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Riga City
SUSTAINABLE ENERGY ACTION PLAN
for 2010-2020

Rīgas enerģētikas aģentūra

Riga 2009/2010

FOREWORD

"Riga City Sustainable Energy Action Plan for 2010-2020" (the Action Plan) has been prepared in connection with the fact that Riga was the first European capital to sign the "COVENANT OF MAYORS"; and drafting of the Action Plan is in conformity with provisions set out in the "COVENANT OF MAYORS". Objective of the Action Plan – to achieve

20-20-20 by 2020.

It means that by 2020 the city commits itself to reduce CO_2 emissions by at least 20 % by improving energy efficiency by 20 % and by ensuring that renewable energy sources account for 20 % of volume of energy to be used.
The Sustainable Energy Action Plan includes initial report and forecasts on CO_2 emissions, measures for action aimed at reducing energy consumption, improving energy efficiency and mobilising renewable energy sources in the administrative territory of Riga city, as well as criteria for assessment of progress in achieving the objectives set in the Action Plan. Main directions for sustainable energy development of the city have been set forth in the Action Plan, and these directions have to be followed when planning and carrying out measures with respect to energy supply, modernisation of energy supply systems, including energy sources, improvement of service quality and in the area of energy consumption, increasing energy efficiency, planning and implementation of reduction of energy consumption, as well as incorporating renewable energy sources in the energy supply process of the city.

The Action Plan has been elaborated within the framework of an international INTERREG IV A project "Covenant of Mayors in the Central Baltic Capitals" (COMBAT) (PVS ID 2621) through cooperation in consortium between 4 Central Baltic Capitals – Stockholm (Sweden) – lead partner, Riga (Latvia), Helsinki (Finland) and Tallinn (Estonia).

COMBAT

CENTRAL BALTIC INTERREG IV A PROGRAMME 2007-2013

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"Riga City Sustainable Energy Action Plan for 2010-2020" has been drafted under the guidance of the Riga Municipal Agency "Riga Energy Agency" (REA) in cooperation with Institute of Physical Energetics (IPE) and JSC "Rīgas Siltums", as well as energy supply organisations, institutions of Riga City Council, service companies, and experts.

AKCIJU SABIEDRĪBA RĪGAS SILTUMS

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Material prepared during elaboration of the Action Plan has been reviewed several times by the Advisory Council (see minutes of the sittings of 6/11/2008, 14/12/2009, 8/01/2010, 26/02/2010, 9/04/2010, 30/04/2010 on the website www.rea.riga.lv) and consultations were rendered by the members of Riga City Council's Expert Advisory Council on Energy Supply Issues (REEKP).

The Action Plan has been reviewed during the sitting of the Scientific Council of the state scientific institute "Institute of Physical Energetics" on 11 May 2010 (minutes are kept with REA's records).

Public consultation on the Action Plan was conducted at the Riga City Council on 17 May 2010. (minutes are kept with REA's records).

CONTENTS

Link between the Action Plan and Riga's strategic planning documents 7

1. Key EU guidelines on implementation of sustainable urban energy policy 8

2. Initial report on CO_2 emissions in Riga City and forecasts for reduction thereof 10

2.1 DESCRIPTION OF RIGA CITY 10

2.1.1 Location, operational profile and demographic situation 10

2.1.2 Airport, port and rail transport 11

2.1.3 Buildings 11

2.1.4 Energy supply 12

2.1.5 Intensity of traffic 13

2.2 PROVISIONS FOR CALCULATION OF EMISSIONS 14

2.3 CO_2 EMISSIONS IN RIGA CITY 1990 - 2008 AND CHOICE OF THE BASE YEAR. 17

2.4 FORECAST FOR ENERGY CONSUMPTION 2005 - 2020 28

2.5 MEASURES FOR REDUCING ENERGY CONSUMPTION, INCREASING ENERGY EFFICIENCY AND USE OF RENEWABLE ENERGY SOURCES FOR THE PERIOD 2005 - 2020 32

2.6 FORECAST FOR CO_2 EMISSIONS FOR 2010–2020 AND MEASURES TO REDUCE EMISSIONS 33

3. Potential for reduction in energy consumption and increase in energy efficiency and use of this potential in Riga. 36

3.1 PRODUCTION AND TRANSMISSION OF ENERGY 36

3.1.1 Heating 36

3.1.1.1 The existing situation in heating 1990 - 2008 36

3.1.1.2 Forecast for development of heat supply and increase in energy efficiency for the period 2005 - 2020 43

3.1.2 Power supply 48

3.1.2.1 The existing situation in power supply 1990 - 2008 48

3.1.2.2 Forecast for development of power supply and increase in energy efficiency for the period 2005 - 2020 51

3.1.3 Fuel consumption, including in the decentralised heating sector 55

3.2 ENERGY CONSUMERS 58

3.2.1 Residential houses sector of the city 58

3.2.1.1. Current situation in the residential houses sector 1990 - 2008 58

3.2.1.2 Measures for reducing energy consumption and increasing energy efficiency for the period 2005 - 2020 65

3.2.2. Public buildings sector of the city 73

3.2.2.1. Current situation in the public buildings sector 1990-2008 73

3.2.2.2 Measures for reducing energy consumption and increasing energy efficiency for the period 2005 - 2020 77

3.2.3 Lighting in the city streets and parks 81

3.4.4 City public transport 84

3.3 URBAN PLANNING MEASURES FOR REDUCTION OF ENERGY CONSUMPTION IN THE CITY 89

4. Utilisation potential of renewable energy sources and their inclusion in the energy mix of Riga 92

4.1 CURRENT SITUATION REGARDING THE UTILISATION OF RENEWABLE ENERGY SOURCES IN THE CITY UP TO 2005 92

4.2 MEASURES FOR INCLUSION OF RENEWABLE ENERGY SOURCES IN THE ENERGY MIX 2005-2020 93

5. Management structures for implementation of the Action Plan 108

6. Public involvement in implementation of the Action Plan 110

7. Financial instruments and financial amounts for implementation of measures under the Action Plan 112

7.1 EXISTING AND POTENTIAL FINANCIAL INSTRUMENTS FOR IMPLEMENTATION OF THE ACTION PLAN 112

7.1.1 EU Structural Funds and Cohesion Fund 112

7.1.2 Green investment schemes 114

7.1.3 National programmes for funding energy efficiency measures.................................... 116

7.1.4 Revolving fund... 116

7.1.5 Third-party funding schemes.. 118

7.1.5.1 Leasing 118

7.1.5.2 Energy service companies.. 119

7.1.5.3 A model for establishment of a municipal energy service company....................... 120

7.1.5.4 Public and private partnership 120

7.1.6 Own funding 121

7.1.7 Aid programme ELENA to prepare for implementation of measures 121

7.2 FINANCIAL AMOUNTS REQUIRED FOR IMPLEMENTATION OF THE ACTION PLAN 123

8. EU, national and municipal aid measures for implementation of the Action Plan............ 125

9. Legislative and regulatory documents required for implementation of the Action Plan ... 127

10. Criteria for assessment of progress in achieving the objectives of the Action Plan.......... 129

11. Information sources and studies used.. 130

Link between the Action Plan and Riga's strategic planning documents

Riga City Sustainable Energy Action Plan for 2010-2020 (the Action Plan) is a detailed **management tool** for Riga municipality in its strategic planning documents:

- **Riga Development Programme 2006-2012 (updated version of 2010);**
- **Riga Long-term Development Strategy until 2025 (updated version of 2010);**

to achieve the said **objectives**:

M 10 – green city with good environmental quality;

M 12 – city with high-quality housing;

and tasks:

U.4.5. – to improve the aesthetic and urban environmental quality of surrounding areas;

U.4.6. – to ensure engineering networks required in the urban areas;

U.4.7. – to ensure such use of urban areas which would be rational and correspond to sustainable development principles;

U.8.3. – to foster cooperation between Riga municipality, national institutions and private sector;

U.8.4. – to encourage attraction of investments;

U.10.5. – to carry out measures for improvement of air quality;

U.10.12. – to encourage environmentally responsible behaviour among the population;

U.10.13. – to promote rational use of heat and electricity;

U.11.2. – to improve street and yard lighting;

U.12.3. – to encourage renovation and improvement of private housings;

U.12.4. – to ensure renovation of the housings owned by the municipality, and maintenance and improvement of infrastructure;

U.12.7. – to promote rational use of heat and electricity in the housings.

Drafting of the Action Plan is provided for in Paragraph 42 of the Investment Plan in the Riga Development Programme 2006-2012 (updated version of 2010).

Implementation of the Action Plan will foster recovery of the Latvian economy and significantly increase employment of the population.

1. Key EU guidelines on implementation of sustainable urban energy policy

Global warming which is to a great extent caused by an increase in greenhouse gas (CO_2, etc.) emissions as a result of human activity has contributed to changes in the climate on the Earth – storms, floods and other natural disasters that destroy people's housings and other material assets, are the cause of mass death of people, threaten existence of certain areas and pose threats to mankind in respect to long-term survival.
Global cooperation on mitigation of climate change begun with the United Nations Framework Convention on Climate Change (Latvia adopted as a law on 23/02/2005) and Kyoto Protocol of 2005 (summit of the heads of state) stipulating commitments taken on by countries by 2012. The next summit of the heads of state took place in COPENHAGEN in 2009 during which new commitments on mitigation of climate change by 2050 were discussed, although taking on commitments is postponed to the coming years. The main objective of the commitments:

To prevent increase in the global average temperature and maintain this rise between 2 and 2.4°C till 2050. In order to achieve this industrialised countries have to reduce CO_2 emissions by 50 % in comparison with the year 2000.

By implementing the new energy policy, on 9 March 2007 European Union (EU) adopted a package "Energy for a Changing World" where it put forward an initiative regarding Covenant of Mayors of the European cities which was prepared and signed in Brussels on 10 February 2009. Riga was the first European capital which adopted the decision on signing the Covenant of Mayors already on 30 September 2008. At the moment more than 1,600 cities have joined the Covenant of Mayors. Text of the Covenant of Mayors comprises the main guidelines and tasks for municipalities in ensuring sustainable energy in the cities, as well as:

- to develop Sustainable Energy Action Plan (SEAP) for the period until 2020;
- commitment to reduce CO_2 emissions by more than 20 % by 2020 through an increase in energy efficiency by 20 % and by ensuring that renewable energy sources account for 20 % of volume of consumption in the energy mix;
- to organise Energy Days in the city on a regular basis;
- acknowledgement that many activities related to energy demand and renewable energy sources and which have to be carried out to combat adverse climate changes fall under the responsibility of municipalities or cannot be implemented without support from the municipality;
- acknowledgement that municipalities which are management bodies closest to the citizens are the ones that have to be at the forefront of activities to be carried out and be an example for others;
- acknowledgement that responsibility for combating global warming is shared between municipalities and their national governments, and these institutions have to be independent from commitments of other parties when carrying out this task;
- to involve civil society of the city in the drafting and implementation of the Action Plan.

On 3 March 2010 the European Commission took new strategic direction – "Europe 2020" the goal of which is to tackle effects of the global economic crisis in Europe and prepare the EU economy for the next decade. Five objectives have been set stipulating what the EU has to do by 2020; and on the basis of these objectives the results achieved could be assessed. One of the said objectives provides that:

"20/20/20" objectives in the area of climate/energy have to be implemented.

When drafting the Sustainable Energy Action Plan, the following key EU directives regarding energy supply, energy efficiency, renewable energy sources and environment were taken into account:

1) Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 **on the energy performance of buildings**;

2) Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 **on the promotion of cogeneration** based on a useful heat demand in the internal energy market;

3) Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 **on energy end-use efficiency and energy services**;

4) Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 **on ambient air quality and cleaner air for Europe**;

5) Directive 2009/28/EC of the European Parliament and of the Council **on the promotion of the use of energy from renewable sources**.

Legal and regulatory documents of the Republic of Latvia where drafted in conformity with EU directives.

2. Initial report on CO_2 emissions in Riga City and forecasts for reduction thereof

2.1 DESCRIPTION OF RIGA CITY

2.1.1 Location, operational profile and demographic situation

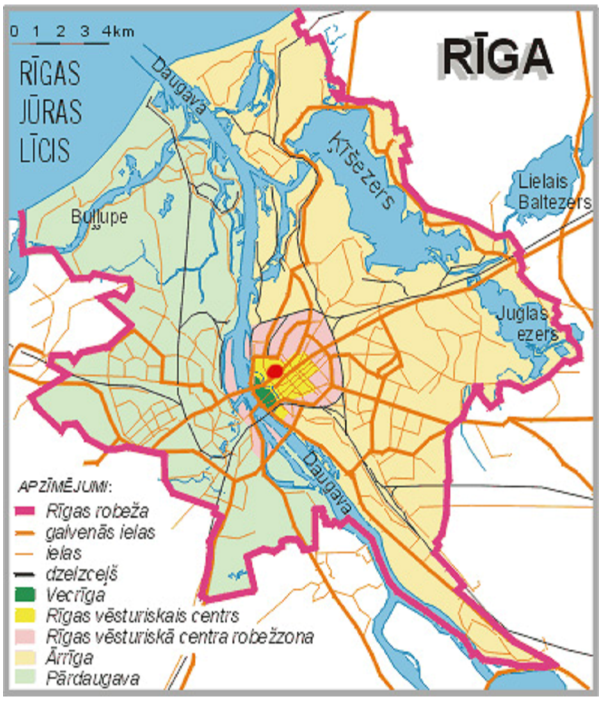
Riga is an old member of the Hanseatic League at the coast of the Gulf of Riga of the Baltic Sea and is considered to be founded in 1201 together with its historical centre which is included in the list of world's cultural heritage. Riga is an architectural masterpiece –a pearl of art nouveau. It is the largest city in the Baltic States and one of the largest metropolises in the Northern Europe; and at the same time Riga is an important transit point with a well-developed airport, port and railway network system.

Riga is rich with water resources; it is a green city with wide park system and recreational areas, as well as adjacent expanse of woodland which ensure appropriate quality of life to the citizens.

Riga's share in the Latvian industry persistently remains above 50 %. One of the largest manufacturing sectors in Riga is food industry. Manufacture of furniture holds a prominent place.

Figure 2.1. Riga – capital of the Republic of Latvia.

Manufacture of wood, wooden products and cork is well-developed. There is printing, publishing and production of records industry here. Textile industry and other types of industrial output can also be found. Construction works are of significant volume. Two largest cogeneration (CHP) plants are located in Riga – Riga TEC-1 and TEC-2 which ensure production of electricity of around 20% of the total energy consumed in the country. It has to be noted that the territory of both Riga airport and Riga TEC-2 is outside city borders. Transit roads to Latvian ports go through Riga. In order to relieve the centre of Riga the Southern Bridge was put into operation in 2008 to which transit cargo flows were shifted.



← Figure 2.2. Map of Riga.

Population of Riga reached the highest level around 1989 – 915 thousand people when approximately 35 % of population was concentrated in Riga. Since 1990 population of Riga is constantly reducing reaching:
1990 – 909,135;
1995 – 824,988;
2000 – 764,329;
2005 – 731,762;
2009 – 713,016.
Although relatively large number of people is flowing in Riga from other regions of the country, the overall trend towards decreasing of city's population is maintained and forecasted also to continue till 2020.

2.1.2 Airport, port and rail transport

Riga airport is located 2 km outside the city borders. In the beginning it was an airport with a small passenger capacity, but since then it has constantly expanded and grown to be an airport of international importance, including transit, with passenger flow of 4 million people in 2009. Further expansion of the airport and increase in the passenger flow are planned.

The port of Riga is located in the territory of the city and covers areas of the Free Port of Riga from the centre of the city on the both banks of the Daugava river to the Gulf of Riga, including also a number of islands in the estuary of Daugava. The port of Riga handles passenger flows and it is an important transit cargo hub with constructed cargo terminals. Since 1990 cargo- and passenger-handling capacity of Riga's port is constantly growing and further growth of the port is planned. In order to ensure cargo turnover without over-burdening the city centre it is planned to construct the Northern crossing of Daugava together with appropriate access roads from the city borders.

Riga is an important rail transport hub, since Riga is the starting point from which railway lines branch off in various directions, including local and international railway lines. Rail transport is very important not only in respect to passenger transportation, but also – cargo transportation which is largely a transit cargo route to Latvian ports. All cargo flows go through Riga's central railway hub. Since 1990 cargo transportation by rail shows a growing trend and this trend is forecasted to continue.

2.1.3 Buildings

Buildings of housing stock of Riga can be divided into 3 periods:

- pre-war buildings – built up to 1940;
- post-war buildings – built from 1945 to 1995;
- new buildings – built since 1996;

Pre-war buildings of the housing stock are mainly houses for small number of families and private multi-apartment rent buildings which were nationalised in 1940s and since 1991 – returned back to the former owners or their heirs through denationalisation in a targeted way. Overall, heat stability of these buildings is relatively good in the city, although buildings with low level of amenities can also be found. Renovation of the buildings is taken care of by their owners.

Post-war buildings, which were erected mainly by use of standardised solutions and – since the middle of the 1960s – also methods of slab construction, have low heat stability which was in line with the construction standards of that time when priority was given to low construction costs. Apartments have all amenities. The said buildings are the main concern of the city, for energy efficiency of these buildings has to be increased and energy consumption has to be reduced while ensuring a reduction of CO_2 emissions.

Buildings erected during this period form the housing stock which principally was privatised when the independence was regained.
Pursuant to the data of statistical surveys, in 1995 there were 23,035 residential houses with 241,520 apartments and total area of 16,243,000 m2 in Riga. Average area of an apartment per capita corresponded to 20.0 square meters which is a low rate in Europe.
1996 is the beginning of a new construction period in Riga which is related to adoption of European-level construction standards. The new buildings which have facilitated formation of a free housing market and partly occupied housing areas are outside the priority range of concerns of the municipality.

The main public buildings – theatres, museums, banks, administrative buildings of the state and the municipality, institutions and offices, universities, schools, pre-school educational establishments, hospitals, shopping centres, sports and recreational centres and buildings are also located in Riga. The schools and kindergartens built during the post-war period and according to standardised designs have to be particularly highlighted, since their heat stability is low.

2.1.4 Energy supply

Latvia is located in the Europe's cold climatic zone and the number of heating degree days is ≥ 4000. Therefore heat is required not only to ensure quality of life, but it is also a prerequisite for survival in the winter period which lasts for approximately 200 calendar days. Heating is a particularly important field of energy sector, for over 60 % of the energy resources consumed in the country are used exactly as heat.

The main type of heating in Riga – district heating which covers 76 % of the consumed volume of heat, using natural gas as fuel, in small amounts also wood-chips. Approximately 70 % of the required volume of heat are produced by two large modernised state cogeneration plants – Riga TEC-1 (2006 – 144 MWel and 377 MWth) and Riga TEC-2 (2009 – 620 MWel and 1124 MWth) which are under responsibility of JSC "Latvenergo". Riga TEC-2 is located in Acone, rural municipality of Stopiņi, approximately 3 km from borders of Riga.

The district heating in the city is ensured by JSC "Rīgas siltums" which produces the remaining 30 % of heat in its 5 heat plants with the capacity of 50 to 402.4 MW, 8 boiler houses of average capacity (1–50 MW), and 29 automated boiler houses with capacity of less than 1 MW. Cogeneration units have been installed in four of the said heat sources of JSC "Rīgas siltums", thus over 90 % of the volume of heat consumed in a centralised way in Riga are produced in cogeneration mode.

Decentralised heating, including partially also for pre-war buildings in the centre of Riga, as well as for industrial sites, is ensured by local boiler installations which are mainly operating in automatic mode with natural gas or firewood. In recent years some large production plants are installing cogeneration units in their heat sources. A small number of coal-fired boiler installations remains still to be dismantled.

Power supply of Riga is ensured from the power network of 110/330 kV which covers the city on both banks of Daugava and inter-connects power production plants. In order to ensure further distribution 24 substations of 110/6-20 kV and 78 distribution points of 10 kV are operating.

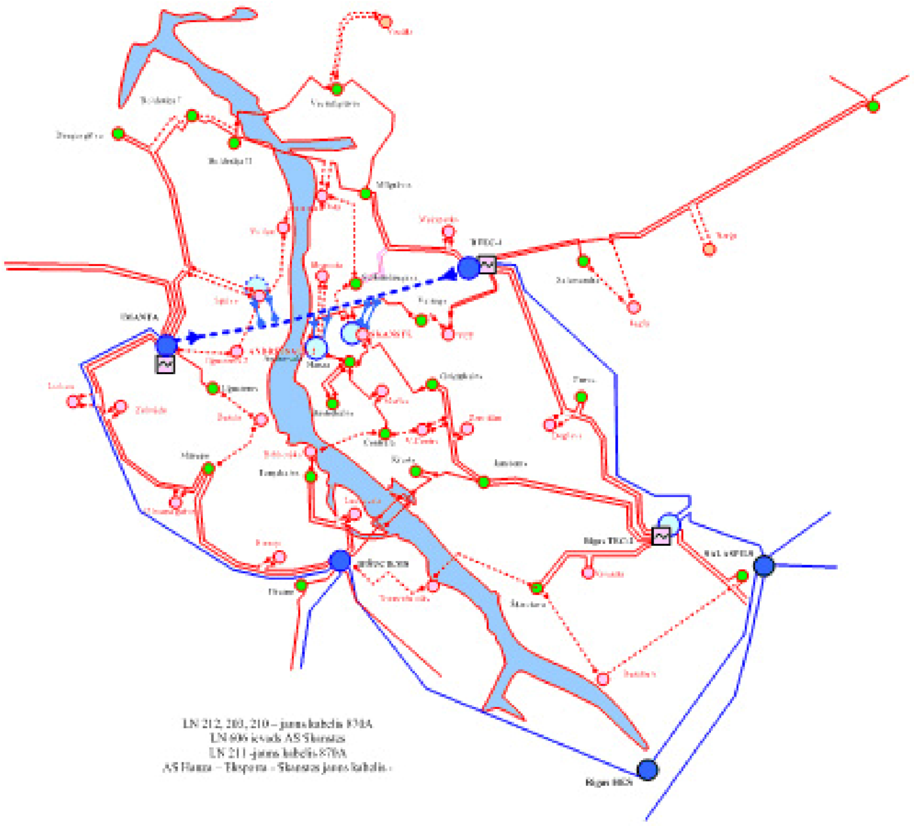


Figure 2.3. Scheme of power networks of Riga. Source: JSC “Latvenergo”.

2.1.5 Intensity of traffic

According to data collected by the Road Traffic Safety Directorate (CSDD) 1,168,756 vehicles were registered on 1 January 2008. Out of these 366,880 (31.39 %) were registered in Riga, 97,580 (8.35 %) were registered in the district of Riga. Thus over one third of the registered vehicles are intensely being used on Riga's streets. The registered traffic intensity in 2008 on average per 24 h on Riga's bridges over the Daugava river (bridges Salu, Akmens and Vanšu):

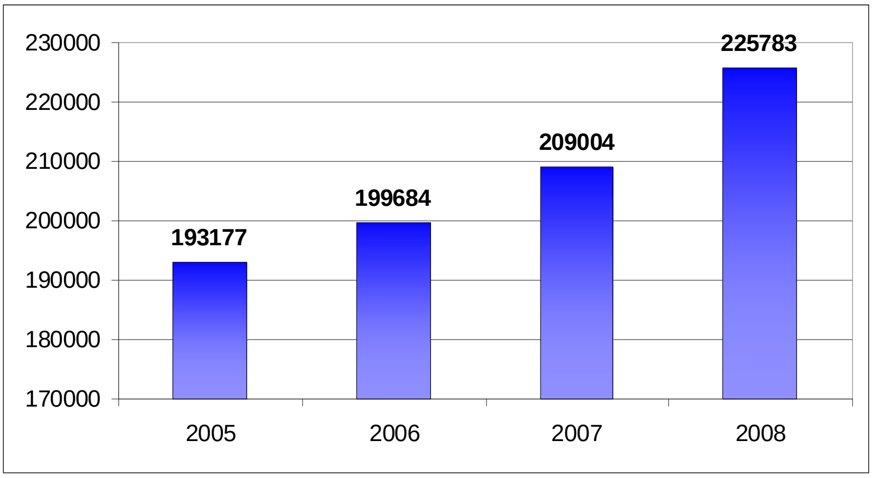


Figure 2.4. Source: Yearbook of the Transport Department of Riga City Council, 2008.

As the economic activity was slowing down due to crisis, traffic flow incoming to the city has also become less intensive in 2008. Traffic flow from the state category 2 roads to city's main roads with number of cars driving into and out per 24 h is shown in the chart below

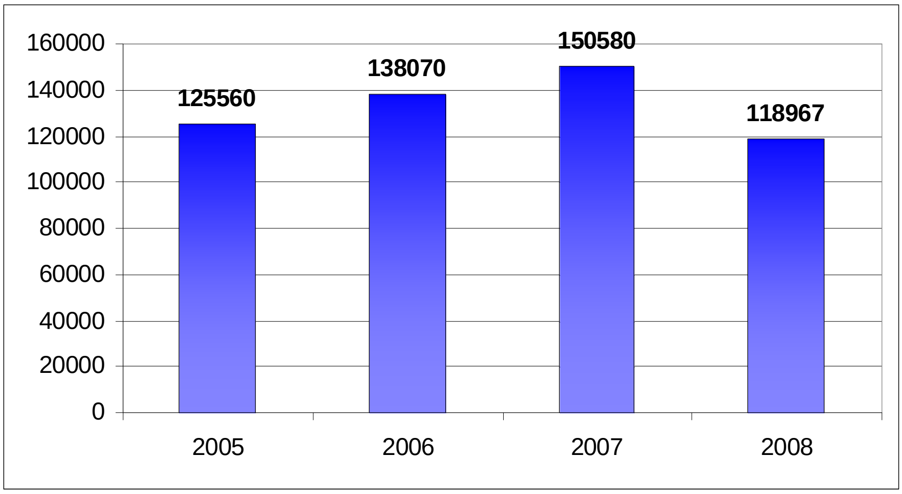


Figure 2.5. Source: Yearbook of the Transport Department of Riga City Council, 2008.

2.2 PROVISIONS FOR CALCULATION OF EMISSIONS

Methodology for calculation of emissions.

Consumption of all types of energy in the respective year in the territory of Riga city irrespective of the location where it is produced is taken as the basis for calculation of volume of carbon dioxide (CO_2) emissions. CO_2 emissions are calculated separately from the power consumption, heat consumption in the district heating system, fuel consumption in transport sector, and energy end-use in households, industry, state and municipal institutions and service sector. Only CO_2 emissions are calculated from the total set of greenhouse gas emissions. Standard methodology and parameters based on the guidelines drafted by the Intergovernmental Panel on Climate Change (IPCC) are used to calculate the emissions. Algorithm for calculation of CO_2 emissions in Riga city:

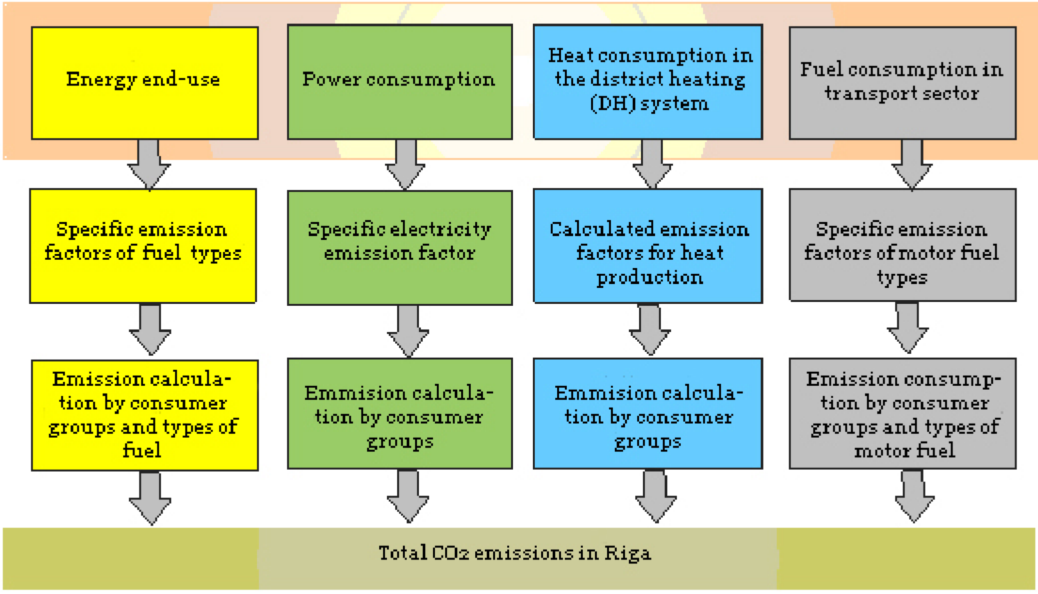


Figure 2.6. Source: Institute of Physical Energetics (IPE).

Energy consumption which is beyond the control and powers of the municipality, for example: maritime and rail transport, all types of cargo transit, aviation services, use of agricultural and construction machinery – are not taken into account in calculation of CO_2 emissions. Emissions from industrial technologies, refrigerators and air conditioning systems, natural processes of putrefaction of organic matter, waste water treatment reservoirs and storage sites for solid waste, as well as open burning processes are also not taken into account.

Emission factors based on the average values of physical properties of fuels applied in Latvia and methodology drafted by the IPCC are used in calculation of CO_2[1].
Emission factor[2]characterising the average structure of Latvian electrical power production is used to calculate CO_2 from power consumption, since power consumption of Riga is ensured from various power production sources.

In order to calculate CO_2 from heat consumption in the district heating system the emission factor is used which is calculated on the basis of heat production structure and fuel structure in the respective year. Algorithm for calculation of CO_2 emission factor for heat production in the district heating system:

[1] "Methodology for calculation of CO2 emissions from stationary combustion of fuel and industrial processes", Latvian Environment, Geology and Meteorology Agency, 2009

[2] Technical Annex to the SEAP template instructions document: The emission factors.

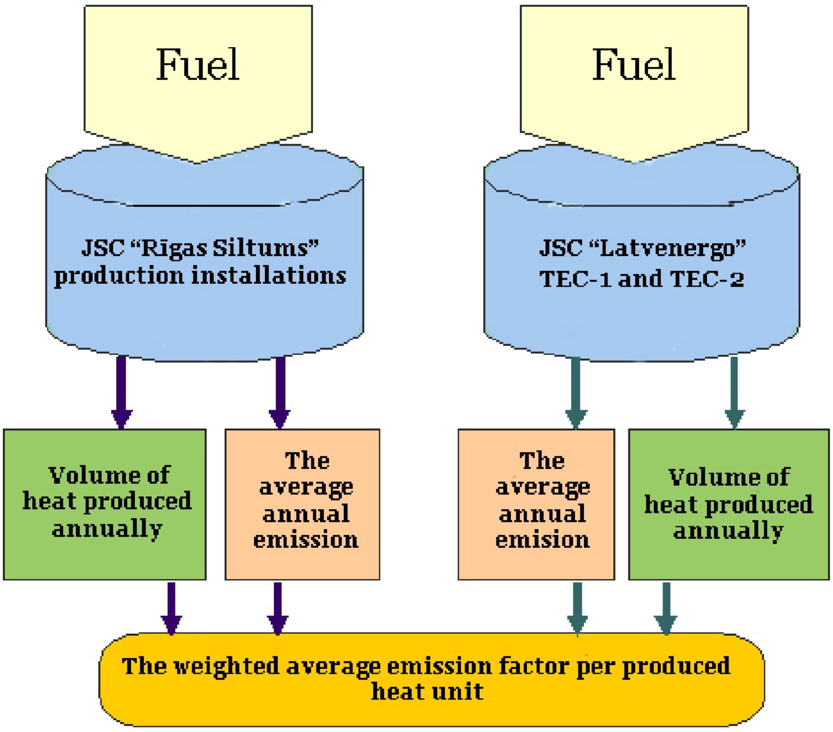


Figure 2.7. Source: IPE.

First of all, factor for emissions from production of heat in the JSC "Rīgas siltums" production sources is calculated, depending on the fuel structure used and volume of heat produced in the respective year. Secondly, factor for emissions from heat production in the JSC "Latvenergo" cogeneration plants is calculated, depending on the fuel structure used and volume of heat produced in the respective year. Thirdly, the weighted average factor for emissions from heat production is calculated by taking into account share of the volume of heat produced in each of the said companies.

Data for emission calculations

Information about the total heat consumption in the district heating system in Riga and by separate consumer groups was received from the main heating operator – AS "Rīgas siltums". Information from JSC "Latvenergo" was used as a basis for power consumption and its distribution by consumer groups. Information provided by JSC "Latvijas gāze" was used to assess the structure of the energy end use, as well as structure of energy production in Riga.

In order to assess the energy end-use in the industrial and service sector of Riga a database "No. 2 – Air – survey on protection of air", available on the home page of the Latvian Environment, Geology and Meteorology Centre, was used. The said survey comprises publicly available information on the volume of fuel used per year for production of heat and/or power and technological processes both at territorial and organisational level. Forms of this report are filled in by companies or institutions (operators) which have a valid authorisation for performance of Category A or B polluting activities or declaration of a Category C polluting activity and which are in conformity with polluting activity stipulated in Annex 1 of the Regulation (EC) No 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register and emit pollutants provided for in the Annex 2. These provisions mean that all

heat production sources with considerable heat load of > 0.2 MW are included in this statistical survey. Therefore the said statistical survey comprises most of the fuel users of Latvia.
The survey is available since 1997. When carrying out analysis, each of the operators was individually assessed and, depending on the special nature of its activities, it was attributed one of the characteristics – industrial company, which since 2005 was included in the sub-group Emission Trading Scheme (ETS) company, commercial and service sector company or municipal and public sector institution. The number of the analysed companies which are the end-users of fuel are listed in the table below which includes also number and structure of the analysed emission operators:

Table 2.1.

	1997	2000	2005	2008
TOTAL	250	293	302	242
ETS sector	not provided separately	not provided separately	13	11
Industry, including construction	129	124	119	68
Commercial sector and Services	98	128	145	138
Municipal and state institutions	23	41	25	25

ETS sector is listed separately since 2005. Information about the final consumption of fuel by companies in the ETS sector is obtained by individually collecting and analysing documentation of these ETS companies – reports on CO_2 emissions in 2005 and 2008, available on the home page of the Latvian Environment, Geology and Meteorology Centre, in the system of Register of Greenhouse Gas Emission Units.
Breakdown of final consumption of fuel by separate consumer sectors is not available for 1990. Data on the consumption of fuel in the said 3 sectors (industrial, commercial, and municipal and state institutions which do not use the service provided by the district heating system) are evaluated in the publication of the Environmental Protection Committee of the Republic of Latvia "Protection of Air in Latvia 1991 (report)" (Riga, 1992). These data are also used in the conducted survey.

In order to assess the energy end-use in the household sector data obtained from the surveys "Consumption of Energy Resources in Households" (respectively, for 1996, 2001 and 2005) carried out by the Central Statistical Bureau (CSB) of the Republic of Latvia, on the structure of energy consumption, number of consumers and description of households were used. Information on the structure of energy consumption in households of Riga city is separately provided in these surveys. Sampling for the survey is made as a stratified one-stage or two-stage household random sampling.

2.3 CO_2 emissions in Riga city 1990 - 2008 and choice of the base year

Choice of base year

Years with a 5-year step from 1990, i.e.: 1990, 1995, 2000 and 2005, were chosen to determine CO_2 emissions. Actual data on energy consumption are used to determine CO_2 emissions during this period taking into account transmission losses. Year 2008 on which the actual volumes of energy consumed are available at the moment of drafting the Action Plan is recorded as control figures.

Year 1990 is chosen as the base or reference year for Riga which matches the choice of the base year in most European cities.

Results of emission calculations for the period 1990 - 2008

Total volume of CO_2 emissions from transport, end-use of heat, electricity and fuel in Riga by these activities in thousands of t (tonnes) of CO_2 equivalents:

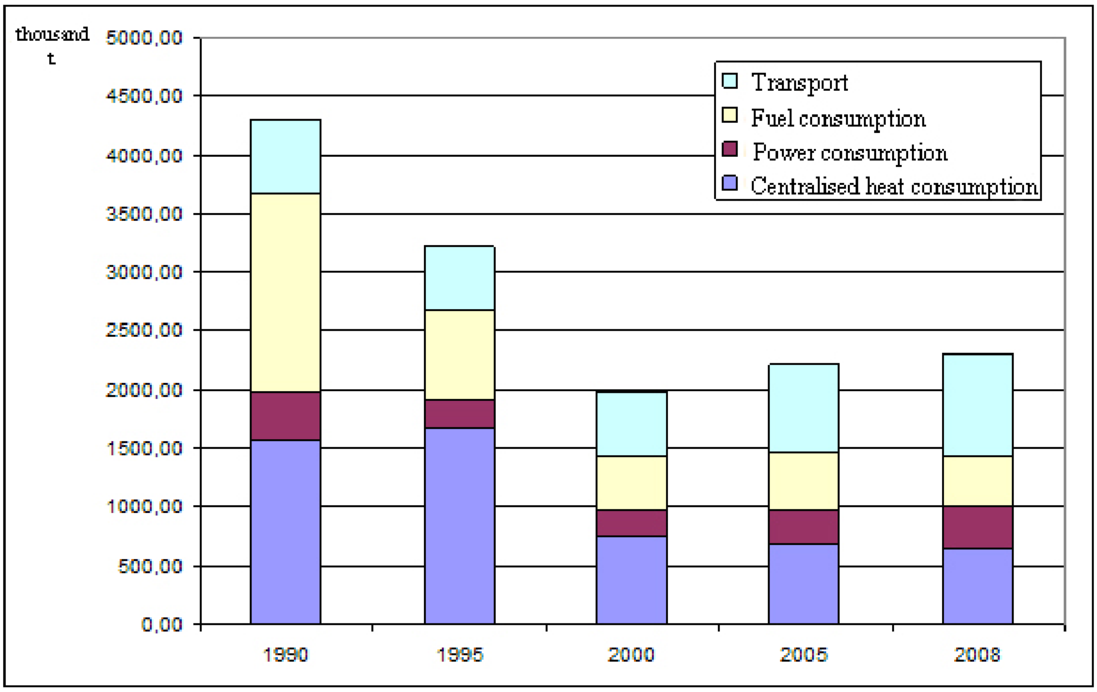


Figure 2.8. Source: IPE.

CO_2 emissions calculated by sectors in thousands of tonnes of CO_2 equivalents:

Table 2.2.

Emission source	1990	1995	2000	2005	2008
Transport	615.3	538.4	552.5	732.6	860.7
Fuel consumption	1696.4	773.4	446.4	494.3	442.7
Power consumption	423.7	232.0	229.9	311.3	344.6
Centralised heat consumption	1559.7	1679.1	753.1	669.2	655.2
Total CO_2 emissions	**4,295.1**	**3,222.8**	**1,981.8**	**2,207.4**	**2,303.2**

Total CO_2 emissions during the period reviewed (1990–2008) have reduced by 46 % in Riga city. Effect of various sectors producing emissions on the total volume of emissions has also changed:

- share of the transport sector has increased from 14 % to 37 %;

- share of emissions from power consumption has increased from 10 % to 15 %;
- share of emissions from heat consumption in the district heating system has decreased from 36 % to 28 %;
- share of emissions from fuel end-use has decreased from 39 % to 20 %.

Following a decreasing trend of emissions from 1990 to 2000 a slow growth can be observed in the period up to 2008. The main reasons for such trend are growth in the number of motor vehicles in the city and increase in power consumption, especially in the households and service sector due to availability of technical equipment of households and service sector, and due to growth in prosperity of citizens.

The chart below describes the ratio of emission volume per resident of the city (CO_2 t per capita):

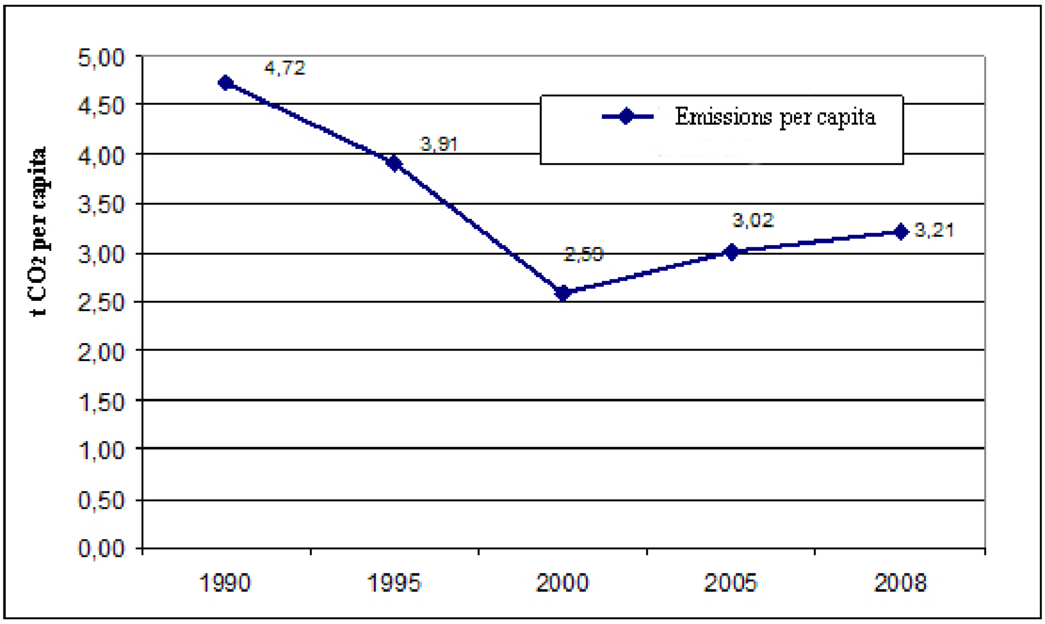


Figure 2.9. Source: IPE.

As it is shown in the figure, CO_2 emissions per capita have reduced by 32 %, despite the significant decline in population during the period reviewed.

Calculation of CO_2 emissions by sectors is shown below.

CO_2 emissions from road transport in Riga

In order to calculate greenhouse gas (GHG) emissions from transport in Riga, the overall traffic flow is divided in three large groups:

- cars registered in Riga;
- public transport vehicles (buses, taxi buses and taxis);
- cars driving into Riga.

Number of cars registered in Riga is obtained from data on the number of cars in Latvia which were collected by CSDD. Only number of cars in good running order is used in the calculation of emissions. Information collected by CSDD and data from Transport Department of Riga City Council are the information sources for identification of number of public transport vehicles.

Number of cars driving into Riga is identified by analysing number of cars in good running order and registered in Riga region and data on traffic flow going into and out of Riga.

Traffic flow going into and out of Riga from the main state roads (number of vehicles per 24 h)

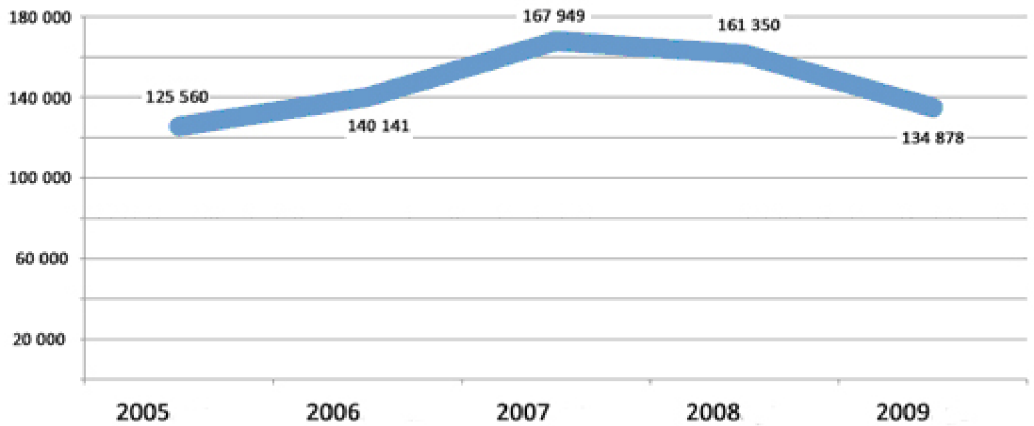


Figure 2.10. Source: Data from the state-owned JSC "Latvijas Valsts ceļi".

In addition to the division of traffic flow described above, it was divided by type of fuel used (petrol, diesel and liquefied petroleum gas (LPG) and by the following transport groups:

- cars;
- light trucks (< 3.5 t);
- trucks (> 3.5 t);
- buses;
- motorcycles and mopeds.

The rapid growth in number of cars after 2000 is the main reason for an increase in consumption of fuel and therefore also for an increase in CO_2 emissions.

Changes in the number of cars in Riga, 1990–2008

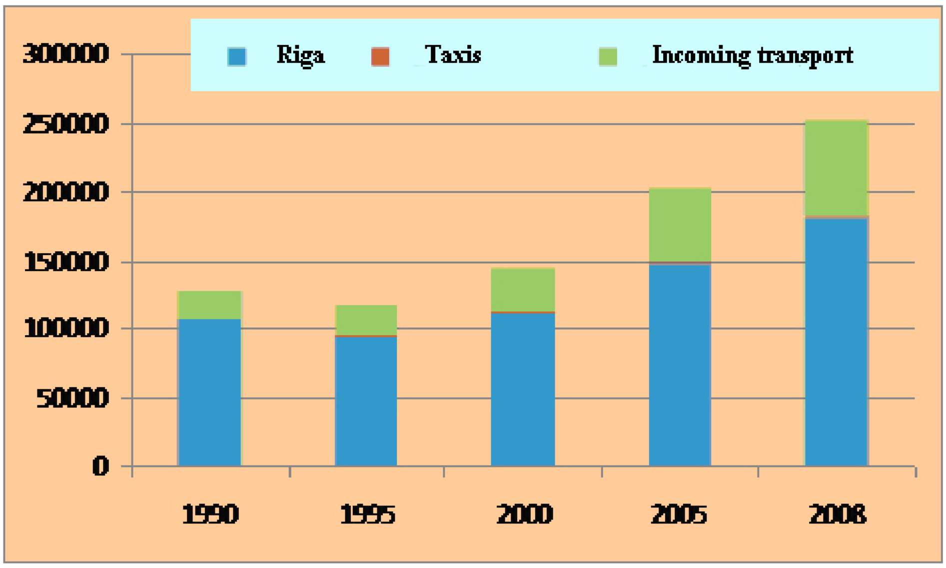


Figure 2.11. Source: IPE.

Both number of cars registered in Riga and number of cars registered outside Riga have increased. In 2008, the total number of cars has increased almost twice compared to 1990. Number of cars driving into Riga has increased more rapidly, namely, 3.3 times during this period.

Changes in the number of trucks in Riga, 1990–2008

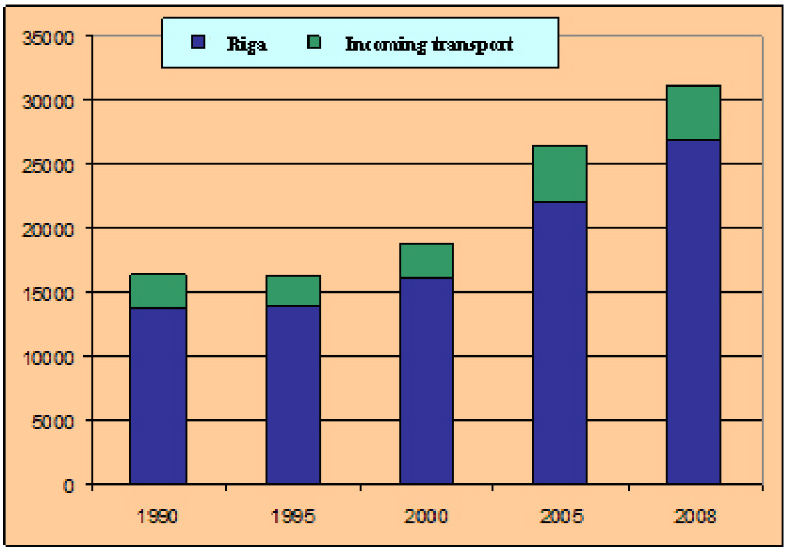


Figure 2.12. Source: IPE.

Similar changes in the number of cars have occurred in respect to trucks the number of which has increased approximately twice.

When analysing the structure of fuel consumption (see Figure 13), it has to be noted that major changes have taken place.
The share of petrol in the total consumption of fuel has reduced and consumption of diesel has increased. The main reason for such changes is that light trucks and trucks shifted to diesel engines, as well as increase in the number of cars using diesel.

Changes in fuel consumption and its structure with respect to road transport in Riga 1990 - 2008, TJ.

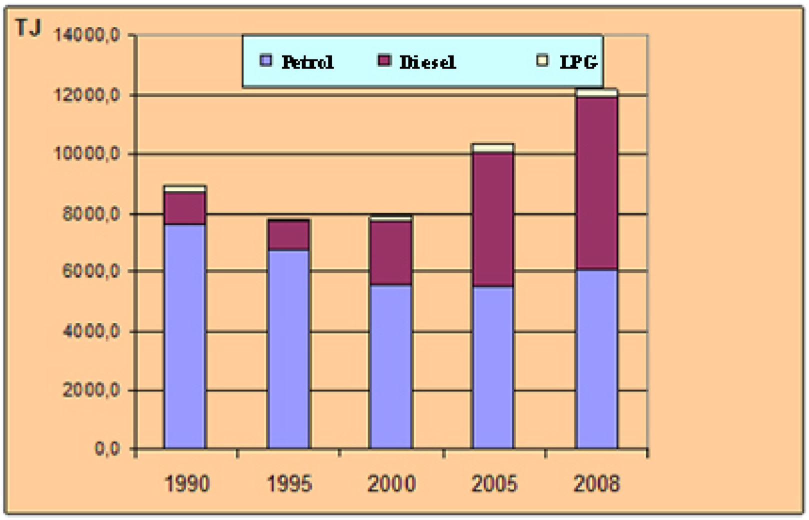


Figure 2.13. Source: IPE.

CO_2 emissions from road transport in Riga calculated by separate traffic flows (in tonnes):

Table 2.3.

Type of transport	**1990**	**1995**	**2000**	**2005**	**2008**
Road vehicles registered in Riga	488,831	445,417	445,720	581,512	690,801
Public transport	65,689	44,966	52,127	54,790	55,342
Incoming transport	60,758	47,980	54,652	96,324	114,535
Total CO_2 emissions	**615,278**	**538,363**	**552,499**	**732,626**	**860,678**

When analysing CO_2 emissions from road transport, it has to be noted that most of is produced by road vehicles registered in Riga (79–80 %). Emissions from road transport flowing into Riga have a growing trend. Its share has grown from 10 % in 1990 to 13.3 % in 2008.

CO_2 emissions from road transport in Riga calculated by separate types of transport (in tonnes):

Table 2.4.

Type of transport	**1990**	**1995**	**2000**	**2005**	**2008**
Cars	426,138	354,360	382,706	521,399	627,739
Light trucks	44,155	43,184	46,722	66,682	85,824
Trucks	87,166	63,630	68,399	86,463	92,694
Buses	57,482	76,965	54,593	57,994	54,222
Motorcycles	336	224	78	87	199
Total CO_2 emissions	**615,278**	**538,363**	**552,499**	**732,626**	**860,678**

From 1990 to 2008 the share of emissions from cars has increased from 69.2 % to 72.9 %. Taking into account structural changes in the fuel consumption, the share of petrol emissions has reduced, while the share of diesel emissions has increased in the total volume of CO_2 emissions from road transport.

CO_2 emissions from road transport in Riga by type of fuel, 1990–2008 (in tonnes)

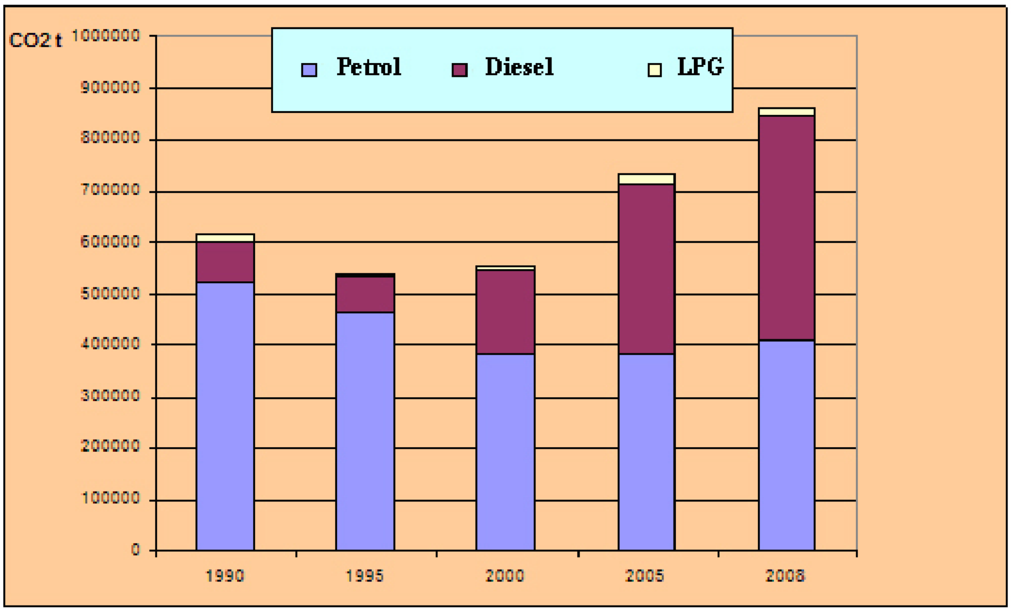


Figure 2.14. Source: IPE.

CO_2 emissions from heat consumption in the district heating system in Riga

Emissions from heat consumption in the district heating system accounted for 28 % of the total emissions in Riga in 2008. Emissions have significantly reduced during the period reviewed. In 2008, the emissions have reduced by 58 % compared to 1990, although at the same time heat consumption has reduced by 53 %. It suggests that in addition to decrease in heat consumption, which is the main factor behind reducing emissions, positive changes have occurred in the heating system. Modernisation of heat sources, introduction of more efficient technologies and reduction of losses had an effect on fall in emissions. In 2008, the weighted average emission factor had reduced by 11.5 % compared to 1990. CO_2 emissions from consumption of the district heat in Riga from 1990 to 2008, in thousands of tonnes of CO_2 equivalents are shown in the chart:

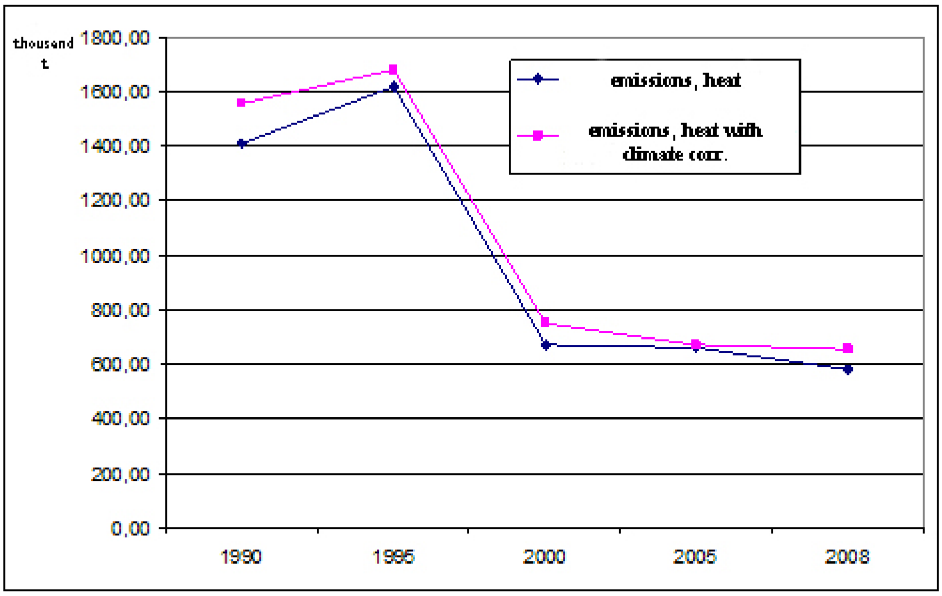


Figure 2.15. Source: IPE.

Taking into account that heat consumption depends on the climate change and in order to gain an insight in heat and emission changes, a coefficient with climate correction is used in the analysis. Households are the largest consumers of heat in the district heating system. In 1990, the households consumed 55 % of the total supplied volume of heat, while the respective share in 2008 was already 75 %.

Factor for emissions from the centralised heat energy in Riga from 1990 to 2008, CO_2 t/MWh:

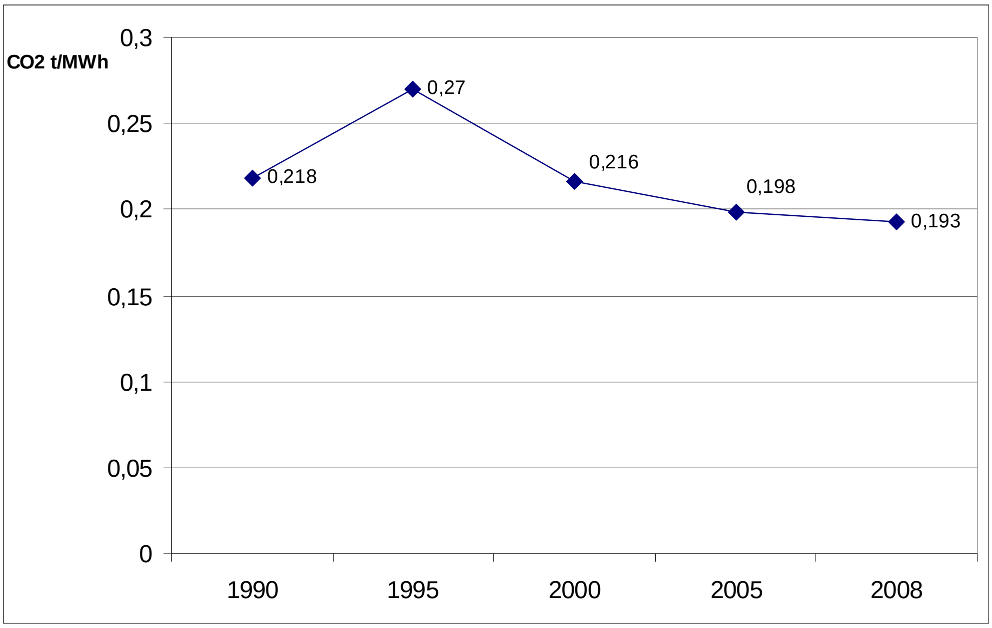


Figure 2.16. Source: IPE.

CO_2 emissions from power consumption in Riga

In 2008, the total power consumption in Riga has reduced approximately by 20 % compared to 1990. When analysing changes in power consumption, it can be noted that these changes are different for each of the consumer groups. Power consumption for street lighting and partially also in the urban transport sector has not shown significant changes. In its turn, power consumption in the commercial and service sectors has increased by more than 40 %. Power consumption in the industry has reduced by approximately 60 %.

The dynamics of power consumption in Riga, 1990 = 1 :

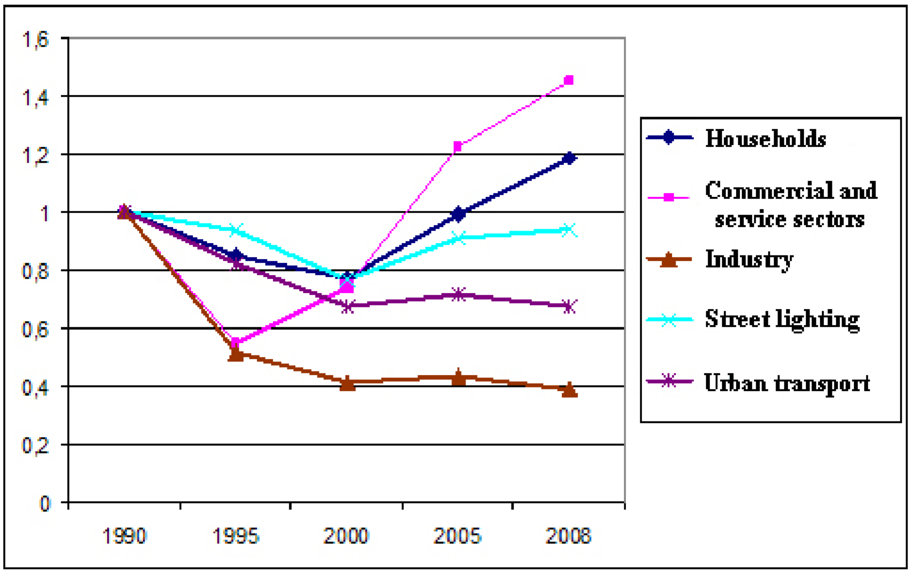


Figure 2.17. Source: IPE.

Changes in power consumption in households are more precisely characterised by ratio reflecting annual power consumption per capita or per household. Levels of consumption become stable from 1995 to 2000, but then over the last eight years consumption has rapidly grown. Power consumption per capita in Riga, kWh per capita annually:

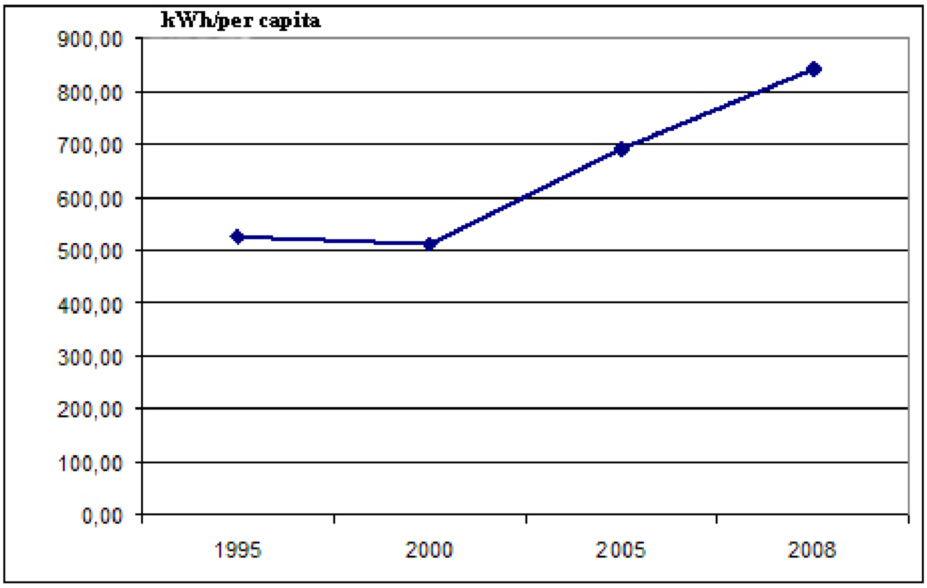


Figure 2.18. Source: IPE.

In order to calculate emissions from power consumption the following **emission factor** is used – **0.143 CO_2 t/MWh**.

Changes in power consumption have mainly affected the dynamics of emission volume. Emissions from power consumption have reduced by 19 % during the period. Following the dramatic fall and stabilisation which lasted until 2000, further on the emissions increased again by almost 50 %. CO_2 emissions from power consumption in Riga 1990 - 2008, thousands of tonnes of CO_2 equivalents.

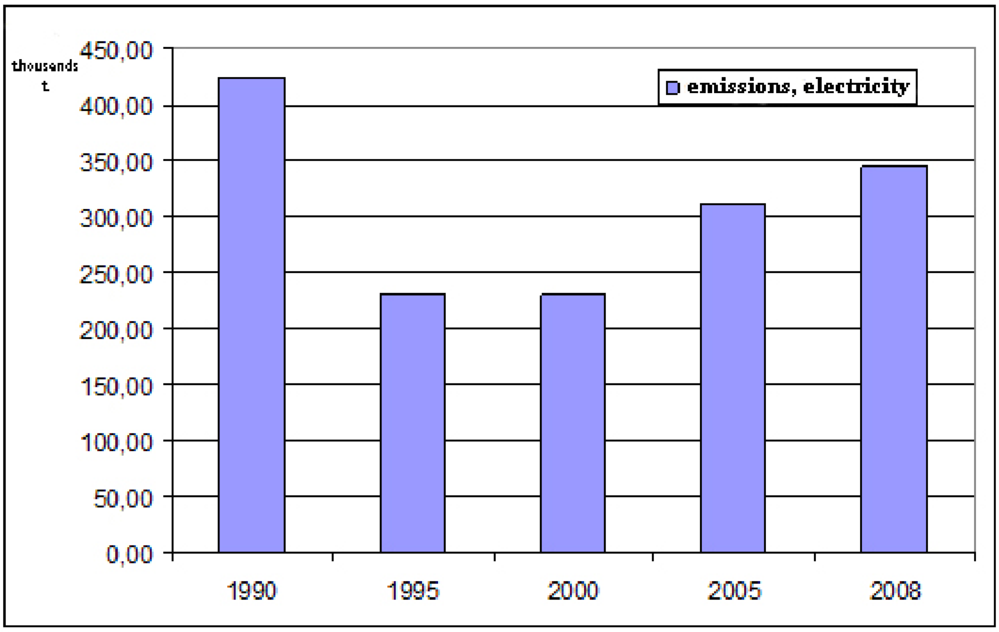


Figure 2.19. Source: IPE.

CO_2 emissions from end-use of fuel in Riga

In 1990, emissions from end-use of fuel formed a significant part of the total CO_2 emissions in Riga city, namely, approximately 40 %. Over the time this share has reduced two-fold (to 20 % in 2008) due to various factors, but this number also suggests that reduction in CO_2 emissions by decreasing the use of fossil fuel in the end-use sectors has to be an integral part of the climate policy of Riga city.

In 2008, CO_2 emissions from end-use of fossil fuel have reduced by 74 % compared to 1990. In 2008, CO_2 emissions in the household sector have reduced by 62 %, but in the industrial and service sector by 76 % compared to 1990.

CO_2 emissions from end-use of fuel in Riga 1990 - 2008, thousands of tonnes of CO_2 equivalents are shown in the chart below:

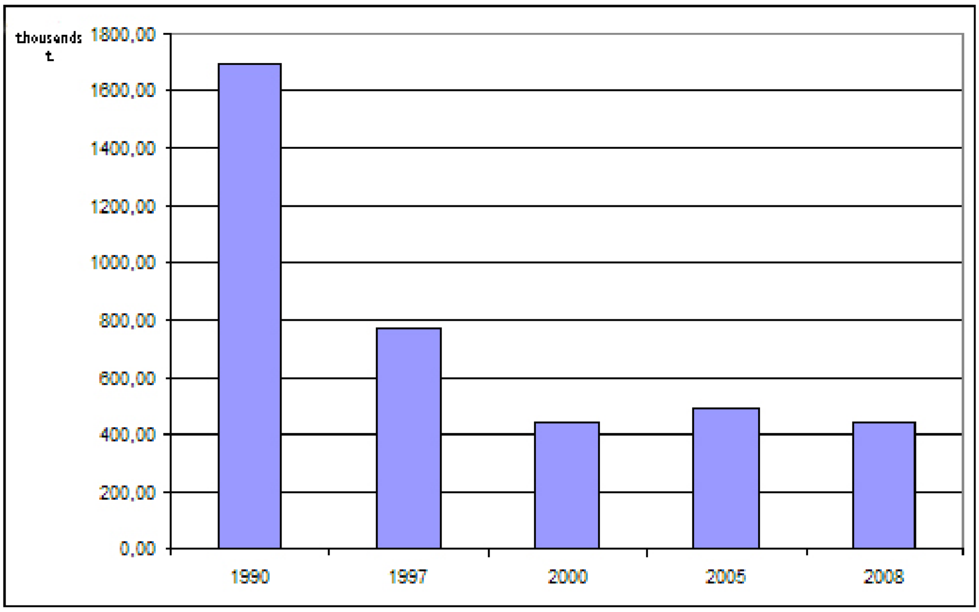


Figure 2.20. Source: IPE.

According to the figure the emissions have reduced significantly by 2000, while volume of CO_2 emissions has become relatively stable during the period after 2000. Fall in CO_2 emissions after 1990 was caused by the following:

1) Reduction in the total volume of fossil fuel consumption was related to restructuring of economy,
2) Increase in use of renewable energy sources for fuel,
3) Replacing fuel oil and increasing the share of natural gas consumption in the balance of fossil fuel resulted in improving the average factor for CO_2 emissions from use of fuel per one fossil fuel unit.

Changes in consumption of fossil fuel and biomass in the end-use of energy, 1990 = 1:

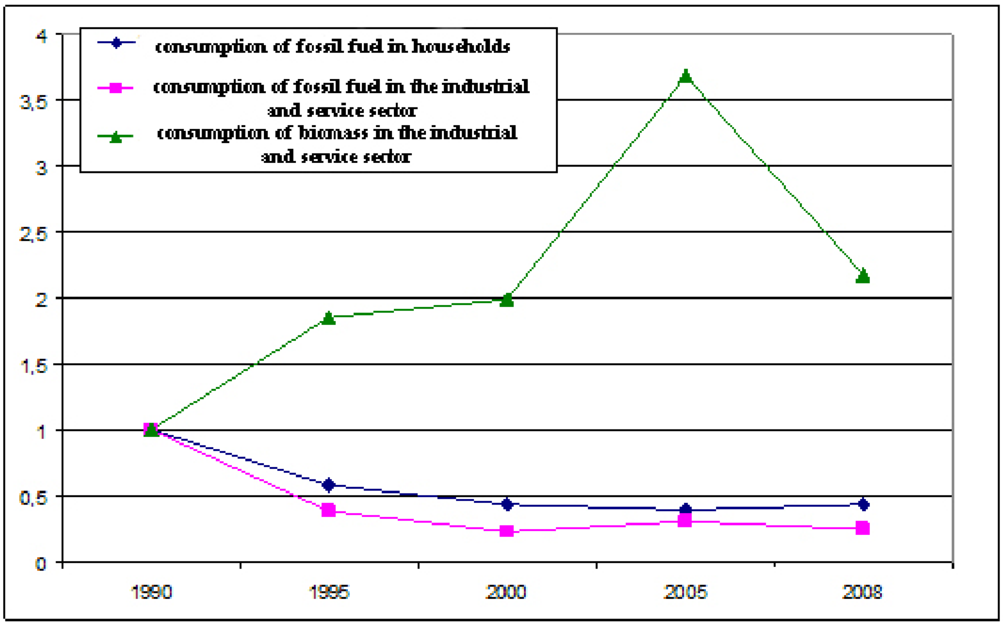


Figure 2.21. Source: IPE.

At the moment natural gas is the principal type of fossil fuel in the city of Riga. The absolute consumption of natural gas has reduced approximately 2.5 times compared to 1990, in its turn, the relative share of natural gas has increased, and therefore other types of fuel have a rather minor role. The absolute volume of consumption of traditional fuel types such as petroleum products and coal has reduced 40 times compared to 1990. Such fuel structure determines priority for climate policy of Riga city also in the future, placing the main focus on increasing the use of renewable energy sources, and energy efficiency measures, in its turn, replacement of "dirty" fossil fuel types will be relevant at specific sites, while overall this measure will have only secondary role.

Factors for CO_2 emissions from fuel types used, CO_2 t/TJ in 2008:

natural gas – 57.91
coal – 92.19
fuel oil – 76.58
diesel – 74.0
wood-chips – 0
wood pellets – 0.

For information: 1 MWh = 3.6 GJ = 0.0036 TJ.

2.4 Forecast for energy consumption 2005 - 2020

Heat

Heat is the most widely used type of energy in city's end-use. In order to make a forecast for heat consumption with the highest degree of certainty possible JSC "Rīgas siltums" has commissioned a survey "Possibilities for optimisation of the district heating system of Riga city from 2010 to 2020" from a specialised designing institute JSC "Siltumelektroprojekts". The said survey was completed in 2010, and the main findings of the survey were summarised in its section "Forecasts for development of heat demand and loads taking into account energy efficiency measures".
Urban development and volume of construction output, which however have shown certain decrease in the recent years due to the global economic recession, foster connection of new sites to the district heating networks. Connection dynamics of loads of the new sites and forecast for potential connections:

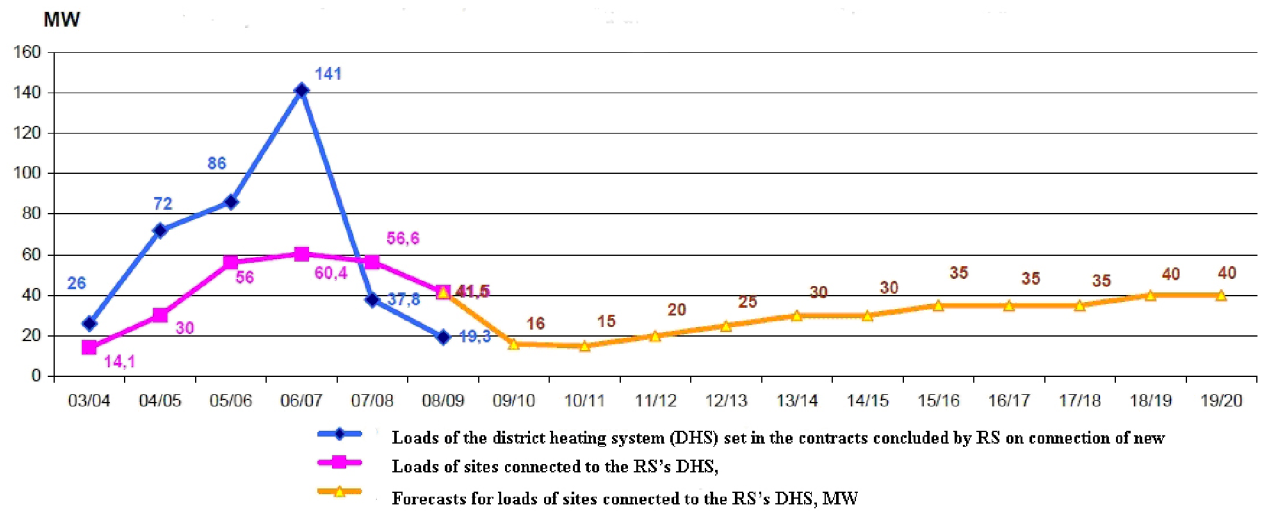


Figure 2.22. Source: JSC “Rīgas siltums” Survey "Possibilities for optimisation of the district heating system of Riga city from 2010 to 2020".

The survey includes forecast for the expected heat consumption by separate consumer groups with total consumption of heat in the respective sector of the city from the year of foundation of JSC "Rīgas siltums", irrespective of the form of property, including:

1) Public and non-residential sector of the city:

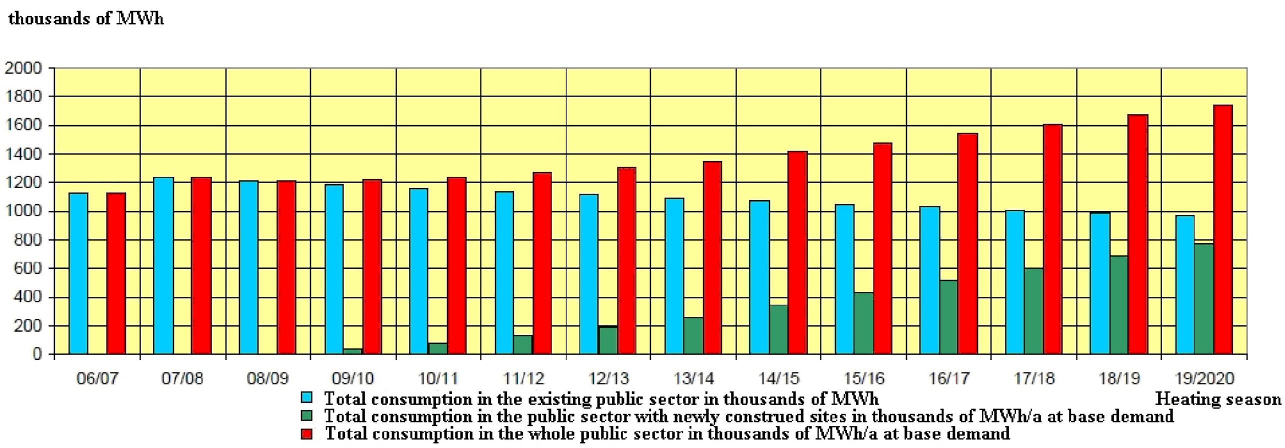


Figure 2.23. Source: JSC “Rīgas siltums” Survey "Possibilities for optimisation of the district heating system of Riga city from 2010 to 2020".

Data included in the chart:

Table 2.5.

Heating season	Total consumption in the existing public sector in thousands of MWh	Total consumption in the public sector with newly constructed sites in thousands of MWh	Total consumption in the whole public sector in thousands of MWh	Heat loads of sites connected to JSC "Rīgas siltums", MW
2006/2007	1,124		1,124	
2007/2008	1,234		1,234	
2008/2009	1,210		1,210	
2009/2010	1,185	34	1,219	16
2014/2015	1,071	344	1,415	40
2019/2020	968	771	1,740	40

2) In the residential houses sector of the city:

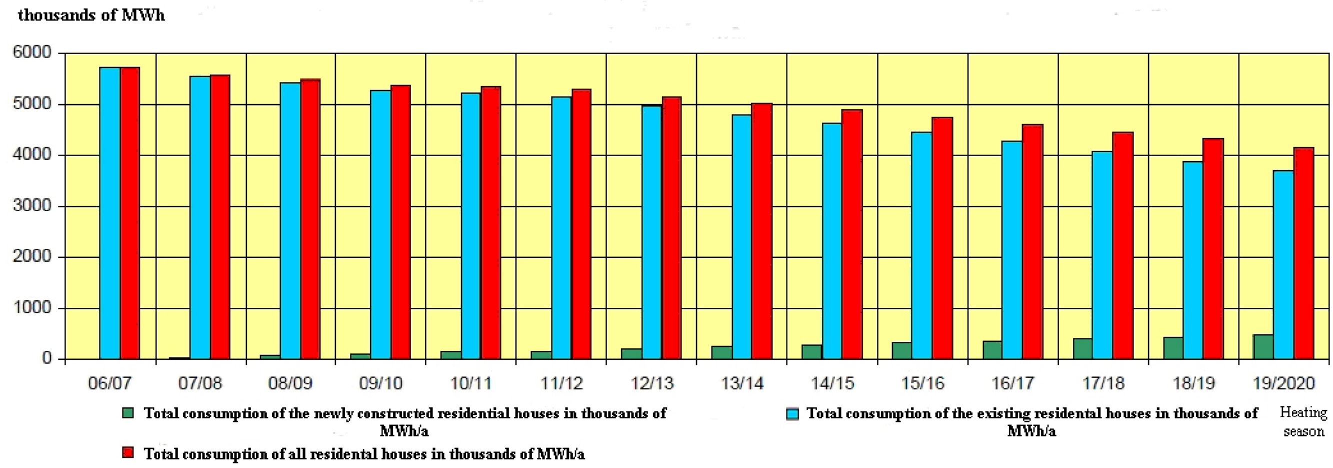


Figure 2.24. Source: JSC “Rīgas siltums” Survey "Possibilities for optimisation of the district heating system of Riga city from 2010 to 2020".

Data included in the chart:

Table 2.6.

Heating season	Total consumption of the existing residential houses in thousands of MWh	Total consumption of the newly constructed residential houses in thousands of MWh	Total consumption of all residential houses in thousands of MWh
2006/2007	5,710		5,710
2007/2008	5,551	6	5,557
2008/2009	5,420	57	5,477
2009/2010	5,276	95	5,371
2014/2015	4,616	267	4,883
2019/2020	3,685	462	4,148

Forecast for the total consumption of heat in the city of Riga by 2020:

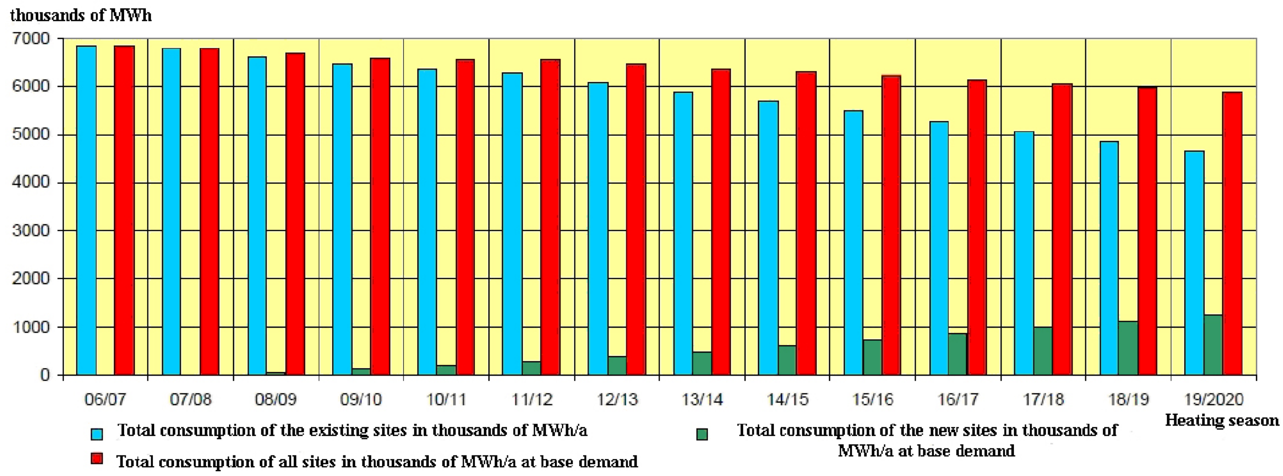


Figure 2.25. Source: JSC “Rīgas siltums” Survey "Possibilities for optimisation of the district heating system of Riga city from 2010 to 2020".

Data included in the chart:

Table 2.7.

Heating season	Total consumption of the existing sites in thousands of MWh	Total consumption of the new sites in thousands of MWh	Total consumption of all sites in thousands of MWh
2006/2007	6,834		6,834
2007/2008	6,785	6	6,790
2008/2009	6,629	57	6,686
2009/2010	6,462	129	6,591
2014/2015	5,688	611	6,299
2019/2020	4,654	1234	5,887

Electricity

Sales of electricity and its expected growth in Riga city, GWh:

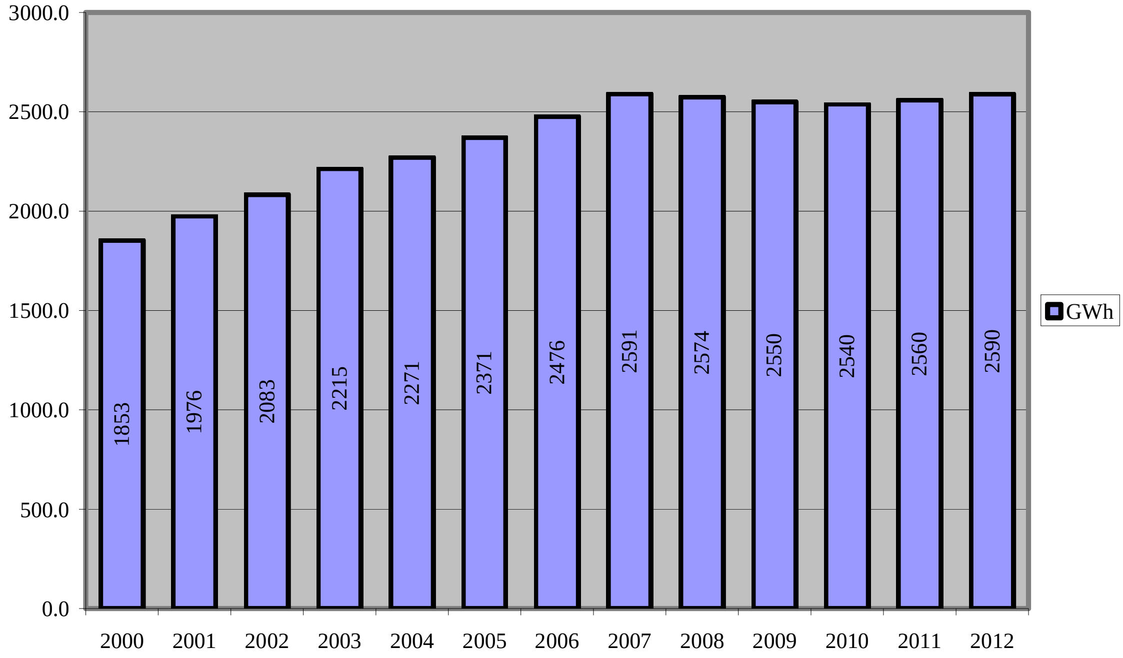


Figure 2.26. Source: JSC "Latvenergo".

As it is shown in the figure, over the recent years power consumption in the city has stabilised, and according to forecasts no major changes will affect it in the coming years. Further forecast for consumption largely depends on the intensity of introducing electric cars in the transport system of the city which could lead to substantial increase in consumption, although part of which would be compensated for by growth in production of electricity from renewable energy sources.

Actual and forecasted maximum electricity loads in Riga city according to data from JSC "Latvenergo", MW:

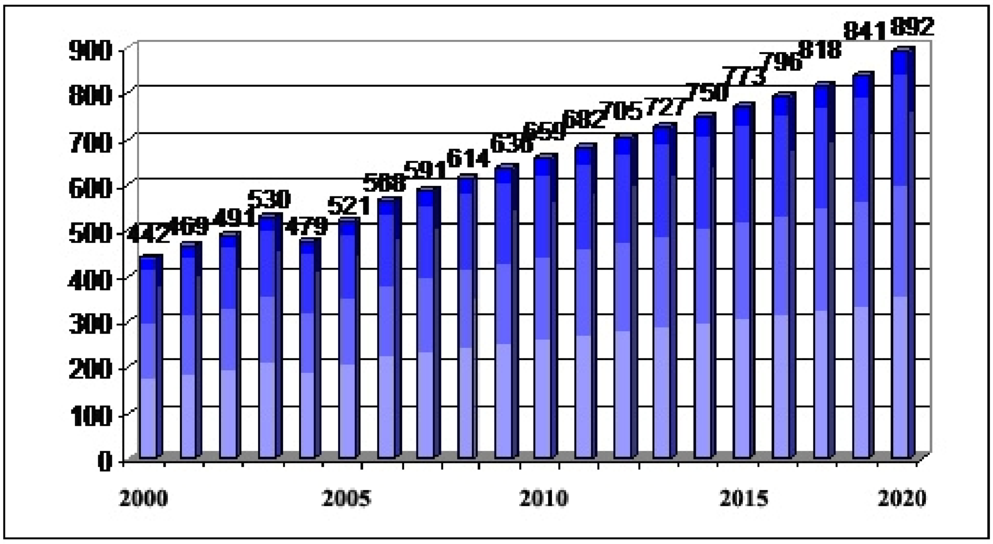


Figure 2.27.

2.5 Measures for reducing energy consumption, increasing energy efficiency and use of renewable energy sources for the period 2005 - 2020

Main measures for reducing energy consumption, increasing energy efficiency and use of renewable energy for the period 2005 - 2020 which are set in the Action Plan:

Table 2.8.

Title of the measure	Results forecast			See Table of the Action Plan
	minimum	optimum	maximum	
Energy efficiency measures, thousands of MWh per year				
1. Production of additional heat without combustion of fuel by installation of condensation economisers in heat sources of JSC "Rīgas siltums": 2010	0.54	0.6	0.66	Table 3.3. item 2
2015	14.76	16.4	18.04	
2. Production of additional heat by installation of an absorption-type heat pump in the cogeneration unit of HP "Imanta": 2015	8.28	9.2	10.12	Table 3.4, item 2
3. Renovation of multi-apartment houses by reducing heat consumption: 2010	2.6	3.9	6.5	Table 3.11. item 10
2015	68.9	130	247	

2020	260	520	780	
4. Renovation of municipal educational establishments by reducing heat consumption: 2010	10.9			Table 3.17. item 1
2015	36.3	38.3	40.3	
2020	70.7	75.7	80.8	
Measures for use of renewable energy				
1. Use of biomass in the form of wood-chips for production of energy at JSC "Rīgas siltums", loose-m3 per year: 2010	57,886			Table 4.3. item 1
2015	198,096			
2. Use of heat pumps for heating in the decentralised sector, volume of the captured heat in thousands of MWh per year: 2020	37.5	45.0	48.2	Table 4.4. item 3
3. Use of solar collectors for preparation of hot water in the multi-apartment houses, and in the common work with the district heating. Volume of the captured heat in thousands of MWh per year: 2020	1.5	10	25	Table 4.6, item 3
4. Use of biofuel in public road transport of the city, % of the total fuel consumption: 2010	4.5	5.75	6	Table 3.21. item 1
2015	6	7.88	10	
2020	9	10	15	

2.6 Forecast for CO_2 emissions for 2010–2020 and measures to reduce emissions

The minimum forecast is assumed as the base when identifying the total balance of CO_2 emissions for the period 1990 - 2020 and assessing the possible reduction in CO_2 emissions by 2020 compared to base or reference year of 1990, also taking into account the deep economic crisis which hit Latvia, and the forecasted relatively slow recovery from the crisis.

Forecasts for heat, power and fuel demand, and assessment of the effect of the measures for reduction of emissions are used as the base for CO_2 emission forecast up to 2020. In the first step, the total CO_2 emissions are forecasted in a "business as usual" scenario without measures, and afterwards the final forecast for CO_2 emissions is produced depending on the chosen scenario for reduction of emissions.

Effect of the measures for reduction in emissions is established by taking into account the volume of energy saved or the volume of fossil fuel replaced, and emission factors for the type of energy or fuel concerned.
The table below comprises the main measures for reduction in emissions for the period 2005 - 2020, and its assessed emission reduction potential:

Table 2.9.

Title of the measure	Forecasted emission reduction potential, CO_2 t per year		
	minimum	optimum	maximum
Production of additional heat without combustion of fuel by installation of condensation economisers in heat sources of JSC "Rīgas siltums", 2010	104	116	127
2015	2,849	3,165	3,482
2020	2,849	3,165	3,482
Production of additional heat by installation of an absorption-type heat pump in the cogeneration unit of HP "Imanta", 2015	1,598	1,775	1,953
2020	1,598	1,775	1,953
Renovation of multi-apartment houses by reducing heat consumption, 2010	502	753	1255
2015	13,298	25,090	47,671
2020	50,180	100,360	150,540
Renovation of municipal educational establishments by reducing heat consumption, 2010		2,103	
2015	7,006	7,392	7,778
2020	13,645	14,610	15,594
Use of biomass in the form of wood-chips for production of energy at JSC "Rīgas siltums", loose-m3 per year: 2010		2,707	
2015		16,244	
2020		16,244	
Use of heat pumps for heating in the decentralised sector, 2020	5,211	6,253	6,698

Use of solar collectors for preparation of hot water in the multi-apartment houses, and in the common work with the district heating, 2020	290	1,930	4,825
Use of biofuel in road transport			
2010	6,065	6,065	6,065
2015	13,689	18,732	24,015
2020	12,332	22,610	35,457
Use of electric cars in road transport			
2015	135	135	155
2020	5,413	5,413	5,413
Total emission savings in 2020, thousands of tonnes of CO_2	**102.72**	**172.74**	**240.58**

According to the results shown in the table, the biggest effect on reduction of emissions can be produced by energy efficiency measures in residential and municipal buildings. Strong contribution can be also made using biomass in the production of heat, as well as using biofuel, and in future also biogas, in the road transport.
According to the forecasts reviewed, in 2020, the largest CO_2 emission sources in Riga will be transport sector the share of which could reach up to 34 % of the total emissions; this is followed by heat consumption in the district heating system (32 %), fuel consumption (18 %) and power consumption (16 %).

The reduction in CO_2 emissions forecasted for 2020 in Riga according to the chosen scenarios compared to base year of 1990:

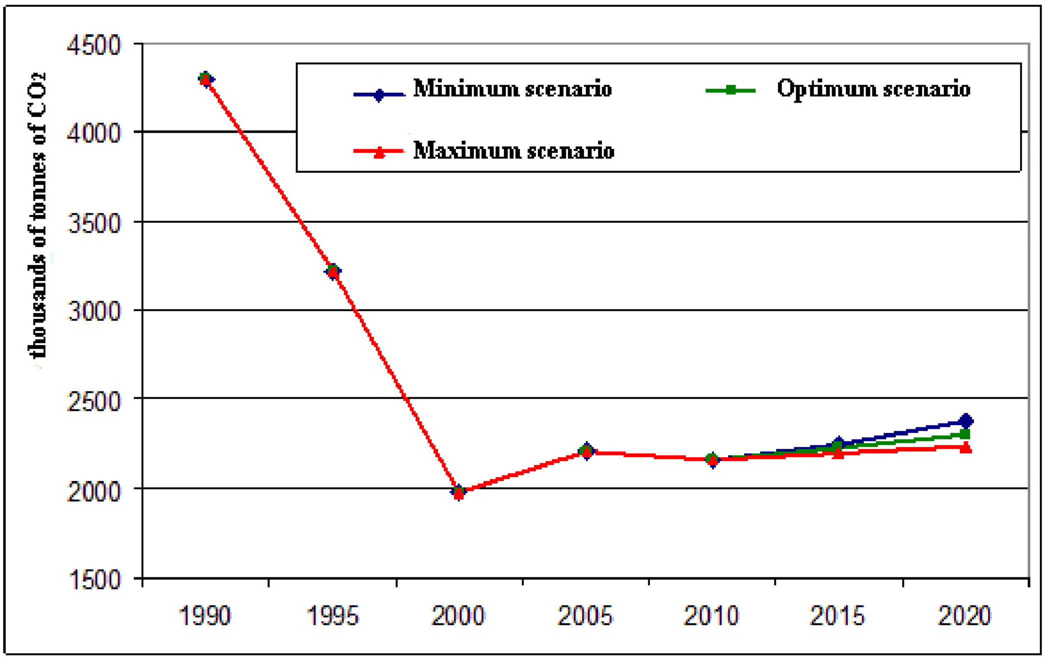


Figure 2.28. Source: IPE.

Table 2.10.

Scenario	Actual emissions in 1990, thousands of t	Forecasted emissions in 2020, thousands of t	Reduction against base year, %
Minimum	4,295	2,377	44.7
Optimum	4,295	2,307	46.3
Maximum	4,295	2,239	47.9

Volume of the forecasted emissions in all scenarios is smaller than the volume in the chosen base year (1990) by more than 40 %.

3. Potential for reduction in energy consumption and increase in energy efficiency and use of this potential in Riga.

3.1 PRODUCTION AND TRANSMISSION OF ENERGY

3.1.1 Heating

3.1.1.1 The existing situation in heating 1990 - 2008

Assessment of the energy supply in the city in general, as well as the assessment of the situation in respect of heating is adjusted to calculations of CO_2 emissions for the chosen years – 1990, 1995, 2000 and 2005 with a progress assessment also for the period up to 2008.

Year 1990 as the base or reference year

In 1990, situation regarding heating in Riga was characterised by a relatively developed district heating origins of which can be traced back to 1955–1957 with construction of TEC-1 and which covered approximately 80 % of the consumption volume in 1990. Two main state thermal power stations – Riga TEC-1 (129.5 MWel; 615 MWth) and Riga TEC-2 (390 MWel; 1,118 MWth) and very large number of boiler houses – around 800 – were in operation, where a significant part of the volume of heat supplied was formed by local boiler houses to which industrial plants, housing stock and public buildings were connected. The remaining boiler houses ensured local heating to sites. Obsolete automation and control equipment and lack of the measuring equipment are characteristic issues for the heat sources.

Natural gas, fuel oil, peat (TEC-1), as well as coal was used as fuel for the district heating. In addition to the said types of fuel, the local boiler houses used also firewood.

The main heat supplier in Riga was state-owned JSC "Latvenergo" district heating introduction administration which was responsible not only for combined heat and power plants, but also for city's main heat plants – Andrejsala, Ķengarags, Vecmīlgrāvis, Imanta and Zasulauks, as well as main district heating networks (approximately 275 km) and booster stations.

The remaining district heating networks (the total length of district heating networks is around 1000 km) was under the responsibility of Riga municipal company "Siltums" and industrial companies. The district heating networks were constructed using mineral wool insulation in the underground channels of folding reinforced concrete blocks, although surface networks on low foundations also were established due to the high ground water level. Approximately 35–45 % of distribution networks were constructed through basements of residential houses due to dense construction in the city. In 1990, separate parts of district heating networks were already constructed by use of direct-burying method for an experimental test with bituminous-perlite insulation – total length of approximately 2 km. Total length of the surface steam networks in the city was around 50 km. The overall condition of the district heating networks was assessed as poor with high deterioration and high heat transmission losses – approximately 30 %.

Changes between 1991 and 1995

As of 1991, significant changes occurred in the heating policy of Latvia, for it was completely transferred into the competency of municipalities. The distortedly developed industrial sector collapsed in Riga and thus, in factories which terminated their production, boiler houses fulfilling functions of the local boiler houses with connected consumers in the city went out of operation. In many cases boiler houses were separated from the factories and begun to operate as independent structures. Riga municipality consolidated its district heating networks, central heat substations and local heat sources, for which it is responsible, according to areas of the city, instead of one company "Siltums" creating separate municipal companies – municipal entity "Pārdaugavas siltums" in the territory of the city on the left bank of Daugava, etc. Using the first loan from the European Bank for Reconstruction and Development, JSC "Latvenergo" carried out urgent repair works in separate sections and at some heat sources of the main district heating networks. Municipal heating companies, like all state-owned energy companies, operated with large mutual debts, and some of the companies had to cease their activities due to debts, for example, municipal entity "Pārdaugavas siltums" which was liquidated by the municipality. City's heat supply was in extremely poor condition, it was operating irregularly, even with interruptions, major changes were required to stabilise the situation. Based on the proposal of the Minister for Energy, in 1995, preparation works were taken up to merge city's heating companies into a single city's heating system – formation of JSC "Rīgas siltums" begun. History of Riga city district heating system:

Table 3.1.

Year	Event
1952	Commencement of designing of the first transmission pipeline.
1956	Commencement of heating of residential houses of Riga sea trade port from HP "Andrejsala"
1958	In order to supervise construction of DHN and ensure its operation DHN workshop of Riga TEC-1 was set up and in January of 1959 it became Riga municipal district heating system workshop and formed part of VU "Latvenergo". The first transmission pipeline was put in operation on 3rd of November. "VEF" and Railway carriage plant were the first clients using DHS.
1959	Transmission pipeline was extended to Matīsa Street. Production site was built at Cēsu Street 3 for the needs of Riga municipal district heating system workshop. At that time, it operated 2.3 km of DHN with 89 clients connected thereto. Volume of heat supplied there in 1959 was 55.2 thousand MWh.
1960	DHNs were extended to central railway terminal.
1961	On the basis of Riga municipal district heating system workshop, "Rīgas siltumtīkli" was established as an independent entity on 1st of June. In 1972, it was transformed into heat system introduction and district heating administration, but in 1992 – into district heating introduction administration that operates within VU "Latvenergo".

1966	When DHNs began to expand, District Heating Services Board of Riga Municipal Housing Administration was established, but in 1971, – Riga city DHN company "Siltums" that serviced SIHB and part of distribution DHN. In 1992, it was restructured by establishing independent municipal companies of the administrative districts of Riga.
1966 1974	In order to cover rapidly increasing consumption of heat, new HPs were built: "Ķengarags", "Daugavgrīva", "Imanta" and "Ziepniekkalns", and also reconstructed and modernised boiler houses "Zasulauks" and "Vecmīlgrāvis" owned by the industrial companies of DHN.
1974	TEC-2 started heat supply for Riga.
14 March 1996	For the first time in Riga's history, a united heating company – JSC "Rīgas siltums" was established that started its operation on 1 May 1996. The company took over assets and functions from district heating system introduction administration of state owned joint stock company under privatisation "Latvenergo" and municipal heating companies of Riga city.

Source: Ā.Žīgurs, promotion paper "Efficiency of District Heating System", 2009.
Acronyms: HP – heat plant; DHN – district heating networks; DHS – district heating system; BH – boiler house; SIHB – internal heating system of buildings.

1996-2000 – rehabilitation of heat supply system and development planning is launched

The process of establishing JSC "Rīgas siltums" has been completed and the company started its operation in the period from March to May 1996. In establishing the company and observing the principle of balance required to ensure its normal operation with different contributions of its various shareholders in such a sensitive sector as heating, which is closely linked to the city population, the following owners and their ownership shares were set forth: Riga city – 49 %, the Ministry of Economics on behalf of the national government – 48.995 %, JSC "Latvenergo" – 0.005 %, and a private bank "Baltijas Tranzīta banka" – 2 %, which invested its share value in monetary form. As the 15 years of the company's operation have shown, this solution has been extremely successful, enabling JSC "Rīgas siltums" to carry out the necessary renovation and modernisation works, to emerge as one of the strongest heating companies in Eastern Europe with a high credit rating and to stabilise its position as such, having very good performance indicators and the lowest heat rate.

In 1997 Riga City Council assessed the current situation and adopted the first Riga City Heat Supply Development Concept Paper 1997–2010. At the same time, the Swedish company FVB (*Fjärrvärmeburån ab*) drafted a rehabilitation project for district heating (DH) in Riga city, using a grant from the Swedish government (SIDA); the project consisted of system rehabilitation measures in accordance with the lines of development stipulated in the Concept Paper. According to the said documents, it was planned to abolish central heat substations (CSP) and to install individual heat substations (ISM) for consumers, also planned were a transfer to independent user connections, significant increase in co-generation in the city, modernisation of TEC-1 and TEC-2 by abolishing peat as fuel, modernisation of heating plants, usage of pre-insulated pipes and direct-burying assembly for the distribution system, as well as starting to use biofuel (wood-chips, pellets for individual use).

In year 2000, the total number of heat sources (boiler houses) in the city, including TEC, has dropped to 437, using the following fuel:

natural gas – 213,
coal – 138,
wood fuel – 95,
fuel oil – 21,

peat – 2,
distillate, diesel – 18.

Rehabilitation of Riga city heat supply system – 1998–2008

The rehabilitation of the city's heating system was carried out by JSC "Rīgas siltums" without increasing heat rate for the general population, but rather by cutting production and distribution costs – reorganising internal structure of the company, significantly increasing energy efficiency in the heat production and distribution process, as well as introducing highly efficient co-generation at heating sources. The following table outlines the sequence of the measures carried out that enabled to improve the heat supply system in Riga city and increase its energy efficiency:

Table 3.2.

Year	Measure
1997	Heat meters were installed at all client premises for heat supplied by JSC "Rīgas siltums". It was possible to start analysis of DHS efficiency on the basis of credible data obtained from these meters.
1999	Riga DHS Rehabilitation Project was drafted and a demo project was implemented – dismantling of five CSPs and installation of 15 ISPs. Dismantling of the remaining CSPs was commenced.
2001	A toll-free telephone line for clients – 80 000 090 was set up, the CSP dismantling programme was completed – all 185 CSPs were closed down and more than 3 thousand ISPs were installed.
2002	The ISP replacement programme is still on-going. Four BH of average capacity were closed in Pārdaugava by construction of DHN from district heating areas to HP "Imanta". A programme was launched for replacement of compensators and armature of heat mains.
2003	The first HS of JSC "Rīgas siltums" was put into operation in cogeneration mode – a gas engine with the electrical capacity of 0.5 MW was installed at the boiler house located on Viestura prospekts. A link for the DHN heat main was constructed in the centre of the city which resulted in a raising of the safety level of DHN, closure of HP "Andrejsala", and increase in district heating area of cogeneration plants owned by JSC "Latvenergo", thus ensuring better use of its capacity.
2004	Cogeneration equipment unit was put in operation at HP "Daugavgrīva". The work on development of the system for automated reading of heat meter data was commenced.
2005	Reconstruction of HP "Imanta" into cogeneration plant was started. Developers of new construction projects appreciated the quality and profitability of the services offered by the company – the total heat load of the connected new clients was growing fast. Development and introduction of operational and technical information system OTIS for control of DHS was completed.
2006	Cogeneration unit of HP "Imanta" was put into operation. The method involving thermovision with aerial photos for monitoring of the technical condition of DHN and identification of damages was successfully used. In order to identify more quickly leakages of the heat carrier colouring of heat carrier with fluorescein was introduced. The programme for replacement of compensators and armature of heat mains was completed.
2007	Taking into account the high share of the automated ISPs and reduction of circulation volume of heat carrier, heat carrier temperature charts and hydraulic modes of DHN for all DHS were revised and approved.
2008	Four new automated BHs using natural gas were put into operation. The ISP modernisation programme was practically completed – number of the modernised ISPs exceeded 8,000.

Source: Ā.Žīgurs, promotion paper "Efficiency of District Heating System", 2009.
Acronyms: DHS – district heating system; ISP – individual heating substation; CSP – central heat substation; BH – boiler house; DHN – district heating network; HS – heating source

Results of the said work are clearly illustrated in the chart which includes the volume of heat actually produced and consumed in thousands of MWh by heating seasons (1st of October–30th of September) in the district heating system:

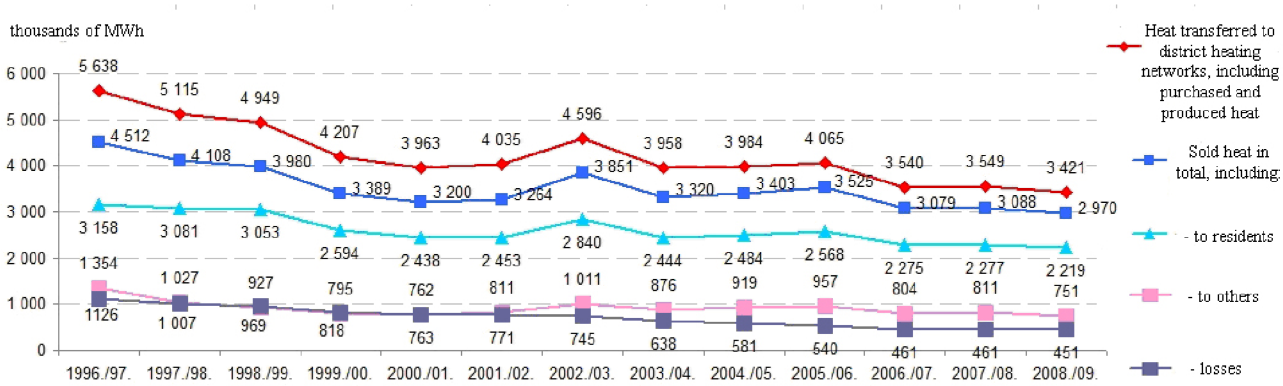


Figure 3.1. Source: JSC "Rīgas siltums".

Dismantling of city's 185 central heat substations (CSPs) and 4-pipeline system from these CSPs to clients together with construction of ISPs in every building connected to the CSPs have to be mentioned among the key measures implemented during rehabilitation of the district heating system. Modernisation of transmission networks was carried out at the same time. Therefore it was possible to significantly reduce the number of accidents in the transmission networks and leakages of the heat carrier. Dynamics of decrease in the average consumption of feed water in networks indicate the achieved results and are shown in the chart below:

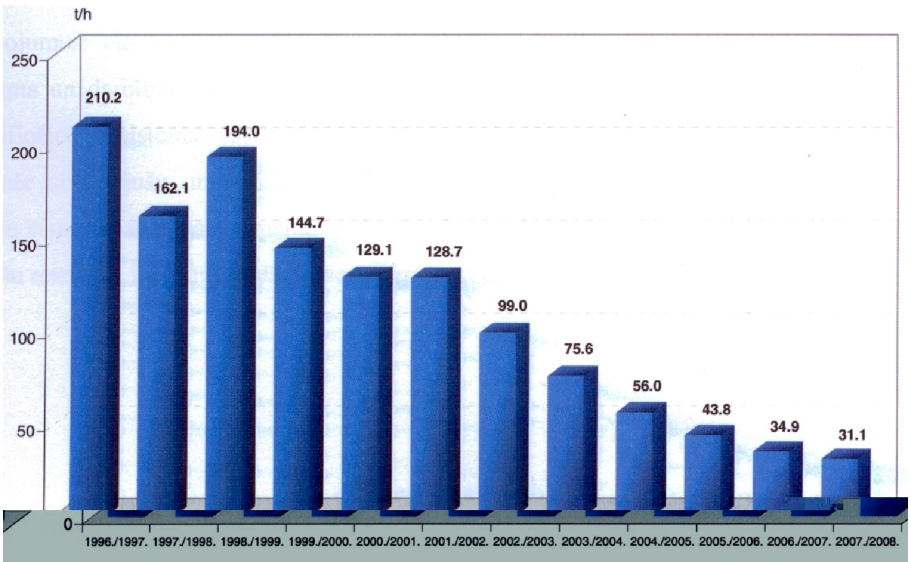


Figure 3.2. Source: Ā.Žīgurs, promotion paper "Efficiency of District Heating System", 2009.

Some worn-out and obsolete transit network sections were dismantled, individual modern fully-automated boiler houses (in Bolderāja, Lubānas Street and in other sites) were built, cogeneration was introduced in a targeted manner, and at the moment, by taking into account also modernisation of both largest city's TEC stations, cogeneration already exceeds 90 % of the volume of heat produced in the district heating system. Upon completion of rehabilitation of the system, significant reduction of heat losses has been actually ensured in the transmission process – 59 %, as it is shown in the chart below:

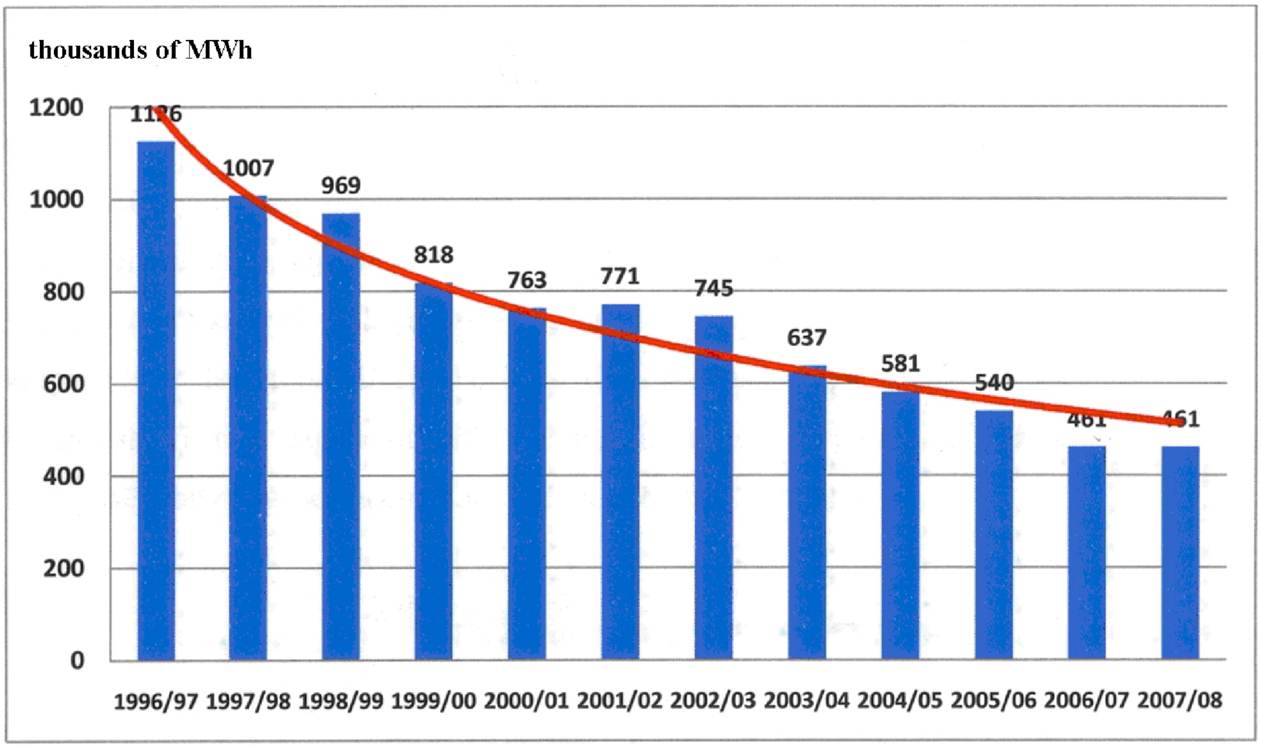


Figure 3.3. Source: Ā.Žīgurs, promotion paper "Efficiency of District Heating System", 2009.

In 2009, the level of heat losses was lower by 13 % of the volume of heat supplied to clients. Following the modernisation, JSC "Rīgas siltums" has become one of the most technically advanced heating companies in the Eastern Europe with high technical specifications of the system, and one of the lowest heat rates and high credit rating.

Heat supply scheme for Riga city:

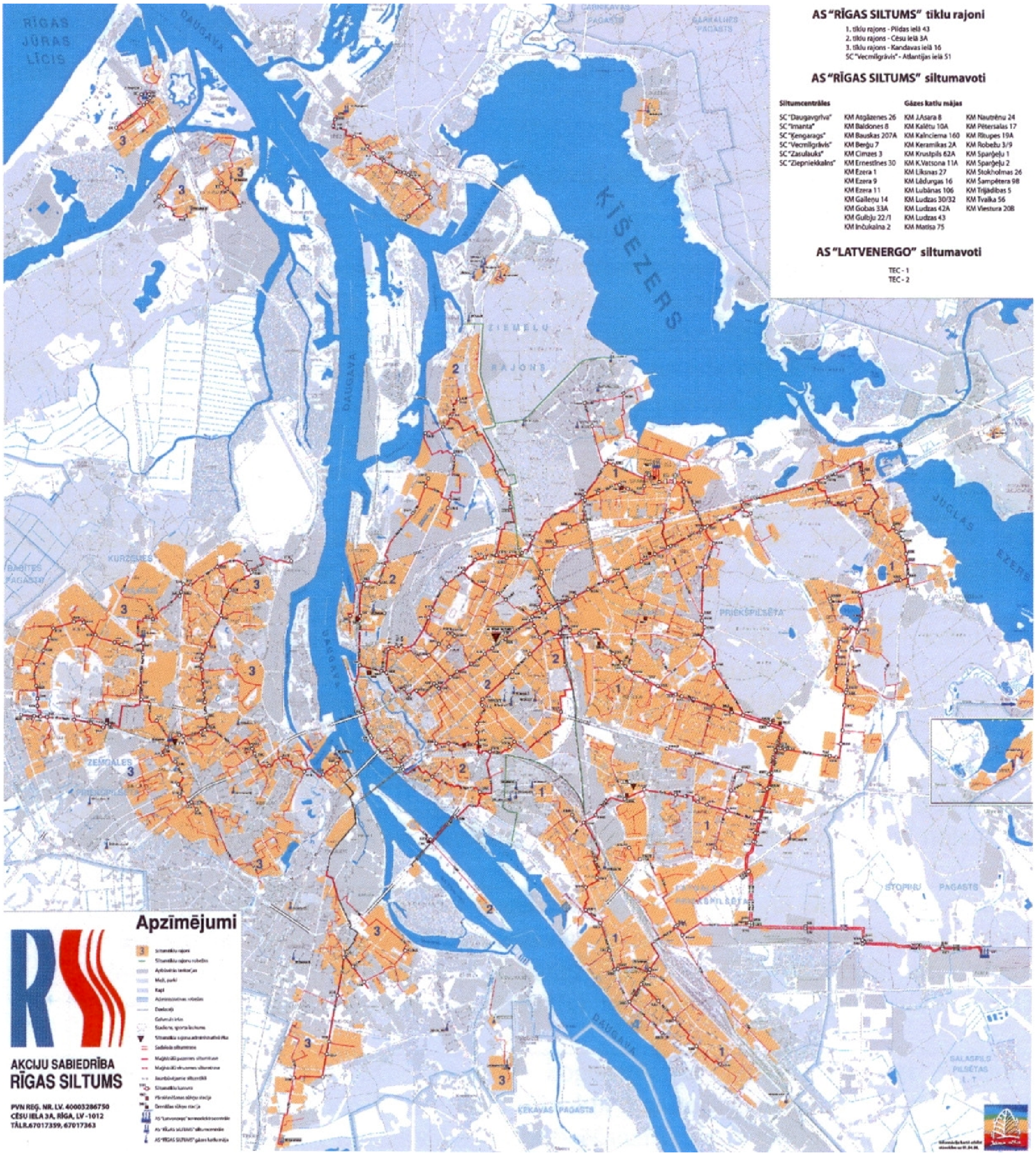


Figure 3.4. Source: JSC "Rīgas siltums".

3.1.1.2 Forecast for development of heat supply and increase in energy efficiency for the period 2005 - 2020

Forecast for changes in the energy efficiency of heat production for the period 2010 - 2020

The key measures which are expected to increase energy efficiency in the sector of heat production:

1) Utilisation of flue-gas heat in the heat sources of Riga city;
2) Use of absorption-type heat pumps to increase energy efficiency of the cogeneration unit;
3) Application of trigeneration technology to increase energy efficiency;
4) Use of renewable energy sources (see Section 4).

Utilisation of flue-gas heat in the heat sources of Riga city

In recent years, one of the energy efficiency measures implemented in the heat sources of JSC "Rīgas siltums" is utilisation of flue-gas heat through installation of condensation economisers behind the boilers for deep cooling of flue gases. These economisers enable production of additional heat without combustion of fuel and increase the energy efficiency of heat production, while reducing CO_2 emissions. Practice shows that condensation economisers of water heating boilers operating on natural gas allow to increase the efficiency rate of boiler units by 6–13 % and, in some cases, when calculating the lowest calorific value, the efficiency rate can reach even 107 %.

Condensation economisers have been installed in Riga at these locations:

• HP "Imanta" behind the water heating boiler KVGM-100 (see Figure 3.5).

KVGM - 100 boilers are the largest water heating boilers installed in Latvia operating on natural gas. In order to install a condensation economiser one of the following three water heating boilers was chosen with base load maintained at 90 MW. The rated heat capacity of the condensation economiser (of passive type) installed behind the boiler is 10 MW.

Figure 3.5. Source: Brochure "Utilisation of Flue-gas Heat in the Heat Sources of Riga City"

The scheme for connection and operational mode of the condensation economiser at outdoor temperature of +8.9 °C:

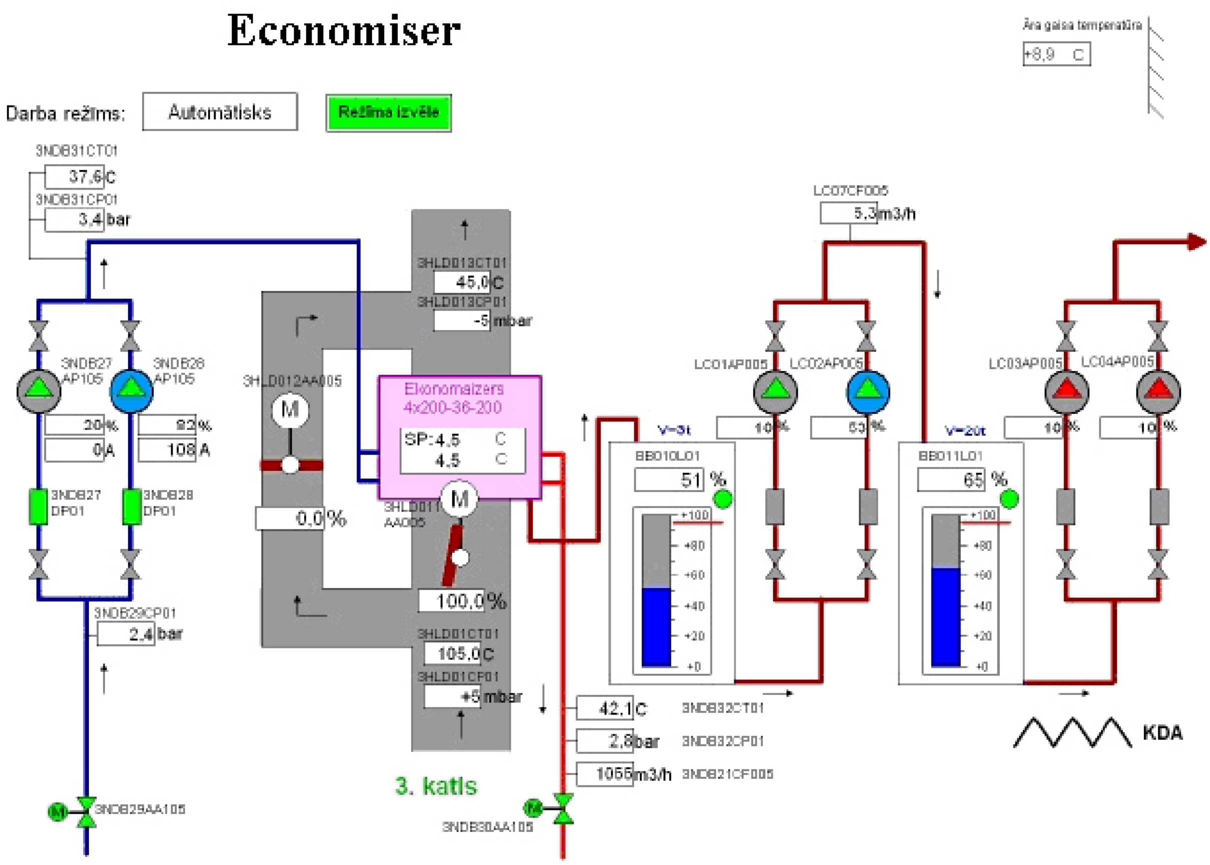


Figure 3.6. Source: Brochure "Utilisation of Flue-gas Heat in the Heat Sources of Riga City"

In the scheme above, the condensate obtained from flue gases can be regarded as one of the benefits. This condensate is applied in a form ready for use to feed district heating networks, thus replacing certain amount of water which would otherwise have to be purchased and treated with chemicals and heat.

Condensation economisers have been installed also at these locations:

- cogeneration plant at Keramikas Street 2a;
- cogeneration plant at Viestura prospekts 20;
- automated gas-fired boiler house at Trijādības Street 5;
- automated gas-fired boiler house at Nautrēnu Street 24;

The best results are expected in the boiler houses of low and average capacity where condensation economisers are operating via direct connection. Operation of condensation economisers with direct connection:

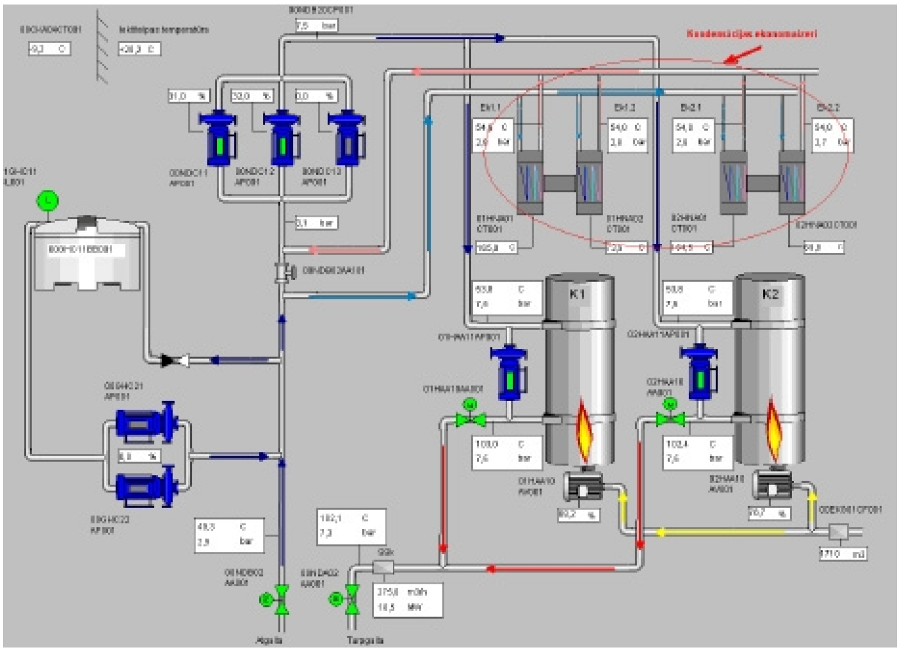


Figure 3.7. Source: Brochure "Utilisation of Flue-gas Heat in the Heat Sources of Riga City"

During the period of five month since November 2009, operation of the equipment installed has shown that the actual savings of fuel (natural gas) for production of additional heat have exceeded the planned savings from the operation of condensation economisers, and has reached 2.896 million m3 already during these five months by reducing proportionally the volume of CO_2 emissions.

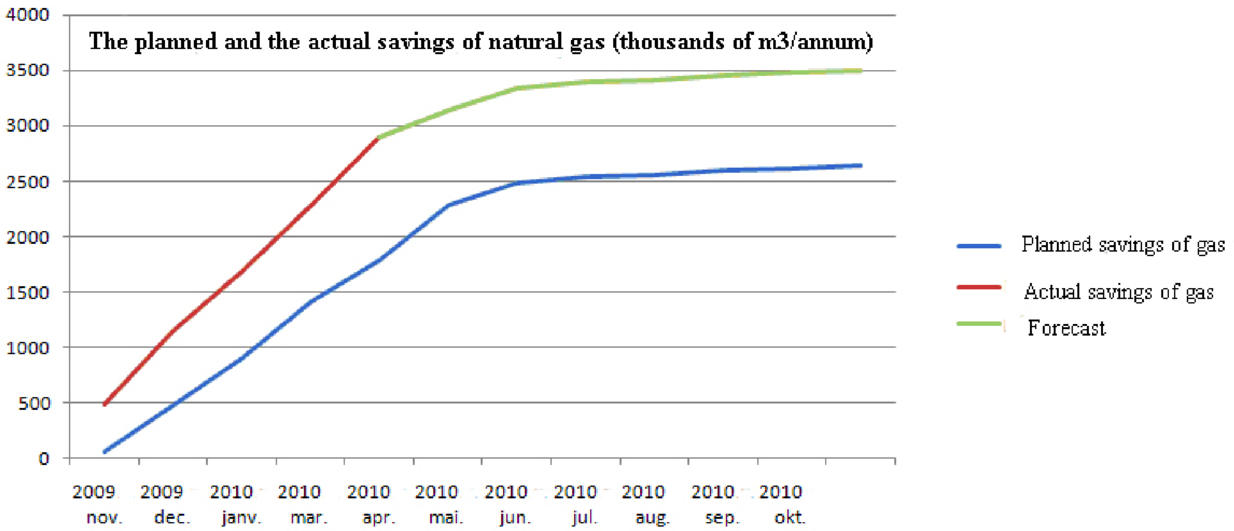


Figure 3.8. Source: JSC "Rīgas Siltums"

Table 3.3.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To install condensation economisers in other heat sources of JSC "Rīgas siltums": - BH on Bauskas Street, - HP "Vecmīlgrāvis", - HP "Daugavgrīva", combined economiser - BH on Gobas Street.	2011 2012 2012 2014	JSC "Rīgas siltums"	Installed capacity: 0.4 MW 2.5 MW 2 MW 0.4 MW
2. Production of additional heat per year using the condensation economisers installed in the district heating system, thousands of MWh per year	2010 2015	JSC "Rīgas siltums"	0.54 / 0.6 / 0.66 * 14.76 / 16.4 /18.04*

*) minimum/optimum/maximum forecast

Use of absorption-type heat pumps to increase energy efficiency of the cogeneration unit

On average, approximately 2 MWh of low-potential heat produced by cooling of gas turbines, steam turbines and gas compressor elements are discharged into the surrounding environment every hour during the operation of the cogeneration unit of HP "Imanta" from the open-type grading units of the cooling system. In addition, in order to ensure proper operation of the boiler approximately 3.5 t/h of hot water of high potential (above 100 °C) is being drained. In order to prevent these unnecessary losses absorption-type heat pump with LiBr absorbent was installed for improvement of efficiency of the equipment.

Principal scheme for absorption-type heat pump:

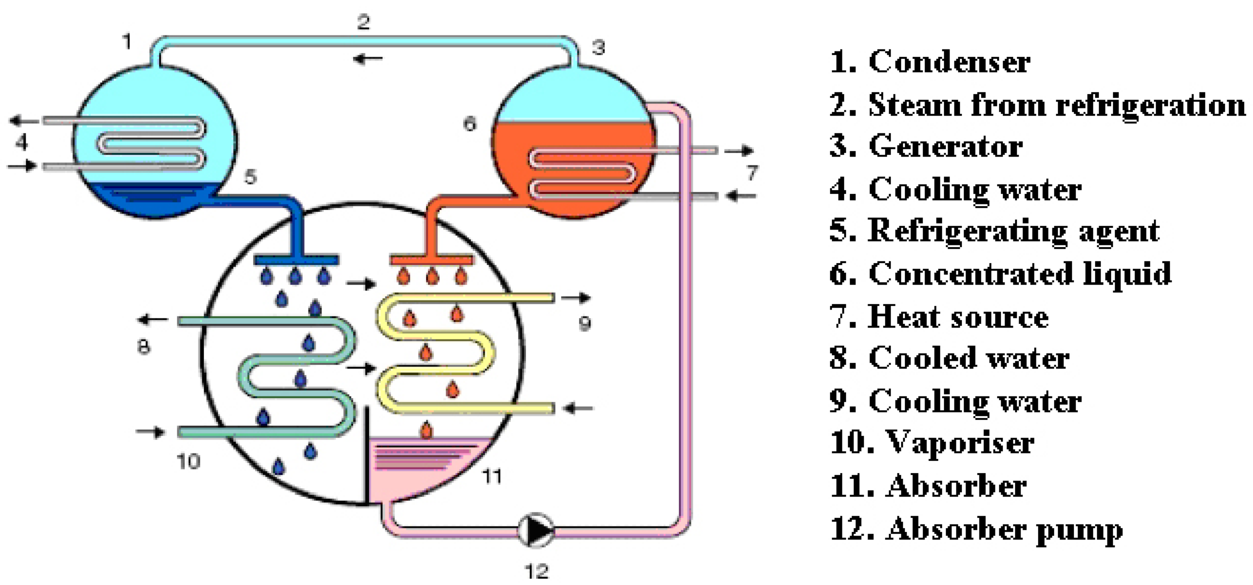


Figure 3.9. Source: A.Cers, presentation "Use of Absorption-type Heat Pumps to Increase Energy Efficiency of the Cogeneration Unit at HP "Imanta". www.rea.riga.lv

The high-potential heat required to ensure the technological process of the absorption heat pump is planned to be obtained from the cogeneration equipment itself, without increasing fuel consumption. The heat pump unit installed, which uses hot water drained so far, allows to receive and transfer heat to consumers every hour in the amount of 2 MWh which will not be discharged in the atmosphere or diverted to sewage system. The measure allows increasing energy efficiency of the plant, reduces power consumption and CO_2 emissions, minimises the risk of icing of cooling towers and, in the present case, reduces consumption of cooling water by 48,000 t per year.

Table 3.4.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To install absorption-type heat pumps to increase energy efficiency of the cogeneration unit at HP "Imanta"	2010-2011	JSC “Rīgas siltums”	Capacity of the heat pump is 2 MW, the total additional heat capacity is 5 MW0
2. Production of additional heat per year using the absorption-type heat pumps in the cogeneration unit at HP "Imanta", thousands of MWh per year	2015	JSC “Rīgas siltums”	8.28 / 9.2 / 10.12*

*) minimum/optimum/maximum forecast

Application of trigeneration technology to increase energy efficiency

Trigeneration is a combined production of electricity, heat and cooling energy. Trigeneration is based on generation of cooling energy in the absorption-type refrigeration machines consuming heat, instead of electricity. Trigeneration is beneficial, for it provides an opportunity to use the heat utilised in the cogeneration units after production of electricity not only for covering of winter heating consumption, but also for conditioning of air to be diverted into premises in summer and for technological needs, thus ensuring that cogeneration units operate at higher capacity the whole year. Options for use of heating capacity for the district heating under climatic conditions of Latvia, as well as changes in the structure of heat loads are distinctively shown in the chart below:

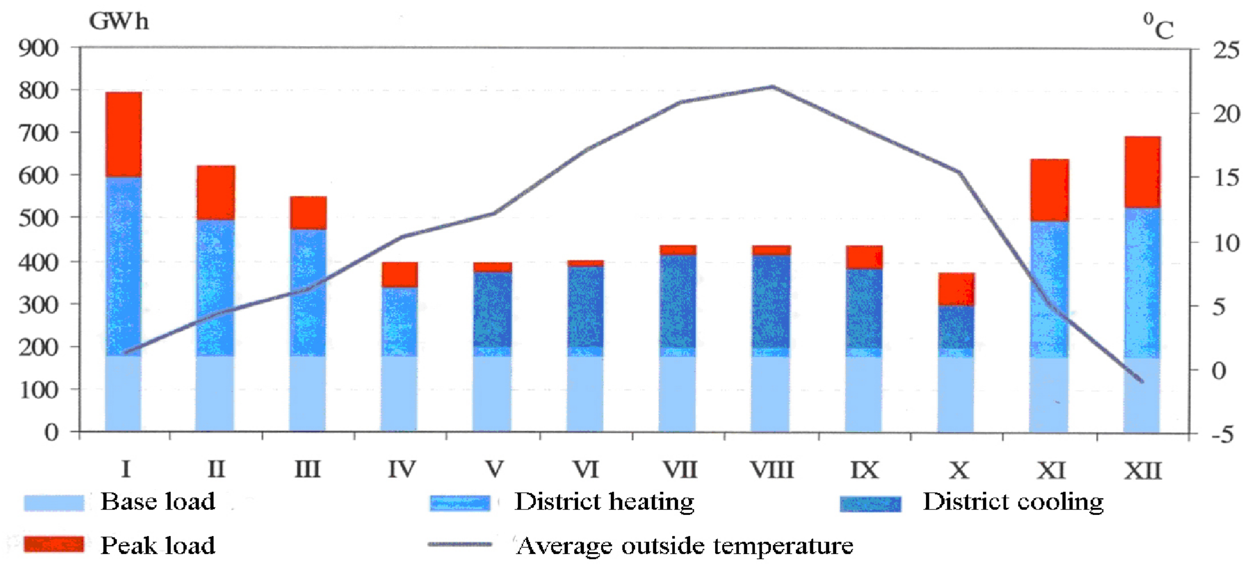


Figure 3.10. Source: Ā.Žīgurs, promotion paper "Efficiency of District Heating System", 2009.

Although at the moment the district cooling is not used in Riga, it has certain potential, taking into account formation of some business centres in the city with relatively heavy load of cooling energy (Torņakalns, area of Skanstes Street, exhibition complex near the airport, etc.)

Table 3.5.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To develop a pilot project for trigeneration in a separate part of city's construction area with consumption of cooling energy required for cooling of premises	2015-2020	JSC “Rīgas siltums”	

3.1.2 Power supply

3.1.2.1 The existing situation in power supply 1990 - 2008

Power production

The largest producers of electricity in Riga city are the three large power plants of JSC "Latvenergo":

1) Riga TEC-1 (on Viskaļu Street) with the electrical capacity of 144 MWel and heat capacity of 177 MWth after the modernisation completed in 2005. This combined-cycle power plant uses natural gas as fuel, the back-up fuel is diesel. Riga TEC-1 is the first cogeneration plant of high capacity in Latvia which is put into operation between 1955 and 1957 with the electrical capacity of 129.5 MWel and heat capacity of 615 MWth, using peat and fuel oil as fuel, later also natural gas.

2) Riga TEC-2 (in Acone, outside Riga) started its operation between 1975 and 1979, initially fuel oil was used as fuel, but following gasification of TEC-2 in 1984 – also natural gas, and fuel oil became the back-up fuel. 21. TEC-2 modernisation is being prepared in the beginning of 21st century.

3) Riga HPP (on Dole island, outside Riga) which started its operation between 1974 and 1975 with the electrical capacity of 402 MWel.

Cogeneration units of heating plants and boiler houses are connected to the combined power networks:

• At boiler house of JSC "Rīgas siltums" on Viestura prospekts with the electrical capacity of 0.5 MWel and heat capacity of 0.65 MWth, which is operating on natural gas. The cogeneration unit was put into operation in 2003

• At HP "Daugavgrīva" (on Lēpju Street) of JSC "Rīgas siltums" which was put into service in 2004 and is operating on wood-chips. The electrical capacity of the unit is 0.5 MWel, but heat capacity is 27.2 MWth.

• At JSC "Ligija Teks" (on Šampētera Street) with the electrical capacity of 1.4 MWel and heat capacity of 41 MWth. The cogeneration unit is designed to be operating on natural gas. This steam-cycle cogeneration unit was put into operation in 2000, however, it is not working already for several years now

• At LTD "MBA" with the electrical capacity of 0.495 MWel. The company's steam-cycle power plant which uses natural gas was put into operation in 2001

• At LTD "Rigens" (on Dzintara Street, Daugavgrīva) with the electrical capacity of 2.1 MWel and heat capacity of 2.6 MWth, which is operating on biogas produced by the waste water treatment plant "Daugavgrīva". The gas-engine cogeneration unit was put into operation in 2002;

• At LTD "Getliņi EKO" (in Stopiņi amalgamated municipality, outside Riga) with the electrical capacity of 5.3 MWel and the potential heat capacity of 6.8 MWth. Since 2002 the gas-engine cogeneration plant is operating on biogas from the landfill

• At cogeneration plant of JSC "Aldaris" (on Tvaika Street) with the electrical capacity of 1.0 MWel and heat capacity of 1.2 MWth. The gas-engine cogeneration unit was put into operation in 2002.

Transmission of electrical power

JSC "Augstsprieguma tīkls" renders power transmission services in the territory of Riga city and is responsible for the following:

- 6 substations of 330 kV in Imanta, Riga TEC-1, Bišuciems, Riga TEC-2, Salaspils and Riga HPP;
- 24 substations of 110/6-20 kV
- high-voltage lines of 330 kV – 70 km;
- high-voltage lines of 110 kV – 250 km.

Supply of electricity to the city is ensured via transmission lines 330 kV: Riga HPP–Bišuciems, Jelgava–Bišuciems, Salaspils–Riga TEC-1 and Bišuciems–Imanta, as well as through power line networks of 110 kV. The city's transmission network was set up according to arch-type scheme, including also Riga TEC-2 located outside the city, with three-beam diagonal connection at a 110 kV substation Hanza. The arch substations of 110 kV – Riga TEC-1, Bišuciems and Imanta are outside-the-arch links with other substations of 110 kV within the power line system.

Power consumption in the city of Riga, GWh:

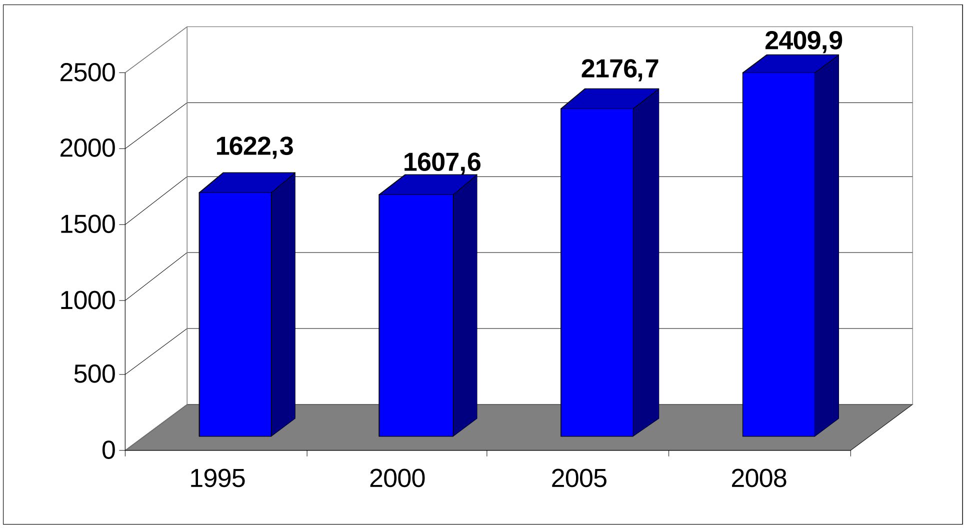


Figure 3.11. Source: JSC “Latvenergo”.

The largest provider of power distribution services in the territory of Riga city is JSC "Sadales tīkls". Power is transferred to consumers via more than 314 thousands of electricity meter points. Sites of the distribution network in the territory of Riga:

- 24 substations of 110/6-20 kV
- 78 distribution points of 10 kV
- 2,126 transformer points of 6–20/0.23–0.4 kV
- 3,166 distribution transformers
- Installed capacity of distribution transformers – 1,339 MVA
- Medium-voltage lines of 6–20 kV – 2,303 km;
  including cable lines – 2,053 km;
- Low-voltage lines of 0.23–0.4 kV – 2,619 km;
  including cable lines – 2,406 km;

Consumption structure in Riga has undergone drastic changes since 1991. In particular, load centres have changed over the last 5 years. Before 1991, there were many industrial companies consuming largest share of electricity, with well-developed power distribution networks. When the primary production was being stopped and the sites were being privatised, frequently factories were divided into individual limited liability companies (LTD). For example, at the moment the territory of the former VEF factory is location for approximately 40 different companies which now own also individual sections of the unified power supply network of VEF. Some of these companies use the said sections as the basis for becoming resellers of electricity, thus increasing electricity price.
A rapid increase in loads of residential houses can be observed. Growth in household loads is overburdening the existing cable networks, leading to quicker deterioration and damaging of their insulation, as well as reduces options for reserves, and the safety of power supply is decreasing. Particular problems exist in respect to beginning of the autumn heating season and the coldest days of winter, when individual electrical heaters are being increasingly used, therefore cases of the power network overloading become frequent, cable protection goes off and fuses are blown. When losing the voltage, the district heating is interrupted in most of the residential houses, because circulator pumps stop working, gas supply to the individual heating boilers is blocked, and electric heating is not working.

Power consumption in Riga city in breakdown by consumer groups, GWh:

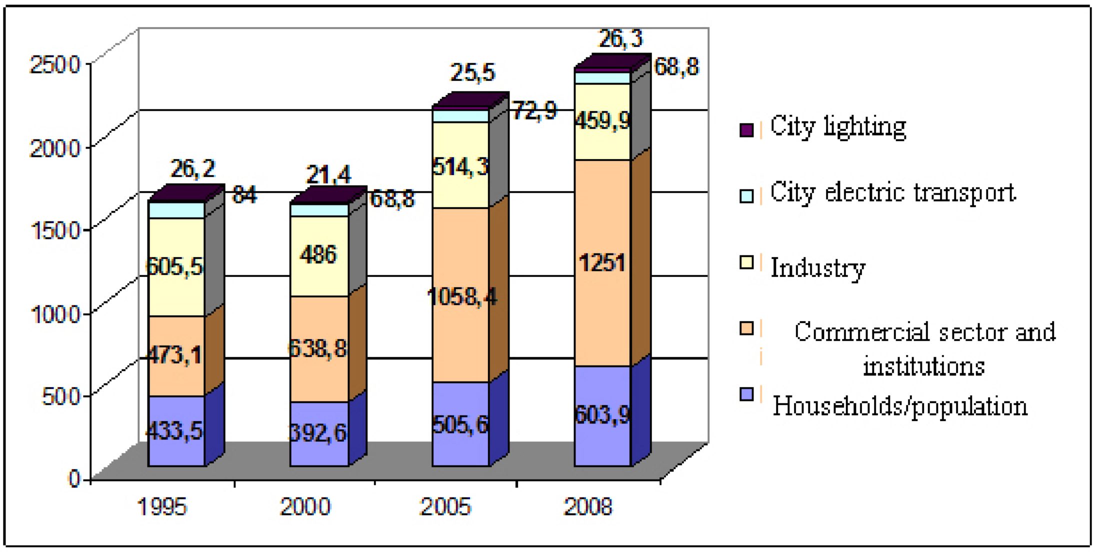


Figure 3.12. Source: JSC “Latvenergo”.

3.1.2.2 Forecast for development of power supply and increase in energy efficiency for the period 2005 - 2020

Modernisation and construction of electrical power production units

After 2005, modernisation, and installation of cogeneration units is being carried out at the following sites:

• In 2009, the first stage of modernisation of Riga TEC-2 was completed by installation of combined-cycle power unit which has significantly increased its efficiency. New cogeneration unit operating on natural gas was installed and will also be capable of working in condensation mode outside the normal heating season. The power capacity of the new unit is up to 407 MWel, while its heat capacity – up to 264 MWth, the efficiency in cogeneration mode – up to 87 %, in condensation mode – up to 57 %. The new power unit, which is one of the state-of-the-art units in Europe, started its operation in the heating season of 2008. Together with equipment of the existing unit, at the moment the total electrical capacity of TEC-2 is 620 MWel, but the heat capacity is 1,124 MWth.

Preparation works for the second stage of modernisation of TEC-2 were carried out, envisaging installation of the new gas-turbine combined cycle unit with the electrical capacity of 427 MWel and heat capacity of 270 MWth. The new unit will operate with high energy efficiency.

• In 2006, a cogeneration unit at HP "Imanta" (on Kurzemes prospekts) was put into service with the electrical capacity of 47.7 MWel and heat capacity of 47.7 MWth which is operating on natural gas;

• In 2007, after the reconstruction the electrical capacity of the cogeneration unit at HP "Daugavgrīva" was increased to 0.6 MWel;

• In 2009, a cogeneration unit was installed in the boiler house on Keramikas Street with the electrical capacity of 2.4 MWel and heat capacity of 3.1 MWth. The gas-engine cogeneration unit is operating on natural gas;

• In 2008, a cogeneration plant LTD "Juglas jauda" (on Brīvības gatve) was put into service with the electrical capacity of 11.8 MWel and heat capacity of 12 MWth. This gas-engine cogeneration plant is operating on natural gas;

The total installed capacity of electricity in the cogeneration plants linked to Riga is 837,295 MWel. It has to be noted that power consumption has a trend of annual growth since 2000, with a small decrease in 2009 due to the economic recession which is distinctively shown in the chart below:

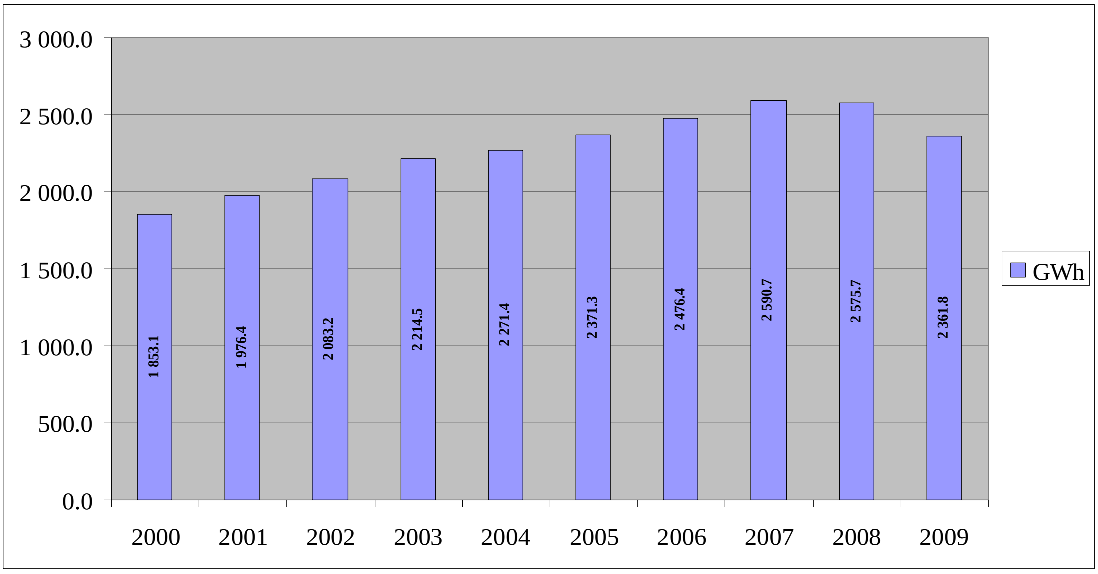


Figure 3.13. Source: JSC "Latvenergo".

Development of power transmission systems and increasing efficiency of power consumption

Significant investments have been made in Riga by increasing operating voltage of the medium-voltage electrical network of the central part of Old Riga and the city from 6 kV to 10 kV. Therefore it was possible to significantly (1.66 times) increase transmission capacity of the cable network. Due to increase in loads, at the moment cables are working on the edge of overload in some places and cannot ensure connection of additional loads. A large amount of work has been done to reduce power transmission losses by implementing technical and organisational measures, as well as making investments in the reconstruction of power networks.

Dynamics of electricity losses in Riga city, % of the amount of electricity transmitted:

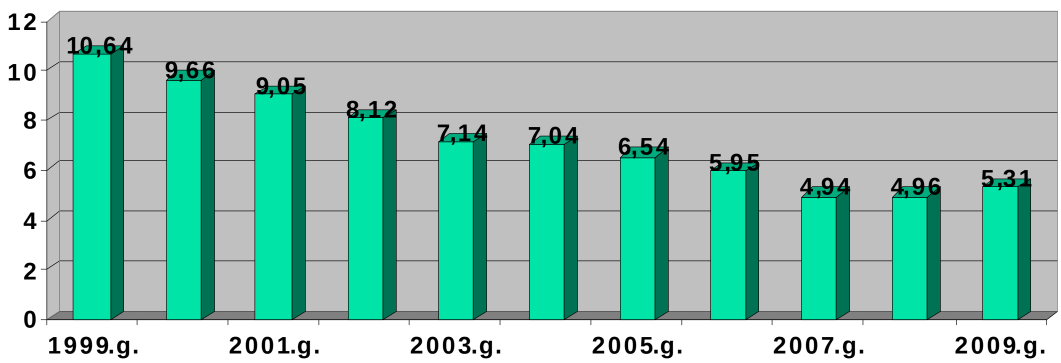


Figure 3.14. Source: JSC "Latvenergo".

JSC "Latvenergo" has to supply large amount of electricity and improve quality of the service, therefore installation of new substations, construction of new lines, and reconstruction of already existing sites have to be continued. Terms set for construction and reconstruction of sites of power supply (in particular, for construction of substations and lines of 110 kV) are related to development of the largest customers and city infrastructure.

It is difficult to supply electricity to the historical centre of Riga due to the fact that morally and technically obsolete electrical wiring of three-wire system of 3x220 V is used to supply electricity to buildings. Therefore, in order to supply electricity to these buildings JSC "Sadales tīkls" is forced to use physically and morally outdated three-wire power network which cannot ensure swift increase in loads. Besides, such wiring is not in conformity with the relevant regulations, and requirements of the European standards, therefore electrical wiring of the buildings has to be immediately reconstructed to ensure a state-of the-art operational voltage of 400/230 V.
In order to fully switch from 3x220 V network which has remained in Riga to voltage of 400/230 V low-voltage cables (approximately 250 km in length) have to be laid again or replaced, 230 transformers have to be installed or replaced, setting up approximately 150 new transformer points for installation of the said transformers, but an appropriate venue has to be found for these points which is a large problem in Riga. Prior to reconstruction of electrical wiring, each owner of a building or user of electricity has to consider the expected power consumption and submit an appropriate application for connection of required capacity to the Riga City Region Office of JSC "Sadales tīkls". Owner of a building has to cover all costs related to reconstruction of the internal electrical wiring of his/her building, for according to Article 18 of the Energy Law "power supply installations which are located inside buildings and constructions and which are utilised only for the supply of such buildings and constructions with electricity, except for control apparatus and meters installed by the power supply operator, are auxiliary properties of the main properties – such buildings and constructions, and all expenses related thereto must be covered and burdens must be borne by the owner or possessor of the main property". Each owner of an apartment covers all costs related to reconstruction of the internal electrical wiring of his/her apartment. Unfortunately, owners frequently underestimate that, if the worn-out electrical wiring is not replaced, the buildings are not protected against fire, and – most importantly – risk is posed to human lives which can be a lot more unacceptable and expensive than the funds invested in improvement of electrical wiring.

In order to assess the existing situation in the dynamics of the specific power consumption of housing stock of the city in 24-hour period, REA has measured loads in two residential houses in the centre of Riga.

In order to take measurements during peak loads, in autumn (in the end of September) fully occupied residential houses were chosen – a 9-storey building with 70 apartments, built from pre-cast reinforced concrete constructions, with gas stoves in the kitchens, the other – a 12-storey building with 49 apartments and electric stoves in the kitchens. On the basis of the measurements, a chart on the specific loads in time of the day was compiled, referring the load in W to the total area of apartments:

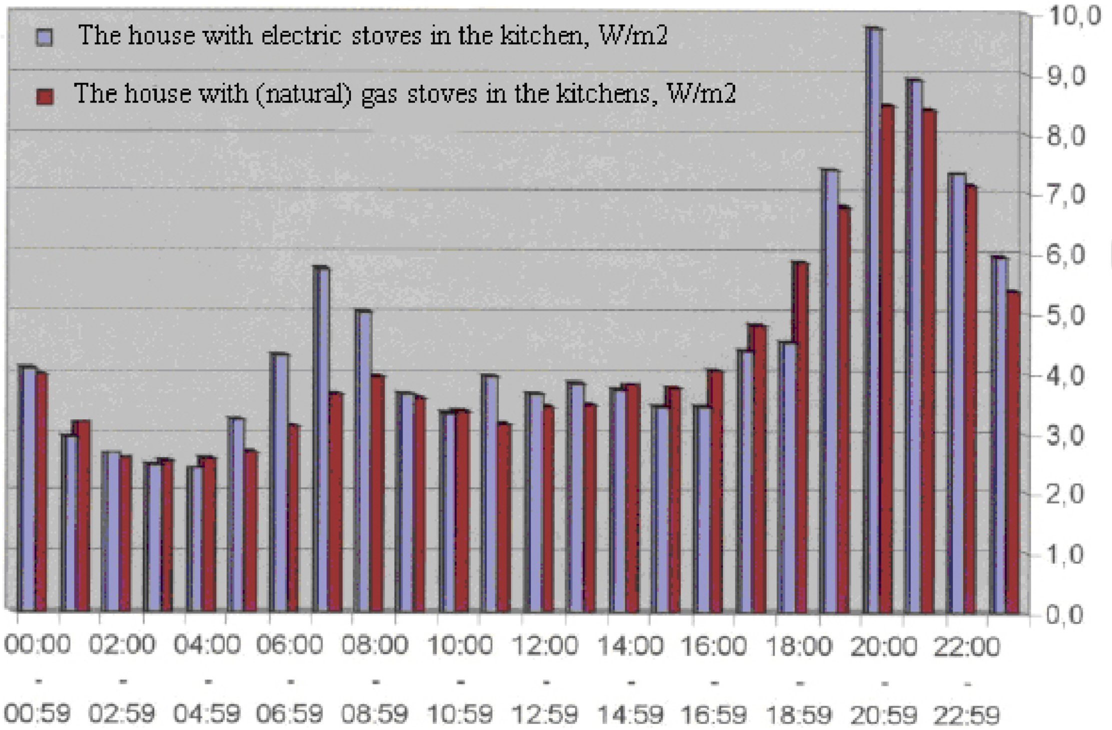


Figure 3.15.

The chart can be used both when preparing data on the expected power consumption to be included in the application for connection of required capacity to the Riga City Region Office of JSC "Sadales tīkls", if reconstruction of the internal electrical wiring will be carried out in the building, and also when renewable energy sources are planned to be used to fully or partially cover power consumption. The said reconstruction of electrical wiring is required to increase energy efficiency of power supply, and it would be useful to carry out this reconstruction together with all the other renovation works focused on reduction of energy consumption. When improving the internal electrical wiring of a building, it would be useful to install a sensor system in the stairwell which would switch on lighting only based on a motion sensor for residents on the stairs.

Table 3.6.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Taking into account the specific character of buildings of Riga's housing stock built by 1993 – the obsolete internal three-wire power network, to foster renovation of this network by carrying out it together with the complex renovation of the building to the greatest extent possible.	2010-2020	REA, cooperation partners	
2. To achieve introduction of a sensor system for lighting in the stairwells during complex house renovation	2010-2020	REA, cooperation partners	10/30/50 %* of the number of renovated houses

3. To set up a network of charging stations for electric cars and hybrid cars in Riga city	2011-2020	JSC "Latvenergo", Riga City Council	

*) minimum/optimum/maximum forecast

3.1.3 Fuel consumption, including in the decentralised heating sector

Supply of natural gas to the city

Supply of natural gas to the city of Riga is ensured by a privately-owned company – JSC "Latvijas gāze" the main shareholders of which are E.ON Ruhrgas International AG (47.23 %), Open Joint Stock Company "Gazprom" (34 %) and LTD "Itera Latvija" (16 %).

Natural gas is supplied to Riga from high-pressure gas pipelines via two high-pressure gas regulation stations (GRS) where gas pressure is reduced from 4.5 MPa to <1.2 MPa for high-pressure gas distribution network and < 0.3 MPa for medium-pressure gas distribution network. GRS-1 is located on the right bank of the Daugava river in Saurieši (outside Riga city), GRS-2 - on the left bank of the Daugava river. In fact, Riga TEC-2 can also be regarded as a GRS, for approximately 1/3 of the consumed natural gas in the city is transferred to Riga through it. Gas supply scheme for Riga city:

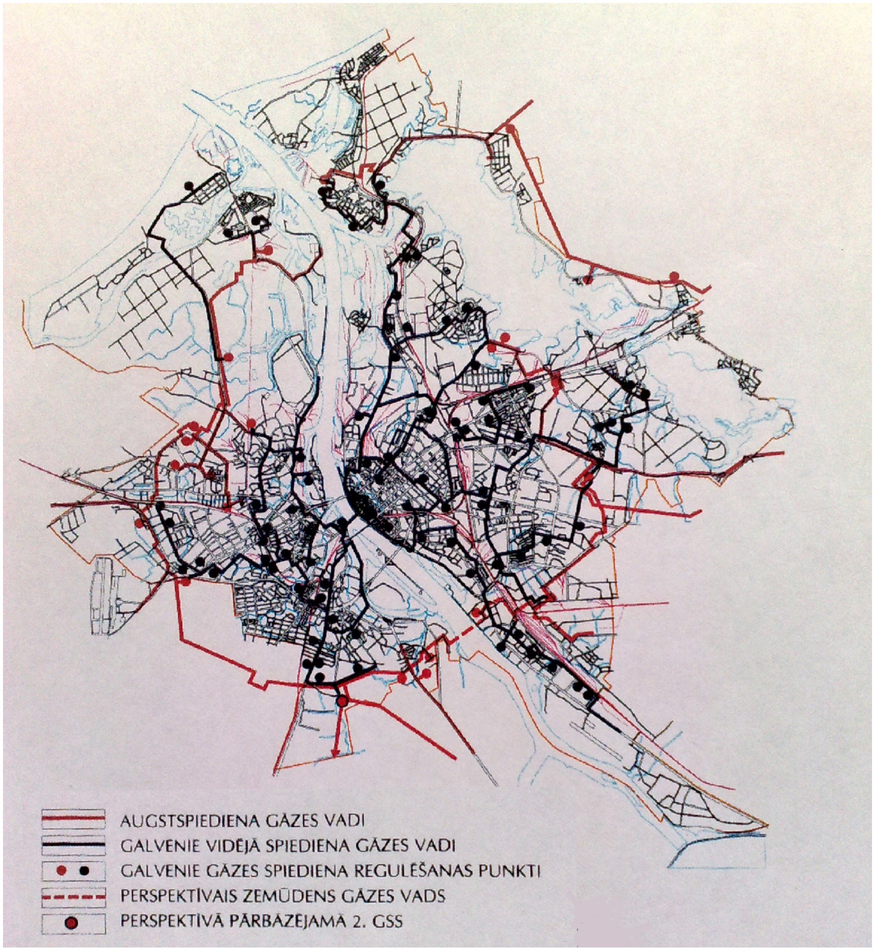


Figure 3.16. Source: LTD "EEE" paper "Analysis of Options for Use of the Heat Produced during the Cogeneration Process", 1998.

Medium and high pressure gas distribution pipelines with high and medium pressure regulation points branch off the GRS. Using high pressure, the gas is supplied to the big gas consumers – TEC-1, HP "Imanta" and some other heating plants, as well as to large industrial clients. Medium-pressure gas distribution network branches off the high-pressure regulation points. The medium-pressure network is not very dense, its total length is only around 200 km. Low-pressure network (< 0.05 bar) is much more dense.

Dynamics of natural gas consumption in Latvia, millions of nm3:

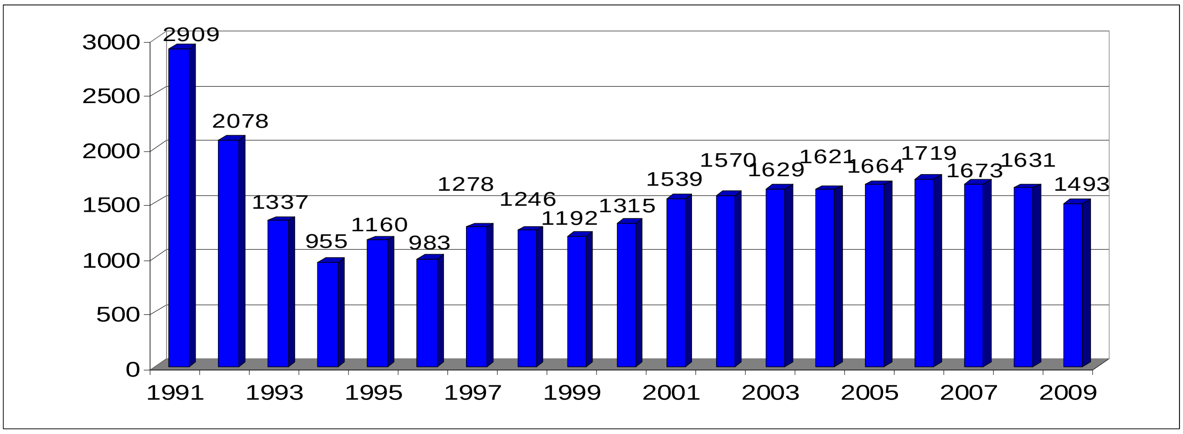


Figure 3.17. Source: JSC "Latvijas gāze".

In recent years consumption of natural gas has increased. In the period reviewed, the lowest consumption was in 1994 and 1996, when the large clients (JSC "Rīgas siltums" and JSC "Latvenergo") were using more fuel oil because of its price which was lower in comparison to the price of natural gas at that time.

Changes in the consumption of natural gas from 1996 when JSC "Rīgas siltums" was established, millions of nm3:

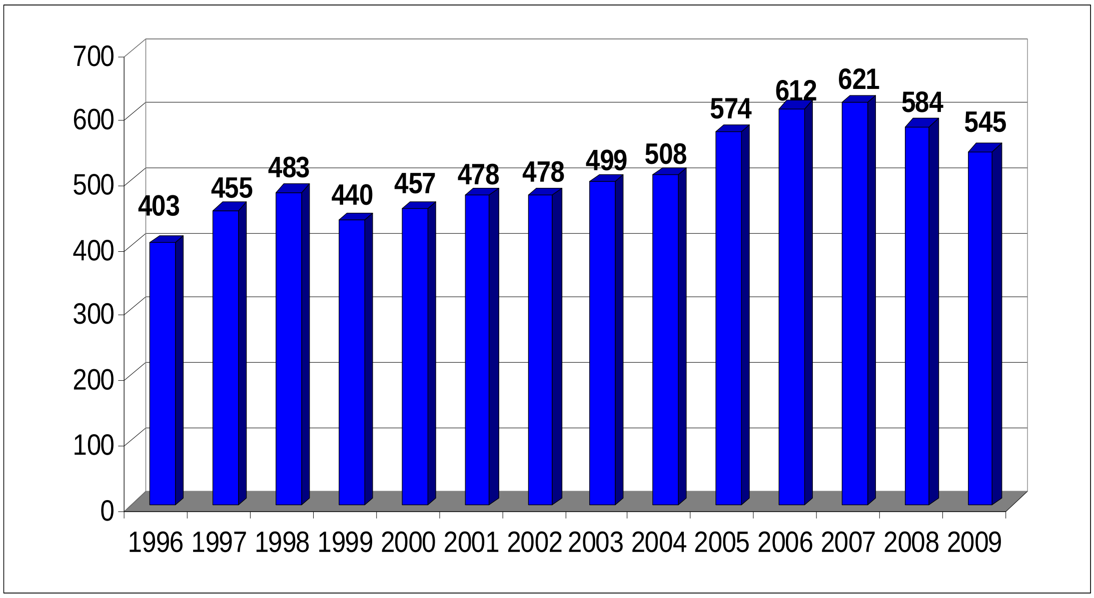


Figure 3.18. Source: JSC "Latvijas gāze".

Seasonal fluctuations can be observed in the consumption of natural gas. The highest consumption of gas is during the winter months, particularly in December, the lowest – in July which is related to the heating season. This shows that gas is a common type of fuel in Riga.

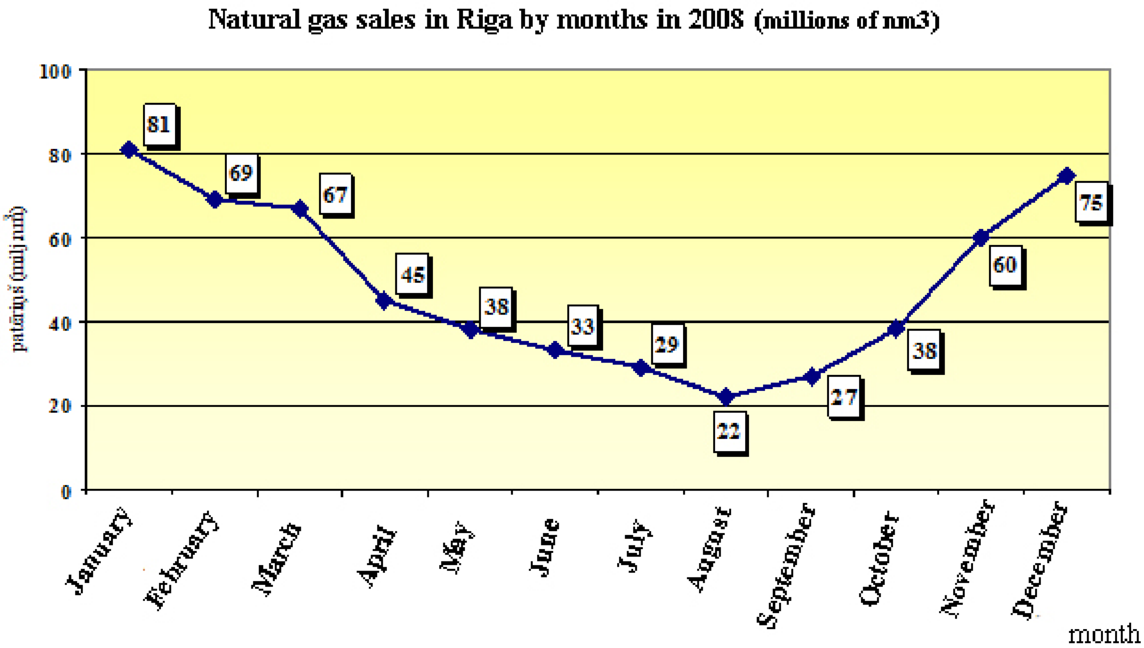


Figure 3.19. Source: JSC “Latvijas gāze”.

Gas infrastructure does not ensure gas to all potential clients in Riga, therefore in order to increase availability of its services as much as possible, JSC "Latvijas gāze" has assessed the largest and the most prospective construction sites for gas supply after 2006. Preparation of their technical design and construction of distribution pipelines depend on demand of the gas client concerned or commencement of development of the detailed territorial plan. Largest projects of JSC "Latvijas gāze" in recent years in Riga were at these locations – Beberbeķi, Bolderāja, Vecdaugava, Mangaļsala, Vecāķi, Jaunciems, Berģi and Dārziņi.

Other types of fuel used

In the beginning of the 1990s, fuel oil containing relatively high content of sulphur – around 3.5 % was broadly used as a fuel in the city. When burning this fuel, emissions containing sulphur were produced, and without scrubbing of flue gases these emissions were emitted in the surrounding environment. The use of fuel oil as fuel in Riga decreased around 1997, when natural gas occupied the dominant role. In order to increase consumption of natural gas installation of individual automated gas-fired boilers, also in individual apartments of multi-apartment residential houses with district heating, was promoted. This was stimulated by the artificially maintained and inadequately low gas rates for small consumers of gas which created an unfair competition in respect to district heating. In the period between 1996 and 2006, a distorted situation in regard of heating was forming in many houses connected to the district heating system in Riga, particularly in the central part of the city, where part of apartments where disconnected from the district heating and using individual gas-fired heating, thus reducing efficiency of heating of the whole building. This situation was resolved only in 2006, when zoning of the city by pollution level of nitrogen dioxide was introduced. Since 2006, gas-fired boilers have not been reinstalled in the central part of the city, although already existing gas-fired heating installations are maintained and will have a negative effect on the energy efficiency of buildings in the long run.

Coal is a traditional type of fuel in the city. 90. In the1990s, relatively large number of heating installations was operating on coal, also in the buildings owned by the municipality – schools, pre-school educational establishments, etc. When the first Riga City Heat Supply Development Concept Paper was adopted in 1997, a targeted work was started to dismantle coal-fired boiler houses. In the beginning of 2010, coal-fired boiler houses were left only in 10 schools and pre-school educational establishments. Dismantling of these boiler houses is addressed in the Action Plan. Coal is used as fuel also in individual residential houses in the central part of the city which have never been connected to district heating. The municipality facilitates switching of such buildings or their parts to more environment-friendly fuel – natural gas or wood pellets.

3.2 ENERGY CONSUMERS

3.2.1 Residential houses sector of the city

3.2.1.1. Current situation in the residential houses sector 1990 - 2008

The housing stock of the city

According to the Central Statistical Bureau of Latvia, in the end of the 1990s – as on 1 January 1999, the housing stock of Riga city comprised 23 thousand houses with the total area of 16.194 million m2. Excluding the buildings owned by natural persons, the total number of residential houses was 8,177 of which 6,451 were owned by the municipality, 518 were owned by cooperative companies of apartment owners, 565 were state-owned, 101 were hotels for personnel of the municipality, organisations and educational establishments, 30 formed the housing stock of educational establishments, 13 were social care homes, 3 were social houses. The housing stock was deteriorated. During the said period, 889 buildings owned by the municipality alone were in critical condition. Due to privatisation of apartments and critical condition of the houses, as well as practices in respect to transfer of ownership of houses from state to municipality and vice versa, the number of houses of the housing stock and their ownership by the city are constantly changing and the provided figures describe the situation only at the moment of data collection.
The biggest concerns of the city are the post-war multi-apartment residential houses which were built between 1945 and 1993. Taking into account the low construction standards at the time of their construction, heat stability of these houses do not comply with the European level. Construction according to standardised designs is characteristic to these houses. By 1960s, limestone-brick buildings were mostly built in Riga and known by simplicity of their finishing. In the end of the 1960s, construction of prefabricated slab buildings was commenced. Thus multi-storey buildings with more than 5 stories are started to be built in the city.

The most common series of residential houses in Riga:

Table 3.7.

Series	Construction period	Number of floors	Location in Riga
1-316	1957–1964	4 - 5	Āgenskalns, Tirzas Street, Viestura prospekts, Grīvas Street
1-318	from 1964	5	Purvciems, Iļģuciems, Ropažu Street, etc.
46A	from 1959	5	Āgenskalns, Tirzas Street

464A	from 1961	5	Ķengarags, Jugla
464A/JI	from 1964	5	Jugla, Ķengarags
464A/JI66	from 1966	5	Ķengarags, Purvciems, Mežciems, Imanta, Iļģuciems
467A	from 1967	5	Purvciems, Ķengarags, Iļģuciems
467B	from 1976	9	Purvciems, Ķengarags, Iļģuciems
602	from 1967	9	Purvciems, Mežciems, Imanta, Pļavnieki
103,104	from 1969	5 - 6	Ķengarags
119	from 1980	6 - 9	Purvciems, Zolitūde

The post-war buildings are the ones which are mainly subject to privatisation, but the privatisation process has been very slow in the city. In the period between 1995 and 2009, approximately 96 % of the housing stock of Riga city have been privatised.
According to the data of Utilities Department of Riga City Council, number of residential houses privatised and managed by the municipality:

Table 3.8.

Groups of houses ranked by area, m2	Number of residential houses	Total area of apartments in the buildings, m2	Average area of a residential house in the group, m2
>2,000	1,869	6,779,373	3,627.3
500-2,000	1,253	1,294,355	1,033
<500	1,120	284,917	254.4
Not complying with sanitary requirements	862	302,170	350.5
Total	5,104	8,660,815	

The number of houses owned by cooperative companies of apartment owners has not changed. In the period reviewed, minor changes can be observed in the number of houses privatised by the state as a result of mutual transfer of ownership of houses to the municipality and vice versa.

Taking into account the available data, Riga Energy Agency has set the number of multi-apartment residential houses in the city to be renovated – approximately 6,000 with the total area around 12 million m2.

Heating systems of residential houses

The internal heating networks of buildings constructed before 1990 are built with one-pipe risers. Heaters of the heating system – cast-iron radiators (in 30-year old buildings old or older) or convectors (in 20-to-30-year-old buildings). According to the expert evaluation, approximately 40 % of the old radiators and convectors in apartments have been replaced with modern heaters, maintaining one-pipe riser system in most cases and creating a bypass for the heater with installation of thermostatic valve in the heater's lead-in. During the renovation of houses, if the heating risers are also changed, the residents choose a two-pipe system. Heat cost allocation devices connected to radiators (allocators) have been installed in Riga's multi-apartment residential houses and are used in no more than 10 buildings, half of which are the renovated buildings. The internal heating system of the buildings erected over the last years is being built as a two-pipe system with thermostatic valve fitted to each heater.

In the period between 1998 and the beginning of 2009, 8,036 of 8,121 heat lead-in buildings were installed with automated individual heat substations (ISM) with the independent connection to external networks. This work has been practically completed.

Dynamics of installation of the automated individual heat substations (ISM):

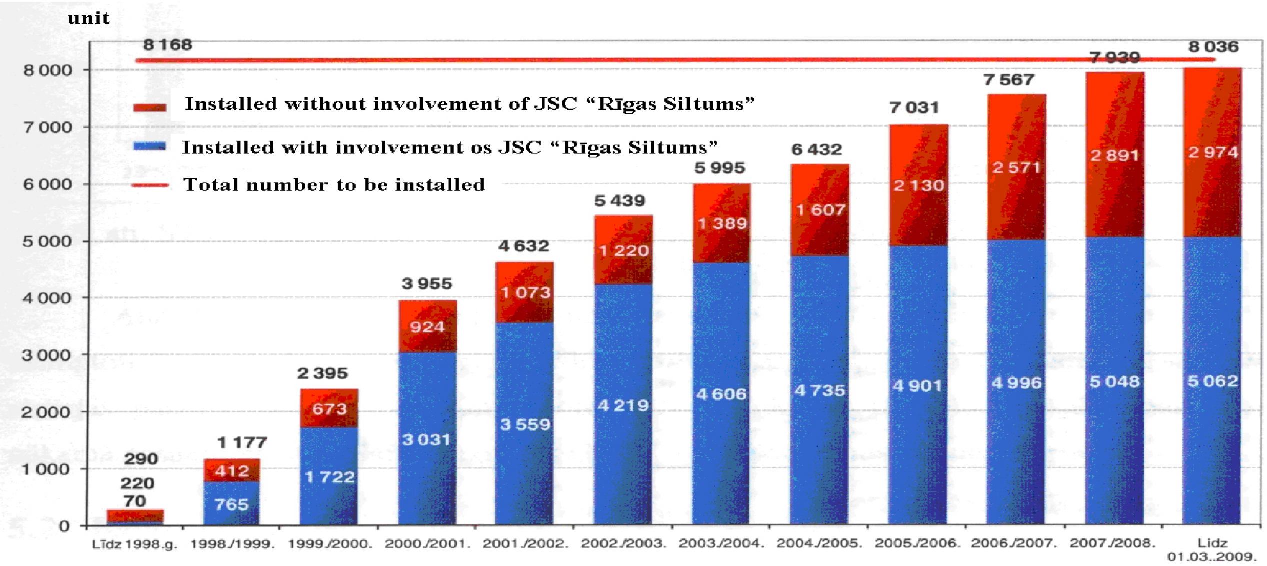


Figure 3.20. Source: Ā.Žīgurs, promotion paper "Efficiency of District Heating System", 2009.

This allowed to introduce regulation of heat consumption in the building which together with the other measures has substantially (even by more than 30 %) decreased heat consumption. Upon proposal of REA, maintenance of the optimum temperature mode has been partly introduced in the residential houses of the housing stock in Riga. Residents are feeling comfortably and are active, if the room temperature is approximately 21°C. However, night time is the period for rest, therefore it useful to reduce the temperature to 17°C. The room temperature will not be significantly reduced, for the room's building components and furniture have a large thermal inertia and release the heat at night, thus maintaining the room temperature high enough. It is useful to start reducing the temperature in the evening at around 22.00, in its turn, raise it to 21°C in the morning at approximately 6.00 o'clock. A similar action has to be performed for hot water – by maintaining the temperature behind the heater around 52°C during the day, while decreasing it to 40°C at night (if shower is used in the house at night), or to 25°C, if there is no need for use of shower at night. Hot water temperature has to be reduced late in the evening at around 24.00, but raised in the morning at approximately 6.00 o'clock. A lower temperature of the hot water at night allows reducing heat consumption related to water circulation. The optimum temperature mode in the building is chosen by the residents themselves upon mutual agreement. By 2009, over 300 multi-apartment houses had introduced the optimum temperature mode for heating in Riga, more than 900 houses – for the hot water. Preparation of the hot water is done at the heat substation of a building, thus the set temperature is automatically maintained and water circulation is ensured in the internal distribution network.

Standard scheme for heating of the building, preparation of the hot water, and connection to the district heating:

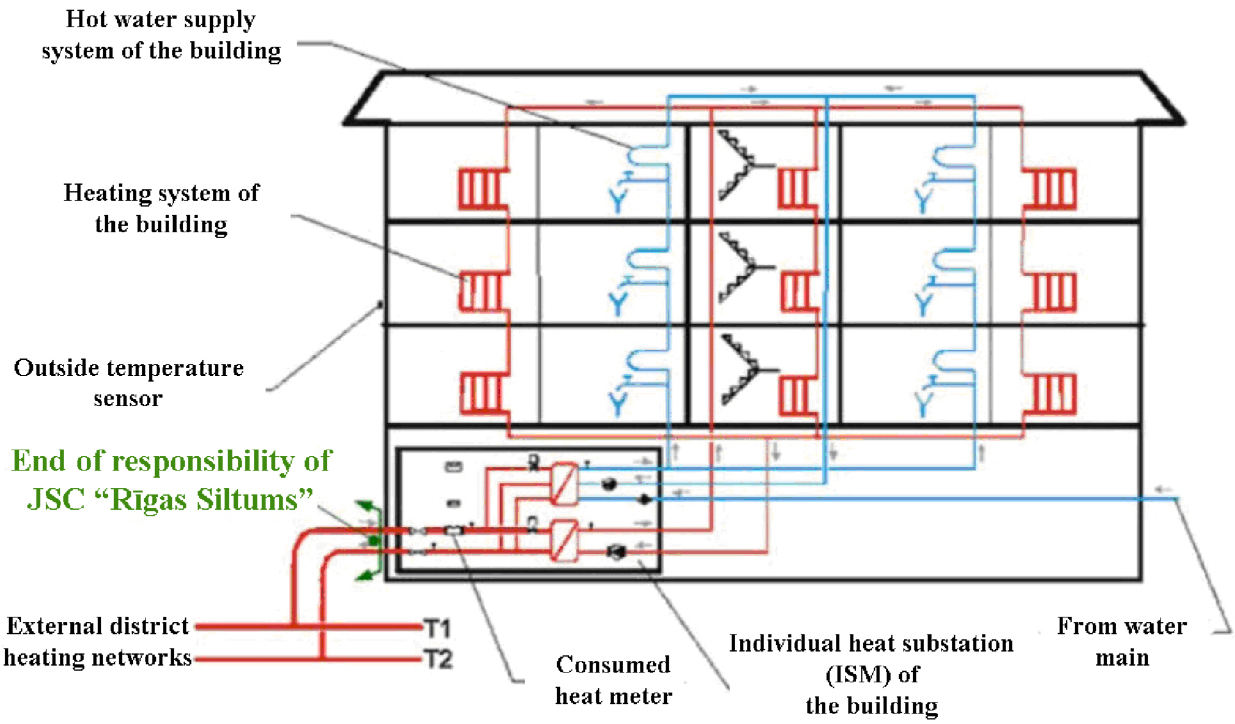


Figure 3.21. Source: JSC "Rīgas siltums".

Since 1997, heat meters have been installed at all sites of heat users, and the clients pay for the consumed heat according to the meter readings.

Already for over a decade, apartments of Riga's residential houses are installed with both cold and hot water meters. The share of apartments installed with these meters accounts for > 98 % of the total number of apartments.

Renovation of the housing stock

The first residential house that underwent complex renovation in Riga in 2001 was the nine-floor multi-apartment building at Ozolciema Street 46/3, and this renovation was given to Riga by the Berlin Senate as a present for the city's 800th anniversary. The second house renovated with the support of Germany was the five-floor building at Celmu Street 5, and the execution of renovation works was co-funded with a loan taken by residents of this house. However, the successfully commenced house renovation activities did not continue, and house insulation stagnated for many years in Riga.

In the middle of 2007, the Riga municipality with the co-funding from the EU programme "Intelligent Energy-Europe" established the Riga Energy Agency (REA) that, inter alia, also began to encourage renovation of residential houses by organising a campaign with participation of all kinds of mass media. Up to 2008, establishment of apartment owners' associations or privatisation of houses on the basis of an apartment owners' authorisation contract was very slow – the number of such houses was just around 140. However, by the beginning of 2009 it already exceeded 1,300.

At the end of 2008, Riga municipality found a way to co-fund the energy audits, and REA organised the first energy audit of 21 residential houses, results of which were summarised in the brochure "Energy Audits of Dwellings – 2008" and which provided an insight into the measures to be implemented during the house renovation process, related problems and costs. By this time, the State Agency "Housing Agency" had already ensured the co-funding for energy audits of 17 residential houses in Riga.

Up to 2009, the Latvian legislation did not envisage a possibility for the state and local governments to be involved with their own funds in renovation of the privatised housing stock. The legislation was amended only at the beginning of 2009, correspondingly drafting the regulatory documents – amendments to laws, requirements for energy audits and their certification, as well as for reporting forms. Not expecting financial support from the municipality, state or Structural Funds, up to 2008 residents organised renovation by themselves ensuring complex renovation for additional 10 multi-apartment houses by using bank loans only. In 2008, the total number of houses in the city that underwent complex renovation reached 12.

Table 3.9.

Address of the residential house	Total area of apartments according to the heat supplier data m2	Renovation time
1. Ozolciema Street 46/3	3,955.90	2001
2. Celmu Street 5	2,969.30	2004
3. Mārcienas Street 3 (cooperative “Pavadonis”)	3,070.90	2007
4. D. Brantkalna Street 7	4,136.90	2008
5. Kurzemes prospekts 14	2,397.16	2008
6. Bebru Street 4	1,684.33	2008
7. Kurzemes prospekts 4	2,314.24	2008
8. Lielvārdes Street 101 (cooperative “Bāka-2”)	3,911.01	2004-2008
9. Lielvārdes Street 103 (cooperative “Bāka-2”)	3,948.17	2004-2008
10. Lielvārdes Street 105 (cooperative “Bāka-2”)	3,992.10	2004-2008
11. S. Eizenšteina Street 49	2,051.03	2008
12. Ieriķu Street 44	869.00	2008
Total:	35,300.04	

In spring of 2009, upon the end of the heating season REA made a comparison of the 5-year specific heat consumption during the heating season for these renovated residential houses:

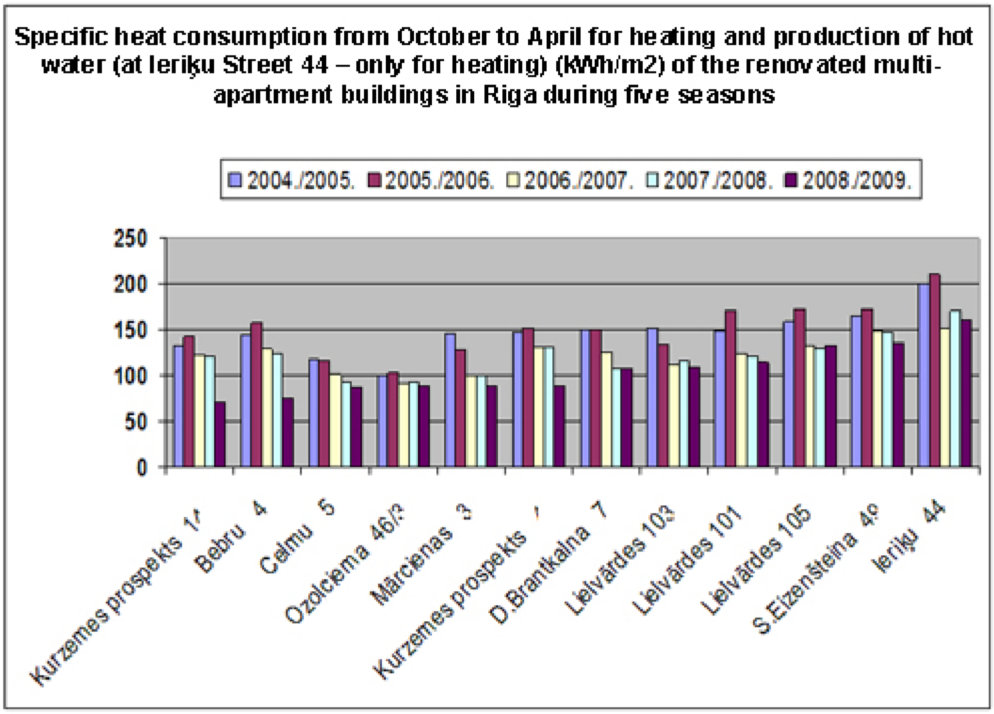


Figure 3.22.

According to the data analysis conducted in 1997 by the Swedish company “FVB” (during the development of the Riga District Heating Rehabilitation Project of JSC “Rīgas siltums”), in 1990 the average specific heat consumption of the houses connected to the district heating system was 339 kWh per m2 of the apartments' area. The next evaluation was conducted in 2006 (based on the data of 2005) while developing the second Riga Heat Supply Development Concept for 2006–2016, when on average the annual specific heat consumption of the houses connected to the district heating system had decreased to 231 kWh per m2 of the apartments' area or by 32 % compared to the base year.

Since the end of 2007 REA has created a database of multi-apartment buildings connected to the district heating system by listing the heat consumption of these buildings over the past 5 years and conducting the pre-audit appraisal of these buildings. Energy efficiency indicators together with pictures of the characteristic buildings are put on digital maps of the city neighbourhoods. The following is an example of such map.

Specific heat consumption (kWh/m2) of buildings in the area of Krasta Street (from Slāvu Street up to Ogres Street) 2006

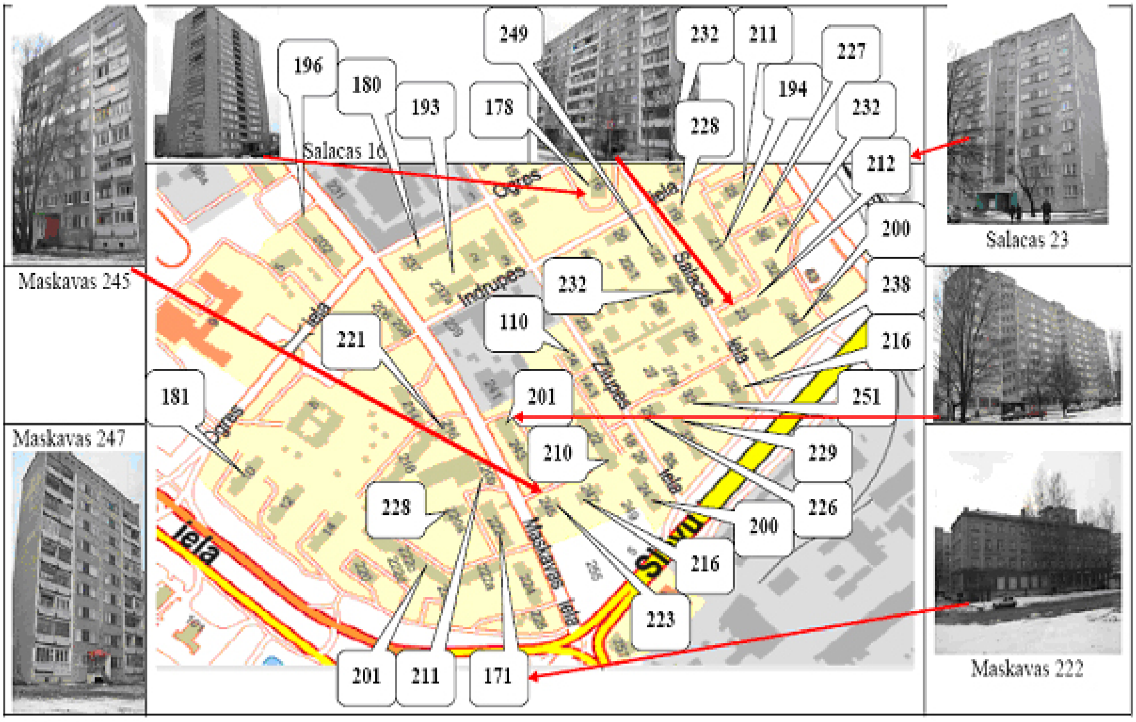


Figure 3.23.

The pre-audit appraisal provides a general insight into the energy efficiency level of multi-apartment houses, and REA uses this appraisal in consulting residents on the necessity to renovate their particular houses.

General situation of the city's neighbourhoods:

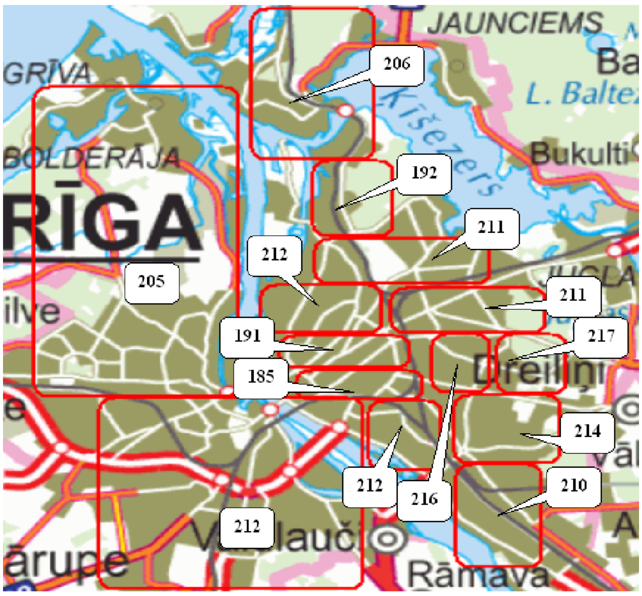


Figure 3.24.

According to the data of the pre-audit energy efficiency appraisal a new annual level of specific heat consumption of multi-apartment buildings connected to the district heating system has been established amounting to 213 kWh/m2, i.e. it has decreased by 37 % compared to the base year. This decrease has been facilitated by introduction of automated individual heat substations (ISM), partial introduction of an optimal temperature mode in residential houses, replacement of heaters in apartments by residents installing temperature regulators, selective replacement of windows in apartments (approximately 30 % of the housing stock according to expert evaluation), as well as by the sealing of windows and other measures. Also the end walls of individual prefabricated slab houses have been insulated with the help of building administrators.

3.2.1.2 Measures for reducing energy consumption and increasing energy efficiency for the period 2005 - 2020

Selecting the extent of renovation

During the complex renovation process of a multi-apartment residential house it is possible to obtain any desirable result regarding reduction of the house's heat consumption. It is evidently demonstrated by the renovation offer of the German company “Luwoge consult” with different possible solutions of heat consumption for heating of one of the standardised prefabricated slab houses on Deglava Street, in Riga.

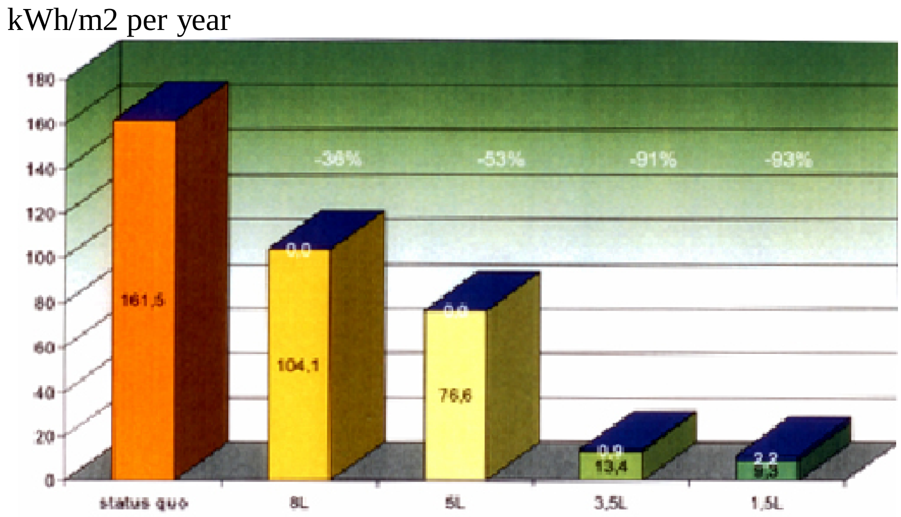


Figure 3.25.

The first column in this figure shows the house's current specific heat consumption for heating per year which is 161.5 kWh/m2. The next column corresponds to 100 kWh/m2 per year. The middle column shows the average consumption which is approximately 80 kWh/m2 per year. The next two columns indicate the levels of low energy consumption and the “passive” house. This type of houses does not require heat supply from external heating systems. The analysis of the offer through evaluation of renovation costs and the gained savings showed that the optimal choice is an energy efficient house with the annual specific consumption for heating amounting to 40 kWh/m2.

REA has conducted an analysis of the gained heat savings of the above mentioned 12 houses in Riga that were renovated first, and the results are shown in this chart.

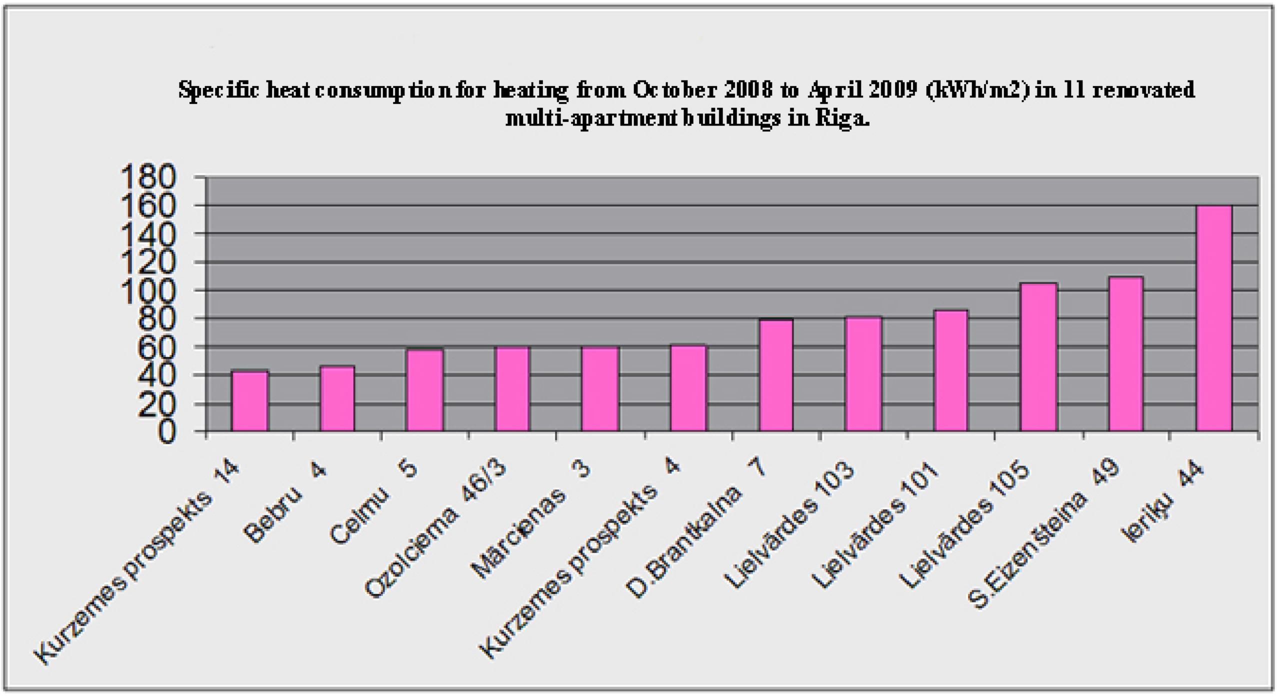


Figure 3.26.

As it is shown in the figure, two of the renovated standardised city houses at Kurzemes prospekts 14 and Bebru Street 4 have achieved the exact optimal result – the annual specific consumption for heating amounting to 40 kWh/m2. The next four houses have also achieved great results – 60 kWh/m2 per year, and the subsequent three houses – 80 kWh/m2 per year. The two penultimate houses have not been fully renovated. A particular case is the last house at Ieriķu Street 44, where the rather expensive insulation technology approach – painting the house with 1 mm thick layer of reflective paint – offered by some company and implemented in the building has not resulted in any heat savings, it has only reduced the humidity in the building. As a result of the analysis, by exploring all buildings on site REA has concluded that the renovation results depend on the selected energy efficiency level and materials, as well as the quality of technology and work execution. Renovation changes the visual appearance of the building and the market value of apartments in the building. Consequently, the residents' investments in house renovation improving mainly that part of the house which is under co-ownership are investments in order to increase the market value of their apartment and their level of comfort.

Table 3.10.

Action Plan			
Measure	Implementati on time	Responsible for implementation	Extent of implementation
1. To achieve optimal selection of energy efficiency level for heating during the complex renovation of multi-apartment residential houses depending on the house structure – from 40 to 60 kWh/m2 (energy efficient house)	2010–2020	REA, cooperation partners	50/80/90%* of the number of renovated houses

2. To prepare and distribute information leaflets for various interest groups (residents, energy auditors, etc.) on selection of the energy efficiency level for houses in complex renovation	2010, 2015	REA, cooperation partners	
3. To organise in the Energy Efficiency Information Centre (EIC) events of expert roundtable discussions on quality issues of multi-apartment house renovation, also ensuring dissemination of information via the REA's website and specialised online portals, etc.	2010–2020	REA EIC, cooperation partners	At least 4 times a year
4. To suggest amendments to legal and regulatory documents by introducing regulation appropriate for the level of energy efficient houses, to participate in drafting legislative acts	Continuously	REA, cooperation partners	

*) minimum/optimum/maximum forecast

Extent of multi-apartment house renovation

The housing stock of Riga city accounts for one third of the national housing stock. According to the appraisal outlined in Section 3.2.3.2, the necessary extent of renovation in the city covers 6,000 houses with the total area of apartments amounting to 12 million m2. If appraisal is done based on costs in 2010, house renovation would require on average LVL 50 per m2 of the apartment area. Approximately LVL 615 million are needed for complex renovation of 6,000 houses in the city. Apart from the above mentioned 12 houses renovated by 2008, additional 2 residential houses have been renovated in the city by using the co-funding from the Structural Funds.

Table 3.11.

Address of the residential house	Total area of apartments according to the heat supplier data m2	Renovation time
1. Dzelzavas Street 84 (cooperative “Bāka-2”)	2,361.04	2009
2. Dzelzavas Street 97 (cooperative “Bāka-2”)	3,002.74	2009
Total:	5,363.78	

In Riga, house renovation is only just beginning, because the extent of work completed up to now amounts to 0.2 % of the total number of buildings and 0.3 % of the total area of apartments.

Fourteen applications requesting co-funding for house renovation from the Structural Funds were prepared and submitted by Riga city in 2009. Contracts were concluded with 6 houses, and renovation was carried out in 2 houses shown in Table 3.10.

In 2009, using the financial reserves accrued by residents for repair works and managed by the administrator projects have been prepared, and insulation of the end walls of 20 multi-apartment standardised houses in the territory managed by LTD “Juglas nami” has been started.

In winter of 2009/2010, the Ministry of Economics received applications from Riga city requesting co-funding for energy audits (27) and technical inspections (14), as well as for development of technical projects (11) in order to prepare necessary documentation for submitting a renovation application requesting the co-funding from the Structural Funds.

Table 3.12.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Preparation and distribution of an information leaflet on possible co-funding sources for energy audits and technical inspections, development of technical projects and renovation of multi-apartment houses	2010–2020	REA, cooperation partners	Annually
2. To participate in campaigns or to organise campaigns on issues of multi-apartment house renovation by preparing and disseminating information in mass media, using REA's website and specialised online portals, participating in conferences and workshops and other campaign measures or organising them	2010–2020	REA, cooperation partners	Annually
3. To achieve complex renovation of multi-apartment residential houses in the city	2010–2020	Riga City Council, REA, cooperation partners	In 2010 – 20/30/50*houses In 2011-2015 530/1000/1900*houses In 2016-2020 2000/4000/6000*houses
4. To achieve drafting of energy audits for multi-apartment residential houses	2010–2020	Riga City Council, REA, cooperation partners	In 2010 – 50/200/500*houses In 2011-2015 1000/2000/3000*houses In 2016-2020 3000/4000/6000*houses
5. To develop and implement municipal support measures for complex renovation of multi-apartment residential houses, including co-funding for energy audits, tax allowances for buildings during the loan period, coverage of the co-funding share of low-income residents, etc.	2010	Riga City Council, REA, cooperation partners	

6. To set up a database of all city houses that have undergone complex renovation with a function of active monitoring for 5 years after completion of renovation	2010–2020	REA, cooperation partners	Annually
7. Data collection and analysis regarding complex renovation of multi-apartment houses performed during a 3-year period by drafting and issuing a brochure in electronic form	2011	REA, cooperation partners	Once every 3 years
8. To carry out an appraisal of the annual specific heat consumption of multi-apartment residential houses connected to the district heating system based on the data of the last 5 years	2011 2016 2021	REA, JSC “Rīgas siltums”	To publish the data on the REA's website for public access
9. To introduce certification and classification of residential houses according to the energy audit data by putting a visual external marking on buildings	2015	Riga City Council, REA, cooperation partners	Note: to be put on audited houses
10. Reduced heat consumption of multi-apartment houses resulting from renovation, in thousands of MWh per year	2010 2015 2020		2.6/ 3.9/ 6.5 * 68.9/130 / 247* 260 / 520 /780*

*) minimum/optimum/maximum forecast

It is forecasted that the dynamics of multi-apartment house renovation will have an increasing tendency according to the following function:

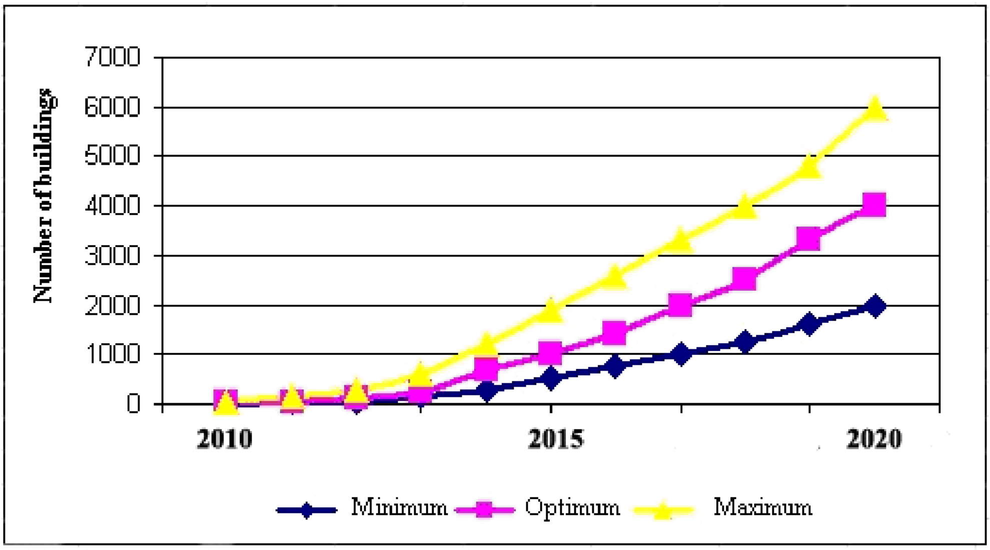


Figure 3.27.

Intensity of renovation in Riga (according to the minimum, optimum or maximum forecast) depends on how the Riga City Council will succeed in dealing with the basic issues – establishment of a revolving fund and energy service companies (energy service company – ESCO, municipal energy service company – MESCO) and their involvement in house renovation.

Renovation of houses' internal heating systems and introduction of individual consumption measurements

When preparing a house for complex renovation, transition to a two-pipe riser system must be planned. It excludes any interference with room temperature and heater size among apartments connected to shared risers, because irrespective of the particular floor of the house all heaters receive the heat carrier with the same temperature. Also the heat insulation of hot water risers and all distribution mains definitely reducing heat consumption in the hot water system must be envisaged.

As it is shown by the practice in Europe and a few of Riga's houses where the heat cost allocation devices (allocators) have been attached to the heaters in apartments, the installation of these devices changes the attitude of residents towards heat consumption, and the heat consumption for heating in houses with allocators under comparable conditions has decreased by approximately 15 %. When installing allocators, a mandatory condition is installation of a temperature regulator in the heater's lead-in, as well as creation of a bypass for the heater in case of one-pipe risers, therefore it is reasonable to rationally combine these works with the house renovation process.

It is common for residents to maintain different temperatures in their apartments. Indicative comparison of the apartments' heat consumption for heating in the house at Ozolciema Street 46/3 according to the allocator readings:

Figure 3.28.

Installation of allocators must become an integral part of complex house renovation. Along with the installation of allocators it is useful to deal with introducing a distance reading system for hot and cold water meters in order to reduce formation of water differences in multi-apartment houses.
For installation of allocators and introduction of a water meter distance reading system it is necessary to receive consent from all owners of apartments in the multi-apartment house. Maintenance of allocators, distance readings and preparation of bills incur additional monthly costs for every apartment, and these costs are covered by the apartment's owner. When heaters are equipped with allocators and temperature regulators in all apartments of a multi-apartment residential house, there is no longer a necessity for changing the heating temperature at the heat substation of the respective house during the day and night.

Table 3.13.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Preparation and distribution of an information leaflet on installation of allocators in apartments, as well as on importance of introducing a two-pipe system during complex house renovation	2010 2015	REA, cooperation partners	To distribute continuously
2. Preparation and distribution of an information leaflet on introduction of a distance reading system in multi-apartment houses for reducing the hot and cold water difference	2010 2015	REA, cooperation partners	To distribute continuously
3. To organise in the Energy Efficiency Information Centre (EIC) events of expert roundtable discussions on individual recording of water consumption in apartments ensuring dissemination of information via the REA's website and specialised online portals, etc.	2010 2015	REA EIC, cooperation partners	
4. To achieve introduction of a two-pipe system during complex house renovation	2010–2020	REA, cooperation partners	30/50/70 %* of the number of houses to be renovated
5. To achieve installation of allocators in apartments during complex house renovation	2010–2020	REA, cooperation partners	50/80/90%* of the number of houses to be renovated
6. To achieve introduction of a distance reading system in multi-apartment houses for hot and cold water meters	2010–2020	REA, cooperation partners	10/30/50%* of the number of houses to be renovated

7. To suggest drafting of regulatory documents on application of allocators and the distance reading system and procedure for calculation of related costs, to participate in drafting these regulatory acts	2010–2020	REA, cooperation partners	

*) minimum/optimum/maximum forecast

Renovation of social residential houses

To ensure support to low-income families in Riga in dealing with the issues of housing, since the end of 1990s Riga city municipality has commenced establishment of a special network of social houses. In social residential houses, a nominal rent is charged for one square meter of the apartment's area – LVL 0.04, and the municipality also covers one fourth of heating costs, but no fares for water and sewage services are charged. Only low-income or particularly vulnerable persons or families, as well as disabled persons are entitled to apartments in social houses. Social houses are owned by the Riga city municipality, and the apartments cannot be privatised.

Social houses are established on the basis of houses owned or purchased by the Riga City Council by reconstructing and adjusting them to meet the requirements of social houses. Ground floors of some houses are adjusted for disabled persons with reduced mobility. When building new houses, the requirements of building standards regarding heat insulation of building structures are taken in account, and modern internal engineering systems including for heat supply are developed. In 2010, the following social houses are located in Riga:

Table 3.14.

Address of the social residential house	Number of apartments	Area of apartments (m2)	Compliance of the house with heat insulation requirements
1. Aglonas Street 35, block No. 3	156	5,918.9	Renovation in 2010
2. Dolomīta Street 1a	49	2,432.9	
3. Garozes Street 15	36	753.06	
4. Meldru Street 58	112	4,331.08	
5. Rēznas Street 10/2	120	6,498.8	Renovation in 2010/2011
6. Ūnijas Street 49	52	2,961.3	Renovation in 2010/2011
7. Emmas Street 3	93	5,307.94	
8. Ziepju Street 13	75	4,270.5	
9. Biešu Street 6	57	2,574.3	
10. Gobas Street 20/1	46	2,723.5	Renovation in 2010/2011
11. Lubānas Street 44/50	94	5,497.9	
12. Gobas Street 20/2	80	4,794.6	Put into operation in 2009, complies with the heat insulation requirements
13. Lubānas Street 129/3	100	4,935	Put into operation in 2009, complies with the heat insulation requirements

14. Lomonosova Street 1/19	88	3,633.04	Put into operation in 2010, complies with the heat insulation requirements
Total		53,909.32	

Source: Riga Development Programme 2006–2012.

Applications requesting co-funding for house renovation from the Structural Funds for 3 new social houses have been submitted. A project application is being prepared regarding installation of solar collectors on roofs of these 3 social houses for domestic hot water production (see section 4.2.).

Table 3.15.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Renovation of the social residential house at Aglonas Street 35/2	2009-2010	Welfare Department	
2. Project for renovation of 3 social residential houses. Submitted for co-funding from the Structural Funds (see Table 3.13)	2010-2011	Welfare Department	

3.2.2. Public buildings sector of the city

3.2.2.1. Current situation in the public buildings sector 1990-2008

The total number of buildings in the municipal public buildings sector exceeds 400. The number of buildings connected to the district heating system the heat consumption of which is paid for by the Riga municipality is 385 with the total area of 1.12 million m2, 138 buildings of which are pre-school educational establishments (PII) with the total area of 190,285 m2, 148 are school buildings with the total area of 676,056 m2 and 96 are other buildings with the area of 255,148 m2.

Breakdown of buildings into groups according to the heated area:

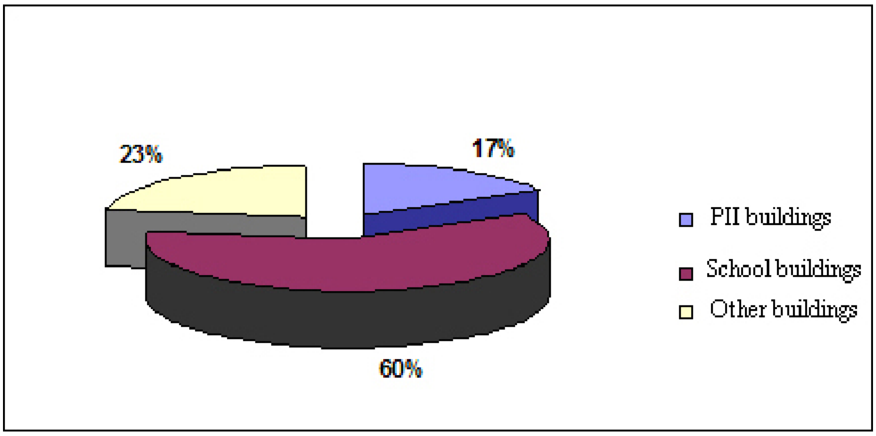


Figure 3.29.

REA has made an appraisal of the actual annual specific heat consumption of these public buildings (kWh/m2). Results are summarised in the following chart:

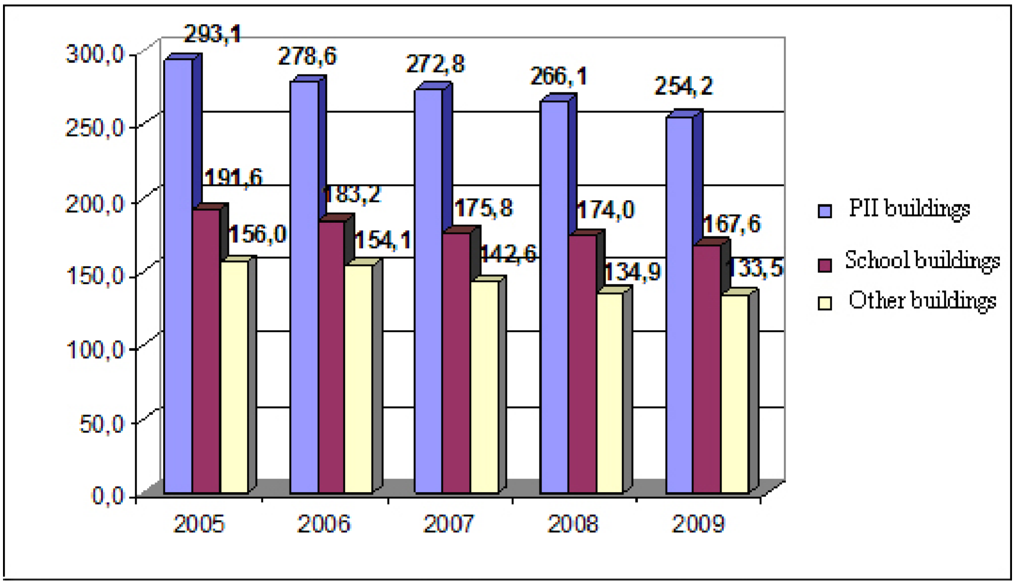


Figure 3.30.

According to the chart, the specific heat consumption tends to decrease every year, but overall it is still rather high, which points out the necessity to perform renovation of buildings and to introduce energy saving measures. Out of these groups of buildings, the highest consumption is shown by the buildings of pre-school educational establishments followed by school and other buildings. Reduction in the specific heat consumption (approximately 9 %) after 2007 is related to the heat insulation improvement measures implemented in buildings of pre-school educational establishments – replacement of windows and doors (in 46 buildings) – and to the REA's proposal for optimisation of the buildings' temperature mode. According to the REA's proposal, during the day heating temperature complying with the requirement of regulatory documents for the relevant group of buildings is maintained in premises of public buildings. At the end of a working day the heating temperature is reduced to 15–16°C, and in the morning, an hour before the start of a working day it is respectively increased according to the day temperature. Reduced heating temperature is maintained throughout the day and night also during weekends and holidays. In its turn, the temperature of hot water is reduced to 25°C during weekends and holidays, maintaining it throughout the day at the level stipulated by requirements of regulatory documents for the respective group of buildings. Changes in temperature are ensured by the modern automated heat substations installed in the buildings.

Actual heat consumption by group of buildings (MWh per year).

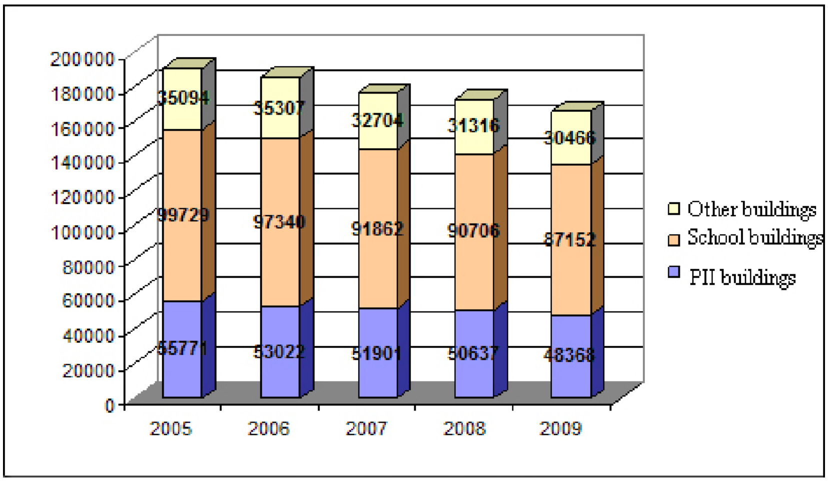


Figure 3.31.

By 2008, the programme for replacement of windows and external doors was implemented and completed in 200 educational establishments of the Riga municipality (out of 354). Replacement of windows and external doors was carried out also in the following 46 educational establishments of the Riga municipality:

1. Riga special pre-school educational establishment No. 2, Vecumnieku Street 7;
2. Riga special pre-school educational establishment No. 55 “Dardedze”, Slokas Street 209;
3. Riga pre-school educational establishment No. 78, Gobas Street 27;
4. Riga pre-school educational establishment No. 80, Buļļu Street 33;
5. Riga pre-school educational establishment No. 129 “Cielaviņa”, Dammes Street 42;
6. Riga pre-school educational establishment No. 139, Lidoņu Street 8;
7. Riga pre-school educational establishment No. 234, Dammes Street 44;
8. Riga Bolderāja pre-school educational establishment, Platā Street 20;
9. Riga pre-school educational establishment “Dzirnaviņas”, Tālavas gatve 7;
10. Riga pre-school educational establishment “Margrietiņa”, Slokas Street 126;
11. Riga pre-school educational establishment “Pūcīte”, Ērgļu Street 1;
12. Riga pre-school educational establishment No. 170, F. Sadovņikova Street 20;
13. Riga special pre-school educational establishment No. 204, Maskavas Street 289;
14. Riga pre-school educational establishment No. 216, Salaspils Street 10;
15. Riga pre-school educational establishment No. 220, Aglonas Street 4a;
16. Riga pre-school educational establishment No. 224, Prūšu Street 82;
17. Riga pre-school educational establishment No. 254, Ak. Mst. Keldiša Street 4;
18. Riga pre-school educational establishment No. 255, Ak. Mst. Keldiša Street 5;
19. Riga pre-school educational establishment No. 256, Ilūkstes Street 28;
20. Riga pre-school educational establishment No. 262, Lubānas Street 127;
21. Riga pre-school educational establishment No. 106, Ūnijas Street 83;
22. Riga pre-school educational establishment No. 236 “Eglīte”, Biķernieku Street 45;
23. Riga pre-school educational establishment No. 241, Hipokrāta Street 25;
24. Riga pre-school educational establishment No. 242, Hipokrāta Street 25a;
25. Riga pre-school educational establishment No. 244, Marsa gatve 8;
26. Riga pre-school educational establishment No. 132 “Ieviņa”, Ventspils Street 13a;
27. Riga pre-school educational establishment No. 209 “Bitīte”, Bišu Street 5;
28. Riga pre-school educational establishment No. 272 “Pērlīte”, Jelgavas Street 86;
29. Riga pre-school educational establishment “Sprīdītis”, Pārslas Street 16;

30. Riga Ziepniekkalns pre-school educational establishment, Svētes Street 7;
31. Riga pre-school educational establishment No. 36, Lugažu Street 13;
32. Riga pre-school educational establishment No. 42, Sofijas Street 3;
33. Riga pre-school educational establishment No. 223, Aptiekas Street 12;
34. Riga Iļģuciems Secondary School, Dzirciema Street 109;
35. Riga Ostvalds Secondary School, Dammes Street 20;
36. Riga Imanta Secondary School, Kurzemes prosp. 158;
37. Riga Secondary School No. 75, Ogres Street 9;
38. Riga Secondary School No. 88, Ilūkstes Street 30;
39. Riga Secondary School No. 80, Andromedas gatve 11;
40. Riga Secondary School No. 89, Hipokrāta Street 27;
41. Riga Secondary School No. 94, Ozolciema Street 26;
42. Riga Ziepniekkalns Primary School, Vienības gatve 184;
43. Riga Zolitūde Grammar School, Ruses Street 22;
44. Riga Secondary School No. 31, Skuju Street 11;
45. Riga Special Secondary School No. 66, Katrīnas Street 2;
46. Riga Secondary School No. 28, Skuju Street 23.

A part of PII buildings still has individual heating systems with boiler houses using coal or other solid fuel. One of them – PII "Kastanītis", Stērstu Street 19 – was renovated in 2010 by dismantling the coal-fired boiler house and constructing a heating system with heat pumps (see Section 4.2 of the Action Plan). The following are the municipal educational establishments where the coal-fired or solid fuel boiler houses must be dismantled:

Table 3.16.

No.	Name of establishment	Address	Notes
1	Riga pre-school educational establishment No. 132	Ventspils Street 13a	Coal-fired boiler house
2	Riga pre-school educational establishment No. 149	Biešu Street 2	Coal-fired boiler house
3	Riga pre-school educational establishment No. 108	Stokholmas Street 3a	Coal-fired boiler house
4	Riga pre-school educational establishment No. 209	Bišu Street 5	Coal-fired boiler house
5	Riga Evening (Shift) Secondary School No. 14	Margrietas Street 4	Coal-fired boiler house
6	O. Kalpaks Riga Applied Arts Elementary School	Skrindu Street 1	Coal-fired boiler house
7	Riga Pārdaugava pre-school educational establishment	Zvārdes Street 17	Coal-fired boiler house
8	Riga Elementary School No. 7	Jaunciems 4th cross line	Boiler using firewood

Source: Property Department of the Riga City Council

Locations of the aforementioned educational establishments in the city.

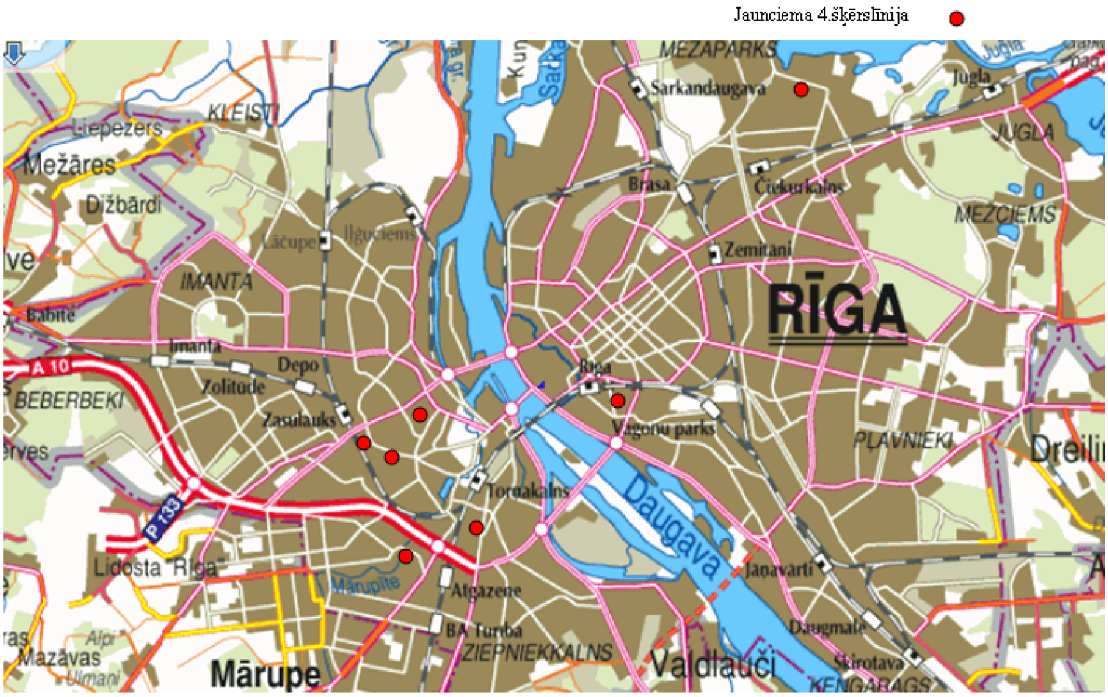


Figure 3.32.

3.2.2.2 Measures for reducing energy consumption and increasing energy efficiency for the period 2005 - 2020

Riga municipality makes determined efforts to ensure complex or partial renovation of buildings of educational establishments and those owned by the municipality, and thus the following pre-school educational establishments and schools have been renovated:

Table 3.17.

Name of educational establishment, type of works carried out	Address	Year of renovation
1. Riga Sanatorium Elementary Boarding School – complex reconstruction and new construction	Brīvības gatve 384a	2010
2. Children and Youth Art Centre “Mīlgrāvis” – renovation and reconstruction	Baltāsbaznīcas Street 14	2009
3. Riga Secondary School No. 40 – renovation	Tērbatas Street 15/17	2009
4. Block No.4 of the building of Riga Lithuanian Secondary School – reconstruction	Prūšu Street 42a	2009
5. Riga Secondary School No. 13 – renovation	Pulkveža Brieža Street 25	2009
6. Riga Secondary School No. 15 – renovation	Visvalža Street 9	2009
7. Riga pre-school educational establishment “Blāzmiņa” – renovation	Skuju Street 14	2009
8. Riga pre-school educational establishment – renovation	Viestura prospekts 57	2009

9. Riga Secondary School No. 3 – complex renovation	Grēcinieku Street 10	2009
10. Riga pre-school educational establishment No. 61 – complex renovation	Vaidavas Street 11	2009
11. Riga pre-school educational establishment No. 231 – complex renovation	Dzelzavas Street 87	2009
12. Riga Bolderāja pre-school educational establishment – complex renovation	Platā Street 20	2009
13. Riga pre-school educational establishment No. 146 – complex renovation	Līksnas Street 27	2009
14. Riga pre-school educational establishment No. 216 – complex renovation	Salaspils Street 10	2009
15. Riga pre-school educational establishment No. 208 – complex renovation	Salaspils Street 18/5	2009
16. Riga A. Pumpurs Elementary School – complex renovation	Maskavas Street 197	2008
17. Riga pre-school educational establishment No. 213 – complex renovation with reconstruction	Vesetas Street 11	2008
18. Riga pre-school educational establishment No. 182 – complex renovation with reconstruction	Dzelzavas Street 17a	2008
19. Riga pre-school educational establishment No. 152 – complex renovation with reconstruction	Juglas Street 1b	2008
20. Riga pre-school educational establishment No. 49 – complex renovation	Grostonas Street 8	2008
21. Riga Secondary School of Cultures – complex renovation with reconstruction	Ganību dambis 7	2008
22. Riga Secondary School No. 94 – complex renovation	Ozolciema Street 26	2009
23. Riga Secondary School No. 72 – complex renovation	Ikšķiles Street 6	2009

Along with renovation of buildings of educational establishments also the external and territorial lighting of these buildings is modernised by using energy efficient high pressure sodium bulbs.

In 2009, energy audits were performed in 24 schools of Riga. REA has conducted the analysis of energy audits of these schools and published the brochure “Energy Audits of Schools 2009” (www.rea.riga.lv). The total average annual energy efficiency of these 24 schools selected for energy audits is 135 kWh/m2. In some of these schools this amount varies from 100 kWh/m2 per year, which is the average in our climate zone when using particular construction materials for buildings, up to 211 kWh/m2, which considerably exceeds the above mentioned consumption. However, it must be noted that several schools with high specific heat consumption have also swimming pools, logically leading to higher heat consumption for swimming pool needs. Yet these schools have not implemented measures in order to recover in the system and use rationally the heat currently drained through the exchange of air and water. This also must be envisaged in the renovation process. The specific electricity consumption in schools is 23.4 kWh/m2. In their turn the expected heat savings in renovation process amount on average to 55.3 kWh/m2.

As a result of school audits, the Property Department of the Riga City Council has prepared and submitted an application for 2 projects to receive funding from the Financial Instrument for Climate Change Mitigation and has concluded a contract with the Ministry of Environment. In 2010, it commenced renovation of 21 schools based on the following projects:

Project "Implementation of energy efficiency measures in the buildings of Riga municipal educational establishments I" (project ID No. KPFI-1/40)
The total project costs are LVL 2,370,892.44, out of which: LVL 1,999,803.78 or 84.35% of costs are covered from the Financial Instrument for Climate Change Mitigation, and LVL 371,088.66 or 15.65 % of costs are covered by Riga municipality.
Within the framework of this project energy efficiency measures will be implemented in the following schools:

1. Riga Secondary School No. 95, Vienības gatve 178, Block No. 2;
2. Riga Secondary School No. 84, Lielvārdes Street 141;
3. Primary school of the Nordic Countries Grammar School, Anniņmuižas Street 11;
4. Nordic Countries Grammar School, P. Lejiņa Street 12;
5. Riga Iļģuciems Secondary School, Dzirciema Street 109;
6. Riga Imanta Secondary School, Kurzemes prosp. 158;
7. Riga Centre Humanitarian Grammar School, K. Barona Street 97a;
8. Riga Secondary School No. 93, Sesku Street 72;
9. Riga Classical Grammar School, Purvciema Street 38;
10. Riga Secondary School No. 85, Nīcgales Street 22;
11. Riga Special Secondary School No. 66, Katrīnas Street 2;

The aim to be achieved by implementing this project is the efficiency indicator of reducing carbon dioxide emissions amounting to 0.486 kg CO_2 /LVL per year. According to the concluded contract the project implementation deadline is 1 December 2010.

Project "Implementation of energy efficiency measures in the buildings of Riga municipal educational establishments II" (project ID No. KPFI-1/41)
The total project costs are LVL 2,368,899.74, out of which: LVL 2,000,000 or 84.43 % of costs are covered from the Financial Instrument for Climate Change Mitigation, and LVL 371,088.66 or 15.57 % of costs are covered by Riga municipality.
Within the framework of this project energy efficiency measures will be implemented in the following schools:

1. Riga Secondary School No. 47, Skaistkalnes Street 7;
2. Riga Zolitūde Grammar School, Ruses Street 22;
3. Riga Rīnūži Secondary School, Ziemeļblāzmas Street 59.
4. Riga Secondary School No. 31, Skuju Street 11;
5. Riga Ostvalds Secondary School, Dammes Street 20;
6. Riga Secondary School No. 75, Ogres Street 9;
7. Riga Secondary School No. 80, Andromedas gatve 11;
8. Riga Secondary School No. 89, Hipokrāta Street 27;
9. Riga Purvciems Secondary School, D. Bratkalna Street 5;
10. Riga Secondary School No. 88, Ilūkstes Street 30;

The aim to be achieved by implementing this project is the efficiency indicator of reducing carbon dioxide emissions amounting to 0.523 kg CO_2 /LVL per year. According to the concluded contract the project implementation deadline is 1 December 2010.

Replacement of windows and doors in the buildings of Riga city educational establishments is continued for the purpose of improving energy efficiency. Since 2009 additional replacement has been carried out in the following buildings:

1. Riga pre-school educational establishment No. 62, Alīses Street 19;
2. Riga pre-school educational establishment No. 172, Maskavas Street 252;
3. Riga pre-school educational establishment No. 57, M. Caunes Street 3;
4. Riga pre-school educational establishment No. 142, Motoru Street 5;
5. Riga pre-school educational establishment No. 221, Kazarmu Street 1a;
6. Riga pre-school educational establishment No. 145, Mores Street 8;
7. Riga pre-school educational establishment No. 81, Grīvas Street 11;
8. Riga pre-school educational establishment No. 275, Valdeķu Street 58;
9. Riga pre-school educational establishment No. 239, A. Keldiša Street 32;
10. Riga pre-school educational establishment No. 112, Brīvības Street 363;
11. Riga pre-school educational establishment No. 66, Vesetas Street 13;
12. Riga pre-school educational establishment No. 173, Maskavas Street 254;
13. Riga pre-school educational establishment No. 193, Maskavas Street 266;
14. Riga pre-school educational establishment No. 196, Maskavas Street 268;
15. Riga pre-school educational establishment “Māra”, Zebiekstes Street 1;
16. Riga pre-school educational establishment No. 259, Jāņa Grestes Street 3;
17. Riga pre-school educational establishment No. 267, Dravnieku Street 8;
18. Riga pre-school educational establishment No. 270, Salnas Street 18;
19. Riga pre-school educational establishment No. 261, Jaunrozes Street 12;
20. Riga pre-school educational establishment No. 273, Ilūkstes Street 101/4;
21. Riga pre-school educational establishment No. 74. Kr. Valdemāra Street 145;
22. Riga pre-school educational establishment No. 232, A. Dombrovska Street 87;
23. Riga pre-school educational establishment No. 4, Vienības gatve 186;
24. Riga Secondary School No. 32, Viļānu Street 13;
25. Riga Rīnūži Secondary School (sports hall), Ziemeļblāzmas Street 59;
26. Riga Secondary School No. 72, Ikšķiles Street 6;
27. Riga Classical Grammar School, Purvciema Street 38.

Table 3.18.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To continue annually the renovation works in educational establishments of Riga city with an aim of fully completing them by 2020. Reduction of heat consumption (thousands of MWh per year	2010 2015 2020	Riga City Council, Property Department of Riga City Council	10.9 36.3/ 38.3 / 40.3* 70.7/75.7/80.8*
2. To conduct energy audits of administrative buildings of the Riga City Council and their energy certification with an aim to prominently display the energy certification data in premises with certain flow of visitors.	2015	Riga City Council	

*) minimum/optimum/maximum forecast

3.2.3 Lighting in the city streets and parks

Modernisation of the city's lighting system

Improvement of the city's lighting system in Riga started in 1995, when replacement of the outdated 400W and 250W high pressure mercury bulbs with high pressure sodium bulbs with capacity of 120W and 150W began. This work was fully completed in 2008. The lighting level has not decreased due to the ergonomics of high pressure sodium bulbs, but along the development of the city new lighting lines have been constructed, and the overall number of lighting points has increased; however, the total installed capacity has considerably reduced which is shown in the following chart.

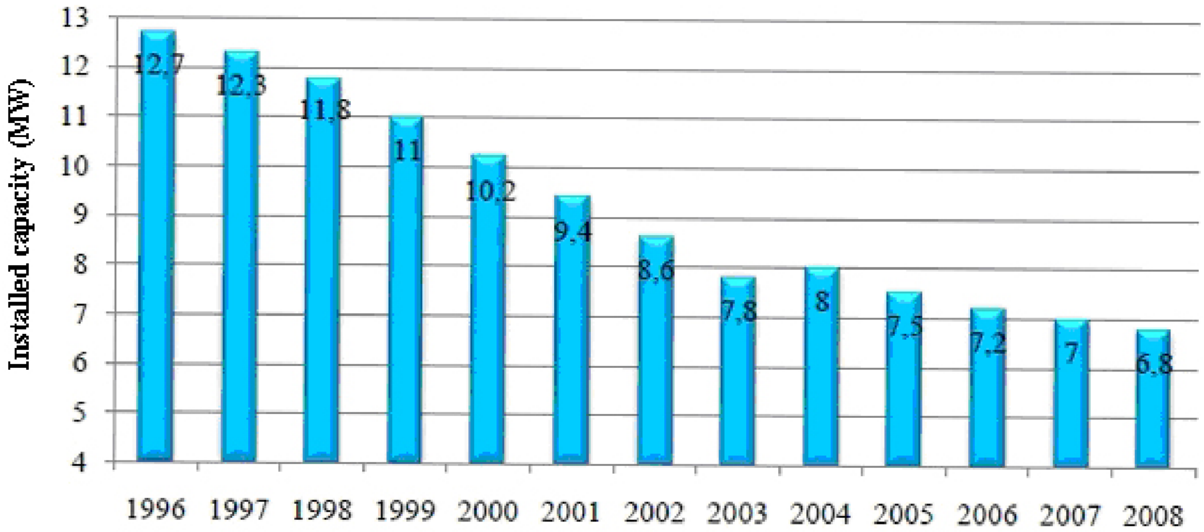


Figure 3.33. Source: Operational Strategy of the Riga Municipal Agency “Rīgas gaisma” for 2009–2013.

In the period 1993–1997, during nights the street lighting was switched off completely due to the limited finances. After 1997 and up to 2002, special saving mode was implemented according to which the lighting was not switched off completely during nights anymore, but only every third installed lamp was on (phase I). Under these conditions the lighting was uneven and insufficient, and due to the unbalanced load the lighting network was being damaged. Since 2002 the street lighting has been ensured in full volume. The lighting intensity in Riga has been gradually adjusted to the level of other European cities, and Riga has made great efforts to ensure visually beautiful, extraordinary and attractive lighting particularly in central part of the Old Riga with rather dense *art nouveau* building structures and main parks and bridges of the city. Buildings, bridges, as well as the channel side in the park are illuminated. The dynamics of electricity consumption is shown in the following chart:

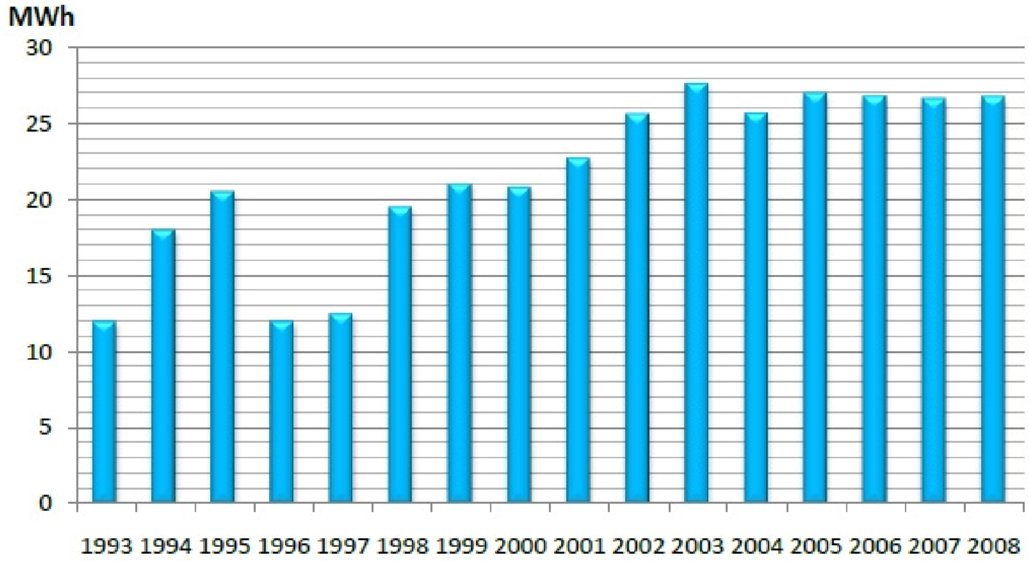


Figure 3.34. Source: Operational Strategy of the Riga Municipal Agency "Rīgas gaisma" for 2009–2013.

In Riga, 44,238 lamps have been installed for street lighting purposes. Depending on the category of street their capacity varies from 70 to 400 W. There are 1,510 illuminated streets, parks, small public gardens and residential areas in Riga with the total length of lighting lines amounting to 1,700 km. Yet there are still 167 streets (95.79 km) or 10 % of the total number of streets without lighting.

Description and development perspective of lighting

The technology of high pressure sodium bulbs used for city lighting purposes is considered one of the most ergonomic in the sector of street and square lighting. These bulbs have high efficacy – 95-150 lm/W and a warm, yellowish light with colour temperature of 2000–2200 K, thus the light is comfortable and acceptable for the latitude of Latvia. The service life of bulbs is up to 24,000 hours which according to the night lighting plan of Riga corresponds to 4 years. Use of these bulbs in combination with high quality lamps is very effective particularly for street lighting purposes, because the light colour of bulbs (colour rendering) meets the standards, and the electricity consumption per emitted light is rather low.

Currently, global efforts are made to modernise the existing lamps with high pressure bulbs. Upon lowering voltage, discharge bulbs allow to reduce also the power consumption, at the same time reducing the volume of emitted light flux. Incorporating electronic control systems in lamps makes it possible to change voltage applied to the bulb as needed. Decrease in traffic intensity during the night allows reducing also the level of lighting thus saving power. Similar voltage reduction equipment can be installed also in lighting control boxes, at the same time lowering the voltage in all connected lighting lines and saving power as much as possible.

Scheme for voltage and lighting reduction during night hours:

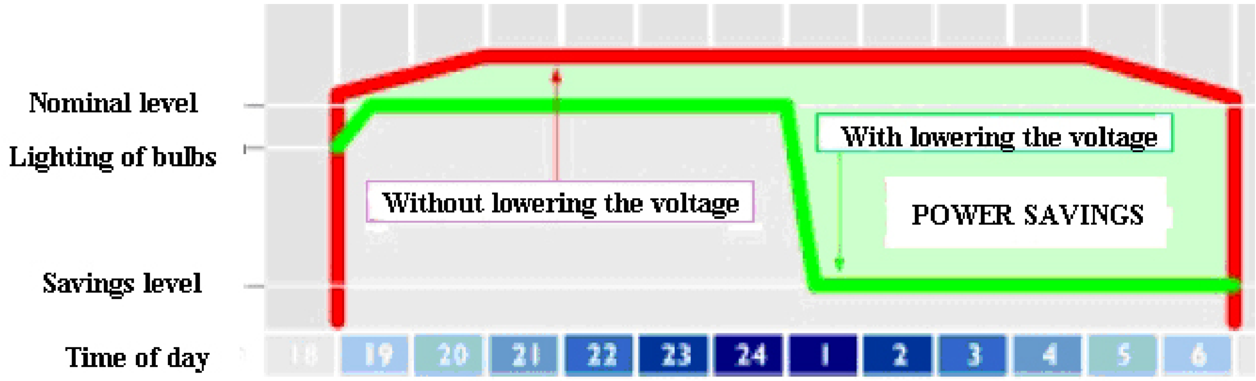


Figure 3.35. Source: Operational Strategy of the Riga Municipal Agency "Rīgas gaisma" for 2009–2013.

One of the most recent lighting trends is light-emitting diode (LED) bulbs and lamps. The operation of such bulbs is based on the ability of specially designed semiconductor crystals to shine when the current flows through them. The light-emitting crystal is very small (<1 mm3), and it is usually placed in a transparent plastic housing with two contacts. The colour of emitted light depends on the crystal's composition and structure – it can be blue, green, yellow, orange, red or white. In order to ensure the necessary light flux, several emitting diodes combined in the so called LED matrix are used in LED lamps. Lamp manufacturers work on creating a LED lamp which according to the light volume is able to illuminate streets and fields the same way as the existing lamps in operation, while consuming 50 % less power.
The comparison of aforementioned bulbs is provided in the following table:

Table 3.19.

Item	HPS2 400W	HPS 250 W	HPS 250 W	LED equivalent bulb No. 1	LED equivalent bulb No. 2
Capacity (W)	400 W	250 W	150 W	168 W	120 W
Voltage (V)	220 V	220 V	220 V	220 V	220 V
Light rendering index (Ra)	25	25	25	>75	>75
Average duration of service life (h)	28,000	28,000	28,000	>50,000	>50,000
Light flux (Im)	48,000	32,000	16,000	12,600	10,800
Efficiency of light efficacy (Im/W)	120	128	106	75	90

Source: Operational Strategy of the Riga Municipal Agency "Rīgas gaisma" for 2009–2013.
Acronym: HPS – *High Pressure Sodium*.

As it results from the table, for now in order to ensure the necessary lighting level on a street or at a square, lamps with high pressure sodium bulbs are more efficient. However, taking into consideration the rapid development of LED technologies, it can be expected that during the activity programming period new LED bulbs with equivalent light efficacy will emerge. In order to carry out extensive replacement of the existing city lighting technologies with LED bulbs, Riga together with other European cities in Finland, Poland, Sweden, Lithuania, Estonia and Germany is developing an international project for implementation of pilot projects and research of their

functioning by involving universities to prepare proposals to the *International Commission on Illumination* (CIE) of the European Union on adopting new legislation in the sector of lighting.
Currently, also LED lamps with alternative power supply sources – solar panels and wind turbines – are offered in the market as a new solution in comparison to the existing technologies. These lamps are positioned on special supports with incorporated panels accumulating solar energy or a wind turbine. The aforementioned structures themselves generate the necessary amount of energy for lighting, and they do not require a power connection with transmission lines. However, taking into account the city's conditions with limited possibilities for using wind turbines, as well as insufficiency of solar light throughout the year, the usefulness of such solutions in Riga must be carefully studied.

Table 3.20.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To introduce controlling possibilities of the city lighting system in order to reduce the lighting intensity during night hours. Power savings as % of the total volume	2010 2015 2020	Riga Municipal Agency “Rīgas gaisma”	- / - / 2 %* 2 / 5 / 10%* 10 / 15/ 20%*
2. To prepare and implement a pilot project for studying the usefulness of LED technologies for street lighting purposes in Riga in order to obtain practical data on costs, efficiency and economic return of these technologies	2010–2015	Riga Municipal Agency “Rīgas gaisma”, Riga Technical University (RTU) and other cooperation partners	
3. To introduce LED technologies for city lighting purposes by using the experience gained in the pilot project and involving potential EU sources of funding	2010–2020	Riga Municipality Agency “Rīgas gaisma”	5 / 10/ 20%* of the city's lighting volume
4. To install LED technology-based lamps with alternative power supply sources (solar panels, wind turbines) as pilot equipment in different areas of the city in order to analyse possibilities of using them for city lighting purposes	2010–2013	Riga Municipal Agency “Rīgas gaisma” RTU and other cooperation partners	

*) minimum/optimum/maximum forecast

3.4.4 City public transport

In 2009, the public transport of Riga city was operated by a unified municipal limited liability company (LTD) “Rīgas satiksme” having at their disposal the following resources:

- for tram service – 253 trams (including 1 low-floor tram), 9 tram routes;
- for trolleybus service – 303 trolleybuses (including 214 low-floor trolleybuses), 20 trolleybus routes;
- for bus service – 478 buses (386 low-floor buses), 53 bus routes.

The dynamics of the number of passengers carried by the city public transport over the last decade (in millions of people):

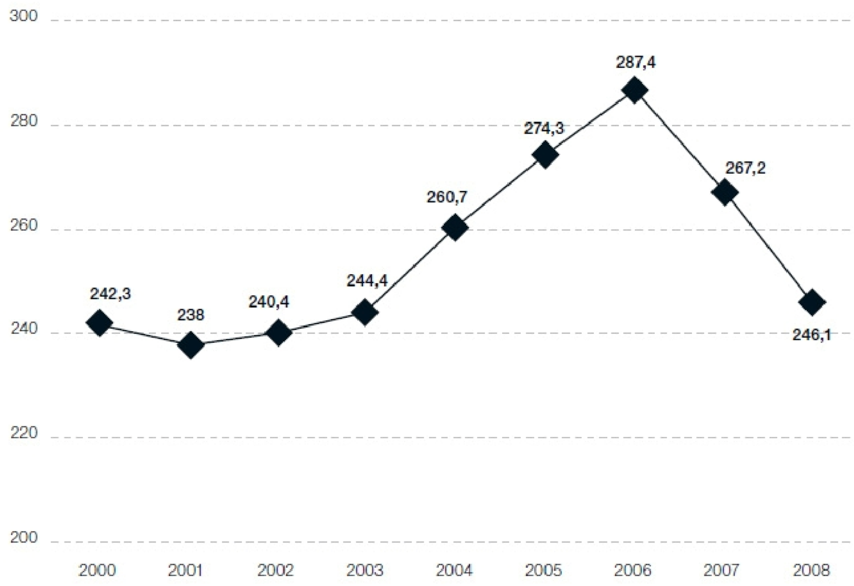


Figure 3.36. Source: Riga Development Programme 2006–2012.

As it is shown in the figure, contrary to the attempts to increase the passenger flow in the city public transport and to relieve city streets from the private transport, since 2006 a considerable decrease in the passenger flow can be observed. Apparently, some conclusions must be drawn, and it is necessary to make the city public transport more appealing and available to residents.

One of development priorities of the public transport is restoration of the transportation fleet. According to the Riga Public Transport Development Concept 2005–2018, electric transport is considered a priority in the city as an environment-friendly mode of transport. Proportion of passengers carried within the city transport network in breakdown by modes of transport in 2005

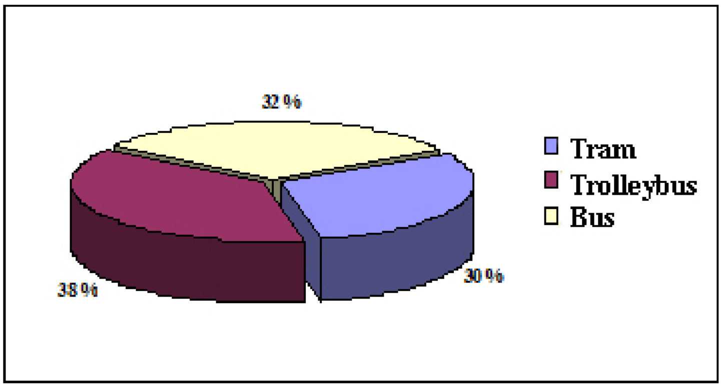


Figure 3.37. Source: Riga Public Transport Development Concept 2005–2008.

Tram and trolleybus services

The tram service has been developing since the end of the 19th century. The trolleybus service began in 1947. Around this time also an administration structure – Riga Tram and Trolleybus Office – was established, and in 2004 it was incorporated in the LTD "Rīgas satiksme".

The trams currently running in Riga were supplied in the 1970s–1980s, and they were manufactured in the former Czechoslovakia. The service life of trams until major repairs as set by the vehicle manufacturer is 15 years. By calculating their remaining service life, it was concluded that 2010 would be the last year of being able to ensure tram service therefore in 1999 major renovation of the tram rolling stock began, as a result of which the tram service life was prolonged by 15 years. Now the average remaining service life of 190 trams renovated from 1999 to 2001 is 7 years. During the period 2005–2008, cars of the rolling stock T-3M consisting of 30 trams were renovated, thus prolonging their service life by 10 years.

Preparations have been made for replacement of the existing trams with low-floor trams that starting from 2010 are supplied by the group of companies - "Škoda Transportation" s.r.o. and LTD "Alkomtrans". The first low-floor tram has been delivered already. It is expected that in 2010, out of the total number ordered (> 300) there will be 20 new low-floor trams delivered. The technical solution of new trams meets the energy efficiency requirements and consumes less power.
Test drive of the first low-floor tram "Škoda T-15" (see Figure 3.39.) along the streets of Riga in April 2010.

Figure 3.38.

The first to appear in Riga were the used JTB trolleybuses from Leningrad and Moscow built in the Yaroslavl Bus Plant before World War II. In the 1950s, the trolleybus fleet was supplemented with trolleybuses manufactured in Engels (Russia). While the first trolleybuses manufactured by the Czech company "Škoda" that were technically superior to the ones manufactured in Russia were delivered to Riga in 1961. The trolleybus rolling stock was outdated at the beginning of this century, because the standard service life was already exceeded, and thus replacement was necessary. Currently, the trolleybus fleet is restored with "Škoda 24Tr Irisbus" and "Ganz Solaris (GST-18)" low-floor trolleybuses. A part of the new trolleybuses is equipped with an incorporated diesel generator device which allows using them also outside the contact network system.

The overall power consumption of trams and trolleybuses of Riga city has slightly reduced and become more stable since 1995 through gradual replacement and modernisation of the transportation fleet. The power consumption is affected by construction of new routes and traffic intensity. The following chart shows the consumption by years selected in the Action Plan (GWh):

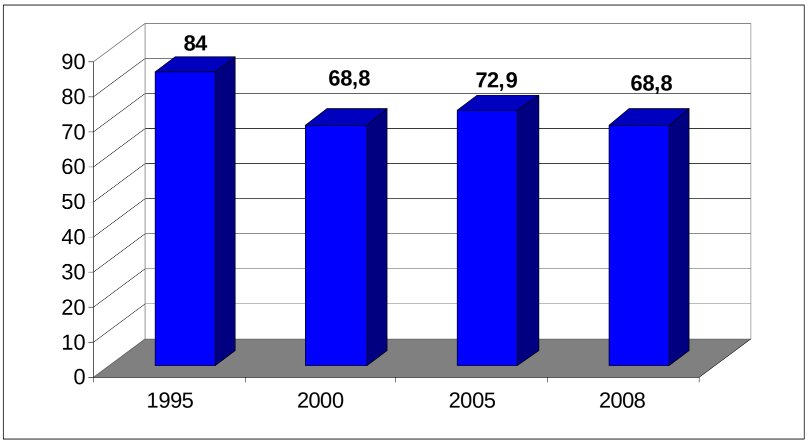


Figure 3.39. Source: JSC "Latvenergo".

Table 3.21.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To carry out the planned gradual replacement of tram and trolleybus fleets with the new low-floor trams and trolleybuses, thus increasing the availability, popularity and use of the public transport among residents	2010–2020	Riga City Council, LTD "Rīgas satiksme"	

Bus service

The public road transport operates in the city since 1946 when the bus fleet of Riga was created under the authority of the Ministry of Road Transport – initially it consisted of only about 15 vehicles. Gradual improvement of the service and infrastructure began. In the 1960s, vehicles were replaced by purchasing from Hungary "Ikarus" buses that carried passengers for many years. Bus routes were also improved by ensuring the service between individual cities and offering international trips. After the Riga Bus Station was built in the 1960s, its main task was to ensure bus services for long-distance routes.

At the end of the 1980s the public road transport was taken over by the municipality. In 1992, when reorganising the bus fleet of Riga, two separate municipal companies were established for passenger transportation in Riga city - the bus fleet "Imanta" carrying passengers along the left bank of Daugava river and bus fleet "Tālava" carrying passengers along the right bank of Daugava. The technical condition of buses was very poor in both of these newly established companies. The first buses manufactured in Europe were delivered from Scandinavia. In order to purchase new buses and to begin construction and reconstruction of service centres, loans were necessary. In 1997, a loan contract was concluded with the World Bank, and already in November first 52 "Mercedes-Benz" buses were delivered. Also the first commercial express route was opened in 1997, and it allowed passengers to reach their destination faster for a slightly larger sum of money by not stopping at certain places. Supplementation of the bus fleet continued. In the period 1997–2006, new buses were purchased, thus gradually replacing the outdated “Ikarus 260” and “Ikarus 280” bus models. Practically, replacement of the old vehicles within bus fleets was completed around 2005, and now the city has modern and energy efficient buses.

Use of biofuel in city road transport

According to the policy and objectives of the European Union set out in the Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources it is stipulated that by 2020 the use of biofuel must reach a share of at least 10 % in the transport sector. In its turn the Biofuel Law of the Republic of Latvia states that by 31 December 2010 the share of biofuel shall increase to at least 5.75 % out of the total amount of fuel in the transport sector.

The bus fleet of Riga uses fuel from the fuel distribution network with a certain share of biofuel that is ensured by fuel distributors.

At the beginning of 2010, the city began testing of a modern natural gas-operated Mercedes- Benz Citaro CNG type bus. It is a low-floor bus. The bus is equipped with an engine that is operated on more environment-friendly and ecologically cleaner fuel – compressed natural gas. It consumes 380 litres of natural gas per 100 km on average. The bus has 8 gas cylinders with the total capacity of 1,520 litres. The new engine has reduced emissions, and its operation is much more silent in comparison to the regular engine.

Table 3.22.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Extent of using biofuel in public road transport of the city, % of the total fuel consumption	2010 2015 2020	Riga City Council, LTD “Rīgas satiksme”	4.5/5.75/6 % * 6/7.88/10%* 9/10/15%*

*) minimum/optimum/maximum forecast

Introduction of electric cars and hybrid cars in the city

Alternative or unconventional road transport fuels considerably reducing air pollution with emissions of harmful substances including greenhouse gas emissions are bioethanol, biodiesel, hydrogen, compressed and liquefied natural gas, liquefied biogas, electricity (stored in an accumulator), etc.

In Europe and the rest of the world, introduction of electric cars (powered only by electric drive) and hybrid cars (equipped with both an electric engine and petrol engine that may operate separately or together) in everyday life is particularly active. To introduce such cars, establishment of an infrastructure for electric charging is necessary. Charging points may be located at petrol stations, next to shopping centres, at multi-storey car parks or established as separate fast-charging stations, as well as they may be in territories of multi-apartment houses and elsewhere. These charging points offer also accumulator battery replacement options. Since 2008 establishment of the respective infrastructure has begun in Israel, Denmark, France, Japan, Finland, England, Norway, Portugal and other countries. The impact of electric cars on environment is clearly demonstrated in the following chart:

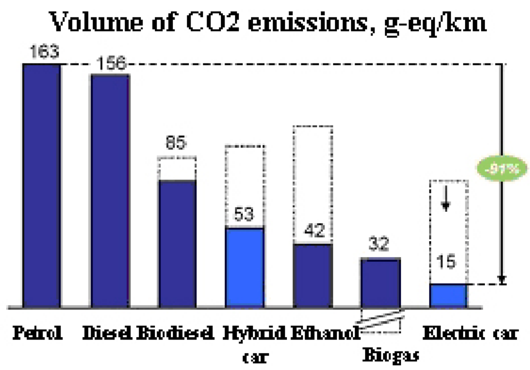


Figure 3.40. Source: Report by JSC "Latvenergo" – "Development trends of electric cars".

The rapid spread of electric cars in cities is facilitated exactly by pollution and noise reduction factors. It is the main reason for the recommendation to deal with introduction of electric cars also in Riga. To set a positive example as being the first to introduce electric cars, it is proposed to start purchasing and using electric cars by municipal institutions engaged in sectors of traffic, environment and urban development, as well as by JSC "Latvenergo". In future, issues on allowing only electric cars to enter the Old Riga, on gradual transition of taxis to cars of electric type, on encouraging residents to use electric cars by offering free parking places in the central part of the city, etc. must be dealt with.

Table 3.23.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Purchase and use of electric cars or hybrid cars by municipal institutions – a pilot project	2011-2015	Riga City Council, LTD "Rīgas satiksme"	5 cars
2. Introduction of electric cars and hybrid cars to reduce pollution in the city, % of the number of cars	2015 2020	Riga City Council, LTD "Rīgas satiksme"	- / 0.5 / 1 %* 1 /2 / 3%*

*) minimum/optimum/maximum forecast

3.3 Urban planning measures for reduction of energy consumption in the city

Starting from 1957, urban construction transitioned from constructing separate buildings, while retaining perimetral buildings, to construction of large residential areas. The practice of scattered positioning of buildings emerged. An internal yard with auxiliary buildings, internal roads and paths, squares and greenery was created for each separate group of buildings. These measures reduced building density while increasing energy consumption at the same time. During privatisation of multi-apartment houses land was allocated to each residential house, but in many places in residential areas of scattered type free land remained, and according to the EU guidelines about the impact of building density on energy consumption this land is to be handed over for construction.

It has not been characteristic for residents of Riga, contrary to many other European cities, to use bicycle as an everyday means of transport, and it was more of a recreational vehicle. The practice of using bicycles as everyday means of transport is steadily expanding in the city due to the understanding that each individual personally must contribute to the reduction of CO_2 emissions by using an environment-friendly means of transport. The use of bicycles is mainly promoted by young people who have travelled around Europe, and now they adopt this experience from Western countries. To meet the needs of the increasing bicycle traffic and to ensure its safety, the municipality is actively building bicycle lanes. Also bicycle parking places are being established next to municipal institutions.

Scheme of the existing and future bicycle lanes in Riga

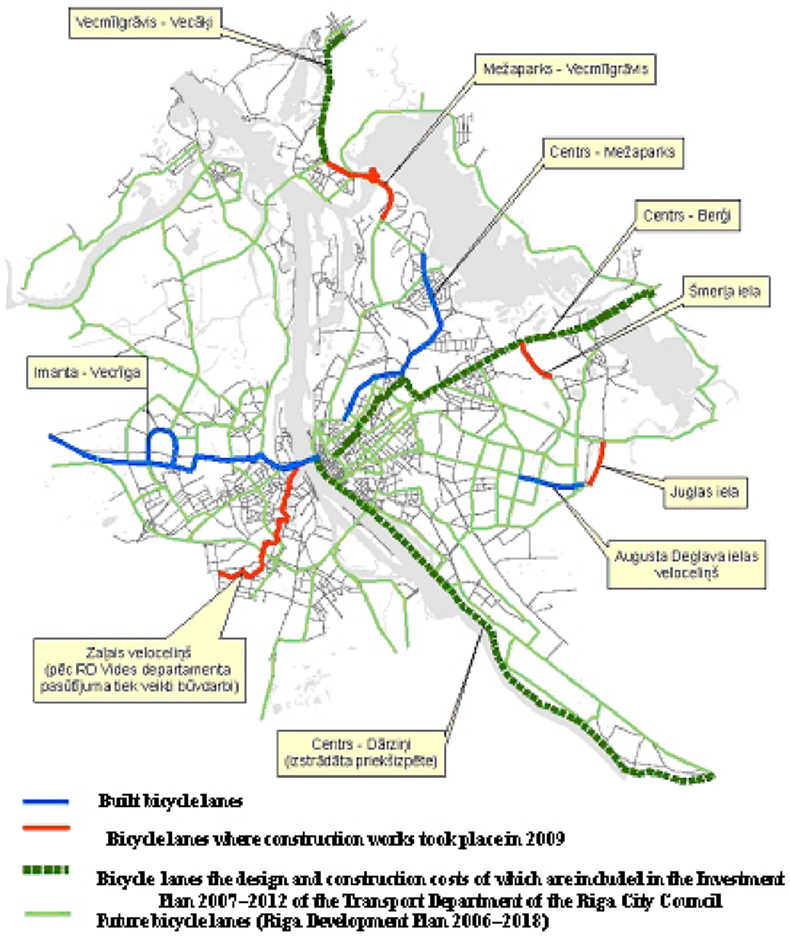


Figure 3.41. Source: Yearbook of the Transport Department of Riga City Council, 2008.

Every day a rather large number of private cars enters Riga. In order to relieve the streets from traffic and to reduce the volume of mobile emissions, it is envisaged within the framework of urban development planning to build multi-storey car parks outside the city centre and along main roads with good public transport traffic to encourage the people entering Riga to act according to the principle “park and ride”. A part of these car parks have already been built.

Based on the EU guidelines and experience of European cities, when updating the urban development planning documents individual areas of the city territory are envisaged for construction of low energy building complexes. Up to now no buildings have been constructed or renovated according to the parameters of a “passive” or zero-energy building (< 15 kWh/m2/a), but samples of such excellent buildings have to be created already in the nearest future.

In comparison to the total number of buildings to be renovated (6,000), the work done so far (14 buildings) in Riga forms only a very small part of the work still to be done. Renovated buildings are scattered throughout various residential areas of the city, and different solutions have been used to create their facades and external decorations, and therefore they cannot be considered as a uniform group of urban environment objects. In order to change this situation, the municipality within the framework of the project “Energy Efficient and Integrated Urban Development Action”.(UrbEnergy) develops according to the tendering procedure a project for improved and organised urban environment for a separate neighbourhood of the city – Jugla, envisaging not only improvement of surroundings of multi-apartment houses, but also external decoration of several groups of buildings to be renovated, including painting. The project to be developed will be a good example for dealing with similar issues regarding other areas in the city.

Table 3.24.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Drafting of regulatory documents for development and provision of uniform urban environment, including external decoration of buildings during the renovation of multi-apartment houses	2011-2012	City Development Department of the Riga City Council	
2. Drafting of regulatory documents regarding conditions on land use in areas of the city territory for construction of low energy buildings	2015-2020	City Development Department of the Riga City Council, cooperation partners	
3. To take into account aspects of energy efficiency and renewable energy sources when drafting the Riga long-term city development strategy	2010-2020	City Development Department of the Riga City Council, cooperation partners	
4. To envisage areas for car parking places outside the city centre and for energy supply facilities including renewable energy production facilities when drafting the territory plan of the municipality	2010-2020	City Development Department of the Riga City Council, cooperation partners	

5. To promote development of environment-friendly transport systems, including the use of public transport services and development of bicycle infrastructure when drafting the territorial plan of the municipality	2010-2020	City Development Department of the Riga City Council, cooperation partners	
6. To envisage conditions for improvement of energy efficiency and for complying with air quality standards in different areas of air pollution in the city at the same time promoting introduction of the best available environment-friendly technologies and cleaner production processes, improvement of flue gas treatment, choice of environment-friendly energy sources and a differential charge for car parking places in the central area of the city depending on the car's emissions of harmful substances, etc. when drafting building regulations for Riga city.	2010-2020	City Development Department of the Riga City Council, cooperation partners	
7. To implement measures for CO_2 emission reduction first in municipal companies and institutions in the sector of city transport development by encouraging them to develop and maintain zero-emission or low-emission car fleets for public transport	2010-2020	Riga City Council	

4. Utilisation potential of renewable energy sources and their inclusion in the energy mix of Riga

4.1 Current situation regarding the utilisation of renewable energy sources in the city up to 2005

Biogas

The city has a long-standing tradition of using biogas. It began along with construction of the Riga waste water treatment plant and putting the complex into operation in 1991. The boiler house of this treatment plant, the design of which was developed by the design institute "Rūpnīcprojekts" in Riga, had the first equipment that implemented industrial use of biogas for heat production in the Soviet Union at that time. Earlier, biogas was burned in a torch at its place of origin. The boiler house was mainly built to meet technological needs of treatment equipment, as well as for heating of buildings in the complex. At that time it was not possible to establish a biogas cogeneration plant due to the lack of appropriate electricity generation equipment. Such project (PPP) was implemented, and since the end of the 1990s a plant with the electrical capacity of 2.1 MWel

operates at the waste water treatment plant "Daugavgrīva". The plant uses the heat for its technological processes, while the electricity is sold to the network of JSC "Latvenergo".
The second biogas cogeneration plant also was built, and since 2002 it operates in the solid household waste landfill "Getliņi" located in the vicinity of Riga, in Stopiņi rural municipality, outside the borders of the city. The electrical capacity of the plant owned by LTD "Getliņi EKO" (PPP) is 5.3 MWel, but the potential heat capacity – 6.8 MWth.

Biomass

Since 2004 biomass in the form of wood-chips is used in small quantities in the district heating system, in the cogeneration unit of the heat plant "Daugavgrīva" with the electrical capacity of 0.5 MWel and heat capacity of 27.2 MWth.

4.2 Measures for inclusion of renewable energy sources in the energy mix 2005-2020

From the range of renewable energy sources potentially available to Riga city, the following are the main ones:
1) Use of biogas for energy production;
2) Energy production by incineration of solid household waste;
3) Use of biomass for energy production;
4) Biomass production;
5) Use of heat pumps in the city's heat supply system;
6) Possibilities of using geothermal energy in Riga city;
7) Use of solar energy in the power supply system of the city;
8) Use of waste water heat for heat production by applying high-capacity heat pumps.

Use of biogas for energy production

After 2005, both biogas cogeneration plants continued to operate – at the waste water treatment plant "Daugavgrīva", where biogas is produced through the process of biological treatment (fermentation) of waste waters, and at the LTD "Getliņi EKO" based on the solid waste landfill of Getliņi, where biogas is produced from waste, and it is emitted in the process of decomposition of waste organic fraction. Whereas the cogeneration plant at "Daugavgrīva" operates at full capacity, this is not the case in Getliņi. The plant uses heat to meet its technological needs regarding heating of biogas and heating of complex premises, but the heat is not fully used, therefore construction of a hothouse unit next to the cogeneration plant is planned for increasing energy efficiency. The electricity is sold to the network of JSC "Latvenergo".

Amount of electricity produced and sold by LTD "Getliņi EKO":

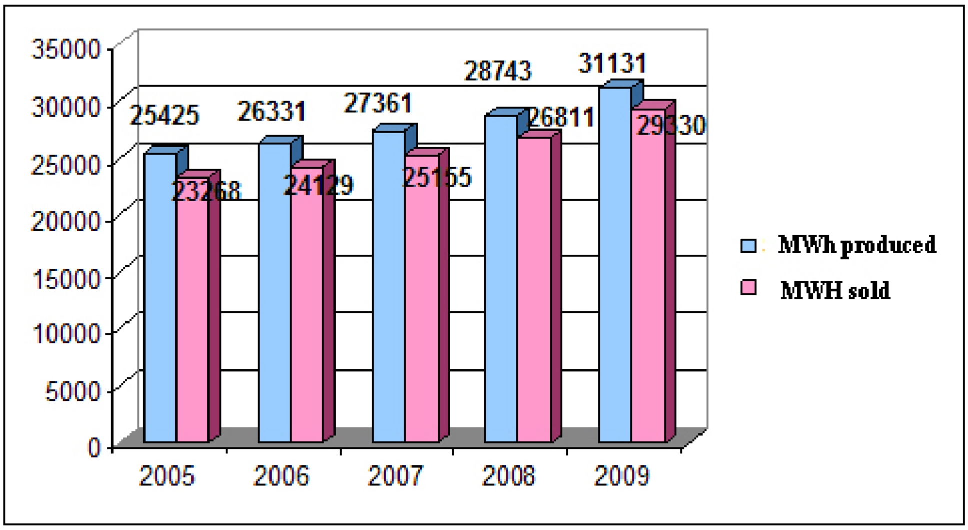


Figure 4.1. Source: presentation of LTD "Getliņi EKO" – "Solid household waste landfills in Latvia".

Riga city does not carry out waste separation at waste collection points. There have been some attempts to introduce waste separation, as well as individual waste separation sites with special containers have been established, but implementation of this measure in everyday life has failed. In the waste landfill of Getliņi the waste is deposited without separation which is unreasonable and also prevents the increase in biogas production in the long term. It is planned to introduce waste separation after its collection by separating the organic mass of waste which is the basis for production of biogas in the waste landfill. Deposition of organic mass only in separate areas will allow to increase biogas production and to raise the capacity of the cogeneration plant.

The energy production capacity will be increased over the next years by installing an economiser of condensation of complex flue gases and special gas engines for using biogas with lower methane concentration. Total increase in capacity – 1 MW.

Table 4.1.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To introduce the maximum possible heat production through the cogeneration process and its rational use	2011-2015	LTD "Getliņi EKO"	

Energy production by incineration of solid household waste

The amount of solid household waste deposited in the centralised waste landfill of Getliņi is directly affected by the public's financial status; this is clearly shown in the following chart:

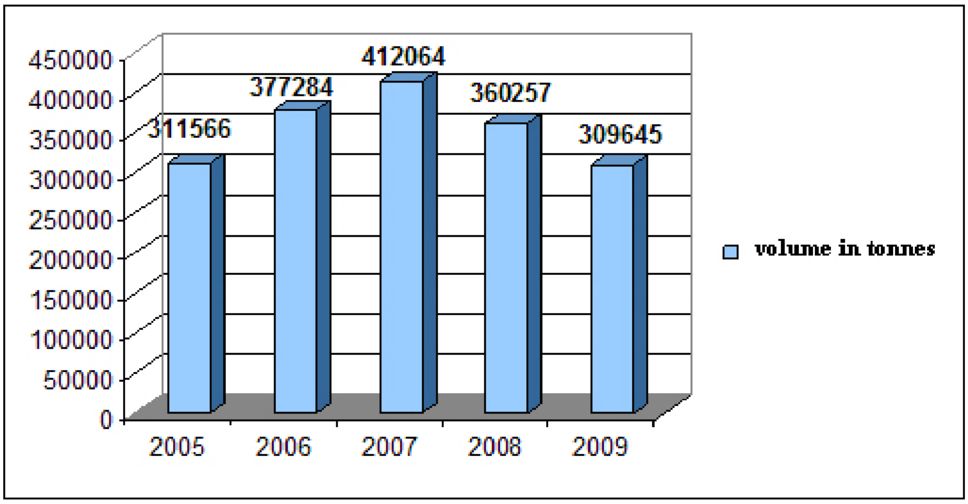


Figure 4.2. Source: presentation of LTD "Getliņi EKO" – "Solid household waste landfills in Latvia".

However, it does not imply that due to the global economic crisis the volume of waste is actually decreasing to the extent shown in the chart. A part of produced waste is brought to the woods and illegal dump sites in order to avoid the payments related to the acceptance of waste in the landfill. It creates an additional burden on the environment and requires an urgent solution.

Breakdown of the solid household waste (according to the data of Riga City Waste Management Plan 2006–2012) out of the total volume of waste brought to the waste landfill of Getliņi in 2002 – 1.1116 million m3:

- 524,520 m3 or 47 % may be deposited;
- 446,400 m3 or 40 % may be incinerated;
- 55,800 m3 or 5 % are secondary raw materials;
- 89,280 m3 or 8 % are inert waste.

For a long time since the line of action was set in municipal strategic documents, as well as in the city heat supply development concept, a necessity to introduce solid waste incineration has been emphasized. Europe has an extensive practice of solid waste incineration. In some countries, such as Sweden and Denmark, the energy produced through solid waste incineration covers a certain share of the total energy consumption. Modern waste incineration technologies have been developed and improved, and they do not have considerable negative impact on the surrounding environment – the impact is smaller than the one caused by depositing this waste in a landfill. A time has come for introducing a positive solution also in Riga city by attracting an investor through a PPP (private-public partnership) for separation of collected waste and installing equipment for incineration of solid combustible fractions of waste in order to produce energy in the cogeneration process. Also construction of a connection link with the district heating network must be envisaged in order to transfer to the network the heat from both cogeneration equipment for solid waste incineration and cogeneration equipment for biogas produced from waste.

Table 4.2.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To introduce waste separation after its collection and incineration of the solid combustible waste fraction with energy production	2011-2020	LTD "Getliņi EKO" and a PPP investor	

Use of biomass for energy production

Use of biomass (wood-chips) for energy production in the district heating system of JSC "Rīgas siltums":

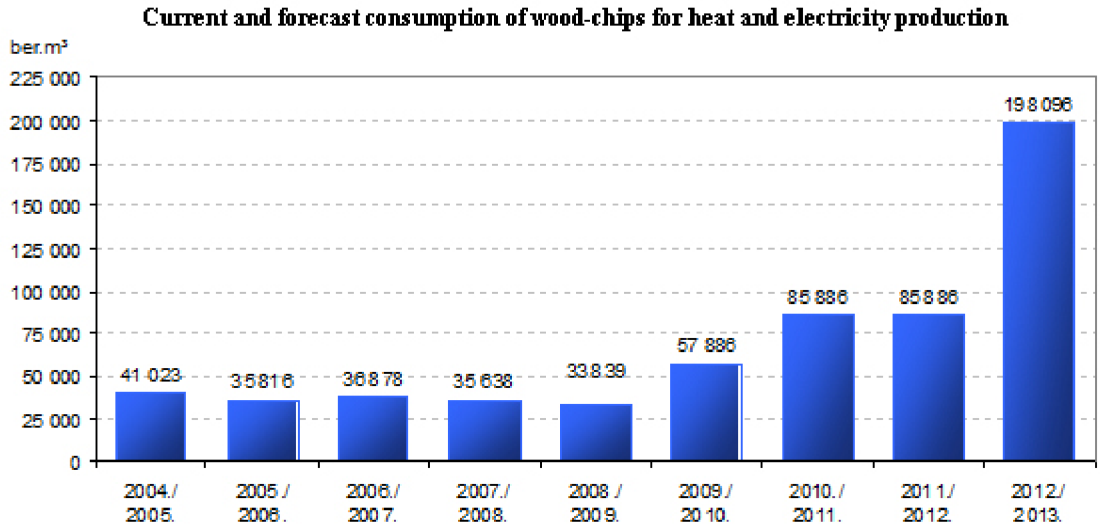


Figure 4.3. Data of JSC "Rīgas siltums".

According to the figure the consumption of wood-chips by the system is low, but it is planned to increase the amount by multiple times over the next years.

In 2007, as a result of reconstruction the electrical capacity of the cogeneration unit at the heat plant "Daugavgrīva" operating on wood-chips was increased to 0.6 MWel. In 2011 it is planned to complete equipping of the one existing boiler DKVR-10/13 with a front furnace for wood-chip combustion with the total capacity of 5 MW. Also, it is envisaged to install by 2013 one additional cogeneration power unit with an option of wood-chip gasification and with electrical capacity of 0.5 MWel and heat capacity of 1 MWth.

Modernisation of the heat plant in Ziepniekkalns has been commenced – a cogeneration unit with the electrical capacity of 4 MWel and heat capacity above 20 MWth is being installed. It is planned to use wood-chips as fuel for the new unit. The unit is to be put in operation in 2012.

The equipment for wood-chip combustion is being installed also in the heat plant "Vecmīlgrāvis" by equipping the plant with two water heating boilers with the total heat capacity of 14 MW. The facility will start to operate in 2010. It is further envisaged to install another unit consisting of two water heating boilers with equivalent capacity for operating on wood-chips.

Also, it is planned to install a water heating boiler with the capacity of 20 MW in the heat plant "Zasulauks" operating on wood-chips which will start to operate in 2014.

Due to the closure of LTD "Komēta" that supplied heat to several residential buildings in the Zemgale administrative district of Riga, in 2008 the building on Gulbju Street 1 was equipped with a local boiler to operate on wood pellets in automatic mode. Riga has an extensive practice of using pellet boilers for heating of individual buildings, also in the private sector.

Storage of woodchips of the heat plant “Daugavgrīva”:

Figure 4.4. Source: JSC “Rīgas siltums”.

Table 4.3.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Installation of two water heating boilers with the total heat capacity of 14 MW in the heat plant “Vecmīlgrāvis” for operation on wood-chips	2009-2010	JSC “Rīgas siltums”	
2. Installation of two water heating boilers with the total heat capacity of 14 MW in the heat plant “Vecmīlgrāvis” for operation on wood-chips	2013-2014	JSC “Rīgas siltums”	
3. Installation of a cogeneration unit in the heat plant “Ziepniekkalns” with electrical capacity of 4 MWel and heat capacity above 20 MWth for operation on wood-chips	2010-2012	JSC “Rīgas siltums”	
4. Equipping of the existing boiler DKVR-10/13 of the heat plant “Daugavgrīva” with a front furnace for wood-chip combustion with the total capacity of 5 MW	2010-2011	JSC “Rīgas siltums”	
5. Installation of one additional cogeneration power unit with an option of wood-chip gJSCification and with electrical capacity of 0.5 MWel and heat capacity of	2012-2013	JSC “Rīgas siltums”	

1 MWth in the heat plant "Daugavgrīva"			
6. Installation of a water heating boiler with the capacity of 20 MW in the heat plant "Zasulauks" for operation on wood-chips	2013-2014	JSC "Rīgas siltums"	
7. To prepare and distribute information on advantages of using wood pellets for local heating of buildings	2011	REA, cooperation partners	
8. Use of wood biomass for energy production at JSC "Rīgas siltums", the amount of fuel per year in loose-m3	2010 2015	JSC "Rīgas siltums"	57,886 198,096

*) minimum/optimum/maximum forecast

Biomass production

Riga is characterised by a well-developed wood industry where wood waste – biomass – is formed as a by-product and is used for production of heat for plants themselves, and it is sold as well. There is also a high-capacity pellet production plant in the territory of the Free Port of Riga, and its products are mainly intended for export.

Riga city is the second largest owner of forests in Latvia after the state itself. Currently, the total area covered by forestland properties of the city which have developed historically and are scattered all over the territory of Latvia is about 56,000 ha. The forests owned by Riga are managed by LTD "Rīgas meži". The economic activity of LTD "Rīgas meži" is oriented towards obtaining funds for management and maintenance of forests, including establishment of recreational territories and provision of high-quality forest planting material, etc. Also the economical assessment of the possibility to introduce assortments of thin-dimension quick-growing osiers - from which wood-chips are made - by expanding the economic activity of LTD "Rīgas meži" is being done. Such measure in cooperation with the Latvian State Forest Research Institute "Silava" has been commenced in the forest district of Olaine cultivating selected quick-growing sorts of osiers suitable for Latvian conditions. In 2008, the first biomass was harvested by organising a seminar visit for interested parties. The following figures show harvesting of biomass during the seminar in Olaine:



Figures 4.5, 4.6 and 4.7

Use of heat pumps in the city's heat supply system

The heat pump is a heating installation that uses solar energy accumulated by the surrounding environment – soil and ground, water bodies and air – for heat production. Therefore different types of heat pumps are available – geothermal or ground heat pumps and air heat pumps. The energy obtained by the heat pump may be used for heating and for hot water by ensuring a well-controlled and safe heating system operating all year round.

The heat pump operates in similar way to a regular refrigerator, but – according to the reverse operation principle. Only a small amount of energy is additionally required to drive a heat pump. The operating efficiency of a heat pump is characterised by the performance rate indicating the volume of heat energy that can be obtained as a result of consuming 1 kWh of electricity for operating heat pumps.

Heat pump operation scheme:

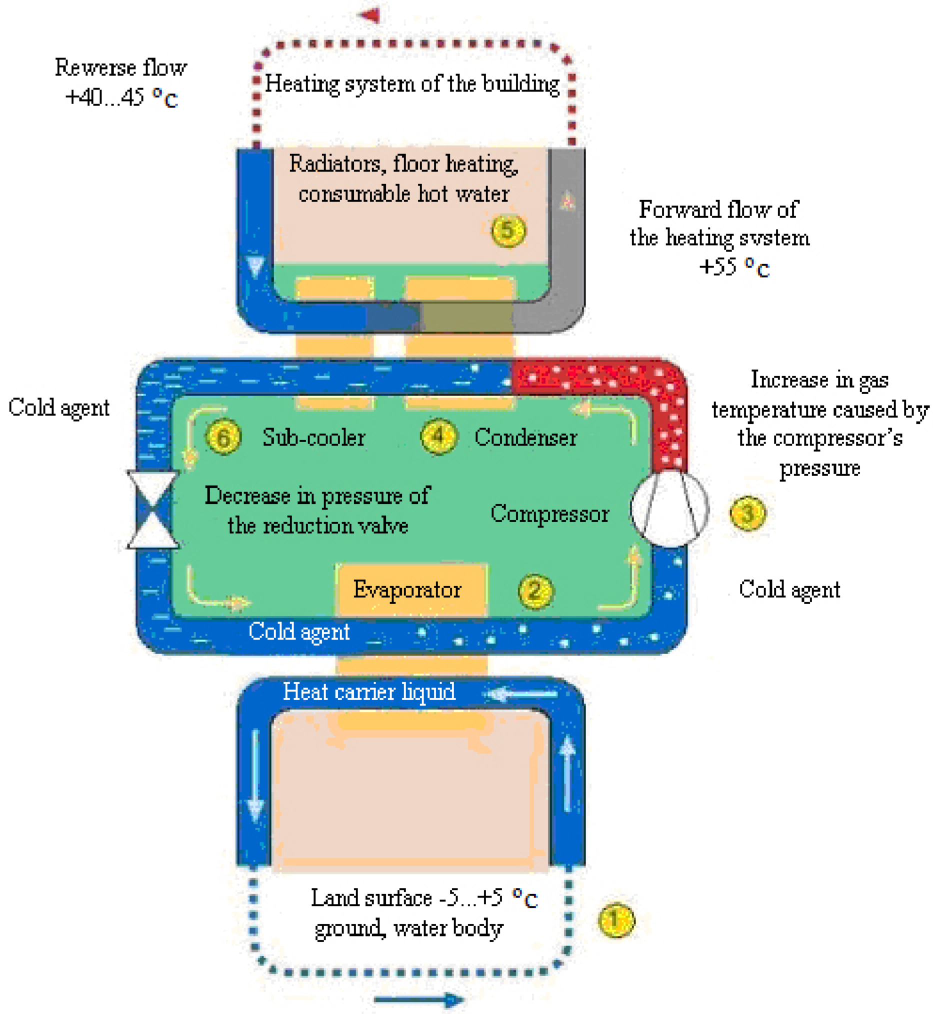


Figure 4.8. Source: www.rea.riga.lv

Although in European countries the use of heat pumps as a type of renewable energy source suitable for new conditions has been rapidly growing (e.g. the number of heat pumps in Sweden is already reaching 600,000 in 2010), they are not widely used in Latvia due to lack of information. Several thousands of the installed heat pumps are mainly used in the private sector regarding where evaluation of the data on operational use of heat pumps is not available. In order to change this situation, REA prepared a project for demonstration of heat pumps in the pre-school educational establishment “Kastanītis” and submitted it to an international call for projects organised by the bilateral Norwegian Financial Mechanism. The project has received positive evaluation, has been granted funding, and it was commenced in 2009.

Heat pumps with thermoprobes installed by deep drilling is a modern and environment-friendly way of heat supply under urban conditions. Construction in the city is characterised by limited available space, therefore in order to install a heat-absorbing collector deep drillings are done, and the number and deepness of these drillings depend on the heat load connected to the collector, the speed of artesian water flow and ground temperature. In its turn, the heat load of the heated building to meet heating needs depends on the heat insulation of enclosing structures of the building. Therefore in order to reduce this load, it is useful to insulate the building before installation of heat pumps. This is the exact solution that is envisaged in the international project. The heat load of the building after insulation would be 48 kW.

Drilling scheme:

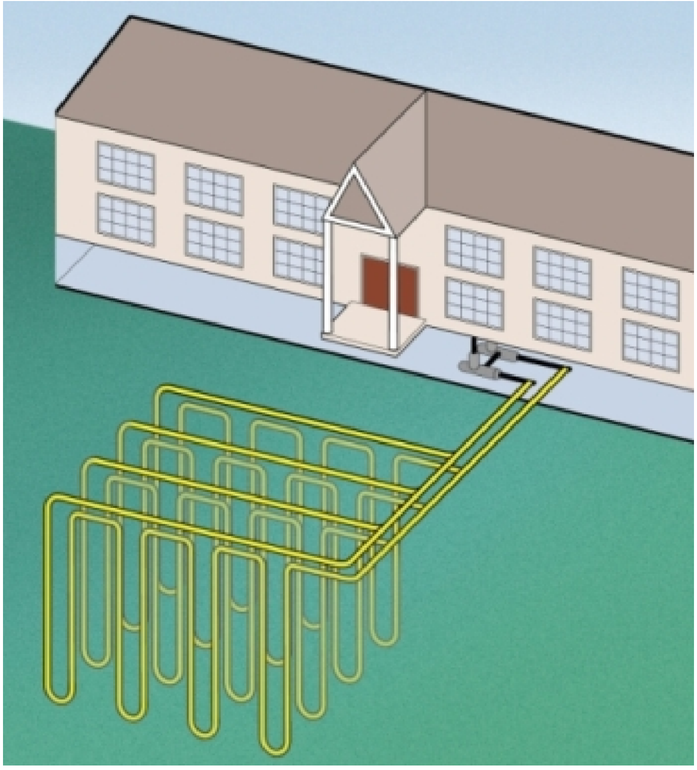


Figure 4.9. Source: http://www.geoxchange.org

According to this load it is envisaged to install 3 heat pump units with the total heat productivity around 75 kW, as well as to create 22 drillings at a depth of 60 m where U-type pipelines absorbing the geothermal energy will be immersed. Glycol or other selected liquid of the heat carrier will be circulating in pipelines. The performance rate of heat pump units to be connected to the heating system of radiators in “Kastanītis” will be > 3.2. The service life of heat pumps reaches 30–40 years without replacing individual parts. Heat pumps are installed together with hot water accumulation reservoirs. The system is equipped with automation installations and operates in automatic mode. Implementation of the project will be completed in 2011. By using the short film (18 min) made during project implementation, as well as data on operational use, residents will be provided with the necessary information. The venue will be available to interested persons for visual inspection.

Table 4.4.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Implementation of the international project “Introducing Heat Pumps for Heat Supply in Riga City: Setting-up a Demonstration Object” (PVS ID 2162) (the bilateral Norwegian Financial Mechanism)	2009-2011	REA, Property Department of the RCC, Baltic Environmental Forum (BEF)	3 heat pumps with the heat capacity of each pump – 25 kW
2. Sharing the experience gained from the demonstration project (heat pumps with thermoprobes installed by deep drilling)	2011-2020	REA, cooperation partners	Continuously

3. Development of a demonstration project involving air source heat pumps in order to evaluate their suitability for heat supply of buildings and possible operation range	2012-2015	REA, cooperation partners	
3. To promote introduction of heat pumps in the heat supply system of Riga city Amount of captured geothermal energy, thousands of MWh	2011-2020	REA, cooperation partners	500/1000/1500* number of newly installed heat pumps 37.5/45.0/48.2 *

*) minimum/optimum/maximum forecast

Possibilities of using geothermal energy in Riga city

Riga is situated in the area of geological anomalies of Latvia where a considerable part of energy potential is deposited in minerals of the land's crystalline foundation rocks. The Marine Geology and Geophysics Institute (ВНИИМореo), which was located in Riga during the Soviet times and conducted research of oil deposits in the Baltic States and the shelf of the Baltic Sea, based on the order by the Ministry of Energy of Latvia in 1989–1990 performed an evaluation of the layout of isotherm surfaces in the territory of Latvia with temperature of 100, 125 and 150°C. Riga is situated in the relatively hot zone, where the absolute locations of surfaces of isotherms with temperature of 100°C are at a depth of 2.75 km or less calculated according to the sea level. Now the technologies for utilisation of the heat from crystalline rocks (hot dry rock energy) have been well established, and they are based on the practice according to which energy can be extracted from crystalline rocks by using surface water and pumping it into the hot crystalline layer that has been crumbled by the hydraulic impact or by using local explosions. Crystalline rocks is a renewable energy source, because the magma (rocks melted at 1,300°C temperature) under the crystalline layer continuously restores the temperature of these rocks.

Map of the area of geological anomalies of Latvia:

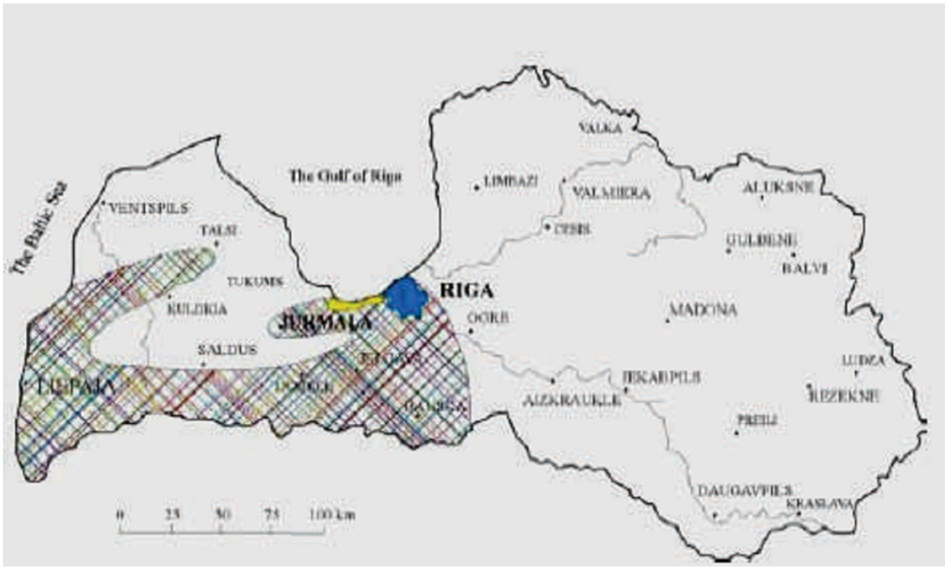


Figure 4.10. Source: gazette “REA vēstnesis” No. 4, www.rea.riga.lv.

European countries have some experience in construction and operating of cogeneration plants using hot dry rock energy as an energy source. The first commercial power plant of this type is operating in Basel, Switzerland for 10 years already. The electrical capacity of this plant is 3 MWel, but heat capacity is 30 MWth. Based on the 20-year cost return period, the cost of heat is EUR 0.02 per kWh, but the cost of electricity – EUR 0.12 per kWh; these costs are equivalent to those of small hydroelectric plants or wind energy plants. In this specific case the depth of the productive layer is 4–6 km, and the temperature of rocks reaches 150–250°C. The efficiency of a Basel-type power plant could be even more improved by applying the Kalina cycle technology the use of which started only in the recent years. If the Kalina cycle is used instead of the so far very well known Renkin cycle, it increases the efficacy of a power plant by about 30 % based on comparison of both cycles. Alexander Kalina is an American scientist of Soviet origin who by using low-potential heat has developed an efficient electrical power generation cycle where a mixture of ammonia and water in proportions of 89 % and 11 % (according to another information source – 85 % and 15 %) respectively is used instead of a working solution – water (Renkin cycle).

During recent years rather intensive construction of cogeneration plants using hot dry rock energy is taking place in Germany and other countries. REA has got acquainted with the information on construction of such plant with the electrical capacity of 3 MWel and heat capacity of 30 MWth in Potsdam (Germany) that is REA's cooperation partner in one of the international projects. Construction of the underground part of the plant has been successfully completed already, and establishment of the plant continues.

Taking into account the potential volumes of hot dry rock resources in Latvia and Riga ensuring the possibility to establish in future cogeneration plants using hot dry rock energy in the area of geological anomalies in Riga or its vicinity and other areas in Latvia, development and implementation of a pilot project for establishment of such station is necessary. It is proposed to implement the pilot project with electrical capacity of 3–4 MWel and heat capacity of 30–40 MWth in Riga by attracting funding from international funds.

Scheme of the general principle of cogeneration plant in Basel:

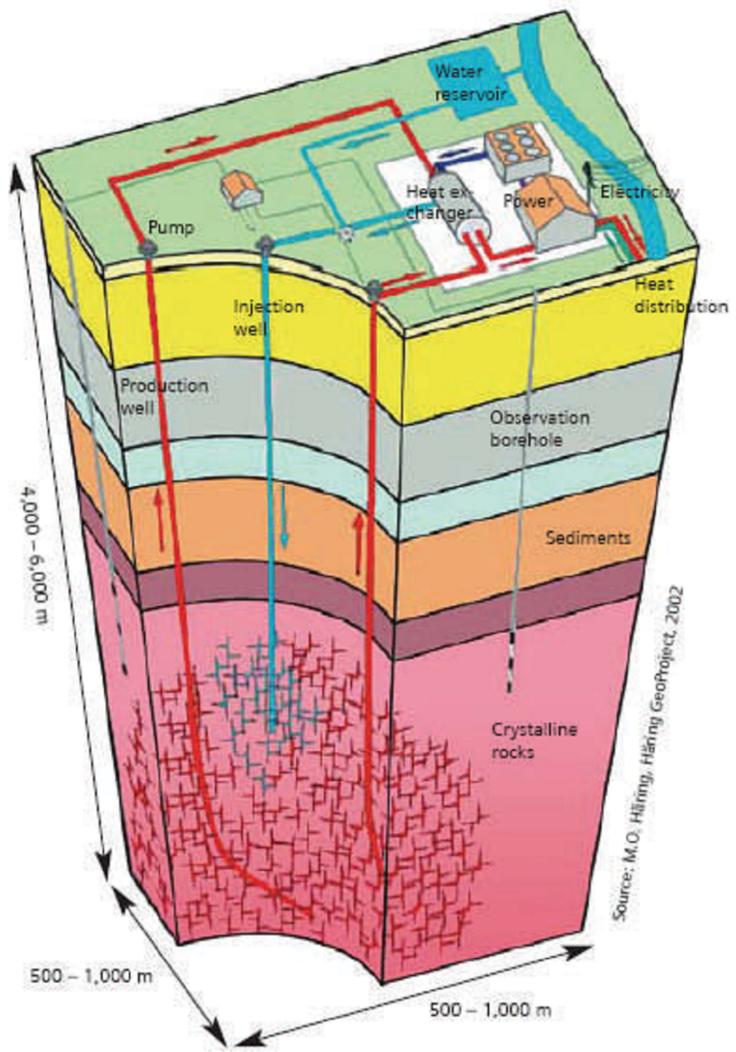


Figure 4.11. Source: gazette “REA vēstnesis” No. 4, www.rea.riga.lv.

REA is a member of the international organisation – Geothermal Panel of the European Technology Platform on Renewable Heating and Cooling (RHC) of the European Commission. Based on the data from presentation "Energy sources of hot dry rocks and possibilities of their utilization in Latvia" (October 2009) by M. Rubīna which is also translated into English, the secretary of the European Geothermal Energy Council, Philippe Dumas has prepared and published online an informative survey on this topic of global interest.

Table 4.5.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Development and implementation of a pilot project for a cogeneration plant using hot dry rock energy with electrical capacity of 3–4 MWel and heat capacity of 30–40 MWth by attracting funding from international funds	2011-2020	REA, cooperation partners	

Use of solar energy in the power supply system of the city

The earth receives a large amount of energy from the sun. There are two types of solar radiation - direct and diffuse solar radiation. The radiation depends on the season, geographical location and the climate of Latvia. The determining factor in using solar energy is the intensity of solar radiation. The average calculated intensity of solar radiation in Latvia is 1,109 kWh/m2.

Monthly global solar radiation values on a horizontal plane in Northern Europe (kWh/m2):

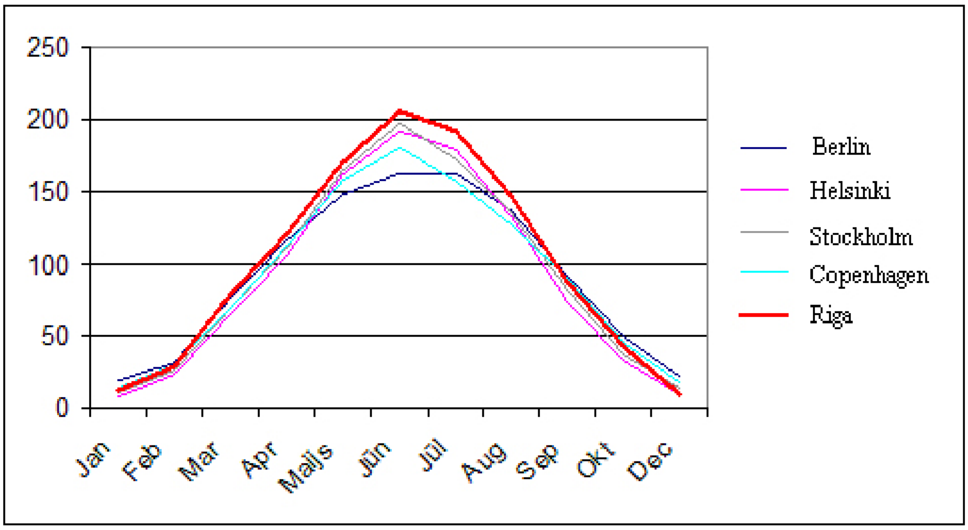


Figure 4.12. Source: Institute of Physical Energetics.

For comparison – annual global solar radiation values on a horizontal plane in Northern Europe (kWh/m2)

- Berlin – 1,031;
- Helsinki – 980;
- Stockholm – 1,026;
- Copenhagen – 1,013;
- **Riga – 1,109**.

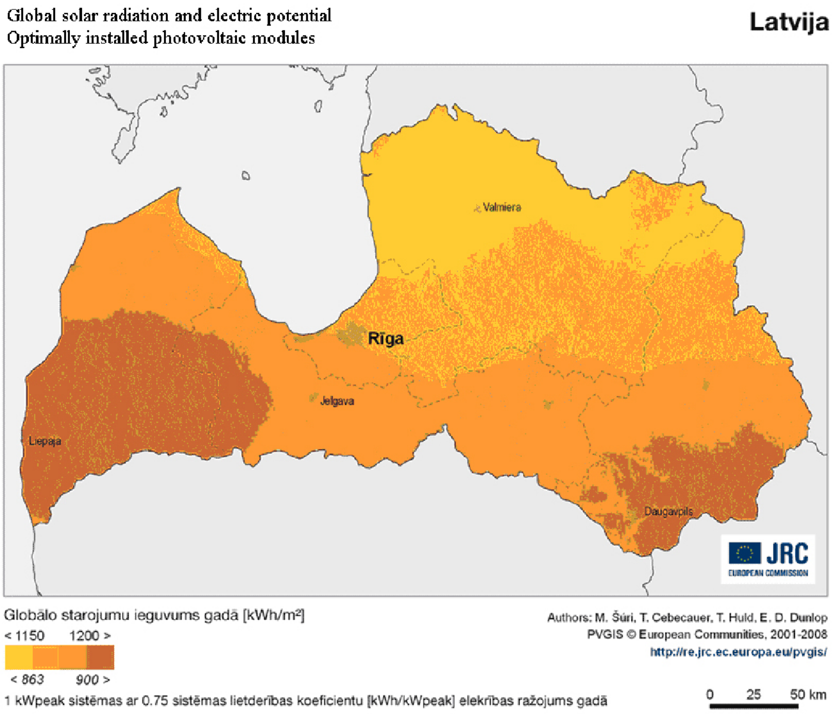


Figure 4.13. Source: www.ecosol.lv

Solar batteries (PV) are used for converting solar energy to electrical energy. The heat is produced by using solar collectors. There are two types of solar collectors – flat plate and vacuum tube solar collectors.

In Latvia, it is possible to obtain 350–450 kWh on average per one square meter including:

- in May, June, July, August and September – 700–800 kWh/m2;
- in October, March and April – 200–300 kWh/m2;
- in November, December, January and February – 40–65 kWh/m2.

Despite the relatively active use of solar batteries and collectors in Europe this equipment is not widely used in Latvia due to lack of information and rather high costs of equipment. In Riga, several private houses are equipped with solar collectors, but no information on their operational indicators is available.

In Latvia, scientific studies on suitability of various designs of solar batteries and collectors to Latvian conditions is dealt with by the Institute of Physical Energetics that has established a site for trials of solar batteries and panels on the roof of the institute. The completed trials confirm the actual potential of using solar energy in Riga.

Site for trials of solar batteries and collectors on the roof of the Institute of Physical Energetics:

Figure 4.14.

In order to obtain information necessary for the general public on costs of installing solar collectors and their operational indicators in Riga, a demonstration project is being prepared for installation of solar collectors on multi-apartment houses in Riga. Two social houses with equivalent hot water consumption per month in the amount of 16 MWh have been selected for this project, and the total surface of installed solar collectors is around 160 m2. Also two different technologies – flat plate solar collectors and vacuum tube solar collectors – have been chosen for installation. It is envisaged that solar collectors will work together with the building's district heating system for hot water production. After the introduction and inspection of these objects an informative material and recommendations on installation of solar collectors on multi-apartment residential houses in Riga will be prepared.

It is intended to create a similar demonstration object for installing solar batteries (PV) on the roof of a municipal building in order to use the obtained energy for operating of conditioning systems by ensuring that batteries work together with the building's power supply system.

Table 4.6.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Development of demonstration objects for installation of solar collectors on three multi-apartment social houses by applying different technologies – flat plate solar collectors, vacuum tube solar collectors,	2010-2011	REA, cooperation partners	Total area of collectors 160x3 = 480 m2

industrial flat plate solar collectors or other			
2. Sharing the experience gained from the demonstration project of solar collectors	2011-2020	REA, cooperation partners	Continuously
3. Development of a demonstration object for installation of solar batteries (PV) on the roof of a municipal building for production of electricity	2011-2012	REA, cooperation partners	
4. Sharing the experience gained from the demonstration project of solar batteries (PV)	2012-2020	REA, cooperation partners	Continuously
5. To facilitate installation of solar collectors on the roofs of multi-apartment buildings for hot water production together with the district heating system of buildings	2011-2020	REA, cooperation partners	30 / 200 / 500* houses by 2020
6. Capturing solar energy for hot water production in residential houses, thousands of MWh per year	2020	REA, cooperation partners	1.5/10/25*
7. To facilitate installation of solar batteries on the roofs of buildings for production of electricity	2012-2020	REA, cooperation partners	5/ 50 / 100 * buildings by 2020

*) minimum/optimum/maximum forecast

Use of waste water heat for heat production by applying high-capacity heat pumps

The designed productivity of the Riga waste water treatment complex "Daugavgrīva" that commenced its operation in 1991 is 350 thousand m3 a day. At the end of the 1990s, 190–230 thousand m3 of waste waters were biologically treated in a 24-hour period. After biological treatment waste waters were settled in secondary basins and then discharged into the Gulf of Riga 3 km away from the coastline. In 1998, the volume of treated waste waters was 74,189.6 million m3.

The temperature of treated waste waters to be discharged into the sea is 8–15°C or higher which demonstrates the possibilities for heat utilisation by using heat pumps. Such solutions have been continuously used in Gothenburg (Sweden) and elsewhere in Europe. High-capacity absorption-type heat pumps are used – higher-potential heat is necessary for ensuring the technological process of these pumps. In order to produce it a boiler is installed at the heat pump plant. Taking into account the location of the waste water treatment complex "Daugavgrīva", it is useful to establish a heat pump plant during construction in the area of Spilve meadows in order to find a solution for the increasing heat load of the city in this area without considerable increase in CO_2 emissions.

Table 4.7.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Drafting of the technical basis for establishment of a high-capacity absorption-type heat pump plant for utilisation of heat originating from the waste waters treated by the waste water treatment complex "Daugavgrīva"	2010-2020	REA, cooperation partners	

5. Management structures for implementation of the Action Plan

In order to ensure implementation of the Action Plan, according to the recommendations of the Covenant of Mayors of the European cities and EU guidelines the municipality is establishing a special management structure involving representatives of all institutions concerned. The main role in organisation and coordination of implementing the Action Plan is played by the municipal energy agency which is supplemented with all necessary additional structures.

Scheme of management structures for implementation of the Riga City Sustainable Energy Action Plan:

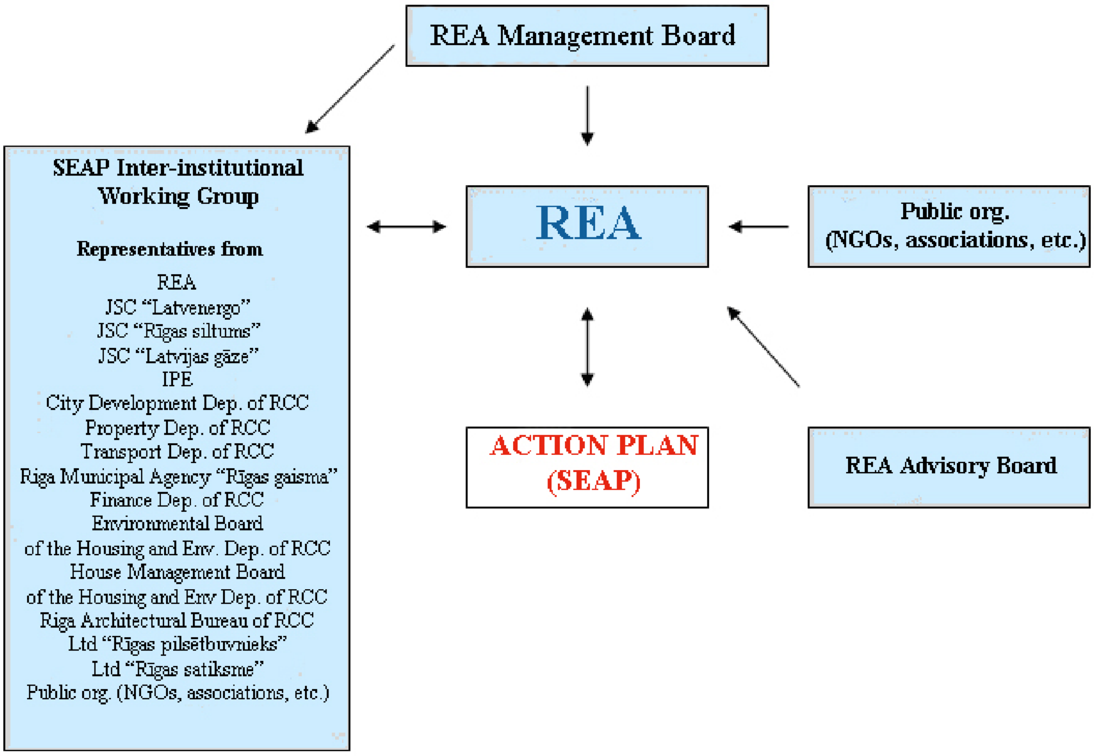


Figure 5.1.

In order to avoid establishment of unnecessary additional structures, during implementation of the Action Plan in Riga the two already existing structures established by the order of Riga City Council and working together with REA – REA Management Board and REA Advisory Board – are to be used. It is necessary under the order by the Riga City Council to create a new Action Plan Steering Group which must include representatives of the structures involved in development and implementation of the Action Plan. Members of REA Management Board, Advisory Board and Action Plan Steering Group do not receive any remuneration. In their turn the public organisations representing interests of various groups of society participate in promoting implementation of the Action Plan by concluding cooperation agreements with REA.
REA Management Board is chaired by the member of the Riga City Council, Chairman of the Housing and Environment Committee. The Deputy Chairman of the Management Board is also a member of the Riga City Council. The Management Board consisting of 11 members includes also a public administration representative of the energy sector, representatives of energy supply and service companies, representatives of energy consumers, as well as representatives of the scientific community and universities. The main task of the existing Management Board is to monitor whether REA's activities comply with the public interests. The Management Board will complete this task in February 2011 along with finishing the international project in relation to the establishment of REA. However, the Management Board is very appropriate for execution of the new task – monitoring of implementation of the Action Plan with participation of representatives from various group of society – therefore it is necessary to change its functions by retaining the composition of the Board.
REA Advisory Board consists of 16 leading national scientists in the energy sector and highly experienced experts in sectors of energy supply and housing. The main task of the Advisory Board is to propose to REA high-quality solutions for technical matters. These functions are to be retained in order to ensure the quality of management for implementation of the Action Plan.
In order to ensure the monitoring related to implementation of the Action Plan creating a certain workload, taking into account the instructions in the EU guidelines for implementation of the Action Plan which suggest one employee per 100,000 residents for this purpose, it is necessary to increase the existing number of REA's full time employees (5 persons) by recruiting 3 energy inspectors who would be responsible for systematic, regular and targeted evaluation of the energy efficiency situation by making observations, listing measures, carrying out necessary measurements and conducting data analysis. Responsibilities of energy inspectors would include also establishment of a register of local renewable energy installations in the territory of Riga municipality.

According to the commitments under the Covenant of Mayors of European cities REA shall draft and submit to the Riga City Council and Covenant of Mayors Office (in Brussels) a Progress Report on implementation of the Action Plan at least once every two years.

Table 5.1.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To draft and adopt decisions of the Riga City Council and other regulatory acts on establishment of a management system for implementation of the Action Plan in Riga municipality	2010	Riga City Council, REA, cooperation partners	

2. To draft the annual Progress Report on implementation of the Action Plan for submission to the Riga City Council and Covenant of Mayors Office	Every year from 2011 to 2021	REA, cooperation partners	
3. To ensure optimal staffing of REA by recruiting 3 energy inspectors in addition to the current number of employees in order to ensure monitoring of the Action Plan	2011	Riga City Council, REA	

6. Public involvement in implementation of the Action Plan

One of the basic conditions that Riga City undertook to fulfil by signing the Covenant of Mayors of European cities is to involve the civil society of the city in drafting and implementation of the Action Plan. Riga City Council has also signed a Memorandum with non-governmental organisations ensuring transparent city administration involving residents. In sectors of energy supply, energy efficiency and renewable energy these conditions are largely complied with by communication and activities carried out by REA within the framework of its functions. It can take several different forms.

The main of these forms is establishment of long-term cooperation with different interest groups represented by societies and associations of residents and professionals and other uniting organisations relating their activities to supporting and implementing energy supply, energy efficiency and renewable energy measures (including the Baltic Environmental Forum (BEF), Latvia's District Heating Association (LDHA), Latvian Apartment Owners Association, Latvian Chamber of Commerce and Industry (LCCI), Coalition for Gender Equality in Latvia, Cooperation Network of Latvian Non-governmental Organisations of Women, etc.) by involving these organisations in information exchange, consultations, working groups, structures for monitoring project management and in development and implementation of joint projects.

Raising awareness of unorganised groups of residents and their involvement is ensured in every way directly and by using information technologies (IT).
The main of these measures is to create and ensure REA's website www.rea.riga.lv available to interested parties and to publish there all information including REA's news and information on activities in the sectors of energy efficiency and renewable energy sources.

When addressing residents on significant issues regarding energy efficiency and use of renewable energy, it is very important to use information leaflets published by REA on its website and in other specialised portals, as well as distributed in paper form in gathering places for residents – in Visitors' Reception Centre of the Riga City Council, in waiting premises of the Visitors' Reception Division of the Housing and Environment Department, at seminars, conferences, discussion clubs and specialised exhibitions available to residents. Information leaflets are also handed over to structures dealing with residents – different associations and societies, administrators of multi-apartment houses, etc. Residents can receive them also through direct consultations for which they visit REA. So far the following 5 information leaflets have been published:
1. How dwellers can reduce heating costs?
2. How dwellers can prepare for starting house renovation.
3. Heat energy tariffs are rapidly increasing – what to do?
4. How to draft an application for house renovation in 2010?

5. Heat pumps with thermoprobes installed by deep drilling in the Riga educational establishment “Kastanītis” in 2010.
So far many thousands of copies of these information leaflets in paper form have been distributed.

Another way to involve residents is their participation in open thematic seminars and discussion club events where different issues in relation to energy efficiency, house renovation and use of renewable energy sources are discussed. Therefore in 2009 alone, REA organised seminars “Energy efficiency measures in sector of energy supply and energy utilisation” and “Possibilities for utilisation of renewable energy sources in the power supply system of the city”, as well as it participated in the seminar “Improvement of heat insulation of multi-apartment residential buildings” and others with its own presentations and handout materials. REA's Energy Efficiency Information Centre has organised already five discussion club events on the following issues:

1. Technical solutions for renovation of ventilation systems in multi-apartment residential buildings and their energy savings potential;
2. Impact of technical solutions for insulation of enclosing structures on utilisation of buildings;
3. Renovation of internal heating systems of buildings. Technical solutions for control and calculation of energy consumption in apartments;
4. Technical solutions for insulation of flat roofs;
5. Technical solutions for increasing the energy efficiency of windows.

Both issues discussed in seminars and in the discussion club are closely related to the Action Plan and reflected in the measures included therein.

In order to provide residents with regular consultations and ensure direct communication thus raising their awareness of building renovation and energy efficiency matters, the issue on premises and related equipment necessary for operation of the Energy Efficiency Information Centre must be solved. It is envisaged also by the international project for establishment of REA.

An efficient model for cooperation with the public is organisation of thematic campaigns. REA has organised its annual campaigns on house renovation by attracting all kinds of public media and cooperation partners, as well as it has been actively participating in the national campaign organised for the first time in relation to house renovation in 2010 by attracting financial resources from the Structural Funds.

Addressing different groups of society and involving them in energy efficiency and renewable energy measures is successfully dealt within the framework of Energy Days which the municipality has committed to organise by signing the Covenant of Mayors of European cities. In 2009, REA organised Energy Days in Riga for the first time. A fundamental measure organised at the same time when Riga Energy Days are opened is the international exhibition of energy efficiency and environmental technologies “Environment and Energy” in the Ķīpsala International Exhibition Centre. Also the Environmental Forum and main thematic seminars, as well as local seminars in the exhibition hall and roundtable discussions take place during the exhibition at the same venue. Within the framework of Energy Days related events – conferences and seminars – are organised for different interest groups also in other venues in the city. Energy Days last for several weeks and are concluded with the Energy Forum.

Table 6.1.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To organize annual Riga Energy Days by expanding activities and involving new cooperation partners while putting the main emphasis on issues of implementing the Action Plan	2010–2020	REA, cooperation partners	Annually, in October – November
2. To participate in supporting organisation of the international exhibition “Environment and Energy”, set up an exhibition stand “Riga Energy Agency” and ensure its active operation	2010-2020	REA	Annually, in October
3. To solve the issue on premises and related equipment necessary for the REA's Energy Efficiency Information Centre. To ensure accessibility of the Energy Efficiency Centre for residents.	2010–2020	Riga City Council, REA	

7. Financial instruments and financial amounts for implementation of measures under the Action Plan

7.1 EXISTING AND POTENTIAL FINANCIAL INSTRUMENTS FOR IMPLEMENTATION OF THE ACTION PLAN

7.1.1 EU Structural Funds and Cohesion Fund

The existing EU Structural and Cohesion Funds are established for the period 2007–2013 for integration of different regions and infrastructure in particular the transport sector including the following:

The European Social Fund (ESF) is oriented towards increasing the competitiveness of residents and their adaptation to the labour market, as well as elimination of all kinds of discrimination, cooperation in the area of reforms, etc.

The European Regional Development Fund (ERDF) supports closing the gap in regional development within the framework of the EU, promotes public and private partnership. This fund provides support to establishment of international networks in the energy sector, measures for environmental protection, improvement of air quality, energy efficiency and use of renewable energy sources.

Cohesion Fund (CF) supports solving of environmental issues and establishment of transport networks in Europe including networks of road, rail, river and sea, as well as air transport. The fund promotes measures that are considered necessary for mitigating environmental changes including increase in energy efficiency and use of renewable energy sources.

The three following initiatives have been developed for EU Structural and Cohesion Funds to support implementation in the period 2007–2013:

- **JASPERS –** joint cooperation of the EU, European Investment Bank (EIB) and European Reconstruction and Development Bank (ERDB) to support regional projects using the aforementioned funds. The support provided by JASPERS is mainly oriented towards transport networks including urban public transport, waste water treatment and solid waste projects, investments in projects of energy efficiency and renewable energy sources, large urban development projects, etc.
- **JEREMIE** - Joint European Resources for Micro to Medium Enterprises. The support is provided by the EU together with the EIB and the European Investment Fund (EIF).
- **JESSICA** - Joint European Support for Sustainable Investment in City Areas implemented by the EIB and the Council of Europe Development Bank (CEB). JESSICA is open to cooperation with users of Structural Funds and is ready to provide expert services for project assessment, as well as loans for investments oriented towards sustainable urban development including establishment of social houses.

Projects are supported also by the international KfW (Kreditanstalt für Wiederaufbau) banking group from Germany.

In Latvia, management (administration, work organisation) of Structural and Cohesion Funds in sectors of energy and house renovation is ensured by the Ministry of Economics issuing respective calls for project applications. For example, in 2009 project applications on the following issues related to energy efficiency were accepted:

1) Activity **“Improvement of Heat Insulation of Multi-apartment Residential Buildings”** under the Operational Programme “Infrastructure and Services”. In 2009, 8 calls for applications were issued. The funding from the Structural Funds is expected to cover 50 % of eligible costs in the sector of house renovation or 60 % if at least 10 % of the building's apartment owners have been granted status of a low-income person. Eligible costs of house renovation shall include conducting of energy audits, preparation of the building's technical assessment, development of a technical design, construction supervision, insulation and replacement of the building's enclosing structures, insulation of the basement's covering, repairs of staircases if works for increasing energy efficiency are carried out, renovation of the heating system, renovation or reconstruction of the ventilation system, restoration of the building's structural parts if envisaged in the energy audit, as well as other renovation works envisaged in the energy audit.

Starting from the 8th call, also in 2010 applications will be accepted continuously as long as there is sufficient funding within this programme.

2) Activity “Development of Cogeneration Power Plants Utilising Renewable Energy Sources” under the Operational Programme “Infrastructure and Services”. AS “Rīgas siltums” has submitted an application for the project “Construction of a biofuel cogeneration power unit with electrical capacity of 4 MW at the HP “Ziepniekkalns” for which an approval and co-funding for eligible costs have been received.

3) Activity “Measures to Increase the Efficiency of District Heating Systems” under the Operational Programme “Infrastructure and Services”. JSC “Rīgas siltums” has submitted to the aforementioned activity an application for the project “Replacement of water heating boilers at the HP ‘Vecmīlgrāvis’” for which it received co-funding from the Cohesion Fund in the amount of 30 % (LVL 374,653.84) of the project's eligible costs, as well as an application for the project

"Reconstruction of the main M-14 of the district heating networks in the section from k-14-5a to K-14- 15" for which it received co-funding from the Cohesion Fund in the amount of 25 % (LVL 604,072.50) of the project's eligible costs.
5) Activity "Improvement of Heat Insulation of Social Residential Buildings". Riga municipality has submitted proposals to this activity, the funding has been received, and in 2009 one social house was renovated. In 2010, acceptance of projects continues, and Riga municipality has already submitted applications for 3 social houses.

Table 7.1.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To monitor calls for tenders, draft and submit applications for co-funding from the Structural Funds according to the topics of tenders	2010–2020	Institutions of the Riga City Council, cooperation partners	

7.1.2 Green investment schemes

Green Investment Schemes (GIS, in Latvian – ZIS) is a global international measure oriented towards reduction of greenhouse gas emissions by compensating emissions of these gases in one location with implementing certain measures for reduction of gas emissions in another location. The principles of this compensation mechanism have been set forth by the Kyoto Protocol, and they are based on the stipulated sales to industrial countries of CO_2 emission allowances formed by considerably reducing these emissions within a certain period of time and existing at the disposal of individual countries. Funds obtained as a result of selling these allowances are to be used only to implement measures for CO_2 emission reduction which is stated in the contract of sale, and the buyer of allowances is responsible for monitoring whether the measures planned to be implemented by using funds obtained from sales of allowances are actually carried out and whether the volume of emissions is actually reducing.
Latvia also has such CO_2 emission allowances as set forth by the EU which have formed after 1990 along with the collapse of industry that was inflated during the Soviet years. Sales of allowances were commenced in 2009 by establishing a financial instrument within the framework of the Kyoto Protocol's flexible mechanisms that is managed by the Ministry of Environment. The operation of the new financial instrument is regulated by the Law "On Participation of the Republic of Latvia in the Flexible Mechanisms of the Kyoto Protocol", and it is envisaged for implementation of measures particularly in municipalities.
Already in 2009, after the first sales transaction of allowances a call for project applications on renovation of buildings owned by municipalities was launched. Riga city submitted applications for 21 school buildings and received funds necessary for their renovation in the amount of LVL 4 million (as co-funding for 80 % of eligible costs of renovation).

In 2010, the aforementioned financial instrument is expanding its operation by envisaging launching >10 various calls for project applications, out of which project tenders on the following topics have already been launched:

- Development of technologies for reduction of greenhouse gas emissions;
- Increase of energy efficiency in municipal buildings (1st round);

- Increase of energy efficiency in the buildings of higher educational establishments;
- Complex solutions for reduction of greenhouse gas emissions in production buildings.

The following project tenders are to be expected:

- Complex solutions for reduction of greenhouse gas emissions in municipal buildings (2nd round for municipal buildings);
- Support to technology transition from fossil to renewable energy sources;
- Use of renewable energy sources in the transport sector;
- Use of renewable energy sources for reduction of greenhouse gas emissions;
- Use of renewable energy sources in the household sector;
- Pilot projects for buildings with low heat consumption;
- Improvement of public awareness on importance and possibilities of reducing greenhouse gas emissions;
- Improvement of awareness in educational establishments on activities for prevention of climate change and reduction in greenhouse gas emissions.

Drafting of project applications for new tenders continues in Riga municipality, among others envisaging the elimination of coal-fired boiler houses in 8 school and pre-school educational establishments by replacing them with modern heating installations, as well as other measures.

Table 7.2.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To draft and submit an application for co-funding provided by the financial instrument of the flexible mechanisms under the Kyoto Protocol for elimination of coal-fired boiler houses in school and pre-school educational establishments	2010-2011	Property Department of Riga City Council	8 school and pre-school educational establishments (see Table 3.15)
2. To draft and submit an application for co-funding provided by the financial instrument of the flexible mechanisms under the Kyoto Protocol for development of a demonstration project involving social houses of Riga by installing solar collectors on their roofs for hot water production	2010-2011	REA, cooperation partners	
3. To draft and submit an application for co-funding provided by the financial instrument of the flexible mechanisms under the Kyoto Protocol for complex solutions to reduce greenhouse gas emissions in municipal buildings (2nd round for municipal buildings)	2010-2011	Property Department of Riga City Council	

4. To draft and submit an application for co-funding provided by the financial instrument of the flexible mechanisms under the Kyoto Protocol for a pilot project on buildings with low heat consumption	2010-2011		
5. To draft and submit an application for co-funding provided by the financial instrument of the flexible mechanisms under the Kyoto Protocol for use of renewable energy sources in the transport sector	2010-2011	Transport Department of Riga City Council	
6. To monitor preparation and launching of project tenders, to notify cooperation partners about these tenders and to participate in drafting of project applications	2011-2013	REA, cooperation partners	

7.1.3 National programmes for funding energy efficiency measures

In 2009, the state aid programme (Regulations No. 59 issued by the Cabinet of Ministers on 05/08/2008) “Regulations regarding the Amount of Co-funding from the State Budget and the Procedures for the Granting thereof for Energy Efficiency Measures in Residential Houses” started its operation, and it is managed by the Ministry of Economics and envisages co-funding in the amount of 80 % for energy audits of multi-apartment houses, preparation of technical surveys and technical designs, as well as co-funding in the amount of 20 % for the completed renovation works. Applications will be accepted continuously in 2010, as long as there is sufficient funding within this programme. The total funding under this programme is LVL 698,034. See the applications submitted by Riga city to this programme in the sub-section 3.2.3.1 “Extent of multi-apartment house renovation” of the Action Plan.

7.1.4 Revolving fund

A revolving fund is a long-term financial instrument established for implementation of investment projects by ensuring funding for projects mainly in the form of a loan (in some cases - in the form of a grant) with low to zero interest rates. The funding is granted to projects with guaranteed returns (mainly for increasing energy efficiency in residential buildings) and not-too-distant crediting periods using again the repaid amounts for crediting of next projects. Repayment of the loan starts after completion of the project when certain financial savings already occur. A revolving fund can be established as a separate account (for example, in a municipality) or a separate structural unit (for example, at national level). Funds are created by donors envisaging contributions in forms of grants, subsidies, loans or other investments with returns. Loans are granted for a specified time period with a fixed rate and by determining certain amount and frequency of repayment.

An illustrative example of a revolving fund's operation at national level is the solutions in Estonia and Lithuania existing since 2009 where in addition to finances of the government also long-term loans with low interest rates provided by the Structural Funds and international banks are attracted.

In Estonia, the revolving fund is managed by "KredEx" with a fixed rate of 4.8 % for 10 years by granting loans via local banks for a period up to 20 years. In its turn, in Lithuania loans are granted for a period of 15 years with an interest rate of 3 %.

Taking into account the situation of severe economic crisis and the large international loan burden, establishment of a revolving fund in Latvia at national level is unlikely. To ensure renovation of multi-apartment houses in Riga and develop a stable and safe crediting system for residents the lack of which has been delaying this process so far, it is necessary to establish a revolving fund in Riga municipality. Management of a revolving fund can be ensured by the Finance Department by opening a separate account. Also other solutions are possible, for example, setting up an earmarked credit line through one of the local banks according to the Estonia's example; however, in this case it must be taken into consideration that the loan interest rate may be higher.

Scheme of establishment and functioning of a revolving fund:

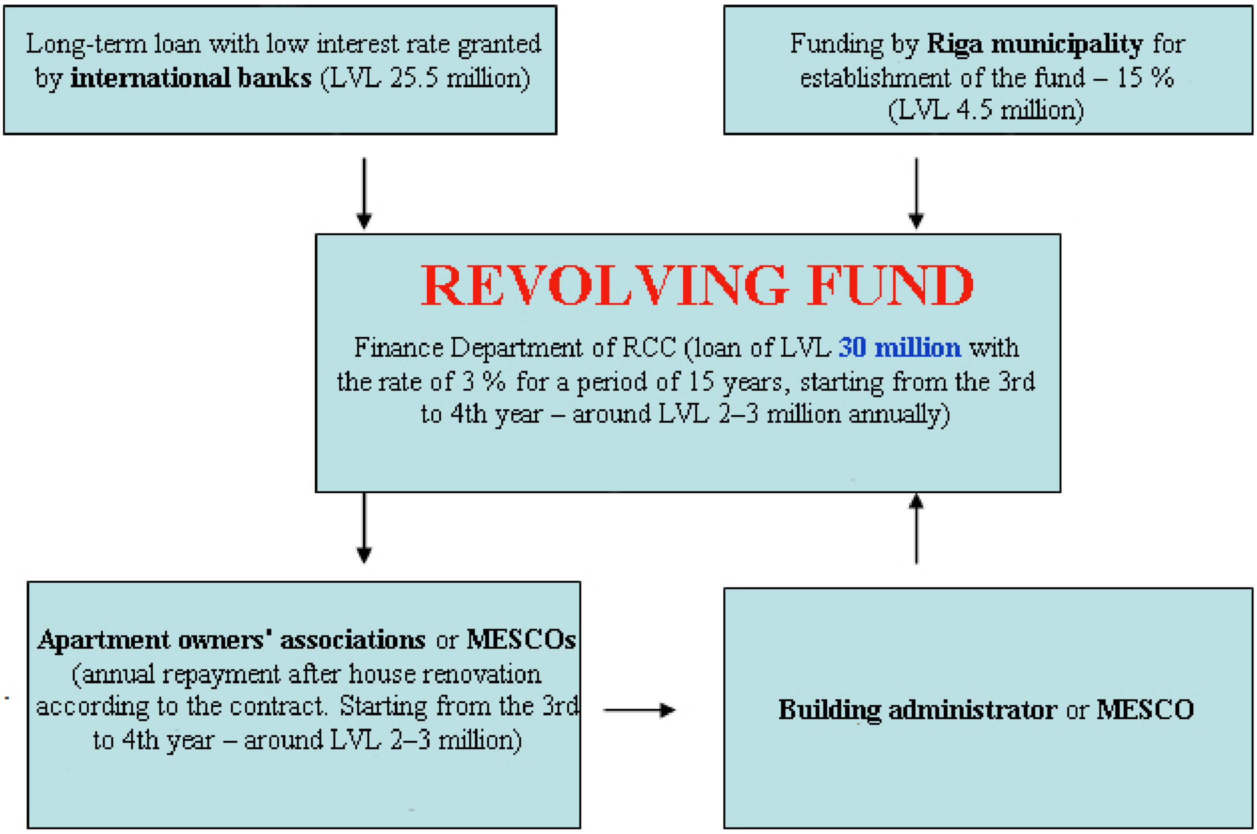


Figure 7.1.

The scheme shows an example when a revolving fund of LVL 30 million is established. The loan is taken by either an apartment owners' association using the loan to cover its co-funding share in house renovation or a municipal energy service company (MESCO) using the loan for the same purpose, and attracting funds in the form of a grant from the Structural Funds or another financial source to cover the other co-funding share. In the case of MESCO when the repayment is based on the contract concluded by MESCO by retaining the previous rate of payment for heat and building management, the loan may be repaid also over a time period shorter than 15 years.

The following are the potential risks of managing a revolving fund:
1) Choice of low-quality or inadequate materials for house insulation or poor quality of works thus failing to ensure the expected energy savings and sufficient financial savings for apartment owners due to reduction in energy consumption that are envisaged for repayment of the loan provided by the revolving fund. The risk can be prevented by ensuring participation of a certified construction supervisor in the renovation process.
2) Insolvency of those apartment owners who have pledged their apartments to banks. By seizing these apartments the banks do not assume the obligations to pay the previously accumulated debts on apartments. To reduce the risk, the building administrator must carefully monitor payments for public utilities and not allow accumulating debts for longer than 2–3 months. However, if it happens, and the owner of such apartment avoids payment after a reminder, legal proceedings must be initiated. If the legal proceedings are initiated before the bank seizes this apartment, it is possible to recover the debt.

Table 7.3.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To establish a municipal revolving fund for renovation of multi-apartment residential houses	2010-2011	Riga City Council, Finance Department, REA	Considering the number of houses to be renovated – at least LVL 30 million

7.1.5 Third-party funding schemes

7.1.5.1 Leasing

Leasing is a financial service as a result of which a lessor transfers to the lessee (within the framework of this document – to residents) rights to use a leasing object in exchange for payments stipulated in the contract. The process of leasing is mainly used for purchase of equipment. The provider of leasing services uses either its own funds or loan resources for purchase and installation of equipment by concluding a contract with the customer stipulating the amount, deadline and frequency of repayment. In Latvia, lessors offer to their customers 3 types of funding through leasing – financial leasing (lease with redemption rights), operational leasing (only lease) and full service leasing (a lessee can use not only the leasing object, but also other advantages ensured by the lessor).
Leasing is an attractive alternative to forming financial reserves that allows achieving fast energy savings by making gradual payments over a longer period of time. After making the final payment the ownership of equipment is fully transferred to a customer.
An illustrative example of a leasing service for increasing energy efficiency in Riga is the installation of individual automated heat substations (ISM) in multi-apartment residential buildings connected to the district heating system, which was organised by the municipality and carried out from 1998 to 2008. Responsibilities of a leasing service provider were undertaken by the main heating organisation of the city – JSC "Rīgas siltums" by using a bank loan, organising beneficial purchases of large batches of equipment for a lower price and ensuring installation or replacement

of heat substations. The leasing repayment procedure was set forth by Riga City Council by envisaging monthly payment of 2.5 santims/m2 until the equipment had been paid off over a period of 6–10 years. Currently, most of 8,036 substations installed in the city have been completely paid off.

7.1.5.2 Energy service companies

An energy service company (ESCO) is a type of business which provides a wide range of energy-related services, including implementation of energy saving projects, provision of energy infrastructure outsourcing services, production and supply of energy, as well as risk management. ESCO contributes to renovation of real estate properties which cannot be funded by the municipality. As the ESCO is financially interested in reaching the best possible energy efficiency indicators, its operation does not pose any risk to the municipality. As a result of renovation of residential houses carried out by ESCO, the city is provided with an improved urban environment with restored housing stock, but the residents – with renovated real estate the market value of which has increased. For this reason, ESCO is a broadly-used initiative in the EU. ESCO can be a company or a group of companies of any industry with free financial resources and possibilities to guarantee loans with low interest rates, as well as an interest to operate in the field of energy efficiency.

ESCO performs in-depth analysis of real estate in order to identify the most rational energy efficiency solution, as well as carries out renovation and maintenance of real estate during the period for recovering the invested funds which can vary from 5 to 20 years. ESCO recovers funds from the difference resulting from implementation of energy efficiency measures. In order to ensure a successful and mutually beneficial cooperation ESCO concludes a fixed-term agreement with the recipient of the service (for example, represented by a residential house apartment owners' association) throughout the duration of which the ESCO assumes all of the obligations related to preparation, funding and implementation of energy efficiency measures, as well as guarantees the expected energy efficiency result and ensures management of the site for the term of the agreement. At the end of the contract, all benefits derived from the renovation have to be transferred to the recipient of the service – the residents.

When concluding ESCO agreement, two options can be used:

1) As a consequence of the agreement, the service provider yields a certain interest from the funds saved throughout the duration of the agreement. It encourages the service provider to achieve the greatest possible savings immediately following the project implementation and maintain it even up to the end of recovery period or termination of the agreement, even increasing the savings by carrying out additional measures.

2) As a consequence of the agreement, residents make a fixed monthly payment per square metre according to the living area.

Two private ESCOs are operating in Latvia – company LTD "Sun Energy Baltic", a subsidiary of the Dutch ESCO group covering the territory of Latvia (currently excluding Riga), and LTD "LATIO" transforming its operations for this work from real estate sector. Various companies have shown certain interest in obtaining information required for operation of an ESCO and starting an ESCO in Latvia, therefore this model for funding of renovation looks promising. Taking into account the large number of houses to be renovated, at least 5–6 ESCOs could simultaneously operate in Riga.

Table 7.4.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To support establishment and operation of private ESCOs in renovation of Riga's multi-apartment residential houses	2010-2020	Riga City Council, REA, cooperation partners	

7.1.5.3 A model for establishment of a municipal energy service company

A municipal energy service company (MESCO) is a company owned by the municipality which is operating according to the ESCO principles and using both financial resources of the municipality and other attracted funding, including from a revolving fund. This practice was mainly used by the German local governments to ensure renovation process. The main objective of a MESCO is not making the maximum possible profit, but improvement of the housing stock of the city and increasing its lifetime, while using the accrued profit to fund its own operations, as well as reducing the amount of expenditure which the municipality and residents have to further provide for maintenance of their property. A considerable advantage of this model is that a MESCO can also ensure renovation of buildings which are outside the scope of the ESCO interests, since these buildings generate less profit.

Municipal company which has experience in organising construction works and supervising them, and in management of multi-apartment buildings can be used as the basis to establish a MESCO, with a prerequisite that residents have confidence in this company. There are only a few such companies with appropriate experience and a positive reputation in Riga - LTD "Rīgas pilsētbūvnieks" and LTD "Juglas nami" can be mentioned among them. A prerequisite for introduction of a MESCO in Riga to ensure funding is establishment of a revolving fund (see Section 7.1.4).

Table 7.5.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Establishment of a municipal energy service company (MESCO)	2010-2011	Riga City Council	

7.1.5.4 Public and private partnership

Public and private partnership (PPP) is a public-private cooperation which is characterised by the following:

a) the cooperation is ensured between one or several public partners and one or several private partners involved in the public and private partnership procedure to meet public needs when carrying out construction works or rendering services;

b) it is a long-term cooperation which can last up to 30 years, or even longer, if the law prescribes so;
c) the public and private partner pools and uses resources available to them (for example, property, financial resources, knowledge and expertise);
d) responsibility and risks are shared between the public partner and the private partner.

In Latvia, the public and private partnership is regulated by the Public–Private Partnerships Law which is in effect since 1 October 2009.

The municipality mainly uses concession method in the PPP model in order to ensure effective cooperation with the private partner. Using this method the private partner can recover the investments made in the site in a most efficient way. So far, PPP is successfully used in Latvia in the projects of the EU Structural Funds and Cohesion Fund regarding introduction of renewable sources of energy.

The PPP can take different forms in the energy and utilities sectors – in the form of concession, joint venture, as well as a DBFO (i.e., Design-Build-Finance-Operate) model. An example in Riga – the district heating operator JSC "Rīgas siltums" which is a joint venture owned by the state, municipality, state-owned JSC "Latvenergo" and private company "DALKIA".

7.1.6 Own funding

Own funding is formed from financial reserve for repair works. It concerns both companies and also apartment owners' associations. Therefore, for example, since 1996 JSC "Rīgas siltums" has been doing rather large amount of work in renovation of transmission pipelines by use of funds provided for in the heat rate for repair works, thus significantly reducing losses in transmission pipelines and increasing energy efficiency in transmission of heat. A similar example in the management of houses is LTD "Juglas nami" which in 2009 started insulation of the end walls of 20 multi-apartment houses by use of reserves accrued from payments of residents for house repair works, thus ensuring fall in consumption of heat in these buildings. Although it has to be noted that, if only own funding is used, important results can be achieved only over a long period of time. As regards the housing stock, such period could be also critical, for it fosters reduction of lifetime of the house.

7.1.7 Aid programme ELENA to prepare for implementation of measures

ELENA is the new EU's programme IEE II developed in 2009 to render technical and financial assistance for local governments which have signed the Covenant of Mayors of European cities (but not limited to that) in faster implementation of their investment programmes regarding renewable energy sources and increasing energy efficiency to meet the 20-20-20 commitments.
The programme ELENA covers 90 % of eligible expenditures for preparation of a clearly defined, specific investment programme. The eligible expenditures include all types of technical support measures required for the specific investment programme – feasibility and market studies, structuring of the programme, drafting of business plans, energy audits, preparation of procurement procedures and contracting, formation of project implementation groups. Costs incurred by the newly recruited staff carrying out this work – actual salary, social security payments and other costs, also form part of the eligible expenditure. As well as VAT, if it can be proved that the grant

recipient cannot reclaim this tax. Nevertheless, eligible expenditure excludes procurements of measurement equipment and computers or costs related to office premises.

Aid from ELENA can be received for preparation of the following investment programmes:
1) Renovation of the publicly owned houses, as well as social and private houses, as well as introduction of efficient air conditioning and ventilation systems, and lighting systems;
2) Energy-efficient street lighting;
3) Integration of renewable energy sources in construction, for example, installation of solar panels on walls, installation of solar collectors on buildings, use of biomass in the local production of heat;
4) Renovation, expansion of the obsolete heating and cooling networks, or construction of new networks which will promote development of cogeneration;
5) Investments in the city's transport sector related to increasing of energy efficiency or use of renewable energy sources;
6) Urban infrastructure related to improvement of energy-efficiency of information and communication technologies, modal transport schemes and use of an alternative fuel for vehicles.

The goal of ELENA is to render support to large-scale programmes (approximately EUR 50 million); however aid can be provided also to smaller projects, if they are grouped under a larger investment programme. When submitting an application for aid under ELENA, investments do not have to be finally set yet. If the funding for the agreed investments in implementation of measures can be obtained from other financial instruments, the applicant has to provide justification as to why exactly the aid from ELENA is the most appropriate one. An important provision of ELENA is a minimum leverage factor of 25 meaning that the amount of grant awarded is not larger than 1/25 of the agreed investments in the programme. If this leverage will not be obtained during the implementation of the programme, then the received grant will have to be recovered in part or in full. Applications for aid from ELENA are accepted as long as enough funds are available for this purpose.

Table 7.6.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. To prepare and submit an application for co-funding in the amount of 90 % under the ELENA programme: 1) To conduct energy audits of Riga's multi-apartment houses, prepare technical surveys and technical designs for these houses, and draw up documents for submission of applications for renovation of houses, and even conclude agreements; 2) To prepare for large-scale installation of solar batteries and collectors on buildings; 3) To prepare for introduction of efficient street lighting; 4) To prepare for introduction of electric cars and their infrastructure in the transport system of the city.	2010-2011	Riga City Council, REA, Riga Municipality Agency “Rīgas gaisma”, Transport Department of RCC, cooperation partners	

7.2 FINANCIAL AMOUNTS REQUIRED FOR IMPLEMENTATION OF THE ACTION PLAN

In order to ensure implementation of the key measures of the Action Plan the following financial amounts are required, assessing the costs according to the post-2010 economic situation:
Table 7.7.

Measure	Implementation time	Responsible for implementation	Funding required, millions of LVL	Potential source of funding
1. Complex renovation of 6,000 multi-apartment houses (see Note 1)	2009-2020	Apartment owners' associations, authorised persons	615.0	Reserves, Structural Funds, loan resources, revolving fund, national and municipality aid measures, ESCO, MESCO.
2. Energy audits of 6,000 multi-apartment houses (see Note 2)	2009-2020	Apartment owners' associations, authorised persons	2.4	National and municipal aid measures, own funding
3. Complex renovation of municipal educational establishments in Riga	2009-2020	Property Department of the Riga City Council	55.0	Funding from the flexible mechanisms of the Kyoto Protocol, budget of the municipality
4. Liquidation of coal-fired boiler houses at 8 educational establishments of Riga municipality along with insulation works	2011-2015	Property Department of the Riga City Council	2.5	Funding from the flexible mechanisms of the Kyoto Protocol, budget of the municipality
5. Renovation and construction of social houses in Riga city	2007-2020	Riga City Council	30.0	Structural Funds, budget of the municipality

6. Conducting energy audits of administrative buildings of the Riga City Council and their energy certification	2014-2015	Riga City Executive Board	0.05	Budget of the municipality
7. Renovation of lighting system in the city streets and parks	2010–2020	Riga Municipality Agency "Rīgas gaisma"	2.0	Structural Funds, budget of the municipality
8. To set up a network of charging stations for electric cars and hybrid cars in Riga city	2011–2020	JSC "Latvenergo"	10.0	Structural Funds, funding from AS "Latvenergo", budget of the municipality
9. Purchase and use of 5 electric or hybrid cars by municipal institutions of the city – a pilot project	2011-2015	Riga City Council, LTD "Rīgas satiksme"	0.125	Structural Funds, budget of the municipality
10. Introduction of electric and hybrid cars in the city's public transport	2015-2020	Riga City Council, LTD "Rīgas satiksme"	5.0	Structural Funds, budget of the municipality
11. Development and implementation of a pilot project for a cogeneration plant using hot dry rock energy with capacity of 3–4 MWel/30–40 MWth (see Note 1)	2011-2020	REA	25.0	Funding from international funds, co-funding from economic operators
12. Development of demonstration objects for installation of solar collectors on the roofs of social houses to ensure that they operate together with the district heating system	2010-2011	REA	0.38	Funding from the flexible mechanisms of the Kyoto Protocol, co-funding from economic operators

13. Development of demonstration object for installation of solar batteries (PV) on the roof of a municipal building to ensure that it operates together with the district heating system	2011-2012	REA	0.2	Funding from the flexible mechanisms of the Kyoto Protocol, co-funding from economic operators
14. A pilot project for building with low heat consumption (see Note 3)	2010-2011		2.25	Funding from the flexible mechanisms of the Kyoto Protocol, budget of the municipality, etc.

*) Notes:
1) Implementation depends on the amount of available funding and organisational support from the municipality.
2) Implementation depends on national and municipal support.
3) Implementation depends on possibilities for attraction of funding.

8. EU, national and municipal aid measures for implementation of the Action Plan

EU aid measures

There are European Union directives in effect, part of which are being amended and supplemented to incorporate the new EU initiatives (commitments in the Covenant of Mayors of the European cities, construction of "passive" houses, and renovation of houses to match the level of "passive" houses, etc.). Considering over 1,600 proposals for actions in European cities in order to meet commitments stipulated in the Covenant of Mayors by 2020, these proposals will introduce new initiatives which will be further incorporated in the EU legal documents.
By 2013, the existing financial aid mechanisms are in place – Structural Funds for investments in the form of grants, other EU Funds for support of projects related to training and transfer of know-how, etc. One of the main EU aid programmes launched in 2009 – ELENA (see Section 7.1.7). The new financial EU programming period will start in 2014, and new aid mechanisms will be developed.

National aid measures

Due to effects of the economic crisis, there are very limited options for involvement in carrying out measures supporting implementation of local Action Plans through national aid and programmes. At the moment a state-funded programme is being carried out on energy efficiency measures in residential houses, and within the framework of this programme owners of apartments can apply for co-funding for energy audits of multi-apartment houses, preparation of technical surveys and technical designs, although funding allocated to the programme is rather small – LVL 698,034.

In the first half of 2010, using the Structural Funds the Ministry of Economics together with the Construction, Energy and Housing State Agency (BEMA), and in close cooperation with the private partners – industry associations, companies, local/regional energy agencies and non-governmental bodies, organised an informative campaign with the slogan "Live warmer" to support renovation of multi-apartment houses. In order to strengthen this co-operation a memorandum of cooperation was signed, REA was among the signatories.
National aid measures will be set forth in the National Sustainable Energy Action Plan to be drafted in 2011.

Municipal aid measures for implementation of the Action Plan

So far, in order to support energy efficiency in Riga city, programmes have been prepared and funds have been allocated for investments only in the public sector of the municipality, including for: installation of the automated heat substations in the educational establishments and other municipal buildings; renovation of educational establishments and replacement of their windows; dismantling of coal-fired boiler houses at educational establishments; modernisation of lighting in the city streets; construction of bicycle lanes, social houses, and city bridges and bypasses, etc. In the recent years, funds from the municipal budget are earmarked each year for renovation and reconstruction of educational establishments which is evidenced by the amount of work done (see Section 3.2.4 of the Action Plan).

The first time the municipality rendered financial aid to residents for renovation of multi-apartment houses was in 2008, when funds of the city's Development Fund were allocated to co-fund energy audits of multi-apartment houses. Energy audits were conducted in 21 multi-apartment houses, results and analysis of which were reflected in the brochure "Energy Audits of Dwellings – 2008" (see www.rea.riga.lv). In 2008, REA participated with this topic in the event organised within the framework of the Sustainable Energy Europe Campaign 2005-2008 (in Brussels) and received a partnership statement from the DG Energy & Transport of the EU.

According to the legislation, the municipality can provide aid for renovation of residential houses by adopting respective binding rules. Apart from the said municipal aid measures (see Sections 5, 6, 7.1.4, 7.1.5.3, etc. of the Action Plan), from which the most important ones are establishment of a revolving fund and municipal energy service company (MESCO) in support of renovation of multi-apartment houses, additional aid measures are required which can bring about an incentive effect on complex renovation on multi-apartment residential houses and use of renewable energy sources in households, including:

1) Provision of co-funding to conduct energy audits during the period when other sources of funding do not provide such co-funding;
2) Land (property) tax allowances (reduction) for the renovated multi-apartment houses for a period set for repaying the loan;
3) Coverage of the co-funding payment of low-income residents from the social funds of the municipality during the period, when owner of an apartment has acquired the status of a low-income person;
4) Reduction of land (property) tax up to 50 % for households in proportion to the share of use of renewable energy sources (measurable) in the total energy consumption in households.

Table 8.1.

Action Plan			
Measure	Implementation time	Responsible for implementation	Extent of implementation
1. Preparation and adoption of the binding regulations of Riga City Council to support complex renovation of multi-apartment houses and encourage use of renewable energy sources in households	2010-2011	Riga City Council (RCC), REA, respective departments of RCC	

9. Legislative and regulatory documents required for implementation of the Action Plan

In order to ensure implementation of the Action Plan the following key legislative acts have to be drafted and adopted:

Table 9.1.

Area in which the legislative act or regulatory document has to be drafted	Deadline	To be drafted by	Notes
Laws, and regulations of the Cabinet of Ministers (the Cabinet)			
1. Law on Renewable Energy Sources	2010	Ministry of Economics	REA participates in preparation of the draft law
2. Cabinet Regulations related to the Law on Renewable Energy Sources	2011-2012	Ministry of Economics	REA participates in evaluation of the Cabinet Regulations
3. Cabinet Regulations related to state aid for renovation of residential houses	2010-2020	Ministry of Economics	REA participates in evaluation of the Cabinet Regulations
4. Cabinet Regulations related to use of Structural Funds to increase energy efficiency and to support use of renewable energy sources	2010-2020	Ministry of Economics	REA participates in evaluation of the Cabinet Regulations
5. Cabinet Regulations related to use of funding from the flexible mechanisms of the Kyoto Protocol to increase energy efficiency and to support use of renewable energy sources	2010-2020	Ministry of Economics	Participation of REA in evaluation of the Cabinet Regulations
6. To make amendments to legal and regulatory documents by introducing regulation appropriate for the level of energy efficient houses	Continuously	Ministry of Economics	REA suggests and participates in drafting of legislative acts

7. To draft regulatory documents on application of allocators and distance reading system of meters and procedure for calculation of related costs	2010-2012	Ministry of Economics	REA suggests and participates in drafting of legislative acts
Municipal legal framework			
1. On setting up of management system for implementation of the Action Plan	2010-2011	REA	
2. On establishment of a revolving fund	2010-2011	RCC	
3. On establishment of a municipal energy service company (MESCO)	2010-2011	RCC	
4. Drafting of regulatory documents for development and provision of uniform urban environment, including external decoration of buildings during the renovation of multi-apartment houses	2011-2012	City Development Department of RCC, Riga City Architectural Bureau, Riga City Construction Board	
5. Drafting of regulatory documents regarding conditions on land use in areas of the city territory for construction of low energy buildings	2015-2020	City Development Department of RCC, Riga City Architectural Bureau, Riga City Construction Board	
6. On introduction of electric cars and hybrid cars at municipal institutions	2015	RCC	
7. On energy audits of administrative buildings of the Riga City Council and their energy certification, as well as on display of the energy certification data in premises with certain flow of visitors	2014-2015	Riga City Executive Board	
8. On energy certification and classification of residential houses according to the energy audit data by putting a visual external marking on buildings	2014–2015	REA	
9. On municipal aid to residents for renovation of residential houses	2010	REA	
10. On municipal aid to residents to encourage use of renewable energy sources in households	2011	REA	

10. Criteria for assessment of progress in achieving the objectives of the Action Plan

When setting the intensity of CO_2 emission reduction for a specific period, the main criterion laid down is the ratio of the reduced volume of CO_2 emissions in tonnes, expressed as a percentage, against the volume of CO_2 emissions during the chosen base year.
Taking into account the specific situation in Riga, namely, the continuous decline in population and rather low standard of living with relatively low consumption of electricity in households during the period concerned, volume of CO_2 emissions per capita cannot be applied as a characteristic criterion.

The following is adopted as a criterion for assessment of implementation of energy efficiency measures:

1) production of additional energy per year in MWh, without combustion of fuel;
2) fall in consumption of energy in MWh per year;
3) extent of introduction of specific measures – % of the number of renovated buildings;
4) number of the renovated residential houses and public buildings in the city;
5) number of buildings in the city which have undergone energy audits;
6) electricity consumption savings from city lighting, % of the total consumption.

The following is adopted as a criterion for assessment of introduction of renewable energy sources:

1) share of biofuel used, % of the total fuel consumption in public road transport;
2) number of introduced electric cars and hybrid cars, and % of the total number of public road transport vehicles;
3) production of additional energy from renewable sources in MWh per year;
4) use of renewable energy sources for production of heat in the district heating system, % of the used volume of fuel (MWh) per year;
5) volume of energy in MWh produced from renewable energy sources per year;
6) number of heat pumps installed in the city for local heating;
7) number of buildings in the city on which solar collectors and solar batteries have been installed.

It has to be noted that it is not possible to accurately record the volume of renewable energy sources used in Riga city, since Riga, inter alia, receives electricity also from common network of Riga HPP (see Section 3.1.2 of the Action Plan), which, similarly to thermal power stations, supplies electricity also to consumers outside Riga.

Number of types of individual promotional measures is adopted as a criterion for assessment of introduction of the Action Plan:

1) Number of prepared and disseminated informative sheets, brochures and informative DVDs on energy efficiency and renewable energy sources;
2) Number of thematic roundtable discussions, seminars, conferences, exhibitions;
3) Number of prepared pilot projects (demonstration objects) and feasibility studies;
4) Number of projects prepared for implementation of measures.

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