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Riga smart city
SUSTAINABLE ENERGY ACTION PLAN
2014 - 2020

Covenant of Mayors
Committed to local sustainable energy

Riga 2013/2014

REA
Rīgas enerģētikas aģentūra



Riga was one of the first capitals to sign the Covenant of Mayors in 2008. Through cooperating with other cities in the implementation of a number of energy efficiency projects, Riga has been able to introduce new innovative technologies that add to our comfort and make our lives more environment-friendly. Together with our partners we are committed to bringing our city closer to a smart city's status.

Nils Ušakovs
Mayor of Riga

STEP-UP – Glasgow, Riga, Gothenburg & Ghent are working together to create smarter more sustainable cities.

(Slogan of the Glasgow municipality)

INTRODUCTION

The "Riga Smart City Sustainable Energy Action Plan for 2014 – 2020" (Riga smart city SEAP 2014 – 2020) has been drafted as a follow-up to the first "Riga City Sustainable Energy Action Plan for 2010-2020" (Riga city SEAP 2010 – 2020) developed and approved on July 6, 2010 by the Riga City Council in view of its commitments issuing from the Covenant of Mayors. Initially, the objective of the Action Plan was to exceed the goals of:

20-20-20 by 2020.

This means that the city commits itself to reduce CO_2 emissions by at least 20 % which is to be achieved through a 20 % gain in energy efficiency, and utilize renewable energy sources to account for 20 % of the volume of energy consumed.

As has been shown during the implementation of the SEAP and by the Progress Reports of 2011 and 2012 on the implementation of the SEAP, the CO_2 emissions' reduction plan for 2020 has already been exceeded, with a reduction of 50.69 % achieved by 2011. In view of the city's potential in the field of energy efficiency improvements and use of renewables, there is a need for new and more ambitious goals in line with the actual situation. Thus, given the new initiative of the European Commission (EC) on the European Innovation Partnership on Smart Cities and Communities, we have set our goal to bring the city closer to achieving the status of a smart city by integrating innovative information and communication technologies (ICT) into energy and transportation. For these purposes we have redeveloped the SEAP through transforming it into the Riga smart city SEAP 2014 – 2020. The smart city SEAP is based on the data for 2012; therefore, there is going to be no separate Progress Report for the smart city SEAP implementation.

The smart city SEAP includes an initial review of CO_2 emissions for 1990 – 2012 and projections for 2020, measures for reducing energy consumption and capturing renewable energy sources in the administrative territory of the Riga city, as well as criteria for assessing progress towards the goals of the smart city SEAP. The smart city SEAP states the main development lines towards reaching sustainability of energy supplies and an emission free transportation system, alongside with providing smart ICT for planning and implementing measures with the aim of improving energy supply, upgrading energy supply systems, including energy sources, improving service quality, drafting and implementing energy saving plans, use of renewable resources in municipal energy supply and implementing emission-free mobility.

The smart city SEAP has been elaborated within the framework of the international project elaborated in response to the First Call for support to smart cities of the European Union (EU) Seventh Framework Programme "Strategies towards Energy Performance and Urban Planning (STEP- Up)" (PVS ID 3037) in consortium with the municipal governments of Glasgow (UK), Ghent (Belgium) and Gothenburg (Sweden), which are also redeveloping their Action Plans. The lead partner of the project is the University of Strathclyde (Glasgow, UK). The cooperation partners of the consortium are the energy company "Scottish Power" (UK), the energy company association "Eandis" (Belgium), the SP Technical Research Institute (Sweden), the Gothenburg real estate development company "Älstranden Utveckling" (Sweden), VITO Energy Research Centre (the Netherlands), the Riga Technical University (Latvia), AS "Swedbank" (Latvia) and the Latvian Association of Local and Regional Governments (LPS).



The Riga smart city SEAP for 2014 – 2020 has been drafted under the guidance of the Riga Energy Agency (municipal agency REA) in collaboration with the members of the SEAP Inter-institutional Working Group and other energy supply bodies, institutions of the Riga City Council (RCC), service companies and experts.

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The visual design of the Action Plan has been developed by Rihards Baufals.

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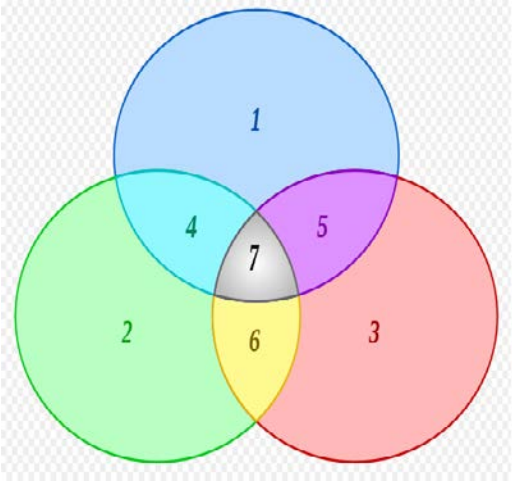
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1. EU initiatives for the involvement of municipalities in ensuring sustainability of energy supply and developing a smart city

Sustainable development of cities provides for the needs of today without threatening the needs of future generations.

Sustainable urban development includes the community (the social dimension), the environment and economy (the economic dimension) which continuously interact with each other. In Wikipedia sustainable development has been illustrated in the following way:



1 – Community
2 – Environment
3 – Economy

Result of interaction:
4 – tolerable
5 – equitable
6 – viable
7 – sustainable

Figure 1.1

Riga has made a commitment to foster ***sustainable urban development,*** both by signing the Charter of European Sustainable Cities and Towns towards Sustainability (also known as the Aalborg Charter) in the 90-ies and by signing the Covenant of Mayors on September 30, 2008. The principles of sustainable development are seen as guidance when drafting the documents for the strategic development of the city. Wikipedia explains these principles in line with the RIO framework. The RIO principles are: integration, the precautionary principle, the "polluter and the user pays" principle, the replacement principle, the life cycle approach, inter-generational and intra-generational equity, effectiveness, democracy, public participation, immediate and long-term integration, integrity, sufficiency and the opportunity and precautionary principle. Among other strategic documents there is the Riga city SEAP 2010 –2020 developed in line with the commitments under the Covenant of Mayors and approved in 2010. On December 18, 2012 the Riga City Council approved the Second Progress Report on the fulfilment of the SEAP for 2011. Drafting and implementation of the SEAP was monitored by the Covenant of Mayors' office in Brussels.

Smart Cities and Communities, which is a European innovation partnership, is a new initiative of the European Commission (EC) formulated in the EC document C (2012) 4701 *final* of July 10, 2012. Partnership in cities and communities refers to three areas: ***energy, transport and information and communication technologies***. The interaction of these areas in the development of smart cities has been illustrated in the EC document in the following way:

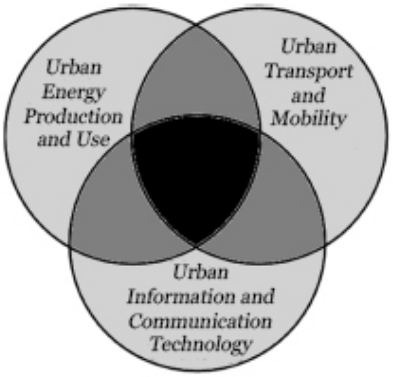


Figure 1.2

As indicated in Wikipedia, smart cities can be identified by six features: sustainable economy, sustainable mobility (transport), a well-managed and resource-sparing environment, wise people, high life quality and smart governance.

A city becomes smart when investment in its residents and in the social sphere, as well as in the traditional (transport) and state-of-art (information and communication technologies) infrastructures ensures sustainable economic development and high life quality through different social group participation and involvement, and smart resource management.

Through joining the partnership of smart cities and communities in the framework of the SET Up project, the municipality of Riga is re-drafting its SEAP to develop a Riga smart city SEAP 2014 – 2020 and set a new goal of bringing the city closer to a smart city status.

2. DESCRIPTION OF RIGA

2.1 Location, operational profile and demographic situation

Riga is a long-standing member of the Hanseatic League at the coast of the Gulf of Riga of the Baltic Sea and is considered to have been 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 jewel of art nouveau. It is the largest city in the Baltic States and one of the largest metropolies in Northern Europe, being also an important transit point with a well-developed airport, port and railway network system.

Riga is rich in water resources; it is a green city with many parks and recreational areas, as well as an adjacent expanse of woodland which ensure appropriate life quality to its citizens.



Figure 2.1

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

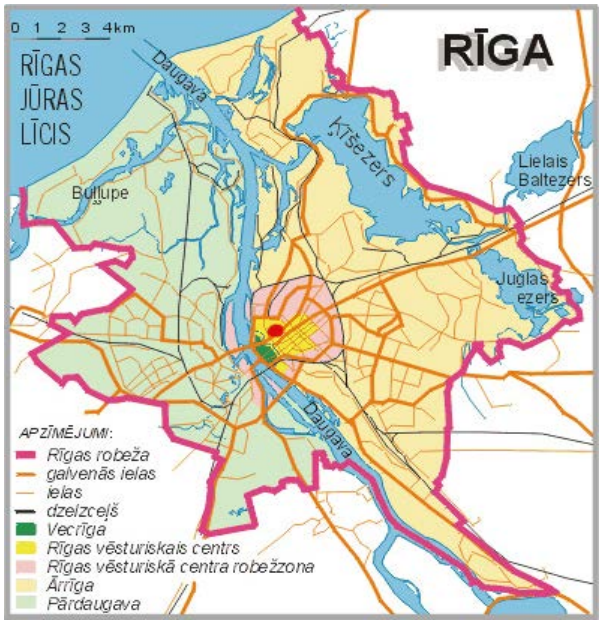


Figure 2.2. Map of Riga

Production of wood, wooden products and cork is well-developed. There is a printing, publishing and records' production industry in the city. Textile industry and other types of industrial output can also be found. There is a significant volume of construction work taking place. Two of the largest cogeneration (CHP) plants are located in Riga, i.e. Riga TEC-1 and Riga TEC-2. They are able to produce around 20% of the total energy consumed in the whole of country.

Notably, both Riga airport and Riga TEC-2 are located outside the city borders.

Transit roads to the Latvian ports go through Riga. In order to relieve the centre of Riga, the Southern Bridge was put into operation in 2008 with transit cargo flows re-directed towards it.

The population of Riga peaked around 1989 when it reached 915 thousand people with approximately 35 % of the Latvian population concentrated in Riga. Since 1990 the population of Riga has been constantly decreasing to reach the following numbers:

1990 – 909 135;
1995 – 824 988;
2000 – 764 329;
2005 – 731 762;
2010 – 713 016,
2011. – 659 418 (census data);
2012 - 649 800 (Riga development program 2014-2020).

Although there is relatively large inflow of people into Riga from other regions of the country, the overall trend has been for the city's population to decrease. It has been forecasted that as the economic situation improves, the population is going to approach 700 000. The rate at which population has been declining is expected to slow down by 2020, when the trend is going to reverse.

2.2 Airport, port and rail transport

The Riga airport is located 2 km outside the city borders. Initially it was an airport with a small passenger capacity, but it has continuously expanded since and grown to be an airport of international importance, including transit, with a passenger flow of 4.8 million people in 2012. Further expansion of the airport and increase in the passenger flow has been planned.

The port of Riga is located in the territory of the city and covers the Riga Free Port areas from the centre of the city on 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 is an important transit cargo hub with cargo terminals. Since 1990 the cargo- and passenger- handling capacity of the Riga port has been continuously growing, and further growth of the port has been planned. In order to ensure cargo turnover without over-burdening the city centre, there is a plan to

construct the Northern crossing of the Daugava together with appropriate access roads from the city borders.

Riga is an important rail transport hub, since the city is the starting point from which railway lines, including local and international railway lines, branch off in various directions,. Rail transport is very important not only with respect to passenger transportation, but also for cargo transportation establishing a transit cargo route to Latvian ports. Almost all cargo flows go through Riga's central railway hub. Since 1990 cargo transportation by rail has been increasing and this trend is forecasted to continue. Electrification of the railway lines is in progress.

2.3 Buildings

There are three types of buildings in Riga:

- pre-war building – built up to 1940;
- post –war buildings – built up to 1940;
- new buildings – built since 1996.

The pre-war buildings are mostly small family houses and private multi-apartment rentals which were first nationalised in 1940s and then, in 1991, resituated to the former owners or their heirs through a targeted denationalisation process. The overall heat stability of these buildings is relatively good in the city, even if some of the buildings have few amenities. Renovation of these buildings has been the responsibility of the owners.

Post-war buildings, which were erected mainly on the basis of standardised solutions and – since the middle of the 1960s – also panel technologies, have low heat stability – in line with the construction standards of that time when priority was given to low construction costs. Apartments have all the amenities. These buildings are the city's main concern, since their energy efficiency needs to be increased and energy consumption made lower alongside reducing CO_2 emissions. The buildings house about 60 % of the city's population, and they form the principal part of the housing stock which was privatised when independence was regained. Renovation of the privatised multi-apartment residential houses was started in 2001.

Pursuant to the data of statistical surveys, in 1995 there were 23 035 residential houses with 241 520 apartments and a total area of 16.243 million m^2 in Riga. The average area of an apartment per capita was 20.0 square meters which is a low figure for Europe.

1996 marked the beginning of a new construction period in Riga related to the adoption of European-level construction standards. The new buildings which have facilitated the formation of a housing market and resulted in spare housing areas are presently outside the scope of priority concerns of the municipality, even though some energy saving measures might be recommended for these buildings.

The main public buildings – theatres, museums, banks, government and municipal administrative buildings, institutions and offices, universities, schools, pre-school educational establishments, hospitals, shopping centres, sports and recreational centres – are also located in Riga. The schools and nursery schools built during the post-war period according to standard solutions have to be placed especially high on the agenda because of their low heat stability. Since 2008 renovation of educational establishments has been in progress.

2.4 Energy supply

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

The main type of heating in Riga is ***district heating*** which covers 76 % of the consumed volume of heat with natural gas and wood-chips used as fuel. In 2011/2012 approximately 69 % of the required heat was produced by two large upgraded state owned cogeneration plants: Riga TEC-1 (37.6 %) and Riga TEC-2 (60.15 %), which are under the responsibility of JSC "Latvenergo", and the private co-generation station "Juglas jauda" (2.22 %). Riga TEC-2 is located in Acone, rural municipality of Stopiņi, approximately 3 km from the border of Riga.

District heating in the city is provided by JSC "Rīgas siltums" which produces the remaining 31 % of heat in its 5 heat plants and 38 automated boiler houses. Cogeneration units have been installed at five of the abovementioned heat sources of JSC "Rīgas siltums" (i.e., HP "Imanta", HP "Daugavgrīva", HP "Ziepniekkalns", BH Keramikas Street 2a and BH Viestura Prospekts 20b); thus, over 90 % of the volume of centrally consumed heat in Riga is produced in the highly efficient cogeneration mode.

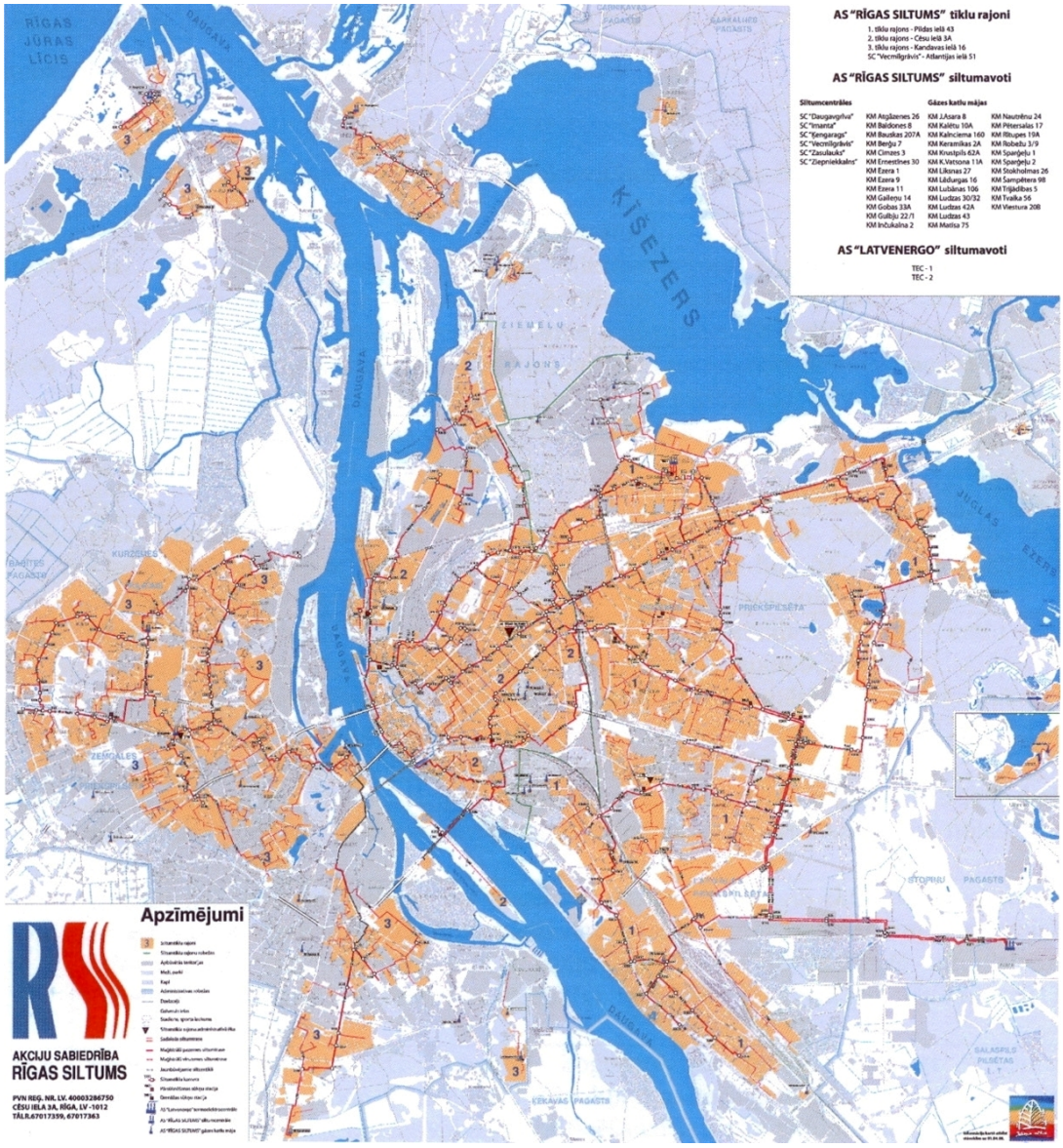


Figure 2.3. Source: JSC "Rīgas siltums"

The district heating system of Riga uses natural gas and wood chips as fuel. Decentralised heating, partly also for the pre-war buildings in the centre of Riga, as well as for industrial sites, is ensured through local boiler installations which mainly operate in the automatic mode on natural gas

or firewood. In recent years some large production plants have been installed co-generation units in their heat sources. A small number of coal-fired boiler installations remains mostly in the private sector; these installations will be gradually dismantled.

Power supply for Riga is ensured from the 110/330kV power network**,** which covers the city on both banks of the Daugava and inter-connects the power production plants. In order to ensure electricity distribution, there are 28 operating substations of 110/10(20) kV and 75 distribution points of 10 kV.

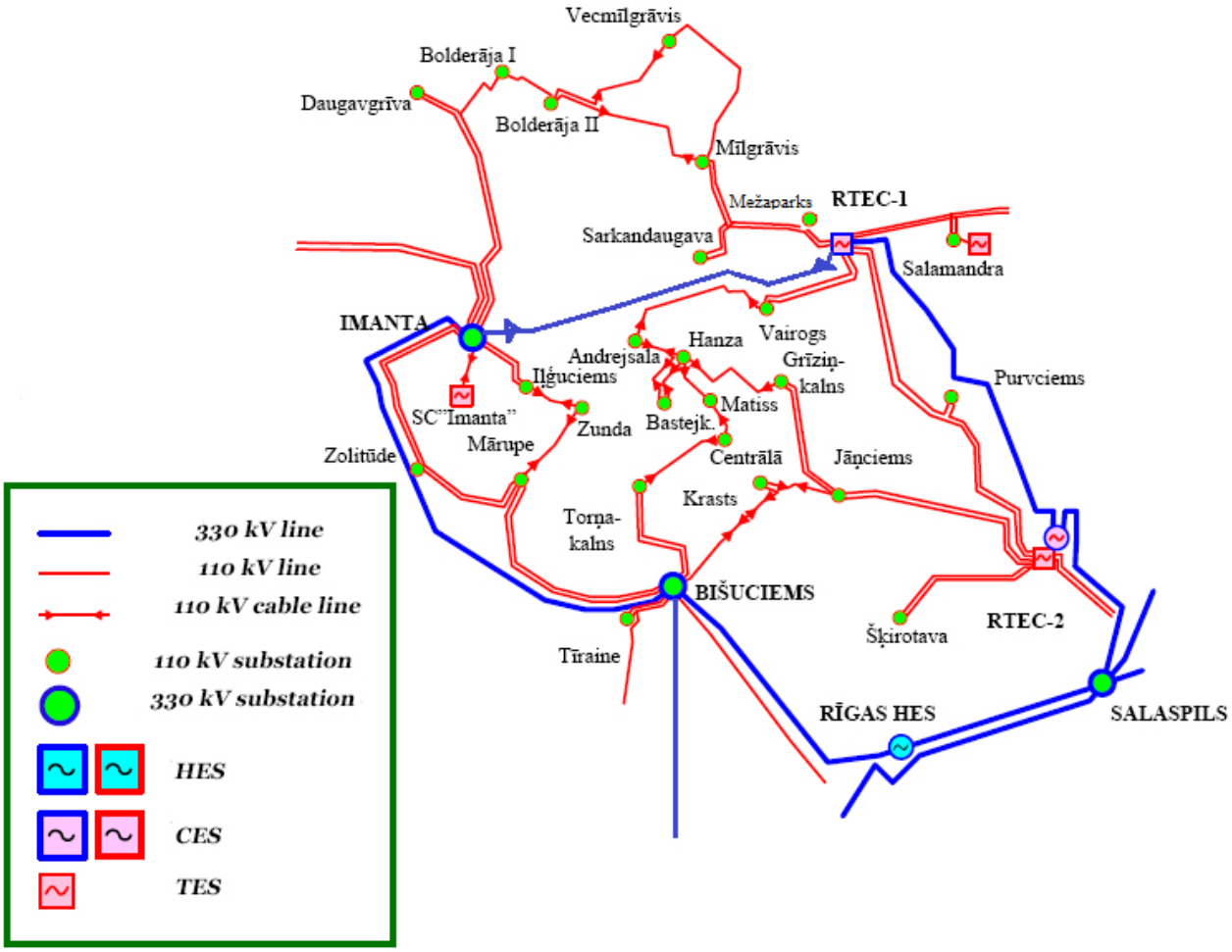


Figure 2.4. Scheme of power networks of Riga. Source: JSC “Latvenergo”

Natural gas, i.e. the main fuel used for the city, is supplied by JSC “Latvijas gaze” through the single gas supply infrastructure: the Inčukalns underground gas storage facility and the gas transmission and distribution system.

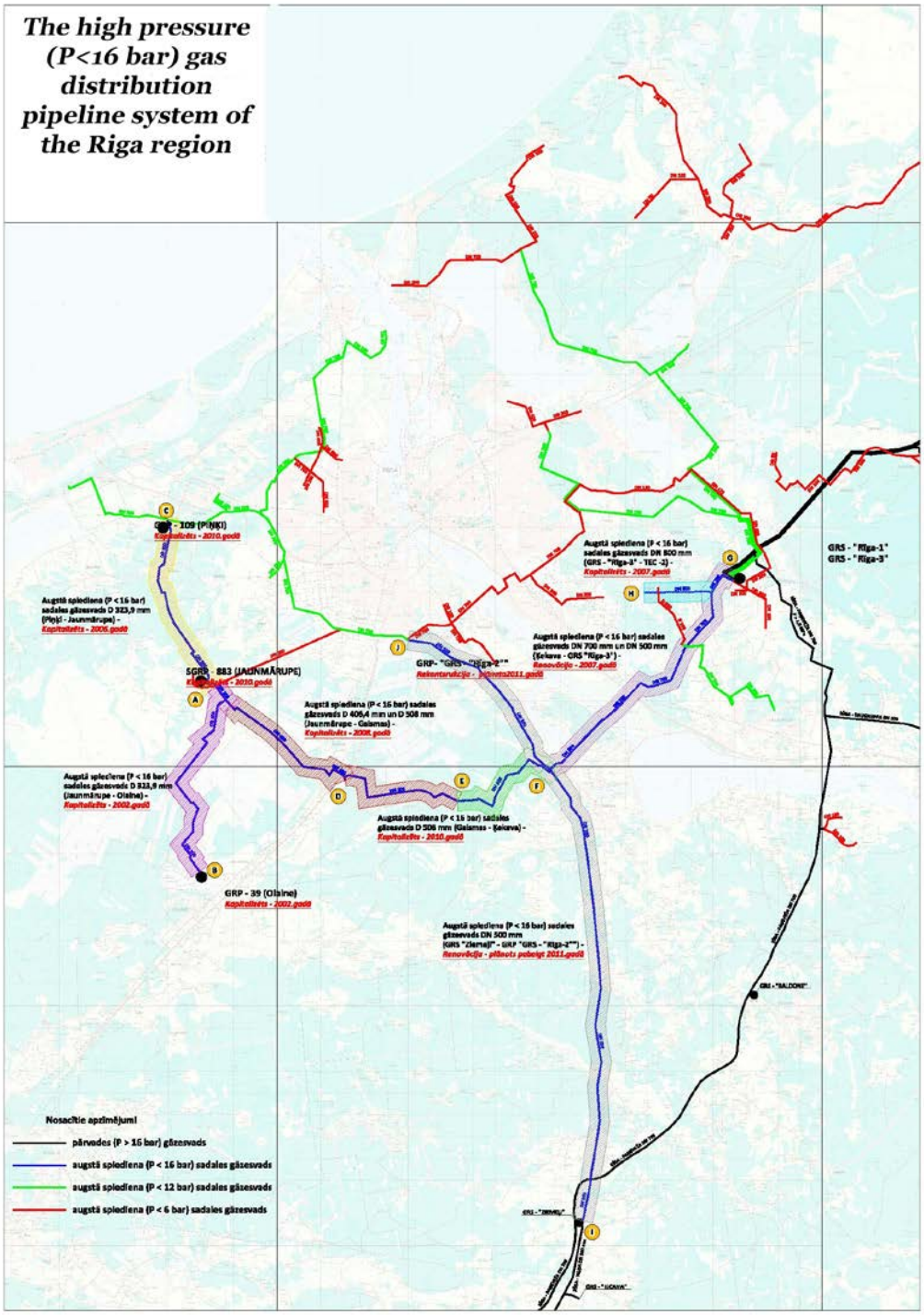


Figure 2.5. Source: JSC "Latvijas gāze

2.5 Urban traffic

In order to relieve the town centre from the heavy transit traffic flow and traffic jams, the Southern Bridge (Dienvidu tilts) was completed and opened up for traffic in 2008. Access roads with transport junctions providing for a smooth operation of the bridge were constructed on both banks of the river. In 2011 the Slāvu juncture which is of extraordinary size and technical complexity for Latvia with three levels of crossings, as well as the two level crossings on Gustavs Zemgals Gatve

and Gaujas Street and Viestura Prospekts and Meža Prospekts which are part of the Eastern (Austrumu) trunk road were completed and opened up for traffic. In 2013 the traffic junction on the left bank in the direction to Zemgale completed the access road network required for the Southern Bridge. Thus, the traffic flow can now be fully re-directed to avoid the city centre, and the new system of access roads forms an exit to the principal road VIA BALTICA.

The Southern Bridge and its access roads

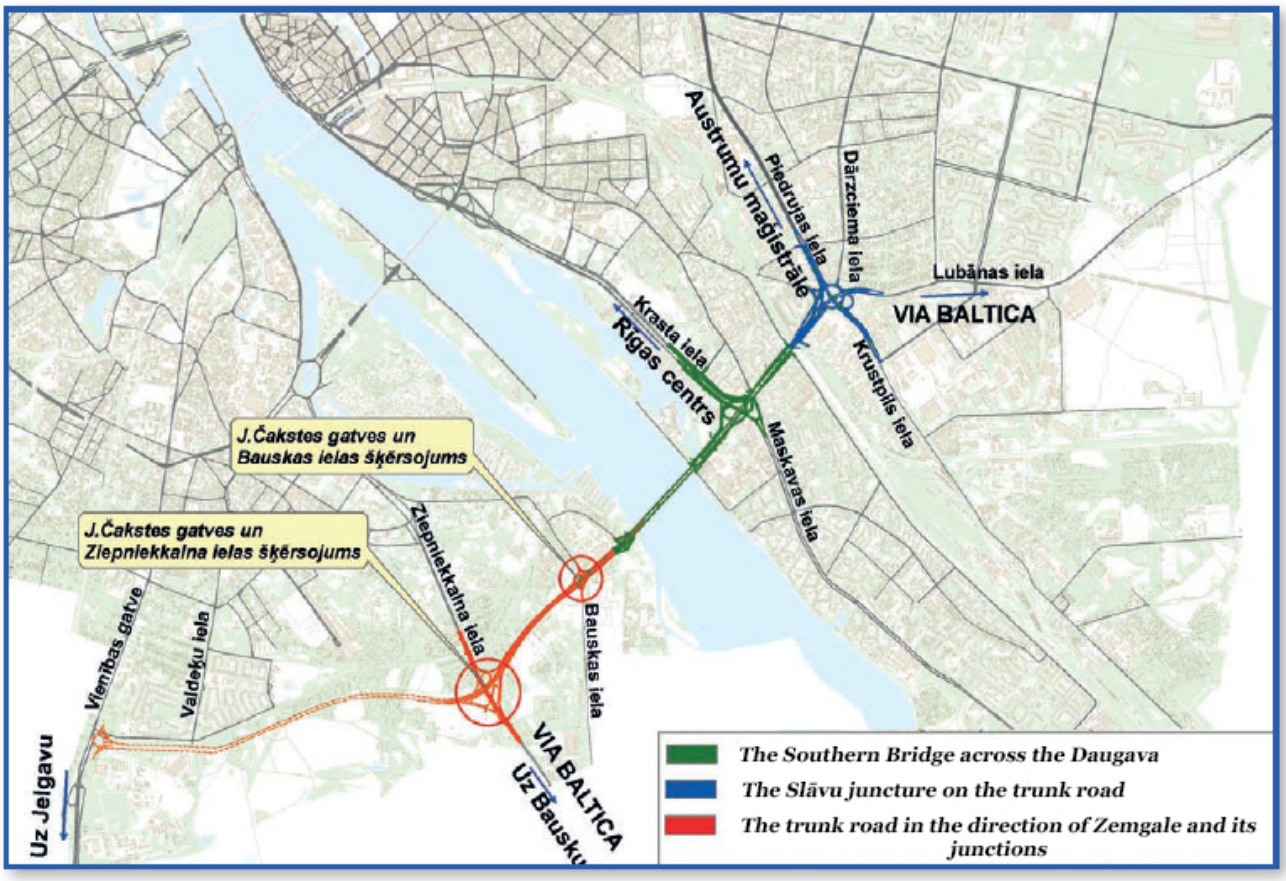


Figure 2.6. Source: Yearbook of the Transport Department of Riga City Council, 2011

Public transport in Riga is provided by a single municipal company Ltd "Rīgas satiksme", which operates trams, trolleybusses and busses for public use. Urban traffic is mostly organized with the help of electric power driven vehicles, which handle more than 54 % of the passenger flow:

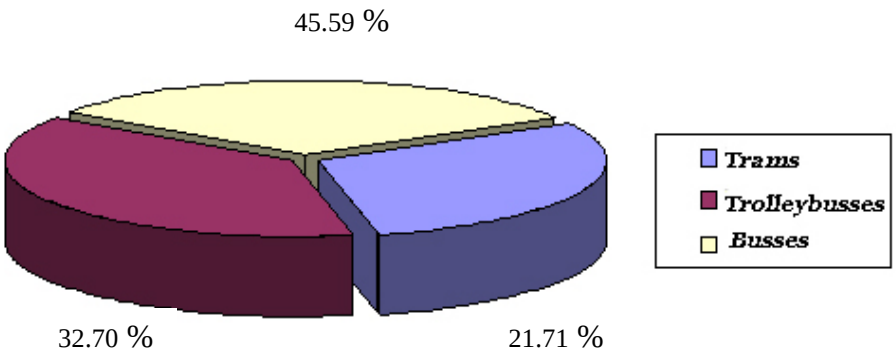


Figure 2.7. Source: data of the Transport Department of Riga City, 2012

The urban public transport system also includes the electrified railway line in the city boundaries. Additionally, there are minivans running along passenger routes. There are also taxi companies in the city. Bicycle hire stations have been organized in the streets of the city.

2.6 The urban information and communication technologies (ICT) system

Information and communication technologies are implemented under centralised governance, which is provided by the Information Technologies' Centre of the Riga City Council. A "Riga City Council ICT support strategy and implementation plan for 2013–2016" has been developed and approved for implementing innovative ICT solutions. The structure of ICT is as follows:

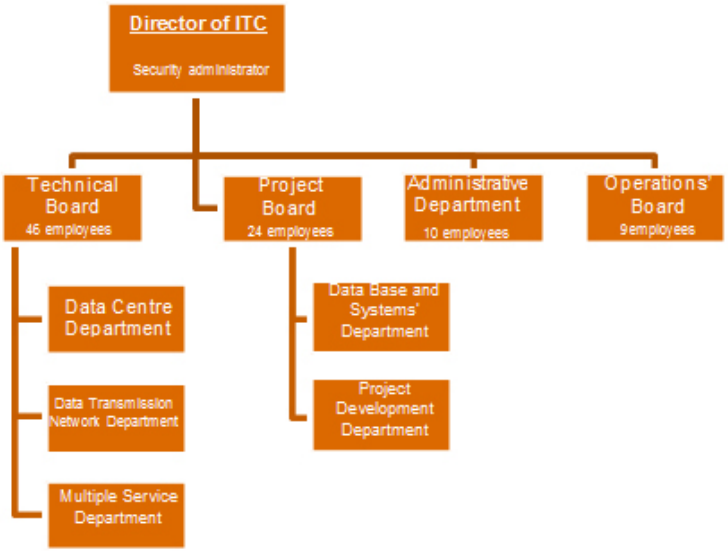


Figure 2.8. Source: Riga City Council ICT support strategy and implementation plan for 2013–2016

ITC ensures a single support system in the field of information technologies, telecommunications and video-surveillance and security for the Riga City Council and the entities of the Riga municipality, the Riga municipal administration and municipality agencies. With separately granted management approval from the Riga City Council this system can also be used to support companies with municipal capital and other institutions.

Since 2005/2006 the Riga municipality has been implementing the **e-city** project (see *www.eriga.lv*), which has proved successful and is continuously being extended through new types of services. Cloud-computing is very important in the implementation of the e-programme. Cloud-computing is essentially meant for adjusting to the specific needs of a company or an institution and supplying them with the required resources by moving the physical server equipment out of its office premises to specialized data centres equipped with a modern cloud-computing platform; this allows to organize the servers and access them from any part of the world, without worrying about accessibility and security. The Riga municipality makes use of cloud computing services.



The municipality's e-system is linked to the information systems of other institutions, including the Population Register, the Cadastre and Address Register, the Land Book, the State Revenue Service and the State Social Insurance Agency, the Road Transport Safety Directorate, the Employment State Agency, the Latvian Post Office, the Housing Agency, the Penalty Register, the Missing Persons' Register, the Latvian Mobile Telephone, the State Education Information System, the Latvian Geospatial Information Agency, etc. The implementation scheme of the municipal ICT strategic development plan for 2013–2016 is set out in figure 2.9.

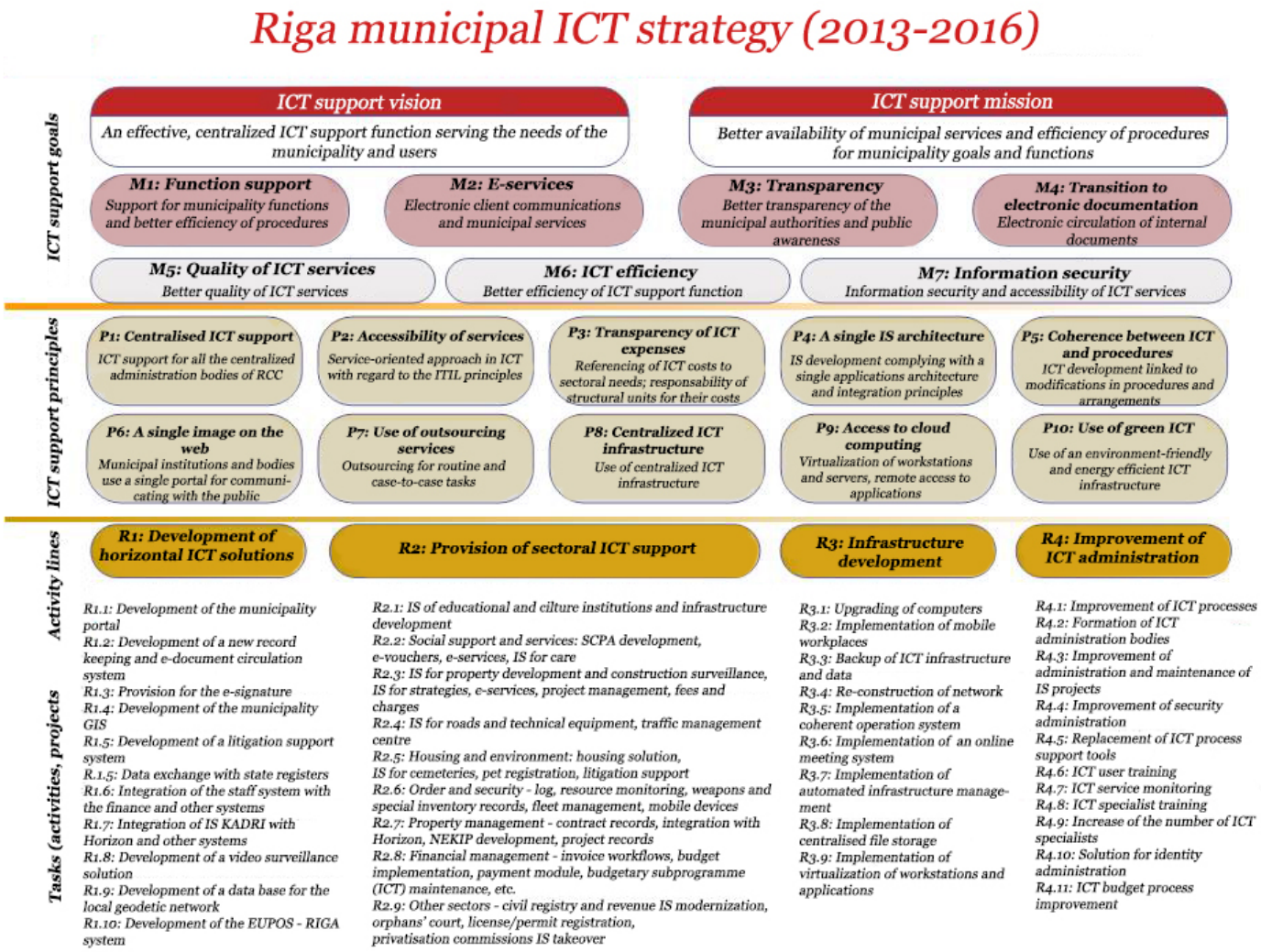


Figure 2.9. Source: Riga municipal ICT support strategy and implementation plan for 2013–2016

The direct communication tools offered by IC technologies for rapid information to the public are actively used to promote awareness among the urban population about energy efficiency and related issues; these tools are seminars and conferences with direct transmission on the internet, posting of events and current information on the web (see www.rea.riga.lv), social networks – Facebook, Twitter, YouTube for engaging with their followers and interactive surveys on topical issues in the field of energy efficiency.

Since 2012 ICT tools have also been used for inter-city and inter-city group communications, mostly for organizing work on international projects and project implementation: these are video and

teleconferences, also webinars (on-line seminars on the internet, which can be joined from own workstations, switched to the internet).

2.7 The social dimension of the city: "A healthy Riga resident in a healthy Riga city"

The social dimension focused on the human being, his or her environment, the preservation of health, education and job opportunities and wellbeing is of primary importance for sustainable urban development. Its implementation requires a lot of attention to urban development issues, including energy and transport, especially given their impact on the environment. Energy production and transport largely account for harmful emissions that have a negative impact on human health. Use of traditional fossil fuels in heating and transport leads to greenhouse gas formation resulting in global climate change manifest in natural disasters, destructive earthquakes, storms, periods of excessively hot weather, massive fires, floods, etc.; such events are not infrequent even in the moderate climatic zone of Latvia. The goal of the smart city SEAP to achieve a meaningful reduction of CO_2 emission levels in the city is directly focussed on improving the overall environmental situation, i.e. on real action to improve the environment for the benefit of human health and the various needs of people.

The smart city SEAP tackles this task in a number of ways. Firstly, it operates to reduce energy use through implementing a number of energy efficiency improvements and energy saving measures. Secondly, it speaks of replacing fossil fuels in heating and transport with renewable resources, which are environmentally balanced and do not lead to high CO_2 emissions. Thirdly, by developing and implementing zero emission mobility in the city, traditional modes of urban transport are gradually replaced.

In 2012, the Riga municipality developed and approved the public health strategy "A healthy Riga resident in a healthy Riga city" for 2012-2021 which highlights a vision for improving residential health, identifying the principal public health issues and setting the activity lines for overcoming problems. The framework of the strategy has been aligned with the urban development strategy of Riga until 2030, and the smart city SEAP is also aligned with the framework. Public involvement in the implementation of the smart city SEAP and the specific contribution of every single resident in achieving the common goal is of utmost importance.

3. The link between SEAP and the strategic planning documents of the Riga City Council

The Riga city SEAP 2010–2020 is the principal strategic development-planning document for the energy sector which is aligned to the long-term urban strategy and development programme. Interaction works according to the following scheme:

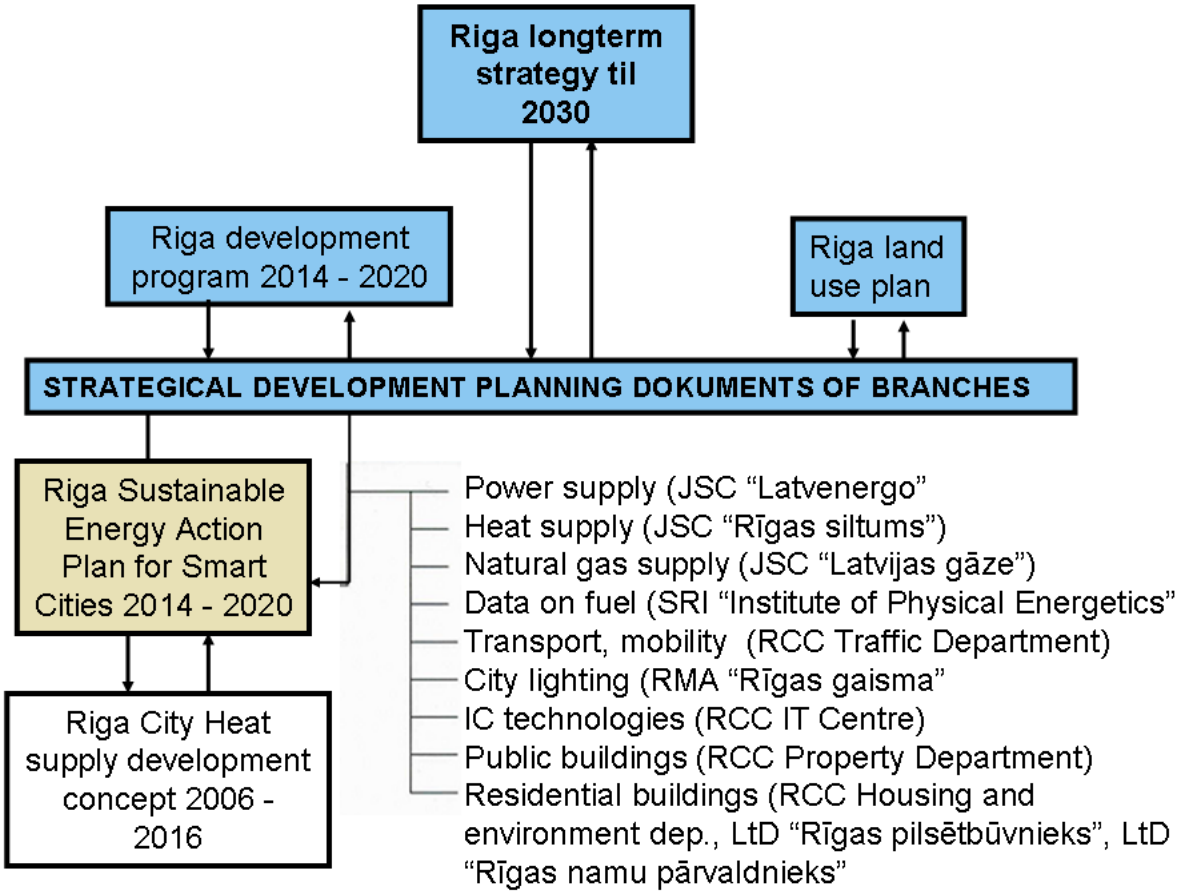


Figure 3.1

Both the Riga long-term development strategy and the Riga development programme formulate the goals and tasks which are binding for developing and implementing the smart city SEAP.

4. Management structures for the implementation of the Smart city SEAP

Decision No 2204 (par.1) of November 9, 2011 of the Riga City Council states that the municipal agency "Riga Energy Agency" (REA) is responsible for organizing and managing the implementation of the Action Plan in the city of Riga. The required additional management bodies have been established for public involvement based participation.

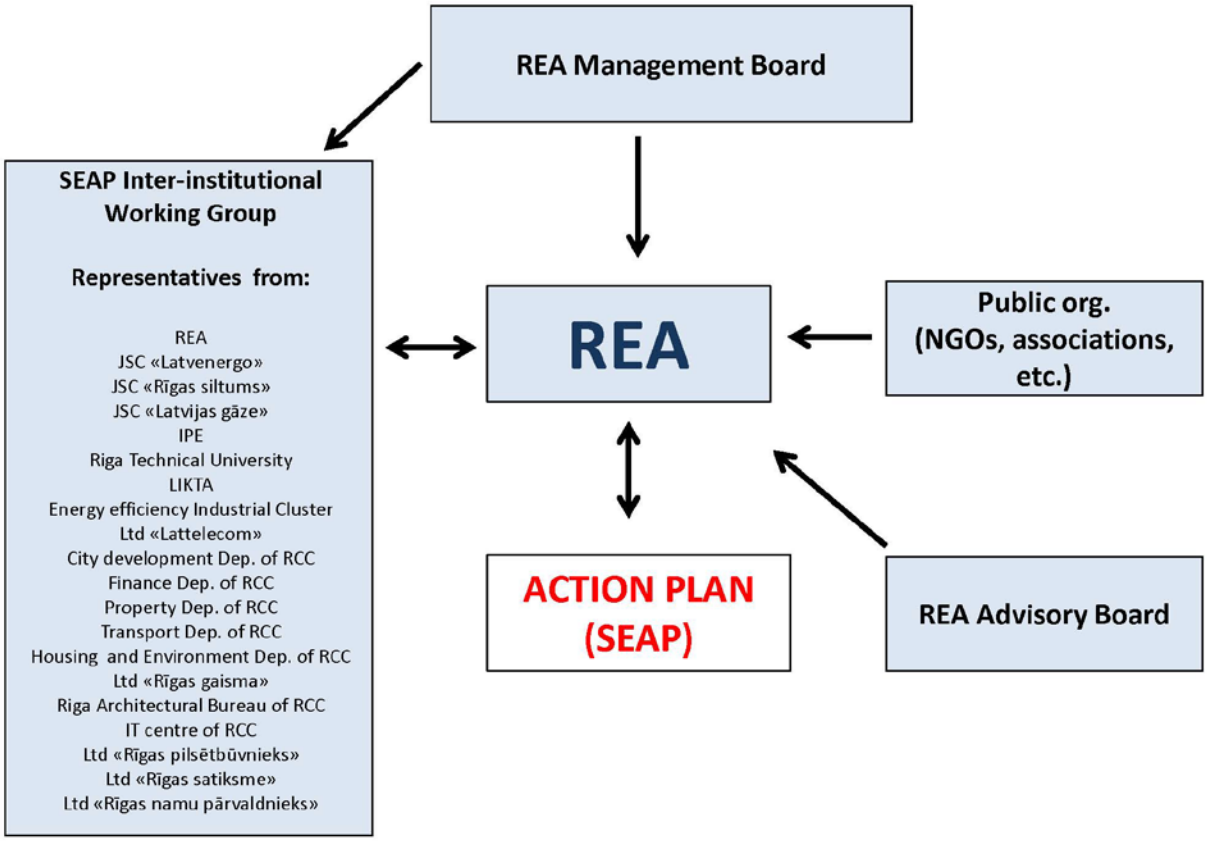


Figure 4.1

The municipal agency REA ***Management Board*** consisting of 12 members is chaired by a Member of the Riga City Council who also chairs the Committee on Social Issues. The Management Board consists of representatives from different community groups, including government administration, energy and service companies, energy consumers, the academia. The Management Board monitors the implementation of the SEAP by assessing the results and the public interest perspective of the process.

The municipal agency REA ***Advisory Board*** includes 16 leading scientists and experts in the energy and housing sector. The main task of the Advisory Board is to provide the municipal agency REA with high quality advice and solutions on the technical issues of energy supply, energy efficiency and use of renewable resources.

Synergies in the implementation of the SEAP are ensured by the ***SEAP Inter-institutional Working Group*** consisting of 21 members who represent the main organizations that participate in the implementation of the SEAP. The SEAP Inter-institutional Working Group is chaired by the Director of the municipal agency REA. Members of the Working Group act as the necessary link to executive bodies, foster exchange of information and participate in drafting the smart city SEAP, the current Progress Reports and the assessment of the smart city SEAP implementation results. Initially in 2013, the Working Group consisted of 14 members, whereas since the implementation of the smart city SEAP their number has been increased by 7 new members representing the industrial sector, public buildings and ICT, as well as the Riga Technical University (RTU).

As evidenced over several years of activity, the Riga municipal management entities that oversee the implementation of the SEAP have effectively coped with their tasks, and the management model that has been chosen and implemented has proved to be efficient.

5. STRUCTURE OF THE SMART CITY SEAP

The structure of the Smart city SEAP is based on the commitments made by the Riga city when it joined the Covenant of Mayors. The main section is on how to calculate and forecast CO_2 emissions. This section summarizes the results of all the other sections and shows the baseline of 1990 (reference year) the reduction of CO_2 emmisions achieved by 2012 and the forecast until 2020. The structural composition of the Smart city SEAP has been set out in the following scheme:

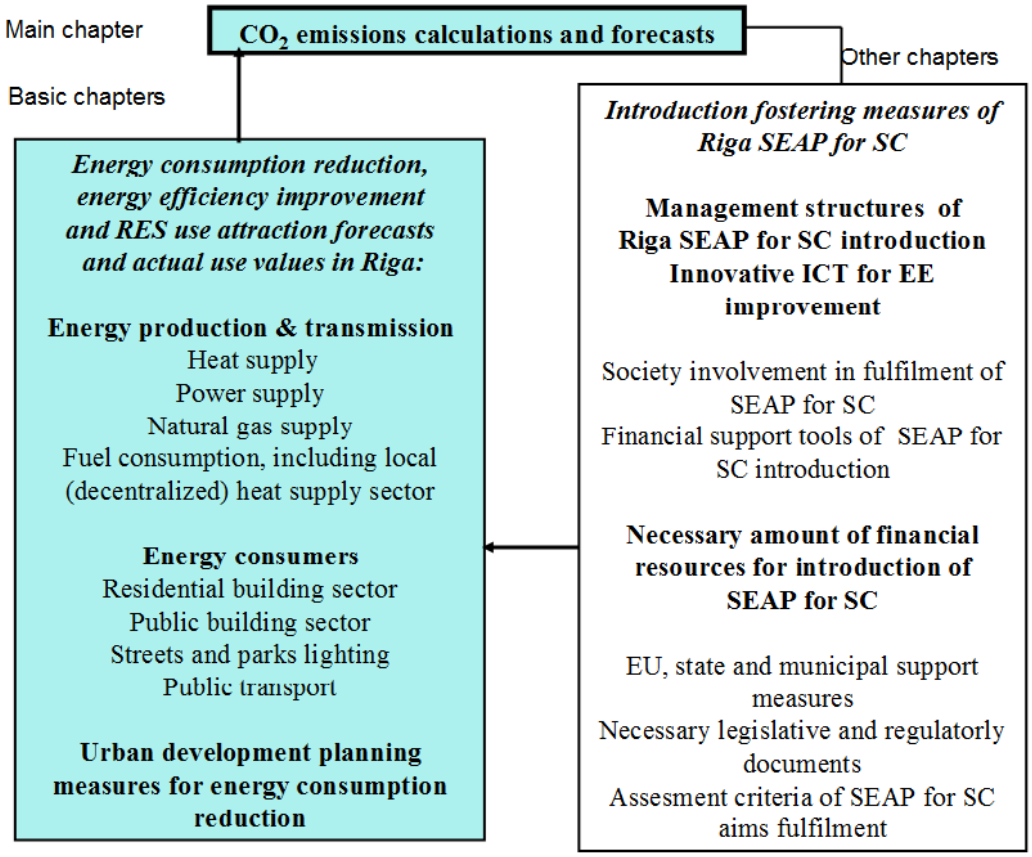


Figure 5.1

Reduction of CO_2 emissions is based on the planning and implementation measures set out in the main section describing the activities for reducing energy consumption, increasing energy efficiency and use of renewable energy resources, structured by type of energy and showing the process in the production and management stage and also in the consumer stage. In the respective sections, the specific actions have been shown in the form of tables, which feature the measure itself, the body responsible for implementation and the planned date of implementation. The economic arguments for selecting the respective measures and the selection options have not been included in the output materials of the smart city SEAP, but they derive from prior research. The costs of the principal measures envisaged by the SEAP and the respective financial sources have been summarized in the section describing the promotional activities for the implementation of SEAP.

The forecast on implementation has three forecasting levels: minimum/optimum/maximum.

6. Energy flows in Riga, 2012

The energy flows presenting urban supply and consumption have been set out in a Sankey diagram. The heat energy flows of 2012 (see figure 6.2) have been expressed in TJ. The left hand side of the diagram shows the type and volume of energy and fuel used in Riga, whereas the right hand side indicates the consumption in separate sectors by energy and fuel type. The Sankey diagram also includes the energy conversion sector represented by the production facilities of the district heating system operator JSC "Rīgas siltums".

Analysis of the structure of energy supply in Riga indicates the following facts:

- The total energy consumption of 2012 was 44 137 TJ;
- Natural gas (26.2 %), electrical power (20.7 %) and heat from the district heating system (20.4 %) accounted for most of the energy consumed;
- Renewable energy sources (apart from the energy supplied by the state-owned hydroelectric power cascade) accounted for 9.9 % of the total energy consumption.

End-user consumption of energy by sector in Riga in 2012:

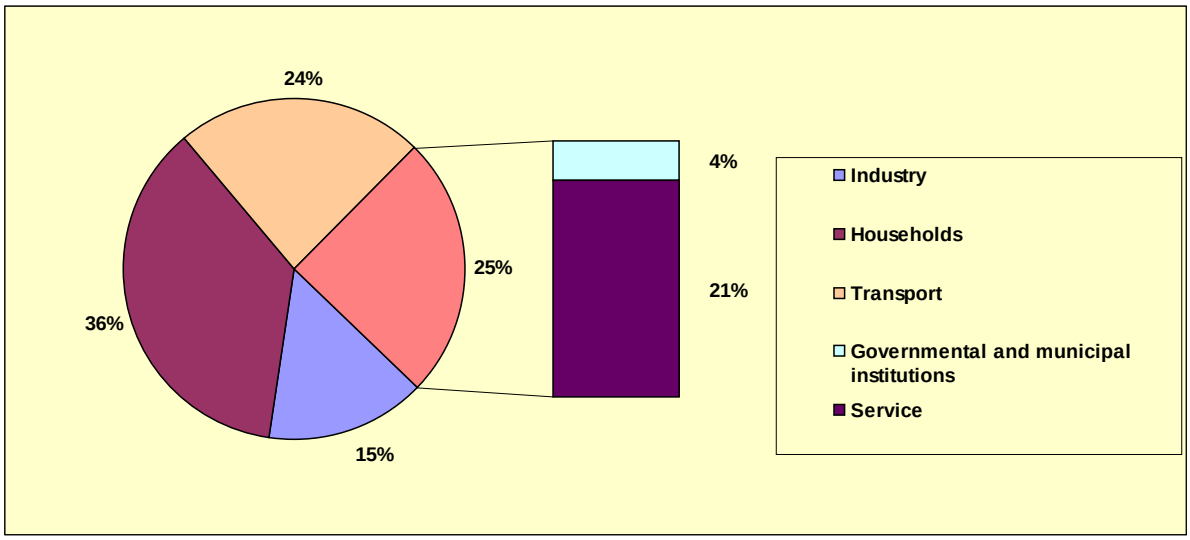


Figure 6.1. Source: Report of the Institute of Physical Energetics (March, 2014)

Analysis of final consumption by sector leads to conclude that the largest energy consumer are households (36 %), followed by the service sector (25 %) and motor vehicle transport (24 %). Industry accounts for about 15 % of the total energy consumption. The figure shows that municipal

and central government authorities in Riga account for as little as 4 % of the total end-user consumption.

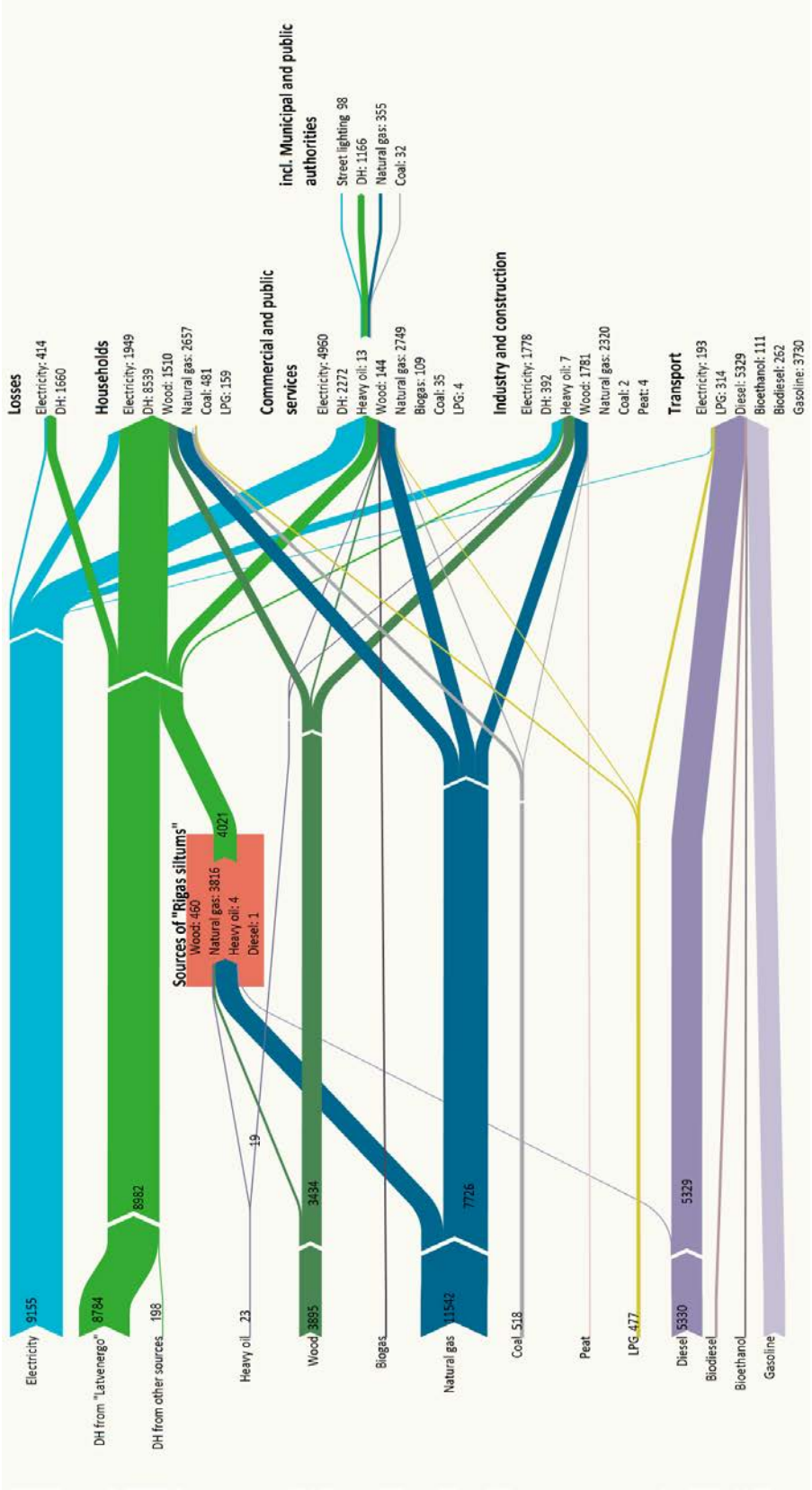


Figure 6.2. Source: Report of the Institute of Physical Energetics (March, 2014)

Analysis of the structure of fuel, energy and end-user energy consumption in Riga indicates the following:

1) The heat supplied by the district heating system accounts for about 27 % of the total end-user consumption. Electrical power is the second most important type of energy: 21 %.
2) Natural gas is the most widely used fuel, which accounts for 18 % of the total end-user consumption. Consumption of natural gas is almost equally distributed between households, the service sector and industry. Natural gas is used for heating, hot water preparation and cooking.
3) Diesel (12.8%) and petrol (8.9%) are used in motor vehicle transport in the transportation sector.
4) Wood as fuel used in industrial and household heat production accounted for a significant part (8.2 %) of end-user energy consumption in 2012.
5) Biogas and biofuel are among the other renewable resources consumed. Renewable energy resources account for 9.4 % of end-user consumption in Riga.

The biggest energy consumers by end-use nave been identified through analysing energy consumption in Riga by sector and type of energy through the available data base "No. 2 – Air – survey on protection of air".

7.Calculations and forecasting of CO2 EMISSIONS

7.1 Conditions for calculating emissions

7.1.1 Methodology for calculating CO2 emissions

Consumption of all types of ***energy and fuel in a given year in the territory of Riga city*** irrespectively of the location where it was produced has been taken as the basis for calculating the volume of carbon dioxide (CO_2) emissions. CO_2 emissions have been calculated separately from power consumption, heat consumption in the district heating system, fuel consumption in the transport sector, and energy end-use in households, industry, government and municipal institutions and the service sector. From the totality of greenhouse gas emissions, notably, only CO_2 emissions have been calculated. ***Standard methodology and parameters*** based on the guidelines drafted by the Intergovernmental Panel on Climate Change (IPCC) have been used to calculate emissions.

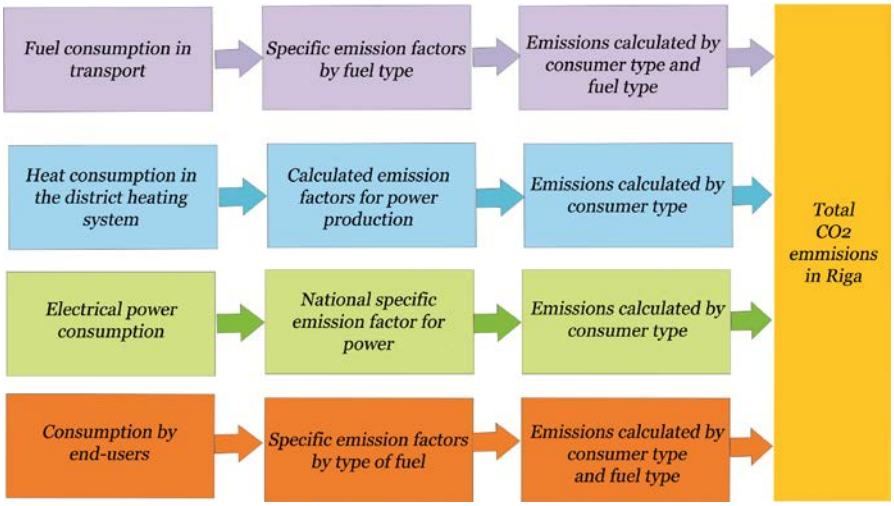


Figure 7.1. Algorithm for calculating emissions. Source: Report of the Institute of Physical Energetics, March 2014

Energy consumption 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, is not taken into account in calculating CO_2 emissions. Emissions from industrial technologies, refrigerators and air conditioning systems, natural 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.

The specific emission factors based on the average values of the physical properties of fuel types utilized in Latvia and methodology drafted by the IPCC are applied in calculating CO_2[1].

Since power consumption of Riga is ensured from various power production sources, including co-generation plants which use gas, biogas and biomass fuel, as well as the power generated in hydroelectric stations, the ***CO_2 emission factor***[2] ***for power consumption*** is based on the average structure of Latvian electrical power production.

In order to find out the CO_2 emissions from ***heat consumption in the district heating system***, the ***emission factor*** is calculated with due account of the heat delivery system and the fuel utilized in the given year. The algorithm for calculating the CO_2 emission factor for heat production in the district heating system is as follows:

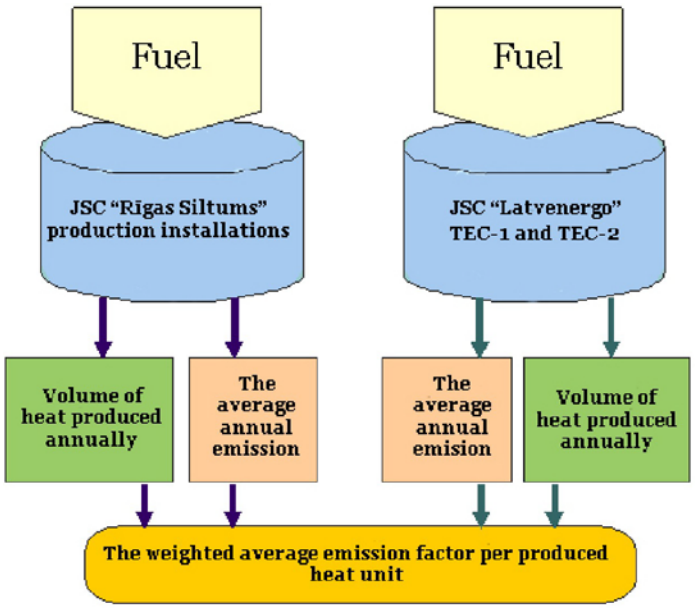


Figure 7.2. Source: Report of the Institute of Physical Energetics, March 2014

In order to calculate the CO_2 emission factor for the Riga district heating system in a given year, firstly, the emission factor for heat production in the JSC "Rīgas siltums" production sources is calculated depending on the fuel structure and the volume of heat produced in that year. Secondly, the emission factor for heat production in the JSC "Latvenergo" cogeneration plants is calculated, depending on the fuel structure and the volume of heat produced in the respective year. Thirdly, the weighted average factor for emissions from heat production in the Riga district heating system is calculated by taking into account the share of the total heat energy produced in each of the abovementioned companies and their proportion in the heat energy delivered by JSC "Rīgas Siltums".

[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.

In order to calculate the transport related CO_2 emissions in Riga, the overall traffic flow is divided into three large groups:

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

The number of cars registered in Riga is obtained from the Road Traffic Safety Directorate (RTSD) car database for Latvia. Thus, emissions are calculated only with account to those cars which have been registered as being in running order. The information collected by RTSD and data from the Transport Department of Riga City Council is the data source for identifying the number of public transport vehicles. The number of incoming cars entering Riga is calculated by analysing the number of cars in running order registered in the Riga region and the data on the traffic flow moving into Riga and out of it.

The COPERT IV (Computer Program to calculate Emissions from Road Transport) model extensively applied in EU Member States has been used for calculating motor vehicle related emissions. In the present paper it has been applied for calculating emissions in the Riga city.

7.1.2 Data for calculating emissions

Information about the total heat consumption in the district heating system of Riga and by separate consumer groups has been obtained from the district heating system operator in Riga, i.e. JSC "Rīgas siltums". Information from JSC "Latvenergo" has been used to establish power consumption and its distribution by consumer groups. Information provided by JSC "Latvijas gaze" has been used to assess the structure of energy utilized by the end-users, as well as the structure of energy production in Riga.

In order to assess the end-use of energy in the industrial and service sectors of Riga, a database "No 2 – Air – survey on protection of air" available on the web site of the Latvian Environment, Geology and Meteorology Centre, has been used. The abovementioned survey comprises publicly available information on the amount of fuel used per year for the production of heat and/or power and the technological processes both at territorial and organisational level. The forms of this report are filled out by companies or institutions (operators) which have a valid authorisation for category A or B polluting activities or an approval for a category C polluting activity and which comply with 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 the pollutants referred to in Annex 2. These provisions mean that all the heat production sources with a meaningful heat load of > 0.2 MW have been included in this statistical survey. Therefore the abovementioned statistical survey covers most of the fuel users of Latvia.

The survey has been available since 1997. During the survey, each of the operators was assessed individually and, depending on the specific activities, marked either as an industrial company included since 2005 into the Emission Trading Scheme (ETS) company subgroup, or a commercial or service company, or else a municipal and public sector institution.

The ETS sector has been listed separately since 2005 for the purpose of analysing fuel consumption. Information about final consumption of fuel by companies in the ETS sector has been obtained by individually collecting and analysing documentation of the respective ETS companies: reports on CO_2 emissions in 2005 and 2012 available on the home page of the Latvian Environment, Geology and Meteorology Centre and in the system of Register of Greenhouse Gas Emission Units.

The data for assessing end-user energy consumption in the household sector were obtained from the surveys "Consumption of Energy Resources in Households" (for 1996, 2001 and 2005) of

the Central Statistical Bureau (CSB) of the Republic of Latvia on the structure of energy consumption including the number of consumers and description of households. Information on the structure of energy consumption in the households of the Riga city has been highlighted separately in these surveys. The data for the survey has been collected during a random stratified one-stage or two-stage household sampling exercise.

7.2 CO_2 emissions in the Riga city between 1990 and 2020

7.2.1 Results of emission calculations

CO_2 emissions in 1990, 1995, 2000, 2005, 2008, 2010 and 2011 have been calculated with the use of the abovementioned methodology for calculating emissions and the available information on energy and fuel consumption in the city of Riga provided by prior studies[3]. This report calculates emissions for 2012 and assesses the impact of the CO_2 emission reduction measures on the emissions in 2012. The total CO_2 emissions in Riga by type of energy consumption in 1990 – 2012 in thousands of tons of CO_2 have been as follows:

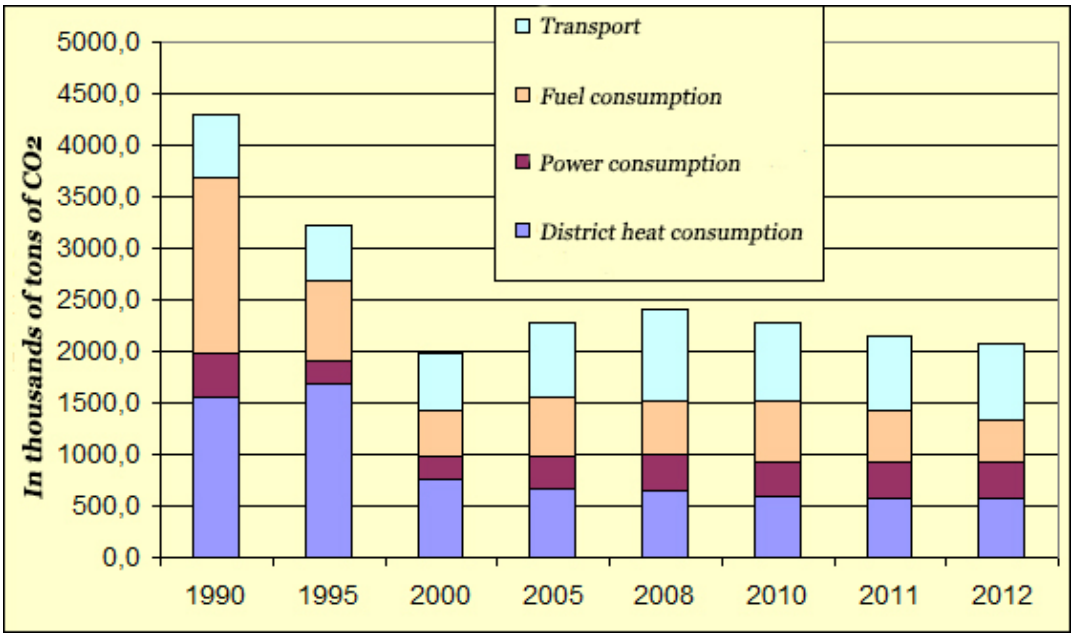


Figure 7.3. Source: Report of the Institute of Physical Energetics, March 2014

In 2012 as compared to the base year (1990) the total CO_2 emissions in the city of Riga have decreased by 51.85 %/

Calculated CO_2 emissions by sector in 2008 – 2012, in thousands of t of CO_2 have been as follows:

[3] Research paper "Impact of energy efficiency and renewable resources on GHG emission reduction in the city of Riga" („Energoefektivitātes un atjaunojamo energoresursu izmantošanas ietekme uz SEG emisiju samazināšanu Rīgas pilsētā"), Institute of Physical Energetics, 2010; research paper "Assessment of GHG emissions for the 2011 SEAP Progress Report"(„SEG emisiju novērtēšana Rīcības plāna izpildes progresa ziņojumam par 2011.gadu"), Institute of Physical Energetics, 2011.

Table No 7.1

Source of emissions	2008	2010	2011	2012
Motor vehicle transport	878	750	737	742
Fuel consumption	524	587	502	402
Electrical power consumption	345	345	338	347
Heat energy consumption (climate corrected) from the district heating system	655	588	579	577
IN TOTAL	2 402	2 271	2 156	**2 068**

The total volume of CO_2 emissions in the base year (1990) was 4 295.1 thousand tons of CO_2.

Analysis of the total CO_2 emissions in the city of Riga in 2012 and the deviation from 2011 and the period between 2008 and 2012 show the following:

- There has been an overall emission reduction of 4 % as compared to 2011 and of 14 % as compared to 2008. The steepest reduction rate as compared to 2011 has been in end-user fuel emissions (-20%), especially in the industrial sector;
- In the other sectors, however, (electrical power consumption and motor vehicle transport) emissions have started to grow by 1 % and 3 % respectively;
- In 2012, motor vehicles (36 %) and heat consumption from the district heating system (28 %) accounted for the largest share of the total emissions, while the remaining emissions came from fuel consumption in different consumer sectors (19 %) and electrical power consumption (17 %).

One of the ways to illustrate CO_2 emissions is to show them in a Sankey diagram. Figure 7.4 shows the sources of CO_2 emissions in the city of Riga in 2012. The width of the band representing the emission flow per energy and fuel type is proportionate to the emission volumes. As seen from the diagram, CO_2 emissions in Riga come from four main sources: the district heating system, gas consumption in end-user sectors, fuel consumption by motor vehicles and electrical power consumption.

Sustainable energy development may be assessed through an indicator that shows emission per resident of the city (t CO_2 /per capita.). This indicator relates to both trends in the use of renewable resources and trends in energy efficiency. Figure 7.5 shows CO_2 emissions in tons per capita in Riga. In 2012, CO_2 emissions per capita decreased by 2.7 % as compared to 2011. Over a five year period the value of the abovementioned indicator has decreased by 7.6 percentage points.

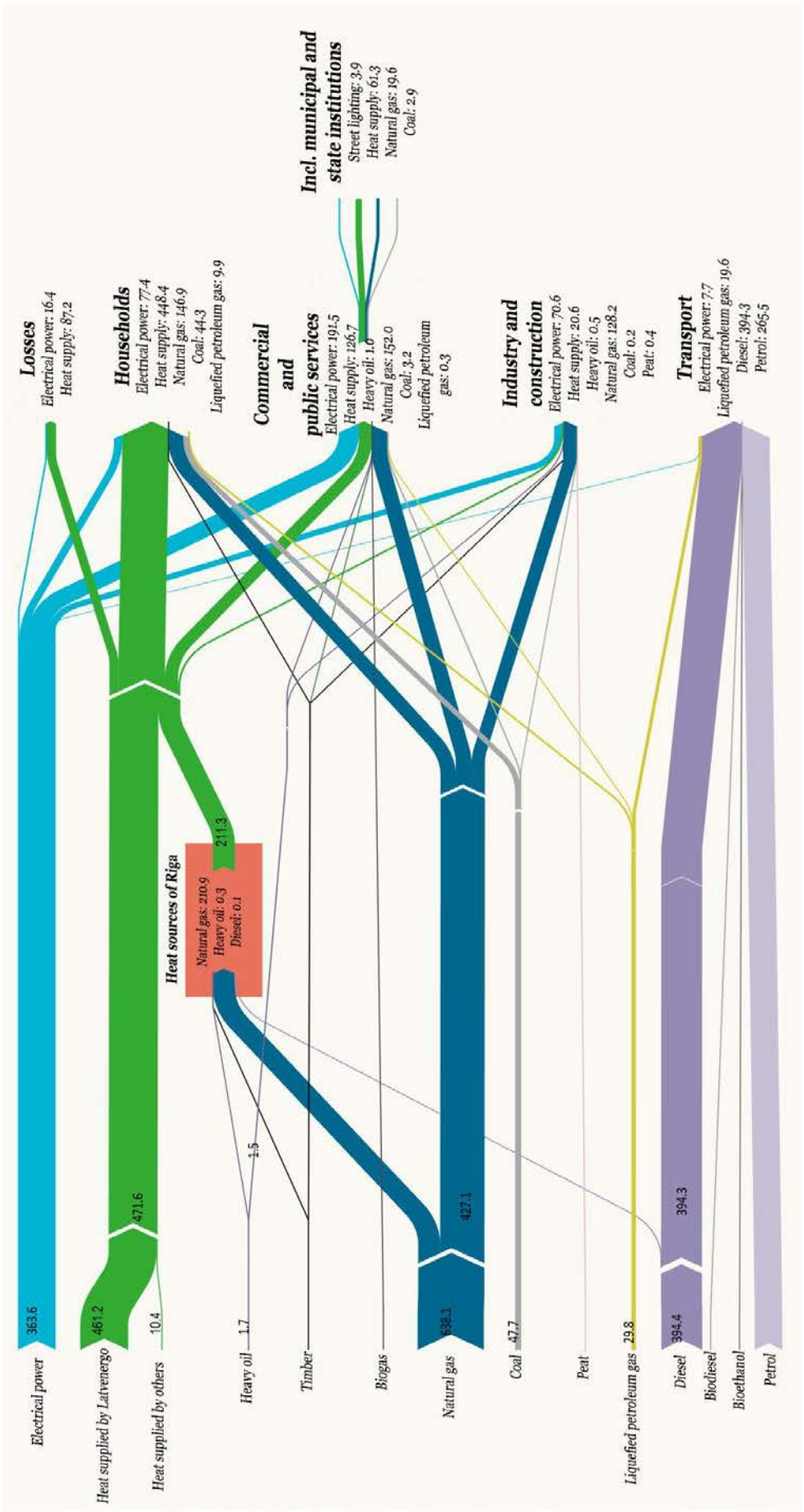


Figure 7.4. Source: Report of the Institute of Physical Energetics, March 2014

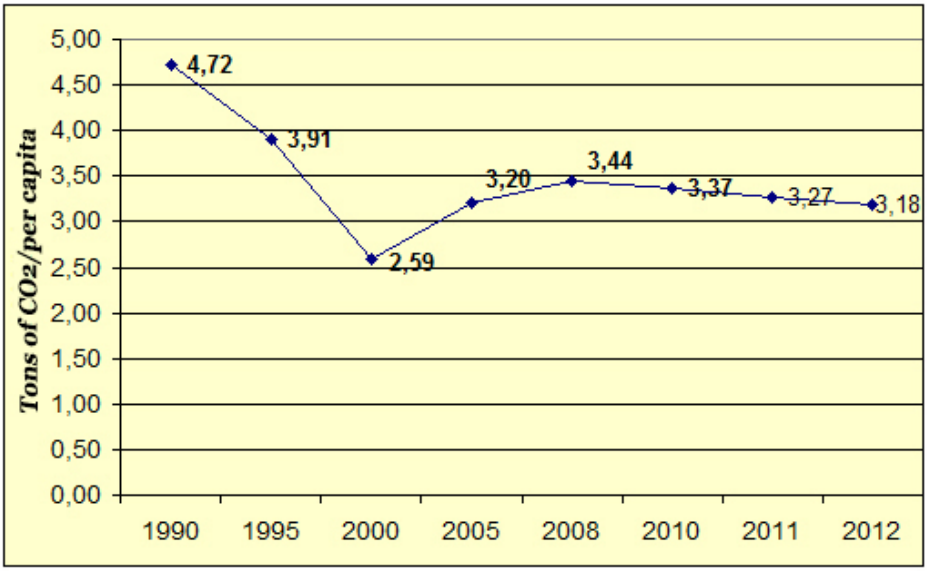


Figure 7.5. Source: Report of the Institute of Physical Energetics, March 2014

The following sections are dedicated to calculations of CO_2 emissions and trends by sector.

7.2.2 CO2 emissions from road transport

In order to calculate CO_2 emissions from transport in Riga, the overall traffic flow is roughly divided into three groups:

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

The number of cars registered in Riga has been obtained from the Road Traffic Safety Directorate (RTSD), which holds records about the motor vehicles registered in Latvia. Therefore, emissions have been calculated only from the cars in running order. Since 2008 emission calculations from the motor vehicles registered in Riga have been performed separately with regard to whether the vehicle is owned by a legal or a private person, with separate calculations for each group. The source of information for identifying the number of public use vehicles is the information aggregated by RTSD, the data recorded by the publicly owned JSC "Latvijas Valsts ceļi" and the data of the Public Transport Department of the Riga City Council. The number of incoming cars entering Riga is calculated by analysing the number of cars in running order registered in the Riga region and the data on the traffic flow moving into Riga and out of it (the information is submitted by JSC "Latvijas Valsts ceļi").

Apart from the abovementioned criteria, the vehicles have also been classified by fuel type (petrol, diesel and liquefied petroleum gas (LPG)) and by vehicle group:

- passenger cars;
- light duty trucks (< 3.5 t);
- heavy duty trucks (> 3.5 t);
- buses;
- motorcycles and motorbikes.

The COPERT IV (Computer Program for Calculating Emissions from Road Transport) model extensively applied in EU Member States has been used for calculating motor vehicle related emissions. In the present paper it has been applied for calculating emissions in the Riga city. The

COPERT IV model used for calculating fuel consumption and emissions from vehicles classifies passenger cars, light duty trucks, heavy duty trucks, motorcycles and buses into groups depending on their technical parameters and use. Passenger cars are classified by engine capacity, whereas trucks are classified according to tonnage, and buses – according to their function and routing (short-distance, urban, inter-city). Motor vehicles are classified by fuel type: petrol, diesel, LPG and natural gas. The production year is taken into account when introducing different classes/standards with regard to the legislative steps described in the EU directives containing the regulatory requirements on harmful vehicle-specific emissions (ECE, EURO) or technological steps ("Conventional").

The rapid growth in the number of cars after 2000 was the main cause of the growing fuel consumption and, consequently, the increase in CO_2 emissions in Riga before 2008. The economic downturn reduced the intensity of the traffic flow, especially over 2010 and 2011; however, in 2012 the numbers have grown again as compared to 2011. Figure 7.6 shows the number of passenger cars in Riga over the 1990–2012 period.

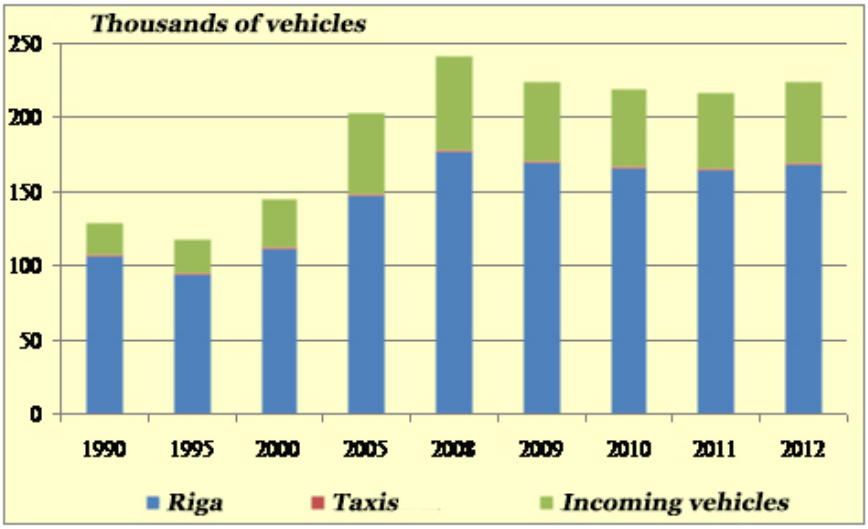


Figure 7.6. Source: Report of the Institute of Physical Energetics, March 2014

The total number of passenger cars by 2008 had increased by almost two times as compared to 1990. In 2012, the flow of passenger cars registered in the Riga district and driving into Riga grew by 2.4 percentage points and 13.5 percentage points accordingly, as compared to 2011. The fuel and the emissions of the motor vehicles were calculated by applying the COPERT IV model given the number of vehicles, the assumptions about their distribution into certain groups (by consumption of fuel, engine capacity, compliance to environmental standards, etc.) and average mileage per year.

Analysis of the structure of fuel consumption (see Figure 13) indicates that major changes have taken place. The share of petrol in the total consumption of fuel has gone down and consumption of diesel has increased. The change has been mainly caused by the switch-over of trucks, including light duty trucks from petrol driven engines to diesel engines, as well as the growing number of passenger cars which drive on diesel.

Changes in motor vehicle fuel consumption and structure in Riga 1990 – 2012

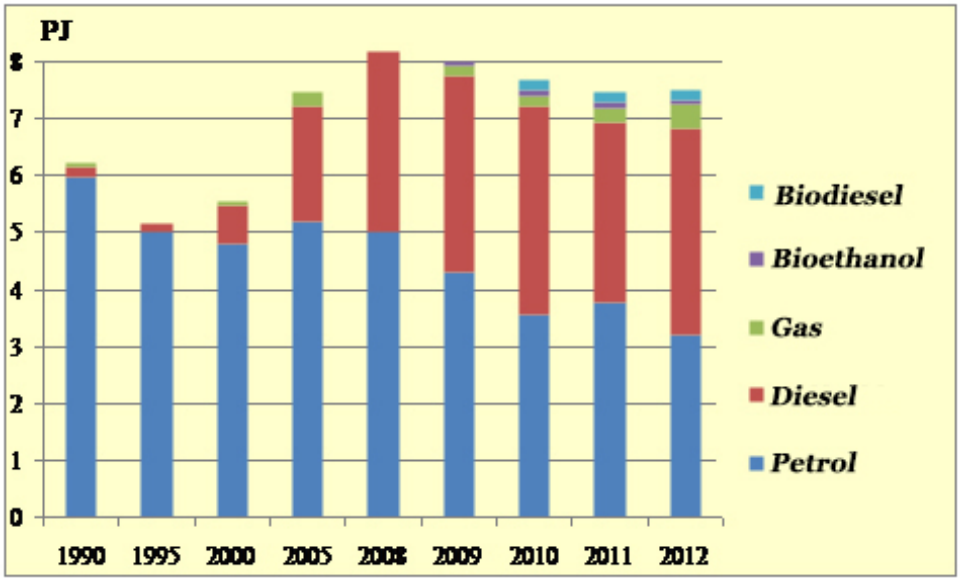


Figure 7.7. Source: Report of the Institute of Physical Energetics, March 2014

In 2012, the calculated fuel consumption in the transport sector of Riga grew by 1 percentage point. The calculated petrol consumption in 2012 declined as compared to 2011 by 14.7 percentage points, whereas the consumption of diesel and liquefied gas (LPG) grew by 13.6 and 68 percentage points respectively.

Notably, in 2012 the share of biofuel (bioethanol and biodiesel) in the total fuel consumption was 3.6 %.

The calculated transport related CO_2 emissions in Riga by traffic flows (in thousands of tons) have been shown in the following table:

Table No 7.2

Type of transport	2008	2010	2011	2012
Vehicles registered in Riga	658	565	555	510
Public transport vehicles	65	58	57	61
Incoming transport flow	155	127	125	171
In total	878	750	737	742

Emissions from motor vehicles accounted for 36 % of the total calculated CO_2 emissions in 2012. Analysis of the CO_2 emissions from motor vehicles shows that the highest share (69 %) can be attributed to the vehicles registered in Riga. The emissions from the vehicles driving into Riga have been steadily growing from 10 % in 2000 to 23 % in 2012. Public transport accounts for about 8 % of the total motor vehicle related emissions in the city of Riga.

The calculated motor vehicle related CO_2 emissions in Riga by separate vehicle types (in thousands of tons) are as follows:

Table7.3

Type of transport	2008	2010	2011	2012
Cars	605.8	535.2	518.7	522.1
Light duty trucks	102.9	98.8	104.9	110.7
Heavy duty trucks	85.0	36.9	35.8	34.6
Buses	83.9	78.1	77.3	74.3
Motorcycles	0.5	0.6	0.4	0.5
In total	878	750	737	742

From 1990 to 2012 the share of emissions from cars has increased from 69.2 % to 70.3 %. Taking into account the changes in the structure of fuel consumption, the share of petrol related emissions has declined, while the share of diesel emissions has increased in the total volume of CO_2 emissions from road transport. Light and heavy duty trucks account for about 15 % of the transport related emissions in the Riga city.

7.2.3 CO_2 emissions from the district heating system of Riga

District heating related emissions accounted for 28 % of the total emissions in the city of Riga in 2012. Emissions have decreased significantly over the period between 2000 and 2012. In 2012 they were by 23.5 percentage points lower than in 2000 even though heat consumption over the same period decreased by only 12.4 percentage points. This means that in addition to reduced heat consumption which is the major factor impacting emissions, there have also been improvements in the efficiency of the district heating system, resulting in a lower carbon footprint. Upgrading of heat sources, implementation of more efficient technologies and reduction of heat losses, together with the increased use of biomass (wood chips) have been the main factors leading to reduced emissions.

Heat consumption in the district heating system of Riga for calculating emissions, in GWh:

Table No 7.4.

Consumer sector	2000	2005	2008	2010	2011	2012
Households	2 425	2 475	2 270	2 520	2 220	2 372
Municipal and government institutions	321	343	327	367	303	324
Commercial and service sector	213	370	293	322	279	307
Industry	143	134	118	130	103	109
Other consumers	63	68	61	43	34	39

By 2012 the weighted average emission factor for the heat energy consumed by the district heating system of Riga (see methodology for calculating CO_2 emissions) had gone down by 13.3 percentage points as compared to 1990.

The chart below sets out the calculated weighted average emission factor of the Riga district heating system in the period between 1990 and 2012 in tons of CO2 /MWh:

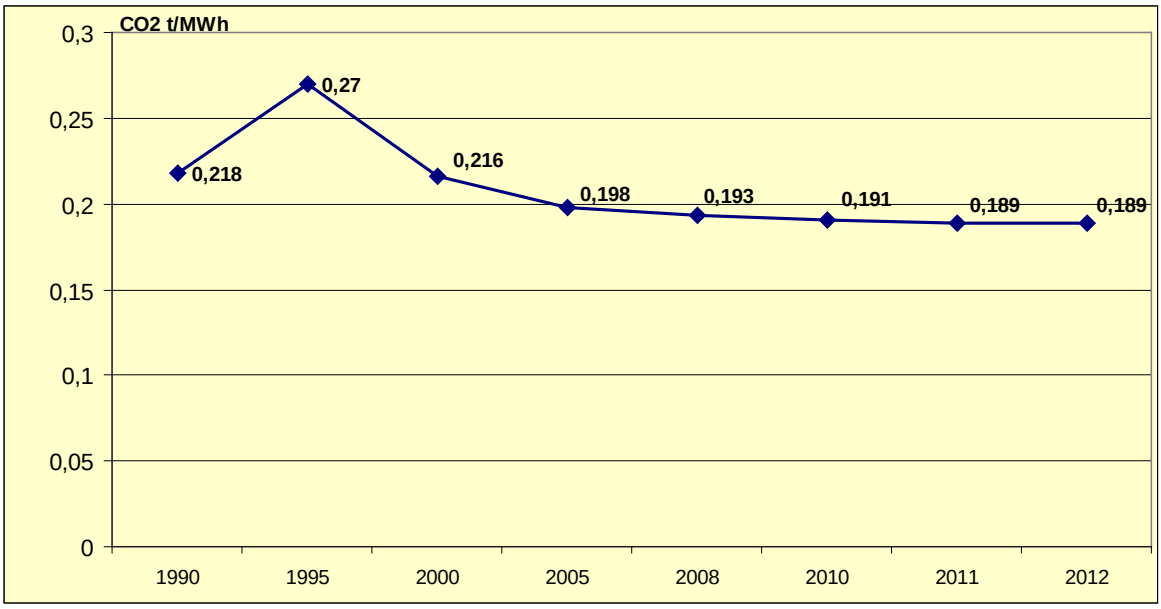


Figure 7.8. Source: Report of the Institute of Physical Energetics, March 2014

Heat consumption in the district heating system of Riga in 2000 – 2012 has been as follows:

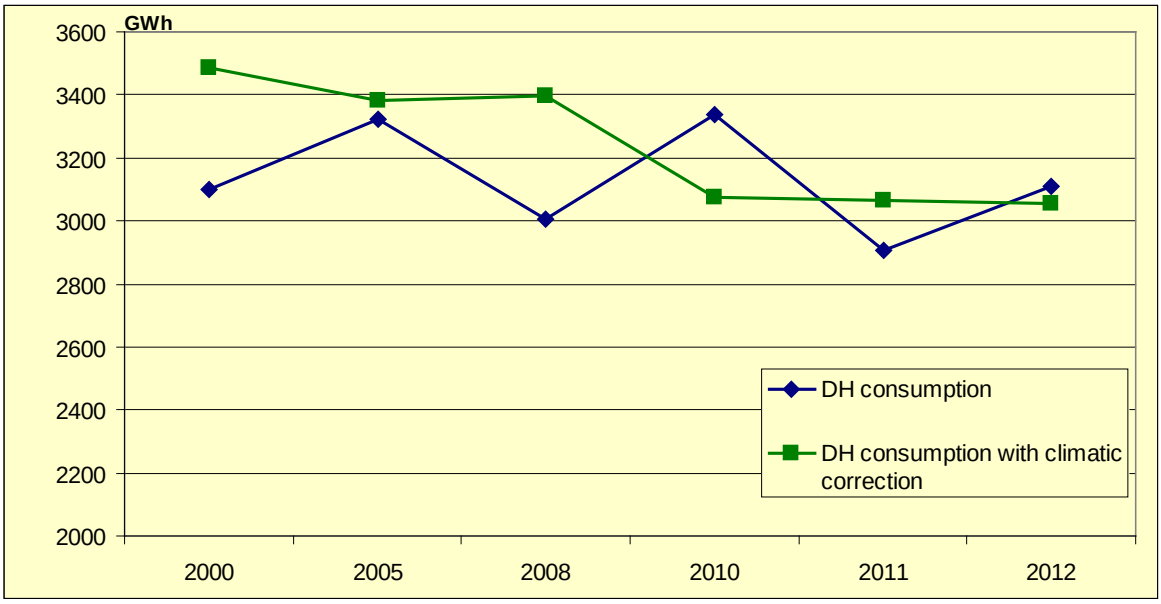


Figure 7.9.Source: Report of the Institute of Physical Energetics, March 2014

Because heat consumption is related to climate change and in order to gain an insight into the actual heat consumption and emission trends, the climate adjustment factor of heating degree days has been used in the analysis. The chart in figure 7.9 clearly speaks about the role of this adjustment factor in analysing heat consumption, since it illustrates both the variations in the actual heat consumption and the real trends in heat consumption between 2000 and 2012. Households have been the largest consumer of district heating. Having consumed 55 % of the total heat supplied in 1990, their consumption has further grown to reach 75 % in 2012.

District heating related CO_2 emissions in Riga over the period between 1990 and 2012 in thousands of tons of CO2 have been as follows:

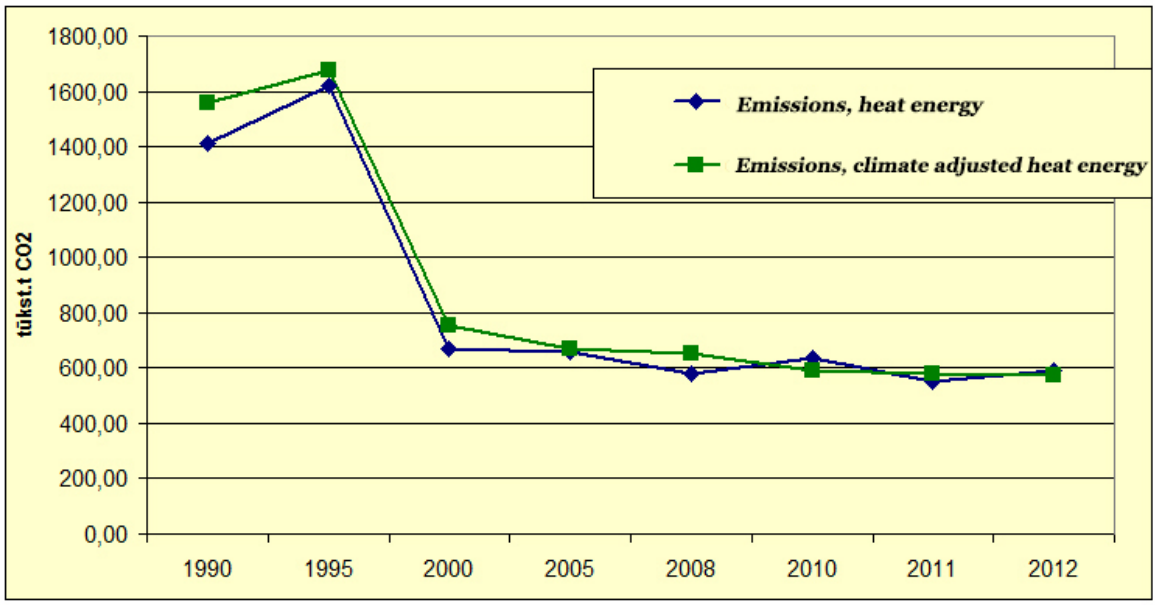


Figure 7.10. Source: Report of the Institute of Physical Energetics, March 2014

Analysis of the district heating system related CO_2 emission trends between 2000 and 2012 shows that reduction of climate adjusted heat consumption by 12.4 percentage points relates to reduction of CO_2 emissions by 23.5 percentage points. These figures clearly show the positive effect of the measures for improving the district heating system on CO_2 emission reduction.

Among the main factors leading to lower emissions were upgrading of the district heating system, reduction of heat losses in the system, extensive use of cogeneration technologies and changes in fuel composition with wider use of wood biomass. In 2012 the share of wood biomass among other types of fuel used for heat production at JSC "Rīgas Siltums" reached as much as 11 %.

7.2.4 CO_2 emissions from power consumption in Riga

As compared to 2011, in 2012 the total power consumption in Riga grew by approximately 2.6 percentage points. Analysis of the changes in power consumption shows a wide variance by consumer group (see Figure 7.11) between 2005 and 2012. There has been almost no change in the power consumption for street lighting, while economies in the electrical power driven vehicle sector have been an impressive 26.4 percentage points. In the household and service sectors consumption of electrical power has grown by 11.2 and 10.7 percentage points respectively. Industrial use has decreased by 11.1 percentage points.

Trends in power consumption in Riga between 1990 and 2012 (1990 =1) have been as follows:

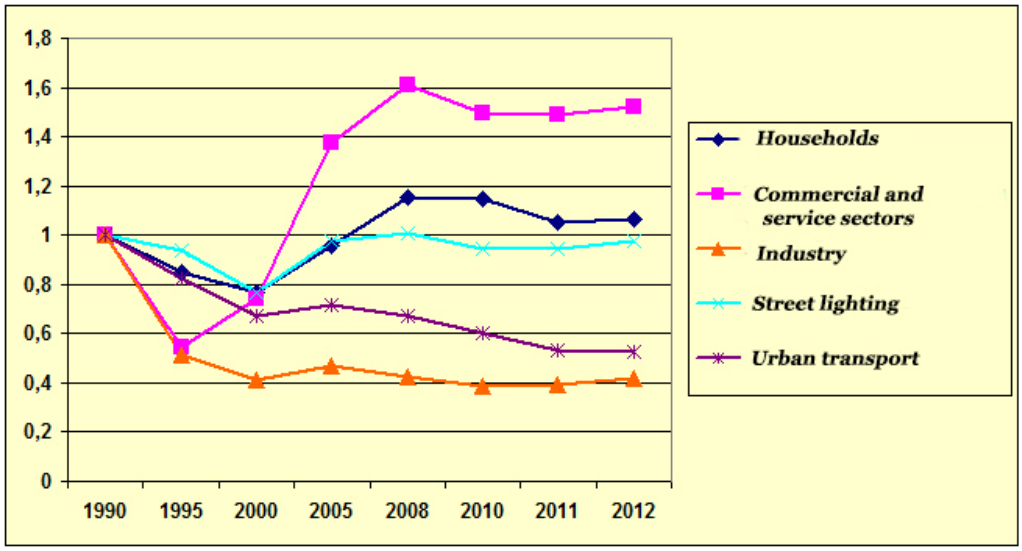


Figure 7.12. Source: Report of the Institute of Physical Energetics, March 2014

The trend in household power consumption is more accurately described by an indicator which shows the annual power consumption per capita or per household. After 1995 – 2000, when levels of consumption became stable, power consumption has rapidly grown over the past 10 years. The growth mainly relates to more extensive use of electrical household equipment and gadgets. As compared to 2005, in 2012 the indicator has grown by 21.9 percentage points.

Power consumption in households per capita in Riga has been as follows:

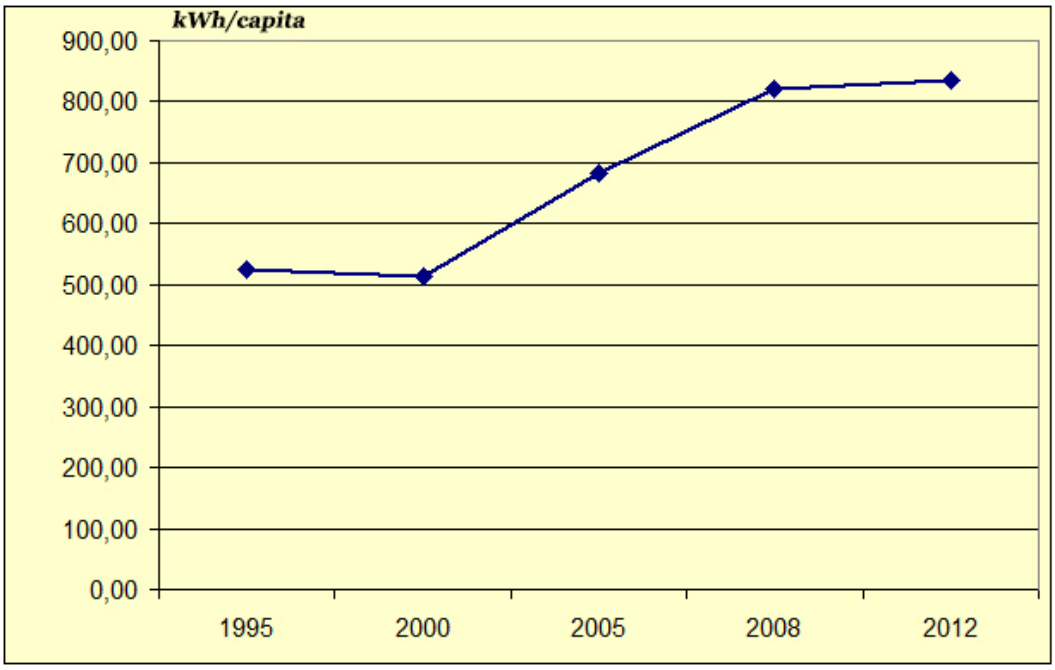


Figure 7.13. Source: Report of the Institute of Physical Energetics, March 2014

The emission factor used for calculating emissions from power consumption is 0.143 CO_2 t/MWh, which is in line with the average emission factor for electric power generation in Latvia.

Emission trends have mainly been affected by changes in electrical power consumption. As compared to 2011, in 2012 emissions from power consumption have grown by 2.6 percentage points. After the rapid growth between 2000 and 2008, there have been but minor variations. The CO_2 emissions related to use of electrical power in Riga between 1990 and 2012 in thousands of CO_2 have been as follows:

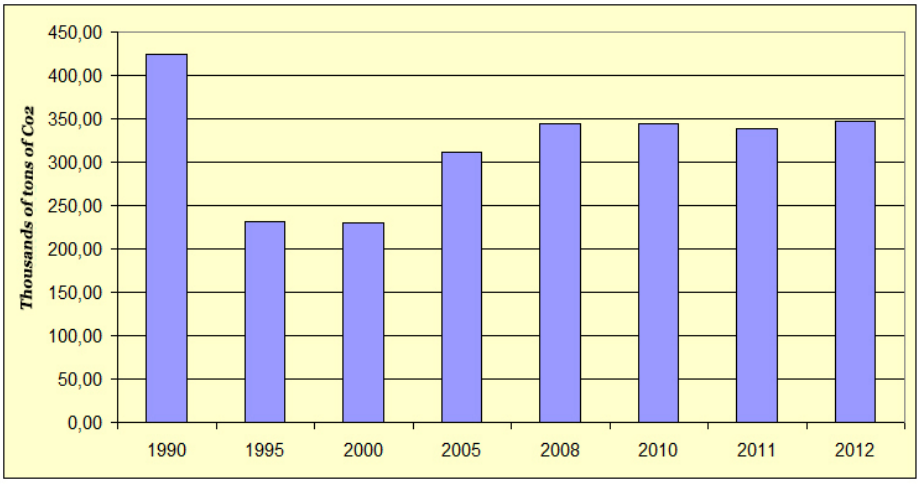


Figure 7.14. Source: Report of the Institute of Physical Energetics, March 2014

7.2.5 CO_2 emissions from end-user fuel consumption in Riga

In 1990, emissions from end-user fuel consumption accounted for a significant part of the total CO_2 emissions in Riga city, namely, for approximately 40 % of all the emission in the city. Over time this share has decreased almost two times (to 19 % in 2012) due to various factors; however, even though the trend has been favourable, reduction of fossil fuels in the end-user sectors still has to be seen as an important part of climate policy in Riga.

As compared to 2011, in 2012 CO_2 emissions from end-user consumption of fossil fuels decreased by 19.9 percentage points. CO_2 emissions from end-user consumption of fuel by type of fuel between 2005 and 2012 in thousands of tons of CO2 have been as follows:

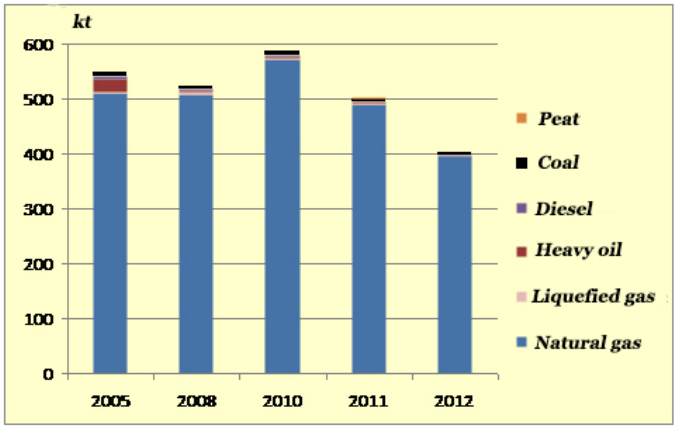


Figure 7.15. Source: Report of the Institute of Physical Energetics, March 2014

After the period between 1990 and 2000, when CO_2 emissions decreased significantly, there has been a period of relative stability. The reduction of CO_2 emissions after 1990 was related to the following factors:

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

CO_2 emissions from end-use of fuel in Riga by consumer group between 2005 and 2012 in thsd. of tons of CO_2 have been as follows:

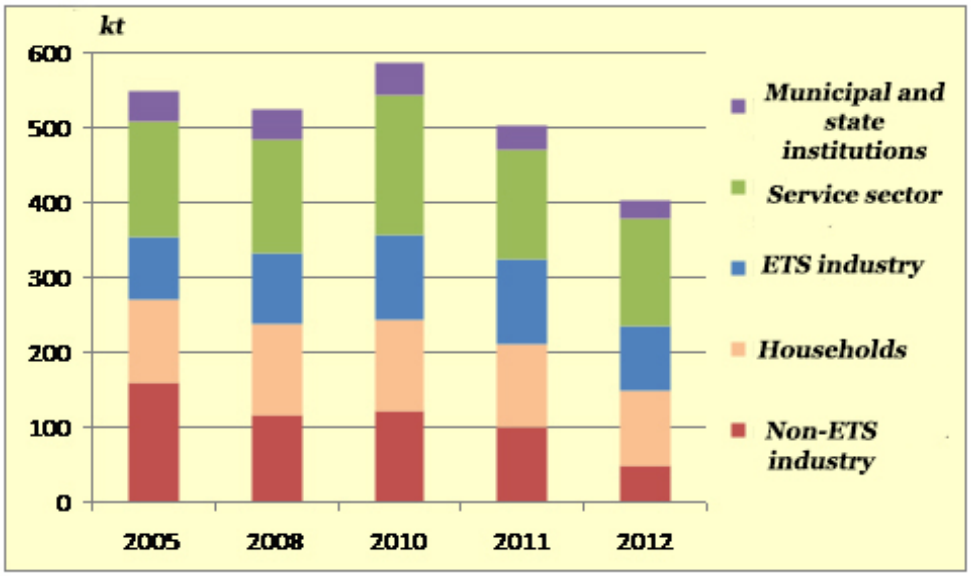


Figure 7.16. Source: Report of the Institute of Physical Energetics, March 2014

In 2012, the main sources of emissions from end user energy consumption were the service sector (35.3 %) and households (24.8 %), whereas the industrial ETS sector and the industrial non-ETS sector accounted for 21.7 % and 12.3 % of the total CO_2 emissions respectively. Emissions from fuel combustion related to the sector of municipal and state institutions accounted for 5.9 % of the total emissions from end-user fuel consumption in 2012.

The sharp reduction in CO_2 emissions from end-user fuel consumption is mainly related to a reduction of emissions in the industrial sector (both ETS and non-ETS industries). One of the reasons for the trend is replacement of fossil fuels (natural gas) with wood biomass in the larger production plants of ETS industry. A more detailed analysis of industry based emission trends would require a more detailed data base for recording fuel use.

Also, the prevailing climate conditions influence variations in emissions from end-user fuel consumption, since in the sector of municipal and state institutions, as well as in the service sector fuel is mostly used for heating. When planning for reduction of emissions, ETS industry businesses have to assess the CO_2 trading conditions and the long-term development plans of their companies. In other sectors it is advisable to use national and municipal support instruments for projects that focus on cutting down emissions through improved energy efficiency and replacement of fossil fuels with renewable energy resources.

End-user fuel consumption in Riga by type of fuel:

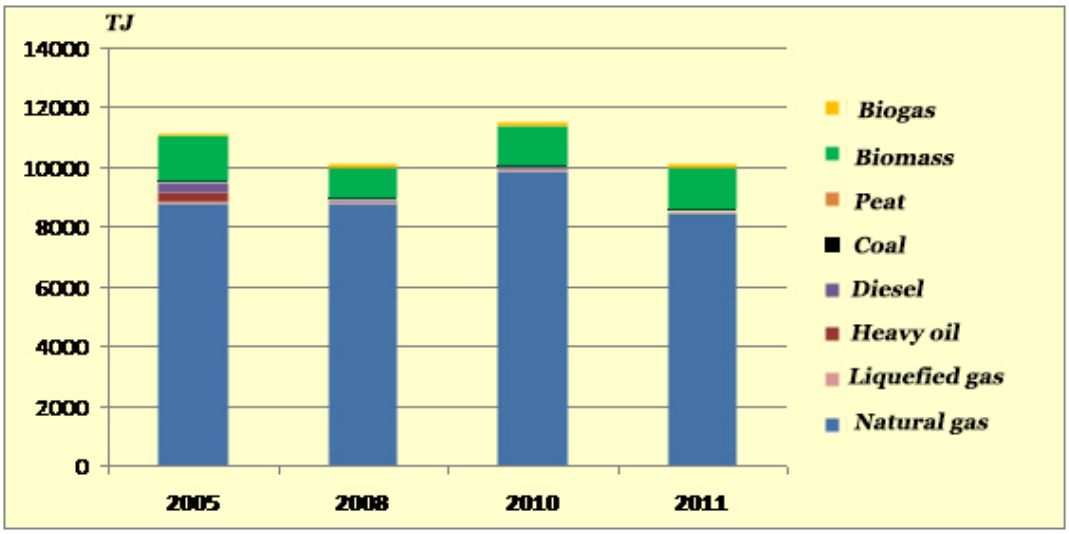


Figure 7.17. Source: Report of the Institute of Physical Energetics, March 2014

As compared to 1990, consumption of natural gas in absolute figures has decreased by approximately 2.5 times, whereas the relative share of CO_2 emissions resulting from natural gas has grown from 60 % in 1995 to 98 % in 2012; thus, other fuels have a considerably inferior role. As compared to 1990, the consumption of such traditional fuels like oil products and coal has in absolute figures decreased by approximately 40 times. The described fuel structure forms a basis for the future climate policies of the Riga city, which mainly focuses on more extensive use of renewable resources and energy efficiency; in turn, replacement of the "unclean" fossil fuel types will be relevant at specific sites, while the overall role of this measure will remain secondary.

The changes in the shares of renewable resources and fossil fuels in the total end-user energy consumption in Riga have been as follows:

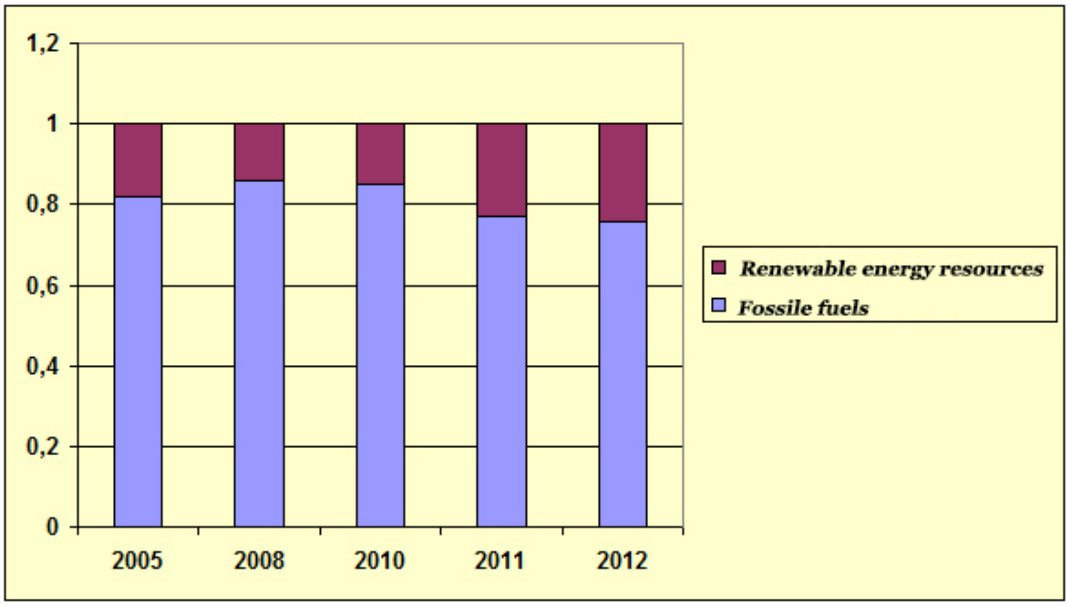


Figure 7.18. Source: Report of the Institute of Physical Energetics, March 2014

One of the measures aimed at reducing emissions is the use of renewable resources to replace fossil fuels. As shown by the chart, consumption of renewable resources (biomass and biogas) following the decline in 2008 and 2010 has been growing and has reached 24.5 % in 2012.

7.2.6 Impact assessment of CO2 emission reduction measures

Two impact assessment methods have been used to evaluate the efficiency of the measures for reducing CO_2 emissions in 2012. The first assessment method is the "bottom-up" method, which is based on the calculated or measured amount of energy either saved or replaced which has been adjusted by the respective fuel or energy emission factor. Generally, emission savings are calculated according to the following formula:

$$EM_{savings} = E * EF$$

where:

$EM_{savings}$ stands for the CO_2 emission savings in the reference year, t CO_2/per year;
E stands for the amount of fuel which has been saved or replaced with renewable energy resources per year, MWh;
EF stands for the emission factor for the energy or fuel type, t CO_2/MWh.

The second assessment method is the "top-down" method, which estimates changes in selected indicators related to energy consumption and emissions over a certain period of time and data of energy consumption in order to identify the volume by which emissions have decreased.

In 2012, the measures implemented in the production sector of the district heating system resulted in additional energy obtained without combustion or use of renewable resources:

- additional heat generated by the absorption type heat pump installed in the cogeneration block of HP "Imanta" (2 500 MWh);
- heat retrieved from flue gas by installing condensation economizers for boiler equipment (41 297 MWh);
- use of wood-chip biomass for energy production at JSC "Rīgas siltums" (89 532 MWh).

The impact of these measures was assessed by the "top-down" method. The potential emissions from the heat supplied by the district heating system are described by the indicator CO_2 t/MWh $_{th}$. Emission savings in the production sector of the district heating system over 2012 were calculated from changes in the abovementioned indicator values by applying the following formula:

$$EM^{CSA}_{savings.} = \left(\frac{EM_{2008}^{CSA}}{E_{2008}} - \frac{EM_{2011}^{CSA}}{E_{2011}}\right) * E_{2011}$$

where:

$EM^{CSA}_{savings}$ stands for CO_2 emission savings in the production sector of the district heating system, CO_2 t/per year;
EM_{2008}^{CSA}; EM_{2012}^{CSA} stands for the CO_2 emission volumes in the production sector of the district heating system in the respective years;
E_{2008}, E_{2012} stands for the amount of heat supplied to the district heating system in the respective years.

The calculated CO_2 emission savings from the measures implemented in the district heating sources in 2012 were 27 155 CO_2 t/per year.

The assessment of the impact on CO_2 emission reduction resulting from the measures has been summarized in the following table:

Table No 7.5

Measure implemented	Estimated reduction of emissions in 2012, t CO_2
Additional heat production by JSC "Rīgas siltums", through installing condensation economizers and an absorption-type heat pump	8 594
Use of biomass for energy production in the heat sources of JSC "Rīgas siltums"	18 561
Use of biofuel in motor vehicles	30 428
IN TOTAL	**57 583**

The impact of the other emission reduction measures listed in the table was assessed by the "bottom up" method, based on the amount of fossil fuels replaced in motor vehicles.

The estimated impact of the CO_2 emission reduction measures implemented in Riga in 2012 has been as follows:

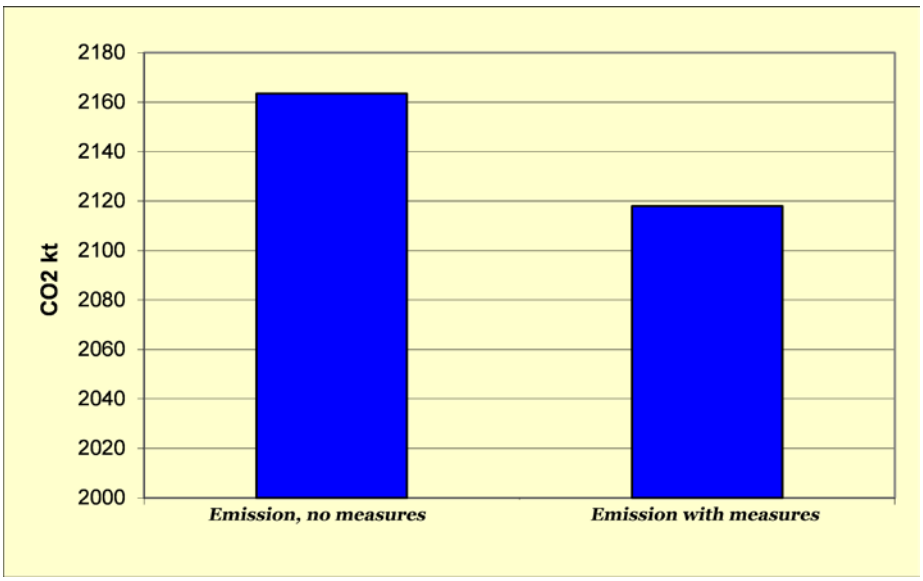


Figure 7.19. Source: Report of the Institute of Physical Energetics, March 2014

The assessment shows that in 2012 the implemented measures have reduced CO_2 emissions in Riga by 2.7 percentage points as compared to a scenario of "no measures".

7.3 Forecast of CO_2 emission reduction

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 the base or reference year of 1990, it is important to take into account the global economic downturn which Latvia, Europe and other countries have been facing and the forecasted relatively slow recovery. We are in a situation when there is hardly a possibility of any significant industrial growth which might result in an increase of CO_2 emissions in the industrial sector.

CO_2 emission forecasts until 2020 are based on the projected heat, electrical power and fuel consumption by end-users and the impact assessment of the measures implemented with a view to reduce emissions.

The amount of energy required is directly related to economic development; therefore, future energy demands have been calculated on the basis of macroeconomic assumptions: population numbers, gross domestic product (GDP), added value by sector of economy and industrial sub-sector, changes in private consumption.

A set of economic, technical and social factors that affect the demand for every single energy service or energy use has been identified in every sector of energy use. In the household sector these factors are as follows:

- Population numbers;
- Private consumption by the residents;
- Number of households;
- Total housing area;
- Projected new housing construction, etc.

The selected factors in the transportation sector are: the total number of kilometres per year covered by passenger cars, light and heavy duty trucks and busses.

The calculated energy consumption by sector and by energy type (heat supplied by the district heating system, electrical power, and fuel) is based on historical correlations between changes in the abovementioned parameters, forecasts of gross domestic product by sector and defined trends in the development of economic, technical and social factors.

Consumption of heat from the district heating system by 2020 is going to be determined by trends in the consumption of two consumer groups, i.e. the already existing buildings and newly constructed buildings. Even though construction volumes have been decreasing over the past few years, urban development is going to result in a higher load on the district heating system.

With restricted access to data on specific consumer group and technological and technical development, the econometric method can be used for forecasting. The econometric method uses a number of macroeconomic indicators and calculated indexes as input. The method postulates a hypothetic relationship between energy consumption and a number of external parameters. The most important factors are trends in GDP, population numbers and income levels and flexibility factors, which describe the interaction of GDP and energy consumption trends. Data on projected sites to be connected to the grid provide additional input for forecasting electricity consumption.

The next step after projecting energy and fuel consumption is to develop a forecast of the total CO_2 emission volumes in a scenario of “business as usual” which presumes no emission reduction measures. This is followed by a final CO_2 emission forecast based on the chosen scenario for reducing emissions.

The impact of emission reduction measures is assessed on the basis of the projected energy savings or the replaced amounts of fossil fuel adjusted by the emission factors for the respective energy or fuel type.

The table below lists the main measures for reducing energy consumption, increasing energy efficiency and use of renewable energy for the period 2013 - 2020 set in SEAP:

Table 7.6

Measure	See Table No in the smart city SEAP	Results forecast for 2020	Forecast of CO_2 emissions' reduction by 2020 [t per year]
Energy efficiency measures, in thousands of MWh per year			
1. Produce additional heat per calendar year with the use of condensation economisers installed in the heat sources of JSC "Rīgas siltums"	Table No 9.3, Line 4	**45.0 /52.0/57.0***	**8.5/9.8/10.7***
2. Produce additional heat per calendar year with the use of the absorption-type heat pump in the cogeneration unit of HP "Imanta"	Table No 9.3, Line 5	**2.5/4.0/6.0***	**0.5/0.8/1.1***
3. Produce heat per calendar year with the use of wood chips for the production of energy at JSC "Rīgas siltums"	Table No 9.3, Line 6	**322/402/483***	**66/83/111***
4. Renovate buildings connected to the district heating system to achieve a 1.5 % yearly reduction in heat consumption by consumer as compared to the average heat energy sold over 2010, 2011and 2012.	Table No 9.10, Line 17	**331.52**	**62.5**
Measures for use of renewable energy, in thousands of MWh per year			
5. Use solar collectors for hot water preparation in buildings	Table No 9.4, Line 3	**3/ 4.5/ 6***	**0.6/0.9/1.1***
6. Capture geothermal energy with the use of heat pumps for heat supply to buildings	Table No 9.4, Line 5	**25/35/45***	**3.5/4.8/6.2***
7.Produce heat energy locally with the use of boiler equipment operating on pellets	Table No 9.4, Line 6	**18/25/32***	**4.5/6.1/7.9***

Measures in the transport system			
8. Extent of bio-fuel use in municipal public transport, % of the total fuel consumption	Table No 9.13, Line 6	**7/ 8.5/ 10%***	**7.8/15.6/23***
9. Number of hydrogen powered (both fuel-cell and battery) vehicles replacing city busses	Table No 9.13, Line 7	**20/30/40***	**0.9/1.5/2.0***
Total emission savings in 2020, in thousands of t of CO_2			**154.8/185/225.5**

*) minimum/optimum/maximum forecast

The final CO_2 emission forecast until 2020 is based on the CO_2 emission forecast in a scenario of "business as usual" with no measures implemented and the assessed impact of measures implemented in three different scenarios:

Table No7.7

Scenario	Actual emissions in reference year (1990), in thsd. of t CO_2	Actual emissions in 2010, in thsd. of t CO_2	Projected emissions in 2020, in thsd. of t CO_2	Reduction against reference year, %
Minimum	4 295	2 271	2 005	**53.3**
Optimum	4 295	2 271	1 956	**54.5**
Maximum	4 295	2 271	1 880	**56.2**

The forecast, which in view of the economic crises has been projected with a deal of caution**, is over 50 % with a goal of 55–60 % set for 2020.**

8. INNOVATIVE INFORMATION AND COMMUNICATION TECHNOLOGIES FOR INCREASED ENERGY EFFICIENCY

8.1 Cloud computing as a basis for the implementation of e-Riga and the universal workplace

Electronic solutions and technologies have become an integral part of every individual's life and are a natural tool of any business focused on development and growth. Mobility, promptness and functionality are concepts that describe the quality of our life in the context of our social and personal life and in the business environment. As we witness the development of the ICT sector over the past years and the services requested by businesses and the community and the respective solutions developed and offered by the ICT sector, it becomes obvious that people increasingly acknowledge the growing role of ICT, take the respective technologies on board and apply them extensively. ICT belongs to "green technologies", which significantly reduce the use of resources and have a direct impact on energy efficiency.

The Riga municipality is among the leading municipalities in Latvia both in the development of effective e-governance and in creating and implementing a universal workplace. The three most effective modules which are of immediate benefit to the residents are:

1) electronic signatures for approval of the decisions of the Municipal Council and other documents;
2) electronic storage of accountancy documents;
3) e-mail addresses for all the municipal employees linked with other cloud computing solutions.

The solutions were developed in reaction to the growing volumes of information required for taking the best decisions, as well as the growing public demand for accessible and easy-to-use public sector services and the ICT support increasingly required by the municipality staff to cope with their work tasks.

The next logical step was the creation and implementation of the universal workplace. The way it works can be schematically shown as follows

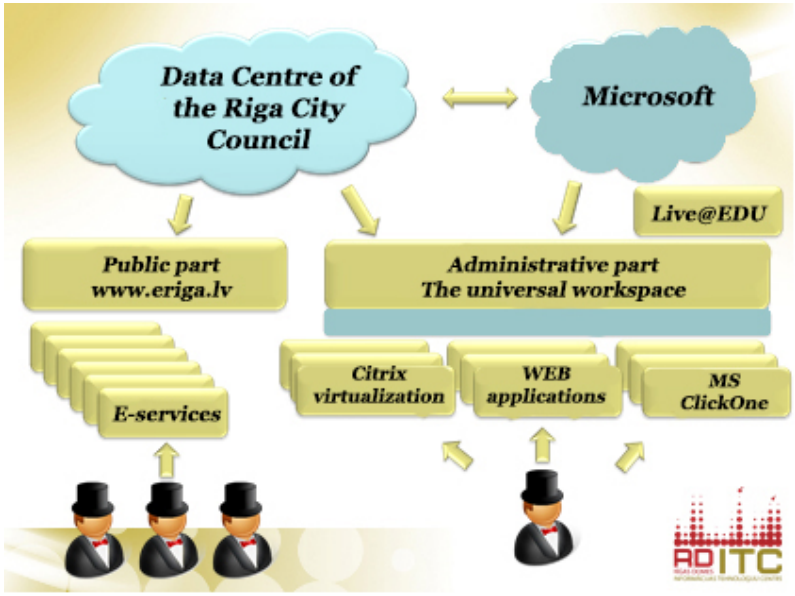


Figure 8.1.Source: the Information Technology Centre of the Riga City Council

The universal workplace with access to data systems allows to work from remote locations from a mobile computer. A good example is the international project manager of the municipal agency REA who even during her maternity leave can follow up on the implementation of projects, which allows her to maintain a link with her work and retain her job qualification. In theory it would be able to make the necessary arrangements for the parent to work remotely from home during the first year when the child needs care and during further periods when home care is required during sickness. The arrangements would effectively relieve both the mother and the employer from stress and provide a positive solution for the employment challenges of women in the reproductive age.

The municipal libraries provide access to computers and the internet free of charge. The municipality in cooperation with the LTD "Lattelecom" has provided free wireless internet coverage in the parks and squares (Vērmanes garden, Bastejkalns, Grīziņkalns, Ziedoņdārzs, etc.), at public transport stops, on separate lines of public transport and in other locations. In 2013 there were as many as 600 free wireless internet access points provided by LTD "Lattelecom" in Riga.

8.2 Integration of ICT into the energy system

Modern IC technologies are promptly becoming part of the energy processes which leads to advancements in energy production, transmission and consumption. A modern and easily accessible infrastructure is being developed. The smart city SEAP contains descriptions of smart city related technical solutions which integrate information and communication technologies and result in energy savings and energy obtained without combustion or with the use of renewable resources. These solutions in the form of demonstration projects have been included in the publicly accessible e-catalogue prepared by municipal agency REA "Best practice projects for a smart city" available on the REA website www.rea.riga.lv in the "Energy efficiency" section. These solutions that have been proved efficient are recommended for multiplication in the municipalities of Riga and elsewhere in Latvia and abroad. The smart city SEAP indicates the following 16 best practice projects:

1) Improvement of energy consumption management in multi-apartment residential buildings;
2) Energy consumption management system in the public sector buildings;
3) Local biogas co-generation with heat utilized in the greenhouse complex;
4) Use of programmed LED lamps for city lighting with remote voltage control;
5) Recover heat from flue gas and cooling flows in energy production plants;
6) Automatic reading of heat consumption data with remote data transmission in the urban district heating system;
7) Introduction of e-tickets and discounts for specific social groups in the municipal public transport;
8) Data-base for multi-apartment residential buildings in Riga;
9) Use of heat pumps with thermoprobes installed by deep drilling for heat supply to buildings in the city;
10) Wood-biomass fuelled boiler house operated in an automatic mode with an efficiency rate >100%;
11) Electric cars for providing municipal technical services;
12) Solar batteries on the roof tops of buildings in the city;
13) Facilitation of energy efficiency in households with the use of smart technologies;
14) Use of solar pumps for heating;
15) Waste water heat recover from multi-apartment residential buildings;
16) Remote reading and transmission of smart meter data in power supply.

Best practice projects continue to be developed and implemented. When their results have been examined, they are going to be included into the e-catalogue of municipal agency REA and the respective data will become part of the Progress Reports of the smart city SEAP.

8.3 Integration of ICT into the system of transport

A single e-token (e-ticket, e-card) valid for all means of transport including passenger rail transport within the city boundaries has been introduced. Some of the e-tickets have multiple functions. The e-tickets for schoolchildren serve also as registration tools granting entrance into the school building and free lunch. For retired residents in the low-income group they are a registration tool for accessing free charity meals, etc. Introduction of the e-ticket in the city is administered by the company LTD "Rīgas karte". The single e-ticket is an efficient means of following-up on passenger flows for the purpose of adjusting public transport schedules. The schedules are made available on a web-site and can be accessed via a mobile phone.

Additionally, the e-card is also valid as a means of paying for parking in the city centre car parks serviced by LTD "Rīgas satiksme". The plan is to use them also for paying for electrical power at the free parking spaces with slow-charging equipment for electrical cars.

ICT provides the residents with the required information on the location of the charging stations for electrical cars, presence of traffic jams and alternative routing, state of the roads, road repairs and their circumvention. The navigation systems help to select the shortest route and to save on fuel and time, as well as to follow the routes taken by company owned vehicles.

9. THE POTENTIAL FOR REDUCING ENERGY CONSUMPTION, IMPROVING ENERGY EFFICIENCY AND INVOLVING RENEWABLE ENERGY RESOURCES AND UTILIZATION OF THAT POTENTIAL IN RIGA IN THE PERIOD BETWEEN 2013 AND 2020

9.1 PRODUCTION AND MANAGEMENT OF ENERGY

9.1.1 HEAT SUPPLY

9.1.1.1 The urban district heating system

Heat production and management

The city has a well-developed district heating system which provides for about 76 % of the total heat energy consumption and can be tracked back to 1955. In 1996 a single heat supply company JSC "Rīgas siltums" with mixed capital ownership was established; in 2013 the shareholders were the Riga City Council (49 %), the Government of Latvia (48.995 %), LTD "Enerģijas Risinājumi. LV" (2 %) and JSC "Latvenergo" (0.005 %). Since 1998 the heat supply system has been rehabilitated and upgraded turning "Rīgas siltums" into a powerful and modern heat supply company in Eastern Europe with excellent productivity indicators and one of the lowest heating tariffs compared to the rest of Latvia and the other capital cities of the Baltic States. JSC "Rīgas siltums" has taken part in the sustainability index survey of FY 2011/2012 where it won the "Silver Group" award. This is proof that the company pursues a policy of sustainability with active stakeholder involvement and implementation of processes to identify and manage risks and

opportunities. By 2012 the company has concluded 6 317 agreements on supplying heat to 7 423 buildings with 8 078 heat units in Riga.

The amount of heat supplied to customers over the past 5 years has been shown in the following chart:

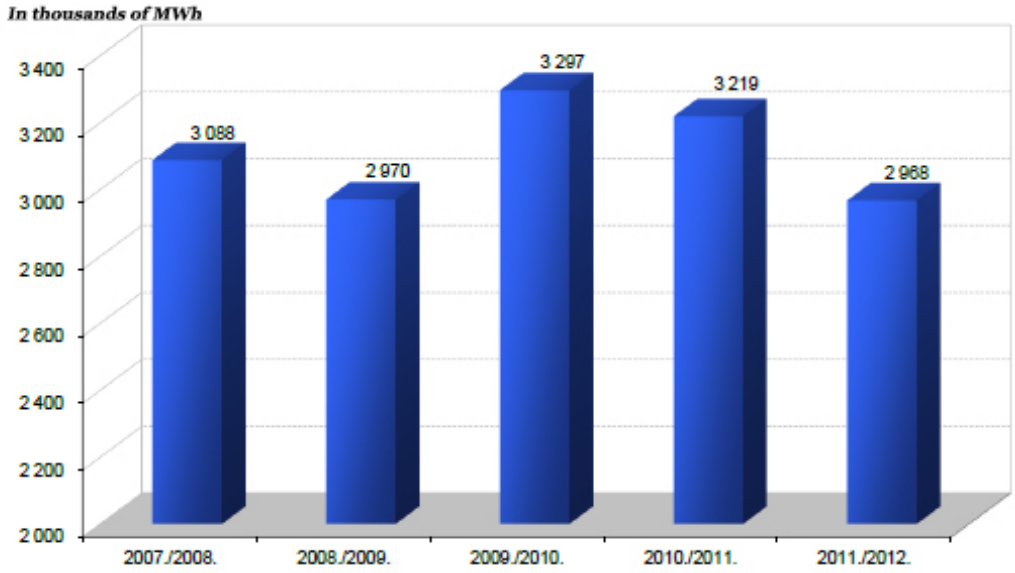


Figure 9.1. Source: annual statement of JSC "Rīgas siltums", 2012

As compared to the previous period, there has been a 2.8 % reduction of supply in 2011/2012 related to a milder winter season and a 10 days' shorter heating period, as well as energy efficiency measures implemented by and for the end-users. The table below compares the duration of the heating season, average out-door temperatures and the heat supplied to the consumers over the past 5 years:

Table 9.1

Fiscal Year	Heat supplied to the consumers, in thousands of MWh	Average outdoor temperatures during the heating season ^{0}C	Duration of the heating season, days
2007./2008.	3088	2,5	201
2008./2009.	2970	1,8	192
2009./2010.	3297	-0,3	201
2010./2011.	3219	-0,4	192
2011./2012.	2968	1,4	193

JSC "Rīgas siltums" uses a network of about 900 km of pipelines for heat distribution. It owns 678.54 km of pipelines with 212.07 km constructed with the help of state-of-art trenchless technologies. The chart below shows the part of the JSC "Rīgas siltums" network reconstructed or newly constructed over the past 5 years:

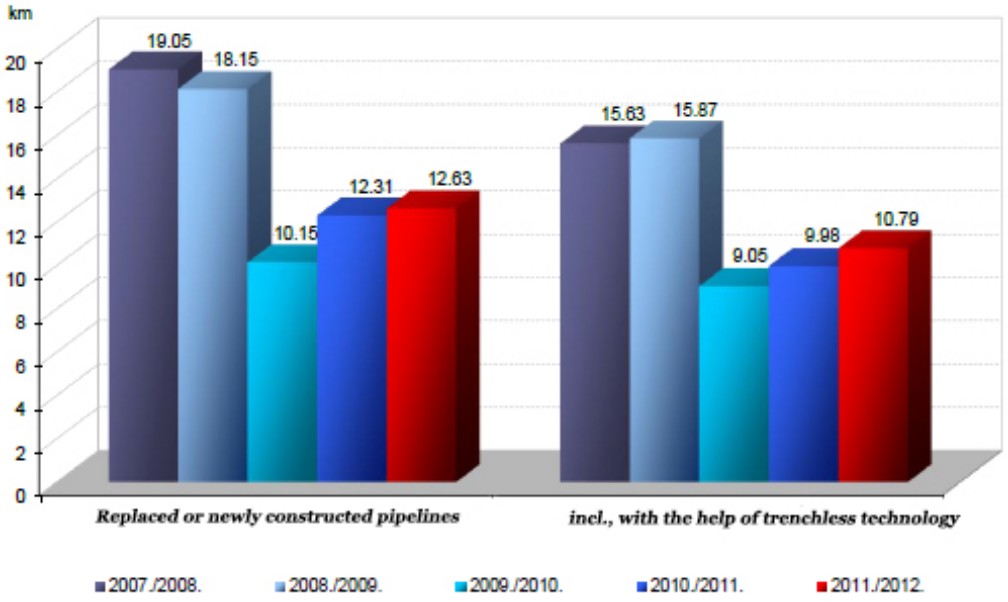


Figure 9.2. Source: annual statement of JSC "Rīgas siltums", 2012

These activities have helped to maintain a low level of heat loss in the transmission networks which has been about 13 % even with the reduced heat supply volumes. The chart below shows the annual reduction of heat losses over the past 5 years:

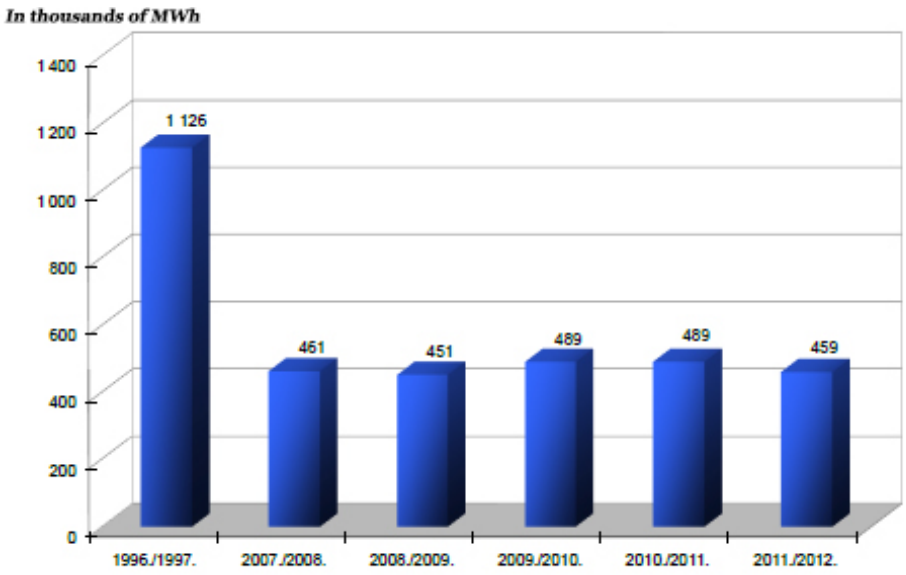


Figure 9.3. Source: annual statement of JSC "Rīgas siltums", 2012

Changes in heat consumption have also been affected by separate consumers who have chosen to disconnect from the district heating system and new clients connected to the network. The disconnected and newly connected customers over the past 5 years are described in the following graph:

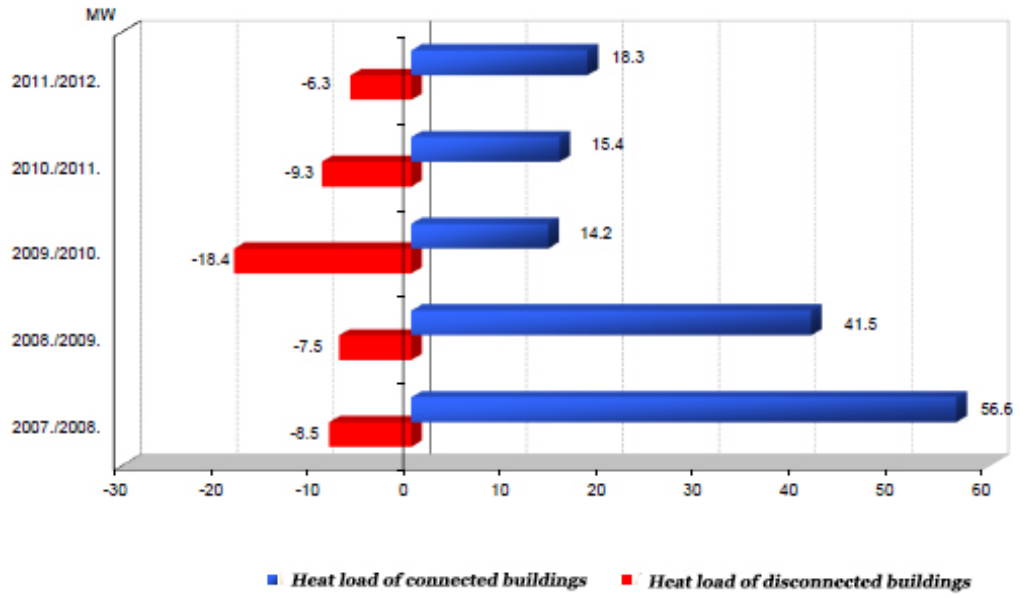


Figure 9.4. Source: annual statement of JSC "Rīgas siltums", 2012

As the economic situation of the country has improved, more new clients have been connected to the district heating system. Also in 2012 a number of new national scale construction projects have been completed, for example, the Latvian National Library building on Mūkusalas Street 3, the National Blood Donor Centre Sēlpils Street 6 and the JSC "Biroju centrs 'Ezerparks'" State Revenue Service building on Talejas Street 1 (in 2013) and other important construction projects which are no less important, i.e. residential housing for low-income groups implemented by LTD "Rīgas pilsētbūvnieks".

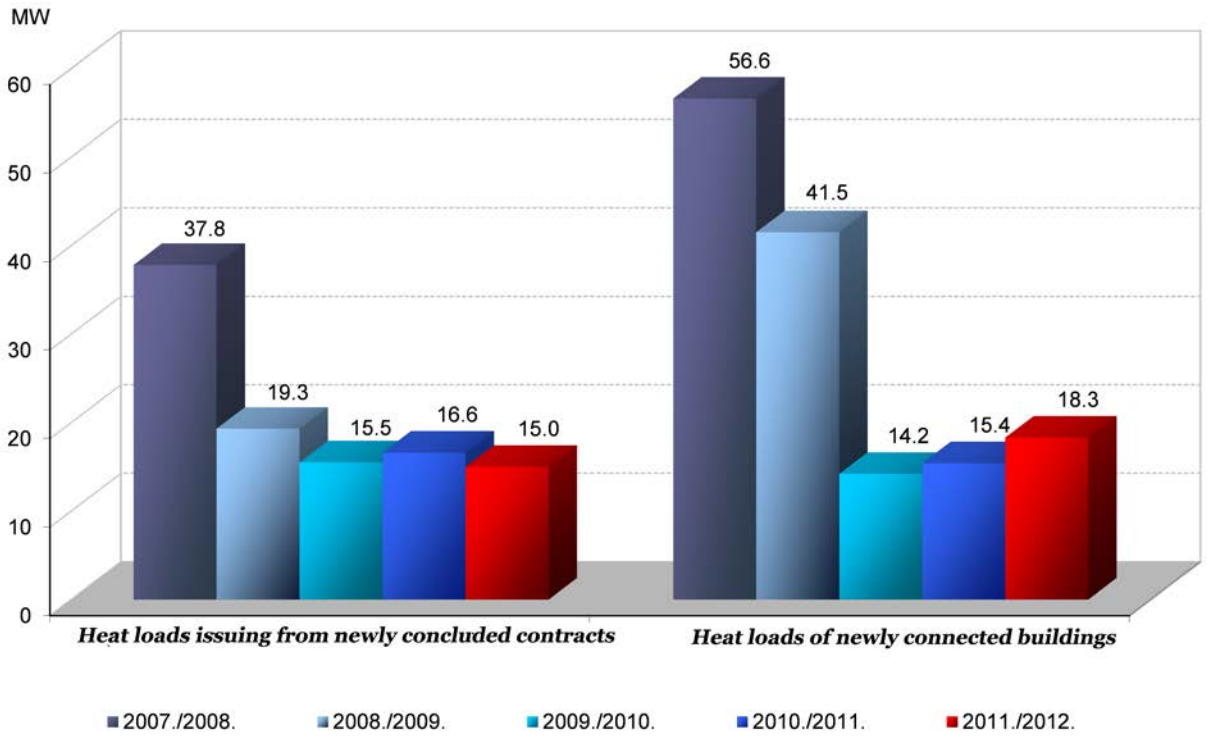


Figure 9.5. Source: annual statement of JSC "Rīgas siltums", 2012

The city has sufficient reserve capacity for heat production and there are no plans for constructing new heat sources fuelled by natural gas. It has been taken into account that by 2020 heat consumption is going to decrease by at least 1.5 % annually as a result of energy efficiency measures; heat will also be retrieved into the heating system from the technological flows and there are going to be other measures covering any additional heating requirements the city may have. The city has implemented a separate solution for trigeneration on the basis of the co-generation unit with the high capacity absorption type heat pump at HP "Imanta" through lowering the temperature of the technological coolants of the combined cycle cogeneration station. An important task by 2020 is to implement a district cooling supply, involving new applications.

Heat consumption by consumer group

A comparison of the heat consumption by consumer group over a calendar year shows that it heavily depends on average outdoor temperatures; the trend, however, is for consumption to decrease in line with the energy efficiency measures implemented for and by the end-users.

Table 9.2

Consumer group	Heat delivered in thsd. of MWh		
	2010	2011	**2012**
1. Households/inhabitants	2 520	2 220	**2 372**
2. Municipal and government institutions	367	303	**324**
3. Commercial and service sector	322	279	**307**
4. Industry	130	103	**109**
5. Other consumers	43	34	**39**
IN TOTAL	3 382	2 939	**3 151**

Source: JSC "Rīgas siltums"

Heat delivered by customer group can be graphically shown as follows:

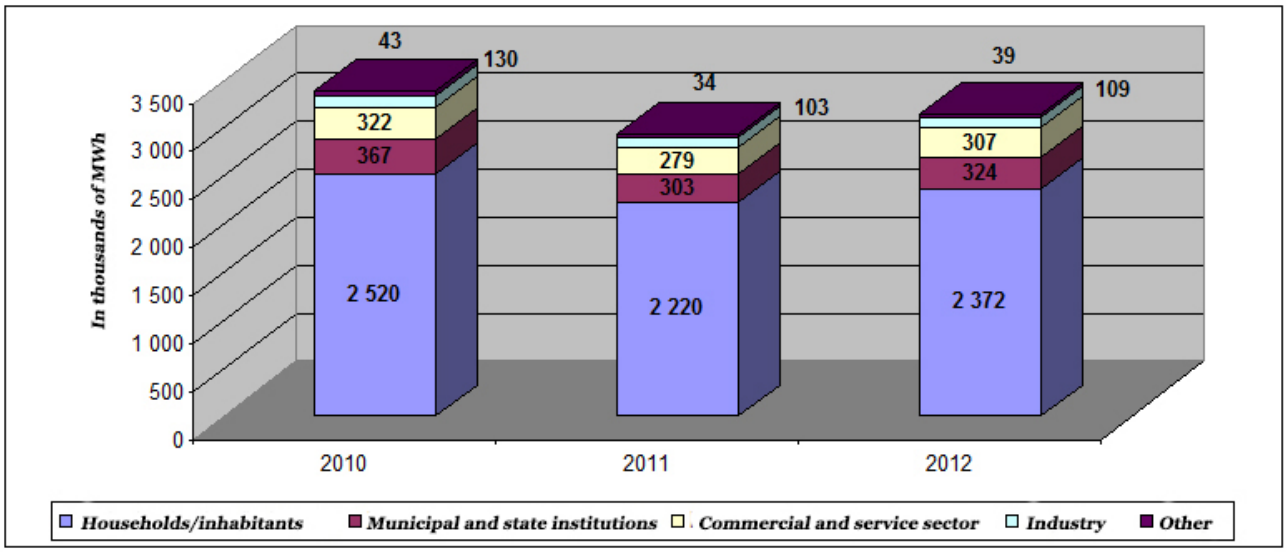


Figure 9.6

Recover of heat from flue gas and cooling flows

With a view to improving energy efficiency, JSC "Rīgas siltums" has implemented a number of measures in the heat sources two of which are of major importance and as best practice examples have been recommended for transfer to other heat supply systems and summarized in the proposal ***"Recover of heat from flue gas and cooling flows in energy production plants"*** included in the e-catalogue ***"Best practice projects for a smart city"*** prepared by the municipal agency REA in 2013. The e-catalogue is publicly available on the REA website www.rea.riga.lv .

The abovementioned best practice examples are as follows:

1) Flue gas heat recover implemented since 2008 by installing after the boiler a condensation type economizer which utilizes not only the physical heat of the flue gas, but also the flue gas water vapour condensation (latent) heat by cooling the flue gas below dew point temperature. This allows increasing the capacity of the boiler installation by 7-30 % without additional combustion. The equipment after the natural gas fuelled boiler is operated at HP "Imanta", boiler house (BH) on Keramikas Street 2a, BH Viestura Prospekts 20, BH Trijādības Street 5, BH Nautrēnu Street 24, BH Bauskas Street 207a and BH Gobas Street 33a, after a wood chip fuelled boiler – at HP "Vecmīlgrāvis", HP "Zasulauks" and HP "Ziepniekkalns". In ***2012 the measure resulted in 41 297 additional MWh produced with no extra fuel consumption.***

2) At the HP "Imanta" cogeneration block the heat from low potential cooling flows for gas and steam turbine and gas compressor cooling is recovered by using a high capacity (2 MW) absorption type heat pump with a LiBr absorbent. The heat with higher potential required for operating the heat pump is provided by the auxiliary steam boiler in the HP. Before the heat pump was installed, low potential cooling flows were cooled in an open type cooling tower which is not used any longer. The flowchart below illustrates the operation of the heat pump:

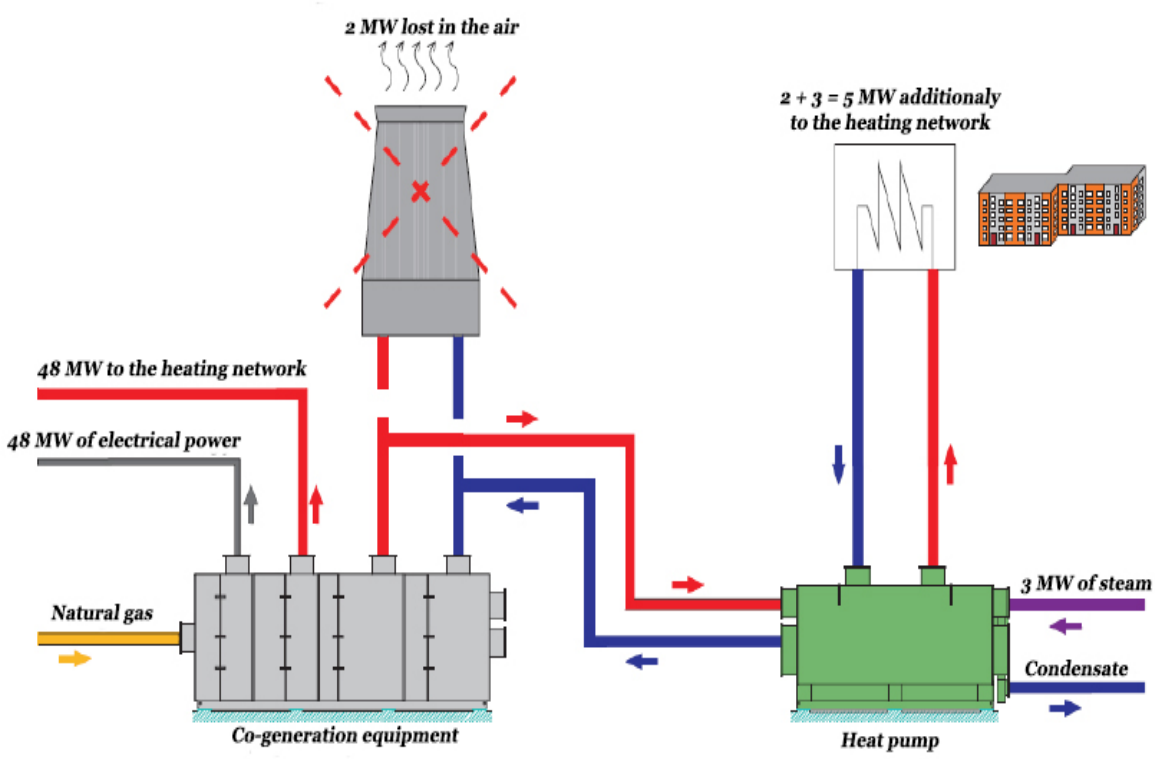


Figure 9.7. Source JSC "Rīgas siltums". E-catalogue "Best practice projects for a smart city".

The measure was introduced towards the end of 2010 and allows for extra heat production with no additional fuel. ***The additional heat energy obtained over 2012 was 2 500 MWh.*** The figure below shows the high capacity absorption type heat pump installed at HP "Imanta".



Figure 9.8. Source: JSC "Rīgas siltums". Photo by Imants Urtāns

Heat production at JSC "Rīgas siltums" from wood biomass

JSC "Rīgas siltums" started to use wood biomass (wood chips) in 1996 when the steam boiler of HP "Daugavgrīva" was equipped with a front furnace for wood-chip combustion and additionally a cogeneration unit with steam turbines was installed. Since then, the company has been focusing on increasing the use of wood chips and has reached significant results. The figure below shows the percentage increase of wood biomass in the total fuel consumption at the HP.

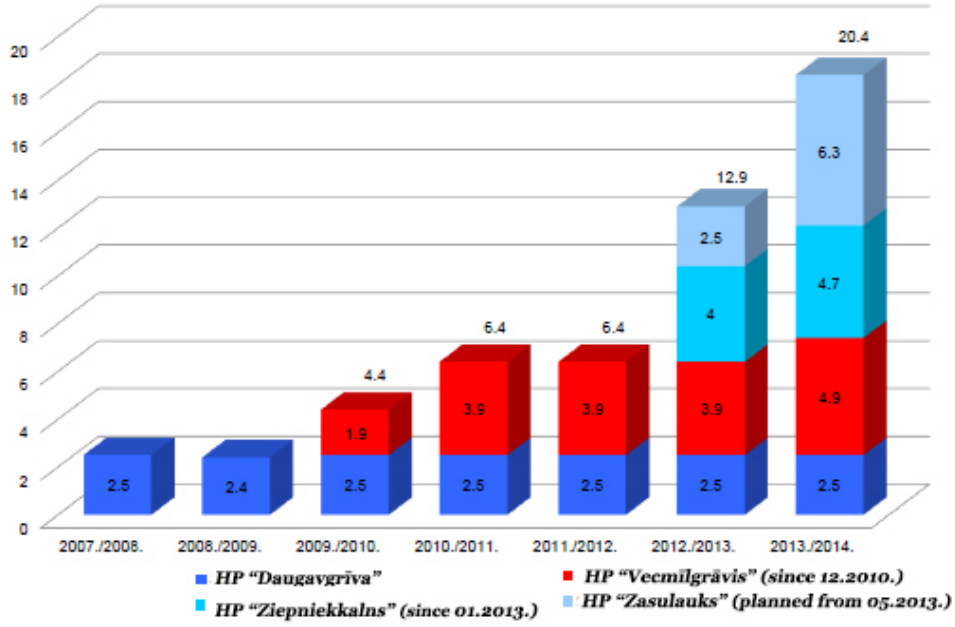


Figure 9.9. Source: annual statement of JSC "Rīgas siltums", 2012

Wood biomass is also used at the upgraded urban heating plants, including HP "Vecmīlgrāvis" and HP "Zasulauks", which now have biomass fuelled boilers equipped with condensation economizers, as well as at the state-of-art cogeneration unit of HP "Ziepniekkalns", which operates in a fully automatic mode. In the abovementioned heat plants the efficiency rate of heat production exceeds 100 % calculated at lowest calorific value of the fuel. The implemented project ***"Wood-biomass fuelled boiler house operated in an automatic mode with an efficiency rate > 100%"*** has been included in the e-catalogue ***"Best practice projects for a smart city"*** prepared by the municipal agency REA in 2013. The total capacity of the wood-chip fuelled boiler is 59.5 MW, which together with the condensation economizers (7.3MW) ensures a 66.8 MW capacity of the state of art wood chip fuelled heat plants. The plan is to install at HP "Daugavgrīva" an additional wood chip boiler (5 MW) with a condensation economizer (1 MW) to be placed into operation in 2016.

During the calendar year of 2012 JSC "Rīgas siltums" has produced 89 532 MWh of heat with the use of wood chips.

Promotion of ICT in the provision of heat supply

By 2008 the programme for installing state-of-art heat units operating in the automatic mode at end user pipe entries was completed; this made it possible to set and maintain the exact temperature regime of heating and hot water preparation required by each site. The city has 8 078 of such heat units. In 2012 there was the next step of introducing state-of-art (smart) meters for remote automatic reading of consumer data of the district heating system from a single dispatch centre. The overall scheme of data collection and transfer is shown in the flow chart below.

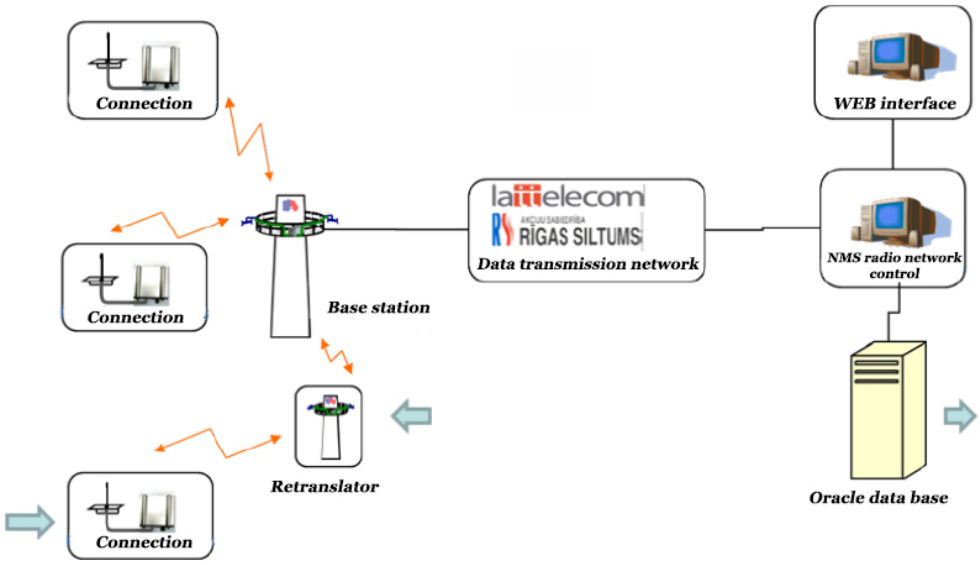


Figure 9.10. Source: JSC "Rīgas siltums". E-catalogue "Best practice projects for a smart city"

Data are transmitted via 86 base stations and a retranslation network installed in the city.

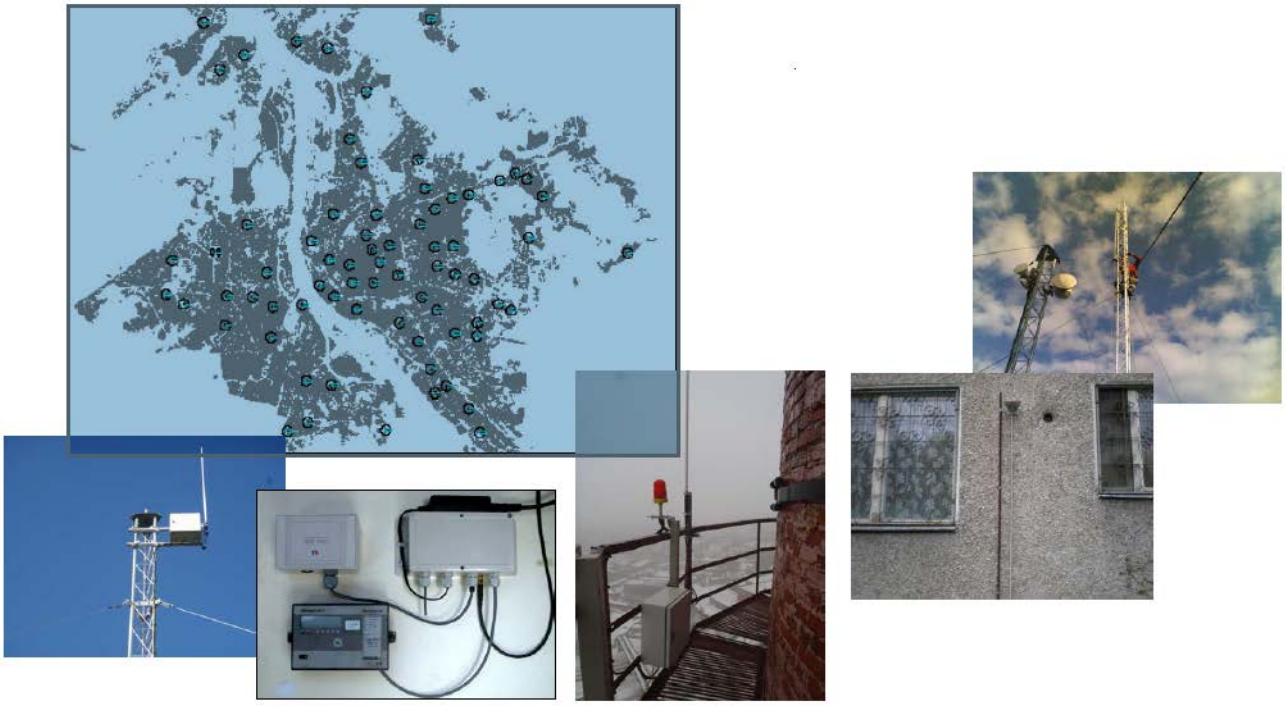


Figure 9.11. Source: JSC "Rīgas siltums". E-catalogue "Best practice projects for a smart city"

The implemented project ***"Automatic reading of heat consumption data with remote data transmission in the urban district heating system"*** has been included in the e-catalogue ***"Best practice projects for a smart city"*** prepared by the municipal agency REA in 2013. For the time being the data transmission resource is used only for reading and collecting the data on one type of energy (i.e. heat) consumption. The data transfer system resource could reasonably be used also for transmitting data on other utilities, such as gas, water and electrical power, which would reduce the costs of introducing the transmission system.

Action Plan in the heat production and management sector

The following principal energy efficiency measures have been planned in the heat energy production and management sector until 2020:

Table 9.3

Action Plan			
Measure	Implementation time	Responsibility for implementation	Extent of implementation
1. Develop a pilot project for trigeneration in a separate part of city's construction area with energy for cooling the premises	2014–2020	JSC "Rīgas siltums"	
2. Install a water heating boiler at the HP "Daugavgrīva"	2015–2016	JSC "Rīgas siltums"	with 5 MW capacity
3. Install a condensation economiser for the recover of flue gas heat at the HP "Daugavgrīva"	2015–2016	JSC "Rīgas siltums"	with 1 MW capacity

4. Produce additional heat per year using the condensation economisers installed in the heat sources of JSC "Rīgas siltums" [in thousands of MWh per year]	2020	JSC "Rīgas siltums"	45.0 /52.0/57.0*
5. Produce additional heat per year with the use of the absorption-type heat pump installed at HP "Imanta" [in thousands of MWh per year]	2020	JSC "Rīgas siltums"	2.5/4.0/6.0*
6.Produce heat energy per calendar year from wood chips [in thousands of MWh per year] JSC "Rīgas siltums"	2020	JSC "Rīgas siltums"	322/402/483*
7. Maintain the district heating network by renovating a total of approximately 12 km of the existing transmission pipelines or building new pipelines, mostly with the use of pre-insulated pipes and trenchless technology. Prevention of heat loss increase in the heating network.	2014–2020	JSC "Rīgas siltums"	
8. Facilitate the use of the remote data transmission system installed by JSC "Rīgas siltums" also for the transmission of other data types: gas, water, electrical power consumption	2014–2020	JSC "Rīgas siltums"	

* minimum/optimum/maximum forecast

9.1.1.2 Local heat production from renewable resources

Heat pumps

In the urban environment there are two types of heat pumps that can be used to heat buildings: heat pumps with thermoprobes installed by deep drilling and air-source heat pumps. Air-sourced heat pumps and air conditioners are widely used in Riga; however, they mostly serve as additional heat sources, mostly in offices and production units. In Latvia there is no inventory for listing air-sourced heat pumps and conditioning systems; their use, state of technical maintenance and mode of operation is the responsibility of the owners.

Heat pumps with thermoprobes installed by deep drilling were first introduced in the urban environment during a demonstration project implemented by the municipality within the framework of an international project in 2009 – 2011 at the pre-school educational establishment (PEE) "Kastanītis", at Stērstu Street 19, to replace the coal fuelled boiler house, as the buildings were renovated.

Overall scheme of the heat pump:

1 - evaporator
2 - compressor
3 - condensator
4 - expansion valve

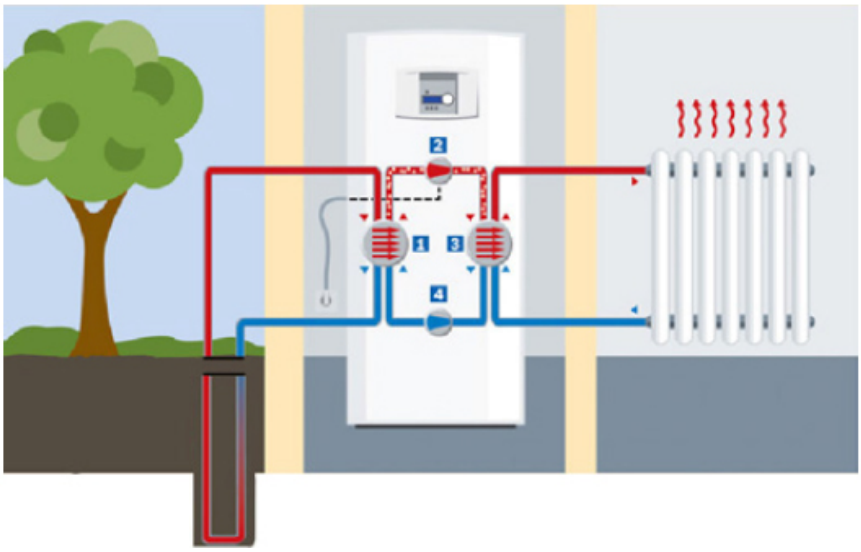


Figure 9.12. Source: Information sheet 6 of municipal agency REA "Innovative heating: heat pump with thermoprobes installed by deep drilling at Riga PEE "Kastanītis"

The equipment operates automatically and is remote-controlled. The project has received the award for being the most energy efficient building in Latvia in 2010. The project under the title ***"Use of heat pumps with thermoprobes installed by deep drilling for heat supply to buildings in the city"*** has been included in the e-catalogue ***"Best practice projects for a smart city"*** prepared by the municipal agency REA in 2013.

The excellent results of the demonstration project led to installing heat pumps with thermoprobes for replacing the coal-fired boiler house of another pre-school educational establishment No 108 at Stokholmas Street in Mežaparks during a comprehensive renovation project of the building.

A number of heat pumps with thermoprobes have been installed also in the privately owned one-family housing sector, but the respective sites have not been listed and there is no data about their number. ESCOs (energy service companies) tend to use them as an additional heat source for multi-apartment houses in combination with the district heating system.

Use of solar collectors for hot water preparation

Solar collectors are increasingly installed on top of the buildings in Riga to utilize the available solar energy for hot water preparation required by the respective sites. In 2011 the municipality applied this solution by installing solar collectors at three pre-school educational establishments in the city as part of the renovation process; the collectors serve as additional heat sources in a system operated on renewable resources: on one site the solar collectors operate together with heat pumps with thermoprobes installed by deep drilling and on the other two sites – together with wood pellet fuelled boilers.

The Earth gets a great deal of energy from the Sun. Riga has a sufficiently high solar energy potential. The following chart shows the monthly global solar radiation values on a horizontal plane in Northern Europe (kWh/m^2):

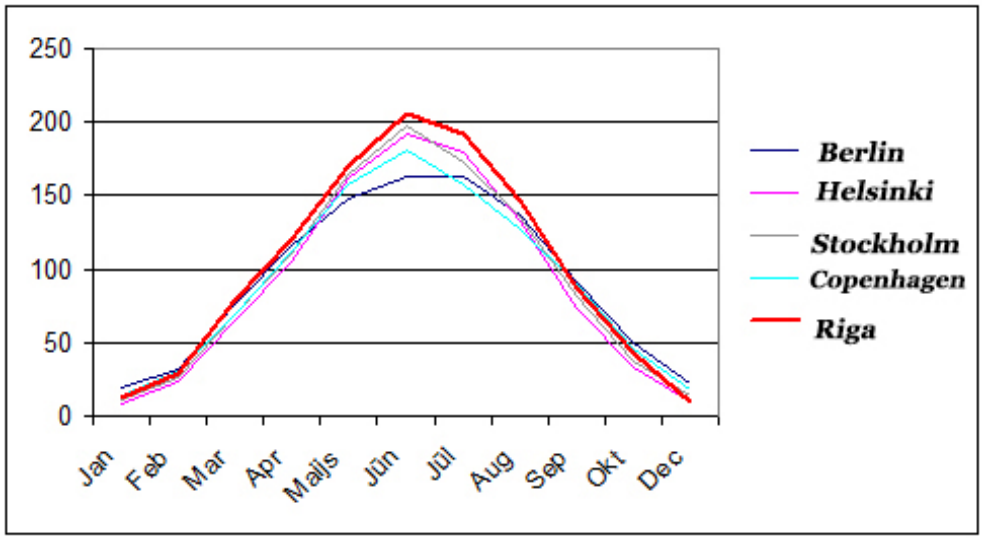


Figure 9.13. Source: Institute of Physical Energetics

Solar radiation may be both direct and diffuse. Radiation depends on season, geographical location and climate. The intensity of solar radiation is a critical factor for solar energy utilization. The average calculated intensity of solar radiation in Latvia is ***1109 kWh/m²*.** For comparison, the annual global solar radiation values on a horizontal plane in the cities of Northern Europe (kWh/m2) are: Berlin – 1031; Helsinki – 980; Stockholm – 1026; Copenhagen – 1013; and ***Riga– 1109.*** The state owned "Institute of Physical Energetics" has been for some time engaged in research on solar energy use; it has developed and maintains a trial site for solar batteries (for electrical power production) and solar collectors (for hot water preparation).

Solar collectors are rather extensively used in privately owned single family houses and in some multi-apartment houses and public buildings, but the sites have not been listed. ESCOs (energy service companies) tend to use them as an additional heat source also for multi-apartment houses in combination with the district heating system.

Wood pellet boilers

Wood pellets are rather widely used in the heating systems of individually owned family houses, partly promoted by the wood pellet boiler production facility Ltd "Grandeg" which has been working in Latvia for a considerable time and is actively promoting its products to the consumers. There are a few production facilities for wood pellets; and even though most of the products are exported, there are enough products on the local market. The abovementioned boilers and equivalent imported equipment have been used both in the private sector and in some multi-apartment houses in Riga and also in some municipally owned buildings to replace the coal fuelled boilers in the municipal pre-school educational establishments. In 2011 wood pellet boilers were installed in three PEE (Ventspils Street 13a, Bišu Street 5, Biešu Street 2a), in 2012: at the secondary school on Margrietas Street 4. In fact, the programme of replacing coal fired boilers in the municipally owned buildings has almost been completed except for one school in Jaunciems where the future use of the building and the issue of fuel replacement have not yet been decided.

In Latvia, as well as in Riga there is no inventory of the installed pellet boilers, they are not being audited for energy efficiency or monitored. Boiler operation, their technical state of repair and economic indicators are the sole responsibility of their owners.

Deep geothermal drilling resources

Riga is situated in an area of geologic anomaly with a considerable part of potential energy deposited in the minerals of the crystalline foundation rocks. The Institute for Marine Geology and Geophysics (ВНИИМоргео), which during the Soviet times had a presence in Riga and prospected for oil deposits in the Baltic States and the shelf of the Baltic Sea under the directions of the Ministry of Energy of Latvia in 1989–1990 evaluated the mapping of the isothermal surfaces in the territory of Latvia with temperatures of 100, 125 and 150°C. Riga is situated in the relatively hot zone, where the absolute marks of isothermal surfaces with a temperature of 100°C are located at a depth of 2.75 km or less below sea level. The technologies for utilizing heat from crystalline rocks (petrothermal energy) have now been well established, and they are based on the practice of extracting energy from crystalline rocks by pumping surface water into the hot crystalline layer which gives way under the hydraulic impact or through a series of local explosions. Crystalline rock is an inexhaustible 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 areas of geological anomaly in Latvia:



Figure 9.14. Source: Bulletin No 4 of municipal agency REA, www.rea.riga.lv

Given the potential of petrothermal resources in Latvia and Riga and the related possibilities of future co-generation station projects for the use of petrothermal energy in Riga, its vicinities and other locations in Latvia, there is a need to develop and implement a pilot project already now. A pilot project with a power generation capacity of 3-4 Mwel and a heat generation capacity of about 30-40 MWth has been planned for implementation in Riga via international funding and other financial sources.

There has been a revival of interest in deep geothermal drilling resources and their utilization in Latvia. The Latvian National Geothermal Association founded in 2010 maintains an active website *www.lnga.lv*. The municipal agency REA is member of the international Geothermal Panel of the European Technology Platform on Renewable Heating and Cooling (RHC) of the European Commission. Contacts with Latvian higher educational establishments have been developed. Proposals for the appropriate legislative amendments are being drafted.

Use of household waste and wastewater for heat production

The municipal landfill for solid waste "Getliņi" with about 300 000 t of household waste deposited on a yearly basis is located outside the administrative territory of Riga in the Stopiņi rural municipality in the vicinity of Riga. There is no waste separation. Since 2002 the landfill produces biogas which is used in a cogeneration station with a power capacity of 5.3 $MW_{el.}$ and a heat capacity of 6.8 $MW_{th.}$ The heat energy is mostly used for a modern greenhouse complex which has been built next to the co-generation station growing vegetables, berries and flowers. Apart from that heat is also used for the technological process of the infiltrate reactor, for heating the office and auxiliary premises and for hot water preparation.

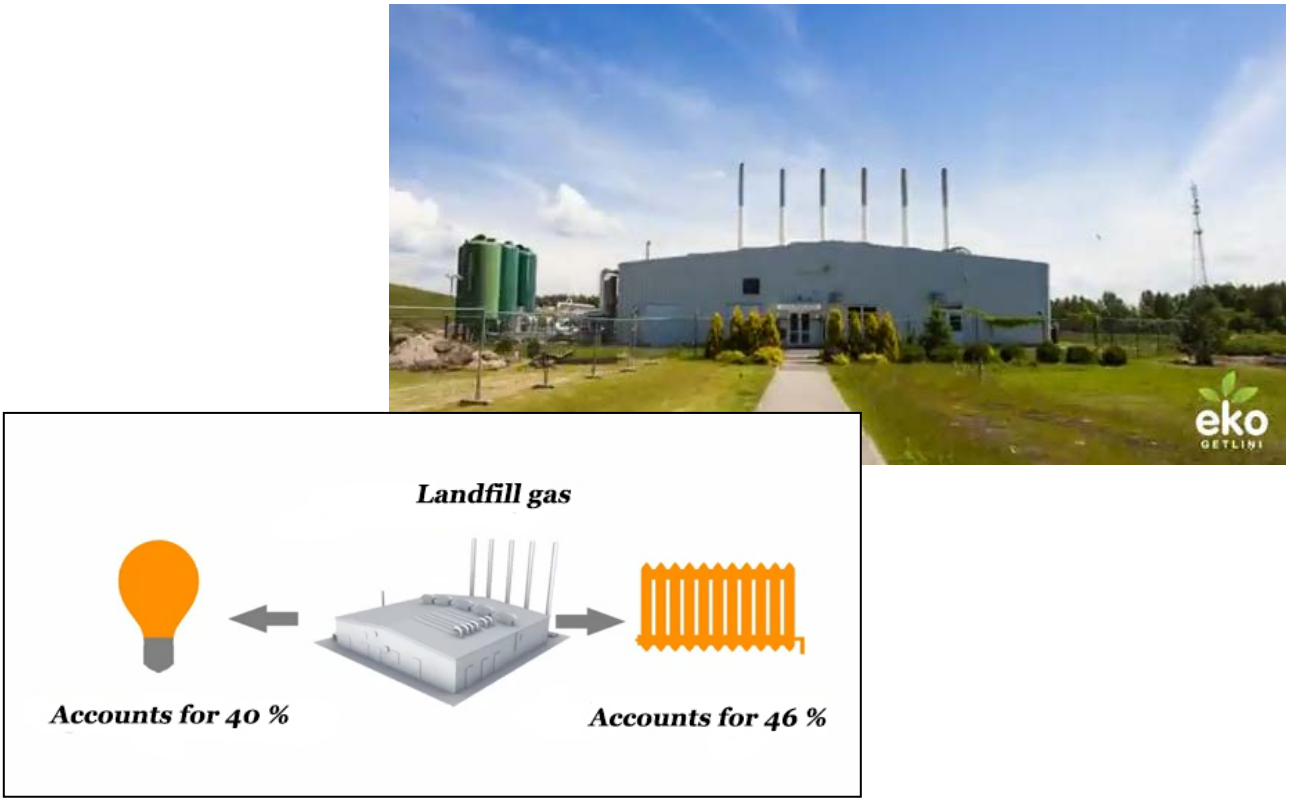


Figure 9.15. Source: LTD "Getliņi EKO". Biogas co-generation station

The theme ***"Local biogas co-generation with heat utilized in the greenhouse complex"*** has been included in the e-catalogue ***"Best practice projects for a smart city"*** prepared by the municipal agency REA. The greenhouse complex occupies a space of 3 625 m^2 and is 5.5 m high. The cultivated plants are grown in mineral wool hung 70 cm above ground. Plant nutrition is based on a computerized fertilizer mixing and dosage programme. The nutritional solution is fed via a sprinkler system. The water comes from deep drillings. The greenhouses are equipped with climate control systems, which provide the environment required for the plants to grow.

A waste separation facility is being set up in Getliņi with the aim to reduce the amount of waste to be deposited in the landfill and return part of the waste for recycling.

The Riga wastewater treatment station, i.e. biological wastewater treatment station (BWT) "Daugavgrīva", is located on Buļļusala, and its design capacity is 350 thousand m^3/per 24 h. After biological treatment, the wastewater is let to settle in secondary basins and then dumped into the Riga Bay 3 km away from the coastline. The volume of wastewater treated in 2012 was 51.5 million m^3. The wastewater is dumped at a temperature of 8 – 15 °C or even higher, which means that the respective heat flow may be utilized by installing high capacity absorption type heat

pumps. Given the location of the wastewater treatment plant, it would be reasonable to time the construction of the heat pump plant with a property development project in the Spilve pastures, so that the additional thermal load in the area could be resolved without a significant growth of CO_2 emissions.

Action Plan for decentralised heat production from renewable resources

The following principal measures for decentralised heat production from renewable resources have been envisaged until 2020:

Table 9.4

Action Plan			
Measure	Implementation time	Responsibility for implementation	Extent of implementation
1. Establish a municipal system for recording decentralised heating sources, including wood pellet boilers, solar collectors, heat pumps with thermoprobes installed by deep drilling, geothermal heat sources installed by deep drilling, etc.	2013–2020	Municipal agency REA, cooperation partners	
2. Facilitate installation of solar collectors on buildings for hot water preparation aligned with district and other types of heat supply systems.	2013–2020	Municipal agency REA, cooperation partners	
3. Capture solar energy for hot water production in residential houses, in thousands of MWh per year	2020	Owners of buildings	3/ 4,5/ 6*
4. Facilitate installation of heat pumps with thermoprobes installed by deep drilling for ensuring heat supply to buildings	2013–2020	Municipal agency REA, cooperation partners	
5. Capture geothermal energy with heat pumps for ensuring heat supply to buildings, in thousands of MWh per year	2020	Owners of buildings	25/35/45*
6. Produce heat locally with the use of boiler installations operating on biomass pellets, in thousands of MWh per year	2020	Owners of buildings	18/25/32*
7. Facilitate removal of coal-fired and other solid fuel operated boiler houses in the private housing sector to subsequently recommend their replacement with boilers operated on wood pellets or other emission free heating installations	2013–2020	Housing and Environment Department of the Riga City Council, municipal agency REA	
8. Develop and implement a pilot project for a cogeneration plant using petrothermal energy with electrical capacity of 3–4 MW and heat capacity of 30–40 MWth.	2013–2020	Municipal agency REA, cooperation partners and investors	
8. Draft the technical basis for establishing a high-capacity absorption-type heat pump plant for utilising the heat originating from waste waters treated at the waste water treatment complex “Daugavgrīva”	2013–2020	Municipal agency REA, cooperation partners and investors	

9. Introduce waste separation after its collection and incineration of the solid combustible waste fraction with energy production	2011–2020	LTD "Getliņi EKO" and investors	

* minimum/optimum/maximum forecast

9.1.2 ELECTRICAL POWER SUPPLY

9.1.2.1 The Riga centralized power supply system

Production and management of electrical power

The largest electrical power producers in Riga are the three major power stations of the State owned concern JSC "Latvenergo":

1) Riga TEC-1 (on Viskaļu Street); its upgrading was completed in 2005 when a new combined-cycle co-generation station on gas and diesel back-up fuel was constructed. Two gas turbines and one steam turbine have been installed. The power generating capacity of the station is 144 Mwel. and its heat producing capacity is 145 MWth. The efficiency rate in cogeneration is 88 %. In 2010 a new boiler for hot water preparation with a capacity of 116 MWth was installed, bringing the total capacity for hot water preparation to 493 MWth.

2) Riga TEC-2 (in Acone, outside Riga); the first phase of upgrading was completed in 2009, by installing a new combined cycle power generating unit, capable of operating in the condensation mode outside the heating season. The new unit has a power generating capacity of up to 407 Mwel. and a heat production capacity up to 264 MWth. In 2013, when the second phase of upgrading was completed, the total power generating capacity of the station increased to 833 Mwel. and the respective heat production capacity – to 544 MWth., with the efficiency rate in cogeneration becoming 89 %.

3) Riga HPP (on Dole Island, outside Riga) with an electrical power generating capacity of 402 MWel.

With the release of the second power generating unit of Riga TEC-2, the old inefficient and environment unfriendly power production units built during the period between 1976 and 1979 have been removed from production. The following chart shows the efficiency of fuel utilization by the TEC equipment:

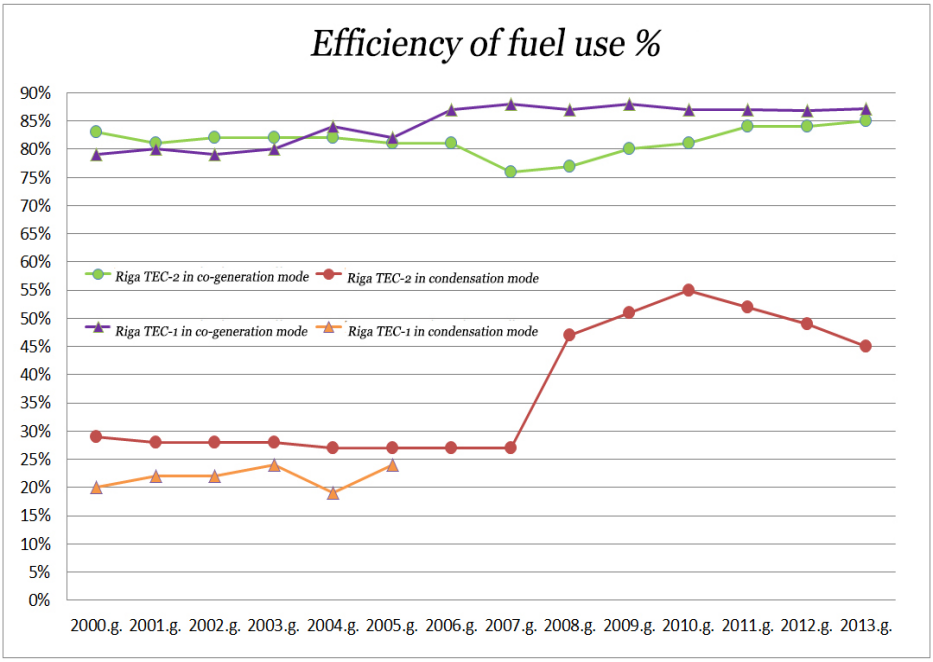


Figure 9.16. Efficiency of fuel use at Riga TEC. Source: JSC "Latvenergo"

Notably, increased energy efficiency has been achieved simultaneously with a significant growth in the share of generated power.

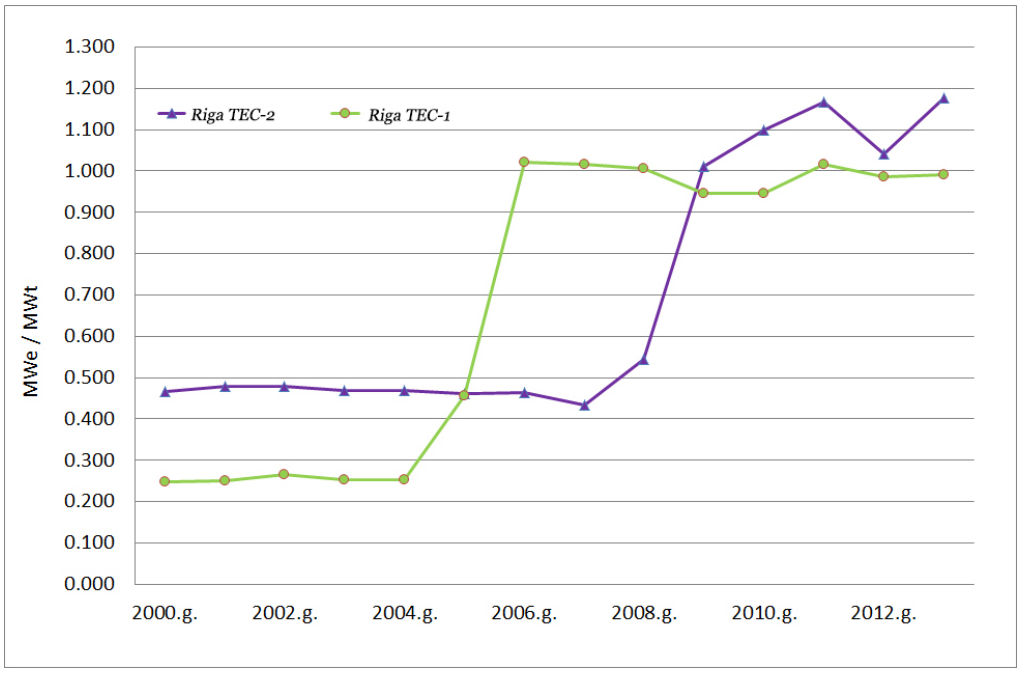
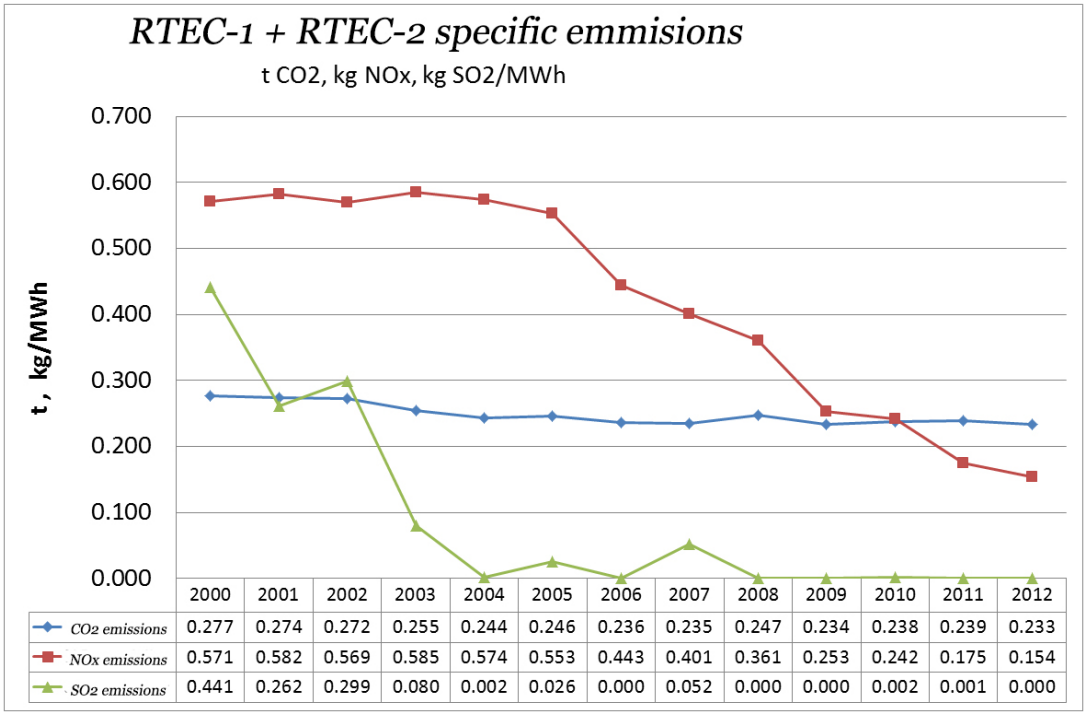


Figure 9.17. Share of electrical power and heat energy produced at Riga TEC. Source:JSC "Latvenergo"

Implementation of the Riga TEC-2 project has resulted in compliance with the standard legislative requirements which state the limit values of NOx and CO emissions in flue gas: NOx – 50 mg/m³ un CO – 100 mg/m³ with an O content of 15 % in flue gas. The achieved reduction of harmful emissions is:



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CO2 emissions	0.277	0.274	0.272	0.255	0.244	0.246	0.236	0.235	0.247	0.234	0.238	0.239	0.233
NOx emissions	0.571	0.582	0.569	0.585	0.574	0.553	0.443	0.401	0.361	0.253	0.242	0.175	0.154
SO2 emissions	0.441	0.262	0.299	0.080	0.002	0.026	0.000	0.052	0.000	0.000	0.002	0.001	0.000

Figure 9.18. Share of harmful emissions in the flue gas of Riga TEC. Source: JSC "Latvenergo"

The total heat production capacity of the Riga TEC-2, including the boilers for hot water preparation is 1124 MWth. The Riga TECs are mostly operated to cover the need for heat, when they basically work in the cogeneration mode. Thus, power generation is mostly secondary to heat consumption, which in turn depends on climate conditions (outdoor temperatures) and the duration of the heating season, as well as market demand. The figure below illustrates the new TEC-2 co-generation unit.



Figure 9.19. The second CCGT power generating unit of Riga TEC-2. Source: JSC "Latvenergo"

At present Riga TEC-2 is the most efficient and state-of-art combined cycle thermoelectric power station in the Baltic States. The following chart shows the savings of energy resources in both Riga TECs when operated in the co-generation mode.

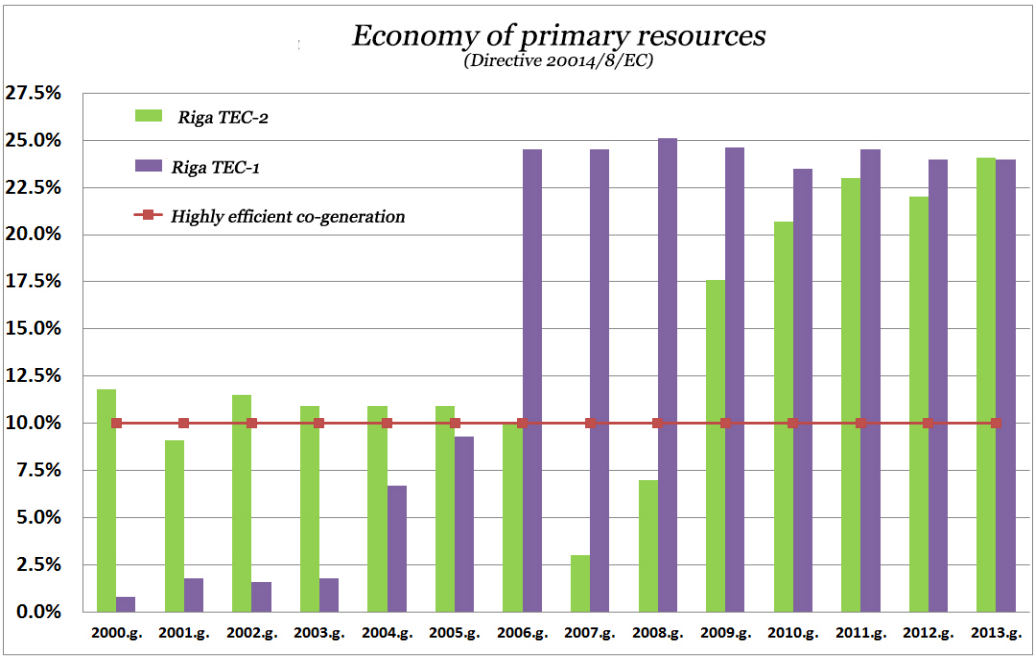


Figure 9.20. Savings of primary energy resources at Riga TEC. Source: JSC "Latvenergo"

With a view to securing heat production in possible disruptions in natural gas supply due to an unexpected break-down, Riga TEC can switch to emergency liquid fuel which is stocked on site in

both power stations. The reconstruction has also resulted in a threefold reduction of own power consumption in Riga TEC, as can be seen from the figure below.

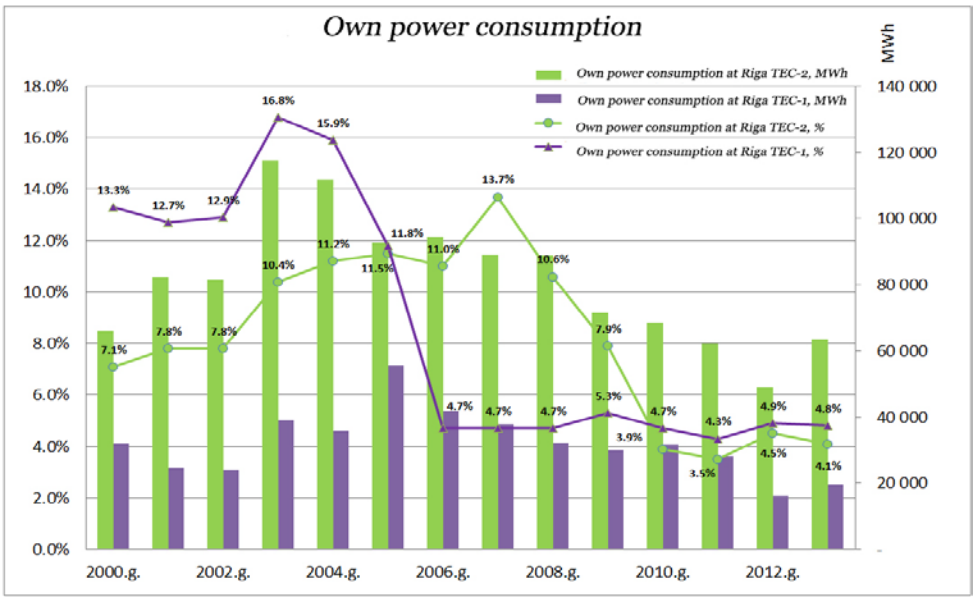


Figure 9.21. Reduction of own consumption of power at Riga TEC. Source: JSC "Latvenergo"

In 2013, Riga TEC generated 1 957 GWh of electrical power, which is by 39 % more than in the previous year. On the other hand, the heat energy produced by Riga TEC in 2013 was 2 305 GWh. Over the past years the production volume in Riga has stabilized, newly connected consumers compensating for the economies gained from energy efficiency measures. The heat produced by Riga TEC is sold to JSC "Rīgas Siltums" at regulated tariffs.



Figure 9.22. Co-generation equipment at Riga TEC- 2. Source: JSC "Latvenergo"

As evidenced by the data collected by Eurostat, Riga and Latvia has the environmentally cleanest and most efficient energy production system in the European Union. The high co-generation rate is an achievement of a global level. The figure below shows more detailed information:

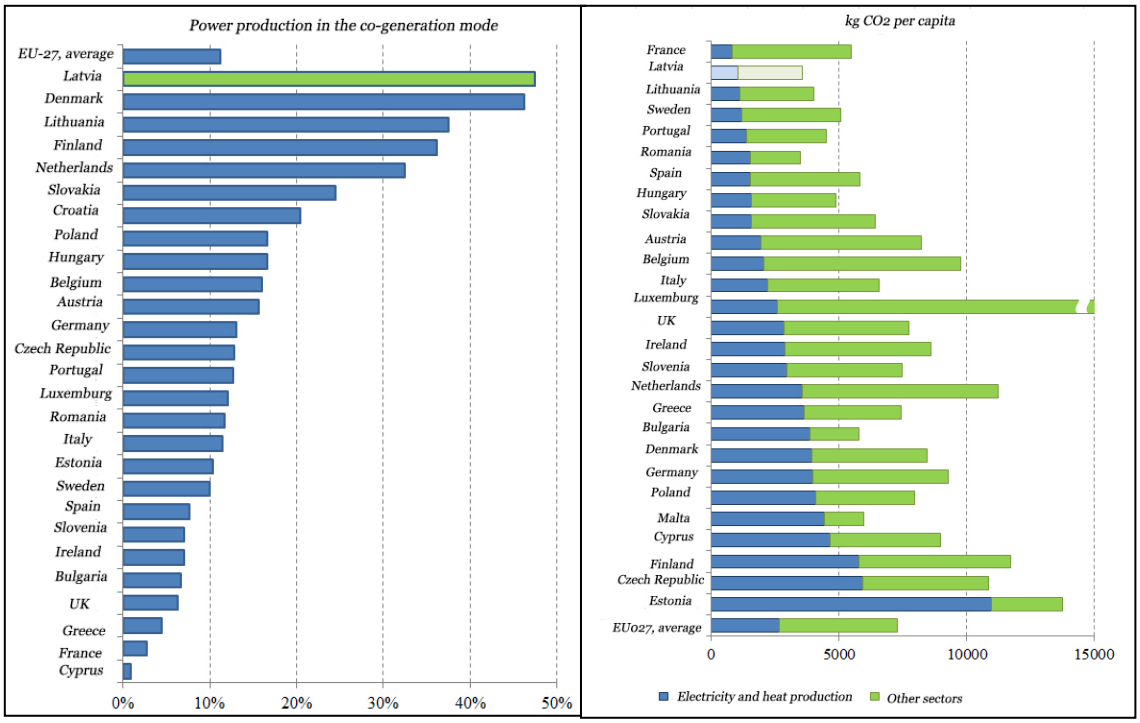


Figure 9.23. Electrical power production in the co-generation mode in RU and CO_2 emissions *per capita* from power generation. Source: Eurostat

Apart from the reconstructed Riga TEC, hydropower plants have also contributed to the results in environment protection. One of them is the Riga HPP. The Riga HPP was released for operation in 1974; it has 6 hydroelectric units with a total capacity of 402 MW_{el}. In 2012 the Riga HPP produced 858 GWh of green energy. The concern "Latvenergo" plans to start reconstruction of the Riga HPP in 2014. The reconstruction is aimed at improving its hydro turbine parameters (efficiency rate and installed capacity), which is going to increase the amount of energy generated from renewable resources and provide for secure and consistent operation of the Riga HPP in the overall power supply system. The reconstruction of the hydro electrical units might be completed by 2022. The reconstructed hydro electrical units are going to be in operation for the next 40 years.

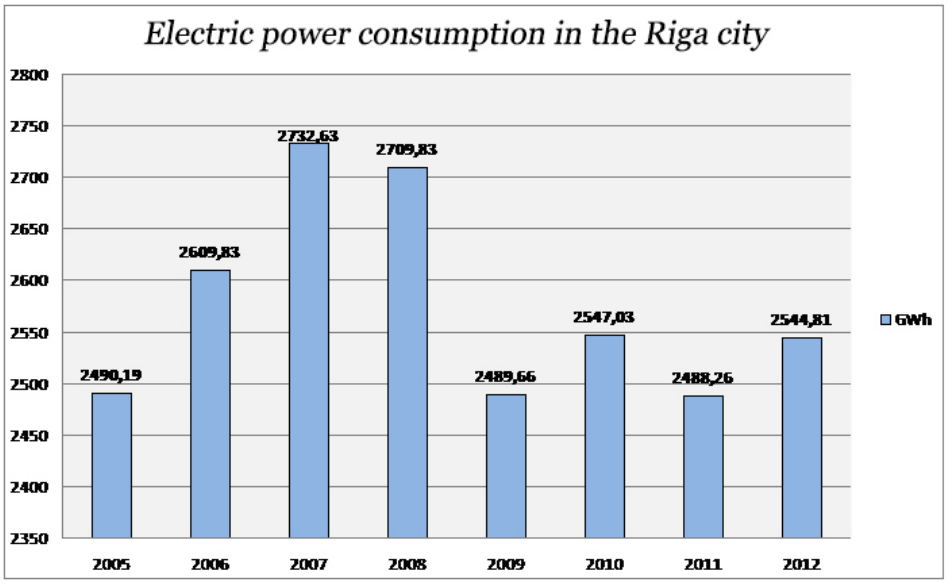


Figure 9.24. Source: JSC "Latvenergo"

Electrical power consumption has been calculated to include all consumers (and the losses during transmission) together with city lighting and electrical vehicles, and it covers also Vecmīlgrāvis in the precincts of Riga (PR).

Electrical power transmission services in the territory of Riga are provided by JSC "Latvijas elektriskie tīkli", which is responsible for:

- 330/110 kV substations – 6 (3 – located in the city, 3 – located in the precincts)
- 110/6-20 kV substations – 28
- 330 kV high voltage transmission lines – 70 km
- 110 kV high voltage transmission lines – 250 km

In 2013 a 330 kV cable connection between RTEC-1 and Imanta was built, completing the 330 kV ring-line around Riga (Salaspils – Riga HPP – Bišuciems – Imanta – RTEC-1 – RTEC-2 – Salaspils). The 330 kV ring-line is connected to the grid via the lines Jelgava – Bišuciems, Jelgava – Salaspils, Salaspils – Valmiera and Salaspils – Aizkraukle. The 330 kV lines ensure power supply from the Riga power stations and the grid to the 330/110 kV substations and from the Riga power stations to eight 110/20(10) kV substations located in different city districts.

The 110 kV urban transmission network is configured as a ring which includes also the Riga TEC-2 outside Riga and a three branch diagonal connection in the 110 kV Hanza substation. The 110 kV ring substations Riga TEC-1, Bišuciems and Imanta are connected to other 110 kV substations of the grid which are outside the ring. Two other power stations, i.e. TEC Imanta (47.7 MW) and TEC "Juglas jauda" (14.9 MW), are connected to the 110 kV network together with Riga TEC-1 and Rīgas TEC-2.

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

- 28 substations of 110/6-20 kV
- 75 distribution points of 10 kV
- 2 276 transformer points of 6–20/0.23–0.4 kV
- 3 166 distribution transformers
- 1 405 MVA of installed capacity of distribution transformers
- 2 357 km of medium-voltage lines of 6–20 kV,
  including 2 344 km of cable lines
- 2 465 km of low-voltage lines of 0.23–0.4 kV,
  including 2 239 km of cable lines

The power transmission lines are regularly overhauled and upgraded, which has allowed maintaining a manageable level of losses, which tend to decrease:

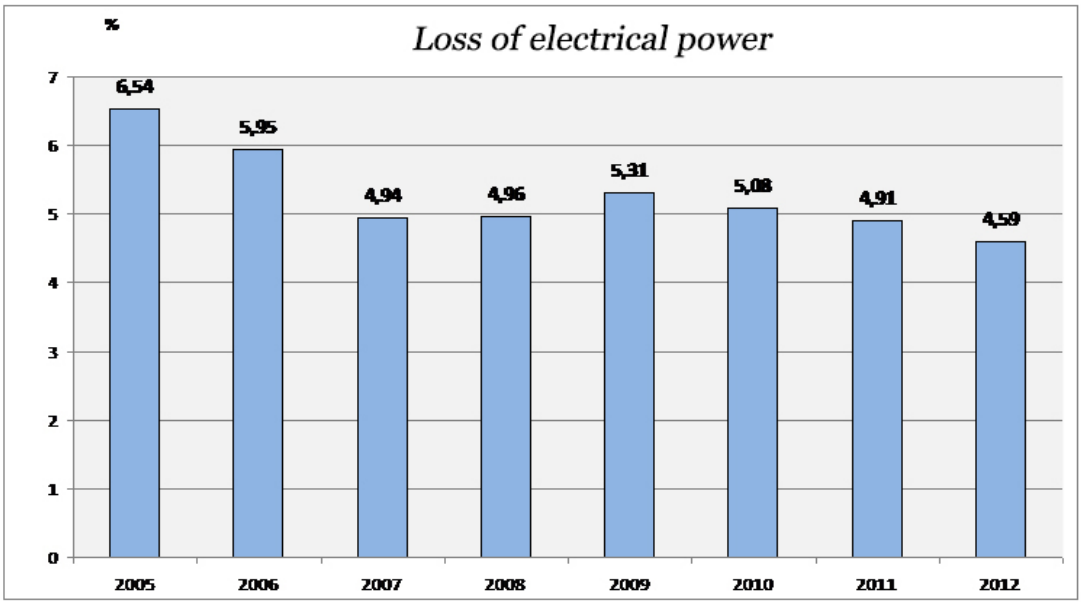


Figure 9.25. Source: JSC "Latvenergo". Losses at PR-Vecmīlgrāvis have not been included

The distribution network is upgraded carried along the following lines:

- Reconstruction of distribution installations of 110/10(20) kV transformer substations
- Reconstruction of 10(20) 0.4 kV transformer substations
- Replacement of transformers
- Reconstruction of 10 kV and 0.4 kV cable network
- Upgrading of the monitoring and control system
- Upgrading of the out-dated 2x220 V network in the historical centre of Riga
- Upgrading of the billing system

Both Riga TEC stations are base stations for power supply to the city that also provide for the national security of energy supply. There are no plans to directly increase the capacity to the centralised power supply system of Riga before 2020. As shown by the research carried out by JSC "Latvenergo", power consumption is going to increase, with a consumption forecast of 2.700 GWh for 2020 and pre-crisis (2007 – 2008) consumption levels to be met at 2016. The large urban users with consumption above 100 kW (200 A and more) have been accommodated with smart power meters and a remote data reading system. The theme ***"Remote reading and transmission of smart meter data in power supply"*** has been included in the e-catalogue ***"Best practice projects for a smart city"*** developed by the municipal agency REA. The measure has been implemented according to the following scheme:

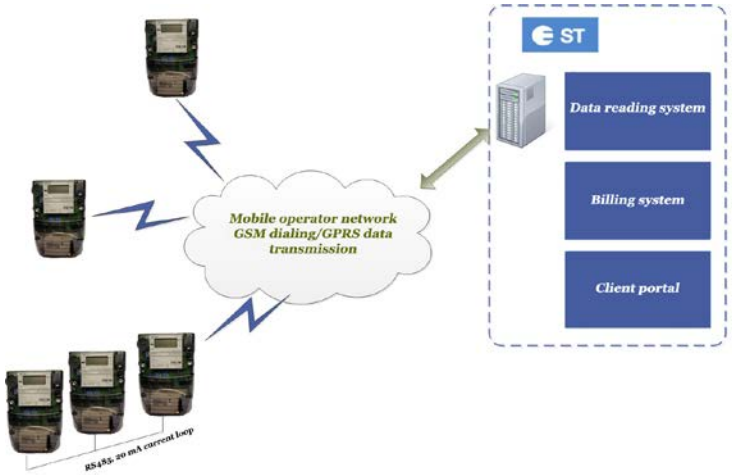


Figure 9.26. Source: JSC "Latvenergo"

Installation of smart metres is going on. JSC "Sadales tīkls" are gradually introducing them in households with an annual consumption of 2 500 kWh and more.

Since 2007 Latvia has ***opened its electrical power market***, and consumers can purchase electricity not only from the concern JSC "Latvenergo", but also from other registered market operators. According to the Public Utilities Commission (PUC) (Regulator) data in 2013 regulated services were provided by 51 electrical power retailer, out of which the following 9 were active service providers: JSC "Latvenergo", Ltd "Enefit", Ltd "Inter Rao Latvia", Ltd "Baltic Energy Services", Ltd "BCG Riga", Ltd "FENZO", Ltd "Baltcom TV", Ltd "Energijos Tiekimos" and the state owned JSC "Latvijas Dzelzceļš" (power supply to own transport and buildings).

Towards the end of 2014 the electrical power market will be opened also for the households. At market opening electrical power will be offered by 4 power retailers: JSC "Latvenergo", Ltd "Baltcom TV", state owned JSC "Latvijas Dzelzceļš" and Ltd"220 Energy". A new branch company of JSC "Latvenergo" has been established for billing; the company is going to be responsible for all customer billing operations irrespectively of the retailer from which the power has been purchased.

Consumption of electrical power by customer group

Consumption of electrical power by customer group shows the trends in energy efficiency measures and the new customers connected to the grid.

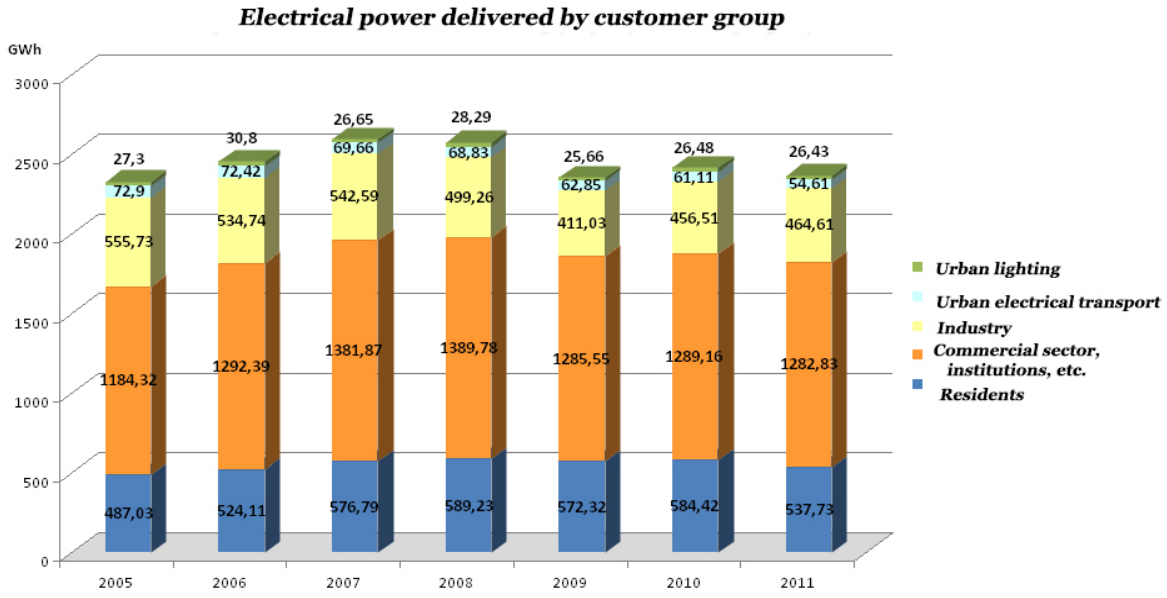


Figure 9.27. Source JSC "Latvenergo"

Aggregated data on yearly consumption and consumption by customer group:

Table 9.5

Consumer groups	Electrical power delivered in GWh by year							
	2005	2006	2007	2008	2009	2010	2011	**2012**
1.Households/inhabitants	487.03	524.11	576.79	589.23	572.32	584.42	537.73	**541.49**
2.Municipality and state institutions, the commercial sector	1 184.32	1 292.39	1 381.87	1 389.78	1 285.55	1 289.16	1 282.83	**1 311.55**

3. Industry	555.73	534.74	542.59	499.26	411.03	456.51	464.61	**493.91**
4. Urban electrical transport	72.9	72.42	69.66	68.83	62.85	61.11	54.61	**53.64**
5. City lighting	27.3	30.8	26.65	28.29	25.66	26.48	26.43	**27.33**
IN TOTAL	2 327.28	2 454.46	2 597.56	2 575.39	2 357.41	2 417.68	2 366.21	**2 427.92**

Source: JSC "Latvenergo"

Power consumption for developing emission free mobility

The sustained growth of electrical and hybrid vehicles in the city since 2009 has facilitated development of a publicly accessible infrastructure for charging these new vehicles. The slow charging system has been established by the public sector ("Zero emission mobility support society") and the private sector in collaboration with JSC "Latvenergo". An e-map of public charging points for electric cars and two-wheel transport has been developed and is maintained; it is available on the web:
http://www.latvenergo.lv/portal/page/portal/Latvian/latvenergo/main_page/korp_atbildi/UZLADES_PUNKTU_KARTE
http://www.bimab.lv/darbiba-2011.php

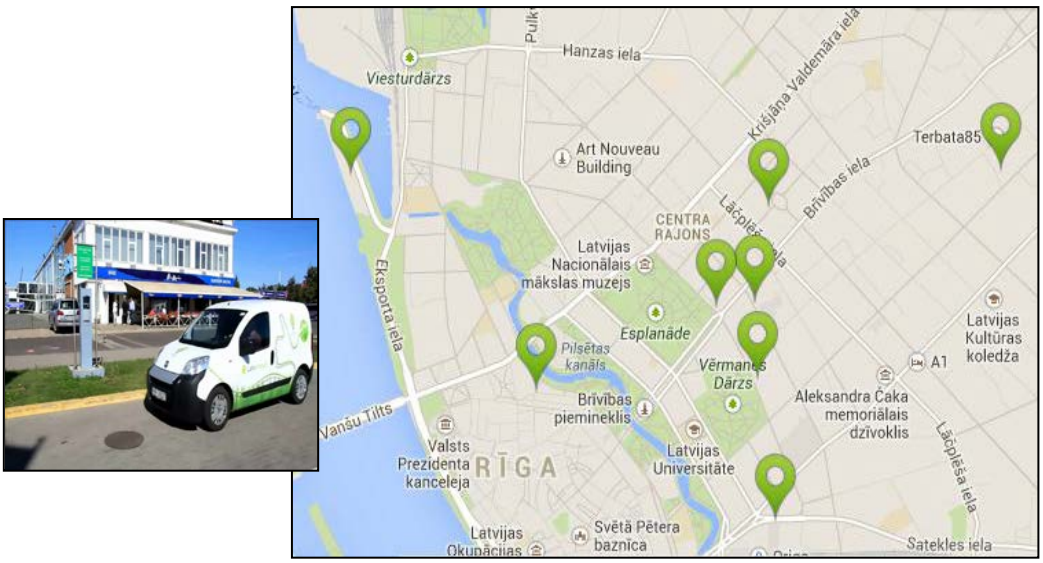


Figure 9.28. Source: JSC "Latvenergo". Publicly accessible slow charging points for electrical cars in Riga

In order to provide fast charging possibilities for electrical cars and open the city for extensive use of electrically powered cars, the municipality has studied the possible locations for the fast charging points and produced a draft map; it has also been implementing the map through the use of available financial support from the government. The plan is to extend an alternative network of slow charging points in the municipality controlled street parking places. The potential charging point locations are shown in the map below:

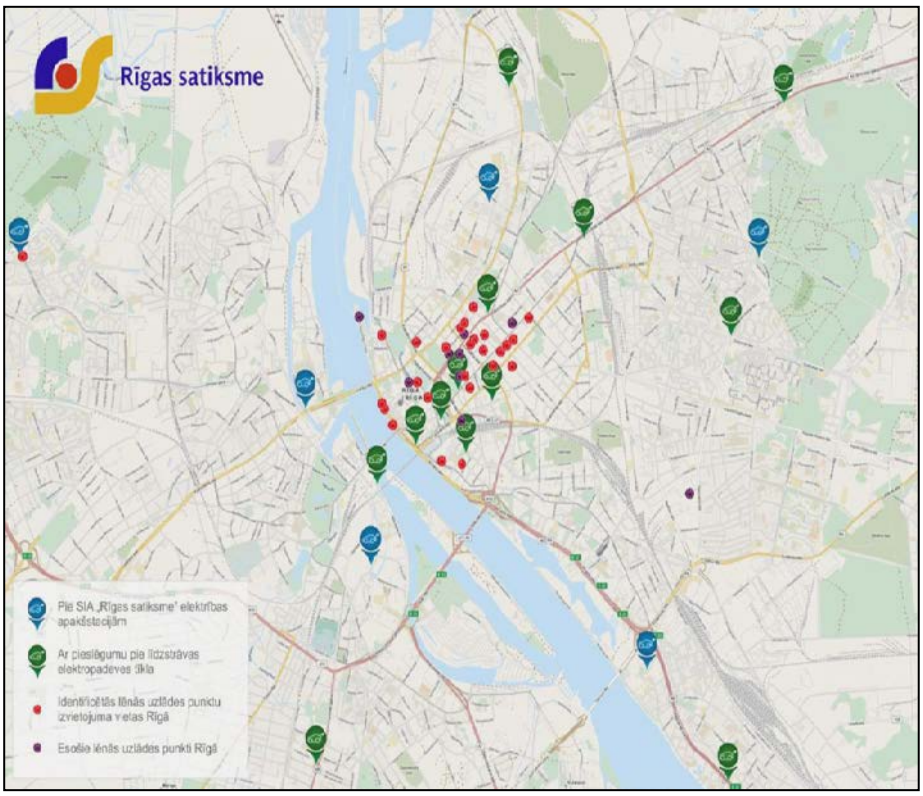


Figure 9.29. Source: Report "Scheme for locating fast-charging stations for electrical cars in Riga"

9.1.2.2 Local electrical power generation, including generation from renewable resources

The local electrical energy producers which sell electrical power to JSC "Latvenergo" grid include the co-generation stations and units of JSC "Rīgas siltums" operating in a high efficiency co-generation mode, i. e. HP "Imanta" with a 47.7 MW power generating capacity (on natural gas), HP "Daugavgrīva" with a 0.6 MW power generating capacity (on wood chips), BH on Viestura Prospekts with a 0.5 MW power generating capacity (on natural gas), BH on Keramikas Street with a 2.4 MW power generating capacity (on natural gas), HP 'Ziepniekkalns" with a 4 MW power generating capacity (on wood chips). Apart from that, the following co-generation stations and units of local electricity producers are connected to the grid: Ltd "MBA" with a power generating capacity of 0.495 MW (on natural gas), Ltd "Rigens" at the municipal waste water treatment plant "Daugavgrīva" with a power generating capacity of 2.1 MW (on biogas), Ltd "Getliņi EKO" at the municipal landfill (Stopiņi rural municipality on the outskirts of Riga) with a power generating capacity of 5.3 MW (on biogas/landfill gas), JSC "Aldaris" with a power generating capacity of 1 MW (on natural gas) and Ltd "Juglas jauda" with a capacity of 11.8 MW (on natural gas).

The largest solar cell complex with a total area of 1200 m² for solar energy production has been installed on the roofs of the hazardous waste treatment plant Ltd "Zaļā Latvija" in Riga. The power generation capacity of the complex is 120 kW.





Figures 9.30 – 9.31. Source: Institute of Physical Energetics

The theme ***"Solar batteries on the roof tops of buildings in the city"*** has been included in the e-catalogue ***"Best practice projects for a smart city"*** developed by the municipal agency REA. There are separate cases of solar batteries mounted in the private sector, but the sites have not been listed.

Information on the use of deep geothermal drilling resources for power production via setting up petrothermal co-generation stations is included in section 9.1.1.3 of the SEAP.

Action plan for energy production and transmission

The following principal measures for electrical power production and management have been envisaged until 2020:

Table 9.6

Action Plan			
Measure	Implementation time	Responsibility for implementation	Extent of implementation
1. Set up a register of the local installations for electric power production from renewable resources (i.e. solar batteries, fuel cells, biogas and biomass fuelled cogeneration stations and other electrical power stations operated on renewables) and their production volumes in Riga	2013–2020	Municipal agency REA, cooperation partners	50 /65 /80 %* from the total number
2. Facilitate installation of solar batteries on buildings in the city for electrical power production	2013–2020	Municipal agency REA, cooperation partners	
3. Facilitate use of fuel elements (hydrogen technology) for creating local energy sources	2013–2020	Municipal agency REA, cooperation partners	
4. Set up a network (smart network) of rapid charging stations for electric cars in the Riga city, ensuring accessibility of Riga for the use of electrical cars	2013–2016	Municipal Agency "Rīgas gaisma", Ltd "Rīgas satiksme", cooperation partners	In 2013 the infrastructure of the charging stations was drafted. CCFI funding has been applied for.

5. Set up a slow charging infrastructure in the Ltd "Rīgas satiksme" car parking network	2013–2016	JSC "Rīgas satiksme", cooperation partners	50/110/230* charging points
6. Facilitate the replacement of the obsolete three-wire power network (3x220V) in the existing housing stock (buildings constructed before 1993) with the 400/230V system	2014–2020	JSC "Sadales tīkls", cooperation partners	
7. Gradually introduce smart domestic electrical power metres in households with annual electric power consumption over 2500 kWh	2013–2020	JSC "Sadales tīkls"	50 /70 /90 %* from the total number
8. Consider optional introduction of smart domestic electrical power metres in households with annual electric power consumption below 2500 kWh	2014–2020	JSC "Sadales tīkls"	15 /23 /30 %* from the total number

* minimum/optimum/maximum forecast

9.1.3 GAS SUPPLY

The gas supply system

Natural gas which is the main fuel in the urban heating system is supplied by the JSC "Latvijas gāze"; gas is supplied through the existing infrastructure for gas supply: the Inčukalns underground gas storage facility, as well as the gas transmission and distribution system.

JSC "Latvijas gāze" is a privately owned company, the main shareholders being E.ON Ruhrgas International AG (47.23%), PJSC "Gazprom" (34%) and Ltd "Itera Latvija" (16%). E.ON Ruhrgas International AG has announced its withdrawal from Latvia, and its shares may become available on the market in the near future. The Government is considering possible procurement of these shares.

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 <1.6 MPa for the high-pressure gas distribution network and < 0.3 MPa for the medium-pressure gas distribution network. In the high pressure P<1.6 MPa distribution system the "Riga bypass" ensures natural gas supply both from the "Rīga-3" GRS in the Stopiņi rural municipality and from the "Ziemeļi" GRs in the Iecava county (see figure 2.5).

In 2012 several measures were taken with a view to ensure better stability and security of gas supply: loops in the pipeline were built in Dārzciems, the existing gas regulating stations and equipment was upgraded, including in the GRS "Rīga – 2" of the former gas transmission system; now, after reconstruction, it belongs to the gas distribution system. The GRS which dates back to the early 60-ies was demounted, it has been replaced by a modern container-type gas regulation point (GRP) No 110, located on Mežkalnu Street in Ziepniekkalns and equipped with telemechanics (SCADA) for remote data reading and automated control. The total cost of this project has been about 1 million LVL/1.42 million EUR.

Construction of GRP -110 further led to completion of the following sections of the former Vilno – Riga gas transmission system:

- from GRS "Rīga – 1" in Stopiņi up to Ķekava, across the river Daugava,
- from GRS "Ziemeļi" in the Iecava municipality up to GRS "Rīga-2" in Ziepniekkalns (renovation and reconstruction).

These sections now operate as part of the distribution system (at a reduced pressure of 1.6 MPa). The reconstruction aims at creating a single system for gas supply for the existing and future consumers of natural gas in Riga. In the period between 2007 and 2011 40 km of new P<1.6 MPa gas distribution system pipelines have been built along the A5 ring road Babīte-Salaspils between Babīte and Ķekava. Another project is GRS "Rīga -3"; it is one of the largest gas regulation stations in the Baltic States with a throughput of 300 000 m³/h in the Stopiņi municipality.

The table below shows the largest consumers of natural gas in Riga over 2012, in thousands of nm³:

Table 9.7

Consumers of natural gas	Address	Consumption in thousands of nm³
1. TEC-1 JSC "Latvenergo"	Viskaļu Street 16	151 927
2. JSC "Rīgas siltums"	43 heat plants and boiler houses	132 407
3. Ltd "Bolderaja Ltd"	Guberņciema Street 7	16 521
4. JSC "B.L.B. Baltijas terminmāls"	Ezera Street 22 14 844	14 844
5. Ltd "Juglas jauda"	Brīvības Street 401	12 614
6. JSC "Latvijas finieris"	Bauskas Street 59	8 941
7. Ltd "UNI-ENERKOM"	Bauskas Street 180	4 191
8. Ltd "Gamma –A"	Andrupes Street 15/17	2 741
9. JSC "Aldaris"	Tvaika Street 44	2 726
10. JSC "Rīgas piena kombināts"	Bauskas Street 180	2 627
11. JSC "Grindeks"	Rencēnu Street 3b	2 339

In 2012 gas supply facilities have been released for operation on 25 construction sites in Riga, with 9.47 km total length of new gas pipes constructed, including:

- 2 496 m in Rītabuļļi
- 1 665 m in Dārziņi
- 1 400 m on Beberbeķu Street

Gas consumption by consumer group

The following chart shows natural gas consumption in Riga over the past years by consumer group, in millions of nm³:

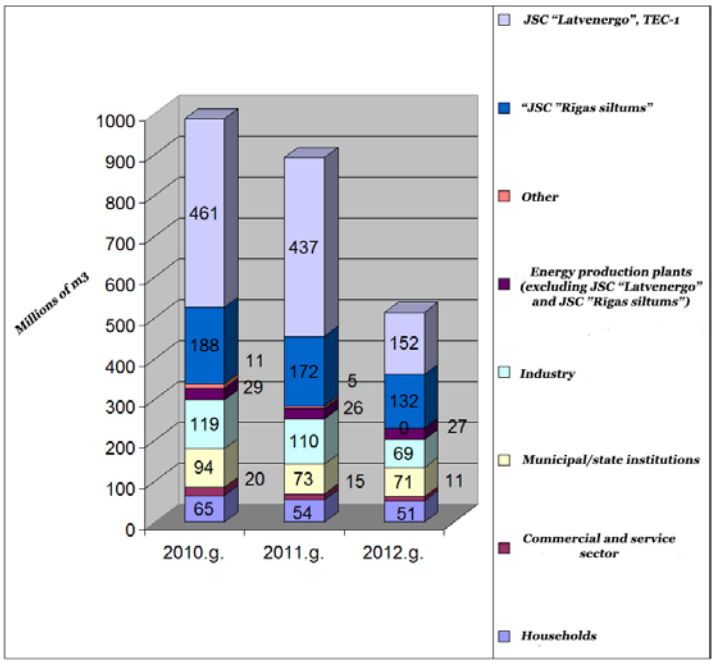


Figure 9.32. Source: JSC "Latvijas gāze"

The data can also be viewed in table format:

Table No 9.8

Consumer groups	Consumption of natural gas, in millions of nm³		
	2010	2011	2012
1. Households	65	54	51
2. The commercial and service sector	20	15	11
3. The municipal/state institutions	94	73	71
4. Industry	119	110	69
5. Energy production companies (excl. JSC "Latvenergo" and JSC "Rīgas siltums")	29	26	27
6. Other consumers	11	5	0
7. JSC "Rīgas siltums"	188	172	132
8. JSC "Latvenergo", TEC-1	461	437	152
IN TOTAL:	**987**	**892**	**513**
9. JSC "Latvenergo", TEC-2 (outside Riga)	461	437	332

The data show that for a number of years since 2010 there has been a focussed effort on reducing the use of natural gas as a fossil fuel, which has led to a decrease of >49 %. The decrease has been compensated for by rather extensive use of renewals utilized in the industrial, household and municipal sector, as well as the energy efficiency measures put in place. There has been a significant reduction in the natural gas utilized by TEC-1, which shows that the open market coupled with high natural gas prices has made it cheaper to buy electrical power on the external market.

9.2 ENERGY CONSUMERS

9.2.1 THE RESIDENTIAL HOUSING SECTOR OF THE CITY

The housing stock of the city and its renovation

The majority of the multi-apartment buildings of the city, especially those built during the post-war period and then privatized, i.e. ***6 000 buildings with the total area about 12 million m²,*** urgently need renovation. Until 2013 there has been comprehensive renovation of ***56 buildings with the total area of 145 043.8 m² or 1.2 % of the total stock,*** *including*:

- before 2008: 12 buildings with the total area of 46 987.4 m²;
- from 2009 to 2012: 28 buildings with the total area of 68 807.4 m²;
- in 2013: 7 buildings with the total area of 29 249.1 m²;
- 9 buildings of social housing with the total area of 39 495.4 m².

In 2013 the City Council has additionally concluded about ***40 agreements*** with the Latvian Investment and Development Agency (LIDA) on involvement of EU structural funds in co-financing housing renovation. Most of the renovation work has to be completed in 2014.

The housing renovation data including the addresses of the renovation sites is available on the website of the municipal agency REA *www.rea.riga.lv* in the "Energy efficiency" section under "Renovation of residential housing".



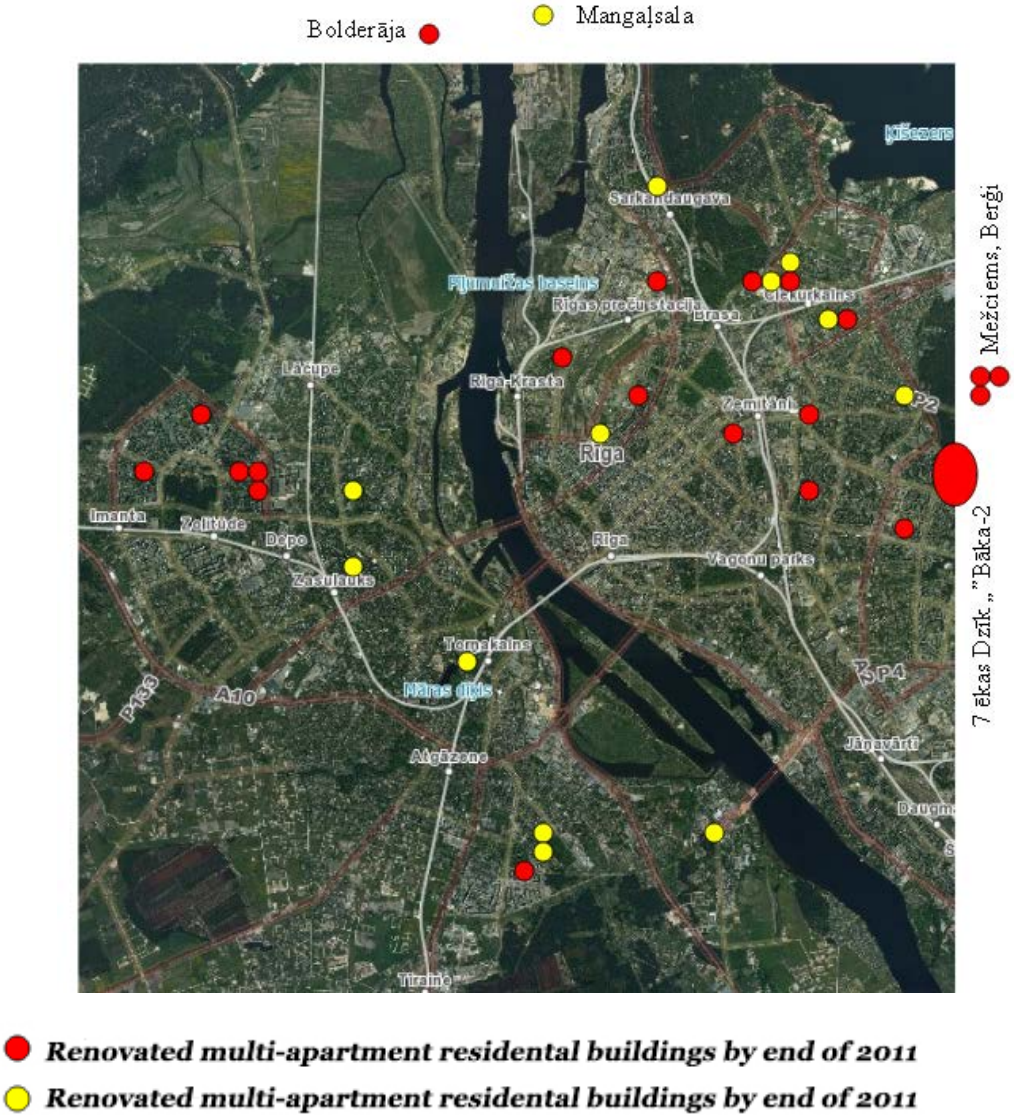




Figure 9.33 – 9.35. Renovated multi-apartment buildings in Riga

The figure below maps the multi-apartment houses which have been comprehensively renovated until late 2012 (excluding the 8 buildings for social housing).

Figure 9.36



Renovated multi-apartment residental buildings by end of 2011

Renovated multi-apartment residental buildings by end of 2011

The map shows that the renovated buildings are spread all over the city area. The renovated buildings with their well-groomed appearance, high heat stability and growing apartment prices set a good example for the neighbourhood to decide in favour of renovation; this is evidenced by the first clusters of renovated buildings in the city. Heat consumption in the renovated houses has on the average decreased by 50 %. However, not all the residents have chosen to implement all the measures which are technically feasible at a given stage. Decisions have been driven by the total renovation costs negotiated by the owners of the apartments.

Under comprehensive renovation we understand a set of measures for increasing heat stability and energy efficiency of the building, including:

- insulation of the attic or the built up roof, the ground floor or the base of the building, the basement and the external walls;
- replacement of the windows in all the building, replacement or insulation of the external doors to comply with the Latvian building standard LBN 002-01;
- renovation of the ventilation system without heat retrieval;
- renovation or replacement of the hot water preparation system with mains pipeline insulation;
- renovation or replacement of the heating units (in Riga before 2008 all buildings were equipped with modern heat exchangers);
- renovation of the heating system, including replacement of radiators and in case of a single pipeline equipping them with a by-pass, installing temperature controls and allocators and other heat metering devices, if the system is not replaced with a two-pipe system with heat meters for every apartment;
- improvement of the functioning of the single pipe system with temperature controls installed on mains with reverse flow temperature control and an automatic balancing system for uniform temperature distribution to the radiators.

The maximum number of energy efficiency measures has been implemented in 7 of the total number of renovated buildings, which serve as an example of what can be achieved through massive renovation activities in a multi-apartment building. The table below shows the actual energy efficiency data (heating + hot water preparation) for these 7 multi-apartment houses.

Table 9.9

Address of the multi-apartment building	**Manager of the building**	**Total utilized are (apartments + non-residential space) m²**	**Actual specific heat consumption in 2012 kWh/m² ***
1. Anniņmuižas Bulvāris 60	OA “AB60”	2200.11	95.75
2. Bebru Street 4	OC “Kurzemes nams 14”	1646.07	96.64
3. Kurzemes Prospekts 14	OC “Kurzemes nams 14”	2342.91	95.09
4. Celmu Street 5	OA “Celmi 5”	2969.3	117.63
5. Rigondas Gatve 7	OA “Rigondas 7”	1916	107.62
6. Ozolciema Street 46 k.3	LTD “Rīgas namu pārvaldnieks”	3955.9	107.48
7. Gaujas Street 29 k.1	OA “Gaujas nams 29”	2160.7	88.92
Average value			**101.3**

*) This indicator needs to be climate corrected, if used for comparing. The average temperature of the heating season in 2012 was 0.6ºC.

Renovation arrangements for multi-apartment residential buildings

Until 2012 the urban housing stock was renovated only by the ***apartment owners' associations (OA)*** or ***cooperatives (OC)***. Therefore, the number of renovated houses in Riga was rather small, since the occupants of multi-apartment houses are people of very different standing and professions, and there are few among them which could assume the task of organizing and managing the renovation process on a professional basis. Around 2012/2013 the situation changed significantly, as the private Dutch international company ***ESCO*** (energy service company) (also under the name of LTD "RenEsco") entered the local market. The successful activities of LTD "RenEsco" outside Riga have been acknowledged in the EU, and it has won the "European Energy Service Initiative" at "EUSEW 2012" in Brussels. LTD "Ren Esco" has concluded 6 agreements on renovating multi-apartment houses in Riga over 2013 and has already started renovation in some of the buildings.

In 2012/2013 the ESCO principle was implemented also by the municipal company LTD "Rīgas namu pārvaldnieks", which manages around 4 300 privatized multi-apartment buildings in Riga. As of today, the company has concluded about 10 ESCO agreements with the buildings under its management, and is actively engaged in the renovation process of the multi-apartment houses. In 2013, some of the renovation work was started. However, the high number of buildings which need renovation and the relatively short period for completing the work (10-15 years) means that there is a need for about 5-6 ESCO companies. This task requires active government support for ESCOs, since the local Latvian companies do not have sufficient financial savings for making investments into ESCO activities. There is a need for affordable loans and availability of targeted state and municipal energy efficiency funds (revolving funds).

Advanced solutions for renovating the single-pipe heating system

The dominant solution in the heating system of the existing residential housing stock of Riga is the single-pipe system with radiators which have partly been replaced by the residents themselves without carrying out any calculations. The different solutions implemented in the apartments of a single building usually lead to a situation when a comfortable temperature may not be maintained throughout the building: in some of the apartments the temperature will inevitably be too high, lest the radiators should be equipped with by-passes and temperature controls, whereas the other apartments will be underheated. The autonomous modern heating units in Riga allow for secondary temperature control in the automatic mode. Primary control is carried out by adjusting the temperature of the heat carrier in the external network depending on the outdoor temperature.

There are advanced technical solutions which help to adjust the single-pipe system to provide for the functionalities of a two-pipe system and, in fact, to have sufficient temperature control for ensuring comfortable temperature in all the apartments. For this end the system needs to be renovated at a minimum cost, including the following measures:

- radiators, where necessary, need to be replaced and equipped with a by-pass and a temperature control for tertiary heat regulation at each radiator. Notably, radiators are part of the collective property of the building and the owners collectively decide on their use;
- allocators (heat cost allocators) or other heat metering devices need to be mounted on radiators, preferably with a remote data reading system;
- the mains of the heating system need to be equipped with temperature controls which can adjust the temperature and control the reverse flow providing simultaneously for balancing of the system. This measure ensures a single heat carrier temperature at each radiator entry and provides for the desirable comfort.

The first building in Riga, where in 2011 all the above mentioned measures, including the allocators, were implemented as part of the comprehensive renovation was the residential building at Gaujas Street 29, which is a good example of a comprehensive renovation project:

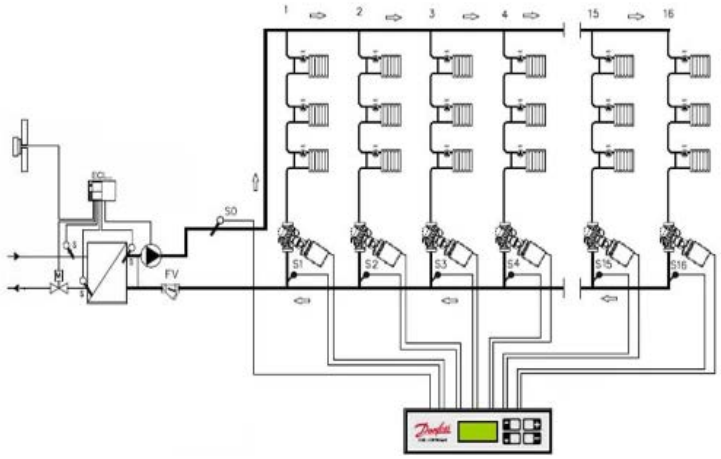




Figure 9.37

The implemented set of measures under the title ***"Improvement of energy consumption management in multi-apartment residential buildings"*** has been included in the e-catalogue "Best practice projects for a smart city" prepared by the municipal agency REA in 2013. It has been extensively applied in the practice of renovation.

Notably, management of heat consumption in the apartment reduces total heat consumption and heating costs, ***if reduction of temperature by 1ºC leads to a 5 – 6% reduction of consumption.*** Software operated temperature controls on radiators provide even better options for adjusting heat consumption. Management of heat consumption (also from remote locations) allows to reduce the temperature during the day and during holidays, when the owners are outside their apartments, or to reduce the temperature by a few degrees during the night when there is less activity and to increase it again for comfort in the morning hours.

Publicly available data base on energy efficiency in multi-apartment buildings

The owners of privatized multi-apartment buildings in Riga (>6000 buildings), apart from a small number of houses (around 200) where energy audits have been conducted, have no idea about their specific annual heat consumption per square metre, which does not promote awareness about the heat stability of the building and the need to improve its energy efficiency. In view of the EU Energy Efficiency Directive 2012/27/EU which states that residents need to be informed about the energy efficiency indicators of their homes/apartments on a regular basis, in 2013 the municipal agency REA set up a data base for the housing stock connected to the district heating system; the data base has been made publicly available through its web site *www.rea.riga.lv* in the "Energy efficiency" section under "Data base on housing". It contains correct and clear information about the actual specific heat consumption of buildings per square metre over the past year, which can be compared to the equivalent indicator for the renovated housing stock. The ***"Data base for multi-apartment residential buildings in Riga"*** as a best practice project has been included in the e-catalogue "Best practice projects for a smart city" prepared by the municipal agency REA in 2013.

The data base is organized according to street names in alphabetical order and contains the following data (sample):

DATA ON HEAT CONSUMPTION IN MULTI-APARTMENT HOUSES IN RIGA: "V"

No	Address	Total utilized floor area (apartaments + non-residental space – n.r.) [m²] Data submitted by properties managers	Property manager	Actual heat energy consumption in 2012 [MWh/per year]	Actual heat energy consumption in 2012 [kWh/m²/per year]	Comments
1.	Vesetas street 8	4794,88	OA „Rakstnieku māja"	967,61	202	

Abbreviations:

n.r. –non-residental stock

Figure 9.38

The data base shows all the actual consumption data for the previous year: from January to December. These data are the reference for calculating the actual specific heat consumption per square metre of utilized space (apartments + non-residential space). The actual specific heat energy consumption data are not intended for comparison with equivalent data for other cities or years. In order for the data to be compared they have to be climate adjusted.

In order to assess the energy efficiency level, the specific heat consumption of the building over a year has to be compared to the average specific heat consumption of a comprehensively renovated building in the same year and in the same city. The result shows the actual energy efficiency of the building or the percentage of heat or heat costs that have been wasted due to lack of comprehensive renovation measures.

The figure for comparison is the ***specific average heat energy consumption in comprehensively renovated multi-apartment residential buildings in 2012 in Riga, i.e. 101 Wh/m².*** For example: the wasted heat or heat costs in percentage for the building on Vesetas Street 8, which in 2012 was not renovated are as follows:

$$\frac{202 - 101}{202} \times 100 = 50\%$$

Because there is a number of residents who do not use the internet, property managers are advised to analyse the data on a monthly basis and print it on the backside of the bills sent out to the customers.

Initially the data base contained 2 856 multi-apartment buildings managed by Ltd "Rīgas namu pārvaldnieks". This number is sufficient for conducting an energy efficiency analysis of the buildings included and extrapolating the data to the city. Thus, ***in 2012 the actual specific heat consumption in multi-apartment residential buildings without renovation in Riga was 201 kWh/m².*** The chart below contains a graphic comparison of the actual specific heat consumption with the average actual specific heat consumption in 7 buildings which have been comprehensively renovated.

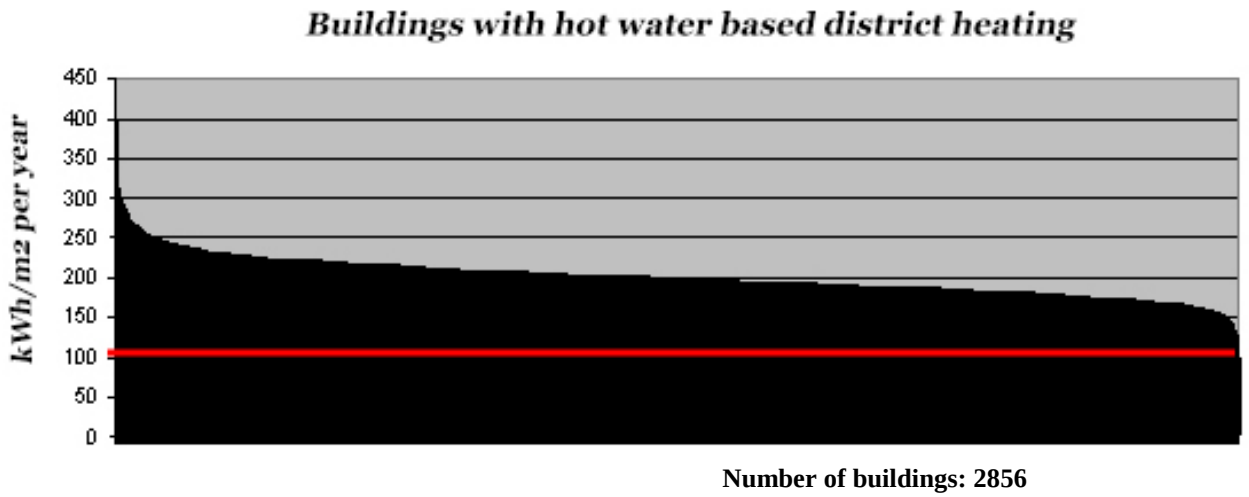
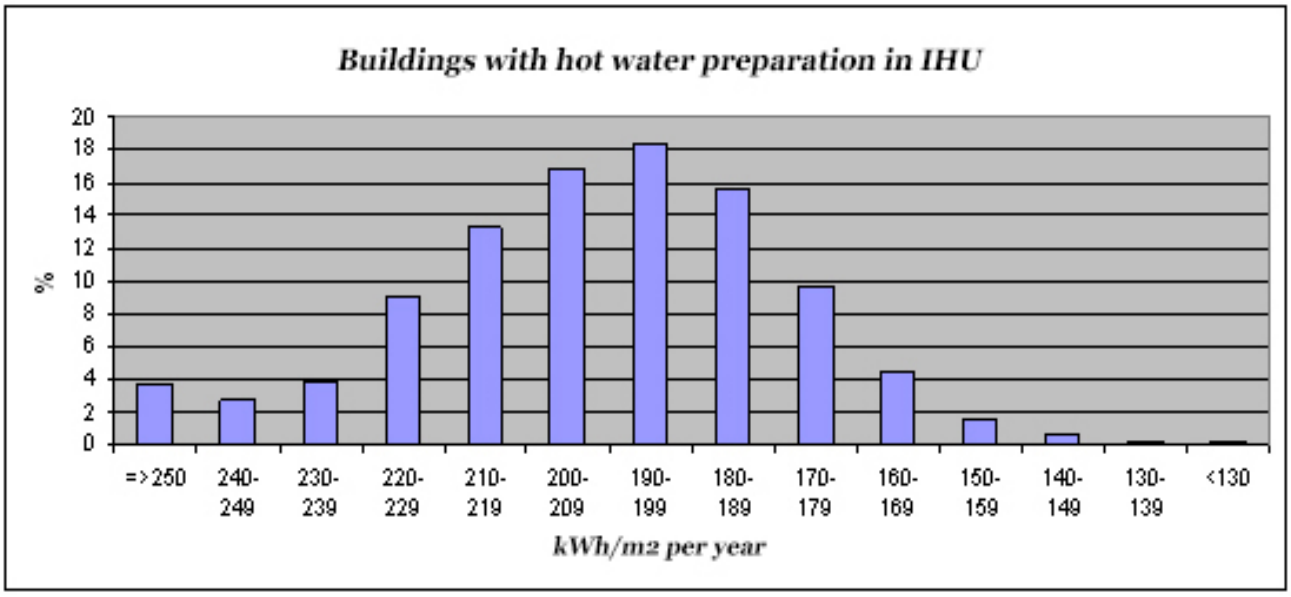


Figure. 9.39

The area above the red line (the average specific heat consumption in comprehensively renovated buildings in Riga over 2012:101 kWh/m²) clearly indicates the potential of the city for reducing heat consumption and CO_2 emissions in the residential sector. According to the data on specific heat consumption over 2012, the buildings included in the REA data base are distributed as follows:



***) IHU – individual heating unit of the building**

Figure 9.40

REA launched the data base in 2013. With three additional energy inspectors hired in 2013, the municipal agency REA will extend the data base by adding to it all the buildings connected to the district heating system.

Municipal support for renovation

In 2007 the Riga municipality with EU support established the "Riga Energy Agency" (REA) for managing and coordinating energy supply, energy efficiency and use of renewable resources in the administrative territory of Riga and for providing accessibility of information on these issues to the residents. REA includes an Energy Efficiency Information Centre which on a

daily basis gives free advice to residents on renovation and other issues; it also organizes educational and information activities: discussions and workshops on quality of renovation, open door activities on renovated buildings, etc.

The Riga municipality has been giving support to renovation activities in multi-apartment residential buildings since 2011. The binding regulations issued by the Riga City Council on the procedure of municipal support for energy efficiency measures in multi-apartment houses have been approved and are in force.

During the period from autumn 2011 to beginning of 2013 the first project on "Housing energy audits 2011" (PVS ID 1961-2786) was implemented with the municipal agency REA arranging for energy audits and developing energy certificates for 102 multi-apartment residential buildings. 80 % of the financing came from the municipality of Riga. In 2013 a new project "Housing energy audits 2013" (PVS 306) was launched with implementation planned for 2013/2014. The financing conditions have been maintained. Residential buildings can be put down for energy audit and energy certification from October 1, 2013; in early 2014 a phased procurement procedure will be started on the basis of the new Cabinet Regulations on the qualification requirements of energy auditors. In the first phase 40 multi-apartment houses are going to be audited.

Another project "Development of sample documents for the renovation of 12 serial multi-apartment residential buildings" (PVS ID 3007) for the 12 most common building types constructed between 1957 and 1993, including full technical documentation (for energy audit, technical surveying, technical project for renovation) is going to be implemented. 100 % of the funding has been allocated by the Riga municipality. Table 9.9 contains an overview of the main building types and the locations of the buildings in the corresponding neighbourhoods.

Table 9.10

Type	Construction period	Number of floors	Location
1-316	1957-1964	4-5	Āgenskalns, Tirzas iela, Viestura prospekts, Grīvas iela
1-318	from 1964	5	Purvciems, Iļģuciems, Ropažu iela u.c.
46A	from 1959	5	Āgenskalns, Tirzas iela
464 A	from 1961	5	Ķengarags, Jugla
464A/Л	from 1964	5	Ķengarags, Jugla
464/ Л66	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

From 2014 the Riga municipality has additionally planned to establish a service consisting of 3 energy inspectors at the municipal agency REA (see OPERATIONAL STRATEGY for 2014 – 2016 of the Riga municipal agency REA approved by the Riga City Council as of December 17, 2013, Decision No 561) for developing the annual energy efficiency indicators for the public e-data base "Data base for multi-apartment residential buildings in Riga", as well as other buildings (altogether >7400), and for giving the appropriate advice on how to reduce energy consumption.

For reach out and accessibility of information about energy efficiency and renovation issues, a free monthly municipal gazette has been developed to be published from 2014 with advice on issues concerning public utilities.

Since the time the single company Ltd "Rīgas namu pārvaldnieks" for management of the privatized municipal multi-apartment residential building stock (about 4 300 buildings) was finally established in 2012/2013, it has been focussing on offering renovation of multi-apartment buildings in line with the ESCO principle. By 2013 as many as about 10 renovation agreements were concluded and their implementation has started. Ltd "Rīgas namu pārvaldnieks" has also facilitated numerous applications for energy audit.

The social sector of municipal multi-apartment buildings

There are 13 buildings for social housing in Riga, which are both existing buildings adapted for the needs of social housing (9) and new constructions (4). A significant part of the social housing accommodations includes complimentary services for the specific needs of the residents. The municipal multi-apartment buildings for social housing are the responsibility of the Housing and Environmental Department of the Riga City Council, and they are managed by the company Ltd "Rīgas pilsētbūvnieks", which is also involved in building and renovation activities in the segment. Ltd "Rīgas pilsētbūvnieks" is also involved in building new municipal multi-apartment housing units for rent in compliance with the Latvian building standards. Energy efficiency data on the rentals built and social housing managed by the company are available on the REA website *www.rea.riga.lv* in the "Energy efficiency" section under "Data base on residential housing in Riga"→ Ltd "Rīgas pilsētbūvnieks". From the total number of social housing units, nine in 2013 complied with the energy efficiency level of comprehensively renovated buildings.

Introduction of energy efficiency and renewable resources in households

Latvia is not listing energy saving measures and use of renewable resources in households. Information on accessible activities is available during exhibitions and workshops held on a regular basis, as well as in professional publications and at professional associations and unions. The results of the measures taken by the households are recorded through the total indicators of energy consumption and are made manifest through the declining energy consumption. Some of the measures are listed together with the funding donor when the measure is carried out with the support of the state or a foundation, because these measures undergo monitoring at a later stage. Some of the measures implemented in the households in Riga and serving as pilot projects for sharing experience, have been listed below:

1) The pilot project ***"Facilitation of energy efficiency in households with the use of smart technologies"***, which has been included in the e-catalogue "Best practice projects for a smart city" prepared by the municipal agency REA in 2013, has been developed and implemented by JSC "Latvenergo" in 500 households part of which are located in Riga. The implementation of the project took place from June 2012 until March 2013. The project was co-financed through the Climate Change Financial Instrument managed by the Ministry of Environment Protection and Regional Development. The project was based on the introduction of smart metres and energy consumption management in households, and energy metering with simple additional devices.



Figure 9.41. Source: JSC "Latvenergo". Set of energy monitoring devices



Figure 9.42. Source: JSC "Latvenergo". Energy metering devices

The flowchart below shows the household energy consumption monitoring system:

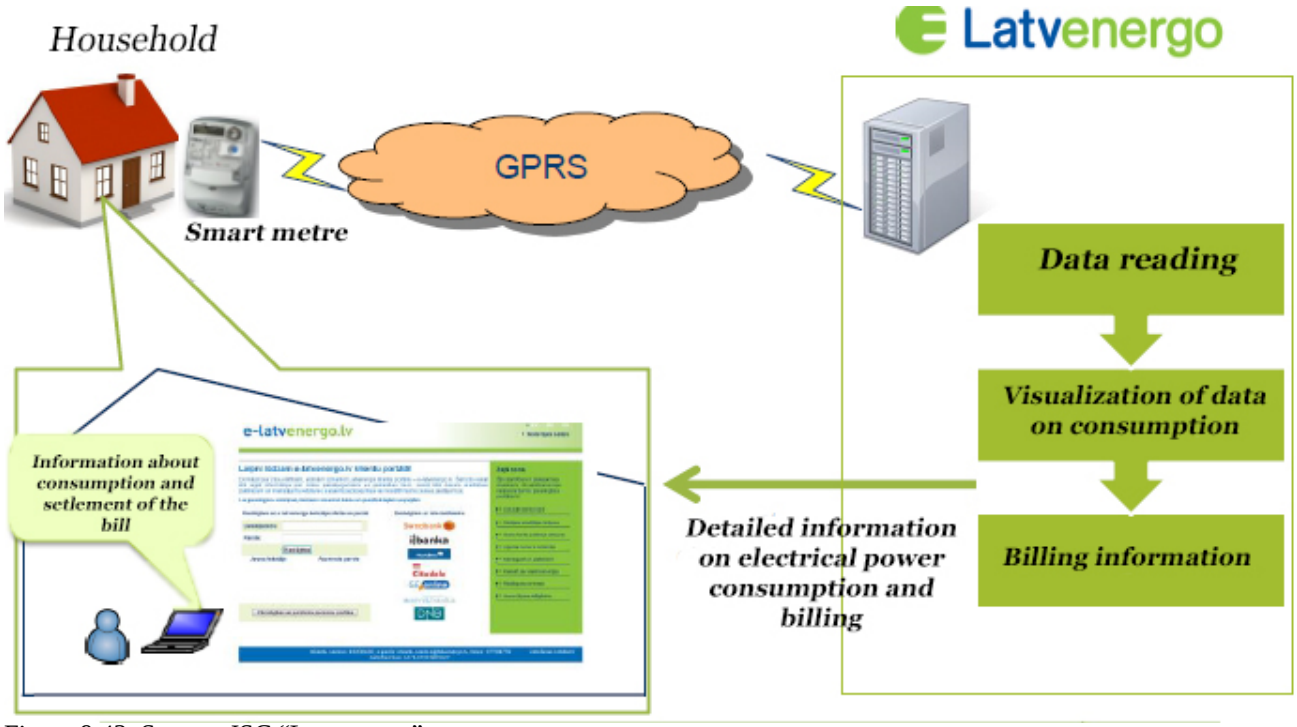


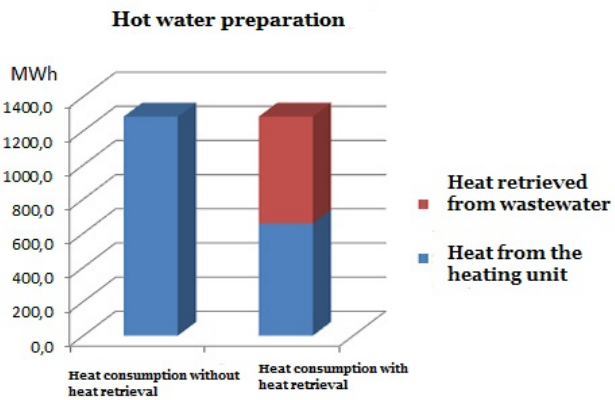
Figure 9.43. Source: JSC "Latvenergo"

The expected reduction of electrical power consumption in the households involved is at least 10 %. Already the first results show that the residents pay attention to avoid leaving devices in the "stand by" mode and replace out-dated household equipment with high power consumption.

2) The project ***"Wastewater heat recover from multi-apartment residential buildings"*** which has been included in the e-catalogue "Best practice projects for a smart city" prepared by the municipal agency REA in 2013, has been developed and implemented in Riga, Ķīpsala, in the student hostel of the Riga Technical University at Āzenes Street 22 and 22a for hot water preparation:



Figure 9.44. Source: Ltd "Menerga Baltic"



Flowchart:

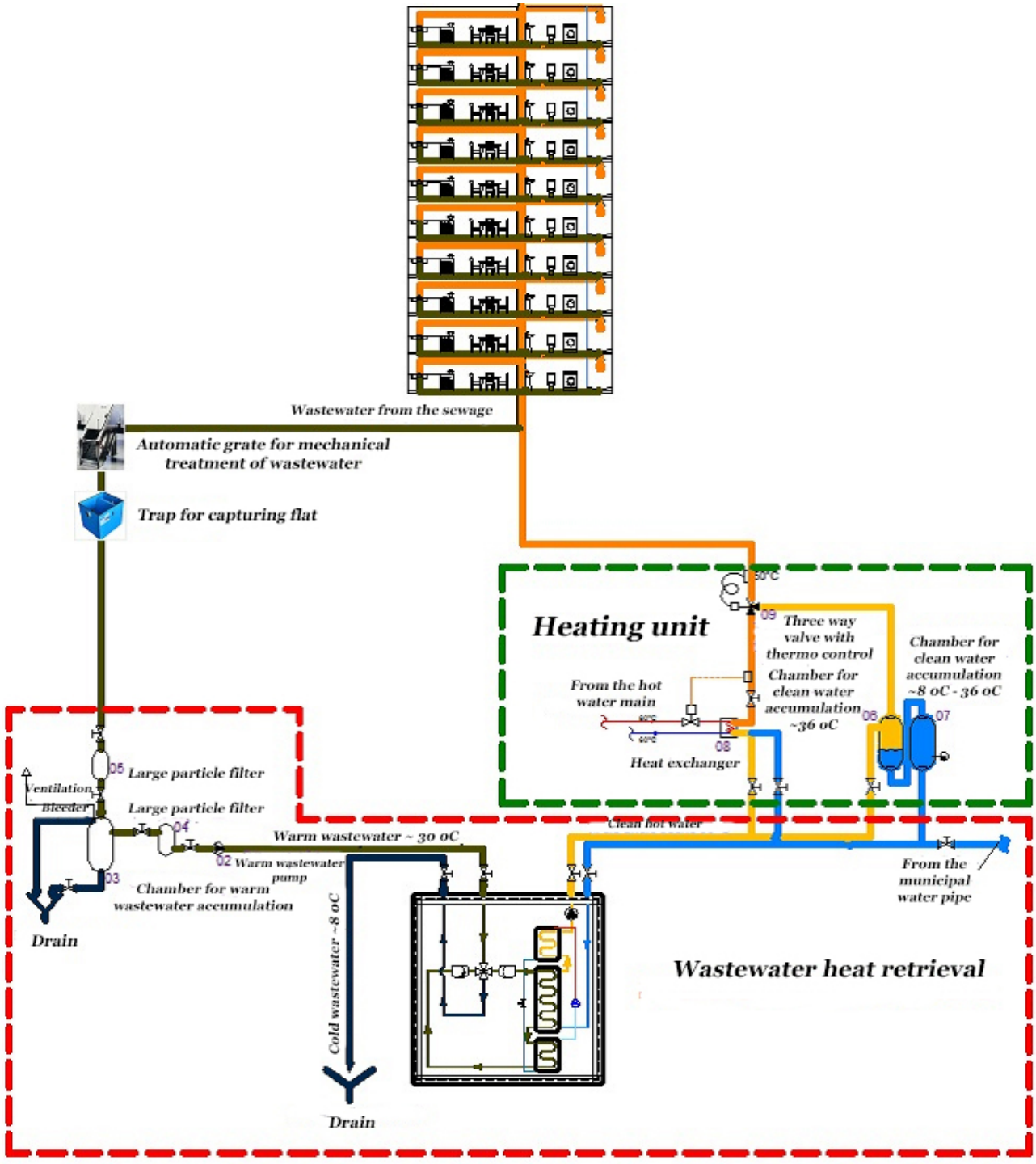


Figure 9.45. Source: Ltd "Menerga Baltic"

As can be seen from the flowchart, the wastewater heat retrieval system implemented in 2013 has led to reducing the heat used for hot water preparation system by about 50 %.

3) The project ***"Use of solar pumps for heating"*** which has been included in the e-catalogue "Best practice projects for a smart city" prepared by the municipal agency REA in 2013, was implemented in March 2013 in individual family house in Riga, at Jūrkalnes Street 5, to replace the electrical power based heating system. The solar pump system includes the following equipment:



Figure 9.46. Source: "Sauleskolektors.lv"

Solar pumps belong to the new generation of solar heating systems, which use both solar and geothermal heat, with 85 % of energy savings. Solar batteries included, the system would generate more energy than the building can consume. The solar pump system can function as a standalone system; however, the separate elements of the system can be used also to improve an existing heating system based on a heat pump.

Action plan for the urban housing sector

The forecast of the action plan on renovating the multi-apartment residential housing stock is based on a function related growth trend:

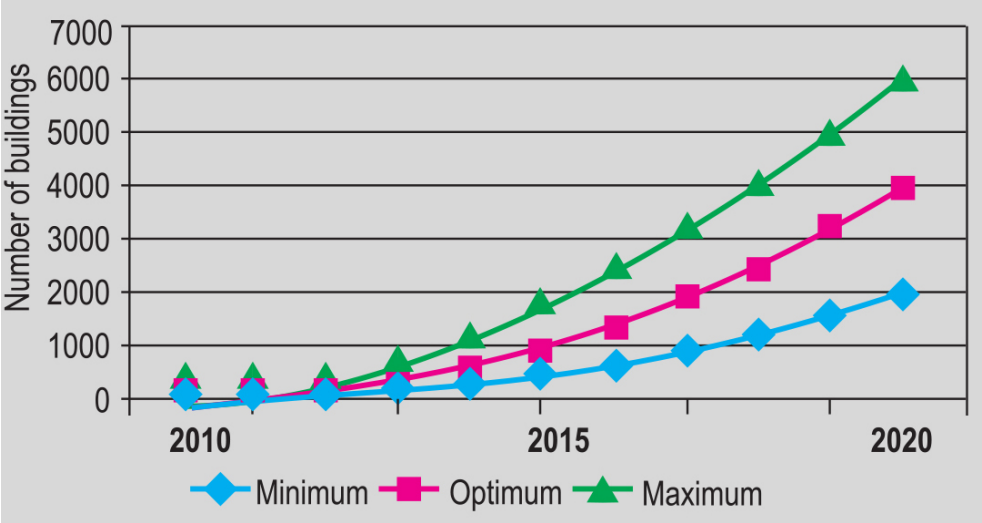


Figure 9.47

The ability to reach the goals and renovation intensity depends on how efficiently the Government and the City Council will succeed in dealing with the basic issues, i.e. providing financial support for energy service companies (ESCO) and setting up an adequately financed Renovation Administration, as well as establishing a revolving fund and involving the participation of energy service companies in the housing stock renovation process. Delays in handling these issues are going to lead to a slowdown in the renovation process.

Table 9.11

Action Plan			
Measure	Implementation time	Responsibility for implementation	Extent of implementation
1. Foster complex renovation of multi-apartment residential buildings	2014 –2020	Municipal agency REA, cooperation partners	2015 – 110/ 500/1000* houses 2020 – 2000/4000/6000* houses
2. Participate in campaigns or organise campaigns on issues of multi-apartment building 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	2013–2020	Municipal agency REA, cooperation partners	Annually
3. Organize and foster development of energy audits and energy certification of multi-apartment residential buildings with the help of municipal financial support	2013–2020	Municipal agency REA, cooperation partners	2015 – 300/ 500/1000* houses 2020 – 2000/4000/6000* houses
4. Establish and maintain a publicly accessible data base on the actual energy efficiency of the Riga multi-apartment residential buildings connected to the district heating network over the past year in kWh/m²	2013–2020	Municipal agency REA, cooperation partners	Annually *www.rea.riga.lv* 2014/2015 – 100%
5. Monitor the renovated multi-apartment residential buildings in Riga with regular (annual) data analysis on the achieved reduction of heat consumption in MWh per year	2013–2020	Municipal agency REA, cooperation partners	Annually
6. Organize development of model technical documentation for renovation of multi-apartment residential buildings for the 12 most common standard series of multi-apartment buildings with 100 % of municipal financing	2013/2015	Municipal agency REA, cooperation partners	

7. Ensure participation of some municipal companies (Ltd "Rīgas namu pārvaldnieks", etc.) in the renovation of multi-apartment residential buildings according to the ESCO principles	2013–2020	Riga City Council	ESCO Ltd "Rīgas namu pārvaldnieks" has started to operate since 2012
8. Foster better energy consumption management in multi-apartment residential buildings by implementing a system for recording energy consumption (allocators or other heat consumption recording devices) and its adjustment in apartments; install temperature regulators with automatic system balancing and backflow temperature control in the heater's lead-ins	2013–2020	Municipal agency REA, cooperation partners	
9. Organize expert roundtable discussion club workshops on quality issues related to renovation of multi-apartment residential buildings	2013–2020	REA Energy Efficiency Information Centre	6 times per year
10. Organize "welcome day" events next to the renovated multi-apartment buildings	2013–2020	REA Energy Efficiency Information Centre	6 times per year
11. Set up a body of 3 energy inspectors at REA to ensure the functioning of the public data base on the annual energy efficiency indicators on every multi-apartment buildings	2014	Riga City Council, REA	
12. Handle the municipal social buildings stock to ensure its compliance with the building standards	2014 –2020	Riga City Council, Ltd "Rīgas pilsētbūvnieks"	
13. Foster use of smart technologies for improving household energy efficiency by introducing local metering and management of consumption	2013–2020	JSC "Latvenergo"	
14. Foster selective implementation of waste water heat retrieval technologies in the city's multi-apartment residential stock	2013–2020	Municipal agency REA, cooperation partners	
15. Foster use of solar pumps for heat supply to buildings in the city	2013–2020	Municipal agency REA, cooperation partners	

16. Foster improvement of the internal electrical wiring systems of the multi-apartment residential stock (built before 1993) and replacement of the three-wire power (3x220V) system with modern voltage cables of 400/230 V	2014 –2020	Building managers, JSC "Sadales tīkls", REA	
17. Support renovation of multi-apartment residential buildings and other buildings connected to the city's centralised heating system to achieve an annual 1.5 % reduction in heat consumption at the end consumer's location as compared to the average heat energy volume sold over 2010, 2011 and 2012	2014 –2020	JSC "Rīgas siltums", Riga City Council, Municipal agency REA	Average heat energy savings per year 47.36 thsd. MWh x 7 years = 331.52 thsd. MWh

*) minimum/optimum/maximum forecast

9.2.2 THE PUBLIC BUILDINGS OF THE CITY AND THEIR RENOVATION

The public buildings of the city

There are more than 400 buildings in the municipal housing sector. In 2012 159 of these buildings were pre-school educational establishments (PEE) and 136 were schools. The number of buildings allocated for educational establishments tends to change, as the system is reorganized and adjusted in line with the number of children and schoolchildren. The Property Department of the Riga City Council performs an annual survey of the municipal educational establishments and their technical assessment, and publishes the results on the department website *www.rdid.lv*. In line with the results of the survey, which are summarized in a table together with the specific addresses of the buildings, 46 PEE had undergone comprehensive renovation by 2012 (+1 PEE which was still in the process of being renovated); alternatively, the number of ***renovated*** schools was 55 (+ 4 schools in the process) which is ***36 % of the total number of educational establishments***. Furthermore, many schools have had their windows replaced, school kitchens, gyms and other premises have undergone renovation and schoolyards have been cleared, etc. According to the comments in the data collected by the Property Department of the Riga City Council, comprehensive renovation of all the educational establishments in Riga is going to be completed during the next 5 years.

Some of the educational establishments have been renovated with co-financing from the Climate Change Financial Instrument (CCFI). The addresses and data of the respective educational institutions are included in the descriptions of the 5 projects implemented with the co-financing of the CCFI; they are available on the Property Department web page.





Figure 9.48 – 9.50. Some of the renovated educational establishments of the Riga municipality



Apart from the abovementioned educational establishments, municipally owned public buildings include unique cultural institutions (the Opera House, the theatres of the city, etc.), sports grounds, administrative and office buildings, etc. Renovation, upgrading and refurbishment refer also to these buildings. Over the past year, renovation has been carried out in the Russian Drama Theatre in the Old Town, and in the Culture Palace "Ziemeļblāzma" in Vecmīlgrāvis. Reconstruction of the unique building of the State Art Museum and its underground annex on Valdemāra Street commenced in 2012 and will be completed by 2015. The photo below shows the Culture Palace "Ziemeļblāzma" after renovation:



Figure 9.51

Energy efficiency of the public buildings

Most of the municipally owned public buildings are connected to the district heating system. Depending on the heating area, the buildings fall into the following groups:

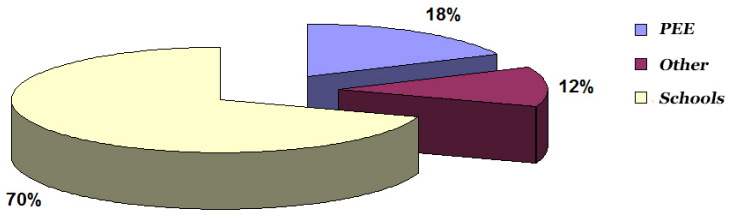


Figure 9.52

The municipal agency REA has assessed these public buildings for actual specific heat consumption in kWh/m². The results for the past 3 years have been summarized in the chart below:

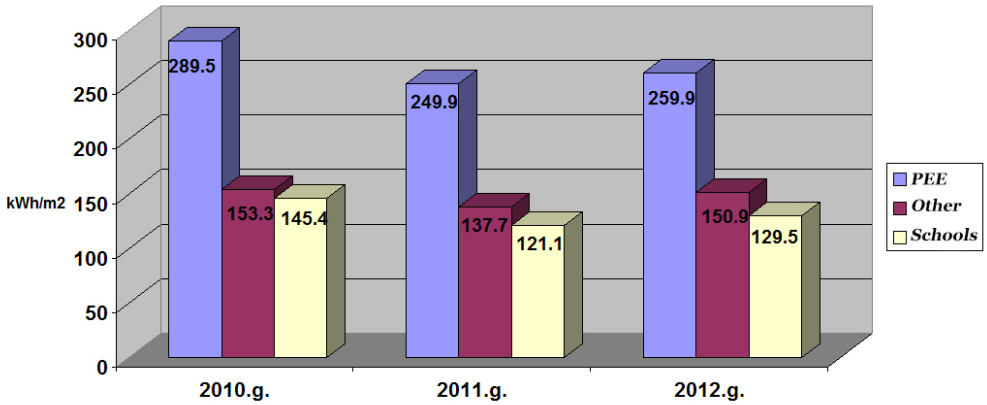


Figure 9.53

As seen from the chart, the specific heat consumption tends to decrease slightly year on year; however, the overall level is quite high which indicates the need for renovation and energy saving measures in the buildings. Among the respective groups of buildings, consumption is highest in the pre-school educational establishments, followed by schools and, then, other buildings. Reduction of specific heat consumption is related to heat stability improvement measures and optimization of temperature modes. In line with the recommendations of the municipal agency REA, the daytime temperatures maintained in the public buildings are in compliance with the regulatory requirements for the specific group of premises. Towards the end of the working hours, the temperature is reduced to 15-16 ºC and, then, again increased in the morning – an hour before work. The indoor temperature is also reduced for the whole period of holidays. Hot water temperatures are also reduced during night-time and on holidays to 35ºC, whereas during daytime they stay compliant to the regulatory requirements for the specific type of premises. Modifications are ensured through the modern automatic heating units in the buildings.

The chart below shows the actual heat consumption by group of buildings in MWh/per year:

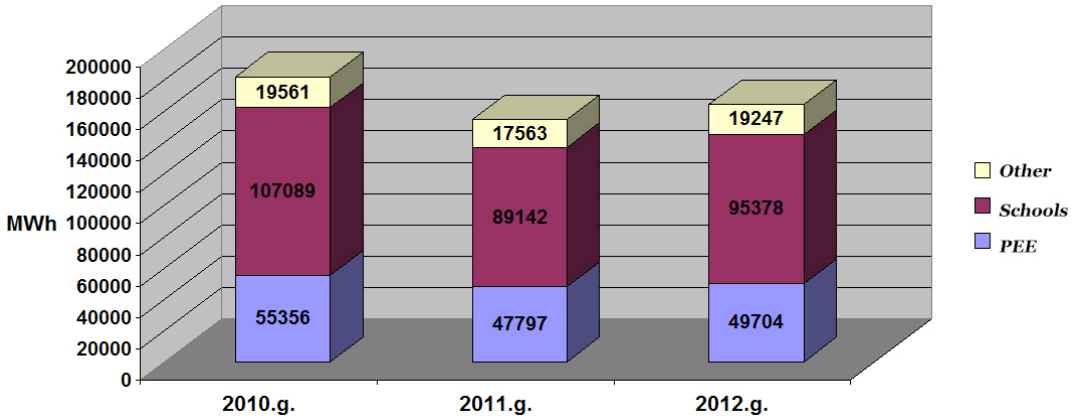


Figure 9.54

In the public buildings modern IC technologies play an important role in management and control of energy consumption. A modern management system has been introduced in the renovated Russian Drama Theatre and in the Culture Palace “Ziemeļblāzma”, also elsewhere, including the municipal

office buildings at Brīvības Street 49/53. The project ***"Energy consumption management system in public buildings"*** has been included in the e-catalogue "Best practice projects for a smart city" prepared by the municipal agency REA in 2013.

Action plan for the public buildings' sector

Table 9.12

Action Plan			
Measure	Implementation time	Responsibility for implementation	Extent of implementation
1. Conduct comprehensive renovation of municipal educational establishments	2013 – 2020	Property Department of Riga City Council	100 % from the total
2. Conduct energy audits of administrative buildings of the Riga City Council and their energy certification with the certification data subsequently displayed in premises with a certain flow of visitors	2014 – 2020	Ltd "Rīgas nami"	100 % from the total
3. Conduct energy audits of educational establishments of the Riga City Council and their energy certification with the certification data subsequently displayed	2012 – 2020	Property Department of Riga City Council	100 % from the total
4. Foster introduction of energy consumption management in the buildings of municipal educational establishments	2013 – 2020	Property Department of Riga City Council, municipal agency REA, cooperation partners	80 /90 /100 % *
5. Foster introduction of energy consumption management in public buildings	2013 – 2020	PropertyDepartment of Riga City Council, Ltd "Rīgas nami", municipal agency REA, cooperation partners	40 /50 /60 % *

*) minimum/optimum/maximum forecast

9.2.3 LIGHTING IN THE STREETS AND PARKS OF THE CITY

City lighting

The Riga city lighting network, which covers street lighting, lighting of the parks, squares and blocks of flats, is managed by the Riga municipal agency "Rīgas gaisma". In 2013 the Riga city lighting system represented a single electrical infrastructure including more than 400 connections to the single power distribution network, 1 280 km of underground cable lines, 560 km of overhead cable lines and 35 800 supports and 46 396 lamps. By 2008 all the lamps of the system were replaced with high pressure sodium lamps. Since 2012 LED lighting has been phased in.

The focus has been on increasing the visual appeal and originality of the city lighting, especially in the centre of the city with the Old Town, the Art Nouveau style neighbourhoods and the major parks and bridges. There is lighting around the buildings, the bridges and the embankment of

the city canal in the park area. Every November, in the middle of the month, a long weekend is devoted to the festival of light "Staro Rīga" with special shows and originally illuminated sites, when the city obtains a fantastic appearance and attracts many tourists. The trend in energy consumption is illustrated by the following chart:

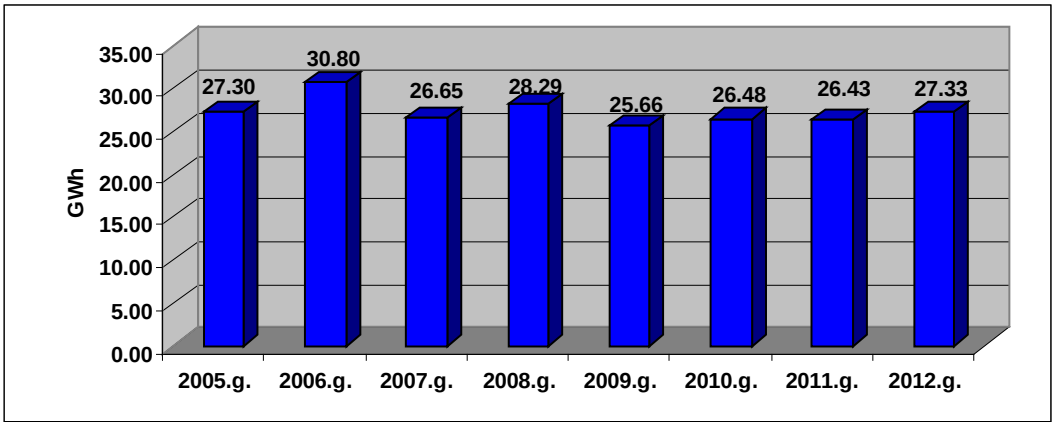


Figure 9.55

As demonstrated by the chart, power consumption for city lighting has remained rather stable and has slightly declined in the period between 2009 and 2011 during the economic downturn. The savings in power consumption gained through upgrading the system has made it possible to install lighting in the streets and areas where it was absent before.

Upgrading of the lighting system

With the support of the Climate Change Financial Instrument LED lighting is being introduced in Riga since 2012. The first two projects, which covered certain sections of streets in the city area, were finalized in 2012. In the framework of these projects, altogether 546 sodium lamps were replaced with 47 LED lamps of a capacity up to 138W and 111 LED lamps of a capacity up to 168 W. During the daytime and at night lighting levels are managed through 7 control systems (for lighting levels' control). The solution of the abovementioned projects under the title ***"Use of programmed LED lamps for city lighting with remote voltage control"*** has been included in the e-catalogue "Best practice projects for a smart city" prepared by the municipal agency REA in 2013. The flow-chart illustrating the solution is the below:



Figure 9.56. Source: Riga municipal agency "Rīgas gaisma"

In 2013 three similar projects supported by the Climate Change Financial Instrument were implemented in the neighbourhoods of Vecāķi, Mangaļsala and Dārziņi with the aim to manage and improve the lighting in the respective areas. There are also plans to do similar work in the neighbourhoods of Kleisti and Trīsciems by 2017, as well as in Bolderāja, Daugavgrīva, Jaunciems, the Maskavas suburb, Ķengarags, Mežaparks and Ziepniekkalns. Conversion of the whole neighbourhood to LED lighting connected to a single control system may reduce energy consumption for lighting in the neighbourhood by up to 40 %. In 2013 the total number of installed LED lamps approached 2 000, which is the best indicator in Latvia and among the best indicators in the region of Northern States. The plan is to increase the number of LED lamps to 5 000 by 2017.

In the framework of the international project "LED-based Intelligent Street Lighting for Energy Saving" (LITES) and with the support of the municipal agency "Rīgas gaisma" 20 distance operated software controlled modern LED lamps with a GSM/WiFi and 10-100 % dimming option have been installed in the student bicycle parking space and its access roads on the Technical University campus. The students are involved in monitoring the operation of the lamps and research.

Action plan in city lighting

Table 9.13

Action Plan			
Measure	Implementation time	Responsibility for implementation	Extent of implementation
1. Introduce LED technologies for city lighting purposes by using the experience gained in the pilot project and involving potential sources of funding	2013 – 2020	Riga municipal agency "Rīgas gaisma"	10 /12 /15% * from the total
2. Install lighting on those category 1 and 2 street sections where lighting is not present and in the neighbourhoods of Kleisti and Trīsciems	2014 – 2020	Riga municipal agency "Rīgas gaisma"	

*) minimum/optimum/maximum forecast

9.2.4 URBAN PUBLIC TRANSPORT

Electricity powered vehicles dominate in the city's public transport system. Public transport is operated by the municipal company LTD "Rīgas satiksme" which has the following resources at its disposal:

- for tram service: 267 trams, including 26 multi-section trams (20 three section trams and 4 four-section trams running along 9 routes);
- for trolleybus service: 267 trolleybuses running along 19 routes;
- for bus service: 432 busses running along 53 routes (+9 night routes);
- 4 860 urban parking lots with payments settled with the help of an e-token.

The out-dated vehicles are being appropriately replaced by modern vehicles which comply with the new requirements, offer greater comfort to the passengers and consume less energy. The total number of passengers in 2013 equalled 150.1 million, which exceeds the figure of 2012 by 6 %. There are also minivans (route taxis) running in the city; the fleet was established in 2012 and provides the service on an outsourcing basis under the control of LTD "Rīgas satiksme".

The Riga bus fleet drives on the fuel available on the fuel distribution network with a 3.6 % addition of biofuel being the national average in 2012.

As stated in the long-term strategy of LTD "Rīgas satiksme" for 2012-2033, the city is building a sustainable, modern, multimodal and integrated system of transportation through implementing innovative, smart and emission free solutions and furthering environmental goals. Public transport development aims at providing a high quality alternative for all social groups which successfully competes with passenger cars.

Modern low-floor multi-section trams with high passenger capacity are going to be the principal means of public transport connecting the main neighbourhoods and sites of the city. In 2013 such multi-section trams were already servicing two routes: No 6 and No 11. They are now being integrated in route No 4, with infrastructure adjusted to the low floor. There are further plans to develop the tramways by extending the routes or building new routes, as new strategically important sites are developed.



Figure 9.57

All public transportation is integrated into a single public transport network within the administrative boundaries of Riga and the precincts up to 15 km outside these boundaries where parking facilities are going to be developed. The electrified railway lines have also been included in the public transport network of the city. Measures are taken to improve vehicle accessibility for people with special needs and passengers with young children.

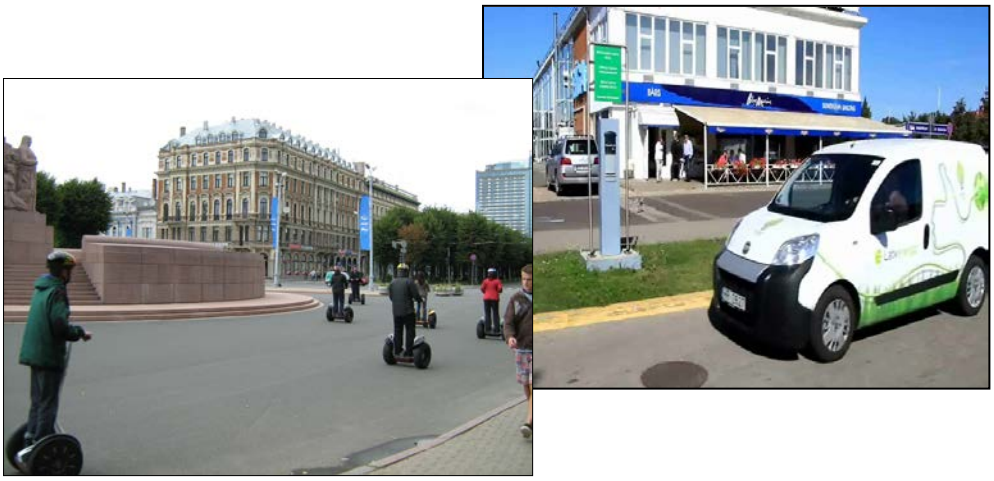
The public vehicle schedules are reviewed for improvement on a regular basis, a single e-token (e-ticket, e-card) valid for all means of public transport has been introduced. Vehicle schedules are available on the internet, and information can be followed via the mobile phone. Solutions are developed to provide free wireless internet access on some public transport lines and at the centrally located stops along transport routes.

Introduction of electrical cars in the city

The Zero Emission Mobility Support Society (*BIMAB*) has been functioning in Riga since 2009/2010 and in cooperation with JSC "Latvenergo" has been actively promoting introduction of electrical cars and electrical bicycles in Riga. *BIMAB* has established and is servicing a zero emission mobility demo centre, where each visitor can personally see different modifications of electrical cars and bikes. Since the abovementioned time, there are also slow moving electrical

tourist buses running in the city, segways are rented as a tourist attraction and the first free electrical vehicle charging station has been set up in the passenger port.

Figures 9.58.-9.59



In 2010 JSC "Latvenergo" purchased the first two electrical cars in Latvia, which was a good addition to the show of electrical vehicles at the annual "Environment and Energy 2010" exhibition during the Riga Energy Days. Since 2011 the Riga municipality, i.e. the municipal agency REA and the company LTD "Rīgas satiksme", have been actively engaged in promoting electrical vehicles in Riga. Activities involve public seminars for disseminating information, municipal support for the "St.Petersbourg - Monte Carlo" electromobile race ("Tallinn - Monte Carlo" before 2012) and municipal participation in the international project "Sustainable Urban Mobility" (SUM project); also the first 5 electrical vehicles have been involved in the municipal technical services, which by 2012 had a total of 8 vehicles. The introduced electrical vehicles and the slow charging infrastructure publicly accessible in the city together with the appropriate e-map has been included in the e-catalogue "Best practice projects for a smart city" prepared by the municipal agency REA in 2013 under the title ***"Electric cars for providing municipal technical services".***



Figure 9.60. The first five municipal electrical vehicles demonstrated in the Town Square

In 2014 the Cabinet of Ministers approved tender regulations for procuring electrical vehicles and setting up fast charging stations with the support of the Climate Change Financial Instrument. Guided by the study performed by the municipality and the scheme developed for fast charging stations in the city of Riga, the municipality is submitting a project for both purchasing electrical vehicles and setting up fast charging stations in the city. The project is planned for implementation

in 2014/2015. From 2015 on Riga is going to be a city fully open for electromobiles and electrical vehicles. Electromobiles are going to be involved in the municipal technical services also in the future.

Phased replacement of public transport busses with hydrogen and other zero emission mobility vehicles

In early 2013 after being present at the activities on hydrogen driven vehicles in Europe in Brussels during the EUSEW of 2012 and the Welcome Day weeks, the municipal agency REA together with the Hydrogen Fuel Cells and Electro-mobility Association (HyER) held the first international public seminar in the Baltic states on innovative hydrogen technologies with speakers from abroad.

The seminar encouraged more activities in 2013: the Riga municipality became associated member of HyER and during the Riga Energy Days in October, 2013 the hydrogen vehicles were directly demonstrated to the public; the show featured a hydrogen bus from Belgium and a light passenger car from the Scone region in Sweden, which is a STEP UP international project partner of the Riga municipality. Hydrogen powered vehicles were displayed at the "Environment and Energy 2010" international exhibition and could be test-driven by the visitors. During the exhibition the municipal agency REA held the second international conference on the use of hydrogen in transport, where officials from other countries together with vehicle producers and distributors shared their experience.





Figures 9.61 and 9.62. Demonstration of hydrogen powered vehicles in the Town Square

In view of the results of the research "Use of hydrogen technologies in the public transport system of the Riga city: environmental and economic aspects" commissioned by LTD "Rīgas satiksme" in 2013, the Riga municipality has decided on phasing in hydrogen driven vehicles in the city to gradually replace the traditional busses with hydrogen driven transport. This step is also important for decreasing the emission load mostly from motor vehicles on the main streets of the city.

A European network of hydrogen filling stations is being developed to foster introduction of hydrogen powered vehicles by providing the necessary coverage for their free movement in Europe. On the initiative of representatives from Sweden the municipality of Riga has engaged in the international project "HIT-2-Corridors", which has been submitted for the TEN-T programme tender. The project provides for the missing links in the coverage of hydrogen filling stations and their location in the cities included in the plan:

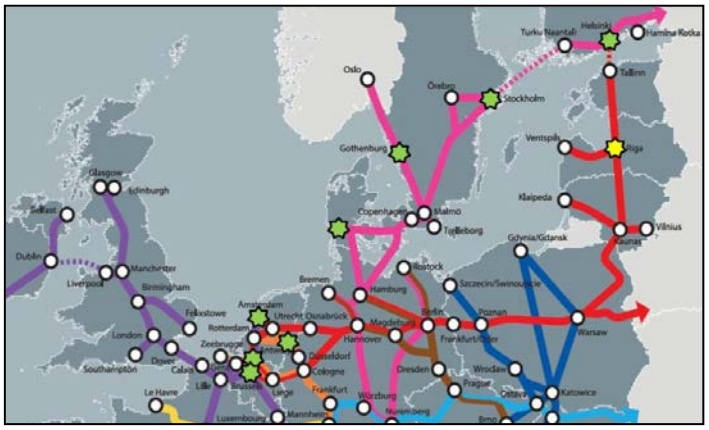


Figure 9.63

The Riga municipality is continuing activities in setting up the necessary contacts and cooperation for introduction of hydrogen powered vehicles.

Development of bicycle transport

Over the past few years bicycle transport in Riga has become a meaningful part of public transport with significant intensity in the streets of Riga. A lot of attention has been given to bicycle lane development, their total length in Riga being more than 44 km in Riga. More bicycle lanes are being built and marked.

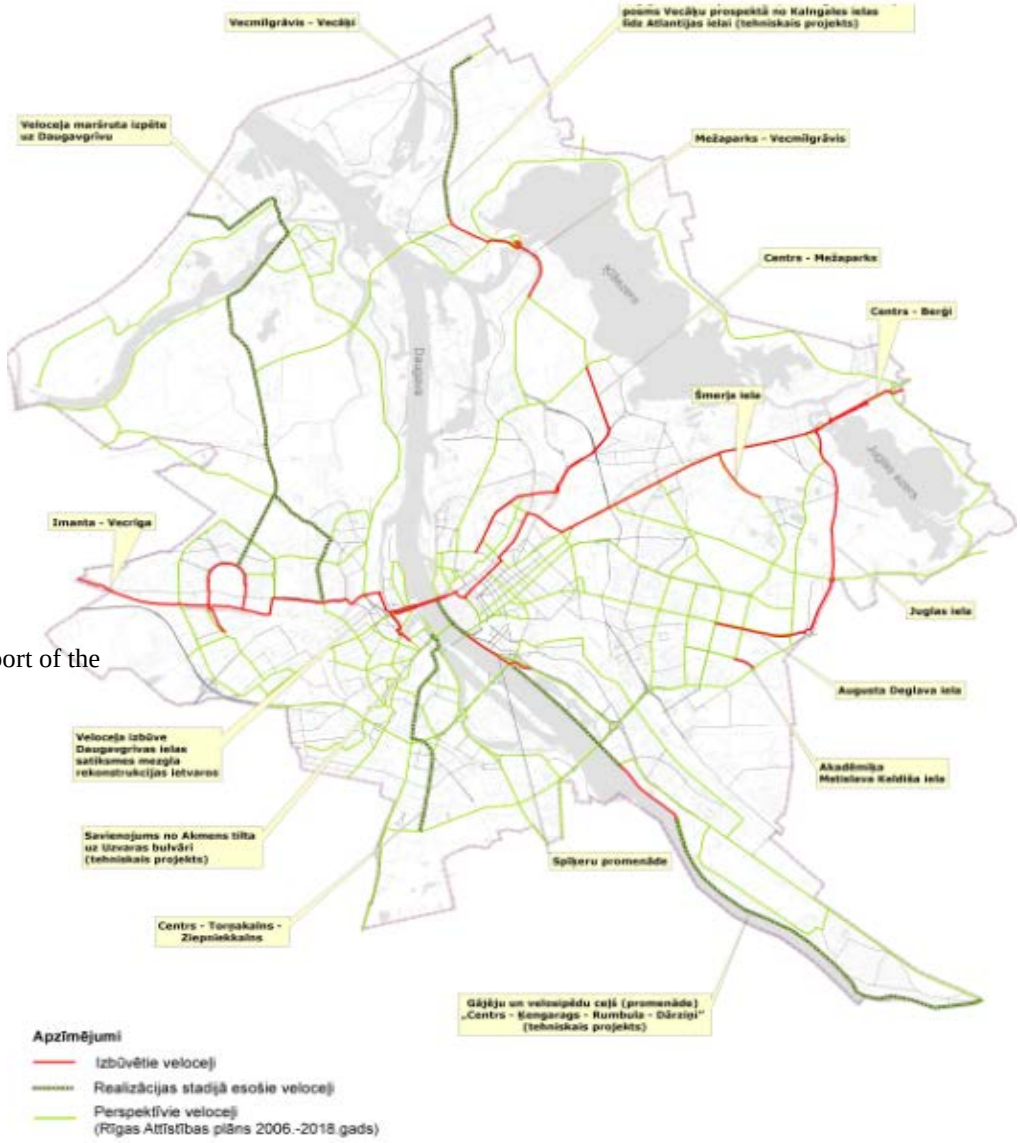


Figure 9.64. Source: Department of Transport of the Riga City Council

Work has been completed to reduce curb height on the corners of the main streets of the city to facilitate driving in the city. More is being done in this area. Bicycle parking facilities are installed next to institutions and schools. The municipality has installed such facilities for about 900 bicycles next to 42 educational institutions. Work is still going on.



Figure 9.65. The promenade with a cycling track running from the old warehouses along the Daugava



Figure 9.66.
A bicycle parking site on the side of the street in the city centre



Figure 9.67.
Company "Sixt" bicycle rental next to a hotel in the city centre

In 2013 a different commercial operator took over the bicycle rental business in Riga. Initially 12 bicycle rentals were set up by the company "Sixt". It has been decided to increase the number of rental points by finding the most suitable places in Riga.

To promote bicycle traffic, the Transport Department of the Riga City Council together with the Road Transport Safety Directorate and the Riga schools has been doing a lot of work in schoolchildren training. The training has targeted both cycling skills and knowledge of traffic regulations. Every spring there is a cycling week, the "Tweed Race", followed by the "European Mobility Week" in autumn and the "Day without a Car" to remind and educate people about alternative possibilities of moving around. The Transport Department also participates in international projects promoting development of bicycle transport development in the city on a regular basis.

Action plan for fostering emission-free mobility

Table 9.14

Action Plan			
Measure	Implementation time	Responsibility for implementation	Extent of implementation
1. Enlarge network of bicycle lanes by constructing or marking new bicycle lanes	2020	Transport Department of Riga City Council	104 km

2. Increase number of bicycle hire stations	2020	Riga City Council, Involved comercial operator	20 hire stations
3. Promote a growing number of bicycle users in the city to a level that a certain percentage of the city's population would use the bicycle on a daily or near daily basis	2020	Transport Department of Riga City Council	10/15/20%*
4. Increase the number of emission free vehicles used by the municipality and its structures to reach a certain number	2015 2020	Ltd "Rīgas satiksme"	20/ 30/ 40* 50/ 70/ 80*
5. Provide free parking possibilities for emission free vehicles at the parking lots serviced by LTD "Rīgas satiksme"	2014–2020	Riga City Council, Ltd "Rīgas satiksme"	
6. Share of bio-fuel in the municipal public transport as a % of total fuel consumption	2020	Ltd "Rīgas satiksme"	7/ 8,5/ 10%*
7. Gradual replacement of public service busses with emission free (hydrogen, fuel cell and battery type) vehicles	2020	Riga City Council, Ltd "Rīgas satiksme"	20/30/40*
8.Foster the construction of publicly accessible hydrogen charging stations in the city	2020	Transport Department of Riga City Council, involved investor	One charging station

*) minimum/optimum/maximum forecast

10 URBAN PLANNING MEASURES FOR REDUCING ENERGY CONSUMPTION

10.1 Innovative urban planning solutions for reducing energy consumption and CO_2 emissions

The move towards smart and sustainable development has changed the urban planning paradigm of the city of Riga: planning that used to be highly liberal and fragmented is replaced by an emphasis on social responsibility and ***smart and compact city development***. Thus the strategic aim by 2030 is to see Riga as:

1) a compact city, which saves resources;
2) friendly to pedestrians, cyclists and public transport focussed on emission free mobility;
3) a city with a deliberated industrial policy;
4) varied and accessible quality housing;
5) modern and resident (client) oriented administration;
6) green territories, green corridors and accessible water lines;
7) high quality environment.

The tasks of 2020 are very important for achieving this goal.

The city has a high number of green areas (in 2012 they covered 26 % of the urban area) planned to be retained and improved; this will also contribute to better CO_2 absorption in the city:

Figure 10.1. Strategic environment impact assessment. Environment review project

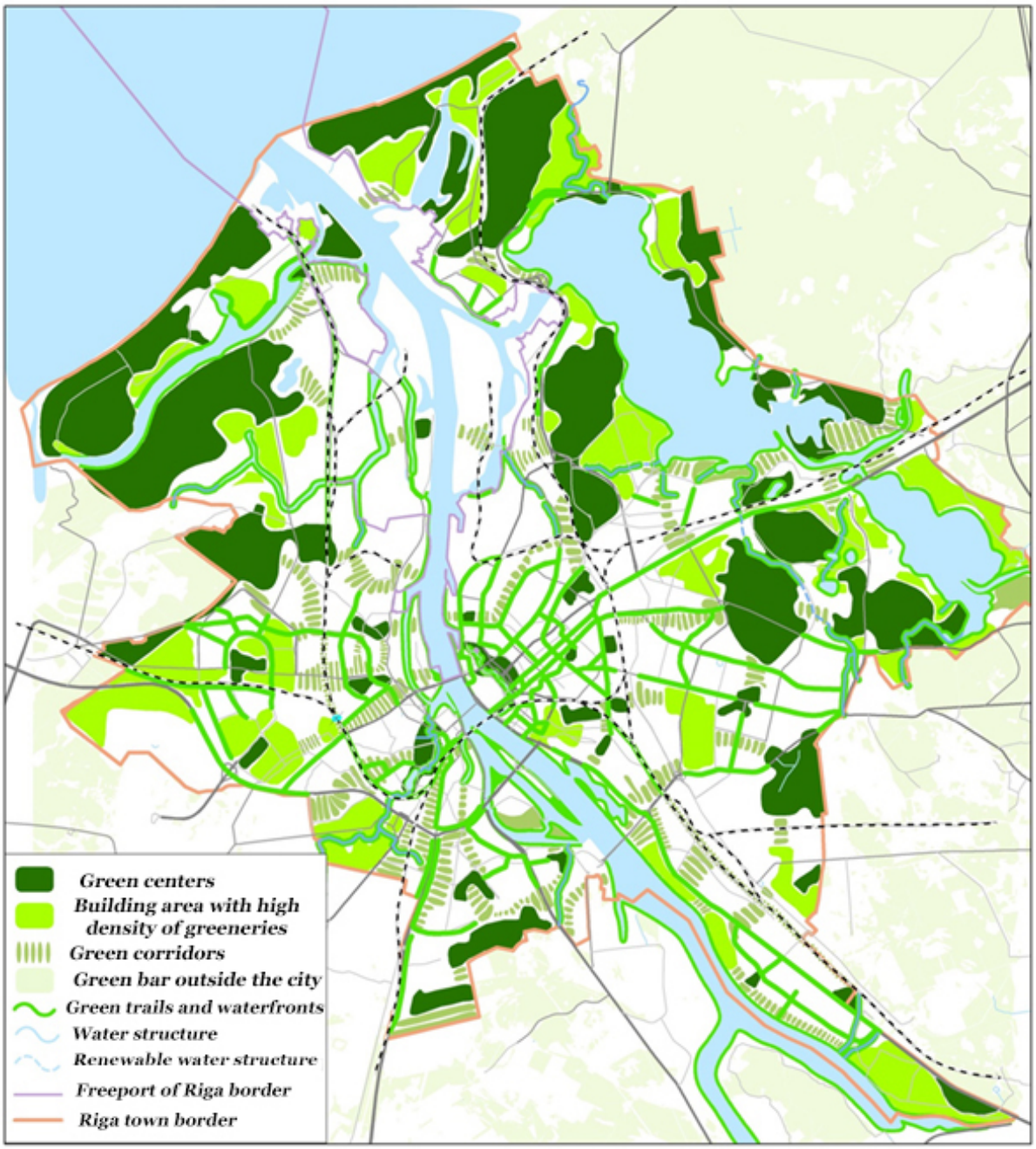


Figure 10.1. Strategic environment impact assessment. Environment review project

The individual parks and squares are linked by green corridors which apart from the housing and recreational function enable residents to move through a high quality and attractive urban environment.

The sectors of future economic priority are the ports, transport and logistics, chemical industry, computer technologies; production of electrical appliances, steel and ironware, professional, scientific and technological services, tourism and education. A lot of attention is paid to renovation with a high focus on educational establishments to be renovated by 2020. In the existing housing sector there are plans for handling both renovation of the buildings and landscaping of the territory inside the housing blocks. There are also plans for new construction of housing and offices coming close to the standards of energy efficient and low energy consumption buildings. The buildings which won the 2013 competition “Sustainable buildings and projects, 2013” are a good

example: the office building "Upmales biroji" on Mūkusalas Street 101, which came first in the competition, and the residential house "Futuris" on the densely built-up Antonijas Street in the city centre, which won the third award:





Figure 10.2. Office building "Upmalas biroji". Source: article by Agrita Lūse in the e-magazine "REA vēstnesis" No 24

Figure 10.3. Residential house "Futuris". Source: article by Agrita Lūse in the e-magazine "REA vēstnesis" No 24

The buildings have excellent planning and visual appeal; they offer a lot of outdoor space for their residents (i.e. building on Antonijas Street) and low energy consumption, e.g. in the "Upmales biroji" office building it is 110 kWh/m²/per year (heat + power consumption), whereas in the residential building "Futuris" (7 318.3 m²) it is 55.52 kWh/m²/per year (heating + hot water supply).

Apart from the abovementioned energy efficient buildings, a low energy consumption office building (27 kWh/m²/per year) in Riga, Andrejostas Street 4a, has been completed with a heating system based on a solar collector and solar batteries, and a geothermal pump. Other low energy consumption buildings are under construction.

In order to implement the compact city urban planning model, until 2020 new construction will mostly be carried out in the empty spaces of the city centre with well-developed infrastructure, the neighbourhood of Skanstes Street where high rise buildings are being developed, the Riga Technical University campus in Ķīpsala and the Torņakalns complex, which is becoming an important multifunctional centre and is included in the multimodal transport network (Central Rail Station – International Bus Station with support stations in Pētersala and Torņakalns).

The railway which crosses the city area is part of the public transport system which functions under a single set of regulations. Electrification of the railway is under way. The public transport routes are going to be extended into the precincts, with a car parking system to be developed in there. A "Riga and precincts mobility plan" (with a final report issued in 2010) has been developed for improving the transport system; among other issues it targets completion and improvement of the main roads' network by directing vehicles as far as possible to the main streets for coping with traffic jams and improving transport flows. The large city ring-road will be gradually improved. An

important part of the plan is public electrical transport, which is going to improve air quality. The development of the urban transport infrastructure is based on the following bottom up principle:

pedestrian – cyclist – public – private – freight transport

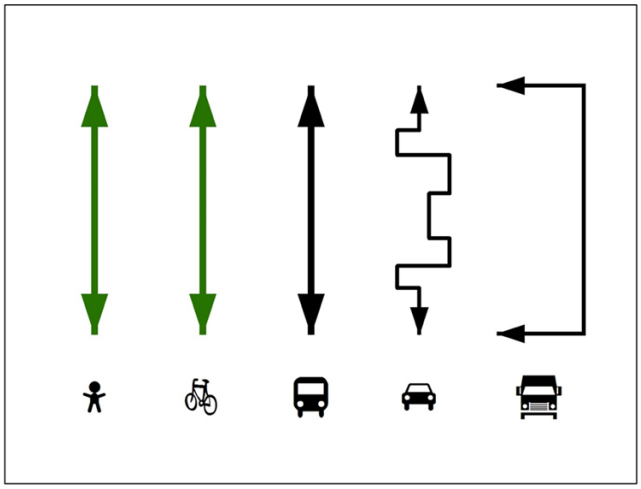


Figure 10.4. Source: Draft strategy for sustainable development of Riga until 2030

Development outlined in the Strategy:

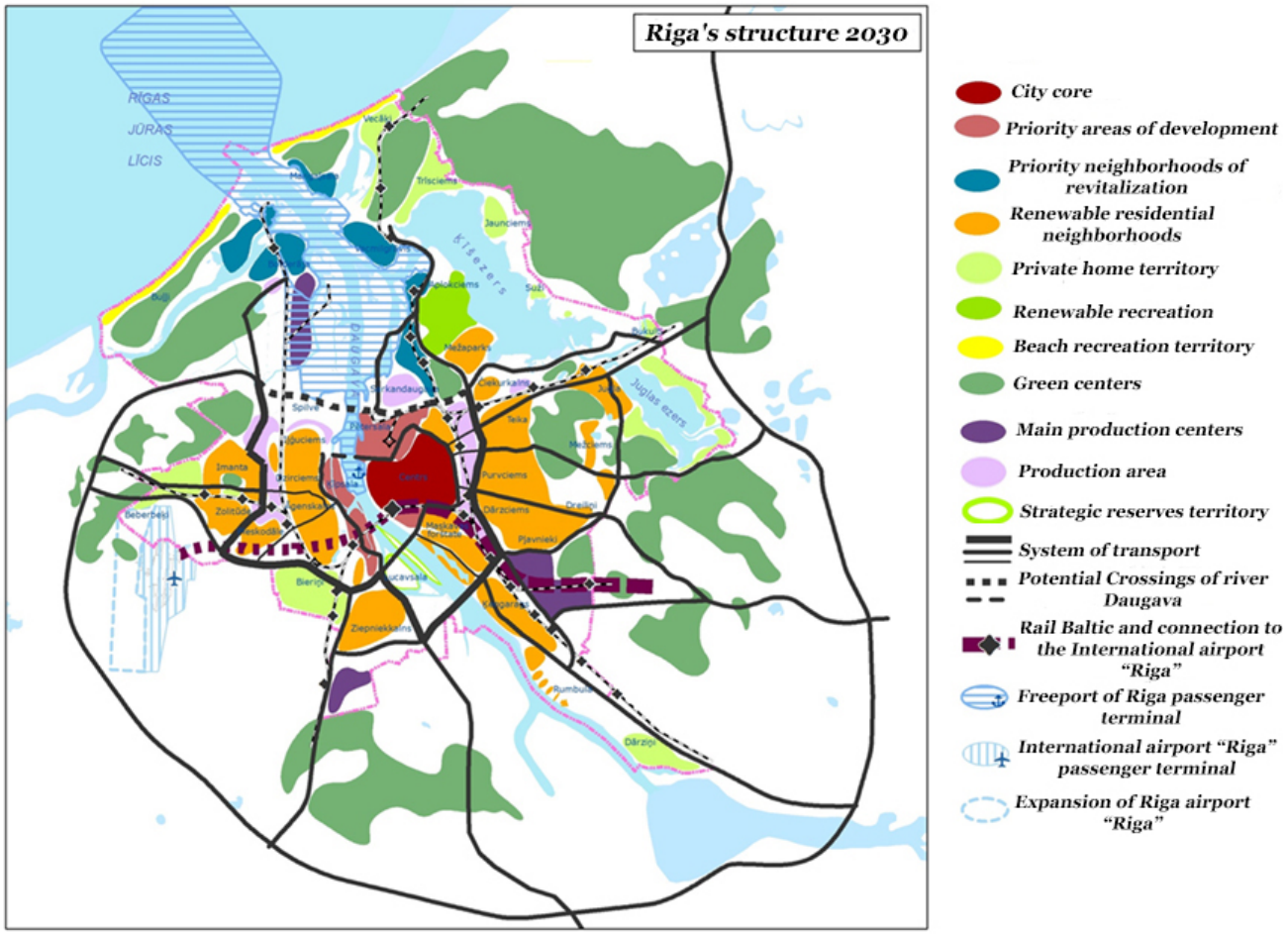


Figure 10.5. Source: Draft strategy for sustainable development of Riga until 2030

10.2 Implementation of innovative solutions in new construction: the Torņakalns model construction project

The structure and location of the model project

The Torņakalns construction project is related to the development of the new Riga city centre, i.e. the Pārdaugava centre. The plan is to build a new administrative centre of the Riga City Council, as well as an academic centre for the University of Latvia and other sites. The first building complex to be constructed is the Academic Centre of the University of Latvia with a Life Sciences Academic Centre housing the Department of Biology, the Department of Chemistry, the Department of Geography and Life Science, the Department of Medicine and the Institute for Microbiology and Biotechnology, as well as the Institute for Chemical Physics. The new building is going to accommodate 6 national research centres: for environment resource acquisition and sustainable use technologies, pharmaceuticals and biomedicine, use of agricultural resources and food, forest and water resources, nanostructured and multifunctional materials, constructions and technologies and public health and clinical medicine. The Academic Centre of the University of Latvia is going to include a number of buildings with the focus to create a comfortable, functional and economic learning, work and living environment oriented towards sustainable development. The Academic Centre for Life Sciences which is going to be completed in 2015 represents the first phase of the project, to be followed by a Humanities' Centre, a Teachers' Training Centre and a Centre for Social Studies:

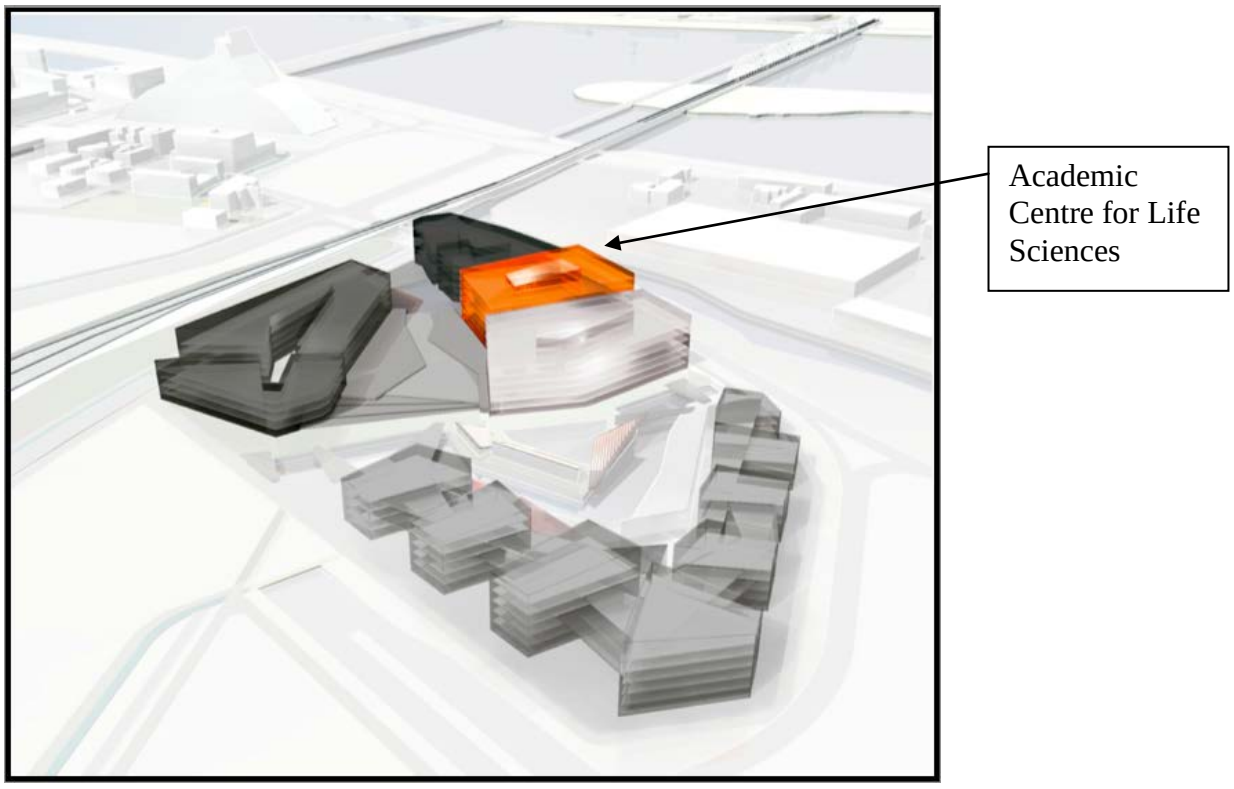


Figure 10.6. Source: Memorandum on construction of the Academic Centre of the University of Latvia

The Latvian University campus project is situated in the territory between the railway (Jaunā Street), Jelgavas Street, Vienības Gatve and the planned junction of Raņķa Dambis and Vienības Gatve. The territory across Jelgavas Street that has been prospected as an urban recreation area is Kīleveina Grāvis. The development goal set for the area is to create a space well-adapted and comfortable for people of different age groups and varied interests, friendly to the existing

ecosystem and urban environment. The area is going to be built up as a small "micro town" with all the functionalities of a town: housing, schools and workplaces, recreational and shopping areas and the required transport services. The projected micro town will have a "slow movement" area with all the functional zones located at a walking distance from each other. According to the plan, the buildings of the Academic Centre of the University of Latvia are located around a square which is going to be the representative public outdoor space of the University of Latvia. The location of the buildings has been determined by a synergy of numerous external factors and the internal functionally separated and active elements. A favourable outdoor climate will be established, and the buildings will be lined around a northern-southern axis in order to have the best possible lighting throughout the academic season. The building of the Life Sciences' Centre is going to be protected from direct sunshine by an extensive "green wall".

Solutions for energy efficiency and utilization of renewable resources for the building complex

The engineering solutions proposed for the Academic Centre for Life Sciences provide for the implementation of a modern energy consumption control system based on information and communication technologies. Energy for heating, as well as for the ventilation and cooling systems is going to be provided by the district heating system. Hot water preparation is going to be handled through solar collectors. Ground heat is going to be integrated in the building's heating and cooling system; the bearing piles of the building are going to function as thermoprobes. The air conditioning equipment has been planned to include heat and humidity retrieval. Two accumulation vats are going to be installed on the roof of the building for rainwater collection to be used for the green areas.

Since around 35-50 % of the power consumed in a building of the particular type is used for lighting, it is going to be provided by luminescent lamps, energy efficient economic lamps and LED diodes. The lamps will be controlled from a multifunctional monitoring system which is going to provide quality lighting of all the premises with due regard of energy efficiency, the latter including measures for maximizing the use of daylight, recording the presence or absence of people on the premises, zoning for required intensity, night mode with permissible local manual control. Renewable energy resources will be used to feed outdoor lighting by using wind rotors and solar-battery equipped light sources with reserve connections to the grid.

11 PROMOTIONAL MEASURES FOR IMPLEMENTING THE SMART CITY SEAP

11.1 PUBLIC INVOLVEMENT IN THE IMPLEMENTATION OF THE SMART CITY ACTION PLAN

One of the key commitments, undertaken by the Riga City upon signing the Covenant of Mayors, is to involve the city`s civil society into elaboration and implementation of the Action Plan. The Riga City Council (RCC) has also signed a Memorandum with non-governmental organizations, which provides a transparent city administration with community involvement. In the energy supply, energy efficiency and renewable energy areas these commitments are to a great extent enforced through contacts and activities, implemented by the Riga municipal agency REA while performing its functions in a number of ways.

The main way is through establishing long-term cooperation with various stakeholders, represented by residents and professional societies, associations and other "umbrella" organisations actively supporting or providing for 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 NGOs of Women, Latvian Association of Local and Regional Governments, etc.) by involving these organizations in information activities, consultations, working groups, project management supervisory bodies, as well as in the development and implementation of joint projects.

Direct outreach to residents and their involvement is ensured through Information Technologies (IT).

In this area the key measure is to maintain the municipal agency REA website *www.rea.riga.lv* and ensure that it is accessible to interested parties, alongside with the Agency's social media accounts on Twitter, Facebook and You Tube, where REA news and main activities in the area of energy efficiency and use of renewable energy sources are presented. The home page regularly carries interactive surveys on topical subjects. As of 2013 there is public access to an e-catalogue of the best practice projects with integrated modern IT technologies implemented in Riga in the areas of energy efficiency and use of renewable energy sources. There is also a functional database accessible to residents and building managers regarding the actual energy efficiency (kWh/m²) performance in the previous calendar year of the multi-apartment houses connected to the district heating system (in 2013 it included 2 856 buildings). Through active cooperation with other news portals, the data on the municipal agency's REA home page are regularly made public on other portals (e.g., Building.lv, etc.). There are links to the municipal agency's REA home page in the home pages of partner cities and organizations, participating in the cooperation, also in the European Internet information system (ManagEnergy, Energy Cities, HyER etc.).

When addressing residents on important subjects in the areas of energy efficiency and use of renewable energy sources, ***datasheets, press releases, leaflets, e-gazette "REA vēstnesis", consultative and other information materials*** are very important. They are made available by the municipal agency REA on its home page and in social media networks, as well as on paper at the locations frequented by visitors – the Visitors' Reception Centre of the Riga City Council, waiting lounge of the Housing and Environment Department's Visitors' Reception Centre, during seminars, conferences, discussion clubs and specialized exhibitions open for residents. This information is also handed over to other bodies dealing with residents – various associations and societies, managers of multi-apartment houses etc. The information can also be obtained during direct consultations, requested by the residents from the municipal agency REA.

Another way to involve residents is their ***participation in open thematic seminars, discussion club events*** and ***Welcome Days*** near the renovated multi-apartment houses, where different issues regarding energy efficiency, housing renovation and use of renewable energy sources are discussed. The subjects debated during seminars, discussion clubs and other events, are closely connected with the Action Plan and are reflected in the measures of the Action Plan.

In order to provide residents with regular consultations and direct contacts for better awareness about housing renovation and energy efficiency matters, an Energy Efficiency Information centre in the framework of the municipal agency REA has been established; properly equipped it performs important work in this area.

Thematic campaigns ar an efficient cooperation model for cooperation. The municipal agency REA has been organizing its own annual campaigns, involving all kinds of mass media and cooperation partners, and also actively participating in the national campaign "Let's live warmer" on renovation of buildings, first held in 2010 and now running on an on-going basis. Campaigning includes the following events:

- In 2011/2012 the municipal agency REA together with JSC "Latvenergo" and Zero emission mobility support society (BIMAB) organized a campaign on introducing electrical cars; as a result a publicly accessible electric cars' charging station network has been established in Riga,

and the municipality has bought the first 8 electrically powered cars and uses them in technical services.

- In 2012 the municipal agency REA together with the Riga IT Demo Centre organized a campaign to acquaint residents and experts with the most recent Information and Technology (ICT) opportunities to be integrated into the energy and transport sector; as a result Riga together with the Strathclyde University in Glasgow (UK) proposed to develop a pilot project "Strategies Towards Energy Performance and Urban Planning (STEP-UP)". The Project which also involves Ghent (Belgium) and Gothenburg (Sweden) and a number of energy supply and scientific organizations provides the framework within which, the smart city action plan is being elaborated to bring cities closer to a smart city status.
- In 2013 the municipal agency REA together with the European Association for Hydrogen and fuel cells and Electro-mobility in European Regions (HyER) organized a campaign, offering an entire set of events to acquaint residents and experts with hydrogen technologies in transport; as a result the Municipality of Riga has joined the HyER, studied the economic and ecological aspects of introducing hydrogen powered buses in municipal public transport, and is currently engaged in specific measures to introduce hydrogen powered vehicles in Riga.

One of the ways how the municipal agency REA cooperates with the public is to seek the engagement of children and secondary school students. In the REA home page there is a section "For secondary school students" which is being updated. In this section there is information and manuals for secondary school students on energy types, energy efficiency and renewable energy sources made available in the Latvian language. The section also contains interesting energy-related games and other information. The municipal agency REA has participated in organizing individual events during the Youth month every autumn; it also participates on an annual basis in the event "Sun Cup", organized by the Institute of Solid State Physics of the University of Latvia. The target group of the "Sun Cup" are secondary school students who build transport vehicle models with renewable energy sources during the event, drive them and organize model competitions. The event attracts a large number of participants and familiarizes students with the potential of renewable energy sources.

Different society groups are addressed and involved in activities promoting energy efficiency and renewable energy sources during the ***City Energy Days***, organized by the municipality to fulfil their commitment issuing from the Covenant of Mayors. The municipal agency REA organized the Riga Energy Days for the first time in 2009. The principal event, in parallel to the opening of the Riga Energy Days, is the International energy, energy efficiency and environment technologies' exhibition "Environment and Energy" which takes place in the exhibition centre Ķīpsala. The exhibition hosts the Environment Forum and the main thematic seminars, as well as local seminars and round table discussions. The Energy Days provide a framework for related events; conferences and seminars are also organized in other places of the City; they address different interest groups. The Energy Days and the related events continue for the entire month of October each year. Special Energy Days in relation to the EUSEW annual events are also organized in Riga and in Bruxelles.

To improve expert knowledge about the development of smart cities, and to provide for the training of such experts, the ***Master Study programme "Energy efficient infrastructure of smart cities"*** is being elaborated within the international project STEP UP for the Faculty of Building and Civil Engineering of the Riga Technical University (RTU) – the programme is subject to accreditation in 2014 and the studies are to begin in September 2014. The municipal agency's REA experts deliver lectures and take part in the work of RTU State examination commission.

An important role is given to inter-city cooperation within a national and cross-border framework; it mainly takes place through cooperation within international projects. Since its establishment the municipal agency REA persistently participates in international projects on energy

efficiency and renewable energy sources, it has established enduring contacts and uses international internet information networks that favour transfer of experience, introduction of innovative and smart solutions in Riga, and has also created a publicly accessible overview – in the form of e-catalogue – of the best (lighthouse) projects introduced in Riga, promoting their implementation in other cities.

Action Plan for public involvement

Table No 11.1

Action Plan			
Measure	Implementation time	Responsibility for implementation	Extent of implementation
1. Organize annual Riga Energy Days, by extending activity and by involving new cooperation partners, with the main emphasis on implementation of the Action Plan.	2014–2020	Municipal agency REA, cooperation partners	Annually – in October
2. Participate in supporting the organization of the international exhibition "Environment and Energy", set up the stand "Riga Energy Agency" and ensure its active operation, as well as organize the key seminar (conference) of the exhibition.	2014–2020	Municipal agency REA	Annually – in October
3. Ensure facilities and activity of the municipal agency's REA Energy Efficiency Information Centre (EIC). Ensure accessibility to the Energy Efficiency Centre for the residents.	2014–2020	Municipal agency REA	Continuously
4. Ensure that information materials (press releases, leaflets, datasheets etc.) on the matters of energy efficiency and use of renewable energy sources are regularly prepared and distributed to the residents.	2014–2020	Municipal agency REA	Continuously
5. Ensure the issuing of the electronic gazette "REA vēstnesis".	2014–2020	Municipal agency REA	Quarterly – 4 times a year
6. Maintain and update website www.rea.riga.lv, where information to the residents and complete information about the REA activities is provided.	2014–2020	Municipal agency REA	No. of visitors > 10.000 a year
7. Organize campaigns for the residents or participate in campaigns regarding topical subjects in the area of energy efficiency and renewable energy sources.	2014–2020	Municipal agency REA	Continuously
8. Participate in organizing an event for secondary school students "Sun Cup".	2014–2020	Municipal agency REA	Annually – in May
9. On a regular basis supplement the publicly available e-catalogue by adding the lighthouse projects, implemented in Riga using innovative and smart solutions.	2013–2020	Municipal agency REA	Continuously

10. Promote changes in the behaviour of electric power users, by organizing educational and training workshops and through promoting interest in consumption management measures.	2013–2020	Municipal agency REA	Continuously
11. Provide for training of specialists for the new Master Study Program "Energy-saving infrastructure of smart cities", offered by the Faculty of Building and Civil Engineering of the Riga Technical University.	2014–2020	The Faculty of Building and Civil Engineering	As of September 2014

11.2 FINANCIAL INSTRUMENTS FOR IMPLEMENING THE SMART CITY SEAP

11.2.1 The EU key financial instrument for research and innovation in years 2014–2020: "Horizon 2020"

The new financial instrument for research and innovation "Horizon 2020" is the most important tool in the new planning period for knowledge-based economic development and finding solutions for topical civil society problems. The amount of the total funding stemming from the financial instrument for the planning period is foreseen at 80 billion EUR, and its programme funds seven sectors – excellence in science, industrial leadership, societal challenges, spreading excellence and widening participation, science with and for society, European Institute of Innovation and Technology (EIT), as well as Euratom. Out of the activities of these sectors the following ones are the most important for the purpose of the Action Plan for a Smart City:

- Information and Communication Technologies;
- Secure, clean and efficient energy;
- Smart, green and integrated transport;

The programme "Horizon 2020" is managed by the centralized supervisory bodies in Europe.

Information and Communication Technologies

The activity "Information and Communication Technologies" (ICT) is included in the industrial leadership section. Importance of the ICT is currently growing and the foreseen research funding, up by 25% in comparison to the previous one, will promote progress in electronics, microsystems and networks. There is a growing possibility to master more and more sophisticated cyber-physical systems and robots, it will lead to progress in data processing and reciprocal human-machine interface. These advancements will provide Europe with a possibility to develop a platform for elaborating next generation ICT for implementing a variety of innovative devices, systems and application software programmes. Already the initial calls for proposals set the foreseen financing level for ICT at approximately EUR 1.2 billion.

ICT is of great importance in creating smart cities, by integrating modern IC technologies into energy and transport.

Secure, clean and efficient energy

The activity "Secure, clean and efficient energy" is part of the section on solving social challenges. The new energy policy supports transfer to secure, sustainable and competitive energy supply in complicated circumstances of energy depletion and shortage, as well as climate change. To aid the project applications in this activity, the programme "Horizon 2020" identifies 7 specific goals and research areas:

- Reducing energy consumption and carbon footprint;
- Low-cost, low-carbon electricity supply;
- Alternative fuels and mobile energy sources;
- A single, smart European electricity grid;

- New knowledge and technologies;
- Robust decision making and public engagement;
- Market uptake of energy and ICT innovation.

The budget volume foreseen for the activity is 931 million EUR. When preparing the applications, the following main priorities must be taken into account:

Energy efficiency. Research and demonstration activities must focus on building renovation, industry processes, supply of heat and cooling, energy-related services, integration of ICT and cooperation with the telecom sector.

Low carbon technologies. It is important to develop and place on the market cost-effective and resource-efficient energy technologies that reduce the carbon footprint and create secure energy supply on the internal market – allowing to secure integration of next generation renewable energy technologies into future's power engineering systems. Research activities within this area will cover: photovoltaics and [concentrated solar power] collectors, wind energy, ocean energy, hydro power, geothermal energy, renewable heating and cooling, energy storage, biofuels and alternative fuels, carbon capture and storage, as well as secure that the research results are introduced into the market.

Smart cities and communities. In order to achieve smart development of cities and communities, new, efficient, and user-friendly technologies and services are required, particularly in the areas of energy, transport and ICT. There must be integrated approaches both in terms of research and development of advanced technological solutions, as well as deployment. Smart city technologies will provide solutions with high market potential in such areas as energy efficiency in cities' localities, digital services and information for the residents and smart mobility services. The "lighthouse" projects of these solutions are foreseen to establish strong partnership between the academic community, industry sectors and cities' municipalities, at the same time giving the residents possibility to participate actively in improving the quality of life in cities. The projects must have significant replication potential. So, for example, the EU funding could help to develop near-zero energy housing blocks, due to better local resource management, sustainable residential house renovation and by applying intersectoral ICT solutions.

Smart, green and integrated transport

The activity "Smart, green and integrated transport" is also part of the section on coping with social challenges. The budget volume foreseen for the activity is EUR 6.339 billion which is a serious announcement of changes in the transport area. Four main goals and research areas have been emphasised:

- Creation of resource efficient transport that respects the environment by making aircraft, vehicles and vessels cleaner and quieter, by minimising their impact on climate, by developing smart equipment, infrastructures and services.
- Introduction of better mobility in cities, by reducing traffic congestion, by developing modern logistics for conveyances, by achieving improvements in traffic security and reduction of accident rates.
- Establishment of a global management system by reinforcing competitiveness and performance in the European transport industry, by establishing a unified administration of vehicle manufacturing industries and related services including logistic processes in Europe.
- A socio-economic and behavioural research and forward looking activities for policy making**.**

11.2.2 EU structural and cohesion funds

For the planning period 2014–2020 the cohesion policy for Europe has been reformed, and this policy in the new planning period 2014–2020 is the main investment policy in the areas of creating work-places and growth. The new cohesion policy helps to achieve the "Europe 2020" strategy goals, ensuring smart, sustainable and integrating growth. The total ***Cohesion Fund (CF)*** funding is EUR 325 billion.

The European Regional Development Fund (ERDF) foresees investments in growth, directed to research and innovations, information and communication technologies, competitiveness of small and medium enterprises and low-carbon economy.

The European Social Fund (ESF) invests in people. The Social Fund supports employment and mobility, better education, social inclusion and better State governance.

The funding of EU Structural Funds is handed over to be monitored by the Member States which form the appropriate programmes.

In February 2014 the Cabinet of Ministers of the Republic of Latvia approved the ***EU Structural Funds activity programme "GROWTH AND EMPLOYMENT"*** (indicative funding – 4.4 billion EUR), and four out of its eight priority directions directly concern the implementation of the Action Plan:

- ICT accessibility, e-government and services (192.8 million EUR);
- Transfer to low-carbon economy in all sectors (491.8 million EUR);
- Environment protection and resource use efficiency (570.9 million EUR);
- Sustainable transportation system (1 159.8 million EUR).

The section ***"ICT accessibility, e-government and services"*** of the programme provides for the following investment priorities:

1) *extension of the deployment of broadband services and roll-out a high-speed networks, and support for the introduction of new technologies and networks for the needs of digital economy.*

The priority is foreseen basically for the rural territories.

2) *enhanced ICT application software in the fields of e-government, e-studies, e-inclusion, e-culture and e-health.*

Within this priority the public administration data exchange, data publication and maintenance infrastructure, data accessibility and possibilities of their use will be improved and perfected, public administration processes will be perfected. The data at the administration's disposal will be opened up for commercial use, including for the creation of innovative business ideas and products, and business automation products that will promote the processes of economic transformation. Electronic accessibility of new services, alongside with the existing ones, required by residents and businesses will be ensured. A technological machine translation base for cross-border cooperation is going to be developed. E-invoicing will be promoted. A single centralised complex ICT platform for public governance based on the cloud computing principles will be further developed. Information system data exchange platforms are going to be developed to facilitate cooperation. It is essential to increase data exchange possibilities between the municipal and national information systems.

The investment priorities foreseen in the programme section ***"Transfer to low-carbon economy in all sectors"*** are the following:

1) *Promote energy efficiency and use of renewable energy sources in businesses.*

The priority provides for improvement of competitiveness, especially in industry and construction, by reducing the amount of energy consumed by the sectors. It covers important energy efficiency improvement measures in the buildings of processing companies, including energy audits and energy

certification of the buildings, as well as renovation – reconstruction of the engineering systems of the buildings, rehabilitation, introduction of energy consumption management, insulation of enclosing structures and use of renewable energy sources for energy supply.

2) *Promote energy efficiency, smart energy management and use of renewable energy sources in the public infrastructure, including public buildings and housing sector.*

The priority falls into two subsections – *for state owned and residential houses,* as well as *for municipal buildings.*

The energy efficiency of *state owned and residential houses* is going to be improved by insulating the enclosing structures of the buildings, reconstruction and rehabilitation of the engineering systems of the buildings, installation of energy consumption controls and management devices, including smart metres, as well as by using renewable energy sources, if the energy efficiency indicators are especially high and there is no negative impact on the district heating system. As part of the programme a loan with partial reimbursement of the base sum has been planned. With a view to improve energy efficiency, the administrative burden related to the measures will be reduced, better access to finances will be granted and public funding made more sustainable; this is going to serve as an encouragement for complex renovation projects and high energy efficiency levels to be achieved. The output indicators will be the forecasted energy efficiency level and the returns on investments (saving vs. investments).

Municipality buildings are going to be treated almost identically. Work is to be done in line with the integrated municipal development programmes, with aid possibilities assessed in synergy with other planned investments and development tools. The programme in this section will grant aid only to the local heat supply systems. Aid will be provided only to infrastructures supported by a clear development strategy stating their possible application in the future. The evaluation criteria are also identical.

3) *Improve energy efficiency and use of local renewable energy sources in the district heating system.*

The priority provides for aid both to enhance heat production efficiency and reduce transmission losses (reconstruction of the heat supply pipelines), and also for the use of renewable energy sources, by aiding installation of approximately 300 MW capacity in this field.

4) *Promote low-carbon strategies for all types of territories, particularly cities, including sustainable multimodal mobility in cities and adaptation measures related to impact reduction (ERAF).*

The priority provides for an infrastructure of rapid charging stations for electric cars in Latvia. Funding for this objective is foreseen also by the Climate Change Financial Instrument (CCFI).

5) *Promote low-carbon strategies for all types of territories, particularly cities, including sustainable multimodal mobility in cities and adaptation measures related to impact reduction (CCFI).*

The priority provides for the development of a friendly public transport infrastructure. The Riga tramway infrastructure development project (with aid covering 70% from the costs) may be mentioned.

The programme section ***"Protecting the environment and promoting resource efficiency"*** provides for the following investment priorities, related to the issues of the SEAP:

5.Invest into the waste management sector in order to comply with the requirements of the Community [Union] "acquis" in the field of environment and to provide for the identified investment needs of the Member States that exceed the mentioned requirements, environment conservation and protection, and promotion of efficient use of resources.

The priority provides for enhanced waste recycling, processing and recovery, including points for collecting sorted waste, pre-treatment of recyclable waste for further processing, public information activities, etc.

The programme section ***"Sustainable transportation system"*** provides for the following investment priority:

1) *Support multimodal unified European transport network, by investing into TEN-T (KF).*

The priority indicates the importance of sea ports as logistics centres of port cities which need secure and efficient connections with inland; it also provides for the management of the shared-use infrastructure of the ports and other measures to reduce carbon emissions. It is important for Riga to improve access roads for the freight flow of the port and to reduce the impact on the central part of the city.

11.2.3 Synergy of "Horizon 2020" and structural funds leading to excellence

To achieve the objectives set for 2020, in the new planning period for 2014–2020 the emphasis of the programme has been on the priorities and funding they require. There are also common strategic priorities deriving from the main EU financial instruments, namely, "Horizon 2020" and in the Structural Funds. Despite the different local objectives of both financial instruments, namely,

- the objective of the "Horizon 2020" is to promote research and innovation, as well as to provide for their coordination and support;
- the objective of the Structural Funds is revival of the European regions;

both programmes have a common strategic objective – to increase competitiveness and enhance growth. The priorities of the strategy are research and innovations, support for entrepreneurship and low-carbon economy. In both programmes the funding amounts have been specifically boosted for these priorities. Both programmes foresee a sustainable energy sector, smart transport and efficient use of resources.

According to the assessment of the European Commission it is the synergy of both programmes that can pave the way to achieve excellence. Cohesion policy plays a complementary role. The ***European Structural and Investment Funds*** (ESIF) acts as a joint financial instrument.

11.2.4 Innovative and growth enhancing EU programmes – European Territorial Cooperation 2014–2020

Innovative and growth enhancing programmes related to development of a sustainable and smart city in the new planning period derive from one of the objectives of EU Structural Funds – "European Territorial Cooperation" (ETC). Among these programmes, which mainly continue the activities commenced during the previous period, are the following:

1) ***Cross-Border Cooperation Programme of the Central Baltic Sea Region***;
2) ***Estonia – Latvia Cross-Border Cooperation Programme***;
3) ***Latvia – Lithuania Cross-Border Cooperation Programme;***
4) ***Latvia – Lithuania – Belarus Cross-Border Cooperation Programme*** within the ***European Neighbourhood Instrument (ENI)***;
5) ***Latvia – Russia Cross-Border Cooperation Programme*** within the European Neighbourhood Instrument (ENI);
6) ***Transnational Cooperation Programme of the Baltic Sea Region; Interregional Cooperation Programme INTERREG VC*** for the entire European Union territory;
7) The urban development network programme ***URBACT III;***
8) The Programme of European territorial development and observation network (***ESPON***);
9) Further participation in the good governance territorial cooperation programme ***INTERACT III,*** which serves as a platform for exchange of experience, training, thematic researches in the ETC programme and project administering system in all Europe.

Work is going on to establish the priorities of the ETC programmes, and the activity programmes have been elaborated. In Latvia the programme is administered by the Ministry of Environmental Protection and Regional Development.

11.2.5 Final funding of Green Investment schemes and other financial instruments for the period 2014/2016

The Climate Change Financial Instrument

Green Investment schemes (GIS) are a global international mechanism, oriented towards reduction of greenhouse gas emissions, by compensating the release of these gases in one place with introduction of specific gas emission reduction measures in another place. The principles of the compensation mechanism are established in the Kyoto Protocol, and they are based on carbon emission trading schemes according to which the CO_2 emission quotas from significant reductions of emissions within certain periods of time may be sold to industrialized countries. The funds obtained from the trading schemes can only be used for CO_2 emission reduction measures as indicated in the sales agreement, and the purchasing country is obliged to control that the measures, to be implemented with the funds obtained through trading, are effectively implemented in the trader's country and that the amount of emissions is *de facto* reduced.

In the past planning period Latvia, too, had such CO_2 emission quotas at its disposal when after 1990 the industry inflated during the Soviet times fell apart. Emission trading started in 2009, when a financial instrument based on the flexible mechanisms of the Kyoto Protocol was established – it is administered by the Ministry of Environment and in Latvia and goes by name "Climate Change Financial Instrument" (CCFI). The operation of this financial instrument is regulated by the law "On Participation of the Republic of Latvia in the Flexible Mechanisms of the Kyoto Protocol", it provides for the implementation of the measures particularly in the municipalities.

Out of CCFI, which amounted 208 million EUR, 2 124 projects have been implemented, 192 projects are still in the implementation stage and there are still 6 project tenders underway on measures to improve energy efficiency, complex solutions for reduction of CO_2 emissions, technological switch from fossil energy sources to renewable energy sources, technology development and information to the public on the importance and potential of CO_2 emissions reduction.

In February 2014 the final two CCFI tenders were announced for the remaining funds, including:

1) "Reduction of greenhouse gas emissions in the transportation sector – support for the introduction of electric cars and a charging stations' infrastructure". The total cost of the project is 5.012 million EUR, divided into 3.341 million EUR for purchasing the electric cars with aid granted at a level of 35–85%, and 1.670 million EUR for the infrastructure of the charging stations with aid granted at a level of 50–85%. The project is going to be implemented in 2014.

2) "Complex solutions to reduce greenhouse gas emissions", round IV. The total cost of the project is 14.493 million EUR with the aid granted at 25–50%. The following measures are eligible for financing: improvement of energy efficiency in buildings, replacement of technical manufacturing facilities with new and more efficient facilities and switching from fossil energy sources to renewable energy sources. The project is going to be implemented by January 2015.

The European Economic Area financial instrument programme for 2009-2014 "National Climate Policy"

The European Economic Area financial instrument is being developed with the participation of Iceland, Liechtenstein and Norway. In 2014 the remaining programme funding is redirected to two tenders:

1) “Development of sustainable buildings, renewable energy sources technologies and innovative emission reduction technologies”. The tender was announced in March 2014. The total financial allocation is 5 million EUR. The project is going to be implemented by April 2016.

2) “Increasing capacity of research and measures to improve public knowledge about climate changes and their consequences”. The tender was announced in April 2014. The total financial allocation is 1.718 million EUR. The project is going to be implemented by April 2016.

The programmes of the abovementioned financial instrument are administered by the Ministry of Environmental Protection and Regional Development. The funds for 2014 have been spent; nevertheless, it is expected that new financial instruments and programmes to improve energy efficiency and attract renewable energy sources will be created.

11.2.6 ESCO operational model for attracting funding in order to improve energy efficiency

The ESCO operational model and energy performance contracting

An energy service company (ESCO) operates as a 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, when the municipality lacks funding. Since an ESCO is financially interested in achieving the best possible energy efficiency indicators, its activities do not pose any risk to the municipality. As a result of the renovation activities of ESCO in the residential housing sector, the city obtains well-managed urban environment with a renovated housing stock, and the residents – a renovated real estate with a higher market value. For this reason ESCO is an extensively used initiative in the European practice. ESCO can be a company or a group of companies in any sector with available financial means and ability to guarantee cheap loans, and interest to work in the energy efficiency field.

ESCO performs an in-depth analysis of a real estate in order to identify the most reasonable energy efficiency solution, it renovates the immovable property related to it and recovers the funds invested for its maintenance in a period which can vary from 5 to 20 years. ESCO recovers its 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 contract with the beneficiary (e.g., represented by an apartment owners’ association of a residential building) throughout the duration of which the ESCO undertakes all the obligations related to preparing, funding and implementing the energy efficiency measures, and guarantees the expected energy efficiency result and ensures the management of the site during the validity of the agreement. When the contract terminates, all the benefits obtained as a result of the renovation become the property of the beneficiaries – the residents.

According to the data of the European Association of ESCO, even though ESCOs have been operating in Europe since 1980, the European market is still insufficiently developed in the area of energy performance contracting (EPC). Such contracting takes place in Austria, Germany, Czech Republic, in the Scandinavian countries, recently also in UK and France. In other European countries it is rarely used or not used at all. The ESCO services are basically offered to the public (national and municipal) sector, because there is less risk of losing the invested funds. ESCO contracting for renovation of privatized multi-apartment houses in a certain sense is a novelty also in Europe. The ESCO and EPC function according to the following scheme:

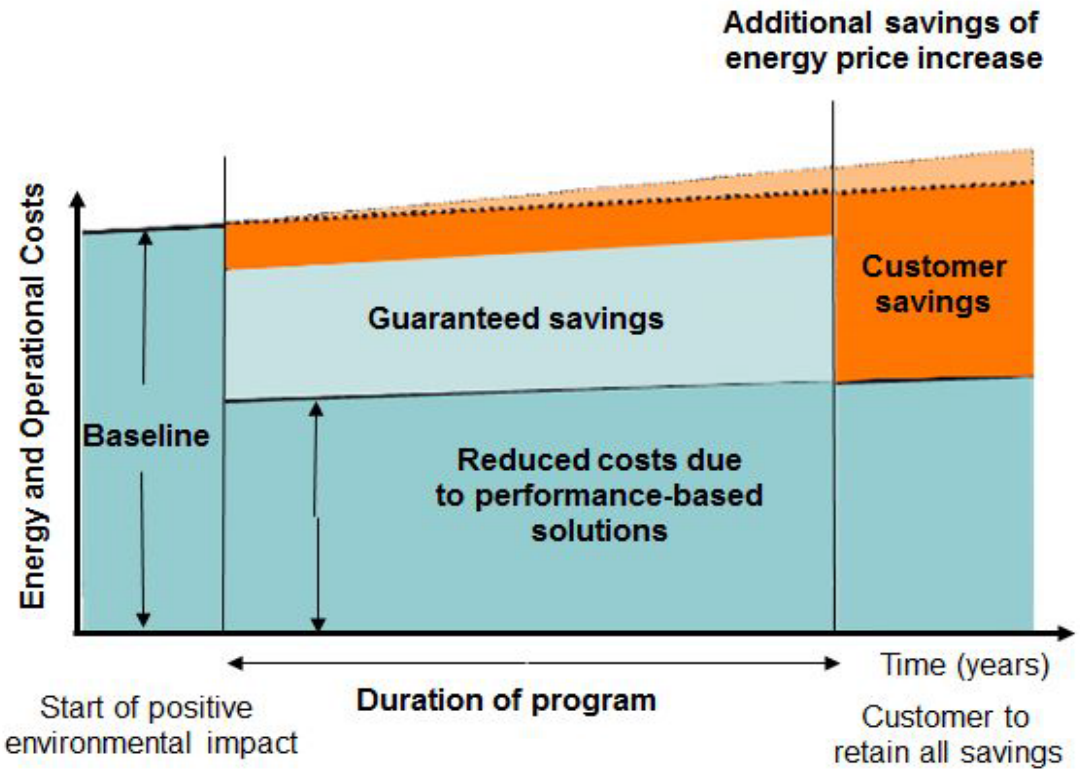


Figure 11.1. Source: European Association of ESCOs

Advantage of using an ESCO and EPC:

- ESCO is the principal and a critical tool for obtaining a steeper growth in energy efficiency volumes;
- ESCO relieves residents from the need to find funding for renovation, since it is provided by ESCO;
- Residents are relieved from the need to arrange renovation work and ensure its quality, since the work is performed by professionally trained staff bearing financial responsibility for the final result;
- After renovation has started, the total energy costs and property management costs for the residents do not increase. They may even become somewhat reduced;
- ESCO activities create many new jobs, promoting national economic growth.

There are two different types of energy performance contracts:

1) a contract on sharing the cost savings by the Parties in percentage during a definite duration period of the project (shared risk of failure to achieve the forecasted energy saving);

2) a guaranteed energy savings contract (protects the client against the risk of failure to achieve the forecasted energy savings, since these forecasted savings for loan repayment are financed by ESCO).

In practice preference is mostly given to guaranteed energy savings' contract.

The administrator's office

A new way to promote renovation of multi-apartment houses in Europe, including UK and other countries, and since 2013 also in Lithuania, is to ***create an administrator's institution for organizing and managing professional renovation*** in privatized multi-apartment houses. Municipalities have government financed administrators invited to work for those multi-apartment houses, who have decided on renovation. The administrator then, instead of the residents, undertakes

all the work and arrangements related to the renovation, including the required documentation (energy audit, technical survey, technical renovation project), approvals, funding possibilities, including loans and credit arrangements required for the renovation, tenders for the construction companies to carry out the work; he also follows up the renovation process and looks after its quality, etc., and supervises loan repayment from the energy savings after the work has been completed. The administrator works on the basis of the EPC contract. Since the services of an administrator are paid by the Government, he is able to work professionally and without bias because no personal financial interests in the renovation process are at stake. The creation of administrator's institution in Latvia and in Riga could be a new incentive to speed up renovation and remove the main current obstacles, because in the majority of residential housing units there are no suitable people who could assume the task to professionally prepare and manage renovation of multi-apartment houses.

11.2.7 Revolving fund

A revolving fund is a long-term financial instrument, which is created to implement investment projects; its task is to provide funding for projects mainly in the form of credit (in some cases also in the form of grant) at a low or 0 interest rate. The funding is given to projects with guaranteed returns on investment (in Latvia it is mostly required for improving the energy efficiency of residential houses) and a predictable payoff period, with reinvestment in the following projects. The loan starts to be returned after the project has been implemented, when certain savings begin. The revolving fund is established as a separate account (e.g., within a municipality), or as a separate entity (e.g., at national level). The initial funding comes from donors, who provide it by way of grants, subsidies, loans or other repayable investments. Loans are granted for a fixed term at a fixed rate and fixed repayment amount and frequency.

Case examples of a revolving fund functioning at national level are solutions in Estonia and Lithuania since 2009, where apart from national funding the revolving funds involve also low-rate long-term loans provided by the Structural Funds and international banks. In Estonia the revolving fund is managed by KredEx at a fixed rate of approximately 3% and a payoff period of 10 years, with loans issued through the local banks for a period up to 20 years. In Lithuania loans are provided with 15 years payoff at a rate of 3%.

Latvia urgently needs a revolving fund at a national level to support renovation of multi-apartment houses; it has to be established during the next planning period according to the document approved by the Cabinet of Ministers "Concept on transposition into legislative provisions of requirements of the Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC".

To promote renovation of multi-apartment houses in Riga and have the much needed stable and secure loan granting system for the residents, it is reasonable to create – in addition to the national support scheme – a revolving fund in the Riga Municipality as well. The revolving fund, which could be established in the form of a separate account, could be managed by the Finance Department; they have the necessary reach out experience gained through collecting property tax. The principal scheme for establishing the revolving fund and its operation is as follows:

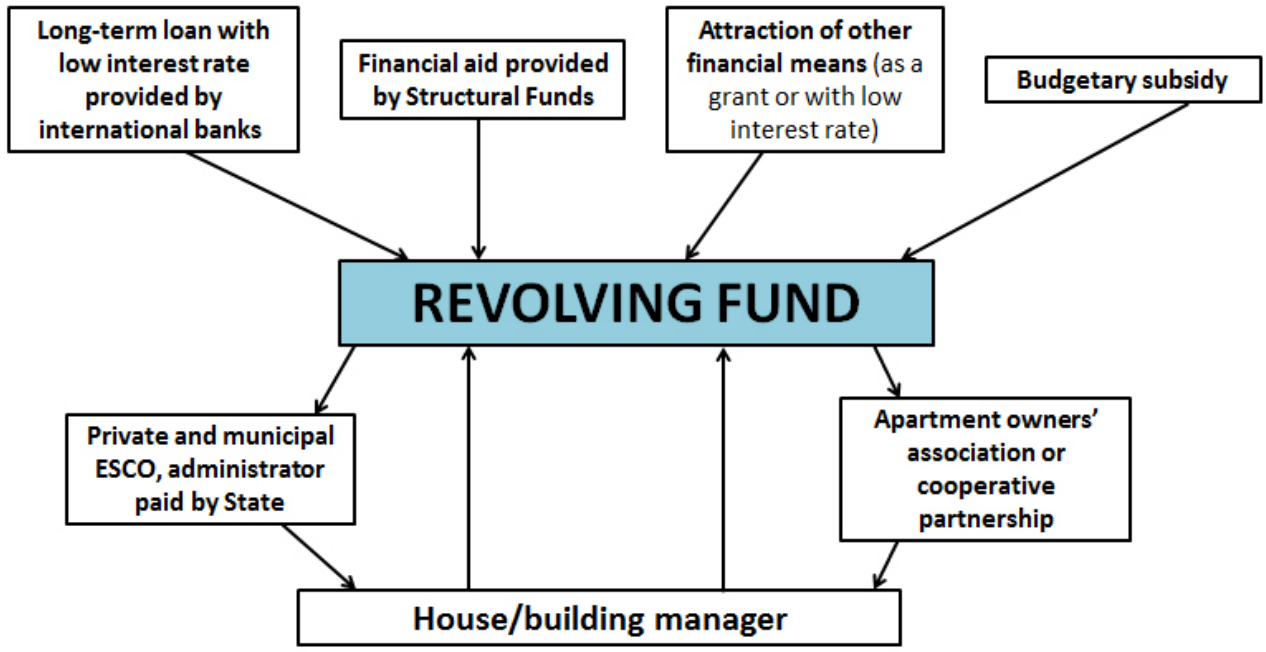


Figure 11.2

11.2.8 National support measures to improve energy efficiency

The national guidelines in the field of support mechanisms to improve energy efficiency are included in the document approved by the Cabinet of Ministers "Concept on transposition into legislative provisions of requirements of the Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC" (hereinafter – "Concept Paper"). As the Concept Paper indicates, ***energy efficiency is going to be declared a national priority***; it is seen as a cost-efficient way to reduce the risks of energy supply security, economic sustainability and competitiveness, at the same time creating more jobs and enhancing growth. The main foci of Government policy and energy efficiency measures are the following: insulation of housing, improved energy efficiency in public and industrial buildings, implementation of an efficient infrastructure for lighting in the public areas of municipalities, improved energy efficiency in heat production and in the transportation sector.

The Concept Paper notes the overall indicative national energy efficiency objective, including two binding objectives:

1) The annual energy savings target for ***the energy supplied to end users is 1.5 %.*** An alternative is to create an energy efficiency obligations' scheme to ensure that by 2020 the cumulative energy savings' target set for the end-users is achieved by the energy suppliers. The required annual savings are calculated from the average amount of energy sold to the end-users over 3 years (the transportation sector excluded) – 2010, 2011 and 2012. The objective can also be achieved without the mentioned scheme – with alternative measures, or by establishing a national energy efficiency fund where payments are made, etc.;
2) The annual renovation target ***for the total area of central government buildings*** (678 460 m²) ***is 3 %.*** There are approximately 400 central government buildings in Riga. A possible alternative is to achieve an equivalent improvement in the total energy efficiency of the central government buildings.

The structure of the Latvian energy efficiency objective, the measures for its achievement and planned volumes:

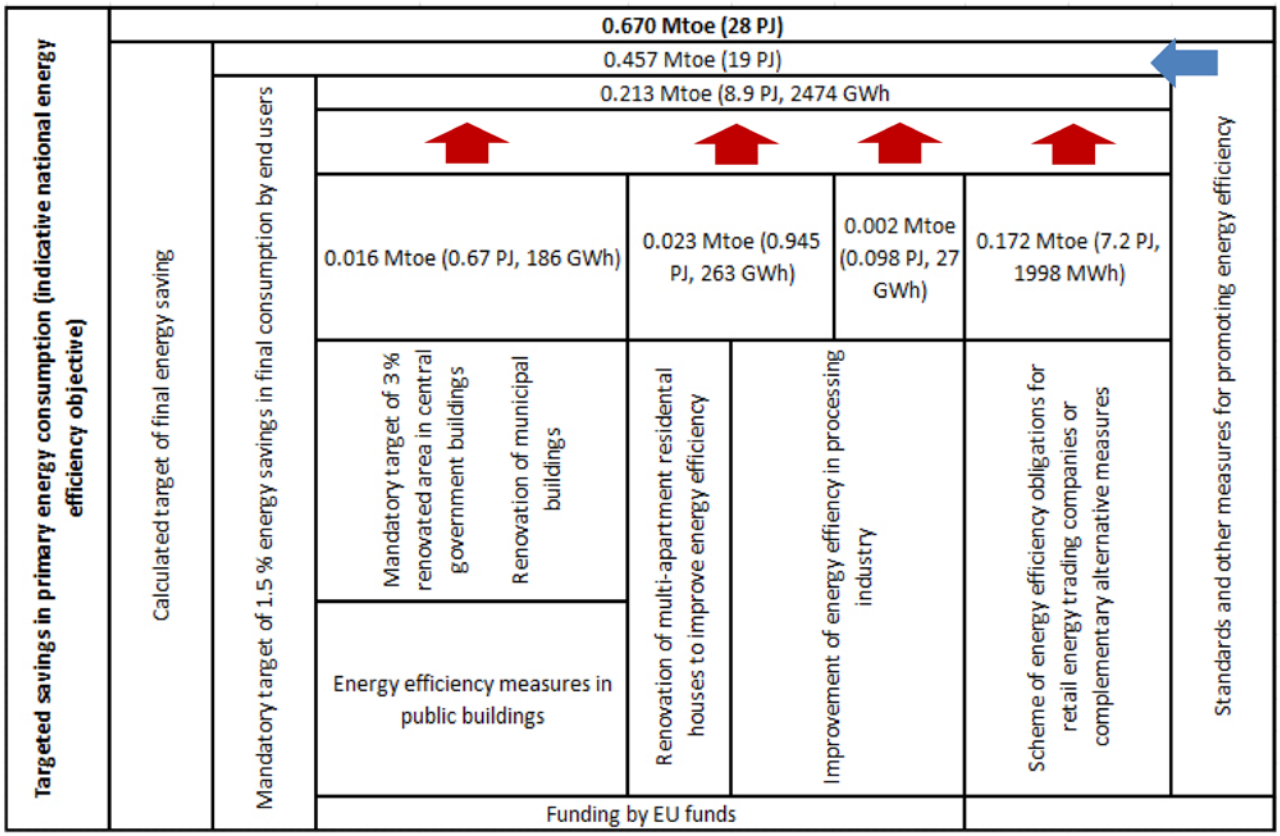


Figure 11.3. Source: Concept paper

As can be seen from the structure set out above, the central government buildings connected to the district heating or gas supply system and the annual renovation target of 3 % is also part of the 1.5 % energy savings' objective at the end-user consumption level.

Year 2014 is shown in the Concept Paper as the initial year for changes to be effected in the national administration system and municipalities for achieving the indicative energy saving goals. The legislative and regulatory documents required to implement these changes are being elaborated. Funding is being earmarked for the performance of separate tasks, e.g., for renovation of public buildings – 100 million EUR, for renovation of multi-apartment houses – 150 million EUR. The issues of developing the ***national energy efficiency fund*** (hereinafter – "Revolving fund ***NEEF***"), the management structure for energy efficiency, i.e. ***Energy Management Agency*** and related issues are dealt with. There is also the issue of type and amount of government support for insulation of buildings in the new planning period 2014–2020. As indicated by a research of the Ministry of Economics, comparing various alternatives funding options for renovation projects (see figure No. 11.4), the solution of choice for a national support mechanism is an option of a 35 % grant on condition that a fixed specific heat consumption for heating is reached after renovation (≤ 70 kWh/m²/per year) and there is a loan with a reduced –2 % (or –3 %) interest rate. Such an option has also been supported by the Latvian Association of Large Cities, including Riga, in a public discussion. The mentioned funding alternatives of a multi-apartment residential housing renovation project:

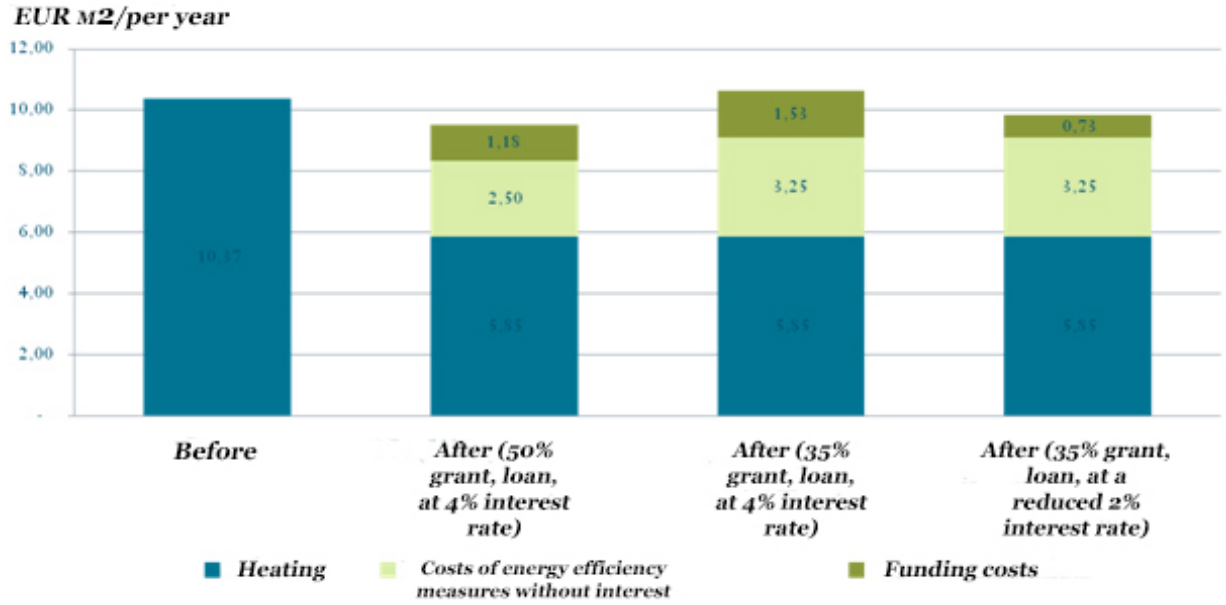


Figure 11.4. Source: Presentation of the Ministry of Economics "Insulation of houses during the EU funds 2014–2020 planning period"

The support regulations include the following provisions:

1) no procurement procedure for choosing the construction company; this provision is going to have a positive impact on the quality of construction works;

2) the manager (the authorized person) of the renovation project chooses the preferred financier – NEEF or a commercial bank;

3) the bank provides a loan, if the project is viable at the interest rate offered by the bank and credit risk is acceptable for the bank;

4) upon application of the bank NEEF provides a grant for the loans provided by the bank;

5) no financial adjustments are made;

6) loans are available for 15 – 20 years.

As shown by the research carried out in 2012 (referenced in the Concept Paper), "Elaboration of the electronic forms for energy savings' calculation required to provide the functioning of energy efficiency monitoring system, evaluation and processing of the data", ***energy savings in the range from 426.86 to 853.72 EUR/MWh can be considered efficient.***

Notably, it has been mentioned in the Concept Paper that municipalities will have the right to contract for enhanced energy efficiency.

In order to develop zero emission mobility, the Cabinet of Ministers approved the "Electric mobility development plan for the 2014–2016 year period" in February, 2014. The plan foresees development of electrically powered transport vehicles and an infrastructure of charging stations. The institution responsible for the introduction is the Ministry of Transport which is going to establish an ***Electric mobility management and coordination institution (EVKI)*** for the purpose**.** Support for the development of an electric car charging infrastructure, as well as for promotional measures for the acquisition of electric cars has been planned. There are going to be tax reliefs on the acquisition of electric cars; the policy planning documents and the required legislation and regulatory documents are going to be elaborated. In the next three years 29.99 million EUR, including budget funding in this amount of 5.7 million EUR will be available for implementing the electric mobility development plan.

11.2.9 Involvement of energy supply companies in improving energy efficiency at end-user level

The involvement of energy supply companies to improve energy efficiency at final customers' level is required by the EU Directive 2012/27/EU on energy efficiency. In order to comply with this requirement the Concept Paper provides for the introduction of a national scheme on implementing energy efficiency measures (EES) which ***will be applied to commercial suppliers in the field of electrical power, natural gas and heat.*** The EES obligations will be allocated by the Ministry of Economics on the basis of the energy volumes delivered. The commercial energy suppliers can perform the energy efficiency measures by themselves or they can outsource the task to subcontractors, or hire other companies (e.g., ESCO) for that purpose. The measures can be performed not only for their own consumers, but also for any other final consumers of the energy. The energy supplier may, for example, make a contribution to the energy efficiency fund amounting to the projected investments in energy efficiency measures. The supplier will have to prove the results of implementing the EES through measurements. Among the energy efficiency measures, recommended in the Concept Paper for complying with the EES are the following:

- insulation of buildings;
- installation of heat controls in apartments and information to residents about the heat control;
- installation of solar collectors for heating and hot water preparation;
- installation of heat pumps;
- installation of heat recovery systems;
- replacement of electric appliances (refrigerators, electric cookers, etc.);
- replacement of lighting;
- introduction of an automatic lighting control and management system;
- replacement of electric motors, pumps and other devices,
- introduction of an energy management system (ISO 50001);
- ESCO services;
- etc.

11.2.10 Provision of municipal funding and support

The Riga City Council annually invests a financially significant part of its municipal budget earmarked for technical solutions that promote energy efficiency in the city and reduction of CO_2 emissions into the following activities:

1) ***renovation of the city's educational establishments***, performed by the Property Department of the Riga City Council. The funding has enabled to complete the renovation of 36% of the total area in educational establishments within 2012 and will provide for complete renovation of all the educational establishments by 2020. Only in 2014 approximately 22 million EUR from the funds of the city's investment plan have been allocated to energy efficiency improvements in the municipality owned buildings, including for the renovation of 22 educational establishments;

2) reconstruction and renovation of unique public buildings (the Latvian National Art Museum, etc.);

3) management of the street and road network system (building of bridges and cross-overs, etc.);

4) acquisition of modern transport vehicles for the city's public transport (low-floor trams, trolleybuses with additional drive, etc.);

5) construction or marking of bicycle lanes within the existing street system, construction of bicycle parking racks/stands near the municipal buildings, including schools;

6) urban planning, research and other measures.

Emphasis has been placed on support measures for the renovation of ***multi-apartment residential buildings***, including the following:

1) on 24 September, 2013, the Riga City Council's Binding Regulations No 47 "On the procedure of providing municipal support for energy efficiency measures in a residential house" were approved; they provide for support related to the performance of energy audits and development of energy certificates (arranged by municipal agency REA) with the municipality co-financing 80% from the energy audit costs; there is also 100 % municipal funding for developing model documentation for the 12 most common types of standard multi-apartment buildings;
2) funding for the project "Housing energy audits 2013" (PVS ID 3006) for the amount of 35 571.80 EUR providing for the energy audits carried out during 2013–2014;
3) funding for the project "Elaboration of technical model documents for the renovation of the 12 most common types of standard multi-apartment buildings" (PVS ID 3007 – arranged by municipal agency REA and LTD "Rīgas namu pārvaldnieks") for the amount of 62 606.36 EUR. Gradual implementation is planned in the 2013–2015 period;
4) property tax reduction up to 90% for a period of 10 years for multi-apartment houses, which are being renovated, as of 2013;
5) a publicly available data base on the energy efficiency of buildings connected to the district heating system has been made publicly available on the website of the municipal agency REA www.rea.riga.lv. In 2013 the data base already contained 2 856 multi-apartment houses of the total number of 7 423 with 8 078 heating units. For establishing and maintaining a complete data base and providing advice to property owners on how to reduce consumption, 3 energy inspectors are going to be recruited by the municipal agency REA in 2014;
6) "Welcome Day" events are organized on a regular basis (organized by the municipal agency REA EIC) next to the renovated buildings;
7) expert discussion club seminars are organized on a regular basis (organized by the municipal agency REA EIC) dealing with the quality of renovation;
8) as of 2012 the LTD "Rīgas namu pārvaldnieks" has started to offer ESCO services in the multi-apartment houses under its management;
9) a free monthly municipal newspaper is published to ensure reach-out and information to residents, including about energy efficiency and renovation of buildings.

Action plan for attracting funding

Table No 11.2

Action Plan			
Measure	Implementation time	Responsibility for implementation	Extent of implement ation
1. Propose state support for the involvement of energy service companies (ESCOs) in the renovation of multi-apartment houses	2013–2020	Municipal agency REA, cooperation partners	
2. Propose state support for establishing a renovation administration service and its operation	2014–2020	Municipal agency REA, cooperation partners	
3. Prepare international project applications for attracting financial resources from the financial instrument "HORIZON 2020".	2014–2020	Riga City Council, municipal agency REA, cooperation partners	

4. Prepare international project applications for attracting financial resources from the financial instrument of the programme "European Territorial Cooperation 2014–2020", etc.	2014–2020	Riga City Council, municipal agency REA, cooperation partners	
5. Promote the creation of revolving funds and their operation at a national and Riga municipality level to support renovation of multi-apartment houses.	2014–2020	Ministry of Economics of the Republic of Latvia, Riga City Council, municipal agency REA, cooperation partners	

11.3 REQUIRED FUNDING AMOUNTS FOR THE IMPLEMENTATION OF THE SMART CITY SEAP

To provide for the implementation of the ***principal measures*** of the Action Plan, the following indicative financial amounts are required, based on a cost estimate with reference to the economic situation in 2014:

Table No. 11.3

Measure	Implementation time	Responsibility for implementation	Required indicative funding, millions of EUR	Potential source of funding
1. Complex renovation of 5 944 multi-apartment houses with the total area of 11.85 million m². Average renovation costs approximately 100 EUR/m² (see the note No. 1)*	2014–2020	Apartment owners community, administrators	**1 185**	Reserves, Structural Funds, loan resources, Revolving funds, national and municipal aid measures, ESCO, funding by energy supply enterprises
2. Elaboration of energy certificates for 5 900 multi-apartment houses (energy audits) with financial aid of the Municipality covering 80% of the energy audit costs	2014–2020	Apartment owners community, administrators, Riga municipality	**3.58**	Reserves, budget of the municipality
3. Comprehensive renovation of the Riga municipality educational establishments	2014–2020	Property Department of the RCC	**170.7**	Budget of the municipality, funding by energy supply enterprises, Climate Change Financial Instrument and others
4. Elaboration of energy certificates (energy audits) for Riga municipality educational establishments and administration and public buildings	2014–2020	Property Department of the RCC	**0.19**	Budget of the municipality

5. Renovation of city lighting by introducing LED lighting	2014–2020	Riga municipal agency "Rīgas gaisma"	**0.5**	Budget of the municipality, Climate Change Financial Instrument, Structural Funds
6. Creation of an infrastructure of rapid charging stations for electric cars	2014–2016	Riga municipal agency "Rīgas gaisma"	**0.48**	Budget of the municipality, Climate change financial instrument
7. Creation of an infrastructure of slow charging stations for electric cars in the car parking spaces of the LTD "Rīgas satiksme"	2014–2020	LTD "Rīgas satiksme"	**0.92**	Budget of the municipality, Climate Change Financial Instrument, Structural Funds
8. Increase of number of zero emission vehicles in the municipal technical services	2014–2020	LTD "Rīgas satiksme"	**2.4**	Budget of the municipality, Climate Change Financial Instrument, Structural Funds
9. Zero emission (hydrogen, fuel elements and batteries) vehicle introduction into city public transport (see note No. 3)*	2014–2020	Riga City Council, LTD "Rīgas satiksme"	**10.6**	EU "Horizon 2020", budget of the municipality
10. Construction of a hydrogen charging station in the city	2014–2020	Ministry of Transport of the Republic of Latvia, Traffic Depart-ment of the RCC	**1.0**	EU "Horizon 2020", external economic operator
11. Extension of the bicycle lane network up to 100 km	2014–2020	Traffic Department of the RCC	**7.9**	Budget of the municipality
12. Support for the secondary-school "Sun Cup"	2014–2020	Municipal agency REA	**0.005**	Budget of the municipality
13.Elaboration and implementation of a pilot project for a cogeneration plant on petrothermal energy, with capacity of 3–4 MWel and 30–40 MWth (see note No. 2)*	2020	Tied merchant	**35.5**	EU "Horizon 2020", fanding bay Tied merchant, Munipal agency REA (tutorials)
14. Establishment and operation of the Riga city revolving fund	2014–2020	Riga City Council, Finance Department of the RCC	**30** (see note No 4)*	Budget of the municipality, Structural Funds, low-interest loans from international banks and credit institutions, grants and other long-term funding
15. Installation of a water heating boiler with capacity of 5 MWth and installation of a condensation economiser in the heat plant "Daugavgrīva"	2015–2016	JSC "Rīgas siltums"	**3.15**	Own capital and Structural Funds

16. Renovation or construction of city's heating networks approximately 12 km/year	2014–2020	JSC "Rīgas siltums"	**42**	Own capital, Structural Funds, Climate change financial instrument

*) Notes:

1) The implementation depends on the available funding amount, development of ESCO activity, formation of the administrator's office and improvements in the national legislative framework, as well as on municipal support.

2) The implementation depends on the possibilities to involve an investor to provide funding.

3) The implementation depends on the possibilities to involve the "Horizon 2020" funding.

4) The exact amount is going to be specified after finalising the the revolving fund operation.

11.4 The legislative and regulatory documents required for implementation of the smart city SEAP

To ensure implementation of the Action Plan, it is necessary to prepare and adopt the following main legislative documents:

Table No 11.4

The area of the legislative act or regulatory document to be elaborated	Term of elaboration	Responsible institution	Comments
Laws and Regulations of the Cabinet of Ministers			
1. Law On the Energy Performance of Buildings (by transposing the EU Directive 2012/27/EU on energy efficiency into legislation of the Republic of Latvia)	2014	Ministry of Economics of the Republic of Latvia	Participation of municipal agency REA and Riga City Council Board of Advisory Experts on Energy Supply Issues (hereinafter – "REEKP") during the drafting period and evaluation of the draft law
2. Elaboration of the Regulations of the Cabinet of Ministers related to the Law On the Energy Performance of Buildings	2014/2015	Ministry of Economics of the Republic of Latvia	Participation of municipal agency REA and REEKP during the drafting period and evaluation of the draft regulations of the Cabinet of Ministers
3. Elaboration of the Regulations of the Cabinet of Ministers related to introduction into apartments of individual heat consumption meters (allocators and other metering devices) and allocation of payments among the residents	2014/2015	Ministry of Economics of the Republic of Latvia, the Project is drafted by the municipal agency REA together with a work group with expert involvement	Participation of municipal agency REA and REEKP
4. Regulations of the Cabinet of Ministers related to the use of Structural Funds to improve energy efficiency and facilitate the use of renewable energy sources	2014–2020	Ministry of Economics of the Republic of Latvia	Participation of municipal agency REA and REEKP during the drafting period and evaluation of the draft regulations of the Cabinet of Ministers

5. Legislation relating to the formation and operation of a state Energy Efficiency (revolving) Fund	2014–2020	Ministry of Economics of the Republic of Latvia	Participation of municipal agency REA and REEKP during the evaluation of the draft legislative acts
6. Legislation relating to the formation and operation of a municipal Energy Efficiency (revolving) Fund	2014–2020	Ministry of Economics of the Republic of Latvia	Participation of the municipal agency REA, REEKP and the Finance Department of the Riga City Council during drafting and evaluation of the draft legislative acts
7. Draft and amend the legislative acts to set a rational energy efficiency level for multi-apartment houses, with a mandatory renovation requirement if surpassed	2014–2020	Ministry of Economics of the Republic of Latvia	Participation of municipal agency REA and REEKP during the drafting period and evaluation of the draft legislative acts
8. Draft and amend the legislative acts to introduce a state paid administrator's service for supporting renovation of multi-apartment houses	2014–2020	Ministry of Economics of the Republic of Latvia	Participation of municipal agency REA and REEKP during the drafting period and evaluation of the draft legislative acts
9. Draft and introduce legislation that establishes a mandatory task for the government to record individual heating equipment with capacity over 20kW and all individual power generation equipment that uses renewable energy sources	2014/2015	Ministry of Economics of the Republic of Latvia	Participation of municipal agency REA and REEKP during the drafting period and evaluation of the draft legislative acts
10. Draft and implement legislation that establishes a mandatory task for the government to record all energy generation from heat recovery during technological processes	2014/2015	Ministry of Economics of the Republic of Latvia	Participation of municipal agency REA and REEKP during the drafting period and evaluation of the draft legislative acts
11. Introduce mandatory registration of the energy certificates issued to buildings in the state register of energy certificates, publicly available to the concerned parties	2014–2020	Ministry of Economics of the Republic of Latvia	Participation of municipal agency REA in presenting information about energy certificates elaborated for multi-apartment houses and municipal public buildings
Municipal legal framework			
1. Develop the concept for the operation of the municipal revolving fund	2014/2015	Municipal agency REA, RCC Finance Department, cooperation partners	In the framework of the international project INFINITE Solutions
2. Draft and implement legislation for the formation and operation of a municipal revolving fund	2015/2016	Riga City Council, RCC Finance Department, municipal agency REA, Cooperation partners	After the Concept (p 1) has been developed

3. Draft and implement legislation for municipal support to residents for the use of renewable energy sources in households	2015–2020	Riga City Council, municipal agency REA	
4. Draft and implement legislation on mandatory introduction of external labelling on buildings indicating the energy efficiency class of the building	2015–2020	Riga City Council, municipal agency REA	
5. Draft and implement legislation on the mandatory display of energy efficiency certification data in a visible place in municipal institutions	2015–2020	Riga City Council, municipal agency REA	
6. Draft and implement legislation on a mandatory requirement to indicate the actual energy efficiency of a multi-apartment residential building in kWh/m² for the previous calendar year on the reverse side of the utility bill issued to the residents; comparison with the average energy efficiency of a renovated building has to be included.	2014–2020	Riga City Council, municipal agency REA	
7. Draft and implement legislation regarding the rights to park electric cars with specific labelling free of charge in the paid parking lots controlled by LTD "Rīgas satiksme"	2014–2020	Riga City Council, LTD "Rīgas satiksme"	
8. Draft and implement legislation enabling a uniform urban environment as a result of the renovation process, including the visual appearance of the renovated buildings	2014–2020	Riga City Council, City Development Department of RCC, Riga City Architectural Bureau, Riga City Construction Board	

11.5 Criteria for assessing the progress in achieving the smart city SEAP objectives

During the implementation process of the smart city SEAP the municipal agency REA regularly (once in a year or two years) drafts a progress report regarding its course towards the objectives set in smart city SEAP. The evaluation of how the objectives are being achieved takes place according to the criteria specified in this section. The "Conclusions" section is an integral part of the progress report; it analyses the smart city SEAP implementation process and suggests measures for facilitating the activities which have slowed down.

The main criterion for evaluating the fulfilment of the smart city SEAP is the CO_2 emissions' percentage ratio in the reporting year vs. the CO_2 emission volumes in tons in the chosen baseline year (1990). The other criteria are seen as promotional in achieving the main

intended objective of the smart city SEAP: reduction of CO_2 (or greenhouse gas) emissions, to obtain a minimum impact on global climate change.

With due regard to the particular conditions of Riga, i.e. with the number of residents steadily decreasing in the past few decades and a fairly low living standard in the period of time under consideration with relatively low electric energy consumption in the households in comparison with the countries of Western Europe, CO_2 emissions per capita can hardly be used as a criterion. This parameter, though it has been set in the smart city SEAP, may not be seen as definitive in describing the trends in the city.

Notably, it is not possible to strictly fix the volume of renewable energy sources utilized in the Riga City, because Riga, *inter alia*, receives electrical power also from the Riga Hydro Electrical Power Plant (Riga HPP) through the single network (see Section 9.1.2 of the SEAP), which, along with the Riga thermal power stations, supplies power also to the consumers outside Riga. The share of renewable energy in the national power supply is approximately 50% of the consumption.

By establishing the ***basic criteria,*** it is important to avoid dual recording of energy savings from the various energy saving measures introduced, therefore the following basic criteria have been adopted:

1) reduction of energy consumption MWh in a calendar year at the end-user level as indicated by the reduction in the amount of energy delivered;
2) amount of the heat recovered during the energy generation process, as well as during the technological processes of production (e.g., recovered flue-gas heat through flue-gas moisture condensation, heat recovery from cooling flows with the use of heat pumps, drain water heat recovery with the use of heat pumps, etc.);
3) use of renewable energy sources for energy production in the district heating system, in per cent of the used fuel amount (MWh) per year;
4) the amount of generated energy (MWh) from renewable energy sources with heat pumps, sun collectors and batteries, fuel elements and other types of renewable energy sources;
5) share of biofuel, in per cent of the total combustible consumption in public road transport;
6) the amount of traditional fuel in the city public transport system replaced by (hydrogen) power.

Additional criteria for the activities to achieve the main objective of the city:

1) comprehensively renovated multi-apartment houses in the city, number and percentage of the total area;
2) comprehensively renovated state owned buildings in Riga, number and percentage of the total area;
3) comprehensively renovated municipality owned education establishments in Riga, number and percentage of the total area;
4) comprehensively renovated municipality owned institution and other buildings (except education establishments) in Riga, number and percentage of the total area;
5) number of multi-apartment houses in Riga, for which energy audits have been elaborated and energy certificates issued;
6) number of standard multi-apartment houses in Riga, for which model documentation has been drafted (energy audit, technical survey and technical renovation project) for repeated use;
7) number of the innovative “lighthouse” projects included in the e-catalogue, implemented in Riga in order to achieve the objectives of the smart city SEAP and containing smart solutions, commendable for multiplication;
8) number of electric cars introduced in the municipal technical services;

9) number of zero emission transport vehicles introduced in the city public transport to replace buses driven on traditional fuel.

The following ***promotional criteria*** for assessing the implementation of the smart city SEAP have been established:

1) the number of information sheets, brochures, professional articles, e-journals, videorecordings and other information materials on energy efficiency and renewable energy sources prepared and disseminated;
2) the number of thematic roundtable discussions, welcome days, seminars and conferences, as well as exhibitions;
3) the number of specialized Energy Days' events;
4) the number of persons who have visited the municipal agency's REA home page, followers of municipal agency REA accounts in the social networks;
5) participation in information campaigns on the subject of energy efficiency and renewable energy sources;
6) number of cities engaged in exchange of experience in the field of energy efficiency and renewable energy sources.

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