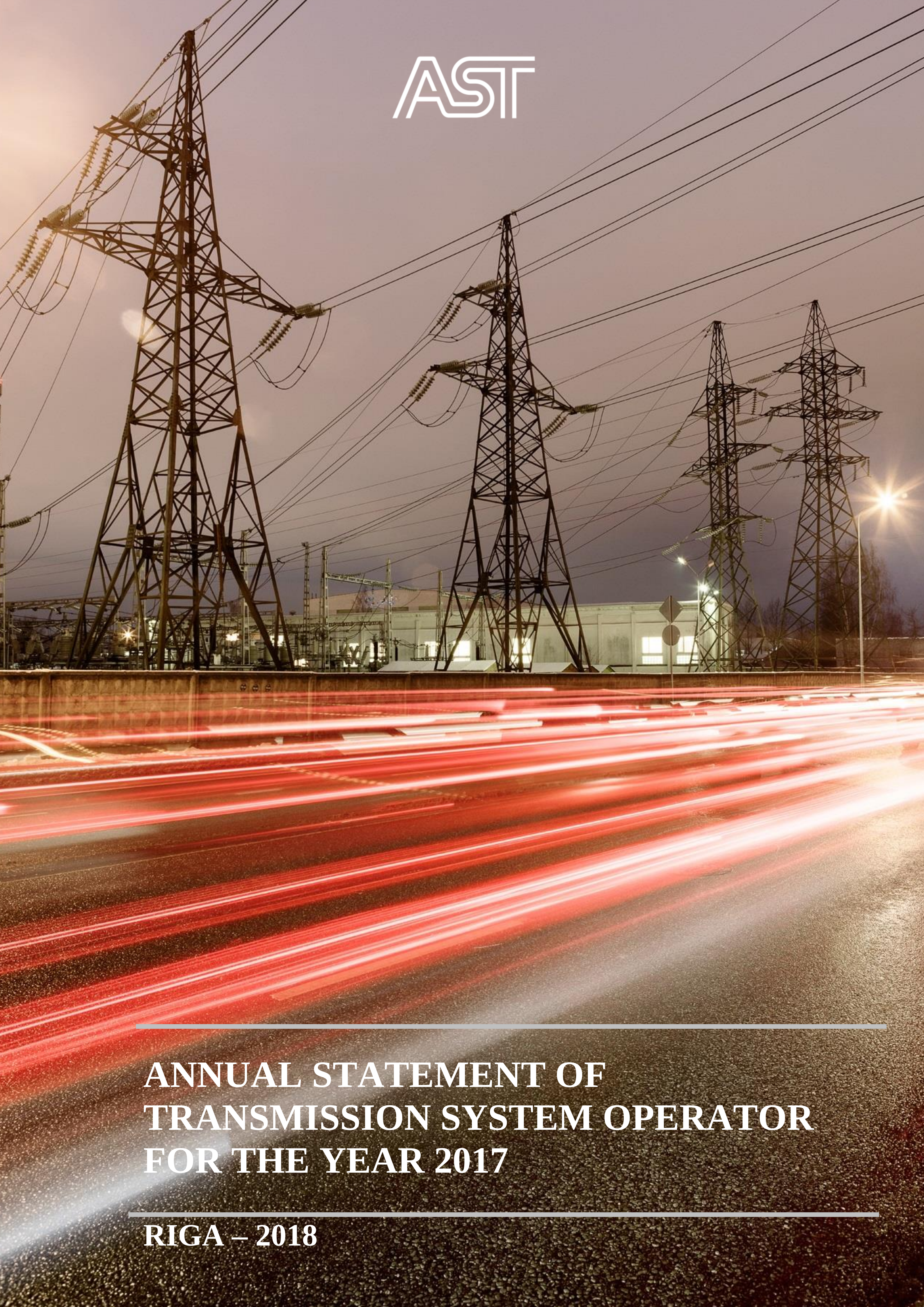

ANNUAL STATEMENT OF TRANSMISSION SYSTEM OPERATOR FOR THE YEAR 2017

RIGA – 2018

SATURS

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

1. Electricity and power demand in the country last year

1.1. Electricity consumption (net) (including losses) by week for year 2017.

Total annual energy consumption including losses equals 7 282 170 MWh.

Table 1

Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Consumption, MWh	161215	162859	158632	156863	156811	165693	156563	152632
Week	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Consumption, MWh	149600	151815	145321	141325	138165	136403	134183	135727
Week	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Consumption, MWh	137974	124791	133359	128822	126695	125635	125732	125954
Week	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Consumption, MWh	116980	121472	120283	121572	122957	125089	127776	129273
Week	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Consumption, MWh	131183	128460	130091	132064	133364	136705	137669	142843
Week	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
Consumption, MWh	143277	143523	148175	149772	148799	149117	150689	154768
Week	**49**	**50**	**51**	**52**	**53**			
Week	155751	156400	154324	137022				

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

Minimum load :	437 MW	25.06.2017	06.00
Maximum load :	1231 MW	05.01.2017	18.00

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

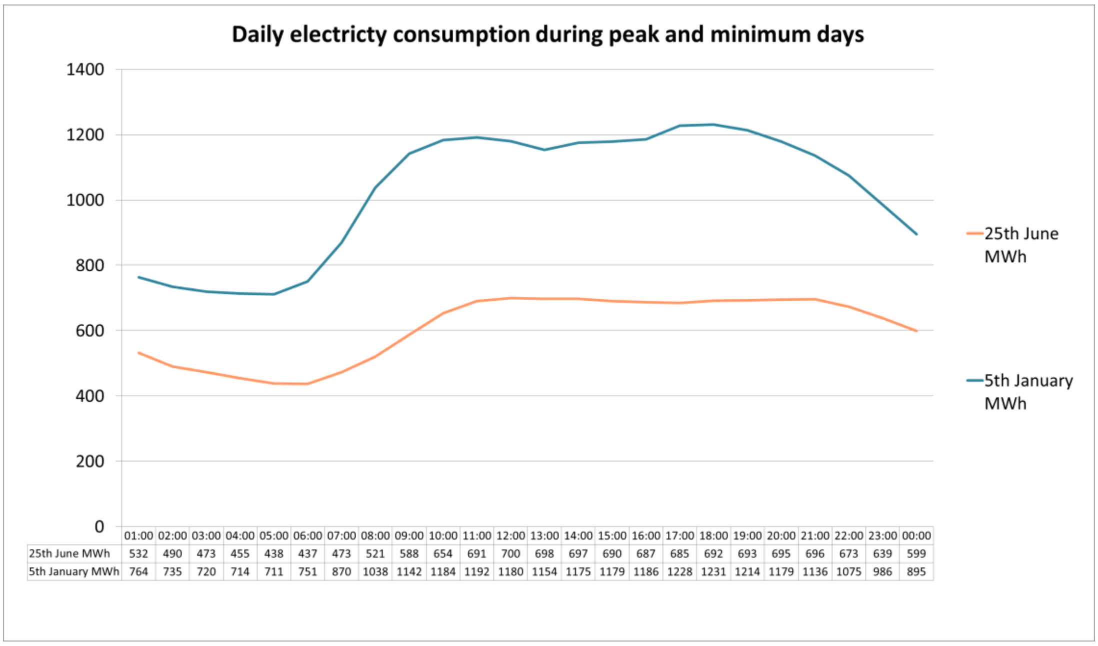

Fig. 1. System load during 24 hours

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

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

Table 2

Year	Annual consumption for Conservative scenario (A)	Annual consumption for Base scenario (B)	Annual consumption for Optimistic scenario (EU2030)	Peak load
	GWh	GWh	GWh	MW
2018	7156	7289	7349	1255
2019	7177	7329	7458	1284
2020	7217	7364	7581	1310
2021	7256	7430	7684	1338
2022	7280	7498	7789	1364
2023	7328	7559	7880	1393
2024	7370	7639	7959	1422
2025	7406	7706	8058	1451
2026	7443	7767	8144	1480
2027	7483	7841	8226	1511
2028	7515	7907	8299	1542

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

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

Electricity and electrical power balances as well as electricity consumption forecast is developed for three scenarios:

A detailed description of the scenarios is following:

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

- **Scenario B "Base scenario"** Electricity system load forecast is based on GDP growth forecast for Latvia, supplied by Ministry of Economics of Latvia, by users of energy sector in Latvia, as well as based on the information on the load and electricity consumption forecast, supplied by distribution system operators. Forecast of generation development takes into account power stations planned for commissioning or de-commissioning based on the information supplied by all power system users to the TSO. In Base scenario (B) production of the Daugava HPP cascade and Riga CHP's is planned based on the annual average production. TSO assumes that in Base scenario Riga CHP-1 after possible change of support scheme for generation will be operated and will participate in covering the maximum peak load. Development of the wind power stations, bio-mass and bio-gas stations, small gas co-generation stations and solar power stations is based on historical development temps data for each type of generation in Latvia at moderate economy development temps in the country.

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

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

Assumptions and explanations for the tables:

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

2) In 2010, a five-party agreement of BRELL ring between the Estonian, Latvian, Lithuanian, Russian and Belarusian TSO provides for the mutual provision of emergency reserves from the beginning of the realization and up to 12 hours. Emergency reserve for Latvia provides BRELL five-party agreement on common emergency reserve maintenance for each of the parties involved, maintaining 100 MW each, which consists of the sum of 500 MW. Taking into consideration the largest generating unit load in Latvia, Latvian power system needs of the emergency reserve is ensured according to the maximum generating units planned load, i.e. up to 440 MW (Riga CHP-2 largest unit). The available power reserves in Latvia is 100 MW, and other missing power amount 340 MW from neighboring power systems can be received only 12 hours.

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

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

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

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

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

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

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

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

11) For conservative scenario (A) it is assumed that Riga CHP-2 can operate in co-generation mode only, when its output power reaches 803 MW net. In Base scenario (B) and Optimistic scenario (EU 2030) it is assumed that Riga CHP-2 maximum net production can reach up to 850 MW with power plant operating in condensation mode.

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

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

Installed capacities (gross) of power stations, MW

Table 3

Years		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Power stations with installed capacity above 40 MW [6)]	**1**	**2609**	**2630**	**2630**	**2652**	**2660**	**2660**	**2660**	**2660**	**2660**	**2660**	**2660**
Including: Daugava HPPs	*1.1*	*1536*	*1558*	*1558*	*1580*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*
Riga CHP-1 [13)]	*1.2*	*144*	*144*	*144*	*0/144*	*0/144*	*0/144*	*0/144*	*0/144*	*0/144*	*0/144*	*0/144*
Riga CHP-2	*1.3*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*	*881*
Imanta CHP [13)]	*1.4*	*48*	*48*	*48*	*48*	*0/48*	*0/48*	*0/48*	*0/48*	*0/48*	*0/48*	*0/48*
Installed capacity of small power stations (conservative scenario A)	**2**	**376**	**383**	**390**	**397**	**404**	**431**	**445**	**459**	**474**	**488**	**502**
Including: Natural gas co-generation stations	*2.1*	*99*	*99*	*98*	*97*	*97*	*96*	*95*	*95*	*94*	*93*	*93*
Hydro power stations	*2.2*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*
Wind power stations [7)]	*2.3*	*78*	*81*	*85*	*88*	*91*	*114*	*125*	*135*	*145*	*156*	*166*
On-shore	*2.3.1.*	*78*	*81*	*85*	*88*	*91*	*94*	*98*	*101*	*104*	*107*	*110*
Off-shore	*2.3.2.*	*0*	*0*	*0*	*0*	*0*	*20*	*27*	*34*	*41*	*49*	*56*
Biomass power stations [8)]	*2.4*	*99*	*100*	*102*	*104*	*105*	*107*	*109*	*110*	*112*	*113*	*115*
Biogas power stations [8]	*2.5*	*68*	*70*	*73*	*75*	*78*	*80*	*83*	*85*	*88*	*90*	*93*
Solar power stations	*2.6*	*2.33*	*2.67*	*3.00*	*3.33*	*3.67*	*4.00*	*4.33*	*4.67*	*5.00*	*5.33*	*5.67*
Installed capacity of small power stations (base scenario B)	**3**	**387**	**405**	**423**	**441**	**459**	**502**	**535**	**568**	**601**	**633**	**666**
Including: Natural gas co-generation stations	*3.1*	*99*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Hydro power stations	*3.2*	*30*	*30*	*31*	*31*	*31*	*31*	*31*	*32*	*32*	*32*	*32*
Wind power stations [7)]	*3.3*	*78*	*92*	*100*	*108*	*117*	*150*	*173*	*197*	*220*	*243*	*267*
On-shore	*3.3.1.*	*78*	*92*	*100*	*108*	*117*	*125*	*133*	*142*	*150*	*158*	*167*
Off-shore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*25*	*40*	*55*	*70*	*85*	*100*
Biomass power stations [8)]	*3.4*	*99*	*103*	*107*	*110*	*113*	*116*	*119*	*123*	*126*	*129*	*132*
Biogas power stations [8]	*3.5*	*68*	*77*	*82*	*88*	*94*	*99*	*105*	*111*	*116*	*122*	*127*
Solar power stations	*3.6*	*2.33*	*3.07*	*3.60*	*4.13*	*4.67*	*5.20*	*5.73*	*6.27*	*6.80*	*7.33*	*7.87*
Installed capacity of small power stations (optimistic scenario EU2030)	**4**	**401**	**433**	**465**	**497**	**560**	**610**	**661**	**712**	**763**	**814**	**865**
Including: Natural gas co-generation stations	*4.1*	*99*	*101*	*102*	*103*	*103*	*104*	*105*	*105*	*106*	*107*	*107*
Hydro power stations	*4.2*	*30*	*31*	*31*	*31*	*32*	*32*	*32*	*33*	*33*	*33*	*34*
Wind power stations [7)]	*4.3*	*78*	*105*	*120*	*135*	*180*	*214*	*248*	*282*	*316*	*349*	*383*
On-shore	*4.3.1.*	*78*	*105*	*120*	*135*	*150*	*165*	*180*	*195*	*210*	*225*	*240*

Off-shore	*4.3.2.*	*0*	*0*	*0*	*0*	*30*	*49*	*68*	*87*	*106*	*124*	*143*
Biomass power stations [8)]	*4.4*	*99*	*109*	*116*	*122*	*128*	*134*	*140*	*147*	*153*	*159*	*165*
Biogas power stations [8)]	*4.5*	*68*	*83*	*92*	*101*	*110*	*119*	*128*	*137*	*146*	*155*	*164*
Solar power stations	*4.6*	*2.33*	*3.73*	*4.60*	*5.47*	*6.33*	*7.20*	*8.07*	*8.93*	*9.80*	*10.67*	*11.53*

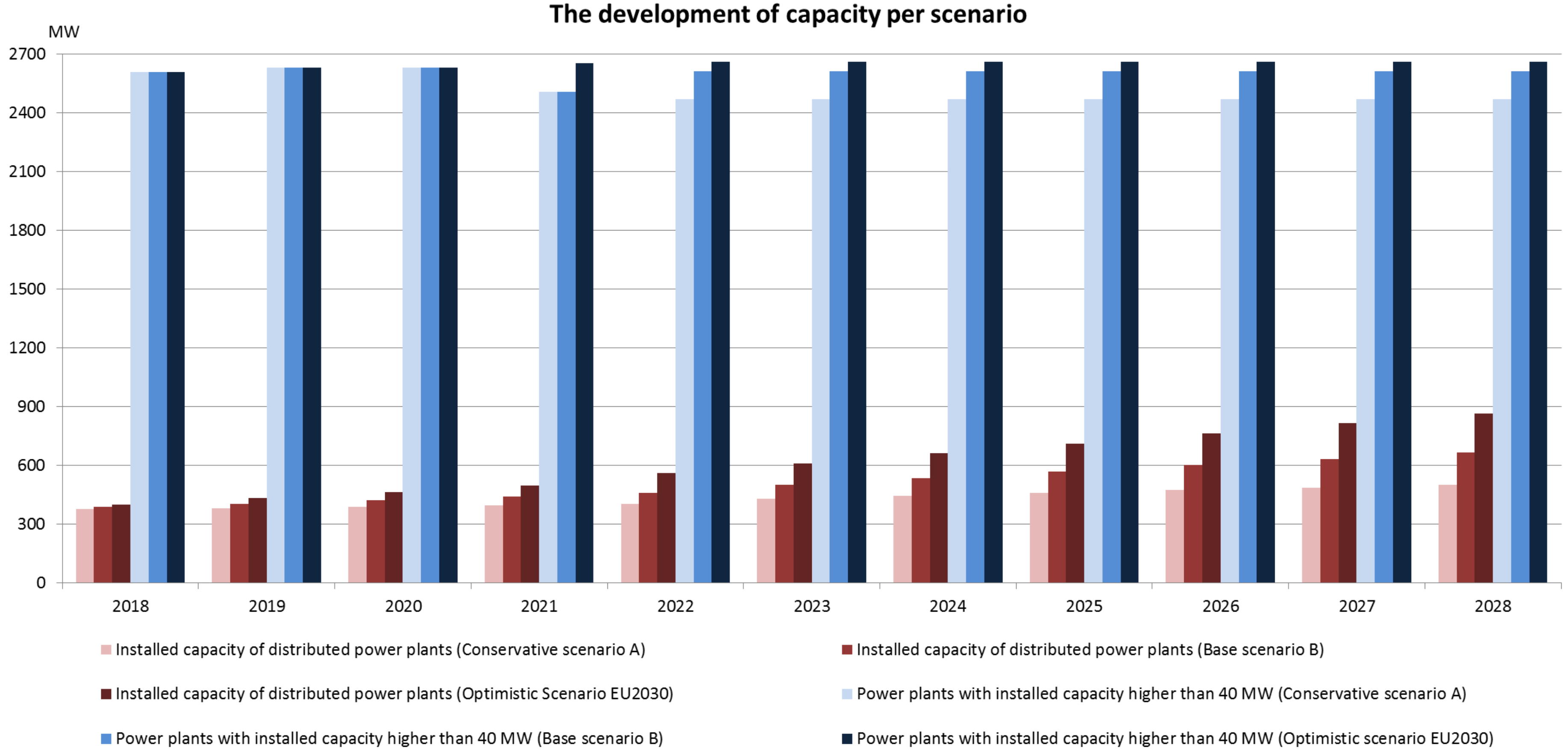

Fig.2. Development of installed capacities in power stations MW (gross) in Latvia for different development scenarios.

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

Table 4

Years		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Maximum load	**1**	**1255**	**1284**	**1310**	**1338**	**1364**	**1393**	**1422**	**1451**	**1480**	**1511**	**1542**
Power stations with installed capacity above 40 MW	**2**	**2513**	**2534**	**2534**	**2417**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**
Including: Daugava HPPs	*2.1*	*1528*	*1550*	*1550*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*139*	*139*	*139*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Riga CHP-2	*2.3*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*
Imanta CHP	*2.4*	*42*	*42*	*42*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**349**	**356**	**363**	**369**	**376**	**402**	**416**	**430**	**444**	**457**	**471**
Including: Natural gas co-generation power stations	*3.1*	*90*	*90*	*89*	*88*	*88*	*87*	*87*	*86*	*85*	*85*	*84*
Hydro power stations	*3.2*	*28*	*28*	*28*	*28*	*28*	*28*	*28*	*28*	*28*	*28*	*28*
Wind power stations	*3.3*	*77*	*81*	*84*	*87*	*90*	*113*	*123*	*134*	*144*	*154*	*164*
Onshore	*3.3.1.*	*77*	*81*	*84*	*87*	*90*	*93*	*97*	*100*	*103*	*106*	*109*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*20*	*27*	*34*	*41*	*48*	*55*
Biomass power stations	*3.4*	*90*	*91*	*93*	*94*	*96*	*97*	*99*	*100*	*102*	*103*	*105*
Biogas power stations	*3.5*	*62*	*64*	*66*	*68*	*71*	*73*	*75*	*77*	*80*	*82*	*84*
Solar power stations	*3.6*	*2.10*	*2.40*	*2.70*	*3.00*	*3.30*	*3.60*	*3.90*	*4.20*	*4.50*	*4.80*	*5.10*
Available capacities for peak load and reserve guaranteeing	**4**	**1438**	**1440**	**1443**	**1307**	**1267**	**1272**	**1275**	**1279**	**1282**	**1285**	**1289**
Including: Daugava HPPs [5)]	*4.01*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*	*270*
Riga CHP-1	*4.02*	*139*	*139*	*139*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Riga CHP-2	*4.03*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*	*803*
Imanta CHP	*4.04*	*42*	*42*	*42*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Natural gas co-generation power stations	*4.05*	*63*	*63*	*62*	*62*	*62*	*61*	*61*	*60*	*60*	*59*	*59*
Hydro power stations	*4.06*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Wind power stations	*4.07*	*8*	*8*	*8*	*9*	*9*	*11*	*12*	*13*	*14*	*15*	*16*
Biomass power stations	*4.08*	*63*	*64*	*65*	*66*	*67*	*68*	*69*	*70*	*71*	*72*	*73*
Biogas power stations	*4.09*	*43*	*45*	*46*	*48*	*50*	*51*	*53*	*54*	*56*	*57*	*59*
Solar power stations	*4.10*	*0.84*	*0.96*	*1.08*	*1.20*	*1.32*	*1.44*	*1.56*	*1.68*	*1.80*	*1.92*	*2.04*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**83**	**85**	**87**	**89**	**91**	**95**	**98**	**100**	**103**	**106**	**109**
Total reserve in Latvia[3)]	**7=5+6**	**183**	**185**	**187**	**189**	**191**	**195**	**198**	**325**	**328**	**331**	**334**
Power surplus (+), deficit (-)	**8=4-1**	**0**	**-29**	**-54**	**-220**	**-288**	**-316**	**-345**	**-497**	**-527**	**-557**	**-587**
Power adequacy	**9=4/1**	**100%**	**98%**	**96%**	**84%**	**79%**	**77%**	**76%**	**66%**	**64%**	**63%**	**62%**

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

Table 5

Years		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Maximum load	**1**	**1255**	**1284**	**1310**	**1338**	**1364**	**1393**	**1422**	**1451**	**1480**	**1511**	**1542**
Power stations with installed capacity above 40 MW	**2**	**2513**	**2534**	**2534**	**2417**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**
Including: Daugava HPPs	*2.1*	*1528*	*1550*	*1550*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*
Riga CHP-2	*2.3*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*
Imanta CHP	*2.4*	*42*	*42*	*42*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**360**	**377**	**394**	**411**	**428**	**470**	**502**	**533**	**565**	**597**	**629**
Including: Natural gas co-generation power stations	*3.1*	*91*	*91*	*91*	*91*	*91*	*91*	*91*	*91*	*91*	*91*	*91*
Hydro power stations	*3.2*	*29*	*29*	*29*	*29*	*30*	*30*	*30*	*30*	*30*	*30*	*31*
Wind power stations	*3.3*	*83*	*91*	*99*	*107*	*116*	*149*	*172*	*195*	*218*	*241*	*264*
Onshore	*3.3.1.*	*83*	*91*	*99*	*107*	*116*	*124*	*132*	*140*	*149*	*157*	*165*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*25*	*40*	*54*	*69*	*84*	*99*
Biomass power stations	*3.4*	*91*	*94*	*97*	*100*	*103*	*106*	*109*	*111*	*114*	*117*	*120*
Biogas power stations	*3.5*	*65*	*70*	*75*	*80*	*85*	*90*	*95*	*101*	*106*	*111*	*116*
Solar power stations	*3.6*	*2.28*	*2.76*	*3.24*	*3.72*	*4.20*	*4.68*	*5.16*	*5.64*	*6.12*	*6.60*	*7.08*
Available capacities for peak load and reserve guaranteeing	**4**	**1568**	**1575**	**1581**	**1587**	**1551**	**1560**	**1568**	**1575**	**1583**	**1591**	**1599**
Including: Daugava HPPs [5)]	*4.01*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*	*350*
Riga CHP-1	*4.02*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*
Riga CHP-2	*4.03*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*
Imanta CHP	*4.04*	*42*	*42*	*42*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Natural gas co-generation power stations	*4.05*	*63*	*63*	*62*	*62*	*62*	*61*	*61*	*60*	*60*	*59*	*59*
Hydro power stations	*4.06*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Wind power stations	*4.07*	*8*	*9*	*10*	*11*	*12*	*15*	*17*	*19*	*22*	*24*	*26*
Biomass power stations	*4.08*	*64*	*66*	*68*	*70*	*72*	*74*	*76*	*78*	*80*	*82*	*84*
Biogas power stations	*4.09*	*45*	*49*	*52*	*56*	*60*	*63*	*67*	*70*	*74*	*78*	*81*
Solar power stations	*4.10*	*0.91*	*1.10*	*1.30*	*1.49*	*1.68*	*1.87*	*2.06*	*2.26*	*2.45*	*2.64*	*2.83*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**84**	**86**	**89**	**91**	**93**	**98**	**102**	**107**	**111**	**115**	**119**
Total reserve in Latvia[3)]	**7=5+6**	**184**	**186**	**189**	**191**	**193**	**198**	**202**	**332**	**336**	**340**	**344**
Power surplus (+), deficit (-)	**8=4-1**	**130**	**105**	**82**	**58**	**-7**	**-32**	**-57**	**-207**	**-233**	**-260**	**-287**
Power adequacy	**9=4/1**	**110%**	**108%**	**106%**	**104%**	**100%**	**98%**	**96%**	**86%**	**84%**	**83%**	**81%**

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

Table 6

Years		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Maximum load	**1**	**1255**	**1284**	**1310**	**1338**	**1364**	**1393**	**1422**	**1451**	**1480**	**1511**	**1542**
Power stations with installed capacity above 40 MW	**2**	**2513**	**2534**	**2534**	**2417**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**	**2383**
Including: Daugava HPPs	*2.1*	*1528*	*1550*	*1550*	*1572*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*	*1580*
Riga CHP-1	*2.2*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*
Riga CHP-2	*2.3*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*
Imanta CHP	*2.4*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*
Small power stations	**3**	**373**	**402**	**432**	**462**	**521**	**569**	**618**	**666**	**714**	**763**	**811**
Including: Natural gas co-generation power stations	*3.1*	*91*	*91*	*91*	*91*	*91*	*91*	*91*	*91*	*91*	*91*	*91*
Hydro power stations	*3.2*	*29*	*29*	*29*	*29*	*30*	*30*	*30*	*30*	*30*	*30*	*31*
Wind power stations	*3.3*	*89*	*104*	*119*	*134*	*178*	*212*	*245*	*279*	*312*	*346*	*380*
Onshore	*3.3.1.*	*89*	*104*	*119*	*134*	*149*	*163*	*178*	*193*	*208*	*223*	*238*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*30*	*48*	*67*	*86*	*105*	*123*	*142*
Biomass power stations	*3.4*	*94*	*99*	*105*	*111*	*116*	*122*	*128*	*133*	*139*	*145*	*150*
Biogas power stations	*3.5*	*68*	*76*	*84*	*92*	*100*	*108*	*117*	*125*	*133*	*141*	*149*
Solar power stations	*3.6*	*2.6*	*3.4*	*4.1*	*4.9*	*5.7*	*6.5*	*7.3*	*8.0*	*8.8*	*9.6*	*10.4*
Available capacities for peak load and reserve guaranteeing	**4**	**1623**	**1634**	**1645**	**1656**	**1670**	**1683**	**1696**	**1709**	**1722**	**1735**	**1748**
Including: Daugava HPPs [5)]	*4.01*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*
Riga CHP-1	*4.02*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*	*139*
Riga CHP-2	*4.03*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*	*850*
Imanta CHP	*4.04*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*	*42*
Natural gas co-generation power stations	*4.05*	*63*	*63*	*62*	*62*	*62*	*61*	*61*	*60*	*60*	*59*	*59*
Hydro power stations	*4.06*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Wind power stations	*4.07*	*9*	*10*	*12*	*13*	*18*	*21*	*25*	*28*	*31*	*35*	*38*
Biomass power stations	*4.08*	*66*	*70*	*74*	*78*	*81*	*85*	*89*	*93*	*97*	*101*	*105*
Biogas power stations	*4.09*	*47*	*53*	*59*	*64*	*70*	*76*	*82*	*87*	*93*	*99*	*104*
Solar power stations	*4.10*	*1.03*	*1.34*	*1.66*	*1.97*	*2.28*	*2.59*	*2.90*	*3.22*	*3.53*	*3.84*	*4.15*
Power system emergency reserve [2)]	**5**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**225**	**225**	**225**	**225**
Power system regulating reserve [4)]	**6**	**84**	**87**	**91**	**94**	**100**	**105**	**110**	**115**	**120**	**125**	**130**
Total reserve in Latvia[3)]	**7=5+6**	**184**	**187**	**191**	**194**	**200**	**205**	**210**	**340**	**345**	**350**	**355**
Power surplus (+), deficit (-)	**8=4-1**	**184**	**163**	**144**	**125**	**106**	**85**	**64**	**-82**	**-103**	**-127**	**-149**
Power adequacy	**9=4/1**	**115%**	**113%**	**111%**	**109%**	**108%**	**106%**	**105%**	**94%**	**93%**	**92%**	**90%**

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

Scenario A

Table 7

Years		**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Energy demand	**1**	**7156**	**7177**	**7217**	**7256**	**7280**	**7328**	**7370**	**7406**	**7443**	**7483**	**7515**
Output in power stations with installed capacity above 40 MW	**2**	**4636**	**4437**	**4437**	**3880**	**3820**	**3820**	**3820**	**3820**	**3820**	**3820**	**3820**
Including: Daugava HPPs [1)]	*2.1*	*2636*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*
Riga CHP-1 [9), 13)]	*2.2*	*483*	*557*	*557*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Riga CHP-2 [9)]	*2.3*	*1457*	*1113*	*1113*	*1113*	*1113*	*1113*	*1113*	*1113*	*1113*	*1113*	*1113*
Imanta CHP	*2.4*	*60*	*60*	*60*	*60*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**1625**	**1650**	**1676**	**1701**	**1726**	**1801**	**1844**	**1887**	**1930**	**1973**	**2016**
Including: Natural gas co-generation power stations	*3.1*	*542*	*538*	*535*	*531*	*527*	*524*	*520*	*516*	*513*	*509*	*505*
Hydro power stations	*3.2*	*78*	*78*	*79*	*79*	*80*	*80*	*81*	*81*	*82*	*82*	*83*
Wind power stations	*3.3*	*155*	*161*	*168*	*174*	*180*	*236*	*260*	*284*	*308*	*332*	*356*
Onshore	*3.3.1.*	*155*	*161*	*168*	*174*	*180*	*187*	*193*	*199*	*206*	*212*	*219*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*50*	*67*	*85*	*103*	*120*	*138*
Biomass power stations	*3.4*	*448*	*456*	*463*	*471*	*478*	*486*	*493*	*501*	*508*	*516*	*523*
Biogas power stations	*3.5*	*401*	*416*	*431*	*445*	*460*	*474*	*489*	*503*	*518*	*533*	*547*
Solar power stations	*3.6*	*0.63*	*0.72*	*0.81*	*0.90*	*0.99*	*1.08*	*1.2*	*1.3*	*1.4*	*1.4*	*1.5*
Possible annual export/import	**4=(2+3)-1**	**-895**	**-1090**	**-1105**	**-1675**	**-1734**	**-1707**	**-1706**	**-1698**	**-1693**	**-1690**	**-1678**
Annual adequacy	**5=(2+3)/1**	**87%**	**85%**	**85%**	**77%**	**76%**	**77%**	**77%**	**77%**	**77%**	**77%**	**78%**

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

Scenario B *Table 8*

Years		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Energy demand	**1**	**7289**	**7329**	**7364**	**7430**	**7498**	**7559**	**7639**	**7706**	**7767**	**7841**	**7907**
Output in power stations with installed capacity above 40 MW	**2**	**4679**	**4824**	**4824**	**4824**	**4764**	**4764**	**4764**	**4764**	**4764**	**4764**	**4764**
Including: Daugava HPPs [1)]	*2.1*	*2636*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*
Riga CHP-1 [9), 13)]	*2.2*	*483*	*557*	*557*	*557*	*557*	*557*	*557*	*557*	*557*	*557*	*557*
Riga CHP-2 [9)]	*2.3*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*	*1500*
Imanta CHP	*2.4*	*60*	*60*	*60*	*60*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Small power stations	**3**	**1661**	**1722**	**1784**	**1845**	**1906**	**2030**	**2128**	**2227**	**2325**	**2424**	**2522**
Including: Natural gas co-generation power stations	*3.1*	*542*	*538*	*535*	*531*	*527*	*524*	*520*	*516*	*513*	*509*	*505*
Hydro power stations	*3.2*	*78*	*78*	*79*	*79*	*80*	*80*	*81*	*81*	*82*	*82*	*83*
Wind power stations	*3.3*	*165*	*182*	*198*	*215*	*231*	*309*	*363*	*417*	*470*	*524*	*578*
Onshore	*3.3.1.*	*165*	*182*	*198*	*215*	*231*	*248*	*264*	*281*	*297*	*314*	*330*
Offshore	*3.3.2.*	*0*	*0*	*0*	*0*	*0*	*62*	*99*	*136*	*173*	*210*	*248*
Biomass power stations	*3.4*	*455*	*470*	*485*	*499*	*514*	*528*	*543*	*557*	*572*	*586*	*601*
Biogas power stations	*3.5*	*420*	*453*	*487*	*520*	*553*	*587*	*620*	*653*	*687*	*720*	*753*
Solar power stations	*3.6*	*0.7*	*0.8*	*1.0*	*1.1*	*1.3*	*1.4*	*1.5*	*1.7*	*1.8*	*2.0*	*2.1*
Possible annual export/import	**4=(2+3)-1**	**-950**	**-783**	**-757**	**-762**	**-828**	**-765**	**-747**	**-716**	**-678**	**-654**	**-621**
Annual adequacy	**5=(2+3)/1**	**87%**	**89%**	**90%**	**90%**	**89%**	**90%**	**90%**	**91%**	**91%**	**92%**	**92%**

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

Scenario EU2030 *Table 9*

Years		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Energy demand	**1**	**7349**	**7458**	**7581**	**7684**	**7789**	**7880**	**7959**	**8058**	**8144**	**8226**	**8299**
Output in power stations with installed capacity above 40 MW	**2**	**9435**	**9506**	**9506**	**9506**	**9506**	**9506**	**9506**	**9506**	**9506**	**9506**	**9506**
Including: Daugava HPPs [1)]	*2.1*	*2636*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*	*2707*
Riga CHP-1 [9), 13)]	*2.2*	*557*	*557*	*557*	*557*	*557*	*557*	*557*	*557*	*557*	*557*	*557*
Riga CHP-2 [9)]	*2.3*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*	*5952*
Imanta CHP	*2.4*	*290*	*290*	*290*	*290*	*290*	*290*	*290*	*290*	*290*	*290*	*290*
Small power stations	**3**	**1720**	**1827**	**1934**	**2085**	**2220**	**2355**	**2490**	**2624**	**2759**	**2894**	**3029**
Including: Natural gas co-generation power stations	*3.1*	*542*	*538*	*535*	*531*	*527*	*524*	*520*	*516*	*513*	*509*	*505*
Hydro power stations	*3.2*	*78*	*78*	*79*	*79*	*80*	*80*	*81*	*81*	*82*	*82*	*83*
Wind power stations	*3.3*	*178*	*208*	*238*	*312*	*370*	*427*	*485*	*543*	*601*	*658*	*716*
Onshore	*3.3.1.*	*178*	*208*	*238*	*267*	*297*	*327*	*356*	*386*	*416*	*446*	*475*
Offshore	*3.3.2.*	*0*	*0*	*0*	*45*	*73*	*101*	*129*	*157*	*185*	*213*	*241*
Biomass power stations	*3.4*	*516*	*547*	*578*	*609*	*640*	*671*	*702*	*733*	*764*	*795*	*826*
Biogas power stations	*3.5*	*406*	*455*	*504*	*553*	*602*	*651*	*700*	*748*	*797*	*846*	*895*
Solar power stations	*3.6*	*0.8*	*1.0*	*1.2*	*1.5*	*1.7*	*1.9*	*2.2*	*2.4*	*2.6*	*2.9*	*3.1*
Possible annual export/import	**4=(2+3)-1**	**3807**	**3875**	**3858**	**3908**	**3937**	**3981**	**4037**	**4072**	**4121**	**4174**	**4236**
Annual adequacy	**5=(2+3)/1**	**152%**	**152%**	**151%**	**151%**	**151%**	**151%**	**151%**	**151%**	**151%**	**151%**	**151%**

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 2018. January (working day, Wednesday of the third week, Peak load)

Table 10

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
01:00	139	417	42	63	43	63	6	8	0	16	0	797
02:00	139	388	42	63	43	63	6	8	0	15	0	767
03:00	139	372	42	63	43	63	6	8	0	15	0	751
04:00	139	355	42	63	43	63	6	8	0	25	0	745
05:00	139	337	42	63	43	63	6	8	0	41	0	742
06:00	139	310	42	63	43	63	6	8	0	109	0	783
07:00	139	357	42	63	43	63	6	8	0	186	0	907
08:00	139	463	42	63	43	63	6	8	0	256	0	1083
09:00	139	569	42	63	43	63	6	8	0	259	0	1191
10:00	139	662	42	63	43	63	6	8	0.84	208	0	1235
11:00	139	718	42	63	43	63	6	8	0.84	160	0	1243
12:00	139	722	42	63	43	63	6	8	0.84	144	0	1231
13:00	139	678	42	63	43	63	6	8	0.84	161	0	1204
14:00	139	667	42	63	43	63	6	8	0.84	194	0	1226
15:00	139	651	42	63	43	63	6	8	0	215	0	1230
16:00	139	629	42	63	43	63	6	8	0	244	0	1237
17:00	139	647	42	63	43	63	6	8	0	270	0	1281
18:00	139	650	42	63	43	63	6	8	0	270	0	1284
19:00	139	632	42	63	43	63	6	8	0	270	0	1266
20:00	139	665	42	63	43	63	6	8	0	201	0	1230
21:00	139	692	42	63	43	63	6	8	0	129	0	1185
22:00	139	649	42	63	43	63	6	8	0	108	0	1121
23:00	139	601	42	63	43	63	6	8	0	64	0	1028
00:00	139	540	42	63	43	63	6	8	0	29	0	933

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

Year 2023. January (working day, Wednesday of the third week, Peak load) *Table 11*

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	652	0	68	51	61	6	11	0	16	0	865
02:00	0	620	0	68	51	61	6	11	0	15	0	832
03:00	0	603	0	68	51	61	6	11	0	15	0	815
04:00	0	586	0	68	51	61	6	11	0	25	0	808
05:00	0	567	0	68	51	61	6	11	0	41	0	805
06:00	0	544	0	68	51	61	6	11	0	109	0	850
07:00	0	602	0	68	51	61	6	11	0	186	0	985
08:00	0	722	0	68	51	61	6	11	0	256	0	1175
09:00	0	803	0	68	51	61	6	11	0	259	34	1293
10:00	0	803	0	68	51	61	6	11	1.44	208	131	1340
11:00	0	803	0	68	51	61	6	11	1.44	160	187	1349
12:00	0	803	0	68	51	61	6	11	1.44	144	190	1336
13:00	0	803	0	68	51	61	6	11	1.44	161	144	1306
14:00	0	803	0	68	51	61	6	11	1.44	194	135	1330
15:00	0	803	0	68	51	61	6	11	0	215	120	1335
16:00	0	803	0	68	51	61	6	11	0	244	98	1342
17:00	0	803	0	68	51	61	6	11	0	270	120	1390
18:00	0	803	0	68	51	61	6	11	0	270	123	1393
19:00	0	803	0	68	51	61	6	11	0	270	104	1374
20:00	0	803	0	68	51	61	6	11	0	201	134	1335
21:00	0	803	0	68	51	61	6	11	0	129	157	1286
22:00	0	803	0	68	51	61	6	11	0	108	109	1217
23:00	0	803	0	68	51	61	6	11	0	64	52	1116
00:00	0	786	0	68	51	61	6	11	0	29	0	1013

Power demand and possible sources for guaranteeing, hourly values.

Scenario A

Year 2028. January (working day, Wednesday of the third week, Peak load) *Table 12*

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	728	0	73	59	59	6	16	0	16	0	957
02:00	0	693	0	73	59	59	6	16	0	15	0	920
03:00	0	674	0	73	59	59	6	16	0	15	0	902
04:00	0	656	0	73	59	59	6	16	0	25	0	894
05:00	0	636	0	73	59	59	6	16	0	41	0	890
06:00	0	618	0	73	59	59	6	16	0	109	0	941
07:00	0	690	0	73	59	59	6	16	0	186	0	1090
08:00	0	803	0	73	59	59	6	16	0	256	28	1300
09:00	0	803	0	73	59	59	6	16	0	259	155	1430
10:00	0	803	0	73	59	59	6	16	2.04	208	257	1483
11:00	0	803	0	73	59	59	6	16	2.04	160	314	1493
12:00	0	803	0	73	59	59	6	16	2.04	144	316	1478
13:00	0	803	0	73	59	59	6	16	2.04	161	266	1445
14:00	0	803	0	73	59	59	6	16	2.04	194	260	1472
15:00	0	803	0	73	59	59	6	16	0	215	246	1477
16:00	0	803	0	73	59	59	6	16	0	244	225	1485
17:00	0	803	0	73	59	59	6	16	0	270	252	1538
18:00	0	803	0	73	59	59	6	16	0	270	255	1542
19:00	0	803	0	73	59	59	6	16	0	270	234	1520
20:00	0	803	0	73	59	59	6	16	0	201	260	1477
21:00	0	803	0	73	59	59	6	16	0	129	278	1423
22:00	0	803	0	73	59	59	6	16	0	108	222	1346
23:00	0	803	0	73	59	59	6	16	0	64	155	1235
00:00	0	803	0	73	59	59	6	16	0	29	75	1121

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 2018. January (working day, Wednesday of the third week, Peak load)

Table 13

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
01:00	139	396	42	64	45	63	6	8	0	34	0	797
02:00	139	379	42	64	45	63	6	8	0	20	0	767
03:00	139	365	42	64	45	63	6	8	0	19	0	751
04:00	139	359	42	64	45	63	6	8	0	19	0	745
05:00	139	342	42	64	45	63	6	8	0	33	0	742
06:00	139	363	42	64	45	63	6	8	0	53	0	783
07:00	139	399	42	64	45	63	6	8	0	141	0	907
08:00	139	474	42	64	45	63	6	8	0	241	0	1083
09:00	139	492	42	64	45	63	6	8	0	332	0	1191
10:00	139	532	42	64	45	63	6	8	0.91	335	0	1235
11:00	139	606	42	64	45	63	6	8	0.91	269	0	1243
12:00	139	655	42	64	45	63	6	8	0.91	208	0	1231
13:00	139	649	42	64	45	63	6	8	0.91	186	0	1204
14:00	139	649	42	64	45	63	6	8	0.91	209	0	1226
15:00	139	612	42	64	45	63	6	8	0	251	0	1230
16:00	139	592	42	64	45	63	6	8	0	278	0	1237
17:00	139	564	42	64	45	63	6	8	0	350	0	1281
18:00	139	567	42	64	45	63	6	8	0	350	0	1284
19:00	139	549	42	64	45	63	6	8	0	350	0	1266
20:00	139	603	42	64	45	63	6	8	0	260	0	1230
21:00	139	651	42	64	45	63	6	8	0	167	0	1185
22:00	139	614	42	64	45	63	6	8	0	140	0	1121
23:00	139	579	42	64	45	63	6	8	0	83	0	1028
00:00	139	528	42	64	45	63	6	8	0	38	0	933

Power demand and possible sources for guaranteeing, hourly values.
Scenario B
Year 2023. January (working day, Wednesday of the third week, Peak load)

Table 14

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
01:00	139	473	0	74	63	61	6	15	0	34	0	865
02:00	139	454	0	74	63	61	6	15	0	20	0	832
03:00	139	438	0	74	63	61	6	15	0	19	0	815
04:00	139	432	0	74	63	61	6	15	0	19	0	808
05:00	139	414	0	74	63	61	6	15	0	33	0	805
06:00	139	439	0	74	63	61	6	15	0	53	0	850
07:00	139	486	0	74	63	61	6	15	0	141	0	985
08:00	139	576	0	74	63	61	6	15	0	241	0	1175
09:00	139	603	0	74	63	61	6	15	0	332	0	1293
10:00	139	645	0	74	63	61	6	15	1.87	335	0	1340
11:00	139	720	0	74	63	61	6	15	1.87	269	0	1349
12:00	139	768	0	74	63	61	6	15	1.87	208	0	1336
13:00	139	760	0	74	63	61	6	15	1.87	186	0	1306
14:00	139	762	0	74	63	61	6	15	1.87	209	0	1330
15:00	139	726	0	74	63	61	6	15	0	251	0	1335
16:00	139	707	0	74	63	61	6	15	0	278	0	1342
17:00	139	682	0	74	63	61	6	15	0	350	0	1390
18:00	139	686	0	74	63	61	6	15	0	350	0	1393
19:00	139	666	0	74	63	61	6	15	0	350	0	1374
20:00	139	717	0	74	63	61	6	15	0	260	0	1335
21:00	139	761	0	74	63	61	6	15	0	167	0	1286
22:00	139	719	0	74	63	61	6	15	0	140	0	1217
23:00	139	676	0	74	63	61	6	15	0	83	0	1116
00:00	139	617	0	74	63	61	6	15	0	38	0	1013

Power demand and possible sources for guaranteeing, hourly values.

Scenario B

Year 2028. January (working day, Wednesday of the third week, Peak load) *Table 15*

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
01:00	139	528	0	84	81	59	6	26	0	34	0	957
02:00	139	505	0	84	81	59	6	26	0	20	0	920
03:00	139	487	0	84	81	59	6	26	0	19	0	902
04:00	139	480	0	84	81	59	6	26	0	19	0	894
05:00	139	462	0	84	81	59	6	26	0	33	0	890
06:00	139	492	0	84	81	59	6	26	0	53	0	941
07:00	139	553	0	84	81	59	6	26	0	141	0	1090
08:00	139	663	0	84	81	59	6	26	0	241	0	1300
09:00	139	703	0	84	81	59	6	26	0	332	0	1430
10:00	139	749	0	84	81	59	6	26	2.83	335	0	1483
11:00	139	825	0	84	81	59	6	26	2.83	269	0	1493
12:00	139	850	0	84	81	59	6	26	2.83	230	0	1478
13:00	139	850	0	84	81	59	6	26	2.83	197	0	1445
14:00	139	850	0	84	81	59	6	26	2.83	224	0	1472
15:00	139	830	0	84	81	59	6	26	0	251	0	1477
16:00	139	812	0	84	81	59	6	26	0	278	0	1485
17:00	139	830	0	84	81	59	6	26	0	313	0	1538
18:00	139	817	0	84	81	59	6	26	0	329	0	1542
19:00	139	775	0	84	81	59	6	26	0	350	0	1520
20:00	139	821	0	84	81	59	6	26	0	260	0	1477
21:00	139	850	0	84	81	59	6	26	0	177	0	1423
22:00	139	811	0	84	81	59	6	26	0	140	0	1346
23:00	139	757	0	84	81	59	6	26	0	83	0	1235
00:00	139	687	0	84	81	59	6	26	0	38	0	1121

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

Power demand and possible sources for guaranteeing, hourly values.
Scenario EU2030
Year 2018. 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	139	386	42	66	47	63	6	9	0	39	0	797
02:00	139	372	42	66	47	63	6	9	0	23	0	767
03:00	139	357	42	66	47	63	6	9	0	22	0	751
04:00	139	351	42	66	47	63	6	9	0	22	0	745
05:00	139	332	42	66	47	63	6	9	0	38	0	742
06:00	139	351	42	66	47	63	6	9	0	61	0	783
07:00	139	374	42	66	47	63	6	9	0	161	0	907
08:00	139	435	42	66	47	63	6	9	0	276	0	1083
09:00	139	440	42	66	47	63	6	9	0	379	0	1191
10:00	139	479	42	66	47	63	6	9	1.03	383	0	1235
11:00	139	563	42	66	47	63	6	9	1.03	308	0	1243
12:00	139	620	42	66	47	63	6	9	1.03	238	0	1231
13:00	139	618	42	66	47	63	6	9	1.03	213	0	1204
14:00	139	614	42	66	47	63	6	9	1.03	239	0	1226
15:00	139	571	42	66	47	63	6	9	0	287	0	1230
16:00	139	547	42	66	47	63	6	9	0	318	0	1237
17:00	139	509	42	66	47	63	6	9	0	400	0	1281
18:00	139	512	42	66	47	63	6	9	0	400	0	1284
19:00	139	494	42	66	47	63	6	9	0	400	0	1266
20:00	139	561	42	66	47	63	6	9	0	297	0	1230
21:00	139	622	42	66	47	63	6	9	0	191	0	1185
22:00	139	590	42	66	47	63	6	9	0	160	0	1121
23:00	139	562	42	66	47	63	6	9	0	94	0	1028
00:00	139	518	42	66	47	63	6	9	0	44	0	933

Power demand and possible sources for guaranteeing, hourly values.
Scenario EU 2030
Year 2023. 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	139	396	42	85	76	61	6	21	0	39	0	865
02:00	139	379	42	85	76	61	6	21	0	23	0	832
03:00	139	363	42	85	76	61	6	21	0	22	0	815
04:00	139	356	42	85	76	61	6	21	0	22	0	808
05:00	139	337	42	85	76	61	6	21	0	38	0	805
06:00	139	359	42	85	76	61	6	21	0	61	0	850
07:00	139	393	42	85	76	61	6	21	0	161	0	985
08:00	139	469	42	85	76	61	6	21	0	276	0	1175
09:00	139	483	42	85	76	61	6	21	0	379	0	1293
10:00	139	524	42	85	76	61	6	21	2.59	383	0	1340
11:00	139	609	42	85	76	61	6	21	2.59	308	0	1349
12:00	139	665	42	85	76	61	6	21	2.59	238	0	1336
13:00	139	661	42	85	76	61	6	21	2.59	213	0	1306
14:00	139	659	42	85	76	61	6	21	2.59	239	0	1330
15:00	139	617	42	85	76	61	6	21	0	287	0	1335
16:00	139	594	42	85	76	61	6	21	0	318	0	1342
17:00	139	560	42	85	76	61	6	21	0	400	0	1390
18:00	139	563	42	85	76	61	6	21	0	400	0	1393
19:00	139	544	42	85	76	61	6	21	0	400	0	1374
20:00	139	607	42	85	76	61	6	21	0	297	0	1335
21:00	139	665	42	85	76	61	6	21	0	191	0	1286
22:00	139	627	42	85	76	61	6	21	0	160	0	1217
23:00	139	592	42	85	76	61	6	21	0	94	0	1116
00:00	139	539	42	85	76	61	6	21	0	44	0	1013

Power demand and possible sources for guaranteeing, hourly values.

Scenario EU 2030

Year 2028. January (working day, Wednesday of the third week, Peak load)

Table 18

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
01:00	139	425	42	105	104	59	6	38	0	39	0	957
02:00	139	404	42	105	104	59	6	38	0	23	0	920
03:00	139	387	42	105	104	59	6	38	0	22	0	902
04:00	139	379	42	105	104	59	6	38	0	22	0	894
05:00	139	360	42	105	104	59	6	38	0	38	0	890
06:00	139	387	42	105	104	59	6	38	0	61	0	941
07:00	139	435	42	105	104	59	6	38	0	161	0	1090
08:00	139	531	42	105	104	59	6	38	0	276	0	1300
09:00	139	558	42	105	104	59	6	38	0	379	0	1430
10:00	139	602	42	105	104	59	6	38	4.15	383	0	1483
11:00	139	688	42	105	104	59	6	38	4.15	308	0	1493
12:00	139	743	42	105	104	59	6	38	4.15	238	0	1478
13:00	139	735	42	105	104	59	6	38	4.15	213	0	1445
14:00	139	736	42	105	104	59	6	38	4.15	239	0	1472
15:00	139	696	42	105	104	59	6	38	0	287	0	1477
16:00	139	674	42	105	104	59	6	38	0	318	0	1485
17:00	139	645	42	105	104	59	6	38	0	400	0	1538
18:00	139	648	42	105	104	59	6	38	0	400	0	1542
19:00	139	627	42	105	104	59	6	38	0	400	0	1520
20:00	139	686	42	105	104	59	6	38	0	297	0	1477
21:00	139	739	42	105	104	59	6	38	0	191	0	1423
22:00	139	693	42	105	104	59	6	38	0	160	0	1346
23:00	139	647	42	105	104	59	6	38	0	94	0	1235
00:00	139	584	42	105	104	59	6	38	0	44	0	1121

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

Scenario A
Year 2018. June – minimum load

Table 19

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
00:00	0	351	0	63	43	63	6	8	0	77	0	611
01:00	0	298	0	63	43	63	6	8	0	62	0	542
02:00	0	262	0	63	43	63	6	8	0	54	0	499
03:00	0	259	0	63	43	63	6	8	0	41	0	482
04:00	0	239	0	63	43	63	6	8	0	42	0	464
05:00	0	184	0	63	43	63	6	8	0	80	0	446
06:00	0	173	0	63	43	63	6	8	0	90	0	445
07:00	0	185	0	63	43	63	6	8	0	130	0	482
08:00	0	170	0	63	43	63	6	8	1	177	0	531
09:00	0	170	0	63	43	63	6	8	1	245	0	599
10:00	0	213	0	63	43	63	6	8	1	269	0	667
11:00	0	256	0	63	43	63	6	8	1	264	0	704
12:00	0	286	0	63	43	63	6	8	1	243	0	714
13:00	0	292	0	63	43	63	6	8	1	235	0	712
14:00	0	276	0	63	43	63	6	8	1	250	0	710
15:00	0	288	0	63	43	63	6	8	1	231	0	703
16:00	0	307	0	63	43	63	6	8	1	208	0	700
17:00	0	342	0	63	43	63	6	8	1	171	0	698
18:00	0	364	0	63	43	63	6	8	1	157	0	705
19:00	0	374	0	63	43	63	6	8	0	150	0	706
20:00	0	357	0	63	43	63	6	8	0	169	0	708
21:00	0	387	0	63	43	63	6	8	0	140	0	709
22:00	0	388	0	63	43	63	6	8	0	115	0	686
23:00	0	375	0	63	43	63	6	8	0	94	0	651

Scenario A
Year 2023. June – minimum load

Table 20

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
00:00	0	415	0	63	43	63	6	11	0	77	0	678
01:00	0	354	0	63	43	63	6	11	0	62	0	602
02:00	0	314	0	63	43	63	6	11	0	54	0	555
03:00	0	313	0	63	43	63	6	11	0	53	0	535
04:00	0	293	0	63	43	63	6	11	0	82	0	515
05:00	0	277	0	63	43	63	6	11	0	83	0	496
06:00	0	233	0	63	43	63	6	11	0	85	0	495
07:00	0	205	0	63	43	63	6	11	0	128	0	535
08:00	0	189	0	63	43	63	6	11	1.73	177	0	590
09:00	0	218	0	63	43	63	6	11	1.73	209	0	666
10:00	0	282	0	63	43	63	6	11	1.73	260	0	740
11:00	0	329	0	63	43	63	6	11	1.73	265	0	782
12:00	0	360	0	63	43	63	6	11	1.73	244	0	792
13:00	0	365	0	63	43	63	6	11	1.73	236	0	790
14:00	0	350	0	63	43	63	6	11	1.73	251	0	789
15:00	0	361	0	63	43	63	6	11	1.73	232	0	781
16:00	0	380	0	63	43	63	6	11	1.73	209	0	778
17:00	0	414	0	63	43	63	6	11	1.73	172	0	775
18:00	0	437	0	63	43	63	6	11	1.73	158	0	783
19:00	0	448	0	63	43	63	6	11	0	150	0	784
20:00	0	432	0	63	43	63	6	11	0	169	0	787
21:00	0	462	0	63	43	63	6	11	0	140	0	788
22:00	0	461	0	63	43	63	6	11	0	115	0	762
23:00	0	443	0	63	43	63	6	11	0	94	0	723

Scenario A

Year 2028. June – minimum load

Table 21

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	460	0	73	59	59	6	16	0	77	0	750
01:00	0	391	0	73	59	59	6	16	0	62	0	666
02:00	0	346	0	73	59	59	6	16	0	54	0	614
03:00	0	343	0	73	59	59	6	16	0	36	0	592
04:00	0	321	0	73	59	59	6	16	0	36	0	570
05:00	0	302	0	73	59	59	6	16	0	33	0	549
06:00	0	259	0	73	59	59	6	16	0	75	0	547
07:00	0	234	0	73	59	59	6	16	0	145	0	592
08:00	0	224	0	73	59	59	6	16	2.45	212	0	652
09:00	0	261	0	73	59	59	6	16	2.45	259	0	736
10:00	0	333	0	73	59	59	6	16	2.45	270	0	819
11:00	0	384	0	73	59	59	6	16	2.45	265	0	865
12:00	0	416	0	73	59	59	6	16	2.45	244	0	877
13:00	0	422	0	73	59	59	6	16	2.45	236	0	874
14:00	0	406	0	73	59	59	6	16	2.45	251	0	873
15:00	0	416	0	73	59	59	6	16	2.45	232	0	864
16:00	0	435	0	73	59	59	6	16	2.45	209	0	860
17:00	0	469	0	73	59	59	6	16	2.45	172	0	858
18:00	0	493	0	73	59	59	6	16	2.45	158	0	867
19:00	0	505	0	73	59	59	6	16	0	150	0	868
20:00	0	489	0	73	59	59	6	16	0	169	0	870
21:00	0	519	0	73	59	59	6	16	0	140	0	872
22:00	0	514	0	73	59	59	6	16	0	115	0	843
23:00	0	493	0	73	59	59	6	16	0	94	0	800

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

Scenario B

Year 2018. June – minimum load

Table 22

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	325	0	64	45	63	6	8	0	100	0	611
01:00	0	182	0	64	45	63	6	8	0	174	0	542
02:00	0	193	0	64	45	63	6	8	0	121	0	499
03:00	0	202	0	64	45	63	6	8	0	95	0	482
04:00	0	178	0	64	45	63	6	8	0	100	0	464
05:00	0	187	0	64	45	63	6	8	0	74	0	446
06:00	0	170	0	64	45	63	6	8	0	90	0	445
07:00	0	170	0	64	45	63	6	8	0	126	0	482
08:00	0	170	0	64	45	63	6	8	1.09	173	0	531
09:00	0	170	0	64	45	63	6	8	1.09	241	0	599
10:00	0	170	0	64	45	63	6	8	1.09	309	0	667
11:00	0	174	0	64	45	63	6	8	1.09	342	0	704
12:00	0	210	0	64	45	63	6	8	1.09	316	0	714
13:00	0	218	0	64	45	63	6	8	1.09	305	0	712
14:00	0	198	0	64	45	63	6	8	1.09	324	0	710
15:00	0	216	0	64	45	63	6	8	1.09	299	0	703
16:00	0	191	0	64	45	63	6	8	1.09	322	0	700
17:00	0	288	0	64	45	63	6	8	1.09	223	0	698
18:00	0	314	0	64	45	63	6	8	1.09	204	0	705
19:00	0	326	0	64	45	63	6	8	0	194	0	706
20:00	0	304	0	64	45	63	6	8	0	218	0	708
21:00	0	342	0	64	45	63	6	8	0	181	0	709
22:00	0	351	0	64	45	63	6	8	0	149	0	686
23:00	0	343	0	64	45	63	6	8	0	122	0	651

Scenario B
Year 2023. June – minimum load

Table 23

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	360	0	74	63	61	6	15	0	100	0	678
01:00	0	304	0	74	63	61	6	15	0	80	0	602
02:00	0	265	0	74	63	61	6	15	0	71	0	555
03:00	0	229	0	74	63	61	6	15	0	89	0	535
04:00	0	185	0	74	63	61	6	15	0	112	0	515
05:00	0	173	0	74	63	61	6	15	0	104	0	496
06:00	0	178	0	74	63	61	6	15	0	98	0	495
07:00	0	170	0	74	63	61	6	15	0	147	0	535
08:00	0	170	0	74	63	61	6	15	2.25	198	0	590
09:00	0	170	0	74	63	61	6	15	2.25	274	0	666
10:00	0	170	0	74	63	61	6	15	2.25	349	0	740
11:00	0	218	0	74	63	61	6	15	2.25	342	0	782
12:00	0	255	0	74	63	61	6	15	2.25	316	0	792
13:00	0	263	0	74	63	61	6	15	2.25	305	0	790
14:00	0	243	0	74	63	61	6	15	2.25	324	0	789
15:00	0	260	0	74	63	61	6	15	2.25	299	0	781
16:00	0	286	0	74	63	61	6	15	2.25	271	0	778
17:00	0	331	0	74	63	61	6	15	2.25	223	0	775
18:00	0	358	0	74	63	61	6	15	2.25	204	0	783
19:00	0	371	0	74	63	61	6	15	0	194	0	784
20:00	0	350	0	74	63	61	6	15	0	218	0	787
21:00	0	388	0	74	63	61	6	15	0	181	0	788
22:00	0	394	0	74	63	61	6	15	0	149	0	762
23:00	0	383	0	74	63	61	6	15	0	122	0	723

Scenario B

Year 2028. June – minimum load *Table 24*

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	394	0	84	81	59	6	26	0	100	0	750
01:00	0	330	0	84	81	59	6	26	0	80	0	666
02:00	0	287	0	84	81	59	6	26	0	71	0	614
03:00	0	290	0	84	81	59	6	26	0	47	0	592
04:00	0	238	0	84	81	59	6	26	0	76	0	570
05:00	0	175	0	84	81	59	6	26	0	117	0	549
06:00	0	182	0	84	81	59	6	26	0	109	0	547
07:00	0	170	0	84	81	59	6	26	0	166	0	592
08:00	0	170	0	84	81	59	6	26	3.40	222	0	652
09:00	0	170	0	84	81	59	6	26	3.40	306	0	736
10:00	0	210	0	84	81	59	6	26	3.40	349	0	819
11:00	0	263	0	84	81	59	6	26	3.40	342	0	865
12:00	0	301	0	84	81	59	6	26	3.40	316	0	877
13:00	0	309	0	84	81	59	6	26	3.40	305	0	874
14:00	0	289	0	84	81	59	6	26	3.40	324	0	873
15:00	0	305	0	84	81	59	6	26	3.40	299	0	864
16:00	0	330	0	84	81	59	6	26	3.40	271	0	860
17:00	0	375	0	84	81	59	6	26	3.40	223	0	858
18:00	0	403	0	84	81	59	6	26	3.40	204	0	867
19:00	0	417	0	84	81	59	6	26	0	194	0	868
20:00	0	396	0	84	81	59	6	26	0	218	0	870
21:00	0	434	0	84	81	59	6	26	0	181	0	872
22:00	0	437	0	84	81	59	6	26	0	149	0	843
23:00	0	422	0	84	81	59	6	26	0	122	0	800

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

Scenario EU 2030

Year 2018. June – minimum load

Table 25

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
00:00	0	213	0	66	47	63	6	9	0	207	0	611
01:00	0	211	0	66	47	63	6	9	0	141	0	542
02:00	0	183	0	66	47	63	6	9	0	126	0	499
03:00	0	188	0	66	47	63	6	9	0	103	0	482
04:00	0	193	0	66	47	63	6	9	0	80	0	464
05:00	0	185	0	66	47	63	6	9	0	71	0	446
06:00	0	170	0	66	47	63	6	9	0	85	0	445
07:00	0	170	0	66	47	63	6	9	0	121	0	482
08:00	0	170	0	66	47	63	6	9	1.24	169	0	531
09:00	0	170	0	66	47	63	6	9	1.24	238	0	599
10:00	0	170	0	66	47	63	6	9	1.24	305	0	667
11:00	0	170	0	66	47	63	6	9	1.24	343	0	704
12:00	0	170	0	66	47	63	6	9	1.24	352	0	714
13:00	0	170	0	66	47	63	6	9	1.24	350	0	712
14:00	0	170	0	66	47	63	6	9	1.24	349	0	710
15:00	0	170	0	66	47	63	6	9	1.24	342	0	703
16:00	0	187	0	66	47	63	6	9	1.24	321	0	700
17:00	0	200	0	66	47	63	6	9	1.24	306	0	698
18:00	0	184	0	66	47	63	6	9	1.24	330	0	705
19:00	0	293	0	66	47	63	6	9	0	222	0	706
20:00	0	268	0	66	47	63	6	9	0	250	0	708
21:00	0	312	0	66	47	63	6	9	0	207	0	709
22:00	0	178	0	66	47	63	6	9	0	317	0	686
23:00	0	321	0	66	47	63	6	9	0	139	0	651

Scenario EU 2030
Year 2023. June – minimum load

Table 26

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs 10)	Import	Load
00:00	0	271	0	85	76	61	6	21	0	158	0	678
01:00	0	180	0	85	76	61	6	21	0	173	0	602
02:00	0	180	0	85	76	61	6	21	0	125	0	555
03:00	0	196	0	85	76	61	6	21	0	90	0	535
04:00	0	180	0	85	76	61	6	21	0	86	0	515
05:00	0	183	0	85	76	61	6	21	0	64	0	496
06:00	0	170	0	85	76	61	6	21	0	75	0	495
07:00	0	170	0	85	76	61	6	21	0	116	0	535
08:00	0	170	0	85	76	61	6	21	3.11	167	0	590
09:00	0	170	0	85	76	61	6	21	3.11	243	0	666
10:00	0	170	0	85	76	61	6	21	3.11	317	0	740
11:00	0	170	0	85	76	61	6	21	3.11	359	0	782
12:00	0	179	0	85	76	61	6	21	3.11	361	0	792
13:00	0	188	0	85	76	61	6	21	3.11	349	0	790
14:00	0	170	0	85	76	61	6	21	3.11	366	0	789
15:00	0	186	0	85	76	61	6	21	3.11	342	0	781
16:00	0	216	0	85	76	61	6	21	3.11	309	0	778
17:00	0	268	0	85	76	61	6	21	3.11	255	0	775
18:00	0	297	0	85	76	61	6	21	3.11	233	0	783
19:00	0	267	0	85	76	61	6	21	0	268	0	784
20:00	0	287	0	85	76	61	6	21	0	250	0	787
21:00	0	282	0	85	76	61	6	21	0	257	0	788
22:00	0	202	0	85	76	61	6	21	0	311	0	762
23:00	0	285	0	85	76	61	6	21	0	189	0	723

Scenario EU 2030

Year 2028. June – minimum load

Table 27

Hour	Riga CHP-1	Riga CHP-2	Imanta CHP	Biomass	Biogas	Gas fueled co-generation	Small HPP	Wind power	Solar power	Daugava HPPs [10)]	Import	Load
00:00	0	324	0	105	104	59	6	38	0	114	0	750
01:00	0	196	0	105	104	59	6	38	0	158	0	666
02:00	0	221	0	105	104	59	6	38	0	81	0	614
03:00	0	180	0	105	104	59	6	38	0	100	0	592
04:00	0	193	0	105	104	59	6	38	0	64	0	570
05:00	0	173	0	105	104	59	6	38	0	63	0	549
06:00	0	170	0	105	104	59	6	38	0	65	0	547
07:00	0	170	0	105	104	59	6	38	0	110	0	592
08:00	0	170	0	105	104	59	6	38	4.98	165	0	652
09:00	0	170	0	105	104	59	6	38	4.98	249	0	736
10:00	0	170	0	105	104	59	6	38	4.98	332	0	819
11:00	0	170	0	105	104	59	6	38	4.98	378	0	865
12:00	0	198	0	105	104	59	6	38	4.98	361	0	877
13:00	0	208	0	105	104	59	6	38	4.98	349	0	874
14:00	0	185	0	105	104	59	6	38	4.98	370	0	873
15:00	0	204	0	105	104	59	6	38	4.98	342	0	864
16:00	0	234	0	105	104	59	6	38	4.98	309	0	860
17:00	0	286	0	105	104	59	6	38	4.98	255	0	858
18:00	0	317	0	105	104	59	6	38	4.98	233	0	867
19:00	0	230	0	105	104	59	6	38	0	326	0	868
20:00	0	309	0	105	104	59	6	38	0	250	0	870
21:00	0	352	0	105	104	59	6	38	0	207	0	872
22:00	0	226	0	105	104	59	6	38	0	305	0	843
23:00	0	201	0	105	104	59	6	38	0	287	0	800

3.2. Information on energy cross-border trade amounts for 2016 comparison to 2017.

Table 28

	Amounts of energy trade in 2016 (MWh)	Amounts of energy trade in 2017 (MWh)
Import	4 828 354	4 072 912
Export	3 794 883	4 137 077

Table 28 shows that in year 2017 the import of electricity decreased by 16 % in compare with 2016, while export from the Latvian electricity system increased by ~9 % in compare the previous year. In 2017, the Latvian electricity system has exported more than imported, which indicates that the electricity balance in 2017 has been positive and about 64 165 MWh of electricity has been exported to the electricity systems of neighboring countries by the Latvian electricity system.

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

The Latvian TSO, as company responsible for the security of supply in Latvia and for reliable operation electricity market in Latvia, operating together with Estonia and Lithuania, following the principles of the Nordic Electricity Market "Nord Pool" conditions, ensure the energy market operations in the Latvian bidding area, provides the continuous balance of power between consumption and generation in Latvia, as well as control and publish the available interconnection capacities for trading with neighboring electricity systems. Since the adoption of the European Union Energy Action Plan 2050, which states that the generation development and national capacity adequacy should be focused on areas with renewable energy potential, to stimulate the reduction of CO_2 emissions and greenhouse effect gas emission reduction, as well as contribute to a more efficient, competitive power generation development, the base capacity adequacy within the territory of one country is not necessarily an indication of adequacy of generating capacity, but it must be evaluated in complex with the available transmission capacities to/from the country or region (see paragraph 3.6.). In normal operation modes Latvian power system transfer capacities with neighboring power systems are sufficient for provision of forecasted electricity imports/exports, and after commissioning of interconnection berween Sweden and Lithuania NordBalt (700 MW) in 2016, the load of Estonia-Latvia cross-border interconnection has decreased and only for 5 % of total time 100 % of interconnection capacity has been used. Nevertheless, operating under above mentioned conditions during the previous years there have not been situations where a Latvian consumers or regions has had to be restricted due to insufficient generating capacity or insufficient capacity on interconnectors with Lithuania, Estonia and Russia. Until now, working synchronously with the Russian Integrated Power System/Unified Power System (IPS/UPS) Latvian TSO in all operation modes has been able to provide the required power (consumption) transmission within the Latvian electricity transmission system, regardless of the operational status of generating units within the territory of the Latvia. At the same time, analyzing the adequacy of capacity on national and regional level, the generating capacity of the Latvian power system is not sufficient to cover the Latvian power system peak load and ensure Latvian power system operation regardless of external conditions, especially in emergency situations caused by the cross-border transfer capacity reductions. Taking into account the mentioned above and possible Baltic power systems future synchronization with electricity systems of continental Europe, the TSO has the opinion that the development of power generating capacities in Latvia's electricity system is desirable for providing the security of operation.

Analyzing the power adequcy for the upcoming years, in the Conservative scenario (A) power (MW) adequacy analysis table (Table 4) shows that generating capacities are sufficient only in 2018 but insufficient to cover the peak load, provide power reserves and meet system regulation and security requirements for winter months throughout the remaining period. For the Conservative scenario (A) very slow development of the Latvian electricity system has been planned and slow economic growth, as the result of changes in support scheme for renewable energy and cogeneration power plants is expected, that operation of natural gas fired power plants, including Riga CHP-1 and Riga CHP- 2, under free market conditions will be less competitive and less effective. Due to the possible change or reduction of the support scheme for producers of renewable resources and cogeneration, according to the information available to TSO, operation of Riga CHP-1 will be stopped from 2021 and therefore this power plant will not participate in the provision of a power balance in Latvia. Similarly, Imanta CHP will be stopped operation in the middle of 2021. In the Conservative scenario (A), according to the generation development tendencies, the capacity shortages are reaching 23 % by year 2023 and 28 % by year 2028. It is planned that, by the 2028, 55 MW of the total net wind generation could be covered by offshore wind farms, the real development of which is currently difficult to predict due to uncertainty in the regulatory enactments for the State aid. Taking into account the slow development of wind power plants, in the Conservative scenario (A) is assumed that the development of off-shore wind farms could start not earlier than year 2023 (the minimum construction period for wind farms is about 5 years, research and the granting of state permits for the construction of off-shore wind farms is about 2 years). Over the reviewed period (2018-2028), the power adequacy ranges from 62 % to 100 %, which indicates that the generation capacity is insufficient to cover electricity consumption, and that the capacity shortage will increase from 0 MW to 587 MW throughout the analyzed period. The Conservative scenario (A) clearly shows that it is very important not to lose/decrease the existing generation in Latvia (Daugava HPP, Riga CHP-1 and Riga CHP-2, Imanta CHP) in order to ensure the electricity balance in the Latvian electricity system. In the Conservative scenario (A), electricity production is analyzed if the Riga CHP-1, Riga CHP-2 and Imanta CHP are working under electricity market conditions where the power stations are less efficient and, in free market conditions are able to produce only part of the maximum possible energy. The electricity balance sheet (Table 7) shows that the electricity deficit in the Latvian electricity system in the Conservative scenario (A) varies from around 895 GWh up to 1734 GWh.

In the Base scenario (B) the power (MW) adequacy analysis table (Table 5), shows that the Latvian power system is able to cover the peak load in the period from 2018 till 2022 and energy deficit during years increases respectively from 2 % till 19 %. Similarly to the Conservative scenario (A), the Base scenario (B) shows that it is essential not to lose/decrease the existing Latvian baseline generation (Daugava HPP`s, Riga CHP-1, Riga CHP-2 and Imanta CHP). In the Base scenario (B) is assumed that the development of off-shore wind farms could gradually started from 2023 after commissioning of the 3rd of Kurzeme Ring, which could provide wind farms connection possibilities to the transmission network on the Baltic Sea coast, therefore development of wind power stations could increase more than planned in the Conservative scenario (A). The electricity balance table (Table 8) shows that in the Base scenario (B), electricity supply in Latvia is not sufficient during whole analyzing period (87-92%), which means that Latvia will import electricity from neighboring power systems to ensure power adequacy. In the Base scenario (B) is assumed that Riga CHP-1 and Riga CHP-2 shall operate according to electricity market conditions "Nord Pool", and electricity production is forecasted according to average long-term volumes. In the Base scenario (B), the increase of wind power plants capacity in the Latvian power system requestes for the higher amount of power reserves as well.

For the Optimistic scenario (EU 2030) the power (MW) adequacy analysis table (Table 6) shows that power system of Latvia being able to cover peak load from 2018 till 2024 (105 % to 115 %), but since 2025, when the Baltic synchronous operation with continental Europe is planned, the power deficit increases (from 6 % to 10 %). Power surplus from 2018 to 2024 shows that electricity export to neighboring countries is possible for cover them of peak load. In the Optimistic scenario (EU 2030) is assumed that the development of off-shore wind farms could gradually started from 2022 using the new development technologies of wind turbines. The wind turbines technologies now already are built with 8 MW of installed capacity, and further development of technologies is expected. The power adequacy table (Table 9) shows that in the Optimistic scenario (EU 2030) power adequacy is sufficient during whole analyzed period (151-152%), which means that electricity import from neighboring countries to ensure Latvia's electricity balance is not necessary, but instead Latvia will be able to export the electricity to neighboring electricity systems. The Optimistic scenario (EU 2030) assumes that Riga CHP-1, Riga CHP-2 and Imanta CHP are operating outside the electricity market conditions and power plants in Latvia are capable to provide the maximum amount of electricity necessary for power supply of Latvia's consumers, taking into account the annual maintenance schedule for each power plant. In the Optimistic scenario (EU 2030), with dramatic increase of wind power production in Latvia, the need for a power reserve is increase.

The total power reserve of Latvian electricity system is not included in the analysis of daily peak load of winter maximum consumption. The Conservative scenario (A) shows that in 2018, the Latvian electricity system is able to cover the daily peak load and the import from neighboring countries to cover the daily peak loads (Table 10) is not necessary. In the Conservative scenario year 2023, the power system in Latvia isw going to import 1834 MWh of electricity from neighboring countries, where the approximate hourly power amount is from 32 MW to 190 MW (Table 11), but from 2028, daily import will increase till 3790 MWh. Starting from 2021, the electricity deficit in the Latvian electricity system is expected, because, according to the TSO available information, due to changes in support scheme to RES and cogeneration producers, is planned that the operation of Riga CHP-1 will be stopped and the station will not participate in the power adequacy of Latvia. Similarly, Imanta CHP will not participate in peak load coverage from 2022. Consequently, the electricity deficit is increase and electricity import is needed. In the Base scenario (B), the Latvian TSO will be able to fully cover the daily load in 2018 (Table 13), in 2023 (Table 14), and a small electricity deficit of 10 MW to 22 MW expected in 2028 (Table 15). The amount of daily electricity import is about 57 MWh. In the Base scenario (B) is possible, if necessary, to export electricity to neighboring countries to help them covering their peak loads during the winter months. In the Optimistic scenario (EU 2030), the Latvian TSO will be able to fully cover the daily load in 2018 (Table 16), in 2023 (Table 17) and in 2028 (Table 18). The development of renewable energy will provide the necessary power and reduce the import of electricity from neighboring countries.

For covering of daily minimum load in Conservative scenario (A) 2018 the Riga CHP-1 and Imanta CHP are out of operation (Table 19) and the balance of power system is basically ensured by renewable energy resources – biomass and biogas, wind power plants, Daugava HPPs, small HPPs, solar power plants and small natural gas cogeneration stations, and only the Riga CHP-2 is used for regulation. The minimum output of the Riga CHP-2 is planned at 170 MW. In the Conservative scenario (A), in 2023 biomass and biogas plants, small HPP, wind and solar power stations, Daugava HPP, small natural gas cogeneration stations are in operation for power adequacy providing, while the regulation of power system has been provided by Riga CHP-2 (Table 20). The minimum output of the Riga CHP-2 is planned to be 170 MW. In this scenario, no additional export of electricity to neighboring countries is planned. From 2028 the base power plants remain the same, only due to load increase, the minimum production of Riga CHP-2 is increased, is necessary to operate with two units of 170 MW (total 340 MW) for covering the daily load in the minimum and maximum demand hours (Table 21). For covering of daily minimum load in Base scenario (B) 2018 the Riga CHP-1 and Imanta CHP are out of operation (Table 22) and the balance of power system is basically ensured by renewable energy resources – biomass and biogas, wind power plants, Daugava HPPs, small HPPs, solar power plants and small natural gas cogeneration stations, and only the Riga CHP-2 is used for regulation. The minimum output of the Riga CHP-2 is planned at 170 MW. In this scenario, no additional export of electricity to neighboring countries is planned. In the Base scenario (B) in 2023, biomass and biogas power plants, small hydropower plants, wind and solar power plants, Daugava HPP, small natural gas cogeneration stations are providing the base part of power and regulation power is provided by Riga CHP-2 (Table 23). The minimum output of the Riga CHP-2 is planned at 170 MW. Additional electricity export to neighboring power systems is not planned, and Daugava HPPs will provide the regulation of minimum load. In 2028 the electricity production with baseline power plants remain the same, only due to the increase of load Riga CHP-2 is being regulated (Table 24). To cover the daily minimum load in the Optimistic scenario (EU 2030), when the most rapid development and use of renewable energy resources is planned, in 2018 Riga CHP-1 and Imanta CHP are out of operation (Table 25) and the balance of power system is provided by renewable energy sources – biomass and biogas, wind power plants, Daugava HPPs, small HPPs, solar power plants and small natural gas cogeneration stations, where only the Riga CHP-2 is providing regulation. The minimum output of the Riga CHP-2 is planned to be 170 MW. In the Optimistic scenario (EU2030) in 2023, biomass and biogas power plants, small HPPs, wind and solar power stations, Daugava HPPs, small natural gas CHP plants are operating as baseline power plants while regulation is provided by Riga CHP-2 (Table 26). The minimum output of the Riga CHP-2 is 170 MW. For 2028 the capacity of base power plants remains the same (Table 27). With increasing of production from renewable energy sources the problems with minimal load and peak load coverage are identified. In order to provide a power regulation services at the minimum load modes, it is necessary to keep in operation highly flexible gas fired power stations (at minimum power output), which then provide coverage of daily peak load as well. In this scenario, in order to ensure the system operational security and provide the balance of electricity, is necessary to export electricity to neighboring power systems electricity produced from renewable energy sources at the minimum system loads, but at peak loads it is necessary to keep in operate a highly flexible gas-fired power stations for the provision of the regulation services, since renewable energy resources alone cannot cover the daily peak load. With development of renewable energy, is necessary to guarantee of fast-regulated emergency (restoration) and replacement reserves that are able to regulate the power balance according to the needs of a daily load profile. To provide fast and controllable emergency and replacement reserves, the TSO could purchase regulation services from existing power plants in Latvia, or purchase these services from electricity producers in neighboring countries, or to install the necessary equipment (for example, battery energy storage systems) in 110 kV or 330 kV substations in order to provide such service.

3.4. Information on required and available emergency reserve capacities, replacement reserves (MW) and amount of reserve utilisation (MWh) in 2017.

Table 29

Month	Max required power reserve	Available power reserve		Realised power reserve
		In Latvia	BRELL agreement, till 12h	
	MW	MW	MW	MWh
January	440	100	340	0
February	440	100	340	0
March	440	100	340	0
April	440	100	340	48.334
May	440	100	340	16.667
June	440	100	340	162.667
July	440	100	340	409.334
August	440	100	340	20.5
September	440	100	340	0
October	440	100	340	0
November	440	100	340	0
December	440	100	340	0

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

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

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

Power adequacy table (Table 4) shows that in year 2018, in the Conservative Scenario (A), the power adequacy of the Latvian electricity system will reach about 100 % but energy adequacy (Table 7) – about 87 %.

In Conservative scenario (A) is expected to have the highest power deficit, since due to the expected changes in the support scheme from 2021, operation of the Riga CHP-1 is foreseen to stop from 2021. Due to the expected shut down of Riga CHP-1 and lack of available generation capacity, especially during the winter periods, the power deficit from 2022 till 2028 will increase from 220 MW to 587 MW. In the Base scenario (B), the 100 % power adequacy will be from 2018 till 2022, but starting from 2023 to 2028 there will be a power deficit from 2 % to 19 %. In the optimistic scenario (EU 2030), the amount of prodecued electrical energy in the time period from 2018 to 2028 will be around 150 %, which indicates that the Latvian electricity system will be able to cover the consumption during all analysing period. From the power adequacy table could conclude that in the Optimistic scenario (EU2030) power adequacy is enough during the time period from 2018 to 2024, but taking into account the possible Baltic synchronous operation with continental Europe, the need for power reserves will increase, and therefore the power deficit will increase to 10 %.

The commissioning of new large capacity power plants in Latvia is not foreseen until 2028 and according to the information available at the AS "Augstsprieguma tīkls" there are no decisions regarding the implementation of large-capacity power plant projects in the Baltic States (including the increase of capacity in big power plants) during the period till 2028. At the same time, the Ministry of Economics of Republic of Latvia, as responsible body for energy sector in Latvia, pointed out that according to EU renewable energy targets 2030, it is believable that large off-shore wind farms projects with installed capacity up to 100 MW and more could be implemented in Latvia till 2030.

The potential future interest from renewable energy producers in Latvia is mainly related with potential off-shore wind farms development on Baltic Sea shore in Kurzeme region. Taking into account the experience of previous years, the period of construction of wind power plant, the development of wind turbines technologies, the commissioning year of the final stage of Kurzeme Ring, the current situation with the issued technical requirements for electricity producers, as well as the current RES legislation in Latvia, the TSO has no reason to believe that submitted wind farm development applications will be implemented in full. Due to this reason, TSO plans that the more intensive development of new big capacity wind farms power plants is expected not sooner than after 5-7 years, but there are no criteria available based on which could objectively evaluate the construction of the planned wind power plants. Due to the potential development of off-shore wind farms in Kurzeme, AS Augstsprieguma tīkls as an energy sector expert participated in the elaboration of maritime spatial planning project led by the Ministry of Environmental Protection and Regional Development, assessing the potential amount of grid-connected wind farms and their potential connection points.

The Information bout development plans received from electricity consumers (both large scale - connected to the transmission network and small ones - connected to the distribution network) in Latvia shows greatly conservative development of consumption for the next ten years.

3.6. Pārvades sistēmas operatora secinājumi par elektroenerģijas ražošanas jaudu un elektroenerģijas pieejamību Baltijas valstu reģionā un Somijā – Latvija, Lietuva, Igaunija un Somija.

In November 2017, the Baltic TSOs –AST, Elering and Litgrid, in cooperation with the Finnish TSO Fingrid, launched study of the operational security and power adequacy in the region with Baltic States together with Finnish electricity system. Power adequacy data exchange report has been prepared by Baltic and Finnish TSOs. The report contains the analysis of power adequacy in the Baltic States together with Finland, potential import/export amounts to/from the region and the peak load amounts. The regional power adequacy has been prepared by TSO according to two methodologies – deterministic and stochastic approaches. A deterministic approach means when all available capacities in the region are taking into account and summarized and the import/export options are evaluated and compared with the peak load in the region, but the stochastic simulation approach (performed with the BID3 market model) is when all available generation is included in the mathematical market model and the program automatically generates many different generation outage variants and calculates the amount of undelivered energy and the number of hours during such modes for covering the load in the region and in each country. The market model provides information on the probability than power adequacy in the region and in each country is insufficient and which station/stations outage creates a contingency for the power balance. Year 2025 has been chosen for the simulation of the probability approach, because it is time when the Baltic States are planning to start a synchronous operation with Continental Europe. For the Baltic Sea countries, the generation data from the ENTSO-E MAF 2017 report (*Mid-Term Adequacy Forecast*) has been used.

According to the deterministic approach, the regional power adequacy assessment of the Baltic States and Finland was performed for two operational scenarios of the electricity system: normal operating mode (N-0) (all elements of the system are in operation) and the outage of two critical elements (the disconnection of two major generating units N-2). In the assessment, the two critical elements are the two largest nuclear power plants in Finland. The power output of the two largest blocks considered varies in the range from 1770 MW to 2500 MW during the evaluation period. The power adequacy assessment estimates the amount of available reserves for the primary, secondary and tertiary reserves. In the assessment it has been assumed that there are no transmission capacity limits between the Baltic States and Finland. Capacity assessment is performed for the time period until 2033.

3.6.1. The power adequacy of Baltic States and Finland by a deterministic approach

Such power adequacy assessment scenario is shown in Figure 3. Taking into account that the primary frequency regulation for Baltic power systems is currently provided by the Russian electricity system, the Baltic States only should provide a secondary reserve until 2025. The figure clearly shows that the electricity system of the Baltic States together with Finland will not be able to provide both the reserve and the necessary capacity to cover the peak load during analyzing period. In order to cover the peak load in Baltic region and Finland, it is necessary to use interconnections with neighboring countries and to import the missing power by them. In the analyzing scenario, Finland is expected to maintain a strategic reserve of 667 MW until 2020. Accordingly, with maintaining of necessary power reserves the power deficit will remain, but available cross-border capacities (approximately 4500 to 5300 MW) will be sufficient to import the missing power from neighboring electricity systems. Imported power in the Baltic States by the year 2033 will be up to 2000 MW.

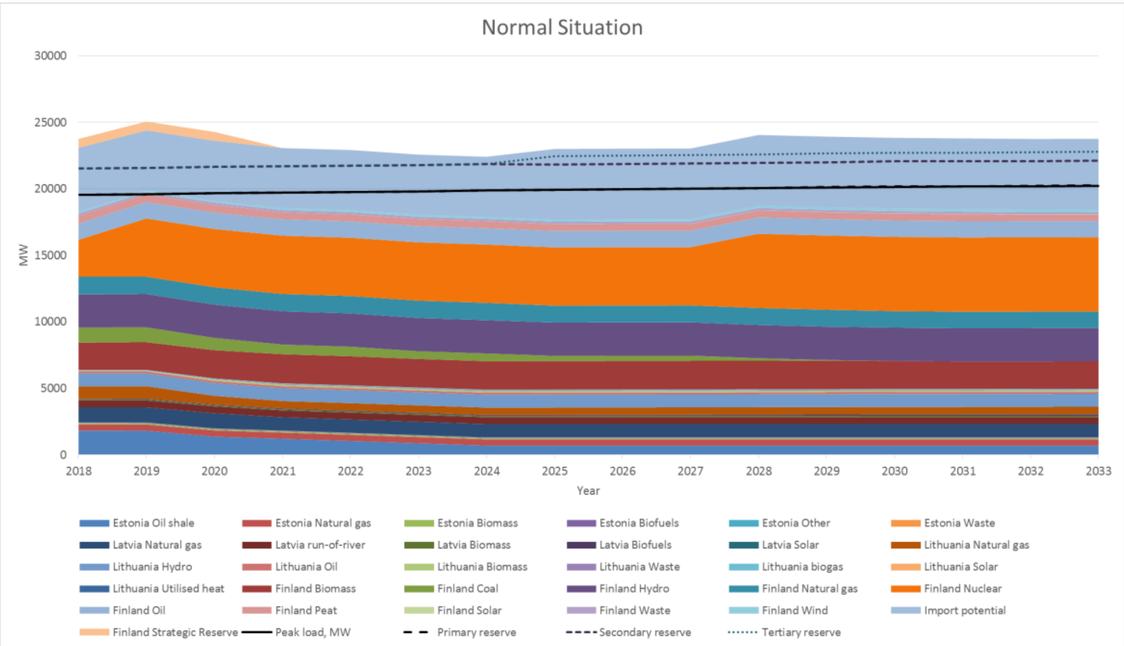

Fig. 3. Power adequacy assessment for the Baltic States and Finland operating synchronously with power systems of continental Europe after 2025

In the scenario with tripping of two largest blocks in Finland (N-2) in 2024, problems with available capacities for covering of power reserve and peak load will arise (see Fig. 4). The graph clearly shows that the Baltic States will import the missing electricity from neighboring countries and the available cross-border capacity of interconnections will be able to provide the necessary capacity for imports, while the transmission capacity of these interconnections will be fully used. To cover the peak load during whole analyzing period, the power import capabilities from neighboring countries will be used.

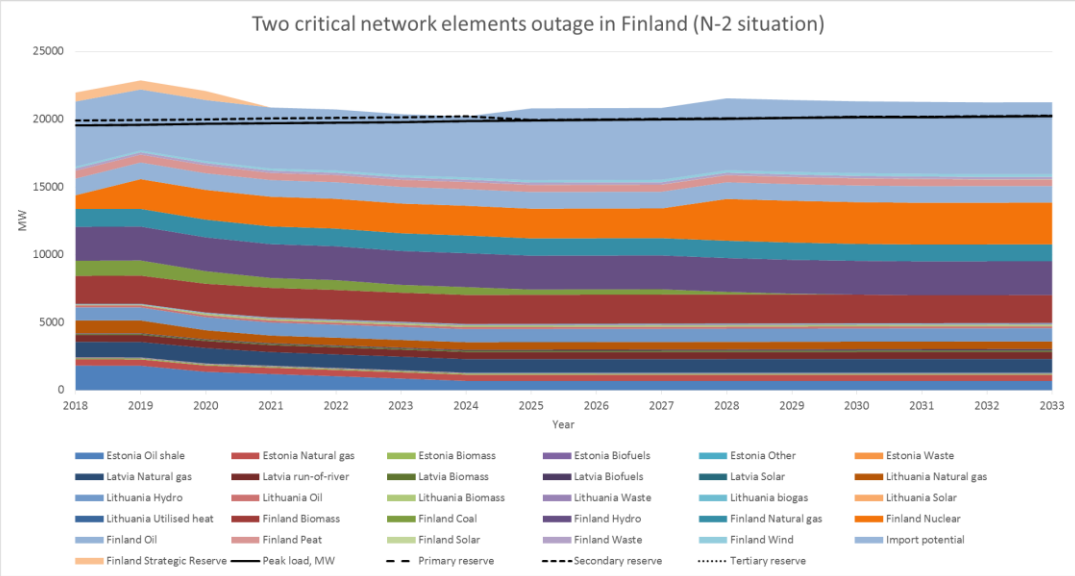

Fig.4. Power adequacy assessment for the Baltic States and Finland operating synchronously with power systems of continental Europe after 2025

3.6.2. Baltic States power adequacy assessment in synchronous operation with continental Europe based on deterministic approach

Taking into account that the final decision on the Baltic synchronization scenario had not been done at the time of the power adequacy calculations, the assessment of the capacity adequacy was performed for the scenario of Baltic States working synchronously with the electricity systems of Continental Europe through one interconnection between Lithuania and Poland (LitPol link 1). In this scenario generating capacities are sufficient to cover the peak load until 2020, and after 2020 the Baltic States will use electricity imports from neighboring electricity systems. Starting from 2028 generation capacities and import capabilities are insufficient to cover peak load and provide an adequate level of security of supply in the Baltic power system. According to the scenario development, the capacity deficit will only increase.

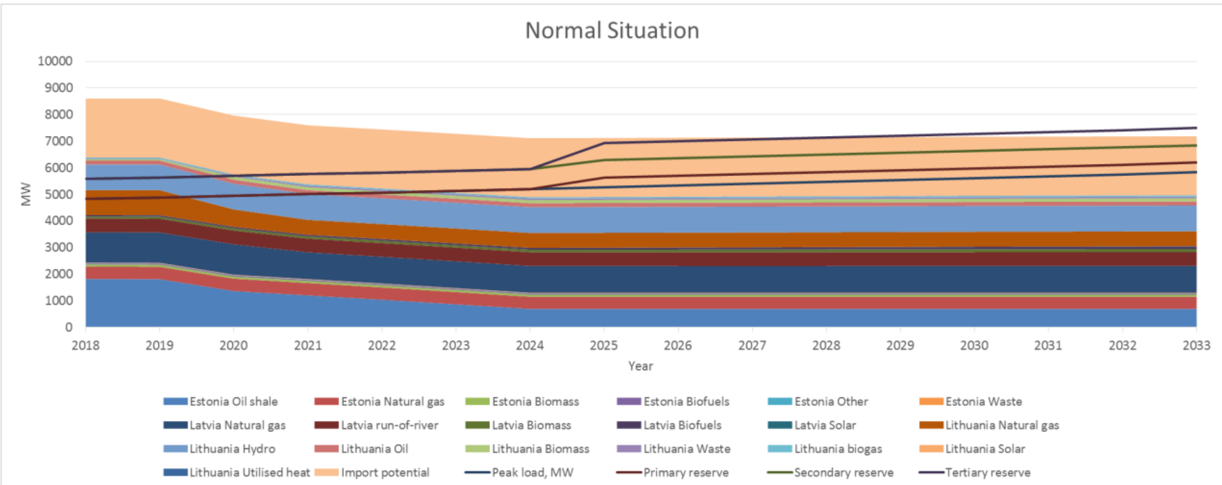

Fig. 5. Power adequacy assessment for the Baltic States operating synchronously with continental Europe through Poland after 2025

Figure 6 shows the power adequacy evaluation of the system in emergency mode when the NordBalt DC cable (700 MW) between Lithuania and Sweden and the Estlink 2 DC cable (650 MW) between Estonia and Finland have been tripped.

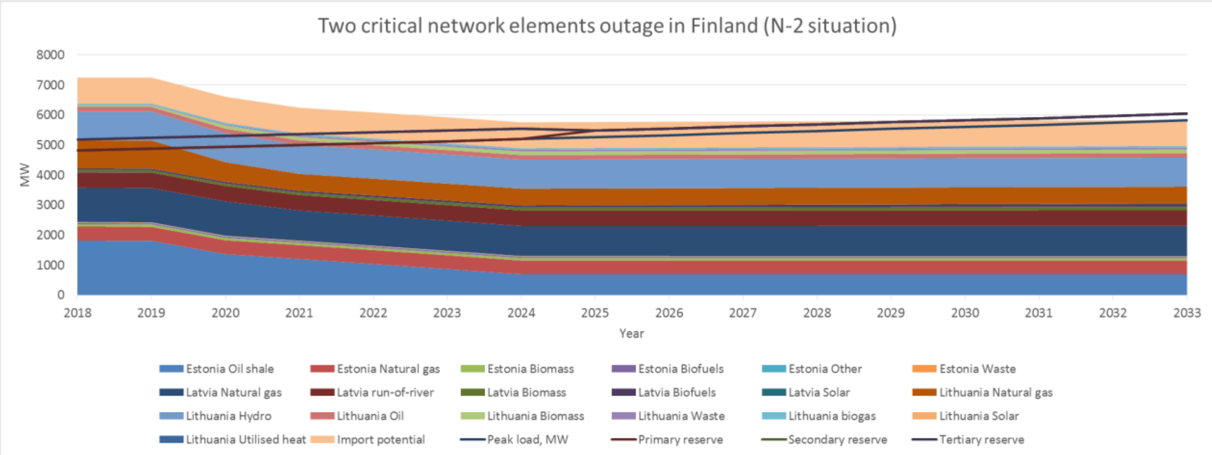

Fig. 6. Power adequacy assessment for the Baltic States operating synchronously with continental Europe through Poland after 2025 after the tripping of two critical network elements

After evaluation of Baltic States power adequacy prepared by transmission system operators of the Baltic States, could conclud that a power deficit or peak load coverage problems could start after 2025 when is planned to start synchronous operation with continental Europe. For peak load coverage the problem could be due to the shutdown of base power plants caused by economic and environmental conditions, as well as provision of secure system operation (emergency and regulation reserves) will become problematic. According to current development plans of generation, after 2030, the Baltic States will not be able to ensure the secure operation of the electricity system and the development of new base power plants in the Baltic States is important.

3.6.3. Power adequacy assessment of Baltic countries in synchronous operation mode with power systems of continental Europe using stochastic simulations

Based on analysis with probabilistic approach for 2025, prepared with BID3 market model, possible amount of hours (*Loss of Reserve requirement Expectation* – LORE) is given where generation capacities in each country may not be sufficient to provide the required amount of reserves and an indication is given for the potential for unserved energy at that time (*Energy Not Supplied*-ENS) (see Fig. 7).

The possible period in Latvia when the capacity might be insufficient to cover the peak load and provide a reserve (LORE) is determined at 0.3 hours. In the analyzed scenario, Imanta CHP and Riga CHP-1 are not in operation. All countries have a LORE volume below 3 hours, which indicates that the capacity level according to the European standard (<3 h/year) is sufficient to cover the load for the analyzed year.

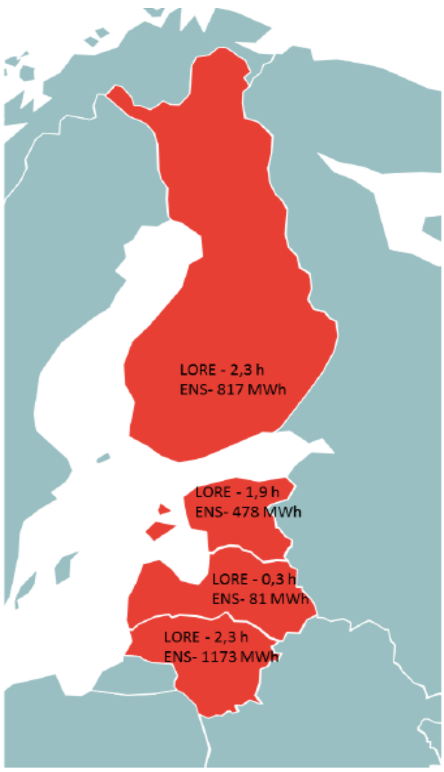

Fig. 7 Power adequacy in Baltic States and Finland based on the probabilistic approach

4. Transmission system adequacy for demand and maintenance quality

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

At present, various operation modes of Baltic power networks are characterised by reduced transmission capacities on the Latvian - Estonian cross-border due to the introduced restrictions by AS "Elering" (Estonian TSO) on cross-border and internal 330 kV transmission lines. Taking into account loading of interconnections between Baltic States, Nordic Countries and Poland, during normal operation the situation in Estonian-Latvian cross-border is not critical and the cross-border is not overloaded, but in emergency and maintenance modes transmission capacity on this cross-border is still limited. In order to eliminate these overloads till 2020 is planned to commissioned Estonian-Latvian third interconnection, but after the mentioned project implementation till 2025, than is expected Baltic power systems sinchronisation with continental Europe, AS "Elering" planing to start the internal 330 kV transmission line reconstructions and elimination of the cross-border congestion. This means that the Latvian - Estonian cross-border capacity congestion will continue until 2025, but constraints will be less than before 2020. As the result of such cross-border capacity congestion, during the emergency or maintenance modes is not possible to provide Latvian power system secure operation and Latvian and Lithuanian consumers possibility of import from the Nordic regions with cheapest electricity prices is limited. In order to completely eliminate cross-border capacity constraints in the cross-section between Estonia and Latvia, the Latvian TSO till 2024 has planned the reconstruction of the two remaining 330 kV transmission lines from the 330 kV substation Valmiera in Latvian territory to 330 kV substations Tartu and Tsirgulina in Estonia.

The transmission capacity on Latvian-Lithuanian cross-border is sufficient and additional problems for electricity transportation in normal modes between Latvian and Lithuania are not expected, hence no additional measures are necessary to improve cross-border capacity between Latvia and Lithuania, expect the case of synchronization scenario with continental Europe. After approval of Baltic States synchronization scenario with continental Europe, which will include one AC line between Lithuania and Poland, as well as an additional DC interconnection between Lithuania and Poland, the congestion of cross-border between Latvia and Lithuania could be possible.

Electricity transmission capacity in the cross-border between Latvia and Russia also is sufficient and in normal operation modes there are no additional problems for the transmission of electricity. Due to Baltic power systems synchronization with continental Europe and desynchronization from power systems of Russia and Belarus, the future development of the cross-border between Latvia and Russia is not planned.

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

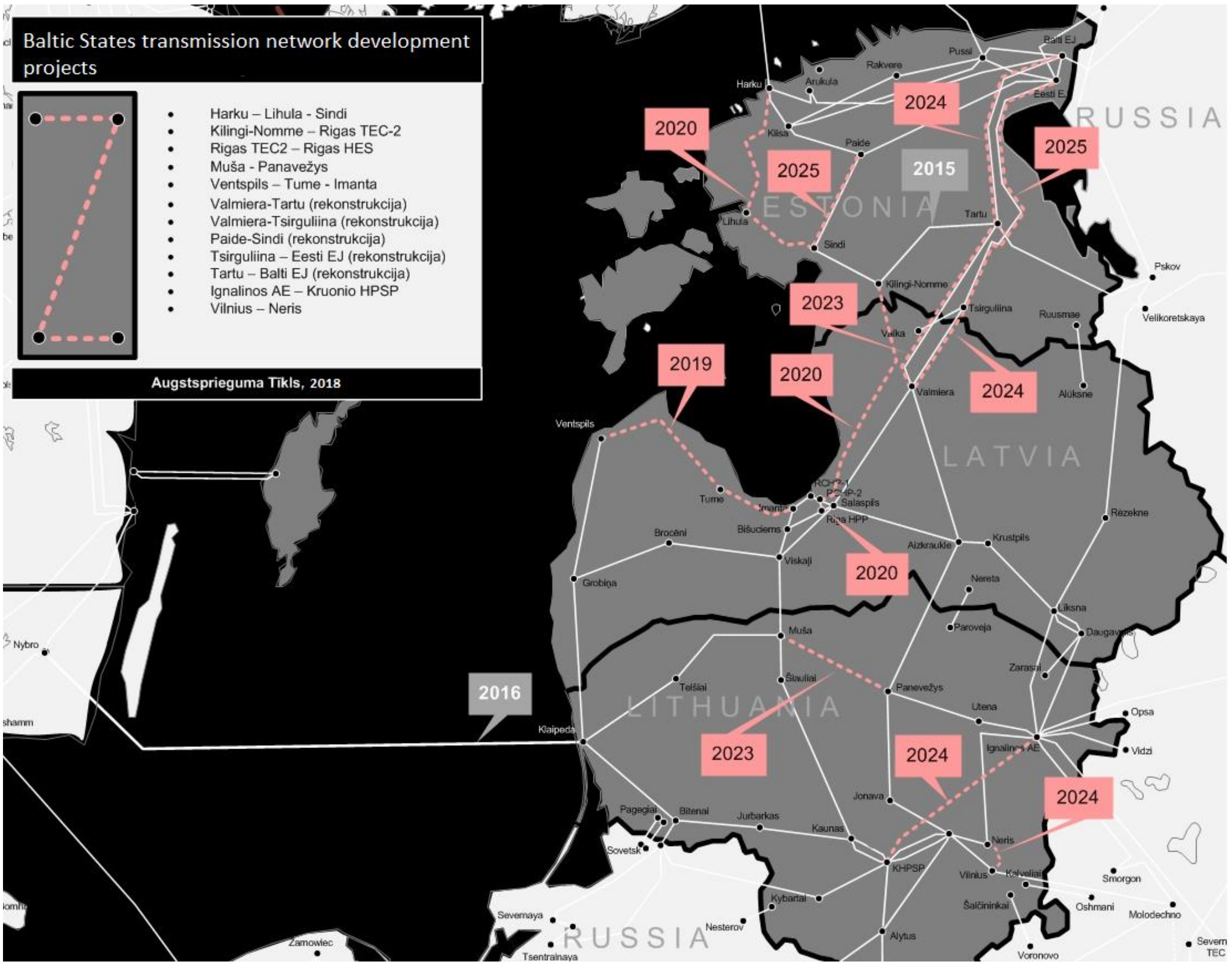

Fig. 8. Transmission infrastructure projects in Baltic countries according to the development plans of Baltic TSOs

4.2.1. Kurzeme Ring 3rd stage “Ventspils-Tume-Imanta”

Co-financed by the European Union
Connecting Europe Facility

The Latvian electricity transmission network 330 kV project Kurzeme Ring 3rd stage "Ventspils-Tume-Imanta" implementation activities have been continued in 2017. The Ventspils-Tume-Imanta electricity transmission line project is included in the following development documents of Latvia and Europe:

- Ten year Network development plan of transmission power system of Latvia,
- ENTSO-E Pan-European Ten Year Network Development Plan of transmission network,
- List of Projects of Common Interest (hereinafter - PCI) with Nr.4.4.1;
- In March 2015, the Cabinet of Ministers of the Republic of Latvia has allocated the status of a National Interest Object to the Kurzeme Ring project.

The whole Kurzeme Ring project will provide the necessary infrastructure for the development of wind farms in the Kurzeme region, will connect the two largest (Western and

Central) production and consumption regions of Latvia, as well as provide additional capacity for full utilization of 700 MW DC link between Sweden and Lithuania (NordBalt project).

In 2017 active work of Project implementation continued using the 45 % European Union co-financing from Connecting Europe Facility (CEF) grants. In July 2017, the first power transmission line pylons were installed and the first 330 kV wires were installed. Construction permits have been received for all stages of construction, and in 2017 active construction works of the transmission line have been continued. By the end of 2017 approx. 30 % of the line pylons were installed and ~25 % of wires were installed. The 330 kV power transmission line is constructed on existing 110 kV line routes and in parallel to the construction of the 330 kV line, works of existing 110 kV substations reconstruction and transit current rating increase of these substations have continued. All mentioned works will increase the security of supply for all Kurzeme region.

The implementation and commissioning of the project is planned by the end of 2019.

4.2.2. Third electricity interconnection between Estonia and Latvia

Co-financed by the European Union
Connecting Europe Facility

In cooperation with the Estonian transmission system operator and the owner of Latvian transmission system, the development of the third Estonia-Latvia electricity interconnection between the 330 kV substations Riga CHP-2 in Latvia and Killingi-Nomme in Estonia is ongoing. The project is implemented using European Union 65 % co-financing of the total project costs in Latvia and Estonia and co-financing is granted from Connecting Europe Facility funds. This interconnection will increase the available transmission capacity between Latvian and Estonian electricity systems and eliminate the congestion in the cross-section of Estonia-Latvia, which currently limits the volume of electricity trade between the Baltic and Nordic countries. The Estonian-Latvian third interconnection project is considered to be one of the most important projects for the whole Baltic Sea Region, as it will facilitate the increase of the transmission capacity of the Estonia-Latvia cross-section by 500/600 MW in the normal operation modes and by 300/500 MW in isolated mode of operation. Estonian-Latvian third interconnection is also one of the backbone projects in the Baltic transmission network, preparing the Baltic States for synchronous operation with electricity networks of Continental Europe. Consequently, the third Latvian-Estonian interconnection, just like the Kurzeme Ring project, is included in the following development documents in Latvia, Estonia and Europe:

- Ten year development plan of transmission power system in Latvia,
- Ten year development plan of transmission power system in Estonia,
- ENTSO-E Pan-European Ten Year Network Development plan of transmission network,
- List of Projects of Common Interest with Nr. 4.2.1,
- With decision of Cabinet of Ministers of the Republic of Latvia project has allocated the status of a National Interest Object in Latvia.

On November 9, 2016, a procurement procedure for the design and construction work has been announced in the territory of Latvia until the Estonian-Latvian border and on February 1, 2018 an agreement with the constructor on the implementation of the project in the territory of Latvia has been concluded. In Estonia, the construction of the transmission line route consists of a section between the 330 kV substation Kilingi-Nomme to the Estonian-Latvian border and with 330 kV Harku-Sindi line, which is a reinforcement of the internal network in Estonia for secure and stable operation of the interconnection. In September 2017, the Estonian TSO concluded agreement with the constructor about implementation of the 330 kV transmission line Harku-Sindi. The Estonian-Latvian border crossing point has been selected and coordinated between the two operators, as well as between the responsible authorities of both countries and between border guards.

The project in the territory of Latvia is constructing along existing 110 kV transmission line routes and in the section from Saulkrasti to Riga CHP-2 substation along the common route with the European Rail project "Rail Baltica" in Latvia.

The planned commissioning date of third interconnection between Latvia and Estonia is end of 2020.

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

Co-financed by the European Union
Connecting Europe Facility

The work on the Latvian electricity transmission network reinforcement project Riga CHP-2 – Riga HPP has been continued in 2017. Riga CHP-2 – Riga HPP project is internal reinforcement of Latvian electricity transmission network that will provide the full functionality of the third Estonia-Latvia interconnection during repair and maintenance modes in the transmission network of Riga region. At the regional level, this network reinforcement will play an important role in increasing the transmission capacity of the Baltic region in the North-South direction, because after the Baltic States have interconnected into the Nordic and Polish electricity systems, the internal reinforcement of the Baltic electricity transmission network is necessary to provide possibility of power flows transmission in north-south direction.

Riga CHP-2 - Riga HPP project is included in following Latvian and European development documents:

- Ten year development plan of transmission power system in Latvia,
- ENTSO-E Pan-European Ten Year Network Development plan of transmission network,
- List of Projects of Common Interest with Nr. 4.2.3.

Taking into account the project significance not only for Latvia but also at the European level the project has received 50 % EU co-financing from the CEF funds, and in May 2017 an agreement between AST and European Innovation and Network Executive Agency has been signed.

The selected route of project affects only one municipality (Salaspils municipality) in territory of Latvia. In April 2017, a public consultation on the project took place in the municipality of Salaspils, where participated representatives of the TSO, representatives from the municipality of Salaspils and the land owners of the affected areas. The Salaspils municipality confirmed it support of project implementation and in July 2017 the Environmental State Bureau issued technical requirements for the implementation of the project in compliance with environmental protection requirements and regulations.

Based on the results of the public consultation and considering the importance of the project for Latvia, for the Baltic and for the whole Europe, on August 16, 2017, the Cabinet of Ministers allocated the status of the National Interest Object for the Riga CHP-2 – Riga HPP project.

On 30 of October 2017 a procurement procedure for transmission line design and construction works has been announced, and on 27 of August 2018 a contract with constructor for the implementation of the project has been signed.

The planned commissioning date of the project is end of 2020, before implementation of third Estonia-Latvia interconnection.

4.2.4. Reconstruction of the existing 330 kV interconnections between Latvia and Estonia.

During development of the Baltic States synchronization project (see detailed description in chapter 4.2.5), also reconstruction of existing 330 kV transmission lines Valmiera (Latvia) - Tartu (Estonia) and Valmiera (Latvia) - Tsirguliina (Estonia) is planned, increasing the transmission capacity in the cross-border between Latvia and Estonia. As mentioned in chapter 4.1 the modernization of these two interconnections will completely eliminate capacity limitations in the cross-border between Estonia and Latvia after 2020, when the third Estonian-Latvian interconnection will be commissioned, as well as to ensure a secure and stable transmission network operation during Baltic States synchronization mode with continental Europe and desynchronization from IPS/UPS. Additionally to mentioned above, both electricity transmission lines were built in the 60s and 70s of the last century (during the Soviet Union period), and building standards of these lines does not longer correspond to existing operational and maintenance requirements, for example, the differences between transmission capacities values on winter and summer seasons impose the optimal and efficient functioning of electricity market. These electricity transmission lines should be completely replaced by new, with high transmission capacity to provide a higher total electricity transmission capacity in the North-South direction in the Baltic region. The reconstruction of both lines is planned immediately after the commissioning of third 330 kV interconnector between Estonia and Latvia, and the commissioning of both projects is expected till 2024.

Both of these projects are included in the Latvian and European Pan-European Ten Year Network Development plans and are included in the list of Projects of Common Interest with No.4.8.1 and No.4.8.3, and projects are essential for the Baltic Synchronization project with Continental Europe. The both projects are candidates for European Union co-financing from CEF funds.

4.2.5. Baltic States synchronization with continental Europe transmission networks and de-synchronization from Russian power system

In 2017 work of Baltic power systems synchronization continental Europe networks was continuing.

According to "Synchronization roadmap" approved by the Baltic TSOs in 2014, the Baltic TSOs in 2017 started activities for isolated operation test preparation to identify wether the Baltic electricity system is able to work in isolated mode independently from other electricity systems. Study of isolated operation of Baltic countries has been finalized in August 2017 with 50 % European co-financing support from the CEF funds, concluded that isolated operation of Baltic States is technically possible, requiring at least two years to prepare for it, and which will require additional investments for testing and possibly for modernization of equipment.

At the end of 2017, the TSOs from Baltic States and Poland launched a dynamic stability study in order to analyze the potential extension of the Continental European system with Baltic electricity systems and its impact to the continental Europe networks. The study has been prepared by consultant from Poland – Institute of Power Energy of Gdansk. At the beginning of 2018, the Baltic States, in co-operation with the ENTSO-E, launched a frequency stability study to test the ability of the Baltic States to provide frequency regulation capacity for synchronization with Continental Europe and to evaluate the possible costs associated with it. The study was prepared by the German energy consultant "Consentec" in cooperation with the Stuttgart Energy Institute. Both studies were completed in June 2018, and the results were presented to the competent authorities in the Baltic States, Poland and Europe. On June 28, 2018, the Prime Ministers of the Baltic States and the President of the European Commission signed a synchronization road map with recommendation to start the necessary steps for synchronization with continental Europe and de-synchronization with the Russian power system. After evaluating of both studies results, the Baltic and Polish TSOs with the support of the ENTSO-E agreed to carry out additional study to identify additional measures and costs necessary for the Baltic synchronization with Continental Europe. Additional study was prepared during June till August 2018, and has been prepared Gdansk Energy Institute from Poland. Based on the last study conclusions, as well as the conclusions and recommendations of the previous studies, prepared in 2018, on 14 of September 2018, the European Commission gave "green light" for the Baltic States synchronization with Continental Europe and recommended to start further technical steps and procedures of Baltic States synchronization. The synchronization scenario between Lithuania and Poland is selected as better option from economical and secure point of view, using a double-circuit AC interconnection Alytus-Elk and with construction of an additional DC interconnector between Poland and Lithuania. In addition, inertia provision measures are necessary with installation of synchronous condensers in the Baltic States and, if necessary, the installation of battery energy storages systems, in order to ensure frequency control and regulation in synchronization mode.

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 paragraph 4.2 will provide secure and reliable operation of transmission network, the power consumption and generation adequacy, stable operation of power stations and electricity transit through Latvia and the Baltic countries, as well as eliminate Baltic countries' energy island operation and connecting it to the power transmission networks of Europe. Despite the fact that after the implementation of regional direct current interconnections with Finland, Sweden and Poland, the Baltic States interconnection transmission capacity has increased, as well as electricity transit through the Latvian electricity transmission networks has decreased insignificantly. In the long term, one of the possible solutions is to stimulate all Latvian, Estonian and Lithuanian power plants to participate in the "Nord Pool” electricity market and promote the electricity market liquidity.

330 kV and 110 kV transmission network is planned to be reconstructed, modernized and developed, according to the electricity transmission system development plan, elaborated by AST and approved by the Public Utilities Commission (PUC). Mentioned plan is published in the AST and PUC websites. In parallel with the development of 330 kV transmission network, the 110 kV transmission network has also to be developed, especially in places where the requirements of reliability n-1 criterion are not realized. In 110 kV network planned 110 kV substation reconstructions are proposed, as well as the planned replacement of aged transformers. In addition to the completed 330 kV loop network around Riga, in Riga region it is necessary to reconstruct the 110 kV substations and improve the 110 kV network in order to increase security of energy supply.

4.4. Existing generation capacities on January 1, 2017, greater than 1 MW.

Latvian power system power stations with installed capacity above 1 MW are presented in the Table 30:

Table 30

No	Station name	Installed capacity (MW)
Natural gas co-generation stations		

1	BK Enerģija	3.9
2	Daugavpils siltumtīkli PAS	3.9
3	DLRR Enerģija SIA	1.698
4	Energy & Communication, AS	3.9
5	LATNEFTEGAZ SIA	3.986
6	Rēzeknes siltumtīkli SIA	5.572
7	Dobeles enerģija SIA	1.5
8	Fortum Latvia, SIA	3.996
9	WINDAU, SIA	3.8
10	Elektro bizness SIA	3.6
11	Mārupes siltumnīcas SIA	1.99
12	Olainfarm enerģija AS	2
13	Olenergo AS	3.12
14	SABIEDRĪBA MĀRUPE, SIA	2
15	Sal-Energo, SIA	3.99
16	VANGAŽU SILDSPĒKS, SIA	2.746
17	Zaļā dārzniecība SIA	1.999
18	Biznesa centrs Tomo SIA	1
19	Rīgas siltums AS	2.4
20	RTU Enerģija SIA	1.56
21	Uni-enerkom, SIA	2.997
22	LIEPĀJAS ENERĢIJA, SIA	4
23	SALDUS SILTUMS, SIA	1.3
24	VALMIERAS ENERĢIJA, AS	4
25	Juglas jauda, SIA	14,9
Biomass and biogas power stations		
1	AD Biogāzes stacija, SIA	1.96
2	Agro Iecava, SIA	1.95
3	Conatus BIOenergy, SIA	1.96
4	Bioenerģija-08, SIA	1.98
5	Biodegviela, SIA	2
6	BIO ZIEDI, SIA	1.998
7	DAILE AGRO, SIA	1
8	Getliņi EKO, BO SIA	5.24
9	Grow Energy, SIA	1.996
10	KŅAVAS GRANULAS, SIA	1
11	LIEPĀJAS RAS, SIA	1
12	RIGENS, SIA	2.096
13	Zaļā Mārupe, SIA	1
14	GRAANUL INVEST, SIA	6.492
15	Krāslavas nami, SIA	1
16	Liepājas Enerģija, SIA	2.5
17	GAS STREAM SIA	1
18	BIO FUTURE, SIA	1
19	Pampāļi, SIA	1
20	EcoZeta, SIA	1.4
21	Saldus enerģija,SIA	1.862
22	BIOEninvest, SIA	1

23	Priekules Bioenerģija, SIA	2.4
24	Piejūras energy, SIA	1.6
25	Agro Lestene, SIA	1.5
26	OŠUKALNS, SIA	1.4
27	EGG Energy SIA	1.996
28	Fortum Jelgava SIA	23,82
29	RĪGAS SILTUMS AS	4
30	Agrofirma Tērvete AS	1.5
31	Zaļās zemes enerģija SIA	1
32	International Investments SIA	1
33	SM Energo SIA	1.1
34	Enefit power un Heat Valka SIA	2.4
35	TURBO ENERĢIJA SIA	1.95
36	Betula Premium SIA	1.9
37	Incukalns Energy SIA	3.999
38	Graanul Pellets Energy SIA	3.99
39	PREIĻU ENERĢĒTIKA SIA	1.15
40	JE Enerģija SIA	1
41	ENERGY RESOURCES CHP RSEZ SIA	3.98
42	TUKUMS DH SIA	1.25
43	Technological solutions SIA	3.980
44	DJF SIA	1.499
45	Dobeles EKO SIA	3.990
46	EKO NRG SIA	3.390
47	Energia Verde SIA	4
48	Rīgas Enerģija SIA	4
Wind power stations		
1	Baltnorvent, SIA, Alsungas VES	2
2	BK Enerģija, SIA	1.95
3	Enercom Plus, SIA	2.75
4	Impakt, SIA Užavas VES	1
5	Lenkas energo, SIA Lenkas VES	2
6	VĒJA PARKS 10, SIA	1.8
7	VĒJA PARKS 11, SIA	1.8
8	VĒJA PARKS 12, SIA	1.8
9	VĒJA PARKS 13, SIA	1.8
10	VĒJA PARKS 14, SIA	1.8
11	VĒJA PARKS 15, SIA	1.8
12	VĒJA PARKS 16, SIA	1.8
13	VĒJA PARKS 17, SIA	1.8
14	VĒJA PARKS 18, SIA	1.8
15	VĒJA PARKS 19, SIA	1.8
16	VĒJA PARKS 20, SIA	1.8
17	WINERGY, SIA	20.7
18	Silfs V SIA	1.1
19	Ainažu VES, Latvenergo AS	1
20	Vides enerģija SIA	6.9
Hydro power plants		

1	Spridzēnu HES, SIA	1.2
Latvenergo power plants		
1	Ķeguma HES	240.1
2	Rīgas HES	402
3	Pļaviņu HES	894
4	Rīgas TEC-1	144
5	Rīgas TEC-2	881
6	Aiviekstes HES	1.32

4.5. Actions during maximum demand or supply deficit periods.

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

4.6. Recommendations and conclusions prepared by TSO

- During the next 10 years, a generating capacity deficit is expected in Latvia and in the all Baltic countries as well. Nearly half of the large generation capacity of thermal power plants (2300 MW) generally in Lithuania and Estonia will be closed in the Baltic States.
- Interconnection reinforcements of the transmission network and closer integration of the Baltic power systems in the European electricity market will play an increasing role in covering the demand of electricity.
- In order not to reduce the security of Latvia's electricity supply in the next decade it is important to ensure that the generation capacity of Latvia is not diminished.
- Due to reduce of generating capacity in Latvia and in the Baltics, is necessary to stimulate the elasticity of electricity demand in order to ensure balancing resources in the power system to ensure continuous balance between supply and demand of electrical energy.
- The share of large, conventional generating capacities will decrease in the coming years, but the role of small, decentralized generation and active consumers will increase, in Latvia it is necessary to introduce a national electricity data exchange platform in order to promote the digitization of the power system and ensure the involvement of decentralized generation add active consumers in balancing of energy systems and provision of reserves.
- On 28 of June 2018 the political decision has been done for Baltic States synchronisation with continental Europe and de-synchronisation from Russia and Belarus. According this power adequacy forecast after 2025 assumed that Baltic power systems are working synchronously with continental Europe.

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