SMALL CHP PLANTS IN LATVIA: REALITY AND POSSIBILITIES

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Abstract
The paper observes different steps which can be made to stimulate the development of small cogeneration using renewable fuels in Latvia.
Combined heat-and-power (CHP) plants generate electricity together with the heat at high efficiencies (depending on technology and type of fuel) and therefore help to save fuel, cut greenhouse gas emissions and reduce electricity costs. According to the Latvian Energy Policies (for the period of 2007-2016yy), one of its main aims is to increase the effective usage of renewable sources of energy and producing of energy in cogeneration process, including the stimulation of small cogeneration.
Today in Latvia there are 12 CHP plants with electrical capacity less than 0.2 MW and 39 CHP plants with electrical capacity 0.2 – 5 MW. During the last two years, the amount of small CHP plants has increased from 36 to 51. Only 5 of existing CHP plants use renewable fuels, the others use natural gas.
The conditions for CHP producers, apart for small-scale CHP, have been difficult over the last few years. The development of small-scale CHP projects is hindered by the lack of experience with new technologies, as for example wood gasification or micro turbines, together with high interconnection. During last time, the procedure of taking business loans became more difficult, as well.
Latvia supports cogeneration by means of feed-in tariffs. The tariffs depend on the installed electricity capacity of the CHP units. The main weak point of the policy measures can be identified as discrimination between different cogeneration plants, and particularly of small and micro systems, because at least 75 % of the heat produced has to be supplied to the centralized district heating, hence the policy does not support industrial or auto-use of cogenerated heat. It is necessary to simplify technical and administrative procedure for newly created CHP plants, especially for the ones with capacity less than 4 MW and the ones using renewable fuel.
In 2011 a training program 'Sustainable heating system with Renewable energy resource' was started in Latvia. The sustainable energy community model (SEC) modified for Latvian circumstances is used in the project. Firstly, there was analyzed the energy efficiency of different Latvian regions to find out the most prospective field for applying the SEC method. The farther steps are to analyze accessible resources (including renewable) for a definite region, and then to create and realize the plan of energy development. While implementing this kind of programs it is possible to stimulate the farther development of cogeneration in Latvia, including small capacity CHP plants, using local renewable fuels.
Key words: cogeneration, local level energy policies, main drivers and main barriers for growth of renewable energy.

Introduction

Nowadays, the world's increasing interest is observed in two aspects of energy problems – energy dependence and climate change. Many investigations are being made on alternative energy sources and new technologies. To achieve the aims of European Union (EU) energy and climate policy till 2013-2020, the European countries have to concentrate on increasing both energy efficiency and renewable fuels usage.

The possible principles of Energy Policy for Europe were elaborated at the Commission's green paper A European Strategy for Sustainable, Competitive and Secure Energy in 2006. As a result of the decision to develop a common energy policy, the first proposals, Energy for a Changing World were published by the European Comission, following a consultation process in 2007. The European Commission has proposed in its Renewable Energy Roadmap 21 a binding target of increasing the level of renewable energy in the EU's overall mix to 20% by 2020. The targets for the member states are calculated using a formula: flat rate 5.75% (one for all EU countries) + extra % (according to GDP).

According to the European Climate and Energy package, Latvia, as a European Union Member state, has to increase the renewable energy as a part of gross final energy consumption from 35% in 2005 to 42% in 2020 (Odiņeca T., 2009) to increase energy efficiency and to reduce the greenhouse gas emissions by 2020. The combination of renewable energy sources (RES) and combined heat and power (CHP) is a key approach to reach the ambitious EU climate protection targets. The aim of the paper is to observe different steps which can be made to stimulate the development of small cogeneration using renewable fuels in Latvia.

Existing situation with CHP plants in Latvia

Latvian energy policy towards CHP plants

Reaching the long-term goals of Latvia's energy sector is a complex process that involves finalizing a long-term strategy, defining and justifying feasible goals and tasks, as well as establishing concrete political, legal and institutional frameworks and tools (Sprūds A., 2010; Latvijas Republikas Ekonomikas ministrija, 2006).

The key strategic document for the energy sector is The Principles of Energy Sector Development 2007-2016, adopted in 2006. This document defines the fundamental principles of the Latvian government policy, as well as long-term goals and a course of action in the energy sector. The importance of the energy sector in the context of overall sustainable development is acknowledged: 'The sufficiency of energy supply in the country is the issue of economic development, the quality of life and state security. The goal of the energy sector development is to ensure balanced, safe, sustainable high quality supply of energy for the economy and country's residents.' The goals spelled in the document are identical to the 'three whales' of the energy sector as defined by the EU, namely: 1) secure supply, 2) encouraged competition and competitiveness, and 3) use of renewable resources.

To put the Principles of Energy Sector Development 2007-2016 into practice, there were mentioned, among other, these plans of action:

- until 2016 to use the potential of cogeneration with common heating load about 300 MW_{th} in Latvian big cities (including Riga), and 100 MW_{th} in other Latvian cities;
- to stimulate the development of CHP plants and energy producing of renewable sources of energy, using the EU Fund's special purpose grants for investments;
- to increase the usage of local renewable primary resources from 65 PJ at the moment to 82 PJ in 2016 (36-37% of local resources in Latvian primary energy resources structure);
- until 2016 to increase the energy efficiency of heat production facilities from 68% to 80-90%.

Using of cogeneration technology is considered appropriate to Latvia's situation: Latvia has a characteristic centralized power supply system, which means inhabited areas have sufficiently high heat loads to accommodate installation of an efficient cogeneration facility. A cogeneration source is close to the heat load, i.e. the energy consumer, who is consuming power at the same time. This means that cogeneration technology has all the advantages of placing an energy source next to the consumer, such as reduced power management and distribution leakage, and increased power supply stability.

A wide variety of fuels can be used in CHP systems, including natural gas, diesel fuel, petrol, biofuels, coal, municipal waste. CHP plants operate at total energy efficiencies of 75-95 %, which means that almost all of the fuel is put to productive use (Flin D., 2010). Because less fuel is used, obvious benefits are received:

- reduced fuel costs;
- reduced fuel supply needs, bringing about a reduction in the logistical needs to transport and store the fuel;
- reduction in emission levels;
- fewer pollutants passing through the engine or turbine, resulting in a reduction in wear.

Review of existing CHP plants in Latvia

Data of the Central Statistical Bureau show that in 2010 in the Republic of Latvia there were 71 active combined heat and power (CHP) plant with total electrical capacity 947.5 megawatts (MW) (Suzdaļenko V. 2011). These CHP plants produced 3050 gigawatt hours (GWh) of electricity and 4673 GWh of heat energy, and it is 58.7% of total volume of heat produced.

There are two types of CHP plants:

- public CHP plants, primary activity of which is generation of heat energy;
- autoproducer CHP plants are generating heat for their own consumption and technological use and partly for sale.

Out of 71 CHP plants, in 2010 there were active 56 public cogeneration plants with installed electrical capacity 932.8 MW, it is 98.4% of total installed capacity of CHP plants, and 15 were autoproducer CHP plants with installed electrical capacity 14.7 MW.

In comparison with 2009, electrical power of cogeneration plants has increased by 1.4%. CHP plants of Riga had the highest installed electrical capacity – 876.3 MW.

In 2010 for the production of heat energy and electricity, CHP plants mainly used natural gas (98.1%), as well as biogas, fuelwood, coal, residual (heavy) fuel oils and bio-diesel oil.

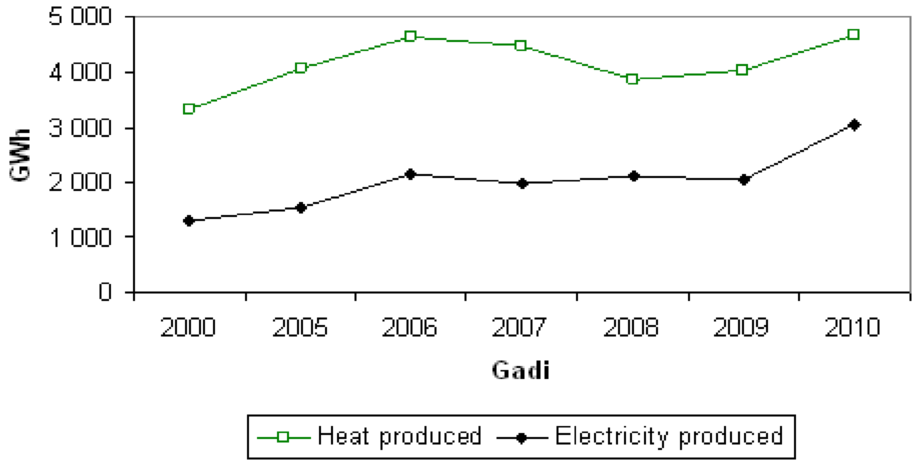
Out of 71 CHP plants, in 2010, 56 plants (both public and autoproducer) with total electric capacity 870 MW were active for more than 6 months, of which:

- 3 combined-cycle turbines with electrical capacity 803 MW;
- 1 gas turbine with heat utilisation;
- 48 internal combustion engines with electrical capacity 61 MW;
- 3 steam backpressure turbines with electrical capacity 4 MW;
- 1 condensing steam turbine.

Methods of support of CHP development

Documents regulating producing of co-generated energy

The most important energy-related legislative document is the Energy Law (2005), which regulates the use of and support for all renewable resources. The government has also adopted a series of regulations



Source: Suzdaļenko V., 2011

Figure 1. **Heat and electricity produced in CHP plants in 2000 to 2010 (GWh)**

Table 1

Number of public CHP plants and installed electrical capacity (MW) in 2010

	Number of public CHP plants	Installed electrical capacity, MW	Electricity produced, GWh	Heat energy produced, GWh
TOTAL	**56**	**932.8**	**2984.8**	**4603.4**
≤ 0.2 MW	8	1.3	7.2	20.2
0.2 < P ≤ 0.5 MW	14	5.7	23.5	99.1
0.5 < P ≤ 1 MW	9	6.2	23.9	197.6
1 < P ≤ 5 MW	21	54.3	323.3	867.4
5 < P ≤ 20 MW	1	11.8	35.7	36.9
> 20 MW	3	853.5	2571.2	3382.2

Source: Suzdaļenko V., 2011

for CHP plants; the most notable among them is the Regulation No. 221 'The Regulation of electrical energy production and forming of prices while producing electrical energy in CHP' (10 March, 2009) (Ministru kabinets, 2009).

Of many possible variants of support schemes for CHP using renewable energy sources (including green certificates, tax exemptions or reductions, tax refunds, premium payments), in Latvia there are used the following: feed-in-tariffs, obligate buying of co-generated electrical power, EU earmarked subsidies for the development of CHP plants using RES.

In the latest amendment to Regulation No.221, a few changes referring to small capacity CHP plants were brought in (Ministru kabinets, 2009; Ministru kabinets, 2005). In the period from 2007 to 2010, the number of CHP plants with electrical capacity 0.2 – 5 MW significantly increased.

The feed-in-tariffs, defined by Regulation No.221, depend on the installed electricity capacity of the CHP units. The main weak point of the policy measures can be identified as discrimination between different cogeneration plants, and particularly of small and micro systems, because at least 75 % of the heat produced has to be supplied to the centralized district heating. Thereby, the policy does not support industrial or individual-use of cogeneration. The natural gas tariff is used as an element of the pricing formula for electricity produced at biogas and biomass power stations, which should be abolished.

Applying a Sustainable Energy Community model for development of CHP

In 2011 a training program 'Sustainable heating system with renewable energy resource' was started in Latvia. The modified sustainable energy community model (SEC) is used in the project.

The Sustainable Energy Community model begins by establishing a clearly defined geographic area called the Sustainable Energy Zone (SEZ). The SEZ establishes sustainable energy targets that are measured and monitored and creates a focal point for partners, projects and proposals to integrate in a structured way. This allows new technologies and techniques to be tried and tested in an incubator or living laboratory environment.

A Sustainable Energy Community is the integration and collaborative action in the wider community

Table 2

Number of public CHP plants and installed electrical capacity (MW) in 2007 and 2010

	2007		2010	
	Number of public CHP plants	Installed electrical capacity, MW	Number of public CHP plants	Installed electrical capacity, MW
TOTAL	**20**	**586,2**	**48**	**931,5**
0.2 < P^1 ≤ 0.5 MW	3	0,637	14	5,7
0.5 < P ≤ 1 MW	0	0	9	6,2
1 < P ≤ 5 MW	9	18,95	21	54,3
5 < P ≤ 20 MW	5	47	1	11,8
> 20 MW	3	519,6	3	853,5

Source: Suzdaļenko V., 2011

(e.g. town or region) to expand and replicate ideas tested in the SEZ. This is delivered through structured engagement with the wider public, private and community sectors to identify synergies and supporting initiatives to influence positive changes in behaviour and policy. An SEC is a community in which everyone works together to adopt a more sustainable pattern of energy supply and use (SEC Program, 2007).

Applying the SEC model modified for Latvian circumstances, firstly, there was analyzed the energy efficiency of different Latvian regions to find out the most prospective field for using the SEC method. Then it is starting the process of energy development planning, which includes 8 steps:

- forming the total vision of region (local energy resources, economy, demography, etc);
- defining of motive power in a region;
- defining of base line of development;
- working out the scenarios of development;
- formulating the strategy;
- formulating the plan of actions;
- monitoring and estimating the progress;
- adapting the new information for the planning process.

While implementing this kind of programs, it is possible to stimulate the farther development of cogeneration in different Latvian regions, using local energy sources.

Usage of renewable energy sources for CHP plants

As it is said before, today for the production of energy CHP plants mainly use natural gas (98.1%). It is explained by the fact that using natural gas as a fuel, it is possible to apply highly effective (with high α-ratio) CHP technologies. One of Latvia's advantages, which also serve as a kind of short-term guarantee of continual supply, is its underground gas storage facilities. The amount of active gas in the currently functional Incukalns underground storage may reach 2.3 billion cubic meters, and there are plans to increase this amount to 3.2 billion cubic meters. The expansion of these storage facilities may bring about several significant advantages, such as strategic reserves, economic benefits and improvement of regional energy supply. Nevertheless, it may also boost local energy and production companies' inclination to use imported gas instead of exploring sustainable local options by means of increasing energy efficiency and using renewable energy sources.

Considering the aforementioned local and regional challenges, as well as the EU commitments, it would make sense for Latvia to utilize the potential of local renewable sources, the largest of which is wood. The economic potential of wood is estimated around 45.5 – 82 PJ a year, which constitutes considerable part of the country's total energy consumption.

Wood gasification technology (a thermo dynamical process that converts wood to a gaseous fuel) used in cogeneration process is more effective than common combustion of wood, because generated gas can be a fuel for such effective CHP technologies as gas turbines, gas-steam turbines and internal combustion sets. Wood gasification is less dangerous for enviroment comparing with common combustion, because during gasification process less emissions go to the atmosphere. Usage of wood fuels not only helps to increase the part of renewable energy in gross final energy consumption, but also gives an opportunity to get more independence from importing of fossil fuel resources. Besides, the gas distribution system in Latvia does not cover large territories, including the territories with big forest density. The advantage of the use of biomass in cogeneration is self-evident, as it allows high efficiency combined with an increase of renewables' share. While CHP equipment fuelled by RES seems to be the first choice from the standpoint of energy efficiency and technical availability, it is not yet widely spread and implemented.

If gas is used in an internal combustion engine for the production of electrical energy, it demands a gasifier and gas of special quality. The world's experience of exploitation of this kind of systems shows, that they are sensitive towards the changes of fuel parameters, changes of the load of equipment, quality of service, and environmental conditions. Necessity of cleaning, cooling and mixing of gas makes the technology rather difficult and expensive (Odiņeca T., 2009).

Today, there are two CHP plants where wood gasification is applied: SIA 'Kņavas granulas' in Vilani (electrical capacity 500 kW and thermal capacity 800 kW) is fuelled by wood granules (the drying of fuel is not necessary), and SIA 'Zaļās enerģijas aģentūra' in Dagda (works since 2010; electrical capacity 500 kW and thermal capacity 800 kW; an internal combustion engine installed) is fuelled by dry woodblocks and dried coarse fraction woodchips (Ozoliņa L., 2011).

CHP goes 'green'

Access to information is a problem in the public energy supply system of Latvia. The frequently used argument goes that energy consumers do not understand this complex issue and therefore no information needs to be released to the general public, except for the regulated energy tariffs. Yet sustainable development is unfathomable without the awareness and understanding of energy producers' and energy consumers' actions and their mutual interconnectivity. Latvia has not made sure there is a system allowing energy consumers to obtain information about the sources of the energy they consume, about the security of energy supply, price predictability and alternative energy options. The lack of such a system hinders the development of a clear policy of the energy sector and impedes investment.

Since 2010 Latvia participates in the EU project 'CHP goes Green' (CHP Goes Grees. Project, 2011). The target for the selected model cities (Berlin, Frankfurt/Main, Hannover, Graz, Prague, Riga, Lyon and Paris) involved in the project is to promote and install 'Green CHP' and the respective technical solutions. All players in the decision-making chain are addressed by CHP goes Green: public and private buildings owners, local key politicians, municipalities, planning engineers, installers, energy companies and industry.

The benefits to the target groups are manifold such as:

- solution-oriented contributions to reaching local energy goals;
- information in terms of innovations, competition and best choices;
- the provision of contact with target groups;
- considerations in terms of feasibility of CHP solutions.

The following major outputs related to the goal will be realized:

- analysis of the regional legal and economic framework and its impact on the regional market exemplarily for the model region;
- derivation of action and implementation plans of good practice specific for the model region;
- the public campaigns addressing policy and decision makers, building owners and youngsters as future decision makers;
- target-group specific promotion of best practices for RES-fueled CHP approaching different groups of building owners, planners and installers;
- initiating new RES-CHP applications;
- training of above mentioned decision makers with regard to technical, ecological and economic issues to support the practical implementation of RES-fueled CHP.

Conclusions

Usage of SEC methodology modified for Latvian circumstances is appropriate for development of cogeneration in definite Latvian districts.

Further market penetration of higher share of cogeneration fuelled by renewables requires removing barriers from the legislative and administrative framework, requires planning and cooperation, capacitating of technical decision makers and general awareness-raising and trust-building among potential promoters, multipliers and users. Moreover, it is a question of cost if alternatives are considered. It is worth investing in developing the new effective technologies used in cogeneration (wood gasification).

It is necessary to simplify the technical and administrative procedure for newly created CHP plants, especially for the ones with small capacity and the ones using renewable fuel. The support mechanisms for using of cogeneration have to apply not only to businesses, but also to individuals. It also can be recommended to abolish the natural gas tariff as an element of the pricing formula for electricity produced at CHP plants using renewables.

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