The threat of depletion of resources, especially non-renewable resources that recently became the basis of energy resources for the mankind, creates a topic for discussion on sustainable development in the field of energy. Heat supply is an important prerequisite for wellbeing. One of the functions of municipal governments in Latvia is to provide heat supply services. The aim of the present paper is to ascertain whether the provision of heat supply in Latvia’s municipalities correspond to the conditions of sustainable development. Heat supply in Latvia, except cities and the towns located in the regions of Riga and Zemgale, is based on renewable energy sources that ensure their sustainable use, however, municipal governments do not organise centralised heating for multi-apartment houses in more than half of Latvia’s territorial units, and this problem is tackled by their residents themselves. In terms of centralised heat supply in Latvia’s regions in the sustainability context, Vidzeme region gained the highest rating, meaning that mostly renewable energy sources are used in this region, heat supply services are cheaper, and centralised heat supply services are more available to the region’s residents, whereas the lowest rating is for Riga region. The monographic method, analysis, synthesis, the graphic method, as well as data range grouping were applied in the present research.

Key words: heat supply, non-renewable and renewable energy sources, municipalities, sustainability.

JEL codes: Q400, Q300, Q200, H700, Q560.

Introduction

The economic basis of any economy is its power industry. The increasing pollution of environment as well as the increase in energy prices are the factors that promoted the development of energy policy guidelines at both European Union and national levels. It has to be admitted that presently the largest part of energy output is concentrated among a few countries. Therefore, energy consumers have limited possibilities for choosing their most appropriate and available type of energy. Interest in energy independence and energy generation for profit are the main factors promoting the development of renewable energy sources in Latvia.

The power industry is defined as an industry of national economy that deals with extraction of energy resources, their processing into energy, and its supply to consumers. Not a single modern industry can exist and develop without the power industry. The power industry impacts the standard of living of residents (Enerģētika un ..., 2002.).

The law of the Republic of Latvia “On Municipalities” delegated several functions to local governments, and one of them is the supply of communal services regarding heating (Par pašvaldībām, 1994), but after the year 2000 it was stipulated that this process has to be done irrespective of who owns housing (Par pašvaldībām,
2000). Since actually all residents of Latvia have lived in a municipality, one can say that municipal governments have a large influence regarding the types of energy resources to be used in supplying heating services for households in respective territories of municipalities. This influence on heat supply for local and individual households decreases, however, it is topical for multi-apartment houses in both rural villages and towns as well as for administrative buildings of municipalities. The research object in this paper is the heat supply of Latvian municipalities, but the research subject is the provision of sustainable resources for centralised heating systems in municipalities.

The aim of the present paper is to ascertain whether the provision of heat supply in Latvia’s municipalities corresponds to the conditions of sustainable development. To achieve the aim, the following research tasks are set forth: 1) to give an insight into the topical issues of using renewable energy sources; 2) to identify the types of resources used in centralised heating systems for multi-apartment houses in Latvian municipalities; 3) to assess the centralised heating systems of Latvian municipalities in the context of sustainability.

Owing to the large potential of consumers, heat supply can be provided on much more different conditions in the republican cities (9 cities in total, the largest one is Rīga with 703581 residents and the smallest one is Jēkabpils with 26284 residents in the beginning of 2011), therefore, centralised heat supply in Latvia’s republican cities will not be analysed in this paper. Only 110 Latvia’s municipalities that are the first level municipalities are included in analysis; as of the beginning of this year, their total population, according to data of the Office of Citizenship and Migration Affairs, was 1096413.

Results and discussion

Use of natural resources in energy supply

Renewable energy sources were used by the mankind until the 18th century when the first fossil energy resources – coal and later oil – were started to be extracted. Fossil fuels gave a significant impulse to industrial development, as they allowed transportation of energy owing to the high concentration of it per unit of volume. Thus, the sites of use of energy were disassociated from the sites of energy extraction, and trade in this sector got a new impulse. At the same time, a new problem emerged – environmental pollution and new threats for human health. Presently, the dominant type of fossil energy is crude oil, but its location in politically risky regions, which is now strained by climate change and care for the future of the planet, makes us search for alternatives. It, of course, does not mean the era of fossil energy is going to end. Although American geologist M. King Hubbert developed a mathematical model in 1956 to determine the maximum quantity of oil extraction or the so called Hubbert Peak Theory, which had to reach its highest level in the 1980s (Hubberts Peak Oil ..., n.y.), the oil resources used in the world’s economy have steadily increased from year to year.

Undoubtedly, the period when oil was cheap and its price increased consumption and promoted energy inefficiency is over. The extraction of oil moves further
and deeper and becomes more expensive as well. A similar situation is observed for natural gas, although it has an advantage compared to the impact of oil products on climate change, as natural gas produces two times less CO₂ emissions than oil products and coal to gain the same amount of energy (Sprūds, 2009).

The increasing number of population and the depletion of fossil resources make us return to the conclusions drawn by the classics of economic theory – Malthus and Medow – who stated that economic growth will stop if there is a lack of resources. Therefore, new energy resources were searched for since the middle of the 20th century, but since the end of the century the progression of this process is featured by the need for sustainable development, which states that satisfying the needs of present generations has to be ensured without causing threats to the next generations in meeting their needs (Bruntland, 1987). The tasks of sustainable development, except economic growth and the wellbeing of population, are also as follows:

- preservation of resources;
- balanced development of the human-made and natural environments;
- provision of the quality of environment that is acceptable for society by stooping or limiting processes degrading the environment and negatively impacting the regeneration of ecosystems and by preventing processes negatively impacting human health and reducing the quality of life (Vide un ilgtspējīga ..., 2010).

In providing energy resources, several natural resources – both renewable and non-renewable ones – are or can be used. From a historical point of view when one type of energy is replaced by a higher-level energy, the replacement of the dominant type of energy is observed, and the efficiencies of extracting and using it are chosen as its most essential characteristics. The use of any individual type of energy is limited in terms of efficiency and scarcity. The period of domination of any type of energy is approximately 100 years. Therefore, if planning the development of territories in a long-term, it is necessary to identify the potential types of energy, besides, the number of alternatives does not have to be limited, as some type of alternative energy might make a combination of types of energy that meets the needs of society in a shorter or a longer period of time.

The energy of flows is usually regarded as a source of renewable energy or environmentally friendly energy; it is an energy that does not depend on the deposits of resources on the earth – wind energy, solar energy, wave energy, hydro energy, geothermal energy, as well as biomass and waste energy (Atjaunojamie energoresursi, n.y.). In fact, these are the types of energy that have to dominate to execute the tasks of sustainable development which require a rational use of resources and balanced development of the human-made and natural environments.

Non-renewable energy sources are fossil resources that formed during a very long period: oil, natural gas, coal etc.

The replacement of the energy resources used for heating in Latvia during the previous 100 years tended towards non-renewable energy sources. Renewable energy sources dominated in heating in the beginning of the 20th century, but, for instance, in 2007, according to the Latvian Association of Heat Supply Enterprises, non-renewable energy sources, mainly natural gas, used in centralised heating, including in the republican cities, accounted for 68.6% of the total heat supply.
Heat supply is an essential component of life quality of Latvia’s population, taking into account our country’s climatic conditions and future forecasts that predict even a wider range of temperature change. The consumer structure of centralised heat supply did not significantly change over the recent years: 1.8% is consumed by industry, 73.7% by households, and 24.5% by other consumers. A positive trend is that the consumption of thermal energy decreases in centralised heat supply systems owing to energy efficiency improvement measures (Siltumapāde EM, n.y.). Local governments are responsible not only for providing heat supply in their administrative territories, but they have to promote energy efficiency improvements and competition in the market of heat supply and fuels. In promoting energy efficiency improvements, the national program “Climate Change Financial Instrument” has successfully started, which includes the following measures:

- increasing the energy efficiency of buildings in both public and private sectors, including municipalities;
- developing and introducing renewable energy sources;
- reducing greenhouse gas emissions (Klimata..., n. y.).

**Types of resources for centralised heat supply in multi-apartment houses**

Within the present research, 110 amalgamated municipalities and 579 territorial units of municipalities in Latvia’s regions were analysed. It was studied whether centralised heat supply services, which are provided by local governments, are available in multi-apartment houses in these territories. If centralised heat supply services were available, the type of energy resources used in the boiler house was ascertained. The data were obtained in interviews, contacting executive directors of the councils of municipalities or employees of administrations.

The authors define three major terms for Latvia’s territorial division, and a further analysis of data is carried out according to these territorial units.

A **planning region** is a derived public entity. Its decision-making body is the Planning Region Development Council. The territories of planning regions, according to the recommendations submitted by local governments, are set by the Cabinet of Ministers. There are five planning regions in Latvia: Kurzeme, Latgale, Rēga, Vidzeme, and Zemgale (Reģionālās ..., 2002). Hereinafter a planning region is called a region.

A **municipality** is an administrative territory, which was established by amalgamating civil parishes, towns, or civil parishes and towns, having one local government (Admīnistratīvi teritoriālā reforma, n.y.). There are 110 municipalities in Latvia: 18 in Kurzeme region, 20 in Zemgale region, 28 in Rēga region, 25 in Vidzeme region, and 19 in Latgale region.

If a municipality included more than administrative territory before the administrative and territorial reform, the administrative territories amalgamated in a municipality are regarded as **territorial units of municipality** – municipality towns or municipality parishes (Administratīvo..., 2008). In total, there are 579 territorial units of municipality in Latvia: 107 in Kurzeme region, 101 in Zemgale region, 92 in Rēga region, 130 in Vidzeme region, and 149 in Latgale region.
The data obtained were grouped by type of energy resources – renewable or non-renewable energy sources, and the types of fuel used in respective municipalities were analysed as well.

Table 1 includes data on the types of fuel used in Latvian municipalities by region.

Table 1. Number of Latvian municipalities by type of fuel used in centralised heat supply systems in multi-apartment houses

<table>
<thead>
<tr>
<th>Type of fuel</th>
<th>Kurzeme region</th>
<th>Zemgale region</th>
<th>Rīga region</th>
<th>Vidzeme region</th>
<th>Latgale region</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firewood</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>19</td>
<td>10</td>
<td>59</td>
</tr>
<tr>
<td>Woodchips</td>
<td>8</td>
<td>7</td>
<td>10</td>
<td>13</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>Natural gas</td>
<td>3</td>
<td>9</td>
<td>19</td>
<td>5</td>
<td>3</td>
<td>39</td>
</tr>
<tr>
<td>Sawdust</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Granules</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Coal</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Straw</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Fuel oil</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Diesel fuel</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Grain</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Waste</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: developed by the authors according to information provided by the administration of municipalities, 2011.

Note: the most popular types of fuel are bolded

Table 1 shows that firewood (11 municipalities) and woodchips (8 municipalities) are the most popular types of fuel in Kurzeme, firewood (10 municipalities) and natural gas (9 municipalities) – in Zemgale region, natural gas (19 municipalities) and woodchips (10 municipalities) – in Rīga region, firewood (19 municipalities) and woodchips (13 municipalities) – in Vidzeme region, and woodchips (11 municipalities) and firewood (10 municipalities) are the most popular types of fuel in Latgale region. In total, the most popular types of fuel in Latvia are firewood (59 municipalities), woodchips (49 municipalities), and natural gas (39 municipalities) followed by sawdust (9 municipalities) and wood granules (9 municipalities); renewable energy sources dominate.

There is no centralised heat supply in multi-apartment houses in Kurzeme region in the municipalities of Dundaga, Mērsrags, and Rucava, in Vidzeme region in the municipality of Mazsalaca, in Latgale region in the municipalities of Cibla, Riebiņi, Rugāji, Vārkava, and Baltinava, in Rīga region in the municipality of Garkalne, while in Zemgale region centralised heat supply is available at least in one administrative and territorial unit of all the region’s municipalities.

More specific types of fuel, such as straw, are used in the municipalities of Grobiņa and Rundāle, grain is used for heating in the municipality of Ilūkste, while waste as a fuel is used in the municipality of Rēzekne.
Fig. 1 presents data on the types of energy resources used in centralised heat supply in multi-apartment houses in the territorial units of municipalities and in the territorial units of municipalities having no centralised heat supply.

![Diagram showing percentage distribution and number of the territorial units of Latvian municipalities broken down by type of energy resources used in centralised heat supply systems in multi-apartment houses.](image)

Source: developed by the authors according to information provided by the administration of municipalities, 2011

Fig. 1. Percentage distribution and number of the territorial units of Latvian municipalities broken down by type of energy resources used in centralised heat supply systems in multi-apartment houses

Fig. 1 shows that the highest proportions of renewable energy sources are in the territorial units of Vidzeme, Kurzeme, and Latgale planning regions – respectively 90.9%, 89.8%, and 86.4%, whereas the lowest proportions of renewable energy sources are in the territorial units of Rīga and Zemgale planning regions – respectively 62.5% and 69.4%. In total, 80.1% of Latvia’s territorial units of municipalities use renewable energy sources, while 19.9% use non-renewable energy sources. Fig. 1 also shows that 101 territorial units of municipalities in Latgale region have no centralised heat supply systems in multi-apartment houses, which is the highest indicator among the other regions. However, 29 territorial units of municipalities in Rīga region have no centralised heat supply systems in multi-apartment houses, which is the lowest indicator among the other regions. In total, 312 territorial units of municipalities or 54% have no centralised heat supply systems in multi-apartment houses in Latvia, meaning that the problem of heat supply has to be solved by their residents themselves.

If the situation is analysed in the municipalities in general, the highest proportions of non-renewable energy sources used in centralised heat supply systems in multi-apartment houses are in Rīga region (56.8%, i.e. 19.3% more than in the territorial units of municipalities) and Zemgale region (43.5%, i.e. 12.9% more than in the territorial units of municipalities), whereas the lowest proportions of non-renewable energy sources used in centralised heat supply systems are in Kurzeme region (17.6%, i.e. 7.4% more than in the territorial units of municipalities) followed by Vidzeme region (20.0%, i.e. 11.9% more than in the territorial units of municipalities) and Latgale region (22.2%, i.e. 8.6% more than in the territorial units of mu-
municipalities). In total, 64.8% of Latvia’s municipalities use renewable energy sources in centralised heat supply systems in multi-apartment houses, which is 15.3% more than in the territorial units of municipalities (80.1%). The above-mentioned fact can be explained by the unavailability of natural gas for the centralised heat supply of multi-apartment houses in the majority of the territorial units of municipalities, therefore, the proportion of renewable energy sources is higher.

Firewood for heating is used in 138 territorial units, woodchips in 85, natural gas in 53, sawdust in 14, granules in 12, coal in 7, straw in 2, oil fuel in 2, grain in 1, and waste in 1 territorial unit.

**Assessment of the sustainability of centralised heat supply**

Presently, the estimate of deposits of natural gas in the world amounts to 180 trillion cubic meters. The only supplier of natural gas to Latvia is Russia; the estimated deposits of gas in this country are 48 trillion cubic meters. Relatively small deposits are along the shores of Norway, in Great Britain and the Netherlands. The European Union consumes 0.6 trillion cubic meters a year, meaning that natural gas will be available for a century, using the present technologies.

A more and more significant factor is the amount of gas emissions that is related not only to ecology, but also to available emission quotas and payments for these quotas. Natural gas produces the smallest amount of CO₂ emissions per unit of thermal energy generated, it is even smaller than for wood, however, it has to be taken into consideration that wood is a renewable natural resource that absorbs carbon dioxide during the process of growing (Kā maksās, n. y.).

The most expensive centralised heating services in 2010 were in Liepāja, while the cheapest – in Mālpils. Unlike the heating season of 2009 when the lowest tariffs of heating were in the towns that used natural gas for heating, the situation in 2010 was completely opposite. The cheapest heating services were available in six Latvian towns that used woodchips, respectively, Mālpils, Ludza, talsi, Rūjiena, Valka, and Plavīnas (30.58–33.38 LVL per megawatt hour (LVL/MWh)). Whereas the most expensive heating services were in four towns using natural gas – Grobiņa, Jūrmala, Rēzekne, and Liepāja (46.61–49.06 LVL/MWh). The towns using both woodchips and natural gas were quite evenly ranked, supplying heating services at average tariffs. The lowest tariffs of heating among the towns using natural gas were in Valmiera (33.96 LVL/MWh), whereas the highest tariffs were in Sigulda (46.33 LVL/MWh).

The analysis of the situation with heating indicates that the price of a megawatt hour of thermal energy generated from woodchips is lower than the price of thermal energy produced from natural gas. For instance, the tariffs of centralised heating in Mālpils and Ludza are among the lowest in Latvia for many years. Yet it has to be noted that boiler houses for woodchips were constructed in these towns a long time ago at low construction costs, and now the towns benefit from these investments, whereas the towns that constructed their woodchip boiler houses during the construction boom had to make larger investments, therefore, thermal energy produced there is more expensive. The largest disadvantage of natural gas is the large fluctuation range of its prices, which causes a sceptical attitude to it, although equipment for
woodchip boiler houses is almost three times costlier than for boiler houses using natural gas (Dārgākā centralizētā apkure..., 2010).

To assess the centralised heat supply of Latvia’s municipalities in the context of sustainability, the authors selected 3 factors:

- thermal energy tariff in megawatt hours LVL/MWh (economic factor). The average thermal energy tariff was computed according to the decisions of municipal regulators on the tariffs approved for the 2010/2011 heating season, and the arithmetic mean of the tariffs of all service providers in the region was computed;

- proportion of centralised heat supply in the territorial units of municipalities (wellbeing factor). It was computed as a ratio between the number of the territorial units of municipalities with centralised heat supply and the total number of territorial units in the region;

- proportion of renewable energy sources in the region (environmental factor). It was computed as a proportion of renewable energy sources used in heat supply in the total number of types of energy resources used in the region.

Any region is ranked within a range from 1 to 5 for each of the indicators. Within the regions, the best value of indicators is rated with a score of 1, while the worst one has a score of 5. For instance, Vidzeme where renewable energy sources are used most in centralised heat supply systems among its territorial units is rated with 1. Among the territorial units, the highest proportion of centralised heating is provided in Rīga region, therefore, its wellbeing rating is 1. The lowest tariffs are in Latgale, therefore, its economic factor’s rating is 1. Then the ratings were summed up, and the most sustainable region is the one whose total sum is the lowest. The sustainability ratings of centralised heat supply are presented in Table 2.

### Table 2. Sustainability ratings of centralised heat supply in multi-apartment buildings in Latvia’s regions

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Regions</th>
<th>Kurzeme</th>
<th>Zemgale</th>
<th>Rīga</th>
<th>Vidzeme</th>
<th>Latgale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable energy sources, %</td>
<td></td>
<td>90</td>
<td>69</td>
<td>63</td>
<td>91</td>
<td>86</td>
</tr>
<tr>
<td>Centralised heat supply, %</td>
<td></td>
<td>47</td>
<td>43</td>
<td>68</td>
<td>48</td>
<td>32</td>
</tr>
<tr>
<td>Thermal energy tariff, LVL/MWh</td>
<td></td>
<td>38</td>
<td>36</td>
<td>39</td>
<td>37</td>
<td>35</td>
</tr>
<tr>
<td>Ratings</td>
<td></td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Environmental factor</td>
<td></td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Wellbeing factor</td>
<td></td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Economic factor</td>
<td></td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>sum</td>
<td></td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>2</td>
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<tr>
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<td></td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

*Source: developed by the authors according to information provided by the administration of municipalities, 2011; Siltumapgādes tarifi, 2011*

An analysis of the 3 sustainability indicators in Table 2 shows that the highest position among the regions belongs to Vidzeme region, followed by the regions of Kurzeme and Latgale with equal total ratings, whereas Rīga region was the worst region in the context of sustainability.
Conclusions

1. The highest proportions of renewable energy sources are in the territorial units of Vidzeme, Kurzeme, and Latgale planning regions – respectively 90.9%, 89.8%, and 86.4%, whereas the lowest proportions of renewable energy sources are in the territorial units of Rīga and Zemgale planning regions – respectively 62.5% and 69.4%. It indicated that the further away from the capital city of Rīga a territory is located, the more “green” energy is used in heat supply. It is a positive fact that irrespective of the availability of a cross-country gas pipeline, many Latvia’s municipalities do not use natural gas for heating. Among the renewable energy sources, firewood and woodchips are the most popular; straw is used in two municipalities and grain and waste are used as sources of thermal energy in two municipalities respectively.

2. In many territorial units of municipalities in Latvia, no centralised heat supply services are provided for residents living in multi-apartment houses – there are 312 (54%) such municipalities of the total of 579; the problem of heat supply has to be solved by their residents themselves, although the law “On Municipalities” stipulates that one of the functions of municipal governments in Latvia is to provide heat supply services for their residents.

3. In terms of centralised heat supply in Latvia’s regions in the sustainability context, Vidzeme region gained the highest rating, meaning that mostly renewable energy sources are used in this region, heat supply services are cheaper, and centralised heat supply services are more available to the region’s residents, whereas the lowest rating is for Rīga region.

Literature


CENTRALIZUOTO LATVIJOS SAVIVALDYBIŲ ŠILUMOS ILGALAIKIO TIEKIMO VERTINIMAS

Modrite Pelse, Juris Gudevics
Latvijos žemės ūkio universitetas


Raktiniai žodžiai: šilumos tiekimas, neatsinaujinantys ir atsinaujinantys energijos šaltiniai, savivaldybės, darnumas.
JEL kodai: Q400, Q300, Q200, H700, Q560.