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

Serbia and Sabac

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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 Serbia. 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 Serbia.

2 Framework conditions for DHC in Serbia

Energy policy in Serbia declares increase of biomass in district heating but the progress report does not show a significant growth. The heating related regulation in Serbia is quite extended and gives wide authorization to local self-government. There are no explicit subsidies for district heating for biomass but some support through energy efficiency fund, feed in tariff for electricity might be utilized as side effect. The permitting procedures for the energy from biomass plants are explained in a guide. A case study in Vrbas shows that 3 years are needed for plant construction with pre-construction phase, while pre-investment phase took 2 years in addition.

Key positive aspects:

- Investments of the local-self government budget, or private not from state budget.
- Development of DH infrastructure in 57 towns
- If applied, DHC increase security of supply, develop energy service market, high level of energy independence and create new jobs.

Key negative aspects:

- Lack of competition in heating/cooling energy and lack of the advanced tariff system.
- High prices of heat for end users

The example of the implementation of DHC project in Serbia are biomass DH plant in Sremska Mitrovica which is given in D2.1 report.

2.1 Energy policy

The energy policy has been created from the Ministry of Energy with documents such as: Energy Strategy, National Renewable Energy Action Plan, Law on the efficient use of energy, National Energy Efficiency Action Plan I-II.

According to Energy Strategy [1], there is the lack of competition in heating/cooling energy and lack of the advanced tariff system. Strategic goals are widening of existing network infrastructure, decreasing usage of liquid fuels and coal, extended use of biomass and communal waste, increased consumption of sanitary hot water, combined heat and power and increased capacity of local self-governments in heat markets regulation.

Also, according to Law on the efficient use of energy, the use of Best Available Technologies should be extended[2]. As one of the goals, the share of biomass in district heating should be increased to 12.5% in 2030. The gradual de-subsidisation in fossil fuel sector is expected and development of local economy and the local resource usage is recommended. Therefore 80 MW biogas and 200 MW biomass are expected.

These planning documents are followed with NREAP progress report[3] which shows the real results regarding heating sector which are shown in Table 1.

[1] http://www.mre.gov.rs/doc/efikasnost-izvori/02%20Nacionalni%20akcioni%20plan%20za%20koriscenje%20obnovljivih%20izvora%20energije%20u%20Republici%20Srbiji1.pdf
[2] http://www.mre.gov.rs/doc/efikasnost-izvori/efikasnost/A_01_Zakon_o_efikasnom_koriscenju_energije.pdf
[3] http://www.mre.gov.rs/doc/efikasnost-izvori/Progress%20Report%20on%20NREAP%20_SERBIA%202014_ENG_FINAL.pdf?uri=CELEX:32009L0028

Table 1 NREAP progress report regarding heating sector

	2012	***2013***
Gross final consumption of RES for heating and cooling [ktoe]	*1031*	*1034*
Biomass	*1025*	*1028*
solid biomass	*1025*	*1028*
biogas	*-*	*-*
bioliquids	*-*	*-*
Share of RES for heating and cooling in GFEC [%]	*23.32*	*21.86*

Although consumption of renewable energy has been slightly increased it still has no positive effects in the increasing share of RES for heating and cooling in gross final energy consumption.

2.2 DHC related legislation

The district heating and cooling projects are under the legislative framework of The Energy Law from 2011 and its amendments from 2012 and 2014[4], Energy Efficiency Law.

The projects in this sector are subject to the licensing except for the smaller units up to 1 MW of heat or electricity and own production. The licences for projects of such size are left on the local self-government. Also, the establishing energy entities for production, distribution and supply, keeping the up-to-date registry, the energy activities that should be reported to Ministry once a year, are duties of local self-government. The local self-government in the heating sector act as regulatory body although Serbian Energy Agency is also responsible in this field. Also, operation of the distribution system is under rules from local self-government unit which are opened to public view. The self-governments are also instructed to support use of renewable energy sources. The planning and development of the heating sector are in the hands of distribution entity.

According to the Energy Efficiency Law 2013 technical requirements for heat production and distribution, and technical energy efficiency measures for district heating are explained. The investment in district heating are solely on the local self-government. Such activities are covered with energy management units which are obligatory for larger municipalities (with more than 20,000 inhabitants). One of mandatory investments is in measurement and regulation equipment for heat supply This Law suggests methodology for district heating tariff system. According to this Law local self-governments may enact financial and other support for energy efficiency. Also, energy efficient equipment may have different tax and custom subsidies. According to this law, self consumed renewable energy may be counted as technical energy efficiency measure. This Law suggests Energy efficiency to be included into the tendering criteria.

Other regulation include

- Regulation on methodology for end user heating price[5]
- Regulation on minimal energy efficiency in the public procurement process[6]
- Regulation on new and replaced sanitary hot water preparation equipment
- Regulation on connection to the heating distribution system

[4] http://www.mre.gov.rs/doc/efikasnost-izvori/EnergyLaw.doc
[5] http://www.mre.gov.rs/doc/efikasnost-izvori/uredba_metodologija_toplotna_energija0138_cyr.pdf
[6] http://www.mre.gov.rs/doc/efikasnost-izvori/Final%20Prav%20EE%20jav%20nab%2025122015.docx

- Regulation on air conditioning equipment
- Regulation on solar hot water preparation equipment
- Regulation on primary energy savings calculation with CHP equipment
- EU legislation
    - Detailed plan of EU legislation adoption has been given in NPAA[7]
    - Directive 2010/31/EU on the energy performance of buildings was planned for adoption in 2014. but still pending[8].

Directive on minimal technical requirements in distribution of heat and electricity was planned for adoption in 2015, but also still pending.

2.3 Incentives – taxes and subsidies

Energy taxes and subsidies, Fossil fuels and renewables

- Existing implicit fossil fuel subsidies[9] expected to be obsolete[10] in future.
- Explicit subsidies for renewables available only for electricity and not for heat, but also relevant in case of combined heat and power production
- Feed in tariff for electricity produced from renewables[11], 2013[12], new in 2016[13].
- The possible renewable heating/cooling support schemes in Czech Republic, Greece, Finland, Hungary, Italy and Lithuania may be found in[14]

Other incentives

- Feed in for high efficiency CHP production[15]
- Fund for energy efficiency[16]

[7] http://www.seio.gov.rs/upload/documents/nacionalna_dokumenta/npaa/npaa_2014_2018.pdf

[8] http://www.seio.gov.rs/upload/documents/nacionalna_dokumenta/npaa/npaa_oktobar_decembar_2015.pdf

[9] Kovacevic A. Fossil Fuel Subsidies in the Western Balkans. 2011.

[10] http://www.mre.gov.rs/doc/efikasnost-izvori/01%20Strategija%20razvoja%20energetike%20Republike%20Srbije%20do%202015%20godine.pdf

[11] MERZ. Uredba o merama podsticaja za povlascene proizvodjace elektricne energije - in Serbian. In: Ministry of Energy DaEPoRoS, editor. 8/2013. Belgrade: Official Gazette of the Republic of Serbia; 2013.

[12] http://www.mre.gov.rs/doc/efikasnost-izvori/B02%20Uredba%20o%20merama%20podsticaja%20za%20povlascene%20proizvodjace05.02.15.pdf

[13] http://www.mre.gov.rs/doc/efikasnost-izvori/Uredba%20o%20visini%20posebne%20naknade%20u%202016.pdf

[14] http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Electricity/Tab4/C14-SDE-44-03_Status%20Review%20on%20RES%20Support%20Schemes_15-Jan-2015.pdf

[15] http://www.mre.gov.rs/doc/efikasnost-izvori/Uredba%20o%20podsticajnim%20merama.pdf

[16] http://www.mre.gov.rs/doc/efikasnost-izvori/efikasnost/Uredba%20Bfond-Sl%20glas%2013-16.docx

2.4 Permitting procedures[17]

Permitting procedures for DHC biomass plant construction are explained in *Guide for Investors: Construction of plants and electricity/heat generation from biomass in Republic of Serbia*[18]. The document include details on:

- Power plant construction procedures and permits
- Right to engage the activity of public interest such as heat production
- Obtaining a licence for heat related activities
- Procedures of connecting the plant to the heat distribution network
- Procedures for obtaining the status of privileged power produces in the case of CHP

The integration of single plant into energy system has broader perspective in energy planning at municipal level, local planning, promoted not only by Ministry but also Covenant of Mayors movement at EU level, academic[19] and non-governmental[20] sector.

2.5 Time for authorization and transaction costs

Experiences in the authorization and transaction costs are from a greenfield investment Mirotin Energy[21] company in Vrbas. The building of the plant started in October 2011. The end of construction works was in July 2012, but plant has been in operation since October 2012, one year after construction start. The procedures prior to building took two years: 6 months for investment decision, 6 months for feasibility study, 2 months for financial negotiation, 1 month for selection of contractors and 9 months for construction work preparation. Pre-investment thinking and studies took another 2 years. The plans for the future include utilization of heat energy during summer for lucerne drying and glasshouse during winter.

Financial assumptions of initial investment costs for the 1 MW biogas plant are 4,500,000 €, of which, 15% are investment subsidy and 10% are own funds and the rest was credit. The business plan resulted in internal rate of return (IRR) of 11.31%, net present value (NPV) of 153,000 € at interest rate of 10% and return of investments (ROI) of 6 years. The results of IRR vary in the sensitivity analysis from 5.02% (maize silage cost 30 EUR/t, interest rate 11%) to 15.12% (maize silage cost 25 EUR/t, interest rate 5%).

[17] Lepotić Kovačević B. IZGRADNJA POSTROJENJA I PROIZVODNJA ELEKTRIČNE/ TOPLOTNE ENERGIJE IZ BIOMASE U REPUBLICI SRBIJI. Vodič za investitore. 2nd ed: United Nations Development Programme; 2013.

[18] Lepotić Kovačević B. IZGRADNJA POSTROJENJA I PROIZVODNJA ELEKTRIČNE/ TOPLOTNE ENERGIJE IZ BIOMASE U REPUBLICI SRBIJI. Vodič za investitore. 2nd ed: United Nations Development Programme; 2013.

[19] Batas Bjelic I, Ciric RM. Optimal distributed generation planning at a local level – A review of Serbian renewable energy development. Renewable and Sustainable Energy Reviews. 2014;39(0):79-86.

[20] Božović Danijela MA, Pavlović M. Vladimir, Popović Mirko. Održivo energetsko upravljanje na lokalnom nivou : preporuke za unapređenje energetskog planiranja u Novom Sadu, Kragujevcu i Aranđelovcu - In Serbian language. Beograd: Beogradska otvorena škola, 2012.

[21] Experiences in planning, construction and operation of biogas plant, Dobrosav Baćović , Association Biogas Serbia, Konferenz: Biomasse und Biogas in Serbien, 5 April 2016, Belgrade, Serbia

3 DHC in Sabac

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.

- Installed capacity total 70 MW
- Three heating networks (two of them physicaly connected but work separately)
- Temperature regime 140/70 ^{o}C, 130/80 ^{o}C & 90/70 ^{o}C
- 22.4 km of pipes, DN 400 max diameter
- 7,500 apartments and houses connected to the DHS
- 470,000 m^2 heated area
- 390 heating substations
- Average heat production 62,000 MWh/a,
- Average 2800 working hours per year
- Heat losses 9.5 %
- Main fuel – natural gas (96%)
- Alternative fuel – mazut S
- 1,000,000 EUR spent in last two years through KfW 4 Program for heat recuperation units, reconstruction of pipelines and modernization substations
- 700,000 EUR plan for this year (2016) for reconstruction of Boiler plant, frequently controls of network pumps and SCADA (continue with KfW4).

3.1 Supply of heating and cooling in Sabac

The district heating cost is comparable to other fuel sources. The small modular district heating systems could ensure long term stability in energy supply and stable costs.

DH sstem operates only during the heating season. In Sabac does not have any centralized systems for supplying hot water.

Beginning in 2017, according to the Law on the efficient use of energy, commitment of the local DH company that every year reduce the consumption of primary energy by 1% compared to the previous year.

Generally, for cooling purposes small split unit are used but in very rare cases there are centralized cooling systems within a building. There is no a remote system for cooling.

3.2 Energy resources available in Sabac

Available energy carriers in City of Sabac are: gas, biomass and electricity. Gas is mainly from import. The electricity is mainly produced in Serbia.

On the heating system are connected 7,500 households which accounts for about 38% of the total number of buildings in the urban part of the city. Also, local utility company "Toplana Šabac" supply 2,500 households with natural gas.

Other households (about 50%) for heating use their own (small) furnaces and boilers. In individual furnace their owners mainly use wood but small number of households use coal. Small furnaces are very inefficient with the efficiency less than 60%. There are a small number of apartments where the owners use electricity for heating.

Solar energy is not used for heating domestic sanitary water. There are several small photovoltaic systems that size are below 30 kW_{el}.

Heat pumps water-water used for heating less than 100 one-family buildings. The average depth of wells is about 20 m, water temperature is between 13 ^{o}C and 14 ^{o}C. The urban part of the city is located on the right bank of the Sava River that has sufficient flow to be able to install a heat pump 4.5 MW of power to be used for heating and cooling of residential settlement located at a distance of about 500 m from the river Sava. Apartments area in a settlement that is now heated from DHS is 110,000 m^2.

Grad располаже могућношћу korišćenja geotermalne energije. The latest studies were conducted 80s of the last century. It is estimated that the city of Sabac and the neighboring municipality Bogatić can use geothermal capacity of 50 MW. The depth of wells is 400 m - 2,000 m and the water temperature 40 ^{o}C to 90 ^{o}C. There are several objects (tourism and agriculture) where geothermal energy is applied.

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

The initiation of DHC system in City of Sabac started in 1979 but the first boiler has been in operation since winter 1986/87. During the 2004 the modernisation of DHC has been done for 9 months which could be good example of current situation. Another project, not in DHC systems but related to, energy efficiency in buildings have been realised successively 2010-2015 resulting in total 34 apartment buildings refurbished with 1,108 apartments insulated, 22 one apartment houses were insulated and in total 66,000 m^2 insulated area.

In the future, the development of DHC and energy efficiency projects will go towards increasing the preservation of high efficiency of DH systems (heat sources and DH networks with heat substations), a continuation of project of the insulation of existing buildings and the implementation of more stringent criteria for new buildings in terms of energy efficiency, and the third direction is the introduction of renewable energy sources.

In suburban and rural areas will be developed a small district heating and cooling system that will use renewable energy, primarily local biomass. The feasibility study that will show the availability of biomass is ongoing. The Program of energy efficiency at the local level (now local government is preparing this document for a three-years period starting from 2017, according to the Law on the efficient use of energy) will be included in the data of energy consumption, energy efficiency measures and the potential of biomass and other renewables. Small district heating systems will play a key role in the development of agricultural activities and processing activities (small process systems for food production and small-scale systems for drying agricultural products and small capacity refrigerators). The use of renewable energy, especially local biomass, should lead to an increase in the volume of fruit and vegetable production and competitiveness in the domestic market but also in neighbouring markets.

3.4 Potential and barriers for DHC in Sabac

Potential barrier is in acceptance of small modular district heating as new concept. The main problems that now we can identify are the weak technical capacity of the local population, the problem of the application (and development) of modern and efficient technologies for energy production and a lack of financial resources.

The level of technical knowledge will be raised through the continuous education of the population (presentations and workshops for stakeholders) and of course through the school education system.

Technology transfer and financing for now are insurmountable barriers. Local authorities are responsible for heating and cooling systems (licenses and incentive measures for the use of renewable energy) but unfortunately, they do not have sufficient capacity to implement their responsibilities and powers.

Another important factor is the issue of citizens' associations and the establishment of cooperatives. For historical reasons, there is a certain lack of confidence in the functioning of cooperatives and required a huge effort to change this situation, and the best way is to inform about examples of good practice from the economically strong areas where cooperatives exist and direct dialogue with decision-makers.