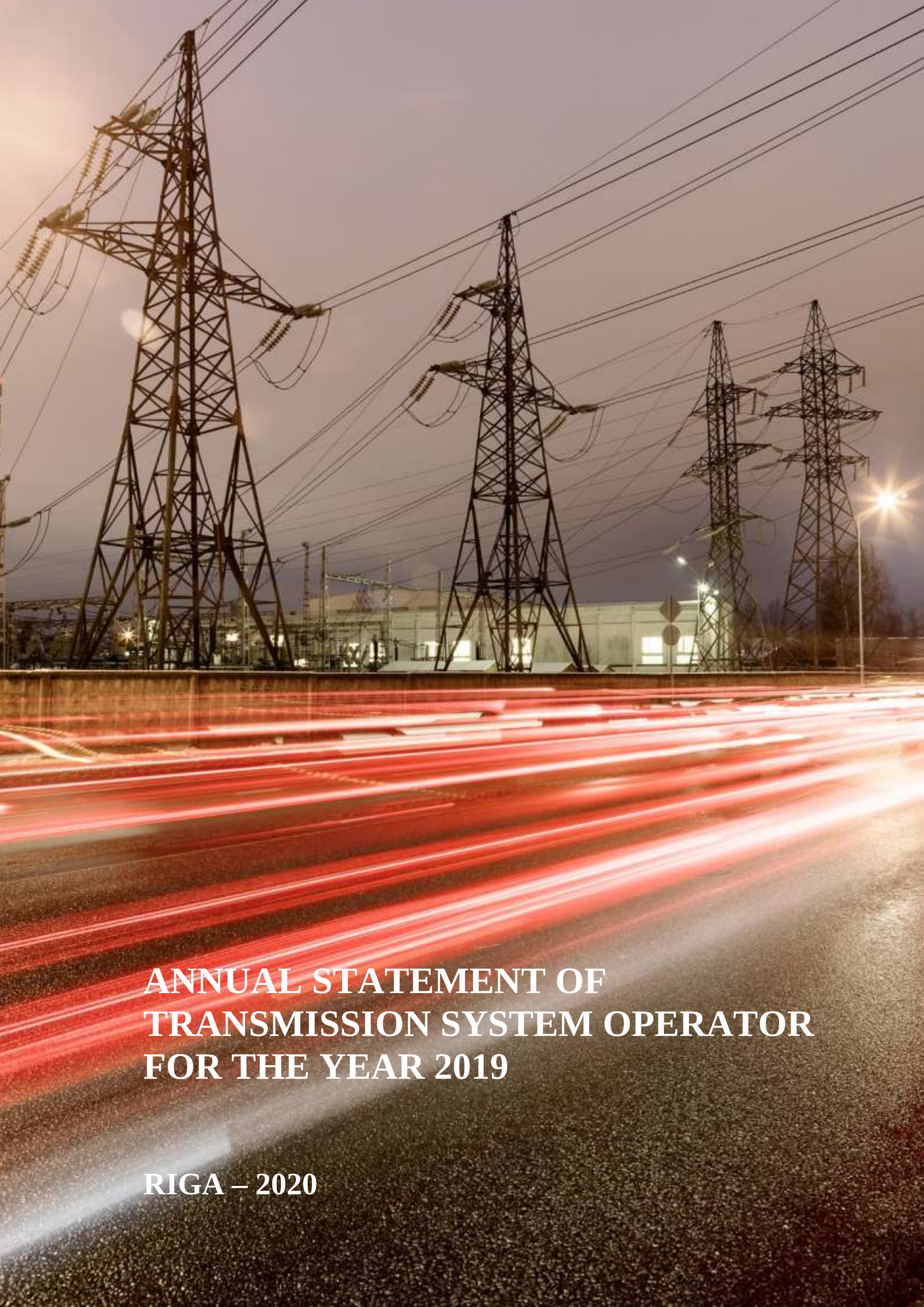


ANNUAL STATEMENT OF TRANSMISSION SYSTEM OPERATOR FOR THE YEAR 2019

RIGA – 2020

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,, informative report on the Latvian Long-Term Energy Strategy for 2030 and the National Energy and Climate Plan 2021-2030 developed by the Ministry of Economics (NECP).

1. Electricity and power demand in the country last year

1.1. Electricity consumption (nett) by week for year 2019

Total annual energy consumption excluding losses equals 7 297 055 MWh.

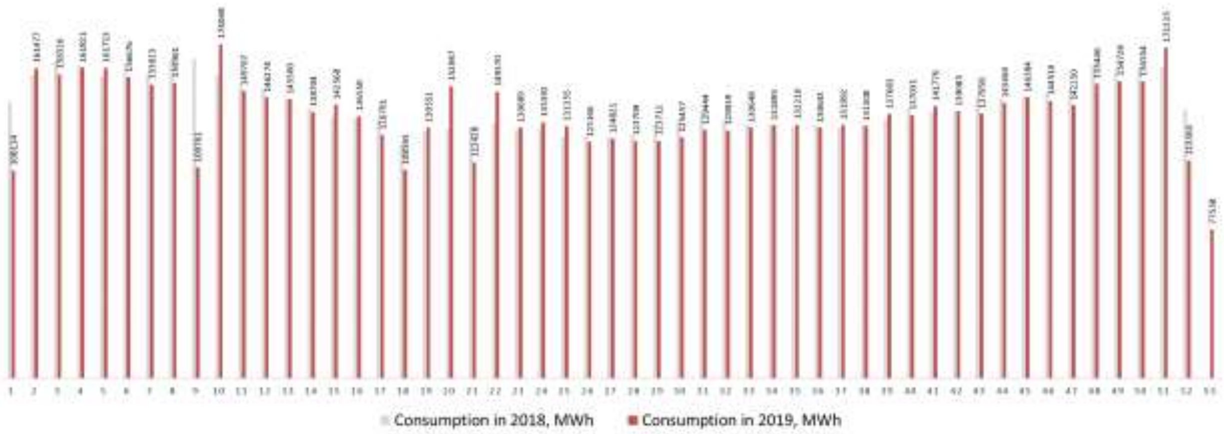
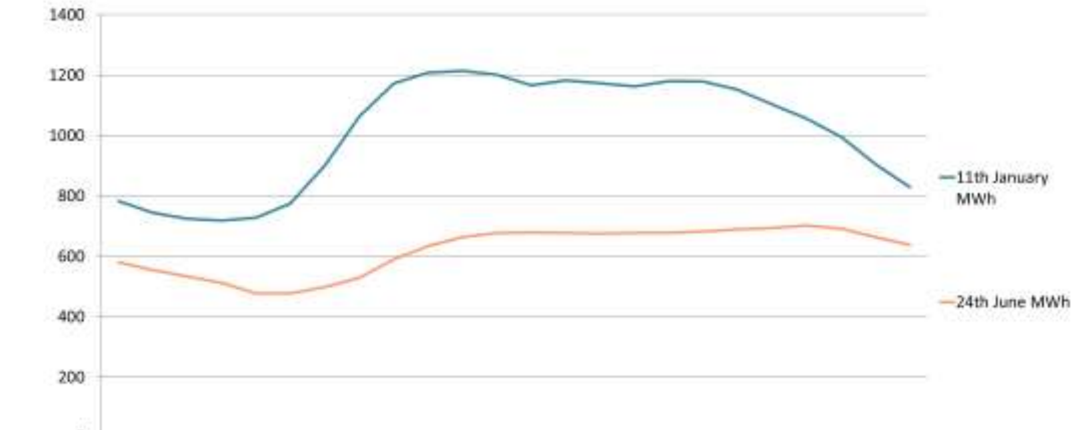


Fig. 1. Weekly electricity consumption (nett) in Latvia

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

Minimum load:	477 MW	24.06.2019	05:00
Maximum load:	1214 MW	11.01.2019	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	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
11th January MWh	783	745	726	719	728	775	902	1063	1173	1208	1214	1202	1166	1182	1174	1163	1180	1180	1150	1103	1056	995	905	829
24th June MWh	580	554	534	513	477	477	499	529	590	634	664	678	676	678	678	678	678	683	690	694	702	692	664	636

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 1). 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
2020	7203	7350	7519	1223
2021	7231	7394	7580	1236
2022	7257	7455	7684	1271
2023	7298	7513	7767	1299
2024	7319	7574	7866	1326
2025	7338	7633	7965	1355
2026	7373	7685	8059	1382
2027	7404	7733	8149	1410
2028	7434	7779	8240	1438
2029	7464	7828	8335	1467
2030	7490	7872	8427	1497

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, as well as based on the connection agreement of Baltic power systems to the synchronous zone of Continental Europe, signed by the electricity transmission system operators (hereinafter TSO) of Baltic States and continental Europe on May 27, 2020.

A detailed description of the scenarios is following:

- **Scenario A "Conservative development":** Electric energy system load forecast is based on information submitted by Latvian distribution system operators regarding load and electricity consumption development. The forecast of the development of generating capacities is planned taking into account the operation of gas power plants in the conditions of the electricity market, mostly operating in the cogeneration mode only during the winter period. In the conservative scenario, the development of wind farms, biomass and biogas plants, small gas cogeneration plants and solar power plants is planned taking into account that the development rates of each generation source in Latvia may be affected by possible changes in the government support scheme. Due to the possible changes of support scheme, it is planned to stop the operation of Imanta CHP in the middle of 2021.

- **Scenario B "Base scenario"**: Electric energy system load forecast is based on the GDP growth forecast supplied by the Ministry of Economics of Latvia, system participants involved in the energy sector, as well as on the information submitted by Latvian distribution system operators taking into account development of load and electricity consumption. The forecast of the development of generating capacities takes into account power plants that are planned to be put into operation or decommissioned in accordance with the information submitted by all electricity power system participants. In the Base scenario (B), the production by the Daugava HPP hydropower plants and both Riga CHPs is planned, based on the average annual production of power plants. The development of wind farms, biomass and biogas power plants, small gas cogeneration plants and solar power plants is planned based on the historical development rate of each generation source in Latvia and moderate economic development rates in the country.

- **Scenario EU2030 "Optimistic development":** Generation capacity development forecast and electricity system load increase based on the GDP growth forecast for Latvia issued by the Ministry of Economics, taking into account planned generation and load development rate to achieve the European Union 2030 targets, Long-Term Energy Strategy 2030 in Latvia and the National Energy and Climate Plan 2021-2030 developed by the Ministry of Economics of Latvia. In this scenario, in addition to the development rates of scenarios A and B, possible future power plants are also taken into account, the commissioning of which, according to the information available for TSO, is considered as possible. The scenario assumes that Imanta CHP retains the ability to participate in the peak load coverage. In this scenario, forecasting state support and development of the transmission electricity system infrastructure, electricity producers from renewable energy sources are forecasted faster development of wind, solar, biomass and biogas power plants.

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 neighbouring 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 will have to independently 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 Economics of Latvia and technical requirements for producers issued by Latvian 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 Latvian market area. 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 Latvian market conditions, 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 for the synchronization of the Baltic States with continental Europe and the de-synchronization from the Russian power system. These measures will be implemented till 2025. Due to this, the Latvian transmission system operator in this report evaluates possible synchronous operation of the Baltic States with continental Europe after 2025 in the regional capacity adequacy analysis.

[13)] According to the information submitted by AS "Rīgas Siltums" district heating operator in the Conservative Scenario (A), it is planned to stop the operation of Imanta CHP in the middle of 2021, due to possible changes in government support scheme.

Installed capacities (gross) of power stations, MW are shown on the Table 2

Table 2

Years		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
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	*1.2*	*158*	*158*	*158*	*158*	*158*	*158*	*158*	*158*	*158*	*158*	*158*
Riga CHP-2	*1.3*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*
Imanta CHP [13)]	*1.4*	*48*	*48*	*0/48*	*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**	**355**	**366**	**377**	**388**	**399**	**429**	**465**	**501**	**537**	**573**	**680**
Including: Natural gas co-generation stations	*2.1*	*72*	*67*	*61*	*56*	*51*	*46*	*41*	*36*	*30*	*25*	*20*
Hydro power stations	*2.2*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*
Wind power stations [7)]	*2.3*	*85*	*94*	*104*	*113*	*123*	*153*	*187*	*222*	*257*	*291*	*400*
On-shore	*2.3.1.*	*85*	*94*	*104*	*113*	*123*	*133*	*142*	*152*	*162*	*171*	*200*
Off-shore	*2.3.2.*	*0*	*0*	*0*	*0*	*0*	*20*	*45*	*70*	*95*	*120*	*200*
Biomass power stations [8)]	*2.4*	*92*	*95*	*97*	*100*	*103*	*106*	*109*	*112*	*114*	*117*	*120*
Biogas power stations [8)]	*2.5*	*68*	*69*	*71*	*72*	*74*	*75*	*77*	*78*	*80*	*81*	*80*
Solar power stations	*2.6*	*9*	*11*	*13*	*15*	*17*	*20*	*22*	*24*	*26*	*28*	*30*
Installed capacity of small power stations (base scenario B)	**3**	**370**	**396**	**421**	**447**	**473**	**529**	**609**	**689**	**769**	**862**	**1003**
Including: Natural gas co-generation stations	*3.1*	*71*	*66*	*60*	*54*	*48*	*43*	*37*	*31*	*26*	*20*	*40*
Hydro power stations	*3.2*	*30*	*31*	*31*	*31*	*31*	*32*	*32*	*32*	*32*	*33*	*33*
Wind power stations [7)]	*3.3*	*92*	*110*	*127*	*144*	*162*	*209*	*280*	*351*	*423*	*508*	*600*
On-shore	*3.3.1.*	*92*	*110*	*127*	*144*	*162*	*179*	*196*	*213*	*231*	*248*	*300*
Off-shore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*30*	*84*	*138*	*192*	*260*	*300*
Biomass power stations [8)]	*3.4*	*94*	*99*	*104*	*109*	*114*	*119*	*123*	*128*	*133*	*138*	*150*
Biogas power stations [8)]	*3.5*	*69*	*72*	*75*	*78*	*81*	*84*	*87*	*91*	*94*	*97*	*100*
Solar power stations	*3.6*	*13*	*19*	*25*	*31*	*37*	*43*	*49*	*55*	*61*	*67*	*80*
Installed capacity of small power stations (optimistic scenario EU2030)	**4**	**392**	**439**	**487**	**574**	**667**	**760**	**852**	**945**	**1037**	**1157**	**1336**
Including: Natural gas co-generation stations	*4.1*	*75*	*74*	*72*	*71*	*69*	*68*	*66*	*65*	*63*	*62*	*60*
Hydro power stations	*4.2*	*30*	*31*	*31*	*32*	*32*	*33*	*33*	*34*	*34*	*35*	*36*
Wind power stations [7)]	*4.3*	*100*	*125*	*150*	*215*	*285*	*355*	*425*	*495*	*565*	*662*	*800*
On-shore	*4.3.1.*	*100*	*125*	*150*	*175*	*200*	*225*	*250*	*275*	*300*	*325*	*400*

Off-shore	*4.3.2.*	*0*	*0*	*0*	*40*	*85*	*130*	*175*	*220*	*265*	*337*	*400*
Biomass power stations [8)]	*4.4*	*96*	*103*	*111*	*118*	*125*	*132*	*140*	*147*	*154*	*161*	*180*
Biogas power stations [8)]	*4.5*	*72*	*78*	*84*	*91*	*97*	*103*	*109*	*115*	*121*	*127*	*140*
Solar power stations	*4.6*	*17*	*28*	*38*	*48*	*58*	*69*	*79*	*89*	*99*	*110*	*120*

The development of capacity per scenario

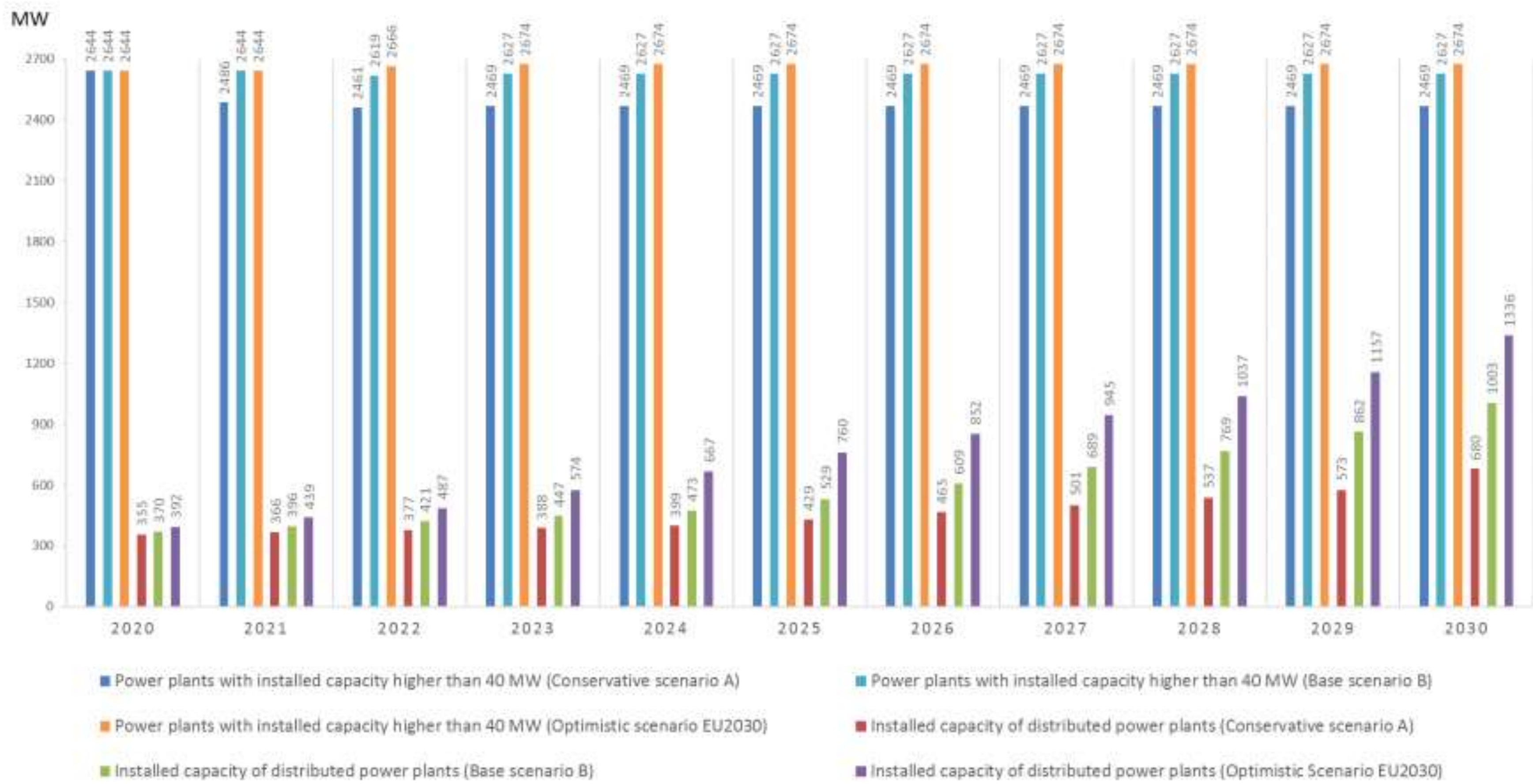


Fig.3. Development of installed capacities in power stations MW (gross) for different development scenarios.

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

Table 3

Years		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Maximum load	**1**	**1223**	**1236**	**1271**	**1299**	**1326**	**1355**	**1382**	**1410**	**1438**	**1467**	**1497**
Power stations with installed capacity above 40 MW	**2**	**2548**	**2548**	**2528**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**
Including: Daugava HPPs	*2.1*	*1550*	*1550*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*
Riga CHP-2	*2.3*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*
Imanta CHP	*2.4*	*42*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**331**	**341**	**352**	**363**	**373**	**404**	**439**	**475**	**510**	**546**	**652**
Including: Natural gas co-generation power stations	*3.1*	*65*	*61*	*56*	*51*	*46*	*42*	*37*	*32*	*28*	*23*	*18*
Hydro power stations	*3.2*	*29*	*29*	*29*	*29*	*29*	*29*	*29*	*29*	*29*	*29*	*29*
Wind power stations	*3.3*	*84*	*93*	*103*	*112*	*122*	*151*	*185*	*220*	*254*	*288*	*396*
Onshore	*3.3.1.*	*84*	*93*	*103*	*112*	*122*	*131*	*141*	*150*	*160*	*169*	*198*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*20*	*45*	*69*	*94*	*119*	*198*
Biomass power stations	*3.4*	*83*	*86*	*89*	*91*	*94*	*96*	*99*	*101*	*104*	*107*	*109*
Biogas power stations	*3.5*	*61*	*63*	*64*	*66*	*67*	*68*	*70*	*71*	*73*	*74*	*73*
Solar power stations	*3.6*	*8*	*10*	*12*	*14*	*16*	*18*	*19*	*21*	*23*	*25*	*27*
Available capacities for peak load and reserve guaranteeing	**4**	**1432**	**1434**	**1393**	**1394**	**1395**	**1398**	**1402**	**1406**	**1409**	**1413**	**1422**
Including: Daugava HPPs [5)]	*4.01*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*
Riga CHP-1	*4.02*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*
Riga CHP-2	*4.03*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*
Imanta CHP	*4.04*	*42*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Natural gas co-generation power stations	*4.05*	*46*	*42*	*39*	*36*	*32*	*29*	*26*	*23*	*19*	*16*	*13*
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*	*12*	*15*	*19*	*22*	*25*	*29*	*40*
Biomass power stations	*4.08*	*58*	*60*	*62*	*64*	*66*	*67*	*69*	*71*	*73*	*75*	*76*
Biogas power stations	*4.09*	*43*	*44*	*45*	*46*	*47*	*48*	*49*	*50*	*51*	*52*	*51*
Solar power stations	*4.10*	*3*	*4*	*5*	*6*	*6*	*7*	*8*	*9*	*9*	*10*	*11*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**82**	**84**	**87**	**89**	**92**	**0**	**0**	**0**	**0**	**0**	**0**
Total reserve in Latvia[3)]	**7=5+6**	**182**	**184**	**187**	**189**	**192**	**225**	**225**	**225**	**225**	**225**	**225**
Power surplus (+), deficit (-)	**8=4-1**	**28**	**14**	**-65**	**-94**	**-123**	**-181**	**-205**	**-229**	**-254**	**-280**	**-300**
Power adequacy	**9=4/1**	**102%**	**101%**	**95%**	**93%**	**91%**	**87%**	**85%**	**84%**	**82%**	**81%**	**80%**

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

Table 4

Years		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Maximum load	**1**	**1223**	**1236**	**1271**	**1299**	**1326**	**1355**	**1382**	**1410**	**1438**	**1467**	**1497**
Power stations with installed capacity above 40 MW	**2**	**2548**	**2548**	**2528**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**
Including: Daugava HPPs	*2.1*	*1550*	*1550*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*153*	*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*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**345**	**370**	**395**	**419**	**444**	**499**	**577**	**656**	**734**	**826**	**961**
Including: Natural gas co-generation power stations	*3.1*	*65*	*60*	*54*	*49*	*44*	*39*	*34*	*29*	*23*	*18*	*36*
Hydro power stations	*3.2*	*29*	*29*	*29*	*30*	*30*	*30*	*30*	*31*	*31*	*31*	*31*
Wind power stations	*3.3*	*91*	*109*	*126*	*143*	*160*	*207*	*277*	*348*	*419*	*503*	*594*
Onshore	*3.3.1.*	*91*	*109*	*126*	*143*	*160*	*177*	*194*	*211*	*228*	*246*	*297*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*30*	*83*	*137*	*190*	*257*	*297*
Biomass power stations	*3.4*	*85*	*90*	*94*	*99*	*103*	*108*	*112*	*117*	*121*	*126*	*136*
Biogas power stations	*3.5*	*63*	*66*	*68*	*71*	*74*	*77*	*79*	*82*	*85*	*88*	*91*
Solar power stations	*3.6*	*12*	*17*	*22*	*28*	*33*	*39*	*44*	*49*	*55*	*60*	*72*
Available capacities for peak load and reserve guaranteeing	**4**	**1564**	**1569**	**1533**	**1539**	**1544**	**1553**	**1564**	**1575**	**1586**	**1599**	**1619**
Including: Daugava HPPs [5)]	*4.01*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*
Riga CHP-1	*4.02*	*153*	*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*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Natural gas co-generation power stations	*4.05*	*46*	*42*	*39*	*36*	*32*	*29*	*26*	*23*	*19*	*16*	*13*
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*	*16*	*21*	*28*	*35*	*42*	*50*	*59*
Biomass power stations	*4.08*	*60*	*63*	*66*	*69*	*72*	*75*	*79*	*82*	*85*	*88*	*95*
Biogas power stations	*4.09*	*44*	*46*	*48*	*50*	*52*	*54*	*56*	*58*	*60*	*61*	*64*
Solar power stations	*4.10*	*5*	*7*	*9*	*11*	*13*	*15*	*18*	*20*	*22*	*24*	*29*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**83**	**85**	**89**	**92**	**96**	**0**	**0**	**0**	**0**	**0**	**0**
Total reserve in Latvia[3)]	**7=5+6**	**183**	**185**	**189**	**192**	**196**	**225**	**225**	**225**	**225**	**225**	**225**
Power surplus (+), deficit (-)	**8=4-1**	**158**	**148**	**74**	**48**	**23**	**-26**	**-43**	**-60**	**-77**	**-94**	**-103**
Power adequacy	**9=4/1**	**113%**	**112%**	**106%**	**104%**	**102%**	**98%**	**97%**	**96%**	**95%**	**94%**	**93%**

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

Table 5

Years		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Maximum load	**1**	**1223**	**1236**	**1271**	**1299**	**1326**	**1355**	**1382**	**1410**	**1438**	**1467**	**1497**
Power stations with installed capacity above 40 MW	**2**	**2548**	**2548**	**2528**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**
Including: Daugava HPPs	*2.1*	*1550*	*1550*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*153*	*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**	**361**	**402**	**444**	**524**	**610**	**696**	**782**	**868**	**953**	**1066**	**1259**
Including: Natural gas co-generation power stations	*3.1*	*65*	*60*	*54*	*49*	*44*	*39*	*34*	*29*	*23*	*18*	*36*
Hydro power stations	*3.2*	*29*	*29*	*29*	*30*	*30*	*30*	*30*	*31*	*31*	*31*	*31*
Wind power stations	*3.3*	*99*	*124*	*149*	*213*	*282*	*351*	*421*	*490*	*559*	*655*	*792*
Onshore	*3.3.1.*	*99*	*124*	*149*	*173*	*198*	*223*	*248*	*272*	*297*	*322*	*396*
Offshore	*3.3.2.*	*0*	*0*	*0*	*40*	*84*	*129*	*173*	*218*	*262*	*334*	*396*
Biomass power stations	*3.4*	*87*	*94*	*101*	*107*	*114*	*120*	*127*	*133*	*140*	*147*	*164*
Biogas power stations	*3.5*	*66*	*71*	*77*	*82*	*88*	*93*	*99*	*105*	*110*	*116*	*127*
Solar power stations	*3.6*	*16*	*25*	*34*	*43*	*53*	*62*	*71*	*80*	*90*	*99*	*108*
Available capacities for peak load and reserve guaranteeing	**4**	**1620**	**1631**	**1642**	**1658**	**1674**	**1689**	**1705**	**1721**	**1737**	**1755**	**1789**
Including: Daugava HPPs [5)]	*4.01*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*
Riga CHP-1	*4.02*	*153*	*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*	*46*	*42*	*39*	*36*	*32*	*29*	*26*	*23*	*19*	*16*	*13*
Hydro power stations	*4.06*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Wind power stations	*4.07*	*10*	*12*	*15*	*21*	*28*	*35*	*42*	*49*	*56*	*66*	*79*
Biomass power stations	*4.08*	*61*	*66*	*70*	*75*	*80*	*84*	*89*	*93*	*98*	*103*	*115*
Biogas power stations	*4.09*	*46*	*50*	*54*	*58*	*62*	*65*	*69*	*73*	*77*	*81*	*89*
Solar power stations	*4.10*	*6*	*10*	*14*	*17*	*21*	*25*	*28*	*32*	*36*	*40*	*43*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**83**	**87**	**91**	**99**	**108**	**0**	**0**	**0**	**0**	**0**	**0**
Total reserve in Latvia[3)]	**7=5+6**	**183**	**187**	**191**	**199**	**208**	**225**	**225**	**225**	**225**	**225**	**225**
Power surplus (+), deficit (-)	**8=4-1**	**213**	**208**	**180**	**160**	**139**	**110**	**98**	**86**	**74**	**63**	**68**
Power adequacy	**9=4/1**	**117%**	**117%**	**114%**	**112%**	**111%**	**108%**	**107%**	**106%**	**105%**	**104%**	**105%**

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

Scenario A *Table 6*

Years		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy demand	**1**	**7203**	**7231**	**7257**	**7298**	**7319**	**7338**	**7373**	**7404**	**7434**	**7464**	**7490**
Output in power stations with installed capacity above 40 MW	**2**	**4613**	**4551**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**
Including: Daugava HPPs [1)]	*2.1*	*2608*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*
Riga CHP-1 [9),]	*2.2*	*562*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*
Riga CHP-2 [9)]	*2.3*	*1386*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*
Imanta CHP	*2.4*	*57*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**1428**	**1441**	**1454**	**1467**	**1481**	**1544**	**1619**	**1694**	**1769**	**1844**	**2077**
Including: Natural gas co-generation power stations	*3.1*	*391*	*363*	*335*	*307*	*278*	*250*	*222*	*194*	*166*	*137*	*109*
Hydro power stations	*3.2*	*69*	*70*	*70*	*71*	*72*	*72*	*73*	*73*	*74*	*75*	*75*
Wind power stations	*3.3*	*168*	*187*	*206*	*225*	*244*	*312*	*393*	*474*	*555*	*636*	*891*
Onshore	*3.3.1.*	*168*	*187*	*206*	*225*	*244*	*263*	*282*	*301*	*320*	*339*	*396*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*50*	*111*	*173*	*235*	*297*	*495*
Biomass power stations	*3.4*	*417*	*430*	*443*	*456*	*469*	*481*	*494*	*507*	*520*	*533*	*545*
Biogas power stations	*3.5*	*381*	*389*	*398*	*407*	*415*	*424*	*433*	*441*	*450*	*459*	*451*
Solar power stations	*3.6*	*1.64*	*2.01*	*2.39*	*2.77*	*3.14*	*3.52*	*3.89*	*4.27*	*4.65*	*5.02*	*5.40*
Possible annual export/import	**4=(2+3)-1**	**-1162**	**-1239**	**-1253**	**-1282**	**-1289**	**-1245**	**-1206**	**-1161**	**-1116**	**-1071**	**-863**
Annual adequacy	**5=(2+3)/1**	**84%**	**83%**	**83%**	**82%**	**82%**	**83%**	**84%**	**84%**	**85%**	**86%**	**88%**

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

Scenario B *Table 7*

Years		**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Energy demand	**1**	**7350**	**7394**	**7455**	**7513**	**7574**	**7633**	**7685**	**7733**	**7779**	**7828**	**7872**
Output in power stations with installed capacity above 40 MW	**2**	**4613**	**4551**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**
Including: Daugava HPPs [1)]	*2.1*	*2608*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*
Riga CHP-1 [9),]	*2.2*	*562*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*
Riga CHP-2 [9)]	*2.3*	*1386*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*
Imanta CHP	*2.4*	*57*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**1490**	**1539**	**1588**	**1637**	**1686**	**1809**	**1991**	**2174**	**2356**	**2572**	**2825**
Including: Natural gas co-generation power stations	*3.1*	*391*	*363*	*335*	*307*	*278*	*250*	*222*	*194*	*166*	*137*	*109*
Hydro power stations	*3.2*	*78*	*79*	*79*	*80*	*81*	*81*	*82*	*83*	*83*	*84*	*85*
Wind power stations	*3.3*	*183*	*217*	*251*	*286*	*320*	*428*	*596*	*764*	*932*	*1134*	*1337*
Onshore	*3.3.1.*	*183*	*217*	*251*	*286*	*320*	*354*	*388*	*423*	*457*	*491*	*594*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*74*	*208*	*342*	*475*	*642*	*743*
Biomass power stations	*3.4*	*427*	*449*	*472*	*494*	*516*	*539*	*561*	*584*	*606*	*628*	*682*
Biogas power stations	*3.5*	*408*	*426*	*444*	*462*	*481*	*499*	*517*	*535*	*553*	*571*	*591*
Solar power stations	*3.6*	*3.5*	*5.1*	*6.7*	*8.4*	*10.0*	*11.6*	*13.2*	*14.8*	*16.5*	*18.1*	*21.6*
Possible annual export/import	**4=(2+3)-1**	**-1246**	**-1304**	**-1318**	**-1327**	**-1339**	**-1275**	**-1145**	**-1010**	**-874**	**-707**	**-498**
Annual adequacy	**5=(2+3)/1**	**83%**	**82%**	**82%**	**82%**	**82%**	**83%**	**85%**	**87%**	**89%**	**91%**	**94%**

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

Scenario EU2030 *Table 8*

Years		**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Energy demand	**1**	**7519**	**7580**	**7684**	**7767**	**7866**	**7965**	**8059**	**8149**	**8240**	**8335**	**8427**
Output in power stations with installed capacity above 40 MW	**2**	**9731**	**9822**	**9820**	**9820**	**9820**	**9820**	**9820**	**9820**	**9820**	**9820**	**9820**
Including: Daugava HPPs [1)]	*2.1*	*2608*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*
Riga CHP-1 [9),]	*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*	*57*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**1546**	**1641**	**1735**	**1956**	**2117**	**2278**	**2439**	**2601**	**2802**	**2990**	**3276**
Including: Natural gas co-generation power stations	*3.1*	*391*	*363*	*335*	*307*	*278*	*250*	*222*	*194*	*166*	*137*	*109*
Hydro power stations	*3.2*	*78*	*79*	*79*	*80*	*81*	*81*	*82*	*83*	*83*	*84*	*85*
Wind power stations	*3.3*	*198*	*248*	*297*	*473*	*589*	*705*	*822*	*938*	*1095*	*1238*	*1386*
Onshore	*3.3.1.*	*198*	*248*	*297*	*347*	*396*	*446*	*495*	*545*	*594*	*644*	*792*
Offshore	*3.3.2.*	*0*	*0*	*0*	*126*	*193*	*260*	*327*	*394*	*500*	*594*	*594*
Biomass power stations	*3.4*	*481*	*517*	*553*	*590*	*626*	*662*	*698*	*734*	*770*	*807*	*900*
Biogas power stations	*3.5*	*393*	*427*	*460*	*494*	*527*	*561*	*594*	*628*	*661*	*695*	*764*
Solar power stations	*3.6*	*4.7*	*7.4*	*10.2*	*13.0*	*15.8*	*18.5*	*21.3*	*24.1*	*26.9*	*29.6*	*32.4*
Possible annual export/import	**4=(2+3)-1**	**3759**	**3883**	**3871**	**4009**	**4071**	**4133**	**4201**	**4271**	**4382**	**4475**	**4669**
Annual adequacy	**5=(2+3)/1**	**150%**	**151%**	**150%**	**152%**	**152%**	**152%**	**152%**	**152%**	**153%**	**154%**	**155%**

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 2020. 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	153	410	42	58	43	46	6	8	0	23	0	789
02:00	153	382	42	58	43	46	6	8	0	13	0	750
03:00	153	355	42	58	43	46	6	8	0	19	0	730
04:00	153	345	42	58	43	46	6	8	0	23	0	724
05:00	153	348	42	58	43	46	6	8	0	30	0	734
06:00	153	383	42	58	43	46	6	8	0	42	0	780
07:00	153	445	42	58	43	46	6	8	0	108	0	908
08:00	153	544	42	58	43	46	6	8	0	171	0	1071
09:00	153	573	42	58	43	46	6	8	0	253	0	1181
10:00	153	599	42	58	43	46	6	8	0	262	0	1217
11:00	153	594	42	58	43	46	6	8	3	270	0	1223
12:00	153	663	42	58	43	46	6	8	3	188	0	1210
13:00	153	635	42	58	43	46	6	8	3	181	0	1175
14:00	153	644	42	58	43	46	6	8	3	188	0	1191
15:00	153	612	42	58	43	46	6	8	3	211	0	1182
16:00	153	595	42	58	43	46	6	8	3	217	0	1171
17:00	153	594	42	58	43	46	6	8	0	239	0	1189
18:00	153	577	42	58	43	46	6	8	0	255	0	1188
19:00	153	552	42	58	43	46	6	8	0	251	0	1159
20:00	153	561	42	58	43	46	6	8	0	195	0	1111
21:00	153	574	42	58	43	46	6	8	0	134	0	1064
22:00	153	529	42	58	43	46	6	8	0	118	0	1002
23:00	153	482	42	58	43	46	6	8	0	74	0	912
00:00	153	433	42	58	43	46	6	8	0	46	0	835

Power demand and possible sources for guaranteeing, hourly values.
Scenario A
Year 2025. 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	153	533	0	67	48	29	6	15	0	23	0	874
02:00	153	500	0	67	48	29	6	15	0	13	0	831
03:00	153	472	0	67	48	29	6	15	0	19	0	808
04:00	153	461	0	67	48	29	6	15	0	23	0	803
05:00	153	465	0	67	48	29	6	15	0	30	0	813
06:00	153	505	0	67	48	29	6	15	0	42	0	865
07:00	153	580	0	67	48	29	6	15	0	108	0	1006
08:00	153	698	0	67	48	29	6	15	0	171	0	1186
09:00	153	738	0	67	48	29	6	15	0	253	0	1308
10:00	153	768	0	67	48	29	6	15	0	262	0	1348
11:00	153	760	0	67	48	29	6	15	7	270	0	1355
12:00	153	827	0	67	48	29	6	15	7	188	0	1341
13:00	153	795	0	67	48	29	6	15	7	181	0	1301
14:00	153	807	0	67	48	29	6	15	7	188	0	1319
15:00	153	773	0	67	48	29	6	15	7	211	0	1310
16:00	153	756	0	67	48	29	6	15	7	217	0	1298
17:00	153	760	0	67	48	29	6	15	0	239	0	1317
18:00	153	743	0	67	48	29	6	15	0	255	0	1316
19:00	153	715	0	67	48	29	6	15	0	251	0	1284
20:00	153	718	0	67	48	29	6	15	0	195	0	1231
21:00	153	726	0	67	48	29	6	15	0	134	0	1178
22:00	153	675	0	67	48	29	6	15	0	118	0	1110
23:00	153	618	0	67	48	29	6	15	0	74	0	1010
00:00	153	561	0	67	48	29	6	15	0	46	0	925

Power demand and possible sources for guaranteeing, hourly values.

Scenario A
Year 2030. 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	153	604	0	76	51	13	6	40	0	23	0	965
02:00	153	568	0	76	51	13	6	40	0	13	0	919
03:00	153	537	0	76	51	13	6	40	0	19	0	893
04:00	153	525	0	76	51	13	6	40	0	23	0	887
05:00	153	530	0	76	51	13	6	40	0	30	0	898
06:00	153	576	0	76	51	13	6	40	0	42	0	955
07:00	153	666	0	76	51	13	6	40	0	108	0	1112
08:00	153	802	0	76	51	13	6	40	0	171	0	1311
09:00	153	803	0	76	51	13	6	40	0	253	52	1446
10:00	153	803	0	76	51	13	6	40	0	262	86	1490
11:00	153	803	0	76	51	13	6	40	11	270	75	1497
12:00	153	803	0	76	51	13	6	40	11	188	141	1481
13:00	153	803	0	76	51	13	6	40	11	181	105	1438
14:00	153	803	0	76	51	13	6	40	11	188	118	1458
15:00	153	803	0	76	51	13	6	40	11	211	84	1447
16:00	153	803	0	76	51	13	6	40	11	217	65	1434
17:00	153	803	0	76	51	13	6	40	0	239	75	1455
18:00	153	803	0	76	51	13	6	40	0	255	58	1454
19:00	153	803	0	76	51	13	6	40	0	251	26	1418
20:00	153	803	0	76	51	13	6	40	0	195	24	1360
21:00	153	803	0	76	51	13	6	40	0	134	27	1302
22:00	153	771	0	76	51	13	6	40	0	118	0	1227
23:00	153	704	0	76	51	13	6	40	0	74	0	1116
00:00	153	638	0	76	51	13	6	40	0	46	0	1022

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 2020. 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	153	400	42	60	44	46	6	9	0	30	0	789
02:00	153	375	42	60	44	46	6	9	0	17	0	750
03:00	153	347	42	60	44	46	6	9	0	24	0	730
04:00	153	335	42	60	44	46	6	9	0	30	0	724
05:00	153	336	42	60	44	46	6	9	0	39	0	734
06:00	153	368	42	60	44	46	6	9	0	54	0	780
07:00	153	410	42	60	44	46	6	9	0	140	0	908
08:00	153	491	42	60	44	46	6	9	0	222	0	1071
09:00	153	495	42	60	44	46	6	9	0	328	0	1181
10:00	153	518	42	60	44	46	6	9	0	340	0	1217
11:00	153	509	42	60	44	46	6	9	5	350	0	1223
12:00	153	603	42	60	44	46	6	9	5	244	0	1210
13:00	153	576	42	60	44	46	6	9	5	235	0	1175
14:00	153	584	42	60	44	46	6	9	5	244	0	1191
15:00	153	545	42	60	44	46	6	9	5	274	0	1182
16:00	153	526	42	60	44	46	6	9	5	282	0	1171
17:00	153	520	42	60	44	46	6	9	0	310	0	1189
18:00	153	499	42	60	44	46	6	9	0	331	0	1188
19:00	153	474	42	60	44	46	6	9	0	326	0	1159
20:00	153	500	42	60	44	46	6	9	0	253	0	1111
21:00	153	531	42	60	44	46	6	9	0	174	0	1064
22:00	153	491	42	60	44	46	6	9	0	152	0	1002
23:00	153	457	42	60	44	46	6	9	0	96	0	912
00:00	153	416	42	60	44	46	6	9	0	60	0	835

Power demand and possible sources for guaranteeing, hourly values.
Scenario B
<u>Year 2025. January (working day, Wednesday of the third week, Peak load)</u>

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	506	0	75	54	29	6	21	0	30	0	874
02:00	153	477	0	75	54	29	6	21	0	17	0	831
03:00	153	447	0	75	54	29	6	21	0	24	0	808
04:00	153	435	0	75	54	29	6	21	0	30	0	803
05:00	153	436	0	75	54	29	6	21	0	39	0	813
06:00	153	473	0	75	54	29	6	21	0	54	0	865
07:00	153	529	0	75	54	29	6	21	0	140	0	1006
08:00	153	628	0	75	54	29	6	21	0	222	0	1186
09:00	153	644	0	75	54	29	6	21	0	328	0	1308
10:00	153	671	0	75	54	29	6	21	0	340	0	1348
11:00	153	652	0	75	54	29	6	21	15	350	0	1355
12:00	153	744	0	75	54	29	6	21	15	244	0	1341
13:00	153	714	0	75	54	29	6	21	15	235	0	1301
14:00	153	723	0	75	54	29	6	21	15	244	0	1319
15:00	153	683	0	75	54	29	6	21	15	274	0	1310
16:00	153	663	0	75	54	29	6	21	15	282	0	1298
17:00	153	670	0	75	54	29	6	21	0	310	0	1317
18:00	153	648	0	75	54	29	6	21	0	331	0	1316
19:00	153	621	0	75	54	29	6	21	0	326	0	1284
20:00	153	641	0	75	54	29	6	21	0	253	0	1231
21:00	153	667	0	75	54	29	6	21	0	174	0	1178
22:00	153	621	0	75	54	29	6	21	0	152	0	1110
23:00	153	576	0	75	54	29	6	21	0	96	0	1010
00:00	153	527	0	75	54	29	6	21	0	60	0	925

Power demand and possible sources for guaranteeing, hourly values.

Scenario B
Year 2030. 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	546	0	95	64	13	6	59	0	30	0	965
02:00	153	512	0	95	64	13	6	59	0	17	0	919
03:00	153	480	0	95	64	13	6	59	0	24	0	893
04:00	153	467	0	95	64	13	6	59	0	30	0	887
05:00	153	470	0	95	64	13	6	59	0	39	0	898
06:00	153	512	0	95	64	13	6	59	0	54	0	955
07:00	153	582	0	95	64	13	6	59	0	140	0	1112
08:00	153	700	0	95	64	13	6	59	0	222	0	1311
09:00	153	729	0	95	64	13	6	59	0	328	0	1446
10:00	153	760	0	95	64	13	6	59	0	340	0	1490
11:00	153	729	0	95	64	13	6	59	29	350	0	1497
12:00	153	820	0	95	64	13	6	59	29	244	0	1481
13:00	153	785	0	95	64	13	6	59	29	235	0	1438
14:00	153	796	0	95	64	13	6	59	29	244	0	1458
15:00	153	755	0	95	64	13	6	59	29	274	0	1447
16:00	153	734	0	95	64	13	6	59	29	282	0	1434
17:00	153	756	0	95	64	13	6	59	0	310	0	1455
18:00	153	734	0	95	64	13	6	59	0	331	0	1454
19:00	153	703	0	95	64	13	6	59	0	326	0	1418
20:00	153	718	0	95	64	13	6	59	0	253	0	1360
21:00	153	739	0	95	64	13	6	59	0	174	0	1302
22:00	153	685	0	95	64	13	6	59	0	152	0	1227
23:00	153	630	0	95	64	13	6	59	0	96	0	1116
00:00	153	572	0	95	64	13	6	59	0	60	0	1022

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
Year 2020. January (working day, Wednesday of the third week, Peak load)

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	153	392	42	61	46	46	6	10	0	34	0	789
02:00	153	368	42	61	46	46	6	10	0	20	0	750
03:00	153	339	42	61	46	46	6	10	0	27	0	730
04:00	153	327	42	61	46	46	6	10	0	35	0	724
05:00	153	326	42	61	46	46	6	10	0	45	0	734
06:00	153	356	42	61	46	46	6	10	0	62	0	780
07:00	153	385	42	61	46	46	6	10	0	160	0	908
08:00	153	455	42	61	46	46	6	10	0	253	0	1071
09:00	153	444	42	61	46	46	6	10	0	374	0	1181
10:00	153	465	42	61	46	46	6	10	0	389	0	1217
11:00	153	454	42	61	46	46	6	10	6	400	0	1223
12:00	153	562	42	61	46	46	6	10	6	279	0	1210
13:00	153	537	42	61	46	46	6	10	6	268	0	1175
14:00	153	543	42	61	46	46	6	10	6	278	0	1191
15:00	153	500	42	61	46	46	6	10	6	313	0	1182
16:00	153	480	42	61	46	46	6	10	6	322	0	1171
17:00	153	472	42	61	46	46	6	10	0	354	0	1189
18:00	153	447	42	61	46	46	6	10	0	378	0	1188
19:00	153	424	42	61	46	46	6	10	0	372	0	1159
20:00	153	460	42	61	46	46	6	10	0	289	0	1111
21:00	153	502	42	61	46	46	6	10	0	199	0	1064
22:00	153	465	42	61	46	46	6	10	0	174	0	1002
23:00	153	439	42	61	46	46	6	10	0	110	0	912
00:00	153	403	42	61	46	46	6	10	0	69	0	835

Power demand and possible sources for guaranteeing, hourly values.

Scenario EU 2030

Year 2025. 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	425	42	84	65	29	6	35	0	34	0	874
02:00	153	397	42	84	65	29	6	35	0	20	0	831
03:00	153	367	42	84	65	29	6	35	0	27	0	808
04:00	153	353	42	84	65	29	6	35	0	35	0	803
05:00	153	354	42	84	65	29	6	35	0	45	0	813
06:00	153	389	42	84	65	29	6	35	0	62	0	865
07:00	153	432	42	84	65	29	6	35	0	160	0	1006
08:00	153	519	42	84	65	29	6	35	0	253	0	1186
09:00	153	520	42	84	65	29	6	35	0	374	0	1308
10:00	153	545	42	84	65	29	6	35	0	389	0	1348
11:00	153	516	42	84	65	29	6	35	25	400	0	1355
12:00	153	623	42	84	65	29	6	35	25	279	0	1341
13:00	153	594	42	84	65	29	6	35	25	268	0	1301
14:00	153	602	42	84	65	29	6	35	25	278	0	1319
15:00	153	557	42	84	65	29	6	35	25	313	0	1310
16:00	153	537	42	84	65	29	6	35	25	322	0	1298
17:00	153	548	42	84	65	29	6	35	0	354	0	1317
18:00	153	524	42	84	65	29	6	35	0	378	0	1316
19:00	153	497	42	84	65	29	6	35	0	372	0	1284
20:00	153	528	42	84	65	29	6	35	0	289	0	1231
21:00	153	565	42	84	65	29	6	35	0	199	0	1178
22:00	153	522	42	84	65	29	6	35	0	174	0	1110
23:00	153	486	42	84	65	29	6	35	0	110	0	1010
00:00	153	442	42	84	65	29	6	35	0	69	0	925

Power demand and possible sources for guaranteeing, hourly values.

Scenario EU 2030
Year 2030. 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	435	42	115	89	13	6	79	0	34	0	965
02:00	153	403	42	115	89	13	6	79	0	20	0	919
03:00	153	370	42	115	89	13	6	79	0	27	0	893
04:00	153	356	42	115	89	13	6	79	0	35	0	887
05:00	153	358	42	115	89	13	6	79	0	45	0	898
06:00	153	398	42	115	89	13	6	79	0	62	0	955
07:00	153	456	42	115	89	13	6	79	0	160	0	1112
08:00	153	562	42	115	89	13	6	79	0	253	0	1311
09:00	153	576	42	115	89	13	6	79	0	374	0	1446
10:00	153	605	42	115	89	13	6	79	0	389	0	1490
11:00	153	558	42	115	89	13	6	79	43	400	0	1497
12:00	153	663	42	115	89	13	6	79	43	279	0	1481
13:00	153	631	42	115	89	13	6	79	43	268	0	1438
14:00	153	640	42	115	89	13	6	79	43	278	0	1458
15:00	153	595	42	115	89	13	6	79	43	313	0	1447
16:00	153	573	42	115	89	13	6	79	43	322	0	1434
17:00	153	605	42	115	89	13	6	79	0	354	0	1455
18:00	153	581	42	115	89	13	6	79	0	378	0	1454
19:00	153	551	42	115	89	13	6	79	0	372	0	1418
20:00	153	576	42	115	89	13	6	79	0	289	0	1360
21:00	153	607	42	115	89	13	6	79	0	199	0	1302
22:00	153	557	42	115	89	13	6	79	0	174	0	1227
23:00	153	510	42	115	89	13	6	79	0	110	0	1116
00:00	153	457	42	115	89	13	6	79	0	69	0	1022

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

Scenario A

Year 2020. 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	364	0	58	43	46	6	8	0	365	0	584
01:00	0	357	0	58	43	46	6	8	0	358	0	558
02:00	0	341	0	58	43	46	6	8	0	342	0	538
03:00	0	332	0	58	43	46	6	8	0	333	0	516
04:00	0	297	0	58	43	46	6	8	0	298	0	481
05:00	0	299	0	58	43	46	6	8	0	299	0	481
06:00	0	293	0	58	43	46	6	8	0	294	0	503
07:00	0	262	0	58	43	46	6	8	0	263	0	533
08:00	0	256	0	58	43	46	6	8	3	256	0	595
09:00	0	229	0	58	43	46	6	8	3	229	0	639
10:00	0	236	0	58	43	46	6	8	3	236	0	668
11:00	0	248	0	58	43	46	6	8	3	249	0	683
12:00	0	268	0	58	43	46	6	8	3	269	0	683
13:00	0	278	0	58	43	46	6	8	3	279	0	683
14:00	0	276	0	58	43	46	6	8	3	277	0	681
15:00	0	304	0	58	43	46	6	8	3	304	0	683
16:00	0	328	0	58	43	46	6	8	3	328	0	683
17:00	0	365	0	58	43	46	6	8	3	366	0	688
18:00	0	387	0	58	43	46	6	8	3	387	0	695
19:00	0	404	0	58	43	46	6	8	0	404	0	699
20:00	0	410	0	58	43	46	6	8	0	411	0	707
21:00	0	426	0	58	43	46	6	8	0	427	0	697
22:00	0	419	0	58	43	46	6	8	0	420	0	669
23:00	0	399	0	58	43	46	6	8	0	400	0	643

Scenario A
Year 2025. 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	487	0	67	48	29	6	15	0	492	0	712
01:00	0	442	0	67	48	29	6	15	0	446	0	647
02:00	0	417	0	67	48	29	6	15	0	422	0	618
03:00	0	408	0	67	48	29	6	15	0	412	0	596
04:00	0	384	0	67	48	29	6	15	0	389	0	572
05:00	0	346	0	67	48	29	6	15	0	351	0	533
06:00	0	319	0	67	48	29	6	15	0	323	0	533
07:00	0	281	0	67	48	29	6	15	0	286	0	557
08:00	0	244	0	67	48	29	6	15	7	248	0	591
09:00	0	240	0	67	48	29	6	15	7	245	0	659
10:00	0	267	0	67	48	29	6	15	7	272	0	708
11:00	0	298	0	67	48	29	6	15	7	303	0	740
12:00	0	333	0	67	48	29	6	15	7	337	0	756
13:00	0	344	0	67	48	29	6	15	7	348	0	757
14:00	0	344	0	67	48	29	6	15	7	349	0	757
15:00	0	367	0	67	48	29	6	15	7	371	0	754
16:00	0	393	0	67	48	29	6	15	7	397	0	757
17:00	0	426	0	67	48	29	6	15	7	430	0	757
18:00	0	446	0	67	48	29	6	15	7	450	0	762
19:00	0	470	0	67	48	29	6	15	0	475	0	770
20:00	0	473	0	67	48	29	6	15	0	478	0	775
21:00	0	508	0	67	48	29	6	15	0	512	0	783
22:00	0	518	0	67	48	29	6	15	0	523	0	772
23:00	0	493	0	67	48	29	6	15	0	498	0	741

Scenario A
Year 2030. 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	542	0	76	51	13	6	40	0	562	0	786
01:00	0	490	0	76	51	13	6	40	0	510	0	715
02:00	0	462	0	76	51	13	6	40	0	482	0	683
03:00	0	450	0	76	51	13	6	40	0	470	0	658
04:00	0	424	0	76	51	13	6	40	0	444	0	632
05:00	0	382	0	76	51	13	6	40	0	402	0	588
06:00	0	354	0	76	51	13	6	40	0	374	0	589
07:00	0	319	0	76	51	13	6	40	0	339	0	615
08:00	0	282	0	76	51	13	6	40	11	302	0	653
09:00	0	286	0	76	51	13	6	40	11	306	0	728
10:00	0	318	0	76	51	13	6	40	11	337	0	782
11:00	0	352	0	76	51	13	6	40	11	372	0	818
12:00	0	388	0	76	51	13	6	40	11	408	0	836
13:00	0	399	0	76	51	13	6	40	11	419	0	836
14:00	0	400	0	76	51	13	6	40	11	420	0	836
15:00	0	422	0	76	51	13	6	40	11	442	0	833
16:00	0	449	0	76	51	13	6	40	11	468	0	836
17:00	0	482	0	76	51	13	6	40	11	501	0	836
18:00	0	502	0	76	51	13	6	40	11	522	0	842
19:00	0	531	0	76	51	13	6	40	0	551	0	851
20:00	0	534	0	76	51	13	6	40	0	554	0	856
21:00	0	570	0	76	51	13	6	40	0	590	0	865
22:00	0	579	0	76	51	13	6	40	0	599	0	853
23:00	0	551	0	76	51	13	6	40	0	571	0	819

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

Scenario B

Year 2020. 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	344	0	60	44	46	6	9	0	76	0	584
01:00	0	342	0	60	44	46	6	9	0	52	0	558
02:00	0	327	0	60	44	46	6	9	0	46	0	538
03:00	0	322	0	60	44	46	6	9	0	30	0	516
04:00	0	287	0	60	44	46	6	9	0	30	0	481
05:00	0	289	0	60	44	46	6	9	0	27	0	481
06:00	0	275	0	60	44	46	6	9	0	63	0	503
07:00	0	226	0	60	44	46	6	9	0	143	0	533
08:00	0	199	0	60	44	46	6	9	5	227	0	595
09:00	0	170	0	60	44	46	6	9	5	319	19	639
10:00	0	170	0	60	44	46	6	9	5	348	19	668
11:00	0	170	0	60	44	46	6	9	5	350	6	683
12:00	0	189	0	60	44	46	6	9	5	326	0	683
13:00	0	202	0	60	44	46	6	9	5	312	0	683
14:00	0	200	0	60	44	46	6	9	5	311	0	681
15:00	0	235	0	60	44	46	6	9	5	279	0	683
16:00	0	266	0	60	44	46	6	9	5	248	0	683
17:00	0	313	0	60	44	46	6	9	5	206	0	688
18:00	0	339	0	60	44	46	6	9	5	187	0	695
19:00	0	361	0	60	44	46	6	9	0	174	0	699
20:00	0	366	0	60	44	46	6	9	0	177	0	707
21:00	0	390	0	60	44	46	6	9	0	143	0	697
22:00	0	390	0	60	44	46	6	9	0	115	0	669
23:00	0	372	0	60	44	46	6	9	0	106	0	643

Scenario B

Year 2025. 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	451	0	75	54	29	6	21	0	76	0	712
01:00	0	410	0	75	54	29	6	21	0	52	0	647
02:00	0	387	0	75	54	29	6	21	0	46	0	618
03:00	0	381	0	75	54	29	6	21	0	30	0	596
04:00	0	358	0	75	54	29	6	21	0	30	0	572
05:00	0	320	0	75	54	29	6	21	0	27	0	533
06:00	0	285	0	75	54	29	6	21	0	63	0	533
07:00	0	229	0	75	54	29	6	21	0	143	0	557
08:00	0	170	0	75	54	29	6	21	15	227	6	591
09:00	0	170	0	75	54	29	6	21	15	319	30	659
10:00	0	170	0	75	54	29	6	21	15	348	10	708
11:00	0	190	0	75	54	29	6	21	15	350	0	740
12:00	0	230	0	75	54	29	6	21	15	326	0	756
13:00	0	244	0	75	54	29	6	21	15	312	0	757
14:00	0	245	0	75	54	29	6	21	15	311	0	757
15:00	0	275	0	75	54	29	6	21	15	279	0	754
16:00	0	308	0	75	54	29	6	21	15	248	0	757
17:00	0	351	0	75	54	29	6	21	15	206	0	757
18:00	0	375	0	75	54	29	6	21	15	187	0	762
19:00	0	411	0	75	54	29	6	21	0	174	0	770
20:00	0	413	0	75	54	29	6	21	0	177	0	775
21:00	0	456	0	75	54	29	6	21	0	143	0	783
22:00	0	473	0	75	54	29	6	21	0	115	0	772
23:00	0	450	0	75	54	29	6	21	0	106	0	741

Scenario B

<u>Year 2030. June – minimum load</u>

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	473	0	95	64	13	6	59	0	76	0	786
01:00	0	426	0	95	64	13	6	59	0	52	0	715
02:00	0	400	0	95	64	13	6	59	0	46	0	683
03:00	0	392	0	95	64	13	6	59	0	30	0	658
04:00	0	366	0	95	64	13	6	59	0	30	0	632
05:00	0	324	0	95	64	13	6	59	0	27	0	588
06:00	0	288	0	95	64	13	6	59	0	63	0	589
07:00	0	235	0	95	64	13	6	59	0	143	0	615
08:00	0	170	0	95	64	13	6	59	29	227	10	653
09:00	0	170	0	95	64	13	6	59	29	319	27	728
10:00	0	170	0	95	64	13	6	59	29	348	1	782
11:00	0	202	0	95	64	13	6	59	29	350	0	818
12:00	0	244	0	95	64	13	6	59	29	326	0	836
13:00	0	258	0	95	64	13	6	59	29	312	0	836
14:00	0	259	0	95	64	13	6	59	29	311	0	836
15:00	0	289	0	95	64	13	6	59	29	279	0	833
16:00	0	322	0	95	64	13	6	59	29	248	0	836
17:00	0	365	0	95	64	13	6	59	29	206	0	836
18:00	0	390	0	95	64	13	6	59	29	187	0	842
19:00	0	439	0	95	64	13	6	59	0	174	0	851
20:00	0	442	0	95	64	13	6	59	0	177	0	856
21:00	0	486	0	95	64	13	6	59	0	143	0	865
22:00	0	502	0	95	64	13	6	59	0	115	0	853
23:00	0	475	0	95	64	13	6	59	0	106	0	819

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

Scenario EU 2030

Year 2020. 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	329	0	61	46	46	6	10	0	87	0	584
01:00	0	330	0	61	46	46	6	10	0	60	0	558
02:00	0	317	0	61	46	46	6	10	0	53	0	538
03:00	0	314	0	61	46	46	6	10	0	34	0	516
04:00	0	278	0	61	46	46	6	10	0	34	0	481
05:00	0	281	0	61	46	46	6	10	0	31	0	481
06:00	0	262	0	61	46	46	6	10	0	72	0	503
07:00	0	201	0	61	46	46	6	10	0	164	0	533
08:00	0	170	0	61	46	46	6	10	6	259	9	595
09:00	0	170	0	61	46	46	6	10	6	364	70	639
10:00	0	170	0	61	46	46	6	10	6	398	74	668
11:00	0	170	0	61	46	46	6	10	6	400	62	683
12:00	0	170	0	61	46	46	6	10	6	372	33	683
13:00	0	170	0	61	46	46	6	10	6	357	18	683
14:00	0	170	0	61	46	46	6	10	6	356	20	681
15:00	0	190	0	61	46	46	6	10	6	318	0	683
16:00	0	225	0	61	46	46	6	10	6	283	0	683
17:00	0	278	0	61	46	46	6	10	6	235	0	688
18:00	0	307	0	61	46	46	6	10	6	213	0	695
19:00	0	331	0	61	46	46	6	10	0	199	0	699
20:00	0	337	0	61	46	46	6	10	0	202	0	707
21:00	0	366	0	61	46	46	6	10	0	163	0	697
22:00	0	369	0	61	46	46	6	10	0	131	0	669
23:00	0	352	0	61	46	46	6	10	0	122	0	643

Scenario EU 2030
Year 2025. 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	405	0	84	65	29	6	35	0	87	0	712
01:00	0	368	0	84	65	29	6	35	0	60	0	647
02:00	0	346	0	84	65	29	6	35	0	53	0	618
03:00	0	342	0	84	65	29	6	35	0	34	0	596
04:00	0	318	0	84	65	29	6	35	0	34	0	572
05:00	0	282	0	84	65	29	6	35	0	31	0	533
06:00	0	241	0	84	65	29	6	35	0	72	0	533
07:00	0	173	0	84	65	29	6	35	0	164	0	557
08:00	0	170	0	84	65	29	6	35	21	259	93	591
09:00	0	170	0	84	65	29	6	35	21	364	131	659
10:00	0	170	0	84	65	29	6	35	21	398	115	708
11:00	0	170	0	84	65	29	6	35	21	400	85	740
12:00	0	170	0	84	65	29	6	35	21	372	41	756
13:00	0	170	0	84	65	29	6	35	21	357	25	757
14:00	0	170	0	84	65	29	6	35	21	356	24	757
15:00	0	181	0	84	65	29	6	35	21	318	0	754
16:00	0	218	0	84	65	29	6	35	21	283	0	757
17:00	0	267	0	84	65	29	6	35	21	235	0	757
18:00	0	294	0	84	65	29	6	35	21	213	0	762
19:00	0	351	0	84	65	29	6	35	0	199	0	770
20:00	0	353	0	84	65	29	6	35	0	202	0	775
21:00	0	400	0	84	65	29	6	35	0	163	0	783
22:00	0	421	0	84	65	29	6	35	0	131	0	772
23:00	0	399	0	84	65	29	6	35	0	122	0	741

Scenario EU 2030

Year 2030. 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	398	0	115	89	13	6	79	0	87	0	786
01:00	0	354	0	115	89	13	6	79	0	60	0	715
02:00	0	329	0	115	89	13	6	79	0	53	0	683
03:00	0	323	0	115	89	13	6	79	0	34	0	658
04:00	0	297	0	115	89	13	6	79	0	34	0	632
05:00	0	256	0	115	89	13	6	79	0	31	0	588
06:00	0	215	0	115	89	13	6	79	0	72	0	589
07:00	0	170	0	115	89	13	6	79	0	164	20	615
08:00	0	170	0	115	89	13	6	79	43	259	121	653
09:00	0	170	0	115	89	13	6	79	43	364	151	728
10:00	0	170	0	115	89	13	6	79	43	398	130	782
11:00	0	170	0	115	89	13	6	79	43	400	96	818
12:00	0	170	0	115	89	13	6	79	43	372	51	836
13:00	0	170	0	115	89	13	6	79	43	357	35	836
14:00	0	170	0	115	89	13	6	79	43	356	34	836
15:00	0	170	0	115	89	13	6	79	43	318	0	833
16:00	0	208	0	115	89	13	6	79	43	283	0	836
17:00	0	257	0	115	89	13	6	79	43	235	0	836
18:00	0	284	0	115	89	13	6	79	43	213	0	842
19:00	0	350	0	115	89	13	6	79	0	199	0	851
20:00	0	353	0	115	89	13	6	79	0	202	0	856
21:00	0	401	0	115	89	13	6	79	0	163	0	865
22:00	0	421	0	115	89	13	6	79	0	131	0	853
23:00	0	396	0	115	89	13	6	79	0	122	0	819

3.2. Information on energy cross-border trade amounts for 2019 in comparison to 2017 and 2018

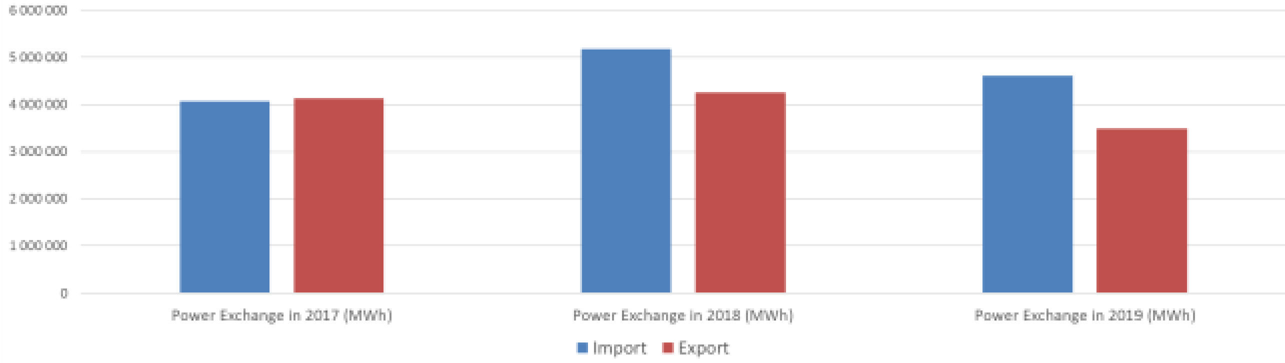


Table 27

	Amounts of energy trade in 2017 (MWh)	Amounts of energy trade in 2018 (MWh)	Amounts of energy trade in 2019 (MWh)
Import	4 072 912	5 173 682	4 610 761
Export	4 137 077	4 264 801	3 492 683

Table 27 shows that in 2019, electricity import is at the approx. same thresholds compared to 2017 and 2018. In compare with 2017, import has increased by about 13%, but in compare with 2018, it has decreased by 11%. Compared to 2017 and 2018, electricity export has decreased by 16% and 18%, respectively. In 2019, the Latvian electricity system imported on average the same amount of electricity as year before, but electricity export from Latvia has significantly decreased. Changes in electricity export is related to the decrease in production by the Daugava hydropower plants, congestions on cross-border capacity, as well as a more resource-rich year in the Nordic countries. The Latvian electricity system totally has imported 1,118,078 MWh (the difference between import and export) of energy from the electricity systems of neighbouring countries, which covered Latvia's annual electricity consumption, and this amount is approximately 15% of Latvia's total electric energy consumption.

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 authority in Latvia for the security of the electricity system and supply under the electricity market conditions, working together with Estonia and Lithuania in accordance with the Nord Pool electricity market principles, ensures market transactions in the Latvian bidding area and provides monitoring, control and publishing of available cross-border capacities for electricity trade with electricity systems of neighbouring 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 CO_2 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-borders with the power systems of neighbouring 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 consumers or regions in Latvia due to insufficient generating capacity or insufficient cross-border capacity with the electricity systems of neighbouring 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, analysing 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 mentioned scenarios, as well as to ensure the operation of Latvian electricity system without impact of external circumstances, especially during the emergency modes caused by the reduction of cross-border transmission capacity. Taking into account existing and further progress towards synchronization of the Baltic States with Continental Europe, the TSO considers that the development of generating capacities in Latvia is essential for the reliable, safe and stable operation of the Latvian electricity system.

Analysing the capacity adequacy for the following years, in the Conservative Scenario (A) the capacity (MW) adequacy analysis table (Table 3) shows that the generating capacity in Latvia is insufficient to cover the peak load, provide capacity reserves and meet system regulation and safety requirements for the winter months from 2022 till 2030. The Conservative Scenario (A) foresees a very slow development of the Latvian electricity system, a slow economic growth, as well as changes in the State support mechanism for renewable energy resources and cogeneration power plants are expected, thus a natural gas power plants, including Riga CHP-1 and Riga CHP-2, operating in a free electricity market conditions will be less competitive and less efficient. Due to the possible changes or reduction of the state support mechanism for producers of renewable resources and cogeneration, is expected that Imanta CHP will be put out of operation in the middle of 2021.

In the Conservative Scenario (A), according to the development tendencies of generation capacities, the capacity deficit reaches 5% by 2022 and 20% by 2030. It is planned that by the 2030, 198 MW of the total net capacity of wind power plants could be covered by offshore wind farms, the real development rates of which are currently difficult to forecast, as no such types of wind turbines are currently installed. Given the slow pace of wind farm development, Conservative Scenario (A) assumes that the development of off-shore wind farms could start no earlier than in 2025 (the minimum construction period for wind farms including surveys and state permitting phases is about 4-6 years). Throughout the reviewed period (2020-2030), capacity adequacy ranges from 80% to 102%, indicating that generating capacity is insufficient to cover electricity consumption, and the capacity deficit will increase from 65 MW to 300 MW throughout the analysed period.

The Conservative Scenario (A) clearly shows that in order to ensure the electricity balance in the Latvian electricity system, it is very important not to lose/reduce the existing Latvian base generation (Daugava HPP, Riga CHP-1 and Riga CHP-2, Imanta CHP). In the Conservative Scenario (A), electricity generation is considered on the condition that Riga CHP-1, Riga CHP-2 and Imanta CHP operate under free electricity market conditions, where these stations are less efficient and can produce only a part of the maximum possible output under free market competition. The electricity balance table (Table 6) shows that the electric energy deficit for the Latvian electricity system in the Conservative Scenario (A) varies from approximately 863 GWh to 1289 GWh, which will be able to be imported through cross-border interconnections to ensure the electricity balance in the system.

In the Base scenario (B) from the capacity (MW) adequacy analysis (Table 4) can be observed that the Latvian electricity system is able to cover the maximum load from 2020 till 2024 and, over the years, the capacity deficit will increase (2-7%) from 2025. Similar with 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). The Base scenario (B) assumes that the development of offshore wind farms could gradually start from 2025 and that the development of wind farms will be slightly faster than planned in Conservative scenario (A). From electricity balance table could see (Table 7) that in the Base scenario (B) the electricity supply will not be sufficient (82-88%) throughout the analysed period, which means that Latvia will import electricity from neighbouring electricity systems and interconnection capacity will be sufficient to ensure electricity balance of Latvia. In the Base scenario (B), is assumed that Riga CHP-1 and Riga CHP-2 are operating according to electricity market conditions and electricity generation is forecasted according to the average long-term volume of power plants production.

In the Optimistic Scenario (EU 2030), the capacity (MW) adequacy analysis (Table 5) shows that the Latvian electricity system is able to cover the maximum load from 2020 to 2030 (117% to 105%). Overcapacity during analysed period indicates that it is possible to export capacity to neighbouring electricity systems to help cover their peak loads. The Optimistic Scenario (EU 2030) assumes that the development of offshore wind farms could start gradually from year 2023. The electricity balance table (Table 8) shows that in the Optimistic Scenario (EU 2030) the supply of electricity will be sufficient throughout the analysed period (150-155%), which means that electricity import from neighbouring countries to ensure Latvia's electricity balance will not be necessary, but Latvia will export electricity to the neighbouring countries.

In the Optimistic Scenario (EU2030) the Riga CHP-1, Riga CHP-2 and Imanta CHP will operate in accordance with the electricity market conditions and are able to generate the maximum possible amount of electricity, taking into account the annual repair schedule of each power plant. In the Optimistic Scenario (EU), the need for a regulation and balancing reserves will increase even faster according to increase of share of wind power plants in the Latvian electricity system. Cross-border capacities will be sufficient to export excess electricity to neighbouring electricity systems.

When analysing the coverage of the daily winter peak load, the total reserve of the Latvian electricity system is not included in the analysis. In the Conservative Scenario (A) we can conclude that in 2020 and 2025 the Latvian electricity system will be able to cover the daily peak load and there will be no need to import electricity to cover the daily peak loads (Tables 9 and 10). In 2030 electricity import will be necessary, ranging from 24 MW to 141 MW, and interconnections capacity will be sufficient to import the necessary extra power into the Latvian electricity system (Table 11). In the Base Scenario (B), Latvian TSO will be able to fully cover the daily load in 2020 (Table 12), in 2025 (Table 13), and in 2030 (Table 14). It is possible to cover 100% of the daily peak load, because the required total power reserve is not included in the tables. In Base Scenario (B), it will be possible to export electricity to neighbouring countries if necessary to help neighbouring countries in covering the peak load during the winter months, as interconnections capacity allows for the export/import of excess capacity.

In the Optimistic Scenario (EU 2030), Latvian TSO will be able to fully cover the daily load in 2020 (Table 15), 2025 (Table 16) and 2030 (Table 17). It is possible to cover 100% of the daily peak load, because the required total power reserve is not included in the tables. The main influencing factors to cover the peak of the winter load are the water inflow in Daugava river and the development of wind power plants.

To cover the daily minimum load in the summer period in the Conservative Scenario (A) in 2020, operation of Riga CHP-1 and Imanta CHP is stopped (Table 18) and the capacity balance is mainly provided by renewable energy resources – biomass and biogas, wind power plants, Daugava HPP`s, small HPP`s, solar power plants, and small natural gas cogeneration plants, while the power system regulation is performed by Riga CHP-2. Power import and export are not planned. The minimum output capacity of Riga CHP-2 is assumed to be 170 MW. In the Conservative Scenario (A) till 2025, biomass and biogas power plants, small HPPs, wind and solar power plants, Daugava HPPs and small natural gas cogeneration plants are operated as base power plants and Riga CHP-2 is providing the system regulation (Table 19). The minimum output capacity of Riga CHP-2 is assumed to be 170 MW. In such scenario, the export of electricity to the neighbouring countries is not planned. By the year 2030, the base power plant list will not change, due to the increase in load only, the generation output of Riga CHP-2 will increase (Table 20).

To cover the daily minimum load in the Base Scenario (B) for year 2020, Riga CHP-1 and Imanta CHP are disabled (Table 21) and the capacity balance is provided in general by renewable energy resources - biomass and biogas, wind power plants, Daugava HPPs, small HPPs, solar power plants, and small natural gas cogeneration plants, while the regulation is provided by Riga CHP-2. The minimum output capacity of Riga CHP-2 is assumed to be 170 MW. In such a scenario, forced electricity exports to neighbouring electricity systems will be around 6 MW to 19 MW. In the Base Scenario (B) until year 2025, biomass and biogas power plants, small HPPs, wind and solar power plants, Daugava HPPs and small natural gas cogeneration plants operate as base power plants and Riga CHP-2 is providing the regulation power (Table 22). The minimum output capacity of Riga CHP-2 is assumed to be 170 MW. Forced electricity exports to neighbouring electricity systems range from 6 MW to 30 MW. By year 2030, the list of base power plants will not change, only due to the increase in load, the Riga CHP-2 will provide regulation power and capacity imports will range from 1 MW to 27 MW (Table 23).

To cover the daily minimum load in the Optimistic Scenario (EU 2030), when the fastest development of renewable energy resources is planned, by 2020 Riga CHP-1 and Imanta CHP are stopped (Table 24) and the power balance is mainly provided by renewable energy resources – biomass and biogas, wind power plants, Daugava HPPs, small HPPs, solar power plants, and small natural gas cogeneration stations, and only Riga CHP-2 is providing the regulation power. The minimum output capacity of Riga CHP-2 is assumed to be 170 MW. Power export is planned from 9 MW to 74 MW and the amount of exported electricity will be approximately 287 MWh. In the Optimistic Scenario (EU2030) till 2025, biomass and biogas power plants, small HPPs, wind and solar power plants, Daugava HPPs and small natural gas cogeneration plants operated as base power plants and Riga CHP-2 is providing regulation (Table 25). The minimum output capacity of Riga CHP-2 is assumed to be 170 MW. Electricity export will be provided by interconnections capacities which are adequate and the amount of exported electricity will range from 24 MW to 131 MW. Approximately 513 MWh of electricity will be exported per day. By 2030, the structure of base power plants will not change (Table 26), but the amount of exported electricity will increase to 638 MWh. The planned electricity export will increase to a maximum of 151 MW per day and the interconnections capacity will be sufficient to export excess capacity to the electricity systems of neighbouring countries.

Increasing of the production of electricity from renewable energy sources creates problems with covering the daily minimum and maximum load. At the minimum load, in order to provide the regulation for electricity system, it is necessary to operate highly manoeuvrable gas-fired stations (minimum capacity provision), which then ensures the coverage of the daily load peaks. In this way, in order to ensure the reliability of the system and the fulfilment of the electricity balance function, it is necessary to export electricity to neighbouring electricity systems, produced from renewable energy sources, at minimum load situations, but at maximum load situations it is necessary to maintain additional highly manoeuvrable gas-fired stations in operation, since it is not possible to cover the daily consumption of the maximum load with renewable energy resources only.

With the development of renewable energy resources, there is a greater need for a quickly adjustable power reserve that is able to adjust the power balance according to the needs of the daily peak load. To ensure a quickly regulated power reserve, the TSO can buy a regulation service from market via existing power plants in Latvia, buy such service from neighbouring electricity producers, or consider installing the necessary equipment (e.g. energy storage batteries) in 110 kV or 330 kV substations to provide this service. Information on the required available capacity reserves (MW) and the amount of reserves used (MWh) in 2019 is shown in Table 28.

Table 28

Month	Max required power reserve	Available power reserve		Realised 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	0
May	440	100	340	197
June	440	100	340	520
July	440	100	340	356.5
August	440	100	340	0
September	440	100	340	0
October	440	100	340	0
November	440	100	340	0
December	440	100	340	0

3.4. 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 2020, in the Conservative Scenario (A), the load adequacy of the Latvian power system will reach approximately 102%, but electrical energy adequacy (Table 7) - 84%. In the Conservative Scenario (A), the largest electricity deficit is expected, because due to the changes in the state support scheme to the renewables and cogeneration, as well as based on the information provided by the producers in previous years, the operation of Imanta CHP is planned to be terminated in 2022. In the Base Scenario (B), the provision of capacity will exceed 100% from 2020 till 2024, but from

2025 till 2030 the power deficit will increase from 2% to 7%. Missing capacity to cover the maximum load will be imported via interconnections from neighboring countries' electricity systems. In the Optimistic Scenario (EU 2030), the amount of electricity generated in the period from 2020 to 2030 will average for 152%, which indicates that the Latvian electricity system will be able to cover the electricity consumption balance in the whole analysied period. In case of maximum output, the Latvian electricity system will be able to ensure the export of electricity to the electricity systems of neighboring countries. The power adequacy table shows that in the Optimistic Scenario (EU 2030) there is sufficient capacity for the whole period from 2020 till 2024, but due to the possible synchronous operation of the Baltic States with continental Europe, the need for capacity reserves will increase in future.

The commissioning of new base load capacity power plants in Latvia is not planned until 2030 and based on the AST available information, no decisions have been made on the implementation of new high capacity power plant projects in the Baltic States. At the same time, the Ministry of Economics of the Republic of Latvia, as the institution responsible for the energy sector in Latvia, points out that the National Energy and Climate Plan (NEPP) sets targets for at least 800 MW of installed capacity of wind energy development by 2030. Taking into account mentioned above, the number of requested permits for increasing the electricity capacity of wind power plants or introducing new generation capacities has significantly increased in 2019 and 2020, reaching total amount of 652 MW of potential installed capacity. The potential future interest from renewable energy producers in Latvia could be mainly related to the possible use of the wind potential of the Baltic Sea shore and the construction of wind farms on the Kurzeme shore. An additional motivating factor is that in the future, European support will be provided for regional and large national wind farm projects via the Connecting Europe Facility funds. Taking into account the experience of previous years, possible construction time of the wind power plants, development trends of wind turbines, commissioning of the last stage of the Kurzeme ring, the current situation with issued technical regulations for electricity producers, as well as current Latvian legislation in the field of renewable energy, the TSO has no reason to believe that the submitted permitting applications will be implemented in full. In this regard, the TSO considers that more intensive development of new power plants is forecasted not earlier than in 3-5 years, but there are no criteria available according to which the planned power plant construction process could be objectively assessed and controlled. Due to the potential development of wind farms in Kurzeme, AST, as an expert in the energy sector, participates in various wind farm development projects in the Baltic Sea, incl. the Maritime Spatial Planning development project led by the Ministry of Environmental Protection and Regional Development, assessing the possible number of connected wind farms and potential connection sites on the Latvian shoret of Baltic Sea, as well as other regional projects for planning the development of offshore wind farms involving several countries of Baltic Sea region.

3.5. Conclusions of the transmission system operator on electricity generation capacity and availability of electricity in the Baltic region and Finland

In November 2018, 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. In addition to that, the Association of European Transmission System Operators of Electricity (ENTSO-E) is preparing capacity adequacy reports for the winter and summer seasons, as well as Mid-Term Adequacy Forecast report. 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 1780 MW to 2490 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 2035.

3.5.1. Power adequacy assessment of the Baltic States and Finland

Scenario of power adequacy assessment of the Baltic States and Finland is shown in Figure 4. Taking into account that the primary frequency regulation in the Baltic power systems currently is provided by the Russian power system, the Baltic States need to guarantee only a secondary reserve till 2025. The tertiary reserve also is not to be provided, due to possibility of it receiving from the members of the BRELL ring for a limited time period, in accordance with the BRELL co-operation agreement. The figure shows that the Baltic power systems, together with the Finnish power system, will not be able to provide the necessary reserves and capacities to cover the peak load throughout the analysed period until 2035. In order to cover the peak load for the Baltic region and Finland, it is necessary to use interconnections with the electricity systems of neighbouring countries, which gives possibility of necessary electricity import, therefore transmission system operators foresee and include the development of cross-border interconnections in the European Ten Year Development Plan.

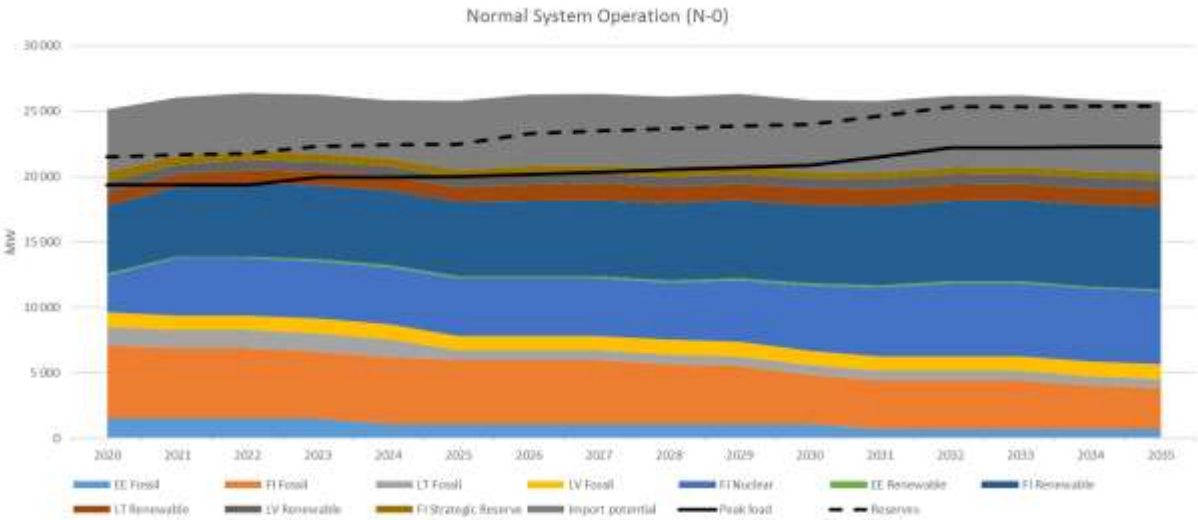


Fig. 4. Power adequacy assessment for the Baltic States and Finland operating synchronously with power systems of Continental Europe after 2025

In the analysed scenario, with Baltic States operating synchronously with Continental Europe, is planned to maintain a strategic power reserve in Finland till 2035, the amount of which could decrease in future from 729 MW till to 470 MW. Accordingly, by maintaining the required power reserves, the electricity deficit for the Baltic States and Finland will remain until 2035, as a result the system will not be able to cover the maximum load with the required amount of reserves. In analysed scenario, the available cross-border capacities (c.a. 4500 MW to 5500 MW) will be sufficient to import the necessary power from neighbouring electricity systems. After 2035, the power deficit could be in the region, which will not be possible to cover by electricity imports from neighbouring countries due to insufficient cross-border capacities to neighbouring electricity systems and due to the lack of information on power adequacy in neighbouring electricity systems.

In the scenario with outage of the two largest generating units in Finland (N-2) in 2024, there will be problems with the available capacities to cover the peak load and reserves in the region (see Figure 5). The figure shows that the Baltic States and Finland will provide the power balance with electricity import through cross-border interconnections to the neighbouring countries, therefore the development of new cross-border interconnection capacities is preferable.

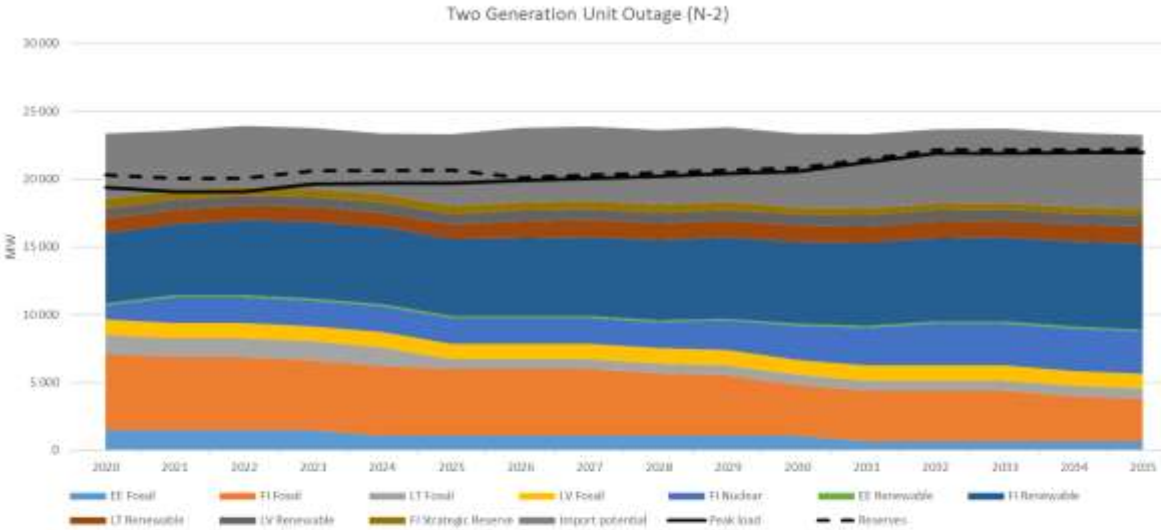


Fig.5. Power adequacy assessment for the Baltic States and Finland operating synchronously with power systems of Continental Europe after 2025

3.5.2. 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. Isolated island mode is a mode when the Baltic power systems are disconnected from IPS/UPS power system and DC interconnections to the Nordic countries and continental Europe are providing only necessary system reserves, therefore their available capacity is reduced. The Baltic States themselves maintain and control the system frequency.

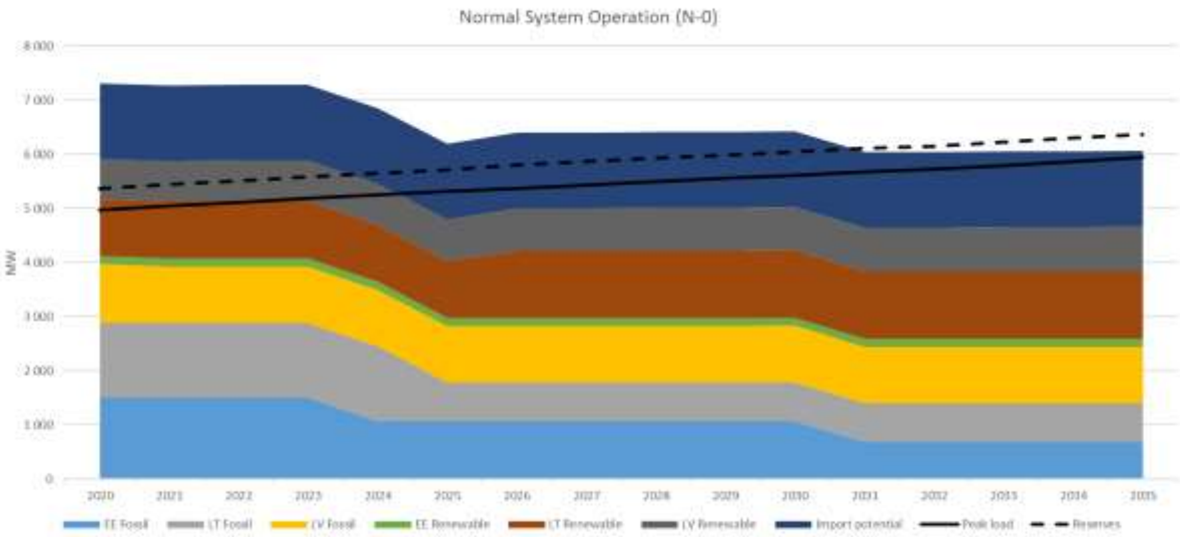


Fig.6. Power adequacy assessment for the Baltic States operating in isolated island mode after 2025

Figure 6 shows that the power adequacy in the Baltic States is sufficient until 2023 to cover the peak load and reserves with its own generation and without electricity import through interconnectors from the electricity systems of neighbouring countries. After 2023, in order to ensure the amount of reserves and to cover the peak load, the Baltic States will cover necessary deficit with electricity import from neighbouring countries – Finland, Sweden and Poland. From 2031, generation capacity and import will be insufficient to cover the peak load and ensure an adequate level of security of supply in the Baltic electricity system. The power deficit ranges from around 68 MW to 310 MW.

Figure 7 shows power adequacy assessment in Baltic States operating in isolated mode during emergency situation with outage of biggest generation unit 400MW, as well as cross-border capacities are limited by 400MW, to provide system reserves for N-2 criterion with outage of second biggest generation unit (also ~400MW). The simultaneous outage of 2 potential generation units in Baltic States is analysed in the given scenario. Based on the power adequacy assessment is concluded, that power deficit or problems with power for peak load covering could be started after 2025, when synchronisation with continental Europe will started. To cover peak load problems could be due to base load capacities, taking into account environmental pollution and provision of power system stability and reliability. Taking into account existing development temps of power generation, after 2030 Baltic power systems will not be able to guarantee secure and stable operation of power system and new base load generation development in Baltic countries is essential and need to be supported.

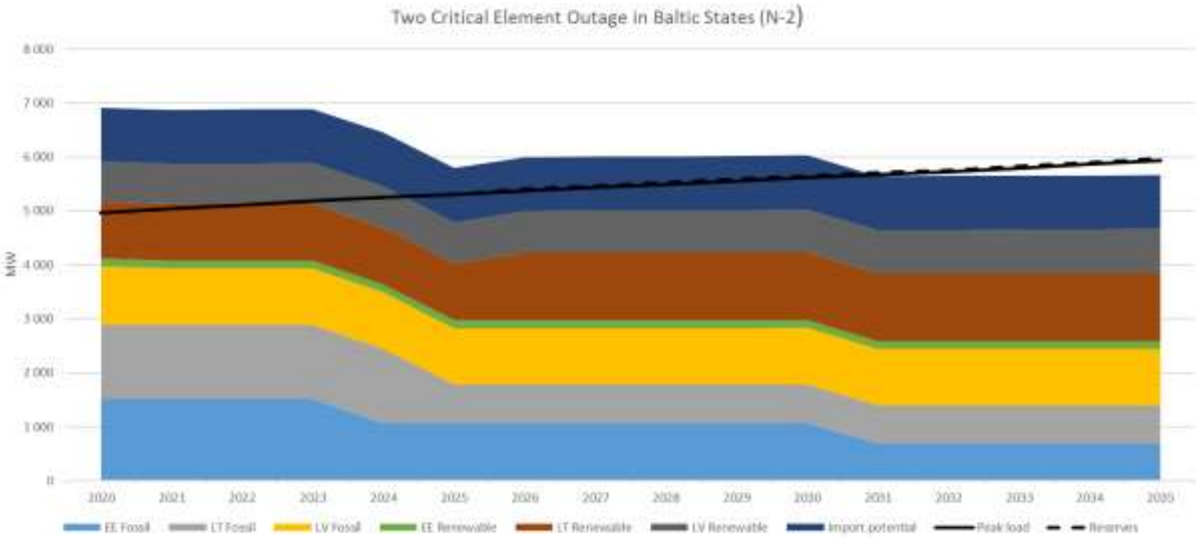


Fig.7. Power adequacy assessment for the Baltic States operating in isolated island mode after 2025, with outage of two critical network elements in Baltic countries

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 partially eliminate these shortcomings, the third Estonia-Latvia electricity interconnector has been planned to commission by the end of 2020, which is on final construction phase in Latvia and Estonia, but due to Covid-19 quarantine restrictions, the works are expected to be completed by the middle of 2021. In order to fully eliminate the restrictions in the Estonia-Latvia cross-border, after commissioning of the third Estonia-Latvia interconnection, till 2024 is planned to reconstruct the existing two Latvian interconnections with Estonia from 330 kV substation Valmiera in Latvia to 330 kV substations in Estonia Tartu and Tsirguliina, as well as Elering plans to reconstruct the existing 330 kV lines to eliminate transmission capacities restrictions in the territory of Estonia by 2025. This means that the transmission capacity of the Latvian-Estonian cross-border will still be limited until 2025, but the restrictions will be lower than before 2021. As a result of such capacity limitation, during emergency and repair modes the normal operation of the electricity system could be problematical, which significantly reduce 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 reconstruction schedule for 330 kV transmission lines till 2025, which is necessary to reinforce the Baltic transmission network for the synchronization, and TSO`s are developing these transmission lines based on a common agreed reconstruction schedule.

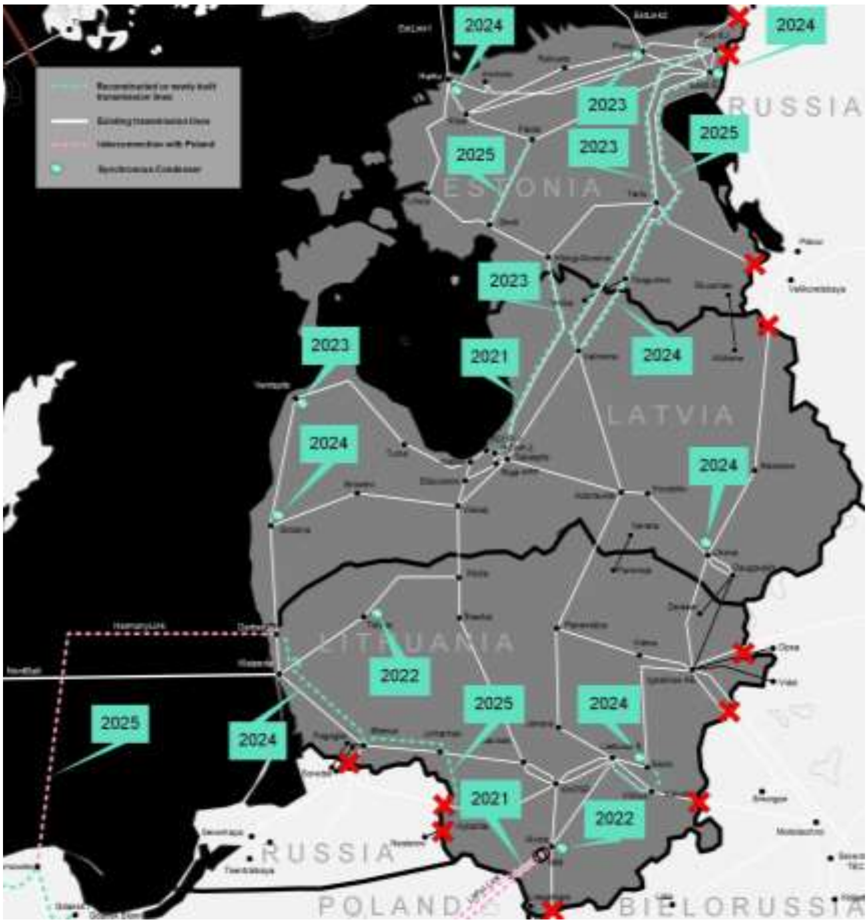


Fig. 8. Transmission infrastructure projects in Baltic countries according to the development plans of Baltic TSOs

Electricity transmission capacity on the Latvian-Lithuanian cross-border is sufficient at present and electricity transmission in the normal operation modes is not problematic, therefore it does not require additional measures for the cross-border capacity increase, except the synchronization scenario. After approval of Baltic States synchronisation scenario with Continental Europe, which will consist of AC double-circuit line between Lithuania and Poland, and additional DC interconnections between Lithuania and Poland, future reinforcement of the Latvian-Lithuanian cross-border could be necessary depending on operation modes and further development of synchronisation project.

The transmission capacity in the Latvian-Russian cross-border is sufficient and does not cause additional problems for electricity transmission under normal operation conditions. Due to Baltic States synchronization with Continental Europe and the desynchronization from Russia and Belarus in 2025, the development of the Latvian-Russian interconnections 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)

4.2.1. The third electricity interconnection between Latvia and Estonia

Co-financed by the European Union
Connecting Europe Facility

In cooperation with the Estonian transmission system operator, the development of the third Estonian-Latvian electrical interconnection between 330 kV substations of Riga CHP-2

in Latvia and Killingi-Nomme in Estonia is in process. The project implementation in Latvia and Estonia is going with allocated 65% EU co-financing from Connecting Europe Facility (CEF) grants. The interconnection will increase the available transmission capacity between the Latvian and Estonian electricity systems and eliminate the congestion in the Estonian-Latvian cross-border that currently limits the electricity trade inside Baltics and between Baltic and Nordic countries. The Estonia-Latvia third interconnection project is considered to be one of the most significant projects for whole Baltic Sea region, as the capacity in the Estonia-Latvia cross-border will increase to 500/600 MW in normal operation mode and up to 300/500 MW in isolated mode. The third Estonia-Latvia interconnection is also one of the backbone projects for the future Baltic synchronization with transmission networks of the Continental Europe.
The construction of transmission line in Estonian territory consists of the stage between the 330 kV substation Kilingi-Nomme to the Estonian-Latvian border and the construction of the 330 kV transmission line Harku-Sindi, which is an internal network reinforcement for secure and stable interconnection operation in Estonia. The transmission line in the territory of Latvia is constructing mainly along the existing 110 kV electricity transmission line routes and in the section from Saulkrasti to the Riga CHP-2 substation along the common route with the "RailBaltica" railway project. Currently, the project is in the final construction stage both in Latvia and Estonia, most part of the planned line pylons have been installed in Latvia, all coordination works have been completed and building permits have been received for all stages of the route. The initial commissioning date of the third Latvian-Estonian interconnection project was scheduled by the end of 2020, but due to Covid-19 restrictions, problems with material supplies and problems with abroad workers, the commissioning date is expected on June 2021.

4.2.2. Electricity transmission network connection "Riga CHP-2 - Riga HPP"

Co-financed by the European Union
Connecting Europe Facility

The work of the Latvian 330 kV electricity transmission network reinforcement project Riga CHP-2 – Riga HPP is on-going. The Riga CHP-2 – Riga HPP project is a reinforcement of the transmission network of Riga city, which will ensure the full functionality of the third Estonian-Latvian interconnection in repair and emergency modes in the transmission networks of the Riga region. At the regional level, this network reinforcement will play an important role in increasing North-South transmission capacity in the Baltic region for Baltic States became connection to the Nordic and Polish electricity systems.

Taking into account the importance of the project not only for Latvia, but also at the European level, the project received 50% EU co-financing from *Connecting Europe Facility* (CEF) funds.

The transmission line route selected for the project is crossing territory only of one municipality, the initial environmental impact assessment has been prepared for project, and Environmental State Service issued technical requirements for project implementation in compliance with environmental protection requirements and regulations. Taking into account the significance of the project for Latvia, Baltics and Europe, on 16 August 2017, the Cabinet of Ministers allocated National Interest Object status for mentioned project.

The project active construction works were ongoing in 2019 in the electricity transmission line and in both substations. The construction works of transmission line are finalised in August 2020 and line was switched on under voltage, construction works at Riga CHP-2 and

Riga HPP 330 kV substations are still on-going on and is planned to be completed by the end of 2020.

4.2.3. Synchronization of the Baltic States with the European Electricity Transmission Networks and Desynchronization from the Russian Unified Electricity System

Co-financed by the European Union
Connecting Europe Facility

The development of Baltic synchronisation project with Continental Europe was on-going in 2019 in Baltic States and in Latvia. On 28 of June 2018, the synchronisation decision was made by signing the synchronization roadmap with the recommended next steps for synchronization with Continental Europe and desynchronization from the Russian unified power system.

On 27 of May 2019, the TSOs of the Baltic States and Continental Europe signed the "Connection Agreement", which consists with annexes of technical requirements that the TSOs of the Baltic States should implement before the start of the synchronous operation. The synchronization project is planned to be implemented in two phases, where the first phase is related to activities of internal Baltic electricity transmission network reinforcement, while the second phase is related to activities identified in the list of technical measures.

- **Phase 1 of the Baltic Synchronization Project.**

The first phase of synchronization consists of reinforcement of the electricity transmission network of the Baltic States, including the development of equipment that will ensure the necessary amount of inertia and frequency regulation and control in synchronization mode with Continental Europe. Under synchronisation phase 1 project the reconstruction of two existing Estonian-Latvian interconnections Valmiera-Tartu and Valmiera-Tsirguliina, installation of synchronous condenser, as well as modernization and installation of power system control and management automation, identified in the ENTSO-E technical requirement list, is planned. The Baltic Synchronization phase 1 received 75% co-financing from CEF grants and on 19 of March 2019, a Grant Agreement between the Baltic TSOs and the European Innovation and Network Executive Agency was signed taking account the conditions for the use and monitoring of the allocated co-financing.

Reconstruction of the existing 330 kV interconnections Valmiera (LV) - Tartu (EE) and Valmiera (LV) - Tsirguliina (EE).

Both reconstructions of 330 kV lines Valmiera (LV) - Tartu (EE) and Valmiera (LV) - Tsirguliina (EE) (Fig. 8) are combined in one activity. The standards followed in the construction of these transmission lines no longer meet the requirements of modern operation, for example, differences in transmission capacity between the winter and summer seasons trouble the optimal and efficient functioning of the electricity market. During synchronisation phase 1, Estonian TSO also plans to reconstruct transmission lines from LV-EE border till Narva power plants in order not to reduce transmission capacity to the electricity market, Latvian and Estonian TSOs plan to reconstruct existing lines step by step. The reconstruction of both 330 kV electricity transmission lines Valmiera (LV) - Tartu (EE) and Valmiera (LV) – Tsirguliina (EE) is planned to start in 2020 with announcement of tendering procedure and future design works. Start of Valmiera-Tartu reconstruction is expected in 2022 and the commissioning in 2023. Whereas, the implementation of the 330 kV electricity transmission line Valmiera (LV) - Tsirguliina (EE) project is planned immediately after the reconstruction of the line Valmiera (LV) - Tartu (EE) and the commissioning of the project is planned in 2024. Both projects are included in the list of projects of common interest, as well as in all national and European development documents.

During the implementation of synchronization phase 1 project, it is necessary to install and upgrade the power system management system and the network telecontrol system with installing power control and management equipment, i.e. phasor measurement units (PMU) and wide area monitoring system (WAMS) in all the most important objects. The deadline for the implementation of these measures is 2025, when the synchronization of the Baltic electricity transmission systems with Continental Europe and the desynchronization from the Russian unified electricity system are planned.

Additionally to frequency control measures, for the stable operation of the electricity system in synchronization mode, the TSOs of the Baltic States must ensure a sufficient amount of inertia for a 24-hour daily interval - according to calculations, Latvia must provide 5700 MWs of inertia. During the implementation of 1st phase of the Baltic synchronization project, the installation of one synchronous condenser of approximately 200 MVA is planned for the provision of inertia service.

- **Phase 2 of the Baltic Synchronization Project.**

Phase 2 of the Baltic Synchronization Project is a continuation of the first phase, during which the construction of DC interconnection between Poland and Lithuania (Harmony link) is planned. Synchronisation phase 2 includes the reinforcement of the necessary transmission infrastructure for the secure operation of Harmony link, the installation of additional equipment to ensure the necessary amount of inertia and the installation of frequency control equipment. The Baltic Synchronization Project is included in the PCI list and Phase 2 of the Baltic Synchronization Project, similar to Phase 1, will be eligible for European co-financing from the CEF grunts. In year 2019, the Baltic TSOs together with the Polish TSOs developed and submitted to the national regulatory authorities an investment request for the 2nd phase of Baltic synchronization, in accordance with EU Regulation 347/2013. On 27 of April 2020 the Baltic and Polish national regulatory authorities issued a cross-border cost allocation decision for the 2nd phase of the Baltic synchronization project. On 26 of May 2020, the TSOs of the Baltic States and Poland prepared and submitted a co-financing application to the European Innovation and Networks Executive Agency to apply for European co-financing from the CEF funds. The decision of co-financing issued by EC is expected on the end of 2020.

"Augstsprieguma tīkls" as the institution in Latvia responsible for system security and stability, currently implementing technical measures for phases 1 and 2 of the synchronization project, is planning to develop, purchase and install modern and efficient equipment for inertia (synchronous condensers – SC). Taking into account that, after start of synchronization with continental Europe and desynchronization from the Russian electricity system in 2025, AST has to provide frequency containment and restoration reserves. As the market for frequency containment and restoration reserves is not developed yet in the Baltic States and there is a big risk that the availability of such reserves will be insufficient to for implementation of the synchronization project, AST started discussion with Public Utilities Commission about possibility to allow AST to install *battery energy storage system* (BESS).

AST estimates that the provision of such service with this type of equipment is more efficient and cheapest in compare with purchasing this service on the market from existing power plants, as well as with lower operating and maintenance costs. As mentioned above AST sees the risk that in 2025 the reserve market will not be able to provide the above mentioned service with all the necessary reserves. A special regulation of the European Commission (*Clean Energy Package*, CEP) is currently being developed and is being implemented. The regulation obliges for the purchase of a frequency regulation service in the electricity market, but special derogation is possible, or the regulatory authority of a particular country decides otherwise, due to the specifics and necessity of the 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, 2020, greater than 1 MW.

Latvian power system power stations with installed capacity above 1 MW are presented in the Table 29

Table 29

Nr.	Name of power station	Installed capacity (MW)
	Natural gas co-generation stations	
1	BK Enerģija	3.9
2	DLRR Enerģija SIA	1.698
3	Energy & Communication, AS	3.9
4	LATNEFTEGAZ SIA	3.986
5	Rēzeknes siltumtīkli SIA	5.572
6	Fortum Latvia, SIA	3.996
7	Elektro bizness SIA	3.6
8	Mārupes siltumnīcas SIA	1.999
9	Olainfarm enerģija AS	2
10	Olenergo AS	3.12
11	VANGAŽU SILDSPĒKS, SIA	2.746
12	Zaļā dārzniecība SIA	1.999
13	RTU Enerģija SIA	1.56
14	Uni-enerkom, SIA	2.997
15	LIEPĀJAS ENERĢIJA, SIA	4
16	Juglas jauda, SIA	14,9
17	RĪGAS SILTUMS AS (SC Imanta)	47.7
18	RĪGAS SILTUMS AS (KM Keramikas 2A)	2.33
19	BALTIC COMMUNICATION NETWORK SIA	1.3
	Biomass and biogas power stations	
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	1.995
9	LIEPĀJAS RAS, SIA	1.1
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	SM Energo SIA	1.1
27	Enefit power un Heat Valka SIA	2.4
28	Betula Premium SIA	1.9
29	Incukalns Energy SIA	3.999
30	Graanul Pellets Energy SIA	3.99
31	PREIĻU SILTUMS SIA	1.15
32	JE Enerģija SIA	1
33	TUKUMS DH SIA	1.25
34	Technological solutions SIA	3.980
35	DJF SIA	1.4
36	EKO NRG SIA	3.380
37	Energia Verde SIA	3.980
38	Rīgas Enerģija SIA	4
39	AGRO CEMERI SIA	1.5
40	ENERGY RESOURCES CHP RĒZEKNES SPECIĀLĀS EKONOMISKĀS ZONAS SIA	3.98
41	RIGENS, SIA	2.096
42	Dobeles EKO SIA	3.990
43	RĪGAS SILTUMS AS (SC Ziepniekkalns)	4
44	ZIEDI JP AS	1.998
Wind power stations		
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
Latvenergo power stations		
1	Ķeguma HES	248
2	Rīgas HES	402
3	Pļaviņu HES	907.6
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 Economics of the problem of ensuring the balance of power.

5. Key TSO recommendations and conclusions

- Deficit of generating capacities is expected in the next decade 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 involve 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 should not be reduced.
- Power adequacy forecast at State and region level shows that generation capacities in Latvian power system are not sufficient to cover peak load in Latvia and to provide necessary power reserves for analysed scenarios. Taking into account mentioned above and existing progress with Baltic power systems synchronisation with continental Europe, for secure and stable operation of power system of Latvia, the generation and balancing power development in Latvia is necessary, involving in process also energy policy responsible authorities in Latvia.

- In the Baltic States, power adequacy will be sufficient until 2023 to cover the peak load and reserves only with the generation in the Baltics without import from neighbouring countries. The power deficit to cover the peak load could start after 2025, when is planned desynchronization from the Russian power system and to start synchronous operation with Continental Europe. According to the current generation development forecast after 2030, the Baltic States will not be able to provide the secure operation of the electricity system, as the capacity of the power plants in the Baltics together with the import amounts will no longer be sufficient to cover the peak load.
- Due to the planned Baltic synchronisation with Continental Europe, the Baltic TSOs will be oblige to provide load and frequency control in 2025 in normal emergency operation conditions after outages of the bigger generator or overloaded electricity transmission line. In order to create load and frequency regulation in the power system, it is necessary to make capital investments in new equipment, ensure continuous 24h availability in the region and develop the market of system ancillary services. As the market for frequency containment and restoration reserves is not developed in the Baltics and there is a significant risk that the availability of such reserves will be insufficient to ensure load and frequency regulation capacity without impact to the synchronization project, AST has initiated on the Public Utilities Commission to allow AST to install energy storage batteries to guarantee the necessary reserves during the implementation of the synchronization project
- 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 the reduction of generation and balancing capacities, it is necessary to develop the electricity demand response services and the independent aggregation in Latvia in order to provide balancing reserve resources in the electricity system to ensure continuous electricity demand and supply balance. Currently, the most significant obstacle is the lack of regulatory enactments that would regulate the operation of independent aggregation
- Further integration of the Baltic power systems into the Continental European networks will ask Baltic States to realize ambitious projects in a relatively short time period, what will require political support at both national and European level.

AS „Augstsprieguma tīkls”
Member of the Board A.Staltmanis