1.4
37	EKO NRG SIA	3.380
38	Energia Verde SIA	3.980
39	Rīgas Enerģija SIA	4
40	AGRO CEMERI SIA	1.5
41	Barkavas Enerģija SIA	1.5
Wind power plants		
1	Baltnorvent, SIA, Alsungas VES	2
2	BK Enerģija, SIA	1.95
3	Enercom Plus, SIA	2.75
4	Impakt, SIA Užavas VES	1
5	Lenkas energo, SIA Lenkas VES	2
6	VĒJA PARKS 10, SIA	1.8
7	VĒJA PARKS 11, SIA	1.8
8	VĒJA PARKS 12, SIA	1.8
9	VĒJA PARKS 13, SIA	1.8
10	VĒJA PARKS 14, SIA	1.8
11	VĒJA PARKS 15, SIA	1.8
12	VĒJA PARKS 16, SIA	1.8
13	VĒJA PARKS 17, SIA	1.8
14	VĒJA PARKS 18, SIA	1.8
15	VĒJA PARKS 19, SIA	1.8
16	VĒJA PARKS 20, SIA	1.8
17	WINERGY, SIA	20.7
18	Silfs V SIA	1.1
19	Ainažu VES, Latvenergo AS	1.2
20	Vides enerģija SIA	6.9
Hydro power plants		
1	Spridzēnu HES, SIA	1.2
Latvenergo power plants		
1	Ķeguma HES	240.1
2	Rīgas HES	402
3	Pļaviņu HES	894
4	Rīgas TEC-1	144

5	Rīgas TEC-2	881
6	Aiviekstes HES	1.32

4.5. Actions during maximum demand or supply deficit periods.

In case of the deficit of power and energy in Latvian territory and in the neighboring countries to cover the consumption of the Latvian power system, the TSO will be forced to limited or disable from the network a certain number of consumers in order to balance the power consumption and the generation in Latvian power system. In this case, the TSO will act according to Latvian legislation and will inform the Ministry of Economy of the problem of ensuring the balance of power.

Key conclusions and recommendations by TSO

- Deficit of generating capacities is expected in the next decade both in Latvia and in whole Baltics. Around 2,300 MW, or nearly half of the generation capacity of large thermal power plants, will be shut down in the Baltics, and significant wind energy development across the Baltic region is expected. To ensure security of supply and system stability, this will ask involving of bigger amount of balancing power, which, according to current forecasts, will be insufficient. Therefore, in order not to reduce the security of supply and Latvian power system stability in the next decade, it is important to provide that Latvia's existing generation base capacity will not be reduced.
- Interconnections, the reinforcement of the transmission network and the closer integration of the Baltic electricity system into the European electricity market will play an important role to cover the forecasted electricity demand.
- Due to decrease of generation capacities, is necessary to stimulate and support the elasticity of electricity demand in Latvia and Baltic States in order to ensure balancing resources in the electricity system for provision of non-interrupted balance between electricity demand and supply.
- In the coming years, the share of large, conventional generating capacities will decrease, but the role of small, distributed generation and active consumers will increase. In Latvia is necessary to implement a national electricity data exchange platform in order to support the digitalization of the electricity system and to ensure the involvement of distributed generation and active consumers for balancing of electricity system and power reserve provision.
- Further integration of the Baltic power systems into the Continental European networks will ask Baltic States to realise ambitious projects in a relatively short time period, what will require political support at both national and European level.

AS „Augstsprieguma tīkls”
Chairman of the Board

V. Boks