Market uptake of small modular renewable district heating and cooling grids for communities

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Framework conditions on small district heating and cooling grids in Croatia and Ozalj

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CoolHeating website: www.coolheating.eu

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1 Introduction – facilitating DHC

The framework conditions are important for the establishment and operation of collective district heating and cooling systems. A characteristic of collective systems compared to individual systems is that a collective system requires organisation – and this requires framework conditions e.g. to facilitate that the investments in hardware can be financed. The costs of financing should be minimized, reflecting the low risk characterizing district heating and district cooling supply.

Subsidies and taxes is an instrument which can influence the behaviour of the consumers. E.g. in Denmark the tax levels are relatively high, providing further incentive for energy efficiency.

This report (one of five reports constituting deliverable 2.5 in the CoolHeating project) provides an analysis of the framework conditions for small heating systems in the target country Croatia. The analysis comprise the different levels; EU-level (increasing capacity to enact EU-legislation), national level as well as regional and local level.

A key aspect of collective systems is trust. Trust is crucial for realizing the synergies of a collective system. This implies obligation of the consumers to pay for part of the fixed costs, i.e. to provide security that the investments will be reimbursed.

This report is supplemented by a Best Practice report (deliverable 2.1), which contains descriptions of a number of examples of renewable district heating plants in operation. Another supplementing report is on information material for the public (deliverable 3.3), which addresses the aspect of local acceptance.

The template for the report is provided by PlanEnergi, and the content is provided by the partner in Croatia.

2 Framework conditions for DHC in Croatia

Croatian energy policy is divided into a number of laws concerning different subsectors of the energy sector (currently 9 laws) as opposed to some other countries which regulate energy sector with a single law. The heating sector is regulated with a number of different laws and subordinate legislation, the most important being Heat market law. Incentives as such are not existent for the district heating sector in Croatia but they can be received for electricity production in the highly efficient cogeneration facilities, therefore also subsidizing production of heat from the highly efficient cogeneration facilities. In order to implement renewable district heating project in Croatia, a large number of administrative documents and permits has to be obtained therefore making the process rather lengthy. Key positive and negative aspects of framework conditions for DHC in Croatia are listed below.

Key positive aspects:

- Framework for the heat market in Croatia is defined by law (Heat market law)
- A number of different laws and strategies support district heating systems and define Croatian renewable energy goals in the heating sector
- Incentives are defined for electricity production from highly efficient cogeneration

Key negative aspects:

- Even though the framework for the heat market is defined, the market is practically non-existent
- There are no specific incentives for heat production from district heating systems
- The process of implementing renewable district heating projects is lengthy
- There is a large amount of paperwork needed to implement renewable district heating projects

2.1 Energy policy

Croatian energy policy started its transformation in 2001, when a new set of energy laws was passed. Up until then, energy policy was made of ratified treaties concerning energy sector and a number of different legislations (for utilities, mining, urban planning, environmental protection, accounting, concessions, etc.). This set of energy policy contained 5 laws: Energy law; Energy regulation law; Electricity market law; Gas market law; Oil and oil derivatives market law. Energy law regulated important issues regarding organization and operation of the entire energy sector, while other laws regulated issues concerning specific energy markets. Although these laws had a lot of shortcomings, resulting in frequent changes and amendments, they laid foundations for the opening of energy market in Croatia, improvement of the energy services quality and harmonization of energy policy with EU directives.[1] The first law regarding the heat sector was passed in 2005 (Heat production, distribution and supply law) which didn't directly regard heat market opening. Ministry responsible for energy sector is Ministry of Economy.

Today, Croatian energy policy consists of 9 laws[2]:

- Energy law
- Electricity market law
- Gas market law
- Heat market law

[1] Stupin, K. „Stanje i perspektive energetskog zakonodavstva Republike Hrvatske", 2014
[2] https://www.hera.hr/hr/html/zakoni.html

- Oil and oil derivatives market law
- Transport biofuels law
- Energy regulation law
- Renewable energy sources and highly efficient cogeneration law
- Energy efficiency law

Important areas in the energy sector are renewable energy sources and energy efficiency. Up until recently, those areas were covered by different laws (Energy law, electricity market law, Heat market law, etc.) and a number of different legislations which led to difficulties when trying to implement projects in this domain. In order to unify legislation in this area and therefore make it easier to incentivize renewable energy production and energy efficiency, 2 new laws were passed: Energy efficiency law in 2014 and Renewable energy sources and highly efficient cogeneration law in 2015.

There are also a number of strategic documents regarding the energy sector in Croatia. Croatian government issued **Croatian energy development strategy**[3] in 2009. It determines energy policy and plans development of energy sector in Croatia. It also determines, amongst others, national energy programmes, necessary investments in the energy sector and incentives for the renewable energy sources, cogeneration and energy efficiency increase as well as improvement of environmental protection measures.

Another important strategy is **Low-emission Development Strategy**[4] which aims to transform Croatian economy into a competitive low-carbon economy by 2050, in accordance with European strategic guidelines and United Nations Framework Convention on Climate Change. This strategy is a basic document in the field of climate change mitigation as well as a main economic, environmental and development strategy.

National Action Plan for Renewable Energy Sources[5] defines renewable energy goals for different energy sectors for the 2013-2020 period. The goals are: 39% of RES in electricity production (including large hydropower plants), 10 % of RES in transport sector and 19,6 % of RES in heating and cooling sector which shows that a large increase in renewable heating and cooling production is expected by 2020.

National Energy Efficiency Action Plan[6] represents a comprehensive strategy for increasing energy efficiency in Croatia for period 2008-2016. 3 documents have been developed, each for a 3 year period. Every document defines energy savings and progress of energy efficiency policy for previous period and provides guidelines with detailed energy efficiency measures for the next period. In terms of district heating, the third Action Plan (for 2014-2016 period) mainly focuses on introduction of individual metering system of heat consumption as a precondition for all future energy efficiency activities in buildings connected to district heating systems.

2.2 DHC related legislation

Croatian heat sector is regulated by the following laws: **Heat market law**, **Renewable energy sources and highly efficient cogeneration law**, **Energy efficiency law** and **Energy law**. In this paragraph, important parts and definitions of these laws, regarding the heat sector will be presented. Regulatory actions are enforced by Croatian Energy Regulatory Agency (HERA) as defined in Energy regulation law.

[3] http://narodne-novine.nn.hr/clanci/sluzbeni/2009_10_130_3192.html
[4] http://www.hr.undp.org/content/croatia/en/home/library/environment_energy/framework-for-low-emission-development-strategy-for-croatia.html
[5] https://vlada.gov.hr/UserDocsImages/Sjednice/Arhiva/120.%20-%202.pdf
[6] https://ec.europa.eu/energy/sites/ener/files/documents/2014_neeap_en_croatia.pdf

The most important law in the area of district heating systems is **Heat market law**[7] that was passed in 2013**.** This law regulates measures for safe and reliable supply of heat, conditions for obtaining concessions for distribution of heat, or concession for the construction of distribution network. It regulates policies and measures for the safe and reliable production, distribution and supply of heat and energy efficiency measures in heating systems. This law also regulates different solutions regarding the requirements of the EU directives on energy services with the aim of increasing energy efficiency in buildings, reducing the consumption of heat and reducing negative environmental impacts. It has to be noted that district cooling as such does not exist in Croatia yet and therefore it has no legal background. The key players in the heat market, as described in the law, are as follows:

- *Heat producer:* producing heat in the production facilities
- *Heat distributer:* distributing produced heat through the distribution network
- *Heat supplier:* buying heat from the heat producer and making a contract with heat distributor for distribution of heat in order to sell it to the heat buyer
- *Heat buyer:* buying heat in the name of owner(s) of the house/building
- *End buyer:* buying heat from the heat buyer for their own consumption

Heat production, heat supply and heat buying are defined as market activities, while heat distribution is defined as a public service. This way, the framework for the heat market in Croatia is defined, although the market itself is still practically non-existent.

It is stated in the law that construction of district heating systems is of interest for Croatia, as well as use of renewable sources and highly efficient cogeneration for energy production in such facilities. It is also stated that district heating systems have an important role in reaching Croatian energy efficiency goals and that municipalities are obliged to incentivize, plan, approve and provide advantage for construction of district heating systems, according to energy efficiency measures.

Renewable energy sources and highly efficient cogeneration law[8] regulates planning of production and consumption of electricity produced from renewable energy sources and highly efficient cogeneration and defines measures to incentivize it. Although this law is focused on electricity production and consumption, it is also associated with district heating since it deals with highly efficient cogeneration facilities. Highly efficient cogeneration is defined in this law as a cogeneration facility which ensures primary energy savings of at least 10 % compared to separate reference production of electricity and heat (any primary energy saving for facilities with installed electric capacity lower than 1MW). In order to receive incentives for electricity production, one has to be an eligible electricity producer. It is defined that if a production facility is highly efficient cogeneration facility, it can gain the status of an eligible electricity producer.

Energy efficiency law[9] regulates area of efficient use of energy, plans for increasing energy efficiency at local, regional and national level, energy efficiency measures, transmission system operators (TSO) and distribution system operators (DSO) obligations, etc. This law defines efficient district heating and cooling as a district heating or cooling system which uses at least 50 % of renewable energy sources, 50 % waste heat, 75 % heat from cogeneration or 50 % of the combination of such sources and heat. It is stated in the law that obligation of TSO and DSO is to guarantee transport and distribution of electricity from highly

[7] http://narodne-novine.nn.hr/clanci/sluzbeni/2013_06_80_1655.html
[8] http://narodne-novine.nn.hr/clanci/sluzbeni/2015_09_100_1937.html
[9] http://narodne-novine.nn.hr/clanci/sluzbeni/2014_10_127_2399.html

efficient cogeneration and to provide priority or guaranteed access to the grid for electricity from highly efficient cogeneration.

As mentioned before, **Energy law**[10] regulates terms and issues of common interest for the whole energy sector or which are associated with several forms of energy. In order to protect the interests and security of energy supply infrastructure in Croatia, it is defined in this law that heat production facilities, cogeneration facilities, as well as heat distribution networks are objects of interest for Croatia and that owners of such objects are obligated to maintain and modernize them. It is also defined that the use of renewable energy sources and cogeneration is of interest for Croatia.

2.3 Incentives – taxes and subsidies

When it comes to incentives for DHC systems in Croatia, it has to be noted that incentives as such are not existent for the heating sector. This presents a major disadvantage of current legal framework for energy sector in Croatia. Nevertheless, incentives can be received for electricity production in the highly efficient cogeneration facilities, therefore also subsidizing production of heat from the highly efficient cogeneration facilities. Incentives are defined in Energy law as different feed-in tariffs for different electricity production technologies.
In order for a cogeneration facility to receive incentives, it needs to gain the status of an eligible electricity producer, as mentioned before. When signed, the contract for the feed-in tariff is valid for 14 years. The feed-in tariff for electricity production from highly efficient cogeneration is the same regardless of the installed power of the facility. It equals to the reference electricity price, as defined in **Tariff system for production of electricity from renewable energy sources and cogeneration**[11]. This way of subsidizing highly efficient cogeneration was valid until the end of 2015. These incentives also had some downsides, primarily the fact that because of the feed-in tariff for the electricity production, some cogeneration facilities were focused on producing electricity, while the heat was wasted.

Starting at the beginning of 2016, a new way of subsidizing renewable and highly efficient cogeneration electricity production is valid, as defined in Renewable energy sources and highly efficient cogeneration law. This law defines feed-in premiums as means of subsidizing renewable energy sources and highly efficient cogeneration. In this law, each production technology has a quota (in kW) defining total power of electricity production facilities that can be subsidized. The conditions for gaining the status of an eligible electricity producer are the same and the contract is signed for the period of 14 years. Although it is stated in the law that a legislation defining feed-in premiums for different production technologies has to be passed, no such legislation has been passed yet.

Fund for environmental protection and energy efficiency[12] is a centre for gathering and investment of extra budgetary funds in programs and projects for environmental protection, energy efficiency and renewable energy. It co-funded 19 biomass boiler and cogeneration projects in the period 2005-2012. For the 2013-2015 period, its budget for co-funding renewable energy projects (including renewable DHC) was around 14 800 000 €. It also co-funded the construction of distribution network for district heating system in Pokupsko, a best practice example in Croatia.

2.4 Permitting procedures

It has to be taken into account that the process of developing small renewable district heating systems in Croatia is rather lengthy, requiring obtaining a large number of administrative documents and permits. It also requires signing different contracts as defined in a number of different laws (in the area of energy, environmental protection, spatial planning, etc.), resulting in a large amount of paperwork (as shown for the example of Pokupsko in D2.1)

[10] http://narodne-novine.nn.hr/clanci/sluzbeni/2012_10_120_2583.html
[11] http://narodne-novine.nn.hr/clanci/sluzbeni/2013_11_133_2888.html
[12] http://www.fzoeu.hr/

In order to illustrate permitting procedures needed to implement a highly efficient cogeneration project, an example is provided for the city of Velika Gorica. Investor for this example is HEP Toplinarstvo, a publicly owned sister company of the national power company, HEP group, which is by far the biggest district heating operator in Croatia with the share of about 85 % of district heating supply.

As mentioned before, in order to receive incentives for electricity production from highly efficient cogeneration, an eligible electricity producer (EP) status has to be acquired. This procedure can be divided into 5 main parts, as can be seen in Figure 1: preliminary energy approval; energy approval; preliminary decision on acquiring EP status; contract on the electricity purchase; and decision on acquiring EP status.

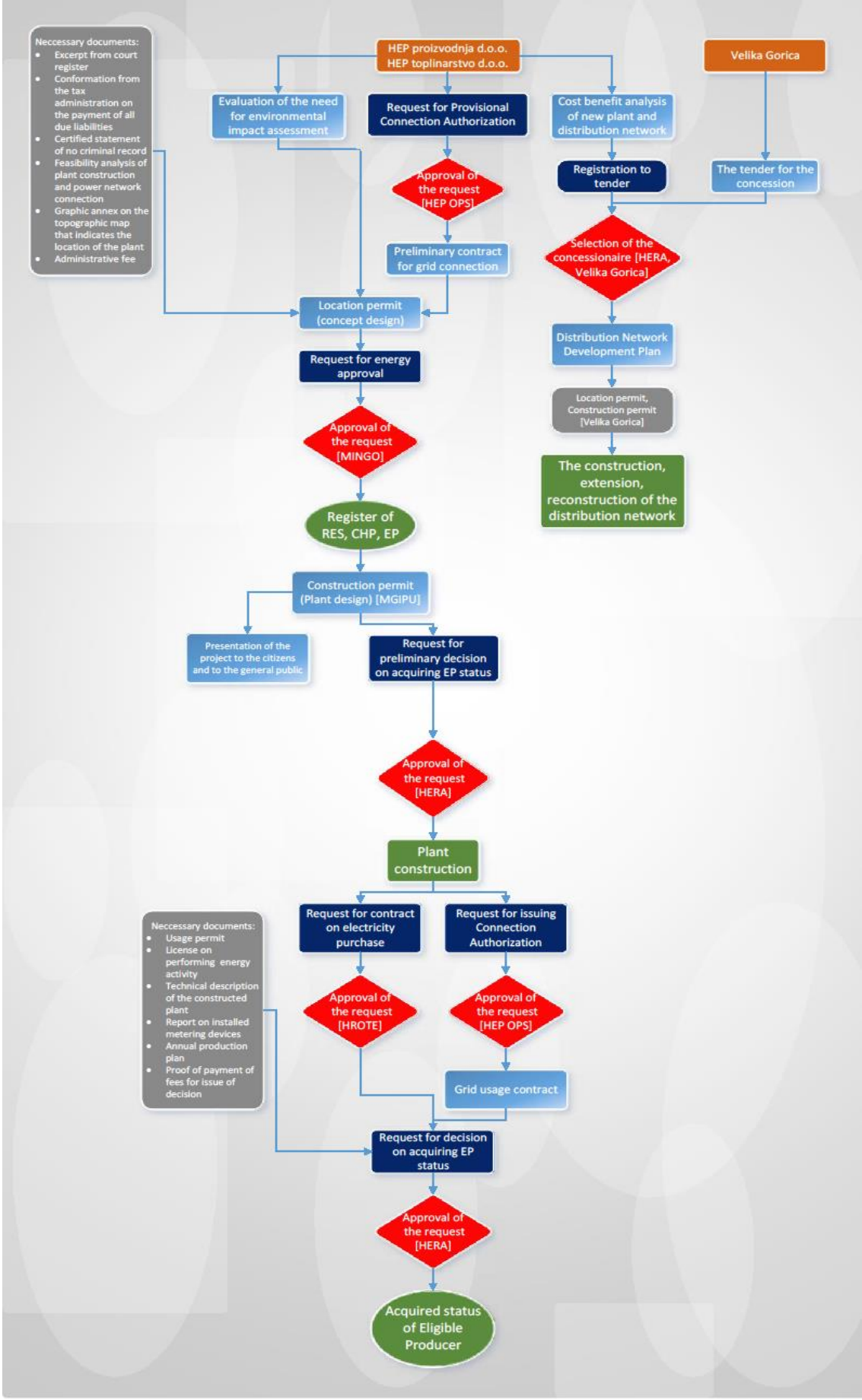

Figure 1. An illustration of needed permitting procedures in order to implement a highly efficient cogeneration project in Croatia

2.5 Time for authorization and transaction costs

In this section, an example will be provided from municipality of Pokupsko, which is Croatian best practice example for a small renewable district heating system, but also the only example of such a system in Croatia. This system started operating in November 2015 as the first biomass fired district heating system in Croatia, but the process of implementing this project was rather lengthy.

The project started in June 2008. By the end of 2008, the concept design was made (3 scenarios were analysed and the optimum scenario was chosen), the project was granted by "Fund for environmental protection and energy efficiency" and the building plot for production facility was bought. The funding was planned to be received from the Instrument for Pre-Accession Assistance in Rural Development (IPARD programme), which would cover 100% of the investment in production facility. At the beginning of 2009, designer was chosen in order to make the project documentation. During this time, documentation was being prepared in order to register to tender for IPARD programme funds with the deadline being the end of January 2011. Meanwhile, location permit was obtained in 2010 and revised and complemented in 2011 and the building permit was obtained (both for distribution network and production facility).It has to be noted that the most complicated part of the project was preparing the documentation and applying to the IPARD programme funds. Funds for 12 biomass district heating systems were planned in IPARD programme and only 1 was actually built. The main reason that more systems weren't built is complicated IPARD registration procedure and poor implementation of tenders (only 3 tenders were issued and the government was changing tender requirements shortly before the deadline). A large number of documents were needed to register to tender and all of the documentation had to be translated to English. This resulted in more than 50 kg of documentation being prepared for IPARD programme.

Agency responsible for implementing IPARD programme in Croatia (Paying Agency for Agriculture, Fisheries and Rural Development) granted the project in August 2011 after which the public procurement for project implementation was announced. None of the bids were valid so the public procurement had to be announced again which was again annulled. Because of this, at the beginning of 2013 the building permit expired and the new one was obtained at the end of 2013. For the third time, the public procurement was announced in May 2014, this time successfully and the contract was signed with the contractor in November 2014. As previously mentioned, the construction ended in November 2015. It can be seen in this example that the construction of the project took around 6 months, while the preparation phase took extremely long, 6 years.

3 DHC in Ozalj

The previous section has focused on the national level and the regulatory framework. This section provides the local perspective, describing the potential for DHC from an implementation point of view. Target city in Croatia is Ozalj, a city situated in the north-west part of Karlovac county, which is a home to 6 837 inhabitants (2011 census). In the last few years there have been a few initiatives for biomass district heating systems that would be used to heat public buildings, private homes and a part of the industrial zone. Unfortunately, until now these initiatives have not yet been followed through. In that context, the CoolHeating project gives an additional mechanism to optimize the ideal fuel and technology mix for the future district heating options in Ozalj.

3.1 Supply of heating and cooling in Ozalj

Currently, there is no district heating system in Ozalj so all the heat is supplied individually, at dwelling level. An analysis of the heating system of Ozalj has been presented in Sustainable Energy Action Plan (SEAP)[13] of the city. Also, as a part of Task 3.4, survey was implemented in Ozalj, which covered 17 % of the overall number of households in Ozalj. This survey also provided input for this chapter. Regarding energy sources that are used for heating in households, biomass covers the largest share, followed by fuel oil (Figure 2). On the other hand, public buildings mainly use fuel oil (91 %) while the rest is covered by electricity. Commercial buildings use all four sources equally. This data, provided in city's SEAP, was estimated by data received from the city and the 2001 population census. Data gathered by surveying households shows that currently, biomass (mostly logwood) has a major share, around 80 %, while the rest is mostly covered by fuel oil. The reason for such a high share of biomass is in high amounts of biomass available locally. Also, a fair number of citizens own a part of surrounding forests and therefore only encounter costs for transferring biomass to their home. This could present a competition for future district heating system in the city, but it can be tackled by enabling citizens to provide their biomass to the district heating system in exchange for lower heating bills.

When it comes to cooling, results from the survey show that around 2/3 of the surveyed citizens do not use cooling, while the others use electricity, i.e. mostly split system units.

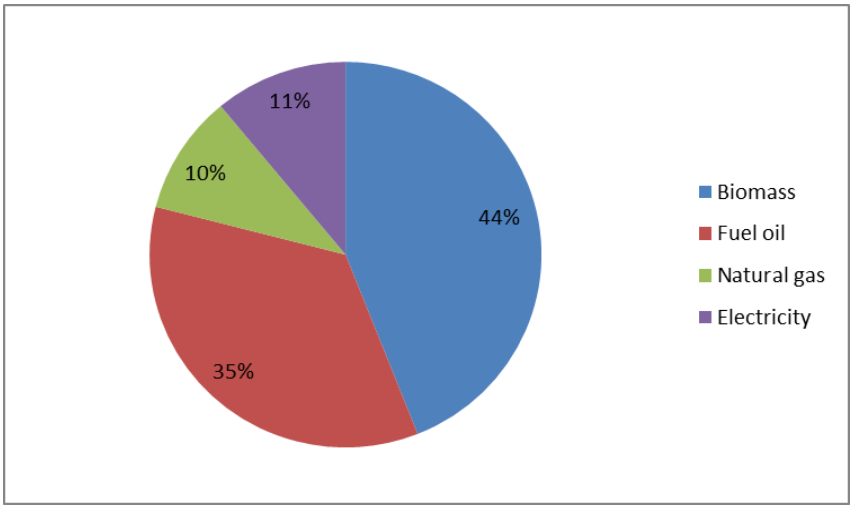

Figure 2. Energy sources used for individual heating in households – source: SEAP Ozalj

[13] http://www.eko.zagreb.hr/UserDocsImages/dokumenti/seap-i%20hr%20gradova/SEAP_OZALJ_radna%20verzija_fin.pdf

3.2 Energy resources available in Ozalj

Concerning fossil fuels, there is no natural gas network in the city; therefore households, which use gas for heating, must have storage where the gas is stored in a form of liquefied petroleum gas. For that reason, gas practically has a negligible share in the heat supply of the city. On the other hand, fuel oil has a much higher share since it is used in most of the public buildings, as well as in households and in commercial buildings. The city also has a small industrial area, close to the city centre, which could supply its excess heat to the district heating network, but could also cover some of its heat demand from the district heating network.

When it comes to renewable energy sources, surrounding area of Ozalj is covered by forests, which gives a high potential for biomass utilisation in future district heating system. This is also the reason why majority of people use wood as energy source for heating, which means that most of the wood in the city is supplied locally. Growing number of citizens of Ozalj are starting to recognize solar heat as a valuable energy source, mostly for domestic hot water preparation. Almost 15 % of surveyed citizens use solar collectors for domestic hot water preparation in combination with other energy sources. Ozalj has a high potential for utilisation of solar energy due to its location (South-East Europe), resulting in high annual values of global irradiation per square meter.

3.3 Initiation, planning, implementation and operation of DHC in Ozalj

Since there is no district heating system in Ozalj, there is also no experience regarding implementation and operation of it. Generally, more information about these steps on national level can be found in chapters 2.4 and 2.5. Nevertheless, a biomass district heating system was actually planned for implementation in Ozalj, as a part of the same programme as best practice example of Pokupsko (IPARD programme, as elaborated in chapter 2.5). The plan was to implement a 1MW biomass boiler, as well as the distribution network to supply 4 public buildings, 4 commercial buildings and 6 residential buildings in the centre of the city. Preparation of the project was similar to the one described in chapter 2.5 since it was supposed to be funded by the same programme, but as was previously mentioned, only 1 out of planned 12 district heating systems was built (Pokupsko district heating). The reason why this system was not built, although all the documentation had been prepared, was that the rules for tender changed just before the implementation and therefore the project could not be applied for funding anymore. During this process, a large amount of documentation was prepared, for example building permits for production facility and distribution network. The process took around 2 years before the project was terminated. Therefore, a lot of time and funds was wasted in this project.

3.4 Potential and barriers for DHC in Ozalj

Due to its location, Ozalj has a high potential for renewable energy utilisation, with an emphasis on biomass, which results in significant potentials for implementation of small renewable district heating system in the city. Existing industry in the city also provides potentials for utilisation of heat from district heating system, but also for supplying the network with excess heat produced in facilities. City's SEAP also supports the idea of implementing biomass district heating system in the city, since this was emphasised as one of priority measures for reducing CO_2 emissions from buildings.

Even though there already were initiatives for a district heating system in Ozalj and the idea was also supported in the city's SEAP, citizens are not familiar with such system and therefore are not aware of its benefits. This contributes to the generally negative public opinion of such systems in Croatia. This has to be tackled by implementing information events in order to educate citizens. Also, all the other barriers presented in previous chapters apply, i.e. poor implementation of tenders for such projects, large amount of needed documentation, permits, signed contracts, etc. resulting in extremely long preparation phase, as shown for the example of Pokupsko district heating.