

FORECASTING OF ELECTRICITY DEMAND IN THE INDUSTRY SECTOR USING LATVIAN MULTISECTORAL MODEL

Velga Ozoliņa, Mg.oec., Riga Technical University,

8 Indrika Str., Riga, LV-1004, Latvia

e-mail: velgo@sesmi.lv

Remigijs Počs, Dr.habil.oec., Prof., Riga Technical University,

8 Indrika Str., Riga, LV-1004, Latvia

Phone: +371 7089655, Fax: +371 7089683, e-mail: rpocs@rtu.lv

Economic development is to a great extent connected with energy consumption. On one hand, it is not possible to produce something or provide services without energy resources. On the other hand, growing amount of production require more energy.

Such a relationship holds also to electricity consumption and GDP in Latvia, as it is seen in Figure 1. One of the major electricity consumers in Latvia is industry. 42.5% of all the electricity in 1990 was consumed in this sector. Regaining freedom at the beginning of 1990's, Latvia's production potential decreased together with the power consumption not only in industry, but also in other sectors.

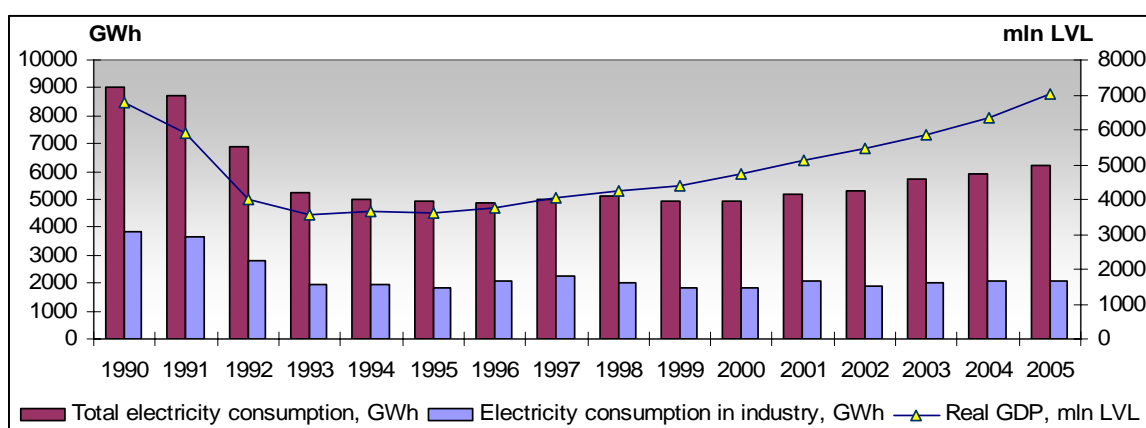


Figure 1. Dynamics of electricity consumption and GDP in Latvia

While different changes occurred in the economy, the share of industry in electricity consumption gradually lowered to 33.5% in 2005 (see Figure 2). Comparing to other electricity consumer groups, industry is still the most important power consumer.

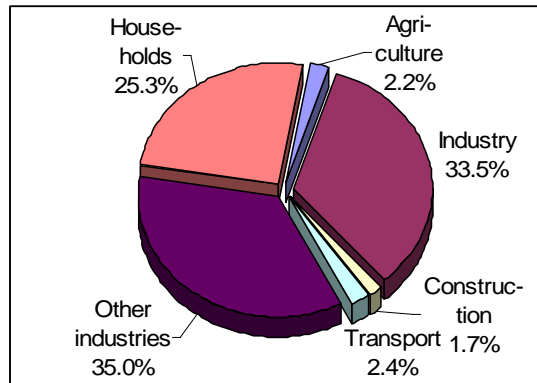


Figure 2. Structure of electricity consumption in 2005, %

Electricity consumption in industry is largely connected with the amount of produced goods. Power consumption in industry (C+D+E)¹ fell together with the decline of output as it is seen in Figure 3. The greatest drop of electricity in industry similarly as in dynamics of the whole electricity consumption was observed in 1992 and 1993, when the amount of consumed power decreased by 20.8% and 23.9% respectively. In 1990 – 2005 there are similar trends in electricity consumption and output dynamics – output grows or declines together with consumption, with exceptions of 1998, 2000 and 2002.

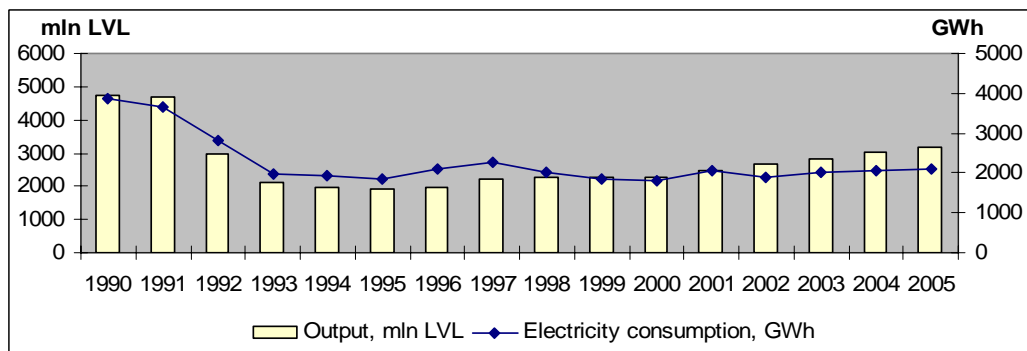


Figure 3. Electricity consumption and output in industry

In the majority of branches of industry electricity consumption has decreased – most of all in manufacture of chemicals and chemical products (D24) – by -491 GWh and in manufacture of fabricated metal products, machinery and equipment, electrical machinery and apparatus and radio, television and communication equipment and apparatus (D28 – D32) – by -450 GWh – branches, which in 1990 were the largest electrical power consumers. During this period electricity consumption has grown only in manufacture of basic metals (D27) and manufacture of rubber and plastics products, medical and surgical equipment and orthopaedic appliances, furniture, manufacturing n.e.s. and recycling (D25; D33; D36; D37). Comparatively large increase is observed in manufacture of wood and wood products (D20), which in 2005 has become the major electricity consumer with 388 GWh (see Figure 4).

¹ Here and further in the brackets – industries and branches by NACE - Classification of Economic Activities in the European Community

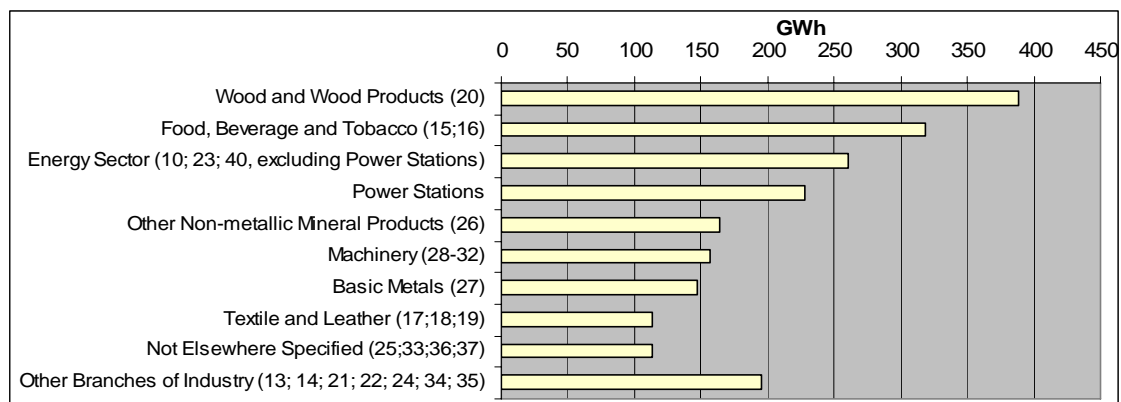


Figure 4. Electricity consumption in the branches of industry in 2005

The analysis of coefficients of electricity consumption to industrial output, which are given in Table 1, shows that in the majority of branches of industry values of these coefficients are decreasing. A decline is particularly evident in manufacture of other non-metallic mineral products (D26) and manufacture of chemicals and chemical products (D24). Decrease in the value of the coefficient in manufacture of chemicals and chemical products (D24) is stepwise – larger falls (in 2000 and 2005) change with the smaller ones. Similar situation is observed in manufacture of textiles, wearing apparel and dressing (D17 – D19), where in 1999 the value of the coefficient is even increasing by a substantial amount.

These coefficients in manufacture of wood and wood products (D20) and in manufacture of motor vehicles, trailers and semi trailers and other transport equipment (D34; D35) do not follow a clear trend of decrease – the values are rather levelling out. However, a small increase in the values of these coefficients is evident in manufacture of pulp, paper and paper products and publishing and printing (D21; D22).

Table 1
Coefficients of Electricity Consumption to Industrial Output in the Branches of Industry, kWh/LVL (at prices of 2000)

Branches of Industry	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Food, Beverage and Tobacco ² (15-16)	0,656	0,574	0,590	0,597	0,640	0,612	0,594	0,560	0,543	0,483	0,490
Textile and Leather (17-19)	1,723	1,477	1,483	1,379	1,609	1,504	1,435	1,457	1,358	1,196	0,650
Wood and Wood Products (20)	1,054	0,869	0,796	0,773	0,807	0,812	0,843	0,720	0,690	0,721	0,760
Pulp, Paper and Printing (21; 22)	0,594	0,507	0,241	0,178	0,222	0,303	0,226	0,297	0,299	0,316	0,288
Chemical, incl. Petrochemical (24)	2,259	2,032	1,857	1,799	1,854	1,413	1,352	1,259	1,276	0,962	0,922
Other Non-metallic Mineral Products (26)	2,785	2,459	2,877	2,128	1,854	1,874	1,568	1,357	1,217	0,990	1,245
Machinery ³ (28-32)	1,115	1,129	0,898	0,954	1,151	0,983	1,025	0,749	0,635	0,599	0,569
Transport Equipment (34; 35)	1,260	1,596	1,965	1,834	1,747	1,331	1,456	1,360	1,428	1,144	1,227

² To industrial output in manufacture of food products and beverages (15)

³ Industrial output does not include manufacture of office machinery and equipment (30)

Further follows the evaluation of relations between electricity consumption and output in separate branches of industry.

In manufacture of food products, beverages and tobacco products (D15; D16), which is one of the major electricity consumers in industry, relationship between electricity consumption and industrial output is not very close, as it is seen in Figure 5. In 2000, 2002 and 2004 electricity consumption in these branches decreases in spite of increase in output. Moreover, output of manufacture of food products and beverages (D15) in 1992 – 1995 is dropping significantly – by more than 60% while electricity consumption in this branch together with manufacture of tobacco products decreases only by 20%. It can be partly explained with the fact that output is given only for manufacture of food products and beverages (D15)⁴, but electricity consumption also for manufacture of tobacco products (D16). Coefficient of correlation between these indicators in 1995 – 2005 is only 0.567. Value of this coefficient in 1995 – 2003 is 0.769, which means that in past few years electricity consumption in these branches is influenced not only by output, but also by other factors.

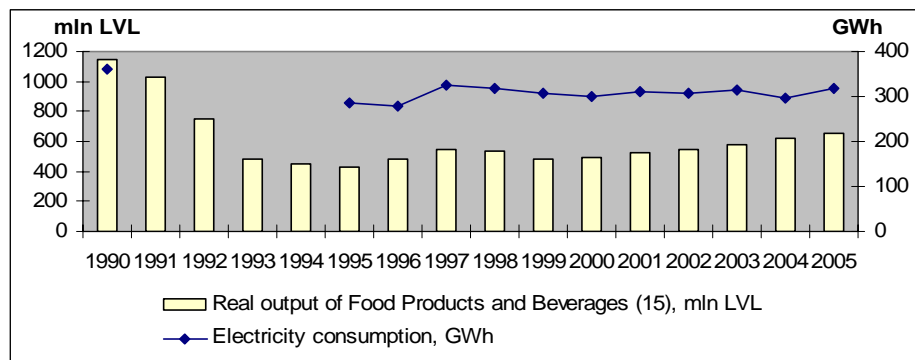


Figure 5. Indicators of manufacture of food products, beverages and tobacco products

Other indicator, which is connected with possible amount of production and electricity consumption, is number of employed in respective industry or branch. On one hand, employees are the ones, who operate machinery and equipment, which consumes power. On the other hand, there is also need for lighting (depending on specific features of working area, time and weather). Despite that, electricity consumption and employment dynamics in manufacture of food products, beverages and tobacco products (D15; D16) are opposite in some years (see Figure 6), value of the coefficient of correlation in 1997 – 2004 is 0.819, which indicates on comparatively close relationship among these indicators.

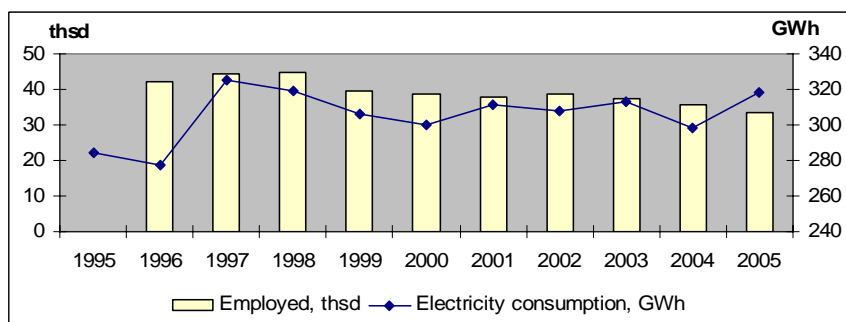


Figure 6. Indicators of manufacture of food products, beverages and tobacco products

⁴ Database of Central Statistical Bureau of Latvia does not provide information on gross industrial output indices of branches 16., 23., 27., 30., 33. and 37. by NACE classification

Dynamics of electricity consumption and output in manufacture of textiles, wearing apparel, furs, leather and leather products (D17 – D19) is not fully consistent – in 1998, 2001 and 2003 – 2005 together with increase of output, electricity consumption declines a little, as it is shown in Figure 7, and in 1999 the trend is adverse.

In these branches output as well as electricity consumption in 2000 – 2003 fluctuates only slightly – range of output (maximum minus minimum value of output) to its average value is only 7.8% and amplitude of electricity consumption is only 5% of its average value. Value of the coefficient of correlation in 1995 – 2003 is pretty high – 0.805. Nevertheless, adverse tendencies in 2004 and 2005 limit potential use of this relation in forecasting.

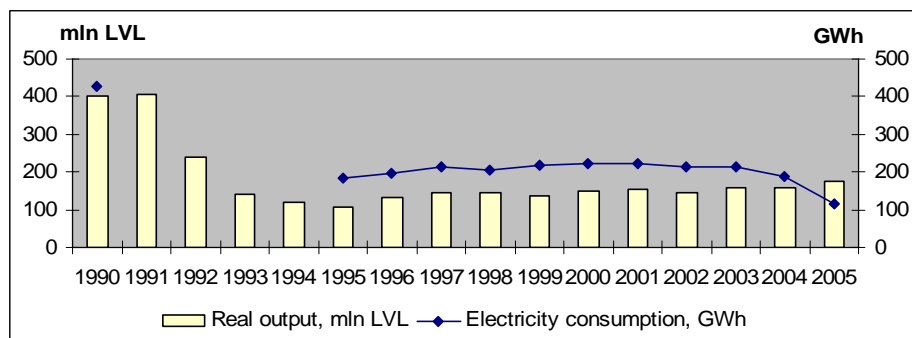


Figure 7. Indicators of manufacture of textiles and leather

Differences in dynamics of output and employment in manufacture of textiles, wearing apparel, furs, leather and leather products (D17 – D19) determine the differences of relations of these indicators to electricity consumption in these branches. Figure 8 illustrates time series of employment and electricity consumption in these branches. Value of the coefficient of correlation indicates close relations between electricity consumption and number of employed. In 1996 – 2005 it is 0.708.

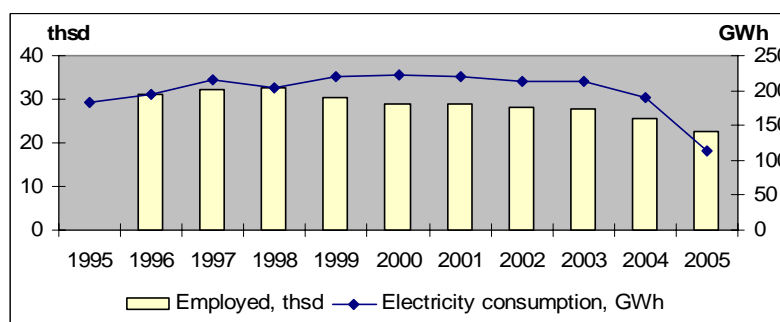


Figure 8. Indicators of manufacture of textiles and leather

In contrast to the majority of branches of industry, whose output decreased dramatically in 1991 – 1993, in manufacture of wood and wood products (D20) decline was negligible, as it is given in Figure 9. Moreover, starting with 1993 output in this branch is only growing. Electricity consumption since 1996 is also increasing and has declined only in 2002. Coefficient of correlation between the output and electricity consumption in 1995 – 2005 is 0.985, which indicates a close relation between these indicators.

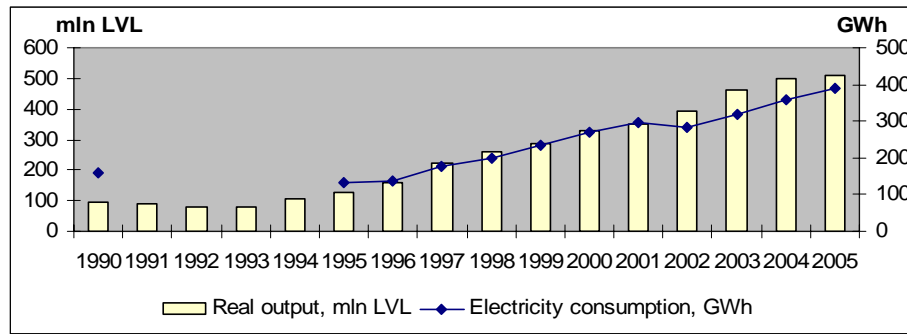


Figure 9. Indicators of manufacture of wood and wood products

Output in manufacture of chemicals and chemical products (D24) in 1992 – 2000 has declined (a small increase is observed in 1997) and thereafter has mainly increased, as it is illustrated in Figure 10. Similar trends are present also in electricity consumption dynamics in this branch, however, since 2002 tendencies in both time series differ. As the value of the coefficient of correlation in 1995 – 2005, which is 0.883, indicates a close relationship between these indicators, output can be used as a factor influencing electricity consumption.

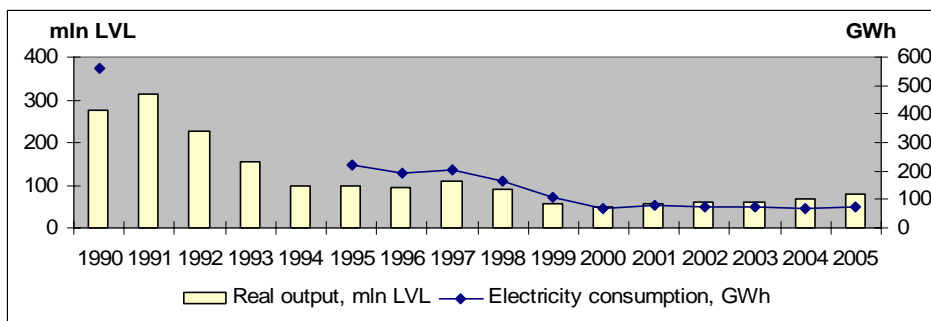


Figure 10. Indicators of manufacture of chemicals and chemical products

In manufacture of other non-metallic mineral products (D26) dynamics of electricity consumption and output is similar starting with 1998 (see Figure 11). Since 2001 output is increasing much faster than electricity consumption, which in 2004 did not even change, comparing with 2003. The coefficient of correlation in 1995 – 2005 is 0.796, therefore the relation between these indicators exist.

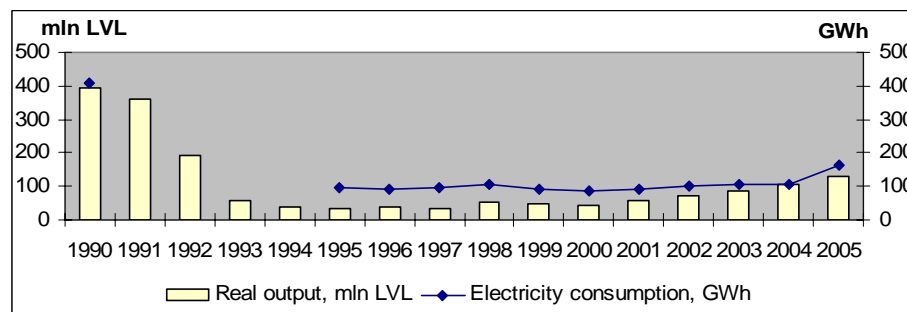


Figure 11. Indicators of manufacture of other non-metallic mineral products

As there are no data available for real output in manufacture of basic metals (D27), electricity consumption is analysed together with the number of employed in this branch. With the exception of 2000, dynamics of electricity consumption and employment are similar,

as it is presented in Figure 12. This relationship is confirmed also with the value of the coefficient of correlation, which in 1996 – 2005 is 0.881.

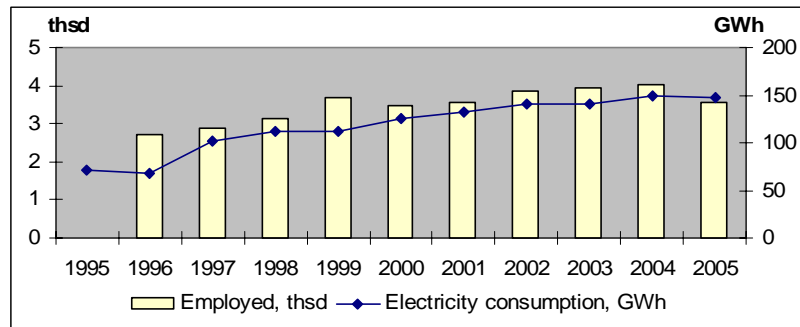


Figure 12. Indicators of manufacture of basic metals

Analysis of electricity consumption and output in manufacture of fabricated metal products, machinery and equipment, electrical machinery and apparatus and radio, television and communication equipment and apparatus (D28 – D32) reveals that dynamics of these time series differ only in 1996 and 2002 (see Figure 13). However, the value of the coefficient of correlation, which is 0.169 in 1995 – 2005 and not more than 0.5 in shorter periods of time, deny possible relationship between these indicators.

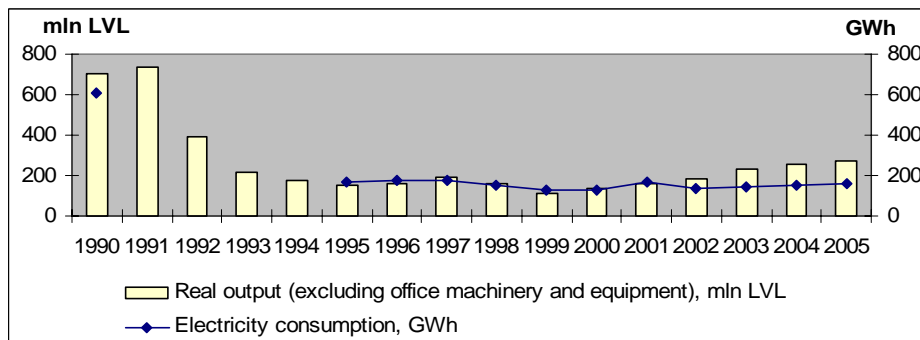


Figure 13. Indicators of manufacture of machinery

Electricity consumption in manufacture of rubber and plastics products, medical and surgical equipment and orthopaedic appliances, furniture, manufacturing not elsewhere specified and recycling (D25; D33; D36; D37) till 1998 does not seem to relate to the output in manufacture of rubber and plastics products and furniture and manufacturing not elsewhere specified (D25; D36), but after 1998 these indicators show similar trends, as it is illustrated in Figure 14. Existing relationship between these variables is substantiated also with the coefficient of correlation, which in 1995 – 2005 is 0.934.

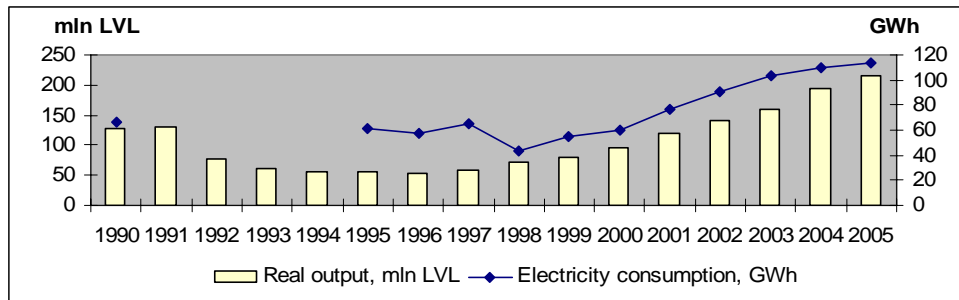


Figure 14. Indicators of manufacturing not elsewhere specified ⁵

Electricity consumption in the rest of the branches of industry is less significant – since 1995 not more than 100 GWh, as it is seen in Figure 15. Trends of electricity consumption in these branches are comparatively stable and in last few years show signs of increase. Electricity consumption in mining and quarrying (C13; C14) grows since 2001, in manufacture of pulp, paper and paper products and publishing and printing (D21; D22) – since 2002 and in manufacture of motor vehicles, trailers and semi trailers and other transport equipment (D34; D35) it grows in 2000, 2003 and 2005.

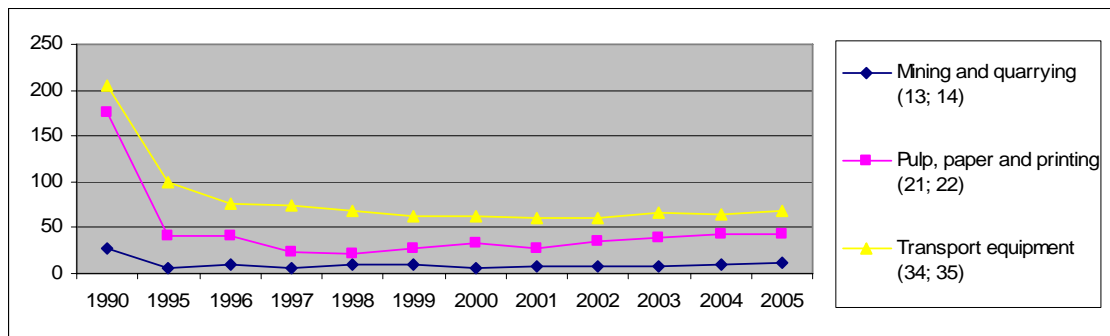


Figure 15. Electricity consumption in other branches of industry, GWh

To the branches of industry belongs also energy sector (C10; D23; E40), which includes also consumption of electric energy in power stations. Electricity consumption in power stations is comparatively stable, though its values change salutatory (see Figure 16). Uneven changes in electricity consumption are observed also in the rest of energy sector. However, here the overall tendency is negative – consumption is gradually decreasing.

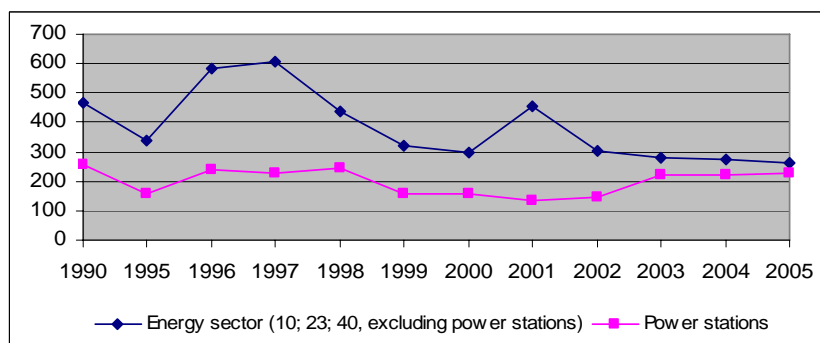


Figure 16. Electricity consumption in energy sector, GWh

⁵ D25 and D36 branches in output, D25, D33, D36 and D37 branches in electricity consumption

Taking into account close relations between electricity consumption and output or employment in majority of branches of industry, appropriate equations have been estimated for electricity consumption forecasting (in brackets t-statistics, R^2 – coefficient of determination, DW – Durbin-Watson criterion, in square brackets – sample). In branches, where such relations were not obvious, trends are used. Electricity consumption in power stations is estimated depending on electricity produced.

$$\begin{aligned} \text{elect_013} &= 0.0781 \cdot \text{out_c} + 6.20 && (1) \\ & \quad (2.6) \quad (7.4) && \\ & && R^2 = 0.49; DW = 1.85 [1997 - 2005], \\ \text{elect_015} &= 2.29 \cdot \text{empl_s015} + 219.01 + 22.32 \cdot \text{d_05} && (2) \\ & \quad (3.5) \quad (8.4) \quad (3.1) && \\ & && R^2 = 0.70; DW = 2.21 [1997 - 2005], \\ \text{elect_017} &= 375.25 \cdot \log(\text{empl_s017}) - 1042.52 && (3) \\ & \quad (7.1) \quad (-5.9) && \\ & && R^2 = 0.91; DW = 1.60 [1999 - 2005], \\ \text{elect_020} &= 0.6432 \cdot \text{out_020} + 43.61 && (4) \\ & \quad (15.1) \quad (3.5) && \\ & && R^2 = 0.97; DW = 1.48 [1995 - 2005], \\ \text{elect_021} &= -44.02 + 31.12 \cdot \log(t) && (5) \\ & \quad (-3.8) \quad (6.7) && \\ & && R^2 = 0.87; DW = 2.46 [1997 - 2005], \\ \text{elect_024} &= 1.44 \cdot \text{out_024} + 286.80 - 116.54 \cdot \log(t) && (6) \\ & \quad (11.4) \quad (11.1) \quad (-14.7) && \\ & && R^2 = 0.99; DW = 2.21 [1995 - 2005], \\ \text{elect_026} &= 1.17 \cdot \text{out_026} + 101.38 - 6.67 \cdot t && (7) \\ & \quad (4.2) \quad (6.8) \quad (-2.5) && \\ & && R^2 = 0.79; DW = 2.11 [1995 - 2005], \\ \text{elect_027} &= -791.78 \cdot (1/t) + 198.20 && (8) \\ & \quad (-12.8) \quad (35.7) && \\ & && R^2 = 0.96; DW = 2.29 [1997 - 2005], \\ \text{elect_028} &= 0.3346 \cdot \text{out_s028} + 158.14 - 5.93 \cdot t && (9) \\ & \quad (3.4) \quad (11.5) \quad (-3.9) && \\ & && R^2 = 0.66; DW = 2.33 [1995 - 2005], \\ \text{elect_034} &= 0.5641 \cdot \text{out_s034} + 92.52 - 21.39 \cdot \log(t) && (10) \\ & \quad (5.3) \quad (7.5) \quad (-5.2) && \\ & && R^2 = 0.92; DW = 2.02 [1995 - 2005], \\ \text{elect_037} &= 0.4160 \cdot \text{out_s037} + 27.97 && (11) \\ & \quad (7.7) \quad (4.0) && \\ & && R^2 = 0.88; DW = 1.56 [1996 - 2005], \\ \text{elect_010} &= 21228.31 \cdot (1/t^2) + 184.77 && (12) \\ & \quad (5.2) \quad (4.3) && \\ & && R^2 = 0.77; DW = 2.36 [1996 - 2004], \\ \text{d(elect_energo)} &= 0.0088 \cdot \text{d(elect_r_tot)} - 3.80 - 83.14 \cdot \text{d_95} + 83.80 \cdot \text{d_03} && (13) \\ & \quad (1.5) \quad (-0.6) \quad (-3.9) \quad (4.0) && \\ & && R^2 = 0.79; DW = 1.86 [1992 - 2005], \end{aligned}$$

where elect_013 – electricity consumption in mining and quarrying (excluding mining of coal and lignite; extraction of peat);

out_c	– real industrial output of mining and quarrying;
elect_015	– electricity consumption in manufacture of food products, beverage and tobacco products;
empl_s015	– number of employed in manufacturing of food, beverage and tobacco;
d_05	– dummy (1990 – 2004 = 0, otherwise = 1).
elect_017	– electricity consumption in manufacture of textile and leather;
empl_s017	– number of employed in manufacture of textile and leather;
elect_020	– electricity consumption in manufacture of wood and wood products;
out_020	– real industrial output of wood and wood products;
elect_021	– electricity consumption in pulp, paper and printing;
t	– time trend (t = 1, 2, 3,...n);
elect_024	– electricity consumption in chemical, incl. petrochemical manufacturing;
out_024	– real industrial output of chemical, incl. petrochemical manufacturing;
elect_026	– electricity consumption in manufacture of non-metallic mineral products;
out_026	– real industrial output of non-metallic mineral products;
elect_027	– electricity consumption in manufacture of basic metals;
elect_028	– electricity consumption in machinery;
out_s028	– real industrial output of machinery (excluding office machinery and equipment);
elect_034	– electricity consumption in manufacture of transport equipment;
out_s034	– real industrial output of manufacture of transport equipment;
elect_037	– electricity consumption in other industry branches;
out_s037	– real industrial output in manufacture of rubber and plastics products and manufacture of furniture; manufacturing not elsewhere specified;
elect_010	– electricity consumption in energy sector (excluding power stations);
elect_energo	– electricity consumption in power stations;
d_95	– dummy (1995 = 1, otherwise = 0);
d_03	– dummy (2003 = 1, otherwise = 0).

In the equations for electricity consumption forecasting in the branches of industry industrial output indicators are used, but in INFORUM model there are indicators of output from National Accounts. In order to use output forecasts obtained with INFORUM model to evaluate future output of the branches of industry, conversion coefficients are used (see Table 2).

In majority of branches values of conversion coefficients for future years are set at the level of 2005. In branches, where these values are showing stable decrease – manufacture of textiles (D17), manufacture of pulp, paper and paper products (D21), manufacture of machinery and equipment (D29), manufacture of other transport equipment (D35) and manufacture of furniture, manufacturing not elsewhere specified (D36) – valued of conversion coefficients keep declining till 2020.

Table 2

Conversion coefficients of industrial output indicators⁶

Branches of Industry	2000	2001	2002	2003	2004	2005
Manufacture of food products and beverages (D15)	0.917	0.753	0.764	0.797	0.829	0.792
Manufacture of textiles (D17)	0.916	0.769	0.667	0.631	0.560	0.520
Manufacture of wearing apparel; dressing and dyeing of fur (D18)	0.434	0.321	0.266	0.235	0.238	0.188
Manufacture of leather and leather products (D19)	0.613	0.168	0.127	0.105	0.125	0.114
Manufacture of wood and wood products (D20)	0.873	0.862	0.889	0.928	0.895	0.725
Manufacture of pulp, paper and paper products (D21)	0.769	0.724	0.709	0.651	0.565	0.513
Publishing, printing and reproduction of recorded media (D22)	0.881	0.913	0.808	0.819	0.814	0.781
Manufacture of chemicals and chemical products (D24)	0.835	0.537	0.544	0.511	0.559	0.571
Manufacture of rubber and plastic products (D25)	0.904	1.180	1.313	1.620	1.923	2.010
Manufacture of other non-metallic mineral products (D26)	0.704	0.753	0.839	0.888	0.921	0.961
Manufacture of fabricated metal products, except machinery and equipment (D28)	0.789	0.780	0.737	0.880	0.837	0.800
Manufacture of machinery and equipment not elsewhere specified (D29)	1.000	0.937	0.907	0.874	0.840	0.710
Manufacture of electrical machinery and apparatus (D31)	0.912	1.028	1.163	1.222	1.129	1.090
Manufacture of radio, television and communication equipment and apparatus (D32)	1.079	1.190	1.224	1.746	1.394	1.050
Manufacture of motor vehicles, trailers and semi-trailers (D34)	0.776	0.920	0.979	1.164	1.565	1.079
Manufacture of other transport equipment (D35)	0.946	0.576	0.494	0.397	0.331	0.295
Manufacture of furniture; manufacturing not elsewhere specified (D36)	0.948	0.889	0.885	0.773	0.724	0.596

Forecasts of average growth rates of output in branches of industry for 2006 – 2020 obtained with INFORUM model are presented in Table 3. After adjustment of the forecasted output, these indicators are incorporated into electricity consumption block of the model as exogenous variables.

Table 3

Output Forecasts of the Branches of Industry (%)

Branches of Industry	2006-2010	2011-2015	2016-2020	2006-2020
Mining of coal and lignite; extraction of peat (C10)	14.3	8.6	6.9	9.9
Other mining and quarrying (C14)	4.8	3.5	3.0	3.8
Manufacture of food products and beverages (D15)	2.4	2.0	1.9	2.1
Manufacture of tobacco products (D16)	4.1	4.5	2.8	3.8
Manufacture of textiles (D17)	10.8	8.1	6.9	8.6
Manufacture of wearing apparel; dressing and dyeing of fur (D18)	8.0	6.7	6.0	6.9
Manufacture of leather and leather products (D19)	4.0	3.6	2.7	3.5
Manufacture of wood and wood products (D20)	10.1	7.9	7.4	8.4
Manufacture of pulp, paper and paper products	8.9	7.0	6.0	7.3

⁶ Industrial output indicator in Latvian Industry statistics to output indicator in National Accounts statistics

(D21)				
Publishing, printing and reproduction of recorded media (D22)	9.9	7.5	6.2	7.9
Manufacture of coke, refined petroleum products and nuclear fuel (D23)	4.6	3.6	3.4	3.9
Manufacture of chemicals and chemical products (D24)	5.1	4.5	4.5	4.7
Manufacture of rubber and plastic products (D25)	8.2	6.3	5.8	6.8
Manufacture of other non-metallic mineral products (D26)	8.2	6.2	6.0	6.8
Manufacture of basic metals (27)	9.4	7.2	6.8	7.8
Manufacture of fabricated metal products, except machinery and equipment (D28)	8.1	6.2	5.9	6.7
Manufacture of machinery and equipment not elsewhere specified (D29)	8.6	6.2	5.8	6.8
Manufacture of office machinery and computers (D30)	8.0	5.5	5.1	6.2
Manufacture of electrical machinery and apparatus (D31)	9.3	6.6	5.8	7.3
Manufacture of radio, television and communication equipment and apparatus (D32)	8.7	5.4	4.5	6.2
Manufacture of medical, precision and optical instruments, watches and clocks (D33)	9.1	6.8	5.8	7.3
Manufacture of motor vehicles, trailers and semi-trailers (D34)	6.2	3.2	2.0	3.8
Manufacture of other transport equipment (D35)	10.9	7.3	6.2	8.1
Manufacture of furniture; manufacturing not elsewhere specified (D36)	9.8	7.2	6.6	7.9
Recycling (D37)	10.6	7.9	7.3	8.6
Electricity, gas, steam and hot water supply (E40)	4.6	4.0	4.0	4.2
Collection, purification and distribution of water (E41)	3.6	2.2	1.1	2.3

Following forecasts are obtained, using output indicators from INFORUM model, adjusting them and inserting in previously given equations.

According to prognoses, electricity consumption in mining and quarrying (C13; C14) would grow from 11 GWh in 2005 to approximately 19 GWh in 2020, as it is illustrated in Figure 17. Corresponding growth rate would therefore be almost 4% a year.

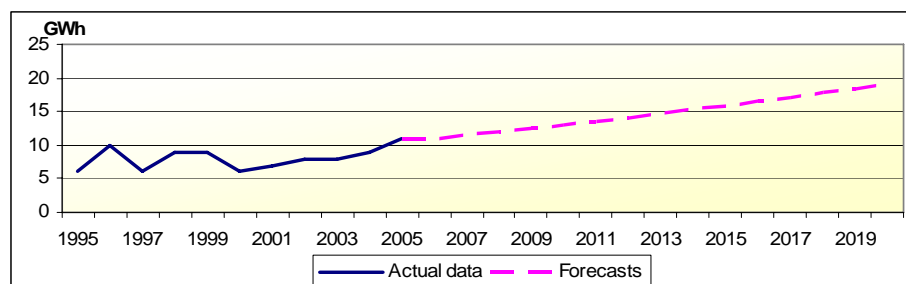


Figure 17. Forecasts of electricity consumption in mining and quarrying, GWh

Amount of consumed electric energy in manufacture of food products, beverages and tobacco products (D15, D16) is forecasted to decrease (see Figure 18). In 2020 electricity

consumption in these branches would be 300 GWh, which roughly corresponds to its average in 1995 – 2005.

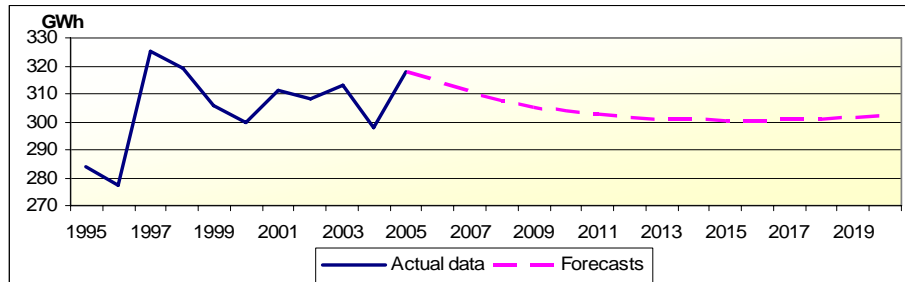


Figure 18. Forecasts of electricity consumption in manufacture of food products, beverages and tobacco products, GWh

In manufacture of textiles, wearing apparel, furs, leather and leather products (D17 – D19) electricity consumption is forecasted to grow from 114 GWh in 2005 to 230 GWh in 2020, as it is seen in Figure 19. Large decline in electricity consumption in 2005 is considered as indistinctive, therefore already in forecasts of 2006 growing electricity consumption is considered.

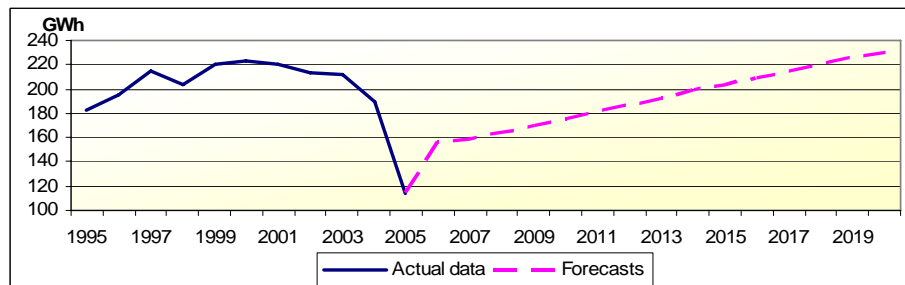


Figure 19. Forecasts of electricity consumption in manufacture of textiles and leather, GWh

Consumption of electric power in manufacture of wood and wood products (D20) is forecasted as continuously increasing. Growing at a rate of about 7% annually, in 2020 it would reach approximately 1150 GWh, as Figure 20 shows.

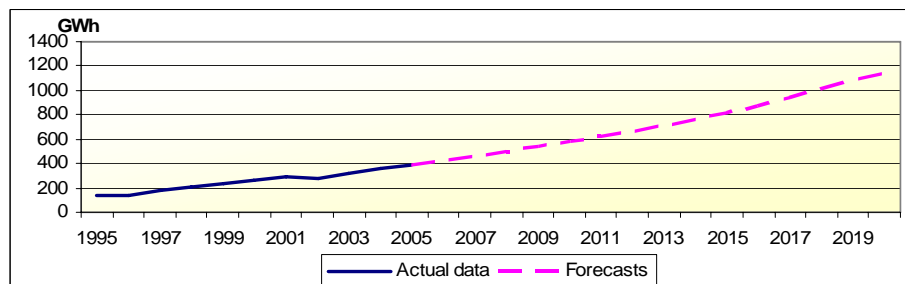


Figure 20. Forecasts of electricity consumption in manufacture of wood and wood products, GWh

In manufacture of pulp, paper and paper products and publishing, printing and reproduction of recorded media (D21, D22) electricity consumption is forecasted to grow 2.6% a year on average. Thereby in 2020 it would be about 63 GWh (see Figure 21)

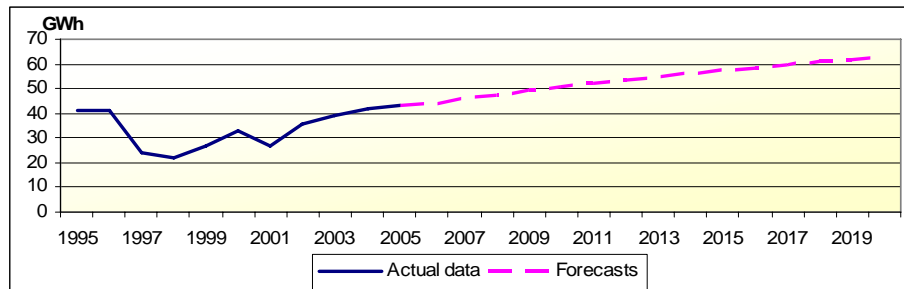


Figure 21. Forecasts of electricity consumption in manufacture of pulp, paper and paper products and printing, GWh.

Electricity consumption in Manufacture of chemicals and chemical products (D24) could increase to 110 GWh in 2020, as Figure 22 illustrates.

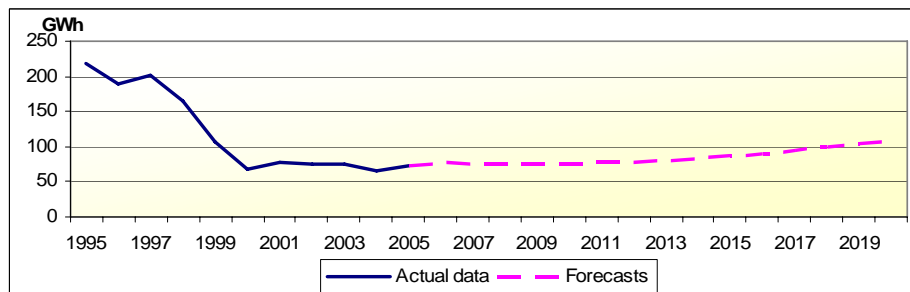


Figure 22. Forecasts of electricity consumption in manufacture of chemicals and chemical products, GWh

According to forecasts, electricity consumption in manufacture of other non-metallic mineral products (D26) could grow from 164 GWh in 2005 to 323 GWh in 2020, as it is seen in Figure 23. Consumption of electric power would grow by 4.6% on average.

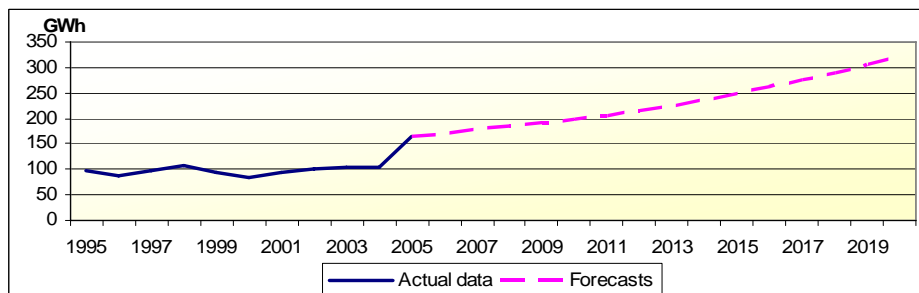


Figure 23. Forecasts of electricity consumption in manufacture of other non-metallic mineral products, GWh.

Prognoses of electricity consumption in manufacture of basic metals (D27) correspond to previous trends of this time series (see Figure 24). In 2020 amount of electric power consumed in this branch would reach 173 GWh.

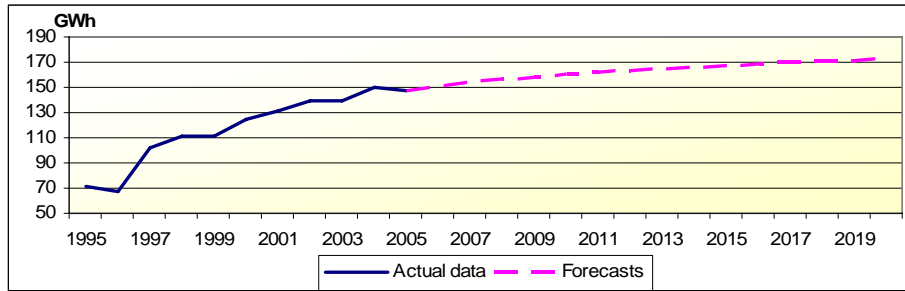


Figure 24. Forecasts of electricity consumption in manufacture of basic metals, GWh

According to the forecasts, electricity consumption in manufacture of fabricated metal products, machinery and equipment not elsewhere specified, electrical machinery and apparatus and radio, television and communication equipment and apparatus (D28 – D32) would grow in the future, as it is seen in Figure 25. With the average growth rate 2% per annum, in 2020 it would be 213 GWh.

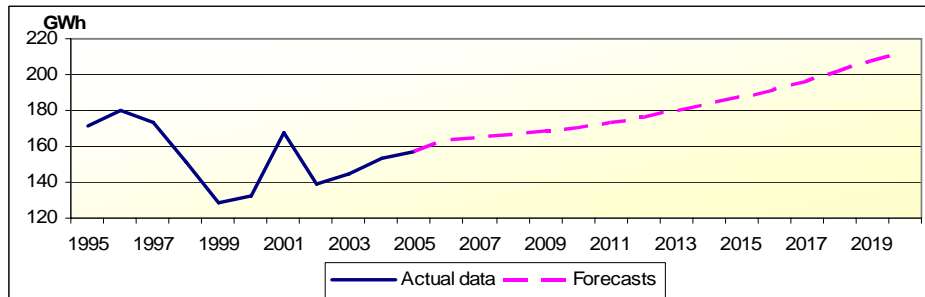


Figure 25. Forecasts of electricity consumption in manufacture of machinery, GWh

It is forecasted that electricity consumption in manufacture of motor vehicles, trailers and semi-trailers and other transport equipment (D34, D35) would increase from 69 GWh in 2005 to 85 GWh in 2020 (see Figure 26).

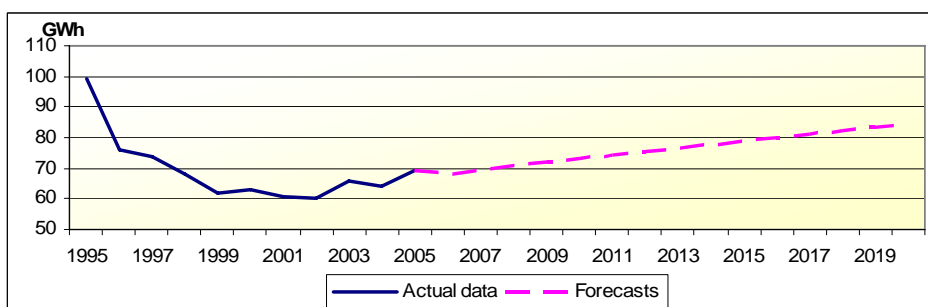


Figure 26. Forecasts of electricity consumption in manufacture of transport equipment, GWh

Electricity consumption in manufacturing not elsewhere specified (D25, D33, D36, D37) is forecasted to be growing. With the growth rate of 5.8% a year, it would reach approximately 265 GWh in 2020, as it is illustrated in Figure 27.

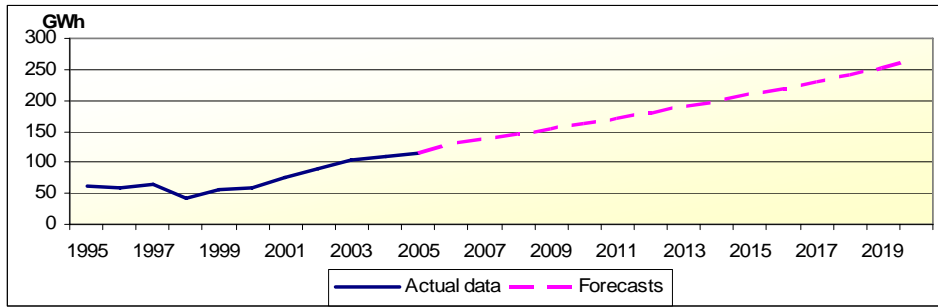


Figure 27. Forecasts of electricity consumption in manufacturing not elsewhere specified, GWh

Using trend to forecast electricity consumption in energy sector (C10, D23, E40 excluding power stations), amount of electrical power consumed would decrease from 260 GWh in 2005 to 205 GWh in 2020 (see Figure 28).

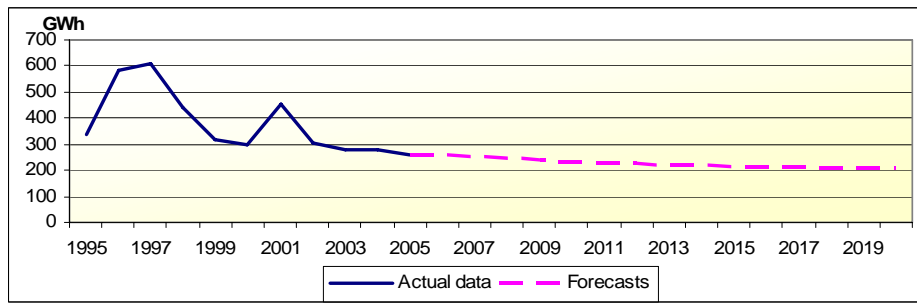


Figure 28. Forecasts of electricity consumption in energy sector (excluding power stations), GWh

Forecasts obtained in modelling electricity consumption in power stations as a function of electric power produced show that electricity consumption in this sector would decline with the exception of 2009, when it is planned to commission TEC-2 after its reconstruction (see Figure 29). In order to evaluate credibility of these forecasts, additional information is needed, including sources of electricity use in power stations and possibilities to improve efficiency of electricity consumption.

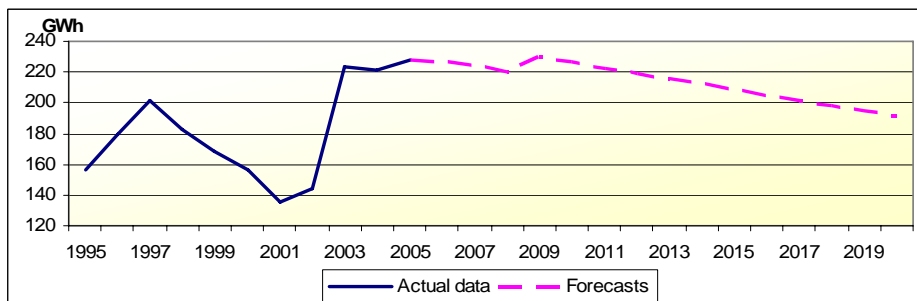


Figure 29. Forecasts of electricity consumption in power stations, GWh

Summing up forecasts shown above, prognoses for electricity consumption in industry are obtained. According to these forecasts, electricity consumption in industry will grow from 2085 GWh in 2005 to approximately 3330 GWh in 2020 (with the growth rate about 3% a year), as it is shown in the Figure 30.

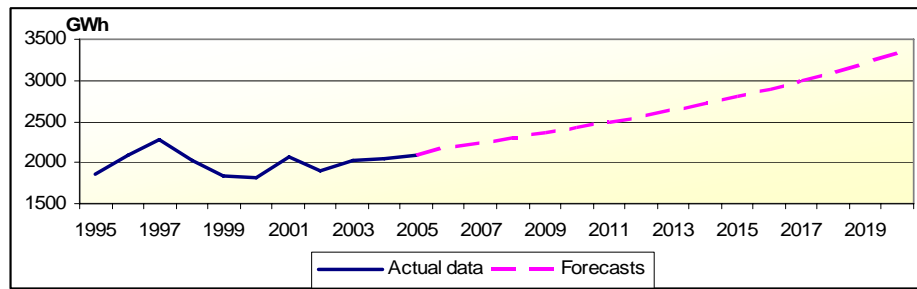


Figure 30. Forecasts of electricity consumption in industry, GWh

By adding forecasts of electricity consumption of other industries and consumer groups as well as forecasts of electricity losses to prognoses of power consumption in industry, forecasts of total electricity consumption in Latvia are obtained. As it is seen in Figure 31, total electricity consumption could reach 11.4 TWh in 2020.

Comparing these forecasts with possible amounts of produced electricity in Latvia – on average 2.8 TWh in Daugava's HPP, 3.3 TWh in Riga's CHPs after 2009 and from 0.5 TWh to 1.1 TWh produced in other plants – it is possible to assess the problems of increasing production capacity of electricity and imports.

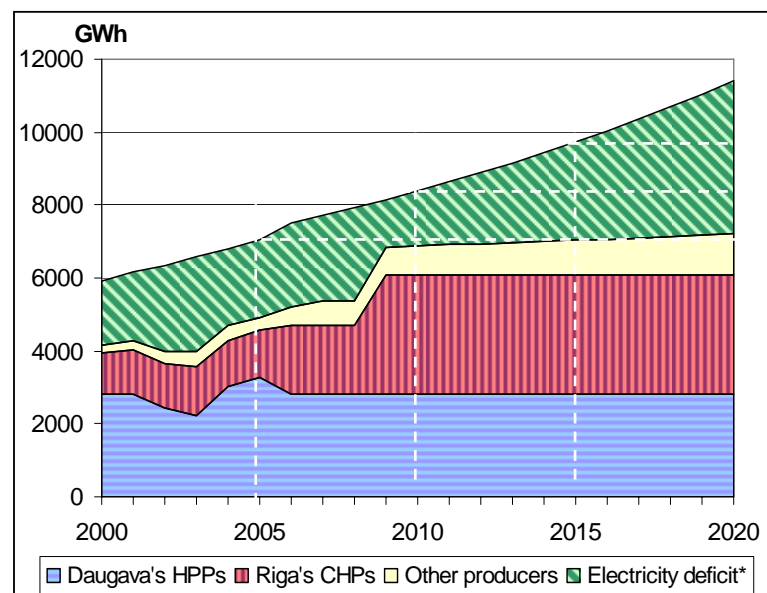


Figure 31. Forecasts of total electricity consumption (including losses), GWh

Analysis of these forecasts show that in the beginning electricity deficit would reduce – to 1.3 TWh in 2009, but then again would increase to 4.2 TWh in 2020 together with proportionally higher electricity consumption growth. Comparing with deficit in 2005 (30.5%) to total electricity consumption, it would decrease till about 16% in 2009 and then again increase to approximately 37% in 2020.

This deficit should be covered with net imports or new production facilities. The choice of new production facilities, more precisely, new capacities should be considered taking into account electricity consumption forecasts as well as other factors like environmental issues, investment needed, origin of resources needed to operate new power plants, desired level of security of electricity supply etc.

* Import = Total electricity consumption + losses – electricity production