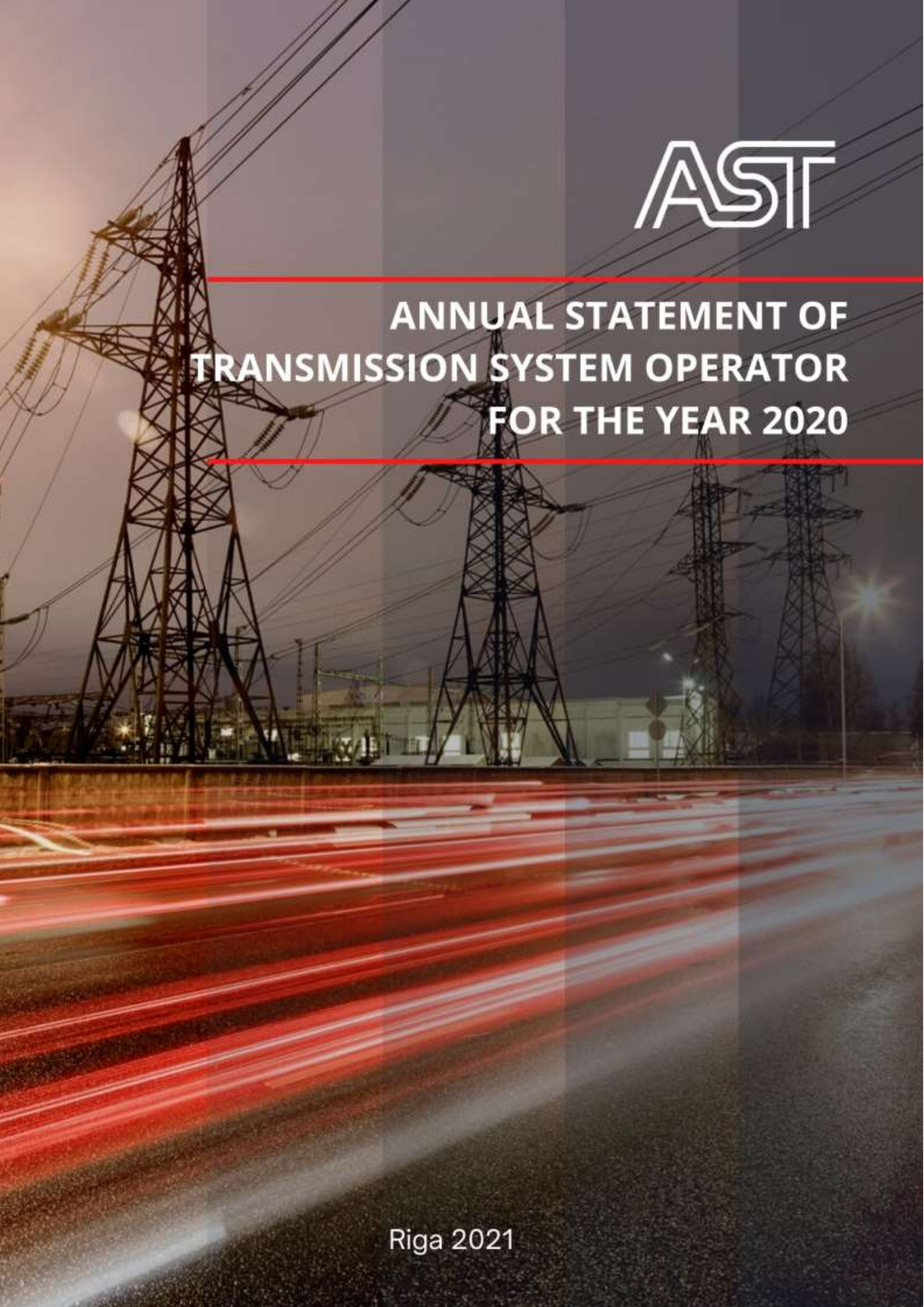

ANNUAL STATEMENT OF TRANSMISSION SYSTEM OPERATOR FOR THE YEAR 2020

Riga 2021

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The report has been prepared in accordance with the Regulations No. 322 “Regulations on the TSO's annual statement” by the Cabinet of Ministers of the Republic of Latvia, in accordance with the informative report on the Latvian Long-Term Energy Strategy for 2030 and the National Energy and Climate Plan 2021-2030 (NECP) developed by the Ministry of Economics.

1. National electricity and capacity demand in the previous year

1.1. Electricity consumption (nett) by week in 2020

The total annual electricity consumption without electricity losses is 7 135 520 MWh.

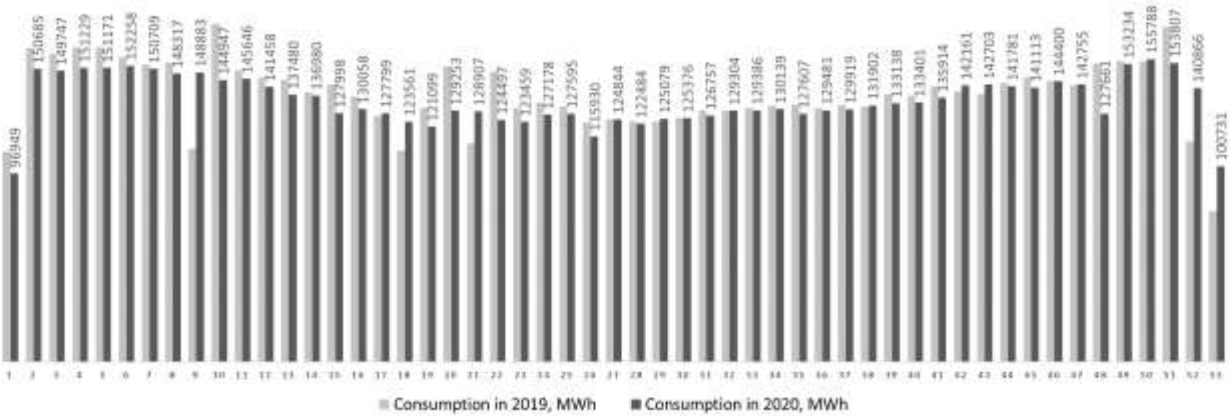

Fig. 1. Electricity consumption in Latvia by weeks (nett) MWh

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

Minimum load:	463 MW	24.06.2020.	06:00
Maximum load:	1184 MW	09.12.2020.	17:00

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

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 in the Conservative scenario (A)	Annual consumption in the Base scenario (B)	Annual consumption in the Optimistic scenario (EU2030)	Peak load
	GWh	GWh	GWh	MW
2021	6961	7213	7379	1197
2022	7041	7333	7560	1230
2023	7145	7441	7646	1261
2024	7220	7518	7725	1288
2025	7294	7595	7823	1315
2026	7362	7665	7915	1342
2027	7394	7731	8005	1369
2028	7407	7797	8095	1397
2029	7473	7866	8188	1425
2030	7535	7931	8279	1454
2031	7554	7980	8354	1480

3. Adequacy assessment of supply and consumption in the reporting period and forecast for the following years (minimum forecast term - 10 years)

3.1. Annual electricity demand and possible sources to cover it

The forecast of the electric energy and power balance, as well as the forecast of electricity consumption have been developed based on three scenarios. All scenarios include the synchronization of the Baltic States with the Continental Europe starting from 2026. The detailed analysis of the scenarios has been selected based on the political roadmap on synchronization of the Baltic electricity transmission grids with the electricity grid of Continental Europe developed by the heads of the governments of the three Baltic states and Poland together with the European Commission on June 28, 2018. Agreement on the connection of the Baltic States to the synchronous zone of Continental Europe, signed by the electricity transmission system operators (hereinafter TSO) has also been taken into account. According to the Latvian development plans which have been approved by the EU, the implementation of the Synchronization project is planned until the end of year 2025.

A detailed description of the scenarios is following:

- **Scenario A "Conservative development":** Electricity system load forecast is based on the information on the future load and electricity consumption submitted by the Latvian distribution system operators. The forecasting of the development of generating capacities takes into account the operation of natural gas power plants under electricity market conditions, mostly operating only in the co-generation mode during the winter period. In the conservative scenario, the development of wind farms, biomass and biogas plants, small gas co-generation plants and solar power plants takes into account the possible changes in the state support scheme. The development of the offshore wind farms is slow, hence the TSO assumes that by 2030 offshore wind farm projects in Latvia will be implemented only partly - 300 MW of installed capacity. In the summer of 2021, the operation of Imanta CHP was terminated, and as of 2029 the Riga CHP-1 power plant and one of the Riga CHP-2 units with a capacity of 442 MW will be shut down due to the planned changes in the state support scheme.

- **Scenario B "Base scenario":** Electricity system load forecast is based on the GDP growth forecast issued by the Ministry of Economics for Latvia, information provided by the stakeholders in the energy sector, as well as based on the information submitted by Latvian distribution system operators on the prognosis of the development of the load and the electricity consumption. The forecast of the development of generating capacities takes into account power plants that are planned to be put into operation or closed in accordance with the information submitted by all participants of the electricity system. In the base scenario (B), the development of Daugava HPP hydropower plants is based on the average annual production of power plants. The production of both Riga CHPs is planned according to the existing electricity market conditions and state aid for the high-capacity gas co-generation plants. The development of wind farms, biomass and biogas 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. The development of offshore wind energy projects is moving ahead according to plan. The TSO has received applications for connecting to the grid the several offshore wind farm projects, including ELWIND, which commissioned fully will add 500 MW to the Latvian installed wind energy capacity. Rapid development of small natural gas co-generation plants is not projected. In the summer of 2021, the operation of Imanta CHP was stopped due to the planned changes in State support scheme.

- **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 the planned generation and load development rate to achieve the European Union 2030 targets, Latvia's Long-Term Energy Strategy 2030 and the National Energy and Climate Plan 2021-2030 developed by the Ministry of Economics. 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 to the TSO, is considered as possible. 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, as RES will be able to replace Riga CHP-1 capacity. The scenario assumes that from 2030, Riga CHP-1 will stop producing electricity due to competition and will not participate in covering of the maximum load. The development of offshore wind farms is developing according to plan and the TSO assumes that offshore wind farm projects, including the ELWIND offshore wind farm project is being implemented in full, which would be 500 MW of installed capacity for Latvia. The power generation in Imanta CHP has been terminated in early 2021 due to the planned changes in state support scheme.

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

Assumptions and explanations for the tables below:

[1)] According to statistical data, the average multi-annual net production of Daugava cascade hydropower plants (hereinafter - Daugava HPP) is 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 account the loading of the largest generation unit in Latvia, the capacity reserve for the needs of the Latvian electricity system should be provided in accordance with the planned loading of the biggest generation unit, i.e. up to 440 MW of Riga CHP-2 largest unit (steam and gas turbines). Taking into account that the reserve of available capacity in Latvia is 100 MW, the missing amount of capacity – 340 MW - can be guaranteed to be received from neighbouring electricity systems only for 12 hours. After year 2025, when the electricity systems of the Baltic States will operate synchronously with the electricity system of Continental Europe, the reserves required for the Latvian electricity system will be called balancing reserves. All the necessary reserves will be used for balancing and maintaining the frequency of the system, so from year 2026, it will not be necessary to maintain additional reserves for balancing. By the end of 2025, the TSO plans to install a total of 80 MW/160 MWh of Battery Energy Storage Systems (BESS) to provide capacity for primary (FCR - Frequency Containment Reserve), secondary (aFRR) automatic Frequency Restoration Reserve) and tertiary (mFRR - manual Frequency Restoration Reserve) frequency control. AST estimates that the total reserve could reach 225 MW, including a frequency maintenance reserve (FCR) of ~ 10 MW, an automatic frequency recovery reserve (aFRR) of ~ 30 MW, and a manual recovery reserve of up to (mFRR) of 185 MW.

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

[4)] The regulation reserve of the electricity system is estimated as 6 % of the maximum load of the system and 10 % of the installed capacity of wind power plants, estimating the day of the winter peak.

[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)] The installed and net capacity of wind power plants in the Conservative scenario (A), Base scenario (B), Optimistic scenario (EU2030) is adopted on the basis of the forecast submitted by the Ministry of Economics on the development of high-capacity wind farms, technical regulations issued by the AS "Augstsprieguma tikls" and AS "Sadales tikls", as well as the Latvian National Energy and Climate Plan 2030, approved by the Ministry of Economics.

8) In the Conservative scenario (A), Base scenario (B), and Optimistic scenario (EU2030) the net capacity of biomass and biogas power plants is presented on the basis of technical regulations issued by AS "Augstsprieguma tikls" and AS "Sadales tikls", as well as Latvian National Energy and Climate Plan 2030.

9) In the electricity balance tables in the Conservative scenario (A) and Base scenario (B), the electricity generation of Riga CHP-1, Riga CHP-2 and Imanta CHP is assessed according to the electricity market conditions in the Latvian electricity trading area. In the optimistic scenario (EU 2030), the electricity generation from Riga CHP-2 is assessed as the maximum possible, that is, based on the electricity market conditions in the Latvian electricity trade area, producing the maximum possible amount of electricity on an annual basis. In order for a co-generation power plants to receive State support for the installed capacity, which is determined by Cabinet Regulation No. 221 “Regulations on Electricity Generation and Pricing in Producing Electricity in Cogeneration”, the number of hours of use of installed electricity capacity should be at least 1200 annually.

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) In the Conservative scenario (A) is assumed that Riga CHP-2 can operate only in co-generation mode, when its maximum net capacity reaches 803 MW, as well, starting from 2029, one of Riga CHP-2 units is shut-down due to termination of State support scheme. In the Conservative Scenario (A) Riga CHP-1 will be stopped producing by 2029. In the Base Scenario (B) and the Optimistic Scenario (EU2030), the maximum net capacity of Riga CHP-2 can reach 850 MW, assuming that the power plant will operate in condensing mode.

12) On June 28, 2018, a political decision was made on the synchronization of the Baltic States with Continental Europe and disconnection (desynchronization) from the electricity systems of Russia and Belarus. These measures will be implemented until the end of year 2025.

13) According to the information submitted by heat producer AS "Rigas Siltums", in the middle of 2021 it is planned to stop the operation of Imanta CHP due to possible changes in the government support scheme for co-generation. The capacity of Imanta CHP is not dismantled, therefore we assume that in all scenarios until year 2021 the capacity of Imanta CHP is still available to cover the maximum load.

Installed capacities (gross) of power stations, MW

Table 2

Years		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Power stations with installed capacity above 40 MW [6)]	**1**	**2644**	**2644**	**2666**	**2666**	**2674**	**2674**	**2674**	**2674**	**2674/ 2029**	**2674/ 2029**	**2674/ 2029**
Including: Daugava HPPs	*1.1*	*1558*	*1558*	*1580*	*1580*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*
Riga CHP-1 [11)]	*1.2*	*158*	*158*	*158*	*158*	*158*	*158*	*158*	*158*	*158/0*	*158/0*	*158/0*
Riga CHP-2 [11)]	*1.3*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881/441*	*881/441*	*881/441*
Imanta CHP [13)]	*1.4*	*48*	*48*	*48*	*48*	*48*	*48*	*48*	*48*	*48*	*48*	*48*
Installed capacity of small power stations (Conservative Scenario A)	**2**	**360**	**370**	**379**	**389**	**399**	**409**	**419**	**428**	**438**	**760**	**800**
Including: Natural gas co-generation stations	*2.1*	*78*	*75*	*73*	*70*	*68*	*65*	*63*	*60*	*58*	*50*	*48*
Hydro power stations	*2.2*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*
Wind power stations [7)]	*2.3*	*81*	*87*	*92*	*98*	*104*	*110*	*115*	*121*	*127*	*450*	*480*
On-shore	*2.3.1.*	*81*	*87*	*92*	*98*	*104*	*110*	*115*	*121*	*127*	*150*	*160*
Off-shore	*2.3.2.*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*300*	*320*
Biomass power stations [8)]	*2.4*	*98*	*101*	*103*	*106*	*109*	*112*	*115*	*118*	*120*	*120*	*123*
Biogas power stations [8)]	*2.5*	*62*	*63*	*65*	*66*	*68*	*69*	*71*	*72*	*74*	*80*	*82*
Solar power stations	*2.6*	*12*	*14*	*16*	*18*	*20*	*22*	*24*	*27*	*29*	*30*	*37*
Installed capacity of small power stations (Base Scenario B)	**3**	**370**	**389**	**409**	**428**	**448**	**468**	**487**	**507**	**527**	**1101**	**1165**
Including: Natural gas co-generation stations	*3.1*	*76*	*72*	*68*	*64*	*60*	*56*	*52*	*48*	*44*	*40*	*37*
Hydro power stations	*3.2*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*31*	*31*	*31*
Wind power stations [7)]	*3.3*	*85*	*94*	*104*	*113*	*123*	*133*	*142*	*152*	*162*	*700*	*745*
On-shore	*3.3.1.*	*85*	*94*	*104*	*113*	*123*	*133*	*142*	*152*	*162*	*200*	*215*
Off-shore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*500*	*530*
Biomass power stations [8)]	*3.4*	*100*	*105*	*110*	*115*	*120*	*125*	*129*	*134*	*139*	*150*	*160*
Biogas power stations [8)]	*3.5*	*63*	*66*	*69*	*72*	*75*	*78*	*82*	*85*	*88*	*100*	*105*
Solar power stations	*3.6*	*16*	*22*	*28*	*34*	*40*	*46*	*52*	*58*	*64*	*80*	*87*
Installed capacity of small power stations (Optimistic Scenario EU 2030)	**4**	**387**	**424**	**460**	**496**	**533**	**669**	**806**	**943**	**1080**	**1301**	**1394**
Including: Natural gas co-generation stations	*4.1*	*76*	*71*	*67*	*63*	*58*	*53*	*49*	*45*	*40*	*30*	*27*
Hydro power stations	*4.2*	*30*	*30*	*30*	*30*	*30*	*30*	*31*	*31*	*31*	*31*	*31*
Wind power stations [7)]	*4.3*	*92*	*110*	*127*	*144*	*162*	*279*	*396*	*513*	*631*	*800*	*870*
On-shore	*4.3.1.*	*92*	*110*	*127*	*144*	*162*	*179*	*196*	*213*	*231*	*300*	*320*

Off-shore	*4.3.2.*	*0*	*0*	*0*	*0*	*0*	*100*	*200*	*300*	*400*	*500*	*550*
Biomass power stations [8)]	*4.4*	*102*	*109*	*117*	*124*	*131*	*138*	*146*	*153*	*160*	*180*	*187*
Biogas power stations [8)]	*4.5*	*66*	*72*	*79*	*85*	*91*	*97*	*103*	*109*	*115*	*140*	*146*
Solar power stations	*4.6*	*20*	*30*	*41*	*51*	*61*	*71*	*82*	*92*	*102*	*120*	*133*

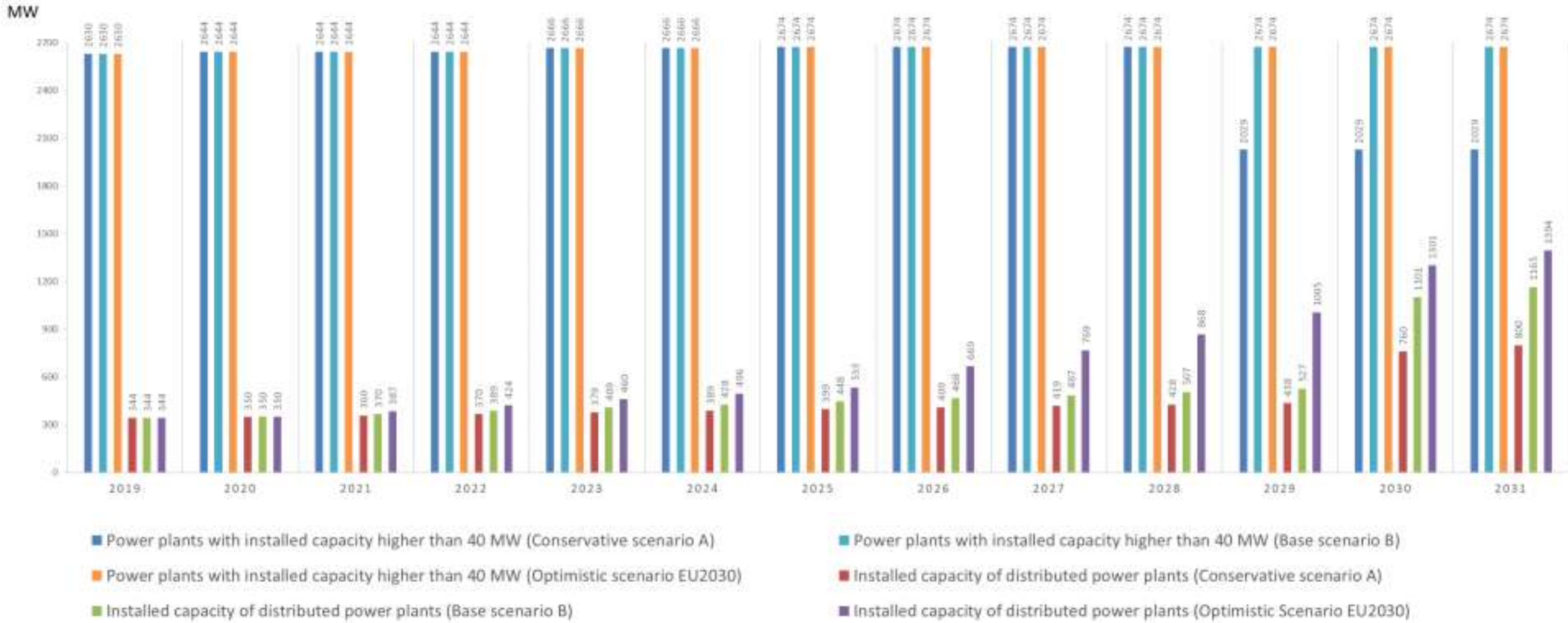

Fig. 3. Development of installed capacities for power plants in different development scenarios, MW (gross)

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

Table 3

Years		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Maximum load	**1**	**1197**	**1230**	**1261**	**1288**	**1315**	**1342**	**1369**	**1397**	**1425**	**1454**	**1480**
Power stations with installed capacity above 40 MW	**2**	**2548**	**2506**	**2528**	**2528**	**2536**	**2536**	**2536**	**2536**	**1981**	**1981**	**1981**
Including: Daugava HPPs	*2.1*	*1550*	*1550*	*1572*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*0*	*0*	*0*
Riga CHP-2	*2.3*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*401*	*401*	*401*
Imanta CHP	*2.4*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**335**	**344**	**353**	**363**	**372**	**382**	**391**	**400**	**410**	**728**	**767**
Including: Natural gas co-generation power stations	*3.1*	*71*	*68*	*66*	*64*	*62*	*59*	*57*	*55*	*53*	*45*	*44*
Hydro power stations	*3.2*	*29*	*29*	*29*	*29*	*29*	*29*	*29*	*29*	*29*	*29*	*29*
Wind power stations	*3.3*	*80*	*86*	*91*	*97*	*103*	*109*	*114*	*120*	*126*	*446*	*475*
Onshore	*3.3.1.*	*80*	*86*	*91*	*97*	*103*	*109*	*114*	*120*	*126*	*149*	*158*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*297*	*317*
Biomass power stations	*3.4*	*89*	*91*	*94*	*97*	*99*	*102*	*104*	*107*	*109*	*109*	*112*
Biogas power stations	*3.5*	*56*	*57*	*59*	*60*	*62*	*63*	*64*	*66*	*67*	*73*	*75*
Solar power stations	*3.6*	*11*	*13*	*14*	*16*	*18*	*20*	*22*	*24*	*26*	*27*	*33*
Available capacities for peak load and reserve guaranteeing	**4**	**1437**	**1397**	**1400**	**1402**	**1405**	**1407**	**1410**	**1413**	**459**	**490**	**498**
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*	*0*	*0*	*0*
Riga CHP-2	*4.03*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*0*	*0*	*0*
Imanta CHP	*4.04*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Natural gas co-generation power stations	*4.05*	*49*	*48*	*46*	*45*	*43*	*42*	*40*	*38*	*37*	*32*	*31*
Hydro power stations	*4.06*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Wind power stations	*4.07*	*8*	*9*	*9*	*10*	*10*	*11*	*11*	*12*	*13*	*45*	*48*
Biomass power stations	*4.08*	*62*	*64*	*66*	*68*	*69*	*71*	*73*	*75*	*77*	*76*	*78*
Biogas power stations	*4.09*	*39*	*40*	*41*	*42*	*43*	*44*	*45*	*46*	*47*	*51*	*52*
Solar power stations	*4.10*	*4*	*5*	*6*	*7*	*7*	*8*	*9*	*10*	*10*	*11*	*13*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**80**	**82**	**85**	**87**	**89**	**0**	**0**	**0**	**0**	**0**	**0**
Total reserve in Latvia[3)]	**7=5+6**	**180**	**182**	**185**	**187**	**314**	**225**	**225**	**225**	**225**	**225**	**225**
Power surplus (+), deficit (-)	**8=4-1**	**60**	**-15**	**-46**	**-73**	**-225**	**-160**	**-184**	**-209**	**-790**	**-787**	**-806**
Power adequacy	**9=4/1**	**105%**	**99%**	**96%**	**94%**	**83%**	**88%**	**87%**	**85%**	**45%**	**46%**	**46%**

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

Table 4

Years		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Maximum load	**1**	**1197**	**1230**	**1261**	**1288**	**1315**	**1342**	**1369**	**1397**	**1425**	**1454**	**1480**
Power stations with installed capacity above 40 MW	**2**	**2548**	**2506**	**2528**	**2528**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**	**2536**
Including: Daugava HPPs	*2.1*	*1550*	*1550*	*1572*	*1572*	*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*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**344**	**363**	**381**	**400**	**418**	**437**	**455**	**474**	**493**	**1058**	**1120**
Including: Natural gas co-generation power stations	*3.1*	*69*	*65*	*62*	*58*	*55*	*51*	*47*	*44*	*40*	*36*	*34*
Hydro power stations	*3.2*	*29*	*29*	*29*	*29*	*29*	*29*	*29*	*29*	*30*	*30*	*30*
Wind power stations	*3.3*	*84*	*93*	*103*	*112*	*122*	*131*	*141*	*150*	*160*	*693*	*738*
Onshore	*3.3.1.*	*84*	*93*	*103*	*112*	*122*	*131*	*141*	*150*	*160*	*198*	*213*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*495*	*525*
Biomass power stations	*3.4*	*91*	*95*	*100*	*104*	*109*	*113*	*118*	*122*	*127*	*136*	*145*
Biogas power stations	*3.5*	*57*	*60*	*63*	*66*	*69*	*71*	*74*	*77*	*80*	*91*	*95*
Solar power stations	*3.6*	*14*	*20*	*25*	*30*	*36*	*41*	*47*	*52*	*57*	*72*	*78*
Available capacities for peak load and reserve guaranteeing	**4**	**1568**	**1532**	**1539**	**1546**	**1552**	**1559**	**1566**	**1572**	**1579**	**1648**	**1663**
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*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Natural gas co-generation power stations	*4.05*	*49*	*48*	*46*	*45*	*43*	*42*	*40*	*38*	*37*	*32*	*31*
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*	*13*	*14*	*15*	*16*	*69*	*74*
Biomass power stations	*4.08*	*64*	*67*	*70*	*73*	*76*	*79*	*82*	*86*	*89*	*95*	*102*
Biogas power stations	*4.09*	*40*	*42*	*44*	*46*	*48*	*50*	*52*	*54*	*56*	*64*	*67*
Solar power stations	*4.10*	*6*	*8*	*10*	*12*	*14*	*16*	*19*	*21*	*23*	*29*	*31*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**80**	**83**	**86**	**89**	**91**	*0*	*0*	*0*	*0*	*0*	*0*
Total reserve in Latvia[3)]	**7=5+6**	**180**	**183**	**186**	**189**	**191**	**225**	**225**	**225**	**225**	**225**	**225**
Power surplus (+), deficit (-)	**8=4-1**	**191**	**120**	**92**	**69**	**-79**	**-8**	**-29**	**-49**	**-71**	**-31**	**-42**
Power adequacy	**9=4/1**	**116%**	**110%**	**107%**	**105%**	**94%**	**99%**	**98%**	**96%**	**95%**	**98%**	**97%**

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

Table 5

Years		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Maximum load	**1**	**1197**	**1230**	**1261**	**1288**	**1315**	**1342**	**1369**	**1397**	**1425**	**1454**	**1480**
Power stations with installed capacity above 40 MW	**2**	**2595**	**2553**	**2575**	**2575**	**2583**	**2583**	**2583**	**2583**	**2583**	**2583**	**2430**
Including: Daugava HPPs	*2.1*	*1550*	*1550*	*1572*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*153*	*0*
Riga CHP-2	*2.3*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*
Imanta CHP	*2.4*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**360**	**395**	**430**	**464**	**498**	**631**	**766**	**899**	**1033**	**1248**	**1317**
Including: Natural gas co-generation power stations	*3.1*	*69*	*65*	*61*	*57*	*53*	*48*	*44*	*41*	*37*	*27*	*25*
Hydro power stations	*3.2*	*29*	*29*	*29*	*29*	*29*	*29*	*30*	*30*	*30*	*30*	*30*
Wind power stations	*3.3*	*91*	*109*	*126*	*143*	*160*	*276*	*392*	*508*	*625*	*792*	*841*
Onshore	*3.3.1.*	*91*	*109*	*126*	*143*	*160*	*177*	*194*	*211*	*228*	*297*	*317*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*99*	*198*	*297*	*396*	*495*	*524*
Biomass power stations	*3.4*	*93*	*100*	*106*	*113*	*119*	*126*	*132*	*139*	*146*	*164*	*170*
Biogas power stations	*3.5*	*60*	*66*	*71*	*77*	*83*	*88*	*94*	*99*	*105*	*127*	*133*
Solar power stations	*3.6*	*18*	*27*	*37*	*46*	*55*	*64*	*74*	*83*	*92*	*108*	*120*
Available capacities for peak load and reserve guaranteeing	**4**	**1624**	**1594**	**1606**	**1619**	**1631**	**1653**	**1676**	**1698**	**1720**	**1766**	**1630**
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*	*0*
Riga CHP-2	*4.03*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*
Imanta CHP	*4.04*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Natural gas co-generation power stations	*4.05*	*49*	*48*	*46*	*45*	*43*	*42*	*40*	*38*	*37*	*32*	*31*
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*	*28*	*39*	*51*	*62*	*79*	*84*
Biomass power stations	*4.08*	*65*	*70*	*74*	*79*	*83*	*88*	*93*	*97*	*102*	*115*	*119*
Biogas power stations	*4.09*	*42*	*46*	*50*	*54*	*58*	*62*	*66*	*70*	*73*	*89*	*93*
Solar power stations	*4.10*	*7*	*11*	*15*	*18*	*22*	*26*	*29*	*33*	*37*	*43*	*48*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**81**	**85**	**88**	**92**	**95**	**0**	**0**	**0**	**0**	**0**	**0**
Total reserve in Latvia[3)]	**7=5+6**	**181**	**185**	**188**	**192**	**195**	**225**	**225**	**225**	**225**	**225**	**225**
Power surplus (+), deficit (-)	**8=4-1**	**246**	**180**	**157**	**139**	**121**	**86**	**81**	**76**	**70**	**88**	**-74**
Power adequacy	**9=4/1**	**121%**	**115%**	**112%**	**111%**	**109%**	**106%**	**106%**	**105%**	**105%**	**106%**	**95%**

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

Scenario A *Table 6*

Years		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Energy demand	**1**	**6961**	**7041**	**7145**	**7220**	**7294**	**7362**	**7394**	**7407**	**7473**	**7535**	**7554**
Output in power stations with installed capacity above 40 MW	**2**	**4565**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**3381**	**3381**	**3381**
Including: Daugava HPPs [1)]	*2.1*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*
Riga CHP-1 [9), 13)]	*2.2*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*0*	*0*	*0*
Riga CHP-2 [9)]	*2.3*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*627*	*627*	*627*
Imanta CHP	*2.4*	*16*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**1446**	**1466**	**1486**	**1506**	**1525**	**1545**	**1565**	**1585**	**1608**	**2385**	**2470**
Including: Natural gas co-generation power stations	*3.1*	*423*	*410*	*396*	*383*	*370*	*356*	*343*	*330*	*316*	*273*	*262*
Hydro power stations	*3.2*	*69*	*69*	*69*	*69*	*69*	*69*	*69*	*69*	*71*	*71*	*71*
Wind power stations	*3.3*	*160*	*171*	*183*	*194*	*206*	*217*	*228*	*240*	*251*	*1040*	*1109*
Onshore	*3.3.1.*	*160*	*171*	*183*	*194*	*206*	*217*	*228*	*240*	*251*	*297*	*317*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*743*	*792*
Biomass power stations	*3.4*	*445*	*457*	*470*	*483*	*496*	*509*	*521*	*534*	*547*	*545*	*559*
Biogas power stations	*3.5*	*347*	*356*	*365*	*373*	*382*	*391*	*399*	*408*	*417*	*451*	*462*
Solar power stations	*3.6*	*2*	*3*	*3*	*3*	*4*	*4*	*4*	*5*	*5*	*5*	*7*
Possible annual export/import	**4=(2+3)-1**	**-950**	**-1026**	**-1110**	**-1166**	**-1220**	**-1268**	**-1280**	**-1273**	**-2484**	**-1769**	**-1704**
Annual adequacy	**5=(2+3)/1**	**86%**	**85%**	**84%**	**84%**	**83%**	**83%**	**83%**	**83%**	**67%**	**77%**	**77%**

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

Scenario B *Table 7*

Years		**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Energy demand	**1**	**7213**	**7333**	**7441**	**7518**	**7595**	**7665**	**7731**	**7797**	**7866**	**7931**	**7980**
Output in power stations with installed capacity above 40 MW	**2**	**4565**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**	**4549**
Including: Daugava HPPs [1)]	*2.1*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*
Riga CHP-1 [9), 13)]	*2.2*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*	*541*
Riga CHP-2 [9)]	*2.3*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*	*1254*
Imanta CHP	*2.4*	*16*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**1499**	**1548**	**1595**	**1643**	**1691**	**1738**	**1786**	**1834**	**1884**	**3280**	**3450**
Including: Natural gas co-generation power stations	*3.1*	*423*	*410*	*396*	*383*	*370*	*356*	*343*	*330*	*316*	*273*	*262*
Hydro power stations	*3.2*	*77*	*77*	*77*	*77*	*77*	*77*	*77*	*77*	*80*	*80*	*80*
Wind power stations	*3.3*	*168*	*187*	*206*	*225*	*244*	*263*	*282*	*301*	*320*	*1634*	*1738*
Onshore	*3.3.1.*	*168*	*187*	*206*	*225*	*244*	*263*	*282*	*301*	*320*	*396*	*426*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1238*	*1312*
Biomass power stations	*3.4*	*454*	*477*	*499*	*521*	*544*	*566*	*588*	*611*	*633*	*682*	*727*
Biogas power stations	*3.5*	*373*	*391*	*409*	*428*	*446*	*464*	*482*	*500*	*518*	*591*	*620*
Solar power stations	*3.6*	*4.3*	*5.9*	*7.5*	*9.1*	*10.7*	*12.4*	*14.0*	*15.6*	*17.2*	*21.6*	*23.5*
Possible annual export/import	**4=(2+3)-1**	**-1149**	**-1237**	**-1297**	**-1327**	**-1355**	**-1377**	**-1396**	**-1414**	**-1433**	**-102**	**19**
Annual adequacy	**5=(2+3)/1**	**84%**	**83%**	**83%**	**82%**	**82%**	**82%**	**82%**	**82%**	**82%**	**99%**	**100%**

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

Scenario EU 2030 *Table 8*

Years		**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Energy demand	**1**	**7379**	**7560**	**7646**	**7725**	**7823**	**7915**	**8005**	**8095**	**8188**	**8279**	**8354**
Output in power stations with installed capacity above 40 MW	**2**	**9836**	**9820**	**9820**	**9820**	**9820**	**9820**	**9820**	**9820**	**9820**	**9820**	**8706**
Including: Daugava HPPs [1)]	*2.1*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*	*2754*
Riga CHP-1 [9), 13)]	*2.2*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*	*1114*	*0*
Riga CHP-2 [9)]	*2.3*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*
Imanta CHP	*2.4*	*16*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**1561**	**1654**	**1748**	**1841**	**2083**	**2269**	**2455**	**2697**	**3053**	**3385**	**3634**
Including: Natural gas co-generation power stations	*3.1*	*423*	*410*	*396*	*383*	*370*	*356*	*343*	*330*	*316*	*273*	*262*
Hydro power stations	*3.2*	*77*	*77*	*77*	*77*	*77*	*77*	*77*	*77*	*80*	*80*	*80*
Wind power stations	*3.3*	*183*	*217*	*251*	*286*	*468*	*595*	*723*	*905*	*1200*	*1337*	*1525*
Onshore	*3.3.1.*	*183*	*217*	*251*	*286*	*320*	*354*	*388*	*423*	*457*	*594*	*634*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*149*	*241*	*334*	*483*	*743*	*743*	*891*
Biomass power stations	*3.4*	*511*	*547*	*583*	*620*	*656*	*692*	*728*	*764*	*800*	*900*	*935*
Biogas power stations	*3.5*	*361*	*395*	*428*	*462*	*495*	*529*	*562*	*596*	*629*	*764*	*796*
Solar power stations	*3.6*	*5.4*	*8.2*	*11.0*	*13.7*	*16.5*	*19.3*	*22.1*	*24.8*	*27.6*	*32.4*	*35.9*
Possible annual export/import	**4=(2+3)-1**	**4018**	**3915**	**3921**	**3936**	**4080**	**4174**	**4270**	**4422**	**4684**	**4926**	**3986**
Annual adequacy	**5=(2+3)/1**	**154%**	**152%**	**151%**	**151%**	**152%**	**153%**	**153%**	**155%**	**157%**	**159%**	**148%**

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 2021. 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	384	42	62	39	49	6	8	0	23	0	766
02:00	153	355	42	62	39	49	6	8	0	13	0	728
03:00	153	330	42	62	39	49	6	8	0	19	0	708
04:00	153	319	42	62	39	49	6	8	0	23	0	702
05:00	153	323	42	62	39	49	6	8	0	30	0	713
06:00	153	354	42	62	39	49	6	8	0	42	0	755
07:00	153	404	42	62	39	49	6	8	0	108	0	871
08:00	153	484	42	62	39	49	6	8	0	171	0	1014
09:00	153	517	42	62	39	49	6	8	0	253	0	1129
10:00	153	548	42	62	39	49	6	8	0	262	0	1170
11:00	153	532	42	62	39	49	6	8	4	270	0	1165
12:00	153	605	42	62	39	49	6	8	4	188	0	1156
13:00	153	583	42	62	39	49	6	8	4	181	0	1127
14:00	153	589	42	62	39	49	6	8	4	188	0	1140
15:00	153	558	42	62	39	49	6	8	4	211	0	1133
16:00	153	557	42	62	39	49	6	8	4	217	0	1137
17:00	153	599	42	62	39	49	6	8	0	239	0	1197
18:00	153	568	42	62	39	49	6	8	0	255	0	1183
19:00	153	544	42	62	39	49	6	8	0	251	0	1154
20:00	153	558	42	62	39	49	6	8	0	195	0	1112
21:00	153	579	42	62	39	49	6	8	0	134	0	1072
22:00	153	535	42	62	39	49	6	8	0	118	0	1012
23:00	153	497	42	62	39	49	6	8	0	74	0	930
00:00	153	440	42	62	39	49	6	8	0	46	0	845

Power demand and possible sources for guaranteeing, hourly values.
Scenario A
Year 2026. 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	510	0	71	44	42	6	11	0	23	0	859
02:00	153	477	0	71	44	42	6	11	0	13	0	816
03:00	153	449	0	71	44	42	6	11	0	19	0	794
04:00	153	437	0	71	44	42	6	11	0	23	0	787
05:00	153	443	0	71	44	42	6	11	0	30	0	799
06:00	153	479	0	71	44	42	6	11	0	42	0	847
07:00	153	543	0	71	44	42	6	11	0	108	0	977
08:00	153	640	0	71	44	42	6	11	0	171	0	1137
09:00	153	688	0	71	44	42	6	11	0	253	0	1266
10:00	153	723	0	71	44	42	6	11	0	262	0	1312
11:00	153	703	0	71	44	42	6	11	8	270	0	1307
12:00	153	775	0	71	44	42	6	11	8	188	0	1297
13:00	153	749	0	71	44	42	6	11	8	181	0	1264
14:00	153	757	0	71	44	42	6	11	8	188	0	1279
15:00	153	725	0	71	44	42	6	11	8	211	0	1271
16:00	153	724	0	71	44	42	6	11	8	217	0	1275
17:00	153	777	0	71	44	42	6	11	0	239	0	1342
18:00	153	745	0	71	44	42	6	11	0	255	0	1326
19:00	153	718	0	71	44	42	6	11	0	251	0	1295
20:00	153	726	0	71	44	42	6	11	0	195	0	1247
21:00	153	743	0	71	44	42	6	11	0	134	0	1203
22:00	153	691	0	71	44	42	6	11	0	118	0	1135
23:00	153	643	0	71	44	42	6	11	0	74	0	1043
00:00	153	575	0	71	44	42	6	11	0	46	0	948

Power demand and possible sources for guaranteeing, hourly values.

Scenario A

Year 2031. January (working day, Wednesday of the third week, peak load)

Table 11

Hour	Riga CHP-1	Riga CHP-2 [11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
01:00	0	401	0	78	52	31	6	48	0	23	309	947
02:00	0	401	0	78	52	31	6	48	0	13	271	900
03:00	0	401	0	78	52	31	6	48	0	19	241	875
04:00	0	401	0	78	52	31	6	48	0	23	229	867
05:00	0	401	0	78	52	31	6	48	0	30	236	881
06:00	0	401	0	78	52	31	6	48	0	42	277	934
07:00	0	401	0	78	52	31	6	48	0	108	354	1077
08:00	0	401	0	78	52	31	6	48	0	171	467	1254
09:00	0	401	0	78	52	31	6	48	0	253	528	1396
10:00	0	401	0	78	52	31	6	48	0	262	568	1446
11:00	0	401	0	78	52	31	6	48	13	270	542	1441
12:00	0	401	0	78	52	31	6	48	13	188	613	1430
13:00	0	401	0	78	52	31	6	48	13	181	584	1394
14:00	0	401	0	78	52	31	6	48	13	188	593	1410
15:00	0	401	0	78	52	31	6	48	13	211	561	1401
16:00	0	401	0	78	52	31	6	48	13	217	560	1406
17:00	0	401	0	78	52	31	6	48	0	239	626	1480
18:00	0	401	0	78	52	31	6	48	0	255	592	1462
19:00	0	401	0	78	52	31	6	48	0	251	561	1427
20:00	0	401	0	78	52	31	6	48	0	195	565	1375
21:00	0	401	0	78	52	31	6	48	0	134	576	1326
22:00	0	401	0	78	52	31	6	48	0	118	518	1251
23:00	0	401	0	78	52	31	6	48	0	74	460	1150
00:00	0	401	0	78	52	31	6	48	0	46	383	1045

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 2021. 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	375	42	64	40	49	6	8	0	30	0	766
02:00	153	349	42	64	40	49	6	8	0	17	0	728
03:00	153	322	42	64	40	49	6	8	0	24	0	708
04:00	153	309	42	64	40	49	6	8	0	30	0	702
05:00	153	312	42	64	40	49	6	8	0	39	0	713
06:00	153	339	42	64	40	49	6	8	0	54	0	755
07:00	153	370	42	64	40	49	6	8	0	140	0	871
08:00	153	431	42	64	40	49	6	8	0	222	0	1014
09:00	153	440	42	64	40	49	6	8	0	328	0	1129
10:00	153	468	42	64	40	49	6	8	0	340	0	1170
11:00	153	448	42	64	40	49	6	8	6	350	0	1165
12:00	153	545	42	64	40	49	6	8	6	244	0	1156
13:00	153	525	42	64	40	49	6	8	6	235	0	1127
14:00	153	529	42	64	40	49	6	8	6	244	0	1140
15:00	153	492	42	64	40	49	6	8	6	274	0	1133
16:00	153	488	42	64	40	49	6	8	6	282	0	1137
17:00	153	525	42	64	40	49	6	8	0	310	0	1197
18:00	153	490	42	64	40	49	6	8	0	331	0	1183
19:00	153	467	42	64	40	49	6	8	0	326	0	1154
20:00	153	498	42	64	40	49	6	8	0	253	0	1112
21:00	153	537	42	64	40	49	6	8	0	174	0	1072
22:00	153	498	42	64	40	49	6	8	0	152	0	1012
23:00	153	472	42	64	40	49	6	8	0	96	0	930
00:00	153	423	42	64	40	49	6	8	0	60	0	845

Power demand and possible sources for guaranteeing, hourly values.
Scenario B
Year 2026. January (working day, Wednesday of the third week, Peak load)

Table 13

Hour	Riga CHP-1	Riga CHP-2[11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
01:00	153	487	0	79	50	42	6	23	0	30	0	859
02:00	153	457	0	79	50	42	6	23	0	17	0	816
03:00	153	427	0	79	50	42	6	23	0	24	0	794
04:00	153	414	0	79	50	42	6	23	0	30	0	787
05:00	153	418	0	79	50	42	6	23	0	39	0	799
06:00	153	451	0	79	50	42	6	23	0	54	0	847
07:00	153	495	0	79	50	42	6	23	0	140	0	977
08:00	153	573	0	79	50	42	6	23	0	222	0	1137
09:00	153	597	0	79	50	42	6	23	0	328	0	1266
10:00	153	629	0	79	50	42	6	23	0	340	0	1312
11:00	153	599	0	79	50	42	6	23	16	350	0	1307
12:00	153	694	0	79	50	42	6	23	16	244	0	1297
13:00	153	671	0	79	50	42	6	23	16	235	0	1264
14:00	153	677	0	79	50	42	6	23	16	244	0	1279
15:00	153	638	0	79	50	42	6	23	16	274	0	1271
16:00	153	635	0	79	50	42	6	23	16	282	0	1275
17:00	153	690	0	79	50	42	6	23	0	310	0	1342
18:00	153	654	0	79	50	42	6	23	0	331	0	1326
19:00	153	627	0	79	50	42	6	23	0	326	0	1295
20:00	153	652	0	79	50	42	6	23	0	253	0	1247
21:00	153	687	0	79	50	42	6	23	0	174	0	1203
22:00	153	640	0	79	50	42	6	23	0	152	0	1135
23:00	153	605	0	79	50	42	6	23	0	96	0	1043
00:00	153	545	0	79	50	42	6	23	0	60	0	948

Power demand and possible sources for guaranteeing, hourly values.

Scenario B

<u>Year 2031. January (working day, Wednesday of the third week, Peak load)</u>

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	486	0	102	67	31	6	74	0	30	0	947
02:00	153	452	0	102	67	31	6	74	0	17	0	900
03:00	153	420	0	102	67	31	6	74	0	24	0	875
04:00	153	406	0	102	67	31	6	74	0	30	0	867
05:00	153	411	0	102	67	31	6	74	0	39	0	881
06:00	153	449	0	102	67	31	6	74	0	54	0	934
07:00	153	506	0	102	67	31	6	74	0	140	0	1077
08:00	153	601	0	102	67	31	6	74	0	222	0	1254
09:00	153	637	0	102	67	31	6	74	0	328	0	1396
10:00	153	675	0	102	67	31	6	74	0	340	0	1446
11:00	153	629	0	102	67	31	6	74	31	350	0	1441
12:00	153	723	0	102	67	31	6	74	31	244	0	1430
13:00	153	696	0	102	67	31	6	74	31	235	0	1394
14:00	153	704	0	102	67	31	6	74	31	244	0	1410
15:00	153	664	0	102	67	31	6	74	31	274	0	1401
16:00	153	662	0	102	67	31	6	74	31	282	0	1406
17:00	153	739	0	102	67	31	6	74	0	310	0	1480
18:00	153	700	0	102	67	31	6	74	0	331	0	1462
19:00	153	671	0	102	67	31	6	74	0	326	0	1427
20:00	153	691	0	102	67	31	6	74	0	253	0	1375
21:00	153	721	0	102	67	31	6	74	0	174	0	1326
22:00	153	667	0	102	67	31	6	74	0	152	0	1251
23:00	153	622	0	102	67	31	6	74	0	96	0	1150
00:00	153	553	0	102	67	31	6	74	0	60	0	1045

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 EU 2030
<u>Year 2021. January (working day, Wednesday of the third week, Peak load)</u>

Table 15

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
01:00	153	366	42	65	42	49	6	9	0	34	0	766
02:00	153	342	42	65	42	49	6	9	0	20	0	728
03:00	153	314	42	65	42	49	6	9	0	27	0	708
04:00	153	301	42	65	42	49	6	9	0	35	0	702
05:00	153	302	42	65	42	49	6	9	0	45	0	713
06:00	153	328	42	65	42	49	6	9	0	62	0	755
07:00	153	345	42	65	42	49	6	9	0	160	0	871
08:00	153	395	42	65	42	49	6	9	0	253	0	1014
09:00	153	389	42	65	42	49	6	9	0	374	0	1129
10:00	153	415	42	65	42	49	6	9	0	389	0	1170
11:00	153	396	42	65	42	49	6	9	4	400	0	1165
12:00	153	508	42	65	42	49	6	9	4	279	0	1156
13:00	153	489	42	65	42	49	6	9	4	268	0	1127
14:00	153	492	42	65	42	49	6	9	4	278	0	1140
15:00	153	450	42	65	42	49	6	9	4	313	0	1133
16:00	153	446	42	65	42	49	6	9	4	322	0	1137
17:00	153	477	42	65	42	49	6	9	0	354	0	1197
18:00	153	439	42	65	42	49	6	9	0	378	0	1183
19:00	153	416	42	65	42	49	6	9	0	372	0	1154
20:00	153	457	42	65	42	49	6	9	0	289	0	1112
21:00	153	508	42	65	42	49	6	9	0	199	0	1072
22:00	153	472	42	65	42	49	6	9	0	174	0	1012
23:00	153	366	42	65	42	49	6	9	0	34	0	930
00:00	153	342	42	65	42	49	6	9	0	20	0	845

Power demand and possible sources for guaranteeing, hourly values.
Scenario EU 2030
Year 2026. 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	448	0	88	62	42	6	28	0	34	0	859
02:00	153	419	0	88	62	42	6	28	0	20	0	816
03:00	153	389	0	88	62	42	6	28	0	27	0	794
04:00	153	375	0	88	62	42	6	28	0	35	0	787
05:00	153	377	0	88	62	42	6	28	0	45	0	799
06:00	153	408	0	88	62	42	6	28	0	62	0	847
07:00	153	440	0	88	62	42	6	28	0	160	0	977
08:00	153	507	0	88	62	42	6	28	0	253	0	1137
09:00	153	515	0	88	62	42	6	28	0	374	0	1266
10:00	153	546	0	88	62	42	6	28	0	389	0	1312
11:00	153	508	0	88	62	42	6	28	22	400	0	1307
12:00	153	619	0	88	62	42	6	28	22	279	0	1297
13:00	153	597	0	88	62	42	6	28	22	268	0	1264
14:00	153	601	0	88	62	42	6	28	22	278	0	1279
15:00	153	558	0	88	62	42	6	28	22	313	0	1271
16:00	153	554	0	88	62	42	6	28	22	322	0	1275
17:00	153	611	0	88	62	42	6	28	0	354	0	1342
18:00	153	571	0	88	62	42	6	28	0	378	0	1326
19:00	153	546	0	88	62	42	6	28	0	372	0	1295
20:00	153	581	0	88	62	42	6	28	0	289	0	1247
21:00	153	627	0	88	62	42	6	28	0	199	0	1203
22:00	153	583	0	88	62	42	6	28	0	174	0	1135
23:00	153	556	0	88	62	42	6	28	0	110	0	1043
00:00	153	502	0	88	62	42	6	28	0	69	0	948

Power demand and possible sources for guaranteeing, hourly values.

Scenario EU 2030

Year 2031. 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	0	581	0	119	93	31	6	84	0	34	0	947
02:00	0	548	0	119	93	31	6	84	0	20	0	900
03:00	0	515	0	119	93	31	6	84	0	27	0	875
04:00	0	500	0	119	93	31	6	84	0	35	0	867
05:00	0	504	0	119	93	31	6	84	0	45	0	881
06:00	0	540	0	119	93	31	6	84	0	62	0	934
07:00	0	585	0	119	93	31	6	84	0	160	0	1077
08:00	0	668	0	119	93	31	6	84	0	253	0	1254
09:00	0	689	0	119	93	31	6	84	0	374	0	1396
10:00	0	725	0	119	93	31	6	84	0	389	0	1446
11:00	0	666	0	119	93	31	6	84	43	400	0	1441
12:00	0	775	0	119	93	31	6	84	43	279	0	1430
13:00	0	750	0	119	93	31	6	84	43	268	0	1394
14:00	0	756	0	119	93	31	6	84	43	278	0	1410
15:00	0	712	0	119	93	31	6	84	43	313	0	1401
16:00	0	709	0	119	93	31	6	84	43	322	0	1406
17:00	0	793	0	119	93	31	6	84	0	354	0	1480
18:00	0	752	0	119	93	31	6	84	0	378	0	1462
19:00	0	723	0	119	93	31	6	84	0	372	0	1427
20:00	0	754	0	119	93	31	6	84	0	289	0	1375
21:00	0	795	0	119	93	31	6	84	0	199	0	1326
22:00	0	745	0	119	93	31	6	84	0	174	0	1251
23:00	0	708	0	119	93	31	6	84	0	110	0	1150
00:00	0	644	0	119	93	31	6	84	0	69	0	1045

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

Scenario A

Year 2021. 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)]	Export	Load
00:00	0	346	0	62	39	49	6	8	0	59	0	569
01:00	0	339	0	62	39	49	6	8	0	40	0	544
02:00	0	327	0	62	39	49	6	8	0	36	0	527
03:00	0	320	0	62	39	49	6	8	0	23	0	507
04:00	0	283	0	62	39	49	6	8	0	23	0	470
05:00	0	283	0	62	39	49	6	8	0	21	0	468
06:00	0	271	0	62	39	49	6	8	0	49	0	484
07:00	0	245	0	62	39	49	6	8	0	110	0	520
08:00	0	219	0	62	39	49	6	8	4	175	0	562
09:00	0	210	0	62	39	49	6	8	4	246	0	625
10:00	0	223	0	62	39	49	6	8	4	268	0	660
11:00	0	234	0	62	39	49	6	8	4	270	0	672
12:00	0	254	0	62	39	49	6	8	4	251	0	674
13:00	0	255	0	62	39	49	6	8	4	241	0	665
14:00	0	250	0	62	39	49	6	8	4	240	0	659
15:00	0	274	0	62	39	49	6	8	4	215	0	658
16:00	0	299	0	62	39	49	6	8	4	191	0	659
17:00	0	335	0	62	39	49	6	8	4	159	0	662
18:00	0	357	0	62	39	49	6	8	4	144	0	670
19:00	0	374	0	62	39	49	6	8	0	135	0	673
20:00	0	376	0	62	39	49	6	8	0	136	0	676
21:00	0	397	0	62	39	49	6	8	0	110	0	671
22:00	0	398	0	62	39	49	6	8	0	89	0	651
23:00	0	384	0	62	39	49	6	8	0	82	0	631

Scenario A
Year 2026. 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)]	Export	Load
00:00	0	475	0	71	44	42	6	11	0	59	0	707
01:00	0	424	0	71	44	42	6	11	0	40	0	638
02:00	0	401	0	71	44	42	6	11	0	36	0	610
03:00	0	394	0	71	44	42	6	11	0	23	0	591
04:00	0	373	0	71	44	42	6	11	0	23	0	569
05:00	0	333	0	71	44	42	6	11	0	21	0	527
06:00	0	303	0	71	44	42	6	11	0	49	0	525
07:00	0	259	0	71	44	42	6	11	0	110	0	543
08:00	0	226	0	71	44	42	6	11	8	175	0	583
09:00	0	203	0	71	44	42	6	11	8	246	0	630
10:00	0	251	0	71	44	42	6	11	8	268	0	701
11:00	0	289	0	71	44	42	6	11	8	270	0	740
12:00	0	321	0	71	44	42	6	11	8	251	0	754
13:00	0	334	0	71	44	42	6	11	8	241	0	756
14:00	0	324	0	71	44	42	6	11	8	240	0	746
15:00	0	343	0	71	44	42	6	11	8	215	0	739
16:00	0	365	0	71	44	42	6	11	8	191	0	738
17:00	0	399	0	71	44	42	6	11	8	159	0	739
18:00	0	417	0	71	44	42	6	11	8	144	0	743
19:00	0	444	0	71	44	42	6	11	0	135	0	752
20:00	0	445	0	71	44	42	6	11	0	136	0	755
21:00	0	475	0	71	44	42	6	11	0	110	0	758
22:00	0	491	0	71	44	42	6	11	0	89	0	753
23:00	0	474	0	71	44	42	6	11	0	82	0	730

Scenario A
Year 2031. 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	401	0	78	52	31	6	48	0	59	106	780
01:00	0	401	0	78	52	31	6	48	0	40	48	704
02:00	0	401	0	78	52	31	6	48	0	36	22	672
03:00	0	401	0	78	52	31	6	48	0	23	13	651
04:00	0	390	0	78	52	31	6	48	0	23	0	627
05:00	0	346	0	78	52	31	6	48	0	21	0	581
06:00	0	316	0	78	52	31	6	48	0	49	0	579
07:00	0	274	0	78	52	31	6	48	0	110	0	599
08:00	0	240	0	78	52	31	6	48	13	175	0	642
09:00	0	221	0	78	52	31	6	48	13	246	0	695
10:00	0	276	0	78	52	31	6	48	13	268	0	772
11:00	0	319	0	78	52	31	6	48	13	270	0	816
12:00	0	352	0	78	52	31	6	48	13	251	0	831
13:00	0	365	0	78	52	31	6	48	13	241	0	834
14:00	0	355	0	78	52	31	6	48	13	240	0	822
15:00	0	372	0	78	52	31	6	48	13	215	0	815
16:00	0	395	0	78	52	31	6	48	13	191	0	814
17:00	0	401	0	78	52	31	6	48	13	159	28	815
18:00	0	401	0	78	52	31	6	48	13	144	46	819
19:00	0	401	0	78	52	31	6	48	0	135	79	829
20:00	0	401	0	78	52	31	6	48	0	136	81	832
21:00	0	401	0	78	52	31	6	48	0	110	111	836
22:00	0	401	0	78	52	31	6	48	0	89	126	830
23:00	0	401	0	78	52	31	6	48	0	82	108	805

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

Scenario B

Year 2021. 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)]	Export	Load
00:00	0	325	0	64	40	49	6	8	0	76	0	569
01:00	0	324	0	64	40	49	6	8	0	52	0	544
02:00	0	313	0	64	40	49	6	8	0	46	0	527
03:00	0	310	0	64	40	49	6	8	0	30	0	507
04:00	0	273	0	64	40	49	6	8	0	30	0	470
05:00	0	273	0	64	40	49	6	8	0	27	0	468
06:00	0	254	0	64	40	49	6	8	0	63	0	484
07:00	0	209	0	64	40	49	6	8	0	143	0	520
08:00	0	170	0	64	40	49	6	8	6	227	7	562
09:00	0	170	0	64	40	49	6	8	6	319	37	625
10:00	0	170	0	64	40	49	6	8	6	348	31	660
11:00	0	170	0	64	40	49	6	8	6	350	21	672
12:00	0	176	0	64	40	49	6	8	6	326	0	674
13:00	0	180	0	64	40	49	6	8	6	312	0	665
14:00	0	175	0	64	40	49	6	8	6	311	0	659
15:00	0	207	0	64	40	49	6	8	6	279	0	658
16:00	0	238	0	64	40	49	6	8	6	248	0	659
17:00	0	284	0	64	40	49	6	8	6	206	0	662
18:00	0	311	0	64	40	49	6	8	6	187	0	670
19:00	0	332	0	64	40	49	6	8	0	174	0	673
20:00	0	333	0	64	40	49	6	8	0	177	0	676
21:00	0	361	0	64	40	49	6	8	0	143	0	671
22:00	0	369	0	64	40	49	6	8	0	115	0	651
23:00	0	357	0	64	40	49	6	8	0	106	0	631

Scenario B
Year 2026. 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)]	Export	Load
00:00	0	441	0	79	50	42	6	13	0	76	0	707
01:00	0	396	0	79	50	42	6	13	0	52	0	638
02:00	0	374	0	79	50	42	6	13	0	46	0	610
03:00	0	371	0	79	50	42	6	13	0	30	0	591
04:00	0	350	0	79	50	42	6	13	0	30	0	569
05:00	0	310	0	79	50	42	6	13	0	27	0	527
06:00	0	272	0	79	50	42	6	13	0	63	0	525
07:00	0	210	0	79	50	42	6	13	0	143	0	543
08:00	0	170	0	79	50	42	6	13	16	227	20	583
09:00	0	170	0	79	50	42	6	13	16	319	65	630
10:00	0	170	0	79	50	42	6	13	16	348	23	701
11:00	0	184	0	79	50	42	6	13	16	350	0	740
12:00	0	222	0	79	50	42	6	13	16	326	0	754
13:00	0	238	0	79	50	42	6	13	16	312	0	756
14:00	0	229	0	79	50	42	6	13	16	311	0	746
15:00	0	254	0	79	50	42	6	13	16	279	0	739
16:00	0	284	0	79	50	42	6	13	16	248	0	738
17:00	0	327	0	79	50	42	6	13	16	206	0	739
18:00	0	350	0	79	50	42	6	13	16	187	0	743
19:00	0	388	0	79	50	42	6	13	0	174	0	752
20:00	0	389	0	79	50	42	6	13	0	177	0	755
21:00	0	426	0	79	50	42	6	13	0	143	0	758
22:00	0	448	0	79	50	42	6	13	0	115	0	753
23:00	0	434	0	79	50	42	6	13	0	106	0	730

Scenario B

Year 2031. June – minimum load

Table 23

Hour	Riga CHP-1	Riga CHP-2[11)]	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Export	Load
00:00	0	425	0	102	67	31	6	74	0	76	0	780
01:00	0	373	0	102	67	31	6	74	0	52	0	704
02:00	0	348	0	102	67	31	6	74	0	46	0	672
03:00	0	343	0	102	67	31	6	74	0	30	0	651
04:00	0	319	0	102	67	31	6	74	0	30	0	627
05:00	0	275	0	102	67	31	6	74	0	27	0	581
06:00	0	237	0	102	67	31	6	74	0	63	0	579
07:00	0	177	0	102	67	31	6	74	0	143	0	599
08:00	0	170	0	102	67	31	6	74	31	227	64	642
09:00	0	170	0	102	67	31	6	74	31	319	104	695
10:00	0	170	0	102	67	31	6	74	31	348	55	772
11:00	0	170	0	102	67	31	6	74	31	350	14	816
12:00	0	196	0	102	67	31	6	74	31	326	0	831
13:00	0	211	0	102	67	31	6	74	31	312	0	834
14:00	0	201	0	102	67	31	6	74	31	311	0	822
15:00	0	226	0	102	67	31	6	74	31	279	0	815
16:00	0	256	0	102	67	31	6	74	31	248	0	814
17:00	0	299	0	102	67	31	6	74	31	206	0	815
18:00	0	322	0	102	67	31	6	74	31	187	0	819
19:00	0	376	0	102	67	31	6	74	0	174	0	829
20:00	0	377	0	102	67	31	6	74	0	177	0	832
21:00	0	415	0	102	67	31	6	74	0	143	0	836
22:00	0	436	0	102	67	31	6	74	0	115	0	830
23:00	0	420	0	102	67	31	6	74	0	106	0	805

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

Scenario EU 2030

<u>Year 2021. June – minimum load</u>

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)]	Export	Load
00:00	0	310	0	65	42	49	6	9	0	87	0	569
01:00	0	313	0	65	42	49	6	9	0	60	0	544
02:00	0	302	0	65	42	49	6	9	0	53	0	527
03:00	0	302	0	65	42	49	6	9	0	34	0	507
04:00	0	265	0	65	42	49	6	9	0	34	0	470
05:00	0	265	0	65	42	49	6	9	0	31	0	468
06:00	0	241	0	65	42	49	6	9	0	72	0	484
07:00	0	185	0	65	42	49	6	9	0	164	0	520
08:00	0	170	0	65	42	49	6	9	7	259	46	562
09:00	0	170	0	65	42	49	6	9	7	364	88	625
10:00	0	170	0	65	42	49	6	9	7	398	86	660
11:00	0	170	0	65	42	49	6	9	7	400	76	672
12:00	0	170	0	65	42	49	6	9	7	372	47	674
13:00	0	170	0	65	42	49	6	9	7	357	40	665
14:00	0	170	0	65	42	49	6	9	7	356	45	659
15:00	0	170	0	65	42	49	6	9	7	318	9	658
16:00	0	197	0	65	42	49	6	9	7	283	0	659
17:00	0	248	0	65	42	49	6	9	7	235	0	662
18:00	0	278	0	65	42	49	6	9	7	213	0	670
19:00	0	302	0	65	42	49	6	9	0	199	0	673
20:00	0	303	0	65	42	49	6	9	0	202	0	676
21:00	0	337	0	65	42	49	6	9	0	163	0	671
22:00	0	348	0	65	42	49	6	9	0	131	0	651
23:00	0	338	0	65	42	49	6	9	0	122	0	631

Scenario EU 2030

Year 2026. 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)]	Export	Load
00:00	0	395	0	88	62	42	6	28	0	87	0	707
01:00	0	354	0	88	62	42	6	28	0	60	0	638
02:00	0	333	0	88	62	42	6	28	0	53	0	610
03:00	0	332	0	88	62	42	6	28	0	34	0	591
04:00	0	311	0	88	62	42	6	28	0	34	0	569
05:00	0	271	0	88	62	42	6	28	0	31	0	527
06:00	0	228	0	88	62	42	6	28	0	72	0	525
07:00	0	170	0	88	62	42	6	28	0	164	15	543
08:00	0	170	0	88	62	42	6	28	28	259	98	583
09:00	0	170	0	88	62	42	6	28	28	364	156	630
10:00	0	170	0	88	62	42	6	28	28	398	119	701
11:00	0	170	0	88	62	42	6	28	28	400	82	740
12:00	0	170	0	88	62	42	6	28	28	372	41	754
13:00	0	170	0	88	62	42	6	28	28	357	23	756
14:00	0	170	0	88	62	42	6	28	28	356	32	746
15:00	0	170	0	88	62	42	6	28	28	318	1	739
16:00	0	202	0	88	62	42	6	28	28	283	0	738
17:00	0	252	0	88	62	42	6	28	28	235	0	739
18:00	0	277	0	88	62	42	6	28	28	213	0	743
19:00	0	328	0	88	62	42	6	28	0	199	0	752
20:00	0	329	0	88	62	42	6	28	0	202	0	755
21:00	0	371	0	88	62	42	6	28	0	163	0	758
22:00	0	397	0	88	62	42	6	28	0	131	0	753
23:00	0	384	0	88	62	42	6	28	0	122	0	730

Scenario EU 2030

Year 2031. 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)]	Export	Load
00:00	0	360	0	119	93	31	6	84	0	87	0	780
01:00	0	312	0	119	93	31	6	84	0	60	0	704
02:00	0	287	0	119	93	31	6	84	0	53	0	672
03:00	0	285	0	119	93	31	6	84	0	34	0	651
04:00	0	261	0	119	93	31	6	84	0	34	0	627
05:00	0	218	0	119	93	31	6	84	0	31	0	581
06:00	0	174	0	119	93	31	6	84	0	72	0	579
07:00	0	170	0	119	93	31	6	84	0	164	67	599
08:00	0	170	0	119	93	31	6	84	48	259	167	642
09:00	0	170	0	119	93	31	6	84	48	364	220	695
10:00	0	170	0	119	93	31	6	84	48	398	175	772
11:00	0	170	0	119	93	31	6	84	48	400	134	816
12:00	0	170	0	119	93	31	6	84	48	372	91	831
13:00	0	170	0	119	93	31	6	84	48	357	73	834
14:00	0	170	0	119	93	31	6	84	48	356	83	822
15:00	0	170	0	119	93	31	6	84	48	318	54	815
16:00	0	170	0	119	93	31	6	84	48	283	20	814
17:00	0	200	0	119	93	31	6	84	48	235	0	815
18:00	0	225	0	119	93	31	6	84	48	213	0	819
19:00	0	297	0	119	93	31	6	84	0	199	0	829
20:00	0	298	0	119	93	31	6	84	0	202	0	832
21:00	0	341	0	119	93	31	6	84	0	163	0	836
22:00	0	366	0	119	93	31	6	84	0	131	0	830
23:00	0	351	0	119	93	31	6	84	0	122	0	805

3.2. Information on energy cross-border trade amounts, comparing year 2020 with 2018 and 2019

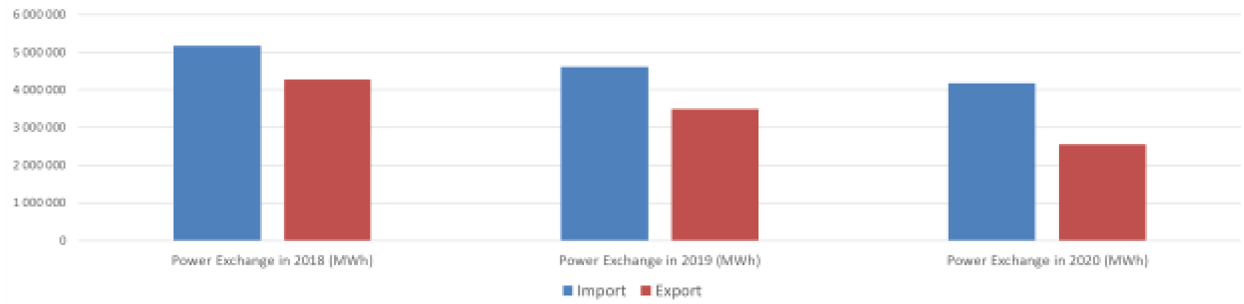

Table 27

	Electricity trade amounts 2018 (MWh)	Electricity trade amounts 2019 (MWh)	Electricity trade amounts 2020 (MWh)
Import	5 173 682	4 610 761	4 173 365
Export	4 264 801	3 492 683	2 547 730

Table 27 shows that in 2020, electricity import, compared to 2018 and 2019 are close to the electricity imports of previous years. Compared to 2018, import has decreased by about 19 %, but compared to 2019, it has decreased by 9 %. Compared to 2018 and 2019, electricity export has decreased by 40 % and 27 %, respectively. In 2019, the Latvian electricity system imported on average the same amount of electricity as a year before, but electricity export from Latvia has significantly decreased. Changes in electricity export amounts are related to the less production of Daugava hydropower plants, restrictions on cross-border capacity, as well as a more resource-rich year in the Nordic countries. The Latvian electricity system has imported 1,625,635 MWh (the difference between import and export) from the electricity systems of neighbouring countries, which covered Latvia's electricity consumption on an annual basis, and this amount is approximately 23% of Latvia's total electricity consumption.

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

The Latvian TSO, as the responsible institution in Latvia for the reliable and stable operation of the electricity system as well as responsible for security of supply under electricity market conditions, is working with Estonia and Lithuania according to the principles of Nordic electricity market "Nord Pool", ensures the trading of market transactions in the Latvian trading area, providing power balance between Latvian consumption and production, and control and publish available interconnection capacities for trade with neighbouring electricity systems. Since the adoption of the European Union (EU) Energy Action Plan 2050, which states that generation development and national power adequacy must be focused on areas with RES potential to stimulate the reduction of CO_2 and other greenhouse gas emissions and the development of more efficient, competitive power plants. The power adequacy within a country is not an evident indicator of the adequacy of base generating capacity, but it must be taken into account together with available transmission capacities to/from the country or region.

In normal operating conditions of the Latvian electricity transmission system, the interconnection transmission capacities with neighbouring electricity systems is sufficient to ensure the forecasted electricity import/export. In previous years, no situations have been identified when it would have been necessary to disconnect any electricity users or regions in Latvia due to insufficient generating capacity or insufficient interconnection capacity with the neighbouring countries. Until now, working synchronously with the Russian unified power system, Latvian TSO has been able to guarantee flows in the Latvian electricity system in all operation conditions, regardless of the amount of generating units operating in the territory of Latvia. At the same time, considering the power adequacy at the national and regional level, the generating capacities in the Latvian electricity system are insufficient to cover the maximum load of the Latvian electricity system and ensure the necessary power reserves in the respective scenarios, as well as to ensure the operation of the Latvian electricity system, especially in emergency situations caused by a capacity reductions in cross-borders with neighbouring countries. Taking into account mentioned above and the further progress of Baltic States synchronization with continental Europe, the TSO considers that the development of sustainable generation and balancing capacities is necessary to ensure the secure operation of the Latvian electricity system.

Analysing the power adequacy for the next years, the Conservative Scenario (A) power (MW) adequacy analysis (Table 3) shows that the generating capacity is insufficient to cover the peak load, provide power reserves and fulfil system regulation requirements for the winter months, during 2022 till 2031. Very slow development of the Latvian electricity system is planned in the Conservative Scenario (A), a slow pace of economic growth, as changes in the state support scheme for RES and co-generation power plants are expected, thus natural gas power plants, including Riga CHP-1 and Riga CHP-2, will be less competitive and less efficient under electricity market conditions.

Based on the possible change or reduction of the state support scheme for RES and co-generation producers, according to the information available in TSO, the electricity production with Imanta CHP has been stoped in the summer 2021. Due to the changes in the State support scheme, the TSO forecasts that one unit of the Riga CHP-2 and the Riga CHP-1 will also be out of operation from 2029. In the Conservative Scenario (A), based on the tendences of generation development, the capacity deficit will reach 1 % in 2022 and 55 % in 2029. Is planned that in 2030 297 MW of the total net capacity of wind power plants could be covered by offshore wind farms, the real development amounts of which are currently difficult to predict, taking into account that no wind power plants have been installed in the territorial waters of Latvia yet.

Due to the slow pace of wind farm development, Conservative Scenario (A) forecasts that the development of off-shore wind farms could be started not earlier than by 2030 (the minimum construction period for wind farms with studies and state permitting is about 4-6 years), when an off-shore wind farm project ELWIND could be implemented partially. During evaluating period (2020-2031), power adequacy ranges are from 45% to 105%, indicating that generating capacity is insufficient to cover electricity consumption, and the electricity deficit increases from 15 MW to 806 MW during evaluating 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 capacities (Daugava HPP, Riga CHP-1, Riga CHP-2, and Imanta CHP). In the Conservative Scenario (A), electricity generation is planned considering that Riga CHP-1, Riga CHP-2 and Imanta CHP are opareting under electricity market conditions, when the such power plans are less efficient and are able to produce only a part of the maximum possible power under during free market competition. The electricity balance table (Table 6) shows that the electricity deficit for the Latvian electricity system in the

Conservative Scenario (A) varies from approximately 950 GWh to 2484 GWh, which will have to be imported via interconnectors to ensure the electricity balance in the system.

In the Base Scenario (B), the power (MW) adequacy analysis table (Table 4) shows that the Latvian electricity system is able to cover the maximum load from 2021 to 2024 and, over the years, the power deficit, starting from 2025 varies from 1 – 5%. Similar to the Conservative Scenario (A), the Base scenario (B) shows that it is important not to lose/reduce the existing Latvian base generation (Daugava HPP, Riga CHP-1, Riga CHP-2 and Imanta CHP) capacities. The Base Scenario (B) assumes that the development of offshore wind farms could start gradually in 2030, and the development of wind farms will be slightly faster than planned in the Conservative Scenario (A). This assumption is based on the fact that the ELWIND wind farm project could be completed in full by the end of 2030, when the installed capacity of the off-shore wind farm would reach 500 MW.

It can be seen from the electricity balance table (Table 7) that in the Base Scenario (B) the supply of electricity will not be sufficient in the period from 2021 to 2030 (82-99%), but after the commissioning of ELWIND offshore project in 2031 electricity supply will exceed 100 %. Till the 2030, Latvia will import electricity from neighbouring countries to ensure the electricity balance, and cross-border transmission capacities will be sufficient to ensure Latvia's electricity balance. In the base scenario (B), it is assumed that Riga CHP-1 and Riga CHP-2 operate according to free electricity market conditions, and electricity production from mentioned power plants is planned according to the development plans submitted by electricity producer Latvenergo AS.

In the Optimistic Scenario (EU 2030), the power (MW) adequacy analysis (Table 5) shows that the Latvian electricity system is able to cover the maximum load from 2021 to 2030 (121% to 106%). Overcapacity throughout the mentioned period shows that it is possible to export electricity to neighbouring power systems to help cover the peak loads of neighbouring countries. The Optimistic Scenario (EU 2030) shows that the development of offshore wind farms could be gradually started from 2026. This assumption is based on the fact that the ELWIND wind farm project could start installing offshore wind turbines from 2026 and the project will be fully implemented by the end of 2030, when the installed capacity of the offshore wind farm will reach 500 MW.

The electrical energy balance table (Table 8) shows that in the Optimistic Scenario (EU 2030) the supply of electricity will be sufficient during the evaluated period (148-159 %), which means that in order to ensure Latvia's electricity balance it will not be necessary to import electricity from neighbouring countries, but Latvia will be able to export electricity to the neighbouring countries. The Optimistic Scenario (EU2030) assumes that the Riga CHP-2 power plant operates in accordance with electricity market conditions and, in order to ensure the security and stable operation of the Latvian electricity system, the system is able to produce the maximum possible amount of electricity, taking into account the power plant's annual repairs and maintenance schedule. In the Optimistic Scenario (EU), by increasing the share of on-shore wind plants in the Latvian electricity system even faster, the need for a regulation reserves will increase. Interconnection capacities will be sufficient to export over electricity to neighbouring electricity systems.

During analysis of the ability to cover the winter daily peak load, the total reserve of the Latvian power system is not included in the evaluation. In the Conservative Scenario (A), is concluded that in 2021 and 2026, 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 load (Tables 9 and 10). In 2031, large electricity import will be necessary, from 229 MW to 626 MW, and interconnection capacities will be sufficient to import the electricity necessary for the Latvian electricity system (Table 11).

In the Base Scenario (B), Latvian TSO will be able to cover the daily peak load in 2021 (Table 12), 2026 (Table 13), and 2031 (Table 14). It is possible to cover 100 % of the daily peak load, because the required total power reserve is not included in the evaluation. In Base Scenario (B), it will be possible to export electricity to neighbouring electricity systems if necessary to help neighbouring countries to cover the peak load during winter months, as interconnection capacities allows to export or import electricity. In the Optimistic Scenario (EU 2030), Latvian TSO will be able to fully cover the daily peak load in 2021 (Table 15), in 2026 (Table 16) and in 2031 (Table 17). It is possible to cover 100% of the daily peak load, because the total power reserves are not included in the tables. The main impacted factors to cover the winter peak load are the water inflow in the Daugava HPP and the development of wind power plants.

To cover the daily minimum load in the summer period in the Conservative Scenario (A) Riga CHP-1 and Imanta CHP are out from operations in 2021 (Table 18), and the power balance is mainly provided by RES – biomass and biogas, wind power plants, Daugava HPPs, small HPPs, solar power plants, and small natural gas co-generation plants, while the regulation is performed by Riga CHP-2. Electricity imports and exports are not planned. The minimum production of Riga CHP-2 is assumed to be 170 MW. In the Conservative Scenario (A) until 2026, biomass and biogas power plants, small HPPs, wind and solar power plants, Daugava HPPs, small natural gas co-generation plants are operated as base power plants and Riga CHP-2 is providing the regulation (Table 19). The minimum production of Riga CHP-2 is assumed to be 170 MW. In such scenario, the forced export of electricity to the neighbouring countries is not planned. In 2031, the Riga CHP-1 and one of the blocks of Riga CHP-2 are stopped due to stop of State support scheme for co-generation. The electricity import will increase and the Latvian electricity system will import from 13 MW to 126 MW (Table 20).

To cover the daily minimum load in the Base Scenario (B) in 2021, Riga CHP-1 and Imanta CHP have been out from the operations (Table 21), and the power balance is mainly provided by RES - biomass and biogas, wind power plants, Daugava HPPs, small HPPs, solar power plants, and small natural gas co-generation plants, and regulation is provided by Riga CHP-2. The minimum output of Riga CHP-2 is assumed to be 170 MW. In such scenario, the electricity export to neighbouring electricity systems will be fom 7 MW to 37 MW. In the base scenario (B) in 2026, biomass and biogas power plants, small HPPs, wind and solar power plants, Daugava HPPs, small natural gas cogeneration plants operate as base power plants and Riga CHP-2 is the regulated generation (Table 22). The minimum output of Riga CHP-2 is assumed to be 170 MW. Forced electricity exports to neighbouring countries is planned from 20 MW to 65 MW. In 2031, the production from base capacity power plants will not change, only due to the increase of peak load in Latvia, the Riga CHP-2 will be operated as the regulated plant and the electricity export will be from 14 MW to 104 MW (see Table 23).

To cover the daily minimum load in the Optimistic Scenario (EU 2030), when the faster development and implementation of RES is planned, in 2021 Riga CHP-1 and Imanta CHP are out from the operations (Table 24), and the electricity balance is mainly provided by RES – biomass and biogas, wind power plants, Daugava HPPs, small HPPs, solar power plants, and small natural gas co-generation plants, and only Riga CHP-2 is providing regulation for power system. The minimum output of Riga CHP-2 is assumed to be 170 MW. Electricity export is planned from 9 MW to 88 MW and the amount of exported electricity will be around 438 MWh.

In the Optimistic Scenario (EU2030) in 2026, biomass and biogas power plants, small HPPs, wind and solar power plants, Daugava HPPs, and small natural gas co-generation plants are operated as base power plants and Riga CHP-2 is regulated power plant (Table 25). The minimum output of Riga CHP-2 is assumed to be 170 MW. Electricity exports will be provided by sufficient interconnection capacities and expected from 1 MW to 156 MW. Approximately 568 MWh of electricity will be exported during the day. In 2031, the base capacity power plants will not be changed (Table 26), but the amount of exported electricity will increase to 1084 MWh. The planned electricity exports will increase to a maximum of 220 MW per day and the interconnection capacities will be sufficient to export over electricity to the neighbouring countries.

By increasing the production of electricity from RES, there are problems with covering the daily minimum and maximum load. At the minimum load, in order to provide the electricity system regulation service, it is necessary to operate highly manoeuvrable gas stations (at their minimum capacity), which then ensures the coverage of the daily load peaks. In this way, in order to ensure the reliability of the system and fulfilment of the electricity balance function, it is necessary to export electricity produced from RES at minimum load to neighbouring countries, but at peak load mode it is necessary to maintain additional gas powered stations, since RES alone cannot cover the daily consumption at the peak load mode. With the development of RES, there is a greater need for a fast regulated power reserve that is able to provide the power balance according to the needs of the daily load. To ensure a fast regulated reserve, the TSO may purchase a service from existing power plants in Latvia, from neighbouring electricity producers or consider installing the necessary equipment (e.g. Battery Energy Storage Systems) in 110 kV or 330 kV substations to provide such service. Information on the required available capacity reserves (MW) and the amount of reserves used (MWh) in 2020 is given in Table 28.

Table 28

Month	Maximum required power reserve	Available power reserve		Realised power reserve
		in Latvia	BRELL agreement up to 12 hours	
	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	236.667
June	440	100	340	450
July	440	100	340	0
August	440	100	340	0
September	440	100	340	25
October	440	100	340	0
November	440	100	340	0
December	440	100	340	61.667

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

Looking at the power adequacy (Table 3), it can be seen that in 2021, in the Conservative Scenario (A), the power self-sufficiency of the Latvian electricity system is approximately 105 %, but with electricity (Table 7) – 86 %. In the Conservative Scenario (A), the largest capacity deficit is expected, because due to changes in State support scheme for RES and co-generation and based on information provided by electricity producers in previous years, the shutdown of Imanta CHP is planned until 2022, as well as shutdown of one unit of Riga CHP-2 after 2028 and shut down of Riga CHP-1, as a result of which the electricity deficit from 2029 increases to 54-55 %. In the Base Scenario (B), the supply of power above 100 % will be from 2021 to 2024, but from 2025 to 2031 the power deficit will increase from 1 to 5%.

Missing electricity to cover the peak load will be imported via interconnectors from neighboring countries. In the Optimistic Scenario (EU 2030), the amount of electricity produced from 2021 to 2031 will be on average 153 %, which indicates that the Latvian electricity system will be able to cover the electricity balance during whole evaluation period. In case of maximum production, the Latvian electricity system will be able to export electricity to the neighboring countries. The power adequacy table shows that in the Optimistic Scenario (EU 2030) there is sufficient capacity in the period from 2021 to 2030. Taking into account the shut down of Riga CHP-1 after 2030, the power deficit by 2031 will be approximately 5 %, or 74 MW. The need for power reserves will increase after 2025 due to expected synchronisation of Baltic States with Continental Europe.

3.5. Development of the Latvian electricity transmission network, taking into account the development of RES and necessary connections to the transmission network

The commissioning of new big capacity power plants in Latvia is not planned until 2031 and, according to the information at the disposal of AS "Augstsprieguma tikls", no decisions have been made on the implementation of 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 policy in Latvia, points out that the National Energy and Climate Plan (NEPP) sets targets for wind energy development by 2030, expecting of development of at least 800 MW of installed wind energy capacities in Latvia.

Based on the above mentioned information, on 18 September 2020, the Governments of Estonia and Latvia jointly signed a Memorandum of Understanding on the development of a joint wind farm project in the Baltic Sea. The joint off-shore wind farm project is planned as a hybrid project, building both an off-shore wind farm and transmission infrastructure together with an interconnection between Estonia and Latvia, which will allow to apply for the status of a regional project and request EU co-financing from the Connecting Europe Facility (CEF) funds. The existing transmission infrastructure will also facilitate the construction of other wind farms in the region, as the grid infrastructure for the common park would allow other potential wind farms to connect to the network in the same region. The installed capacity of the joint Estonian-Latvian wind farm is expected 1000 MW (500 MW for Latvia and 500 MW for Estonia), which is approximately 30 % of the daily peak load of both countries.

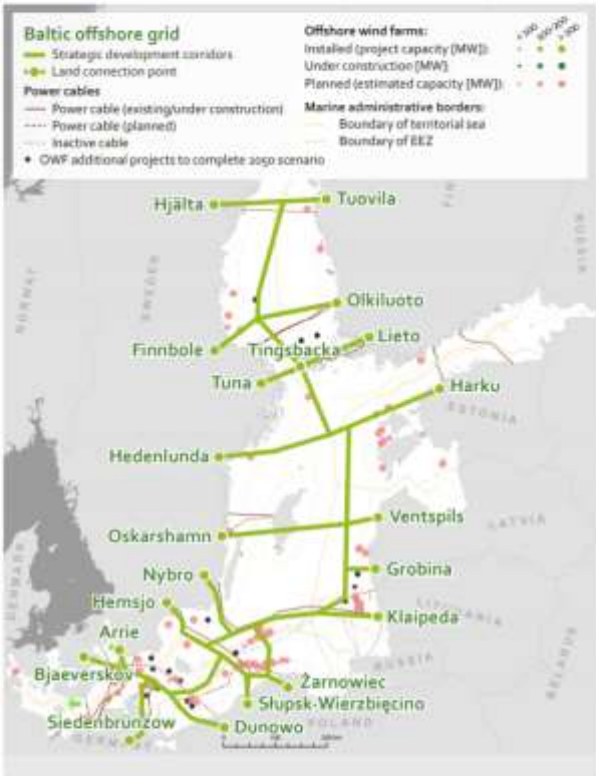

Fig.4 Common Baltic Sea transmission network

In December 2020 ENTSO-E members, TSOs of the Baltic Sea Region from Latvia (AS Augstsprieguma tikls), Estonia (Elering), Lithuania (Litgrid), Finland (Fingrid), Sweden (SvK), Germany (50 Hertz Transmission) and Denmark (Energinet) signed a Memorandum of Understanding on Offshore Wind Farms joint development in the Baltic Sea region. The aim of the Baltic Off shore grid initiative is to promote the development of wind farms in the Baltic Sea and for transmission system operators to cooperate in the development and construction of transmission network infrastructure (see Fig. 4).

The EU has adopted a strategy (COM/2015/080) on a Clean Energy Package, which provides for a certain amount of electricity generated from RES by 2030 and 2050, as a result of which cooperation between neighbouring TSOs is needed to ensure efficient and cost-effective development of the transmission network and establishment of connection points. EU Member States have developed their National Energy Development Plans, which provide development of wind energy production in long-term, so the cooperation must begin immediately, and aim of the document is to facilitate this. The aim of the initiative is to promote in parallel the construction of interconnectors, which will ensure the transmission of wind energy from production sites to consumption centres and the construction of new interconnectors. The Baltic Sea Offshore Grid Initiative aims to share the information between Member States and build a common transmission network in the Baltic Sea, to develop and improve common principles for the development of the Baltic Sea transmission network, to include projects in the Pan-European Ten Year Network Development Plan and to initiate the study in the Baltic Sea. The development of off-shore wind farms and the development of the transmission network should be economically viable, cost-effective and based on market-oriented solutions.

In 2020, the Latvian government approved the Latvian National Maritime Spatial Plan developed by the Ministry of Environmental Protection and Regional Development, which identifies and fixed potential sites for off-shore wind farms construction, as well as possible connections corridors to the electricity transmission infrastructure. On September 18 2020, the Ministry of Economics of Latvia and the Ministry of Economic Affairs and Communications of Estonia, which are responsible for the energy sector in their respective countries, signed a Memorandum of Understanding (MoU) on the development of a joint offshore wind farm project in the Baltic Sea, developing wind farm areas identified in the Maritime Spatial Plan. The project is named ELWIND. As the project has regional statuss, it is planned to implement it as a hybrid project, creating also additional interconnection between Latvia and Estonia. Taking into account mentioned above, the project is expected to be co-financed from the CEF funds, the rules of granting of which will be known after 2022. On the Estonian side, the Estonian Ministry of Economics and Communications is responsible for the development of the ELWIND wind farm project, while on the Latvian side, the Ministry of Economics and the Latvian Investment and Development Agency (LIAA) are involved in the project.

The Latvian and Estonian transmission system operators AS "Augstsprieguma tikls" and AS Elering respectively are involved as responsible parties for infrastructure development and connections to the electricity transmission network in each country. In 2021, AST and Elering are planning to prepare detailed right-of-way study for possible on-shore and off-shore connections, as well as additional study of off-shore technical catalogue to understand the best technical solution (DC or AC) for connecting wind farms to the transmission network and for the construction of the on-shore transmission. The auction of the wind farm project for a potential investor is planned in 2025-2026, and the implementation of the project itself, together with the construction of infrastructure, is planned at the end of 2030.

Estonia and Lithuania also separately plan to develop large off-shore wind farms in the Baltic States by 2030. According to the Latvian TSO available information, the development of the Saare Wind Energy off-shore wind farm project is planned in Estonia - with installed capacity up to 1,400 MW on the West coast of Estonia near the island of Saaremaa. Lithuania also plans to develop high-capacity off-shore wind farms with an installed capacity of 700 MW by 2030 on the Western shore of the Baltic Sea. The next decade will see a major trend in the development of off-shore wind farms, which will make a significant contribution to reducing the EU's overall CO_2 emissions and mitigating climate change.

Starting from 2020, the interest of development of onshore wind farms in the territory of Latvia has significantly increased. Map of Latvia's regions with technical requirements issued by AST on the development of new on-shore wind generating capacity is shown in Fig.5. At present, AST has issued technical requirements for wind farms developers to the connections of on-shore transmission network in Latvia with a total installed capacity up to 1760 MW. Such RES development and its connection to the electricity transmission network, as well as increase of demand in future, gives signals for TSOs for strong long-term planning and reservation of transmission network capacities, as a result, it is necessary to reinforce Latvia's internal transmission network, develop interconnections with neighbouring electricity systems, provide fast power reserves and sufficient amount of inertia from an operational point of view.

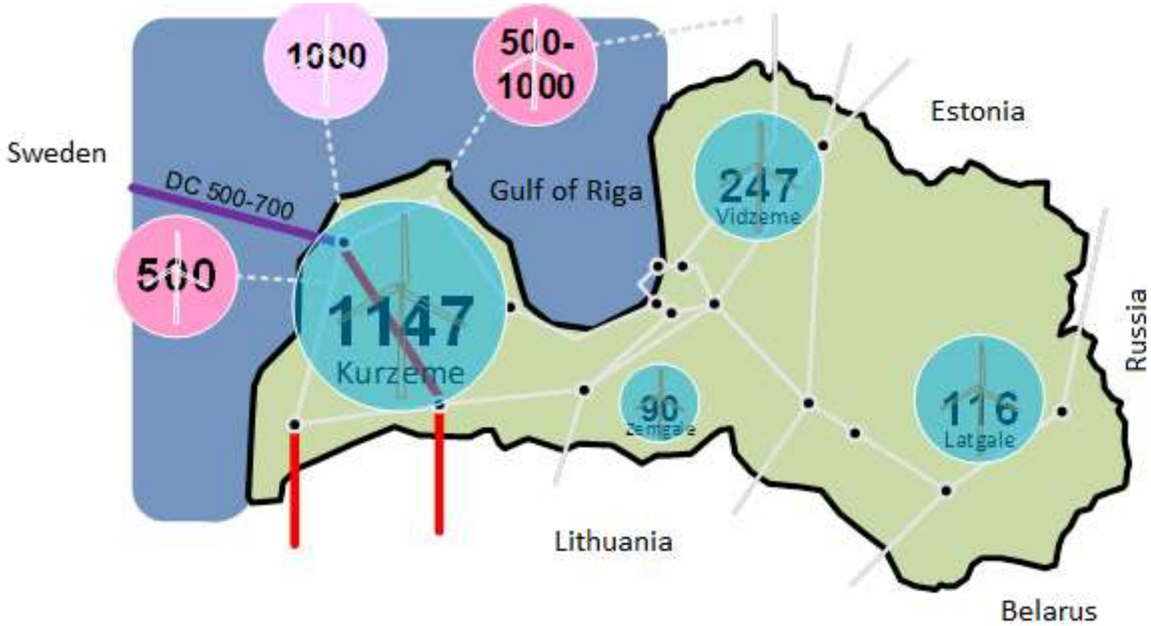

Fig.5 Technical regulations issued by AST for the connection of new wind generating capacity to the transmission network

The development of high-capacity off-shore wind farms, shows necessity and importance to develop interconnections with the electricity systems of neighbouring countries in order to facilitate the EU's goal of integration of the electricity market and ensuring power system security and stability. In this context, since 2014, Latvia is gradually developing the possible construction of a direct current (HVDC) interconnector with Sweden. The preferred implementation time of the project is 2035. The project is included in the European 10-year Development Plan 2020 under the name of LaSGo link, and its capacity between Latvia and Sweden is planned from up to 700 MW. The project has a possibility of EU co-financing receiving in the future for both implementation and more detailed project studies, as well as the preparation of cost-benefit analysis. In connection with the implementation of the ELWIND project, it is necessary to reinforce the Latvian internal transmission network, incl. the existing interconnection Grobiņa (LV) - Darbenai (LT) between Latvia and Lithuania.

3.6. TSO conclusions on electricity generation capacity and availability of electrical energy in the European Union and at regional level

In 2020, the power adequacy at the regional level was assessed in the transmission systems operators association ENTSO-E, where the Latvian TSO AS "Augstsprieguma tikls" is an active member. A Mid-term Adequacy Forecast 2020 (MAF2020) was carried out, which assessed the power adequacy for 2025 and 2030 and replaced the existing power adequacy assessment for the Baltic States and Finland, which has been prepared previously and has been developed only by Baltic and Finnish TSOs. The full Mid-Term Power Adequacy Report is available by the following link: https://eepublicdownloads.entsoe.eu/clean-documents/sdc-documents/MAF/2020/MAF_2020_Executive_Summary.pdf.

A Mid-term Adequacy Forecast report for all European Member States has been developed since 2019. The 2020 version is the latest evaluation report of the EU Member States. The report uses Monte Carlo mathematical probabilistic analysis, which is performed with several market simulations using four market simulators.

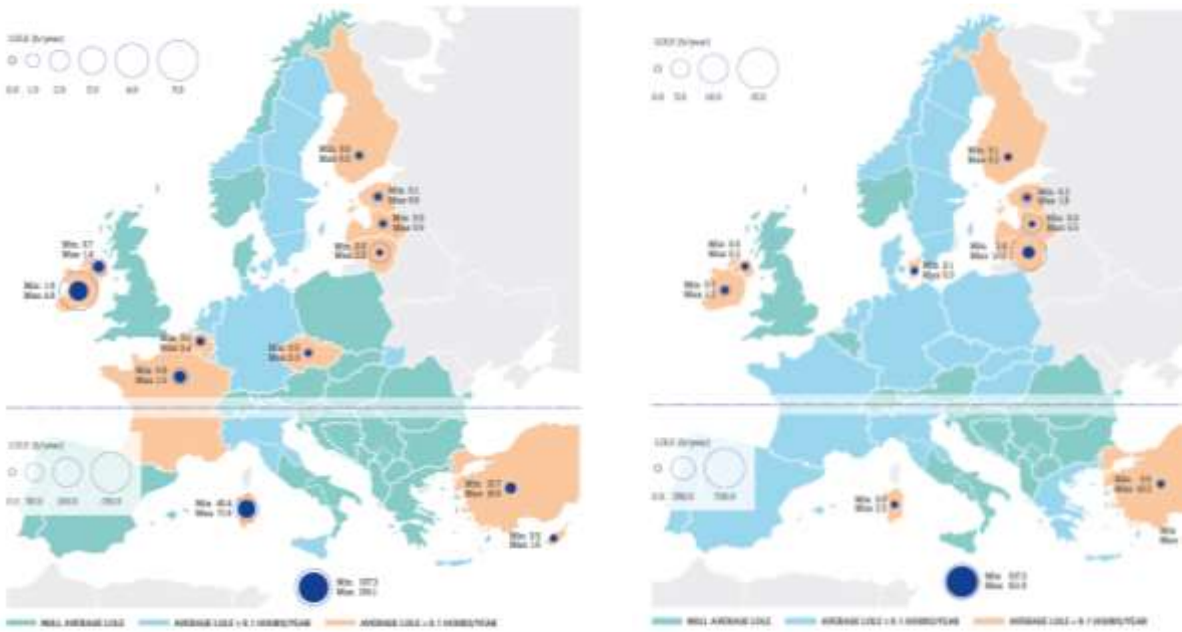

Fig. 6 LOLE values for 2025 and 2030 calculated by ENTSO-E with four different market simulation programs

The power adequacy in the EU for 2025 and 2030 is shown in Figure 6. Power adequacy is characterized by the LOLE *(Loss of Load Expectation)* value, which is calculated for each bidding zone. The values in Fig. 6 on the map are shown for those Member States that are expected to have problems with power adequacy. As a result of market simulations, LOLE (hour/year) values are given in the range from/to, which characterizes the possible power shortage for all simulated scenarios. Fig. 6 shows that the LOLE values for Latvia in 2025 are in the range of 0-0.5 hours/year, which indicates that in 2025 there may be very small issues with the capacity to cover the peak load, but probability of mentioned possibility is quite law. The LOLE value in Latvia is not defined, but the EU guidelines recommend a LOLE value up to 3 hours/year as an acceptable value. Power adequacy problems to cover the load in Latvia are mainly caused by the integrated EU transmission network with the electricity systems of neighbouring countries.

Due to the large deficit of generation capacity in Lithuania and the consistently higher number of hours of undelivered energy (LOLE 0-2 hours/year), neighbouring electricity systems are most affected and there is a risk of undelivered energy as generating capacity would be diverted to the trading area with the largest generation deficit or the highest electricity price. Is expected that in 2030, LOLE values in the Baltic States will increase due to the lack of generating capacity in Lithuania, which results from the interconnection of electricity networks and affects the adequacy of neighbouring countries' electricity systems and capacities in Latvia, Estonia and Finland. Such LOLE values clearly show, that new base generation capacities after 2030 are essential.

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)

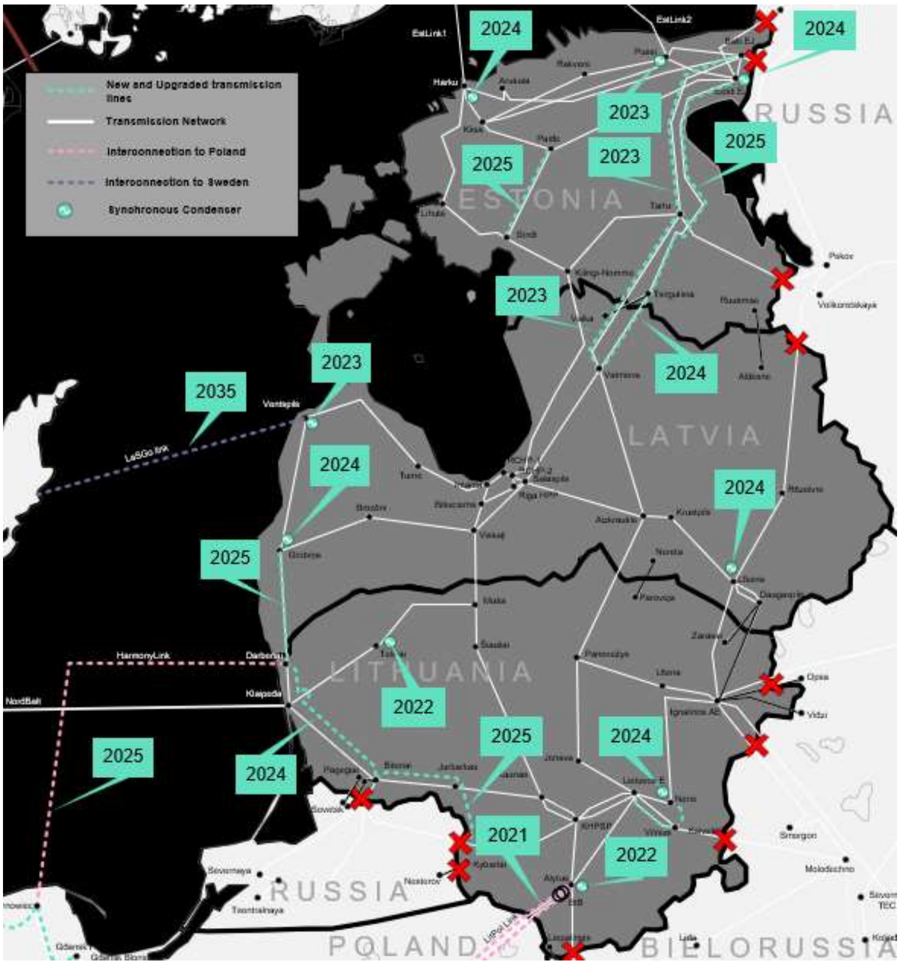

Fig. 7 Baltic projects, in accordance with the development plans of the Baltic TSOs

At present, the cross-capacity of the Latvian-Estonian interconnection has been reduced in various modes of operation of Baltic transmission networks. These restrictions have been enforced by AS Elering (Estonian TSO) on cross-border and internal 330 kV transmission lines. The restrictions are planned to be eliminated by 2025 with reconstruction of the internal 330 kV electricity transmission lines in Estonia under Synchronisation Phase 1 Project. Taking into account the interconnections loading between Baltic States and Nordic countries and Poland, the transmission capacity of the Estonian-Latvian interconnection is not critical and not overloaded in normal operating modes, but in emergency and maintenance modes it still remains limited with significant congestions.

In order to partially eliminate these problems, the third Estonia-Latvia electricity interconnection has been commissioned in August 2021. In order to fully eliminate the Estonian-Latvian cross-border transmission capacity restrictions, during period until 2024, is planned to reconstruct the existing two interconnections between Estonia and Latvia from the 330kV substation Valmiera (Latvia) to 330 kV substations Tartu (Estonia) and Tsirguliina (Estonia). In addition, by 2025, Elering is planning to reconstruct the remaining 330 kV lines for critical sag elimination in the territory of Estonia. This means that the cross-border capacity between Latvia and Estonia 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.

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 in case of planned ELWIND off-shore wind farm project development, when cross-border capacity increase is necessary to transmit big RES generated amount to the Lithuanian electricity system, where big electricity deficit is expected (see outcomes of the MAF-2020 study).

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 Elering, in March 2021, the construction of the Third Estonian-Latvian electrical interconnection between the 330 kV substations Riga CHP-2 in Latvia and Killingi-Nomme in Estonia has been finalised. The project received 65% co-financing from the total eligible costs from Connecting Europe Facility (CEF) funds. The interconnection will increase the available transmission capacity between the Latvian and Estonian electricity systems and eliminate congestion in the Estonian-Latvian cross-border. The third Estonian-Latvian electricity interconnection is considered as one of the most significant projects in the whole Baltic Sea region, and it will increase the cross-border capacity between Estonia-Latvia by 500/600 MW in normal operation modes and up to 300/500 MW in isolated operation mode. The Third Estonian-Latvian electricity interconnection is one of the backbone projects for the future synchronization of the Baltic electricity systems with the networks of Continental Europe. The third Latvian-Estonian interconnection has been officially and solemnly opened on 25 of August 2021 at an opening ceremony in the Killingi-Nomme substation in Estonia (see Fig.8).

Fig. 8 Prime Minister of Latvia Krišjānis Kariņš at the opening ceremony of the Third Estonia-Latvia interconnection in Estonia

4.2.2. Electrical internal transmission line “Riga CHP-2 - Riga HPP”

Co-financed by the European Union
Connecting Europe Facility

On 6th of November, 2020, the construction of the Latvian 330 kV electricity transmission network reinforcement project Riga CHP-2 - Riga HPP has been completed and commissioned. The Riga CHP-2 - Riga HPP electricity transmission line project is the internal reinforcement of the Latvian electricity transmission network, which ensures the full functionality of the Third Estonian-Latvian electricity interconnection in the emergency modes and during unexpected outages in the transmission networks of the Riga region. At the regional level, this network reinforcement will play an important role in increasing North-South electricity transmission capacity in the Baltic region, for internal Baltic network reinforcement after the connection of the Baltic States with Nordic and Polish electricity systems. Taking into account the significance of the project not only for Latvia, but also in the EU level, the project has been constructed with 50% EU co-financing from Connecting Europe Facility (CEF) funds.


Fig. 9. 330 kV electricity transmission line Riga CHP-2 – Riga HPP

4.2.3. Batic States synchronization with continental Europe networks and desynchronization from the Russian Unified Electricity System

Co-financed by the European Union
Connecting Europe Facility

In 2020, 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.**

As part of the synchronization phase 1, it is planned to reinforce the electricity transmission network of the Baltic States, including the installation of equipment that will provide the necessary amount of inertia and frequency regulation and control in synchronization mode with Continental Europe. Under Phase 1, the reconstruction of two existing Latvian- Estonian interconnections Valmiera - Tartu and Valmiera - Tsirguliina, installation of one synchronous condenser, as well as modernization and installation of power control and management automation are identified in the list of technical requirements concluded together "Connection Agreement".

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 works of the existing 330 kV Valmiera - Tartu and Valmiera - Tsirguliina interconnections between Latvia and Estonia is proceeding according to the plan and no significant delays are expected. Reconstruction of both 330 kV lines is combined in one activity (see Fig. 7). Taking into account that under synchronisation Phase 1 project, Estonian TSOs also plans to reconstruct transmission lines to Narva power plants, in order not to reduce transmission capacity to the electricity market, Latvian and Estonian TSOs plan to reconstruct existing lines one by one, according to AST and Elering agreed reconstruction schedules. The procurement procedure for both lines announced in 2020 and on July 2021 procurement has been finalised, and on 16th of July agreement with tender winner – constructor EMPOWER and LEONHARD WEISS has been signed for the reconstruction of both electricity transmission lines. Reconstruction of the Valmiera-Tartui line is planned to start in middle 2022 and to commission in the middle of 2023. The reconstruction of the 330 kV electricity transmission line Valmiera - Tsirguliina project is planned immediately after the reconstruction of the electricity transmission line Valmiera - Tartu with the date of commissioning in the middle of 2024. Both projects are included in the list of Projects of Common Interest under the synchronization cluster, as well as projects are included in all National and European development documents.

Under Synchronisation project Phase 1, it is necessary to create and modernize the electricity control and management systems, IT systems and the telecommunication network by installing power control and management equipment (PMU - Phasor Measurement Units and WAMS - Wide Area Monitoring System) in all the significant network objects. The deadline for the implementation of these measures is 2025, when the synchronization of the Baltic electricity systems with Continental Europe and the desynchronization from the Russian unified power system is expected.

In addition to the frequency control measures, for the secure and stable operation in synchronization mode, the Baltic TSOs should provide a sufficient amount of synchronous inertia for the 24-hour time period. Based on the technical requirements from Catalogue of Measures, Latvia must provide 5700 MWs of inertia during 24 hours per day. Under Baltic Synchronisation Phase 1 project, the installation of one synchronous condenser with approximately 200 MVA capacity is planned for the provision of inertia service, where in 2021 AST announced a public procurement for the technical design and construction of synchronous condensers.

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

Phase 2 of the Baltic Synchronization Project foresees the construction of DC interconnection between Poland and Lithuania (Project "Harmony Link"), the construction of the necessary infrastructure for interconnection connection to the transmission network, reinforcement of the transmission network in Lithuania and Poland for secure and stable operation, installation of synchronous condensers in the Baltic States, as well as installation of frequency control equipment. The Baltic synchronization project is also included in the 4th PCI list and is candidate for 5th PCI list.

In 2020, the activities of the 2nd phase of the project received 75 % of European Co-financing from the Connecting Europe Facility funds for a total amount of 960 million euros. Most of the co-financing - 493 million euros - is planned for the construction of the "Harmony Link" interconnection between Lithuania and Poland. 166.5 millions EUR have been allocated for the installation of synchronous condensers in Estonia, Latvia and Lithuania. The remaining amount is planned for the modernization and construction of the Polish internal transmission network. AST part of synchronization Phase 2 project is related for the construction of two synchronous condensers with total costs of 74 MEUR. The application for support of other activities of the second phase of the synchronization project from CEF is planned to be submitted in October 2021 under CEF call 2021.

Taking into account technical requirements from connection agreement, during synchronisation mode AST will have to participate in frequency regulation activities and provide frequency containment and restoration reserves. As the market for frequency regulation reserves is not developed in the Baltics yet and there is a significant risk that the availability of such reserves will be insufficient, to not delayed the implementation of the synchronization project, AST required to Latvian Regulatory authority (Public Utilities Commission) to allow AST to install Battery Energy Storage Systems for frequency regulation.

The need for the use of such equipment was also confirmed by the joint market study, prepared by TSOs of Latvia, Lithuania and Estonia, which showed that neither Latvia nor the Baltics will be able to provide automatic Frequency Containment Reserves (FCR), Frequency Restoration Reserves (aFRR) and manual Frequency Restoration Reserves (mFRR) with existing capacity resources. The market study concluded that balancing capacity reserves could be provided if the new projects from electricity market participants identified in the public market consultation were implemented. However, it should be noted that most of the new projects proposed in the public consultation from the electricity market participants in the market test are wind and solar generation parks, and they form a significant down-regulation reserve for aFRR in the Baltic States. The availability of reserves from such energy sources cannot be guaranteed due to problems from existing generation resources. Moreover, as shows AST experience, most of the projects, proposed in the market study from market participants are not implemented. Therefore, reliance on the implementation of these projects poses a significant risk to the implementation of the Synchronization project. Taking into account conclusions from the market study, AST considers that there is a significant risk of the necessary reserves for FCR and aFRR are not being available by the end 2025 and AST will not be able to meet on time Baltic synchronisation with Continental Europe in the frame of *Agreement on the condition of the future synchronous interconnection of power system of Baltic states and power system of Continental Europe*.

In order to avoid this risk, AST considers for necessity to install Battery Energy Storage Systems with a usable, actually available total capacity of 80 MW/160 MWh by year 2025. Based on the conclusions of the market test, on 21st September 2021, the Cabinet of Ministers of the Republic of Latvia adopted a decision on granting permission to AST to purchase, develop, install, manage and operate Battery Energy Storage Systems. AST estimates that the provision of this service with this type of equipment is more efficient and less costly than the purchase such services from the existing market participants, as well as with lower operating and maintenance costs.

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 Public Utilities Commission (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, 2021, 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 the station	Installed capacity (MW)
Natural gas co-generation stations – 99.1 MW		
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	Elektro bizness SIA	2.7
7	Mārupes siltumnīcas SIA	1.999
8	Olainfarm enerģija AS	2
9	Olenergo AS	3.12
10	Zaļā dārzniecība SIA	1.999
11	RTU Enerģija SIA	1.56
12	LIEPĀJAS ENERĢIJA, SIA	4
13	Juglas jauda, SIA	14,9
14	RĪGAS SILTUMS AS (SC Imanta)	47.7
15	RĪGAS SILTUMS AS (KM Keramikas 2A)	2.33
16	BALTIC COMMUNICATION NETWORK SIA	1.3
17	B-ENERGO, SIA	1.998
18	BIOSIL, SIA	1.998
19	DAUGAVPILS SILTUMTĪKLI PAS	2.055
20	DIENVIDLATGALES ĪPAŠUMI, SIA	1.998
21	RB VIDZEME	1.998
22	RESIDENCE ENERGY	1.24
Bio-mass, bio-gas stations – 96.4 MW		
1	AD Biogāzes stacija, SIA	1.96
2	Agro Iecava, SIA	1.95
3	Conatus BIOenergy, SIA	1.96
4	Bioenerģija-08, SIA	1.6
5	Biodegviela, SIA	2
6	DAILE AGRO, SIA	1
7	Getliņi EKO, BO SIA	6.5
8	Grow Energy, SIA	1.995
9	LIEPĀJAS RAS, SIA	1.1
10	GRAANUL INVEST, SIA	6.5
11	Liepājas Enerģija, SIA	2.4
12	GAS STREAM SIA	1
13	BIO FUTURE, SIA	1
14	Pampāļi, SIA	1
15	EcoZeta, SIA	1.4
16	Saldus enerģija,SIA	1.8
17	Piejūras Energy, SIA	1.6
18	Agro Lestene, SIA	1.5
19	OŠUKALNS, SIA	1.4
20	EGG Energy SIA	1.996
21	Fortum Jelgava SIA	23,82
22	Agrofirma Tērvete AS	1.5
23	SM Energo SIA	1.1
24	Enefit power un Heat Valka SIA	2.4
25	Betula Premium SIA	1.9
26	Incukalns Energy SIA	3.999
27	Graanul Pellets Energy SIA	3.99
28	PREIĻU SILTUMS SIA	1.15
29	JE Enerģija SIA	1
30	TUKUMS DH SIA	1.705

31	Technological solutions SIA	3.98
32	DJF SIA	1.4
33	EKO NRG SIA	3.380
34	Energia Verde SIA	3.5
35	Rīgas Enerģija SIA	4
36	ENERGY RESOURCES CHP RĒZEKNES SPECIĀLĀS EKONOMISKĀS ZONAS SIA	3.98
37	RIGENS, SIA	1.998
38	Dobeles EKO SIA	3.990
39	RĪGAS SILTUMS AS (SC Ziepniekkalns)	4
40	Baltijas dārzeņi SIA	1.329
41	ZIEDI JP AS	1.998
42	NODEGI ZS	2.4
Wind generation stations – 64.7 MW		
1	Baltnorvent, SIA, Alsungas VES	2
2	BK Enerģija, SIA	1.95
3	Enercom Plus, SIA	1
4	Impakt, SIA Užavas VES	1
5	Lenkas energo, SIA Lenkas VES	2.745
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
20	Vides enerģija SIA	6.9
21	W.E.S. SIA	4.75
22	NBT5 ENERGY	1.75
Hydro power plants – 1.2 MW		
1	Spridzēnu HES, SIA	1.2
Latvenergo power stations – 1717.3 MW		
1	Kegums HPP	248
2	Riga HPP	402
3	Plavinas HPP	908
4	Riga CHP-1	158
5	Riga CHP-2	832/881
6	Aiviekste HPP	1.32

4.5. Action in case of peak demand or shortage of suppliers

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. It is planned to close and de-commission almost 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, as well as the expected development of large wind farms, incl. the ELWIND project, 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.
- 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 needs to develop, install, manage and operate Battery Energy Storage Systems in Latvia.
- 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 tikls”
Chairman of the Board

G. Jēkabsone