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Co2mmunity

RENESCO

Assessment of the technical, financial and legal aspects of the implementation of Community energy projects

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CONTENT

INTRODUCTION

The assessment of technical, economic and legal aspects has been carried out in accordance with the project “Co2mmunity” of the INTERREG Baltic Sea transnational cooperation programme for the year of 2014-2020, whose final aim is to promote the development of community energy projects in the area of Baltic Sea region through the participating target groups, to launch cross-border learning processes between field leaders and followers and to strengthen the capacity of the Baltic Sea development planners in the field of community energy projects. The main instrument for achieving this goal is the establishment and functioning of the RENCOP (Renewable Energy Source Cooperative Partnership) in partner regions.

The use of renewable energy resources in Latvia is generally taken positively, but in times when specific projects are developed, such as the construction of wind farm, increased biomass extraction or the construction of biogas power plants, these projects often face strong resistance from local residents. The reasons for protests against such projects are quite diverse, but one of the prevailing reasons is that residents close to the site of project implementation do not benefit economically or socially from the renewable energy source (RES) project, but the negative impact of projects (changes in landscape, noise, odours) is felt by many.

In recent years, there has been increased talk in Europe about the need to localise energy production: the process of decentralisation of the electricity market, introduction of renewable energy sources into the market, decreasing dependency on using the fossil energy sources with a goal to achieve local or regional self-sufficiency in terms of energy source usage. For example, it can be decentralised production of electric energy using RES from which benefits a certain group of people (such as cooperative members or municipal residents); local government initiatives for small-scale energy production by attracting local residents (allowing to invest in parts of the project) or by providing specific benefits to local residents; energy efficiency schemes.

Therefore, most often the term “community energy” refers to the following types of projects:

- Projects that provide benefits to local economic development and have a positive social impact;
- Energy projects are partially or fully owned by the local community;
- Community energy is an alternative to traditional energy companies and ESCO;
- The form of the community energy business is opposed to those forms where investors have control and are focused on maximum profit (and the sale of energy resources as much as possible);

The document produced by the project “Co2mmunity” of the INTERREG Baltic Sea transnational cooperation programme for the years of 2014-2020 aims to assess the technical, legal and financial aspects of community energy projects. This includes the development of an analytical report on the feasibility of energy projects for renewable energy communities, which will also serve as guidelines for project promoters or as an integrated module for the introduction of community projects in different situation. In community energy project described communities are – population groups, cooperatives, apartment owners associations, a project for energy production using renewable energy sources, taken together by several private house owners or separately with local governments and/or private companies.

The report has been produced in accordance to currently known technical solutions and the analysis of existing legislation and existing financial instruments. The report and conclusions obtained during it’s preparation are based on an analysis of three pilot projects.

MULTIPLE HOUSEHOLD BUILDING PROJECT WITH SOLAR COLLECTORS

1. Legal aspects of energy production

Given that the objective of the project is not to make a profit but to produce heat energy for self-consumption or for hot water provision, the project is in line with the legal aspects of an association or foundation, which brings together the residents of a multiple household building to create a single association with a goal to produce centralised supply of hot water while creating a foundation that can organise a fund with the intent to implement it in the project. The project could be carried out by the association by concluding an agreement with the energy service company (hereinafter ESCO), during which ESCO undertakes all the obligations related to the preparation, financing and implementation of energy efficiency measurements, guaranteeing the intended energy efficiency outcome and ensuring the management of the site during the duration of the contract.

A second legal model – the project can be carried out by the association in cooperation with the building administrator, where all organisational and technical activities are carried out by the administrator, while the financing is carried out by the residents using their building provision. When carrying out a project in cooperation with the building administrator, the administrator may request additional payment for additional work and annual maintenance of the system.

Trade issues of energy production

Heating and electricity supply services may be both regulated and non-regulated, the conditions on which it depends can be found in the Cabinet regulations No 1227 *"Noteikumi par regulējamiem sabiedrisko pakalpojumu veidiem" (Regulations concerning regulated types of public services).* The price of the regulated heating service shall be calculated by the public service provider in accordance with Decision No 1/7 *"Siltumenerģijas apgādes pakalpojumu tarifu aprēķināšanas metodika" (Methodology for calculating tariffs on heat supply services)* issued by the Regulator.

Heat energy production should not be regulated within the scope of this project, since the amount of heat energy demand is between 45.7 MWh/year and 62.4 MWh/year, which doesn't exceed the maximum of 5000 MWh/year, as well the heating energy produced is not delivered to the heating networks of the regulated heating system operator. Heat energy trade must not be regulated because the traded heat energy is not supplied via the heating networks of the regulated heating system operator.[1] In particular, the heat energy supply of this project is only for self-consumption of the multiple household building. In the case of non-regulated energy trade, by national law *"Par sabiedrisko pakalpojumu regulatoriem" (Regulators of public services): tariffs shall be determined to the extent that the tariff payments made by consumer cover economically justified public service costs and ensure the cost-effectiveness of public services. If factors affecting tariffs, such as cost-effectiveness, change, the Regulator may propose a tariff review and require the public service provider to submit a calculated draft tariff within a specified timeline, together with a justification for the costs involved in the tariffs.*[2]

[1] https://likumi.lv/ta/id/49833-energetikas-likums Chapter III, "Nekustamā īpašuma lietošanas tiesību aprobežojumi sakarā ar energoapgādes komersanta objektu atrašanos tajā" (Restrictions on the rights to use immovable property due to the location of the energy supply registered trader's objects in property)
[2] https://likumi.lv/ta/id/12483-par-sabiedrisko-pakalpojumu-regulatoriem Chapter IV, "Tarifu noteikšana" (Determination of tariff), Article 20, "Tarifu apmērs" (Amount of tariff).

2. Technical aspects of energy production

Assumptions, technical specifications and solutions

Generally, there are used to types of solar collector technology – flat plate and evacuated tube collectors. Evacuated tube solar collectors get higher efficiency compared with flat plate solar collectors. The advantage of this type of solar collector is effective operation at lower ambient temperatures. Evacuated tube collector is isolated from the surroundings in a vacuum space that allows nearly full prevention of heat losses in the environment at the expense of the heat transferring material and convection. The absorbing surface, which converts solar radiation energy into heat, has a cylinder shape. In result the area that is exposed to sun is the same during different times throughout the day.

Description of the selected technology

This project considers the possibility of integrating solar heating system to cover part of the demand for domestic hot water. The proposed system for analysis is designed as a low flow system with an insulated hot water container, with an external heat exchanger and stratification intake tube. For the generation of hot water (heat energy), it is intended to install solar collector system that covers area of 140 m^2. The system will be installed on the flat roof of the multiple household building. The project may be carried out for the residents of the building or entrepreneur by taking loan from the bank. The recommended solar collectors are flat plate solar collectors, while the storage tank is a standard insulated storage tank.

Calculation of the selected energy base line

In order to cover the demand, it is assumed that one person needs surface of 0.8 - 1.5 m^2 of the active absorption area. In addition, when determining the capacity of the warm water boiler, a standard indicator for daily hot water consumption per person of 40-60 l of water at temperature of 55 ^oC may be applied. The daily hot water consumption of the building is between 2250 l/day and 3232 l/day. Taking into account the temperature difference of 45 °C, this consumption corresponds to the annual energy consumption of 45.7 - 62.4 MWh/year. A parameter study has been performed to measure the size of the system for differences in the area of the solar collector and the capacity of container. For each case study, the net value of the solar energy used, the additional heat and heat losses from the storage tank have been calculated. This system should allow solar power fraction levels to be reached between 45% and 55% of the building's hot water demand.

Provisional time schedule for the implementation of the project

Table 1, time schedule for the implementation of the project

Stage	Period	Characteristic
Procurement	2 months	*Technical specifications, procurement regulation, preparation of contract drafts.*
Development of technical project	3 months	*In accordance to design tasks*
Document coordination in other establishments	1-4 weeks	*e.g. gas, utilities, water supply, central heat supplier*
Obtaining permits		
Document coordination with building authority	2-4 weeks	*Clarification, response to deficiencies*
Conclusion of works contract	1-2 weeks	*Coordination and signing of the agreement*
Assembly and delivery of equipment	2 months	*Logistics, storage, assembly*
Construction	4 months	*Work meeting, performance of work*
Commissioning	2 weeks	*P/N acts, hydraulic testing,*
Document coordination with building authority	2 weeks	*Project document coordination with building authority*

Description of the required project documentation

For the development of project documentation, the standards and documents in force in Latvia, the construction standards, as well as the design task of the commissioning party are used as a basis. Engineering communications shall be designed in the premises specified by the contracting party. The project is designed on the basis of the architectural design of the premises and their functional application.

Technical risk analysis

Table 2, technical risk analysis

PROS	CONS
▪ Heat energy from renewable energy sources ▪ Possibility to reduce energy consumption prices and reduce risks associated with rising energy prices	▪ The amount of energy produced, and therefore the time of return on investment depends on the weather ▪ High initial investment and long-time of return on investment ▪ The equipment of the collector and hot water system itself needs to be monitored and maintained, disposal is difficult
OPPORTUNITIES	**RISKS**
▪ It is possible to apply for projects organised by European Union funds and to obtain support for the project ▪ Heat energy costs are less dependent on central heating or natural gas tariffs ▪ The project can be carried out through the services of ESCO company, thereby reducing the risks associated with the operation and maintenance of equipment, as well as the financial risks from taking a loan ▪ To be independent from the failures of centralised systems	▪ Property damage or risk of liability caused by errors during the implementation of new projects ▪ Risks related to the viability of the project operator, such as risks related to core staff, financial justification and technical capacity to execute plans ▪ Risk of insufficient funding ▪ Risk of increased costs for key production factors such as labour or modules or reduction of the energy tariff produced ▪ Risk of exceeding expectations over degradation of equipment components over time ▪ Risk of policy changes that may affect the cost-efficiency of the project ▪ Generated amount of energy depending on the intensity of solar radiation

3. Financial aspects of energy production

Financial and economic analysis input data:

- Economic lifetime: 20 years
- Inflation: 2%
- Discount rate: 6%
- Maintenance costs: 1.5 €/m^2
- Energy quantity generated from solar collector: 53.20 MWh/year
- Additionally, required electric energy: 1300 kWh/year
- Electric energy tariff: 0.15 €/kWh + VAT
- Solar collector reducing coefficient of performance: 0.5%/year

Table 3, assessment of costs

No	POSITION	Unit	PRICE, €
1	System optimization and project development		4,099.00
2	High efficiency flat plate solar collector system	140.00 m^2	56,926.00
3	Cost of installation		18,307.00
4	Transportation		1,707.00
5	Unforeseen expenditure – 5%		4,052.00
	SUBTOTAL		***85,091.43***
	VAT 21%		*17,869.20*
	TOTAL INVESTMENT		**102,960.63**

Accounting and analysis of potential sources of financing

Solar collector projects can be funded by participating in tenders organised either in the context of national budget programmes, such as the Emission Allowance auction (EUA) programmes, or in the context of the EU fund, such as co-financing projects organised by the Central Finance and Contract Agency (CFLA). For the financing of project, it is also possible to take a loan from the national development financial institution ALTUM, which finances energy efficiency and renewable energy source projects, as well as from banks. An analysis of the cash flow for the project has been completed to assess the situation for possible financing from the financial institution. In regards to the financing of the project, the following assumptions have been taken into account:

- *interest rate: 3.5%*
- *own funds invested: 25%*
- *loan conditions: 17 years*

Table 4 shows the cash flow of the first years and the calculation of cost-efficiency of the project, the table shows also the revenue of the project. For analysis of cost-efficiency, the net present value (NPV) of the investment has been calculated on the basis of a simple analysis of the cash flow of the project for 20 years, taking into account that 25% of the project costs are self-financed and 75% covered by a bank loan. Figure 1 shows table with the cash flow and accumulated cash flow of the project.

Table 4, project cash flow for calculating net present value

Cash flow model		**2020**	**2021**	**2022**
Operating life of equipment	Years	0	1	2
Total investment	€	85,091		
Loan	€	63,819		
Own funding	€	21,273		
Loan payment	€/year		5,044.42	5,044.42
Savings				
Heat energy tariff	€/MWh	113.99	116.27	118.59
Solar collector reducing coefficient of performance	%		0.01	0.01
Energy generated from sun	MWh/year		53.20	52.93
Gross margin, €/year	*€/year*		*6,185.51*	*6,277.68*
Costs				
Electric energy tariff	€/kWh	0.15	0.15	0.16
Additionally, required electric energy	kWh/year		1,300.00	1,300.00
Additional electric energy costs	€/year		198.90	202.88
System maintenance costs	€/year		214.20	218.48
Total cost of heat energy provision	*€/year*		*413.10*	*421.36*
EBITDA, €/year	€/year		5,772.41	5,856.31
Project cash flow				
Net cash flow	€/year	-21,272.86	727.99	811.89
Accumulated cash flow	€/year	-21,272.86	-20,544.86	-19,732.97
Discount factor – 6%	6%	1.00	0.94	0.89

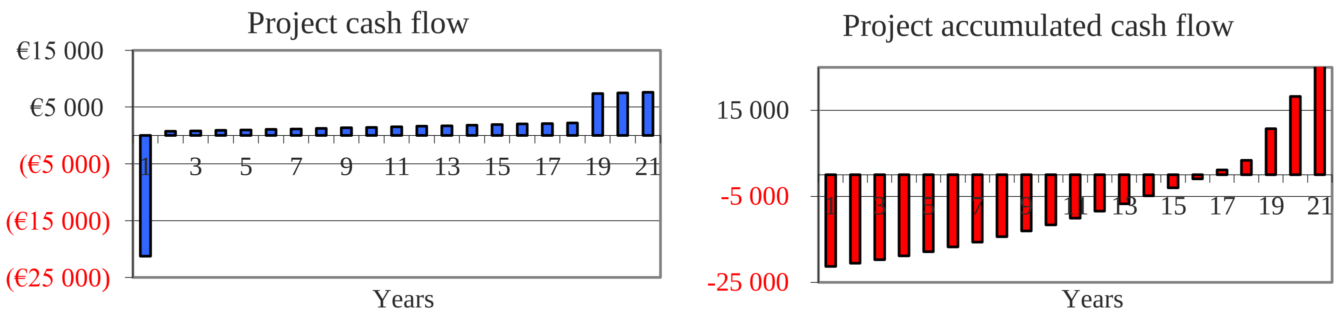


Figure 1 shows project cash flow and accumulated cash flow with the financing of the project

In this analysis, you can see that the project is cost-effective, i.e. its NPV value is positive if the heat energy tariff is a minimum of **113.99 €/MWh**, in which case the IRR is **6%**.

Risk and sensitivity analysis for critical variables

In accordance with sensitivity analysis the following conclusions were reached:

- If the heat energy tariff decreases by 113.99 €/MWh, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the heat energy tariff decreases by 5%, NPV value decreases by 3,983.00€.
- If the electric energy tariff increases by 0.15 €/MWh, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the electric energy tariff decreases by 5%, NPV value increases by 133.00 €.
- If the investment exceeds 85,091.00 €, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the investment decreases by 5%, NPV value increases by 3,706.00 €. If the investment is reduced by 5%, the minimum heat energy tariff, which makes the project beneficial, is already 108.69 €/MWh, which is by 5.30 €/MWh less.
- If own funding increases and exceeds 25%, the NPV value becomes negative, so it is no longer beneficial to implement the project. If own funding decreases by 5%, NPV value increases by 731.00 €.
- If the discount rate increases and exceeds 6%, NPV value becomes negative, so it is no longer beneficial to implement the project. If the discount rate decreases from 6% to 5%, NPV value increases by 2,745.00 €.

Description of payment procedures

The community decides to carry out the installation/maintenance of solar collectors by itself or with the administrator	Source of investment – bank loan. For the maintenance of solar collectors, responsible specialists are hired once a year to carry out the maintenance of the system. Once a month, residents make a repayment of the loan to the bank (*principal sum and %*) for the purchase of solar collectors and a monthly maintenance fee (€/m^2). In addition, the administrator prepares individual monthly invoices for apartments (*management, utilities + hot water heating*), which is covered monthly by residents paying a fixed tariff of €/m^3 or €/MWh for heating hot water, which isn't prepared with the help of solar collectors.
The community decides and concludes an agreement with ESCO for the installation/ maintenance of solar collectors	On the basis of the concluded agreement, ESCO invests money in solar collector installation and maintenance. The base price of heating costs are calculated and fixed for hot water €/m^3 at 100% rate, this includes investments and profits for services provided by ESCO. Each month, following the indications of the hot water meter, ESCO shall prepare an invoice for the services provided. If ESCO is cooperating with the association or the existing administrator for invoicing. ESCO shall invoice the administrator/association for the services provided in the building, in this specific case for the supply of heat energy. Defined service – **"Heat energy supply"** with applied VAT rate 12%. The administrator/association shall

	prepare individual monthly invoices for apartments (*management, utilities + heat supply*) The administrator/association for the administration of invoices shall deduct 2-7% (*mutually approved rate*) from the invoice prepared by ESCO to cover administrative costs for the administration of invoices, debt collection, etc.

MULTIPLE HOUSEHOLD BUILDING PROJECT WITH CONTEINER TYPE BOILER ROOM

1. Legal aspects of energy production

Similarly, as in the project of multiple household building with solar collectors, it is also in conformity with the legal form of the association or foundation. The project can be carried out by concluding an agreement with the ESCO Company. As a second option – the project can be carried out by the association in cooperation with the building administrator, where all organisational and technical activities are carried out by the administrator, while the financing is carried out by the residents using their building provision. When carrying out a project in cooperation with the building administrator, the administrator may request additional payment for additional work and annual maintenance of the system. The third option – the project can be carried out on the initiative of the association itself and all organisational and technical activities are carried out by the Management Board of the association, which is authorised to conclude contracts with suppliers and installers of equipment. Main financial sources are residents, building provision and bank loan.

Trade issues of energy production

For this project, the production, marketing and supply of heat energy must not be regulated. In particular, the heat energy supply of this project is only for self-consumption of the multiple household building. As the service isn't regulated the tariff rate is decided by the energy producer.

Table 5, the most appropriate legal model for the specific project

		Maintenance	Accounting
1	According to the vote of residents administrator installs granular boiler	The administrator shall maintain the boiler, hire a responsible specialist who shall ensure the operation and maintenance of the granular boiler.	The cost of heat energy production is calculated by the heating area, €/m^2, or by the heat energy meter MWh. Investments are covered by the provision of building.
2	With the vote from community association decides to install granular boiler	The association shall maintain the boiler, hire a responsible specialist who shall ensure the operation and maintenance of the granular boiler.	The cost of heat energy production and investments are calculated in accordance to heating area, €/m^2, or by the heat energy meter MWh.
3	The association decides and concludes an agreement with ESCO for the installation of granular boiler	ESCO invests money in boiler installation and provides heat energy production. The tariff of heat energy is fixed each year, by calculating the cost of supplied solid fuel.	Heat energy production cost and investments are included in the heat energy tariff, which has been coordinated with the building's residents or association, €/MWh

2. Technical aspects of energy production

Assumptions, technical specifications and solutions

During the second pilot project, a 140 kW container-type boiler room with granular boilers, a granular warehouse and a boiler-binder system for the production of heat energy is intended to be installed in multiple household building.

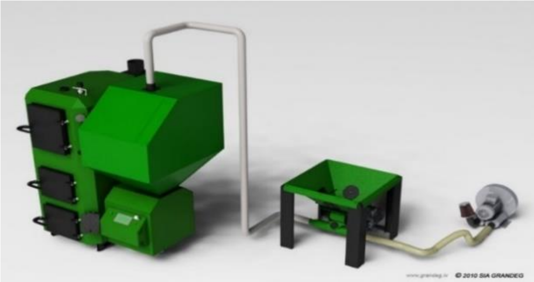


Figure 2, boiler plan

Multiple household building's total area with 30 apartments is 1,900m^2. There are total of 75 residents in the building. The project is implemented by the association of apartment owners together with a private company (technology suppliers, installers and maintenance) involving the building administration company and project investors. The project will be implemented by the entrepreneur taking bank loan and concluding an agreement with the residents on the supply of heat energy.

Base line

The demand and calculation of building's heat energy is based on data measured by a real non-renovated series-type building with 30 apartments, in which the heat is provided by the central heating system. The heat energy consumption of this building in year 2018 was 319 MWh/year. This value was used for the project's financial and economical analysis. In the calculations it was accepted, that the granular boiler is able to produce all the necessary heat energy. In this case heat energy isn't supplied for the network.

Table 6, time schedule for the implementation of the project

Stage	Period	Characteristic
Procurement	2 months	*Technical specifications, procurement regulation, preparation of contract drafts.*
Development of technical project	2 months	*In accordance to design tasks*
Document coordination in other establishments	1-2 months	*Gas, electricity, utilities, water supply, central heat supplier*
Obtaining permits	1-4 weeks	*Environment permits*
Document coordination with building authority	2-4 weeks	*Clarification, response to deficiencies*
Assembly and delivery of equipment	3 months	*Logistics, storage, assembly*
Conclusion of works contract	1-2 weeks	*Coordination and signing of the agreement*
Construction	4 months	*Work meeting, performance of work*
Commissioning	2-4 weeks	*P/N acts, hydraulic testing,*
Document coordination with building authority	3 weeks	*Project document coordination with building authority*

Description of the required project documentation

Description of technical project

For the development of project documentation, the standards and documents in force in Latvia, the construction standards, as well as the design task of the commissioning party are used as a basis. Engineering communications shall be designed in the premises specified by the contracting party. The project is designed on the basis of the architectural design of the premises and their functional application.

List of the required permits

Assessing whether a permit for the relevant category of polluting activity is necessary, it is possible to perform in conformity with the relevant Annex of the Law On Pollution or by the Cabinet Regulation No 1082[3] in 30th of November, 2010*, "Kārtība, kādā piesakāmas A, B un C kategorijas piesārņojošās darbības un izsniedzamas atļaujas A un B kategorijas piesārņojošo darbību veikšanai" (Procedures by which Category A, B and C polluting activities are to be applied and permitted for the*

[3] https://m.likumi.lv/doc.php?id=222147

performance of Category A and B polluting activities). Equipment that requires *"Ietekmes uz vidi" (environmental impact) evaluation or primary assessment, you can get acquainted with the Law "Par ietekmes uz vidi novērtējumu" (On Environmental Impact Assessment),* adopted by Saeima[4].

In the case of this project, it isn't necessary to obtain either a category B or a category C permit. As well it isn't necessary to obtain environmental impact assessment or primary assessment, as the capacity of the equipment is lower than 1 MW.

Technical risk analysis

Table1 7, technical risk analysis

PROS	CONS
▪ Higher proportion of renewable energy sources ▪ Independent heat energy production ▪ High efficiency of boiler room ▪ Possibility to reduce heat energy consumption prices ▪ Reduced loss of heat energy during transmission ▪ Higher energy efficiency of the overall system	▪ Higher costs of staff ▪ Higher specific costs of heat energy production ▪ Requires more regular cleaning and human monitoring of boiler
OPPORTUNITIES	**RISKS**
▪ Attracting external funding ▪ Mobilisation of EU funds for the realisation of development projects ▪ Technological development and modernisation	▪ Granule cost increase ▪ Decrease in efficiency ▪ Decrease in solvency of residents ▪ Shortage of qualified staff ▪ Maintenance cost increase

3. Financial aspects of energy production

- Economic lifetime: 15 years
- Inflation: 2%
- Discount rate: 6%
- Maintenance costs: 120 €/month
- Heat energy consumption of the building: 319 MWh/t
- Granule consumption: 72.34 t/year
- Electric energy tariff: 0.15 €/kWh + VAT
- Granule price: 182 €/t

Table 8, assessment of costs

No	POSITION	Unit	PRICE, €
1	System optimization and project development		4,613.00
2	Container-type boiler room heating system	140 kW	65,900.00
3	Cost of installation		2,115.39
4	Transportation		2,178.85
5	Unforeseen expenditure – 5%		3,740.36
	SUBTOTAL		***78,547.60***
	VAT 21%		*16,495.00*
	TOTAL INVESTMENT		**95,042.60**

Accounting and analysis of potential sources of financing

For granular boiler projects, funding can be obtained on the same basis as for the solar collector project. An analysis of the cash flow for the project has been completed to assess the situation for possible financing from the financial institution. In regards to the financing of the project, the following assumption has been taken into account:

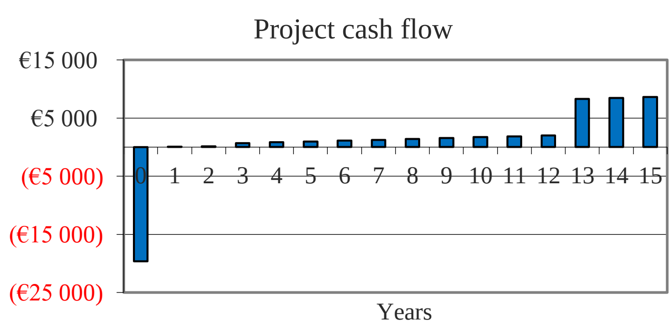
- *interest rate: 3.5%*
- *own funds invested: 25%*
- *loan conditions: 12 years*

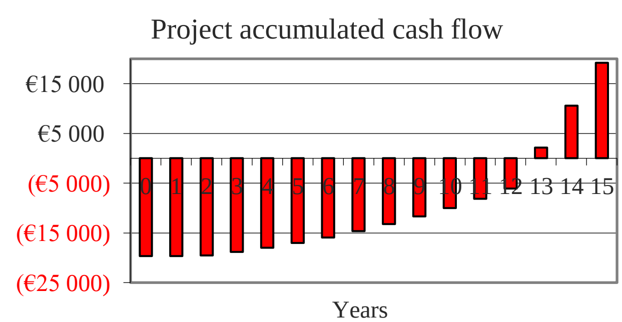
[4] https://likumi.lv/ta/id/51522-par-ietekmes-uz-vidi-novertejumu

Table 9 shows the cash flow of the first years and the calculation of cost-efficiency of the project, the table shows also the revenue of the project. For analysis of cost-efficiency, the net present value (NPV) of the investment has been calculated on the basis of a simple analysis of the cash flow of the project for 15 years, taking into account that 25% of the project costs are self-financed and 75% covered by a bank loan.

Table 9, providing heating with a container-type boiler room

Cash flow model		**2020**	**2021**	**2022**
Operating life of equipment	Years	0	1	2
Total investment	€	78,548		
Loan	€	58,911		
Own funding	€	19,637		
Loan payment	€/year		6,096.31	6,096.31
Savings				
End consumer tariff	€/MWh	67.37	68.72	70.10
Heat energy generated with granules	MWh/year		319.00	319.00
Gross margin, €/year	*€/year*		*21,492.37*	*21,922.22*
Costs				
Granule price	€/t	182.00	185.64	189.35
Consumed granules	t		72	72
Granule costs	€/year		13,429.20	13,697.78
Cost of maintenance	€/year		1,440.00	1,468.80
Operating costs	€/year		525.60	536.11
Total cost of heat energy provision	*€/year*		*15,394.80*	*15,702.69*
EBITDA	€/year		6,097.57	6,219.52
Project cash flow				
Net cash flow	€/year	-19,637.00	1	123
Accumulated cash flow	€/year	-19,637.00	-19,636.00	-19,512.00
Discount factor – 6%	6%	1.00	0.94	0.89
NPV 6%	0.00			
IRR	6%			





1*Figure 3 shows project cash flow and accumulated cash flow with the financing of the project*

In this analysis, you can see that the project is cost-effective, i.e. its NPV value is positive if the end consumer's heat energy tariff is a minimum of **67.37 €/MWh**, in which case the IRR is **6%**.

Risk and sensitivity analysis for critical variables

The following conclusions were reached:

- If the end consumer's tariff decreases below 67.37 €/MWh, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the end consumer's tariff increases by 5%, NPV value increases by 11,974.00 €.
- If the electric energy tariff increases over 150 €/MWh, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the electric energy tariff decreases by 5%, NPV value decreases by 288.00 €.
- If the necessary investment exceeds 78,548.00 €, therefore the NPV value becomes negative, so it is no longer beneficial to implement the project. If the necessary investment increases by 5%, NPV value decreases by 3,537.00 €. If the investment is reduced by 5%, the minimum heat energy tariff, which makes the project beneficial, is already 66.38 €/MWh, which is by 0.10 €/MWh less.
- If the self-financing proportion is over 75%, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the self-financing proportion increases by 5%, NPV value decreases by 520.00 €.
- If the discount rate exceeds 6%, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the discount rate decreases from 6% to 5%, NPV value increases by 2,245.00 €

Description of payment procedures.

According to the vote of residents administrator installs granular boiler	Financing source – bank loan and community savings. Service and maintenance of granular boilers is carried out by administrator. Once a month, community makes a repayment of the loan to the bank (*principal sum and %*) and a monthly maintenance fee. Local residents pay the price per MWh of the amount of heat energy reported, according to a fixed heat energy tariff of €/MWh against the estimated area representing the heat energy price of €/m^2. Defined service – **"Heating"** with applied VAT rate of 12% and **"Water heating"** calculated in accordance to the hot water meter in m^3, with applied VAT rate of 12%. In addition, the administrator shall prepare individual monthly invoices that consist of services (*management, utilities, heat energy supply, hot water heating*) for each apartment
Community/association decide and install granular boiler	Financing source – bank loan and community savings. For the maintenance of granular boiler, a specialist is hired that is responsible for service and maintenance of the system. Once a month, community makes a repayment of the loan to the bank (*principal sum and %*) and a monthly maintenance fee. Local residents pay the price per MWh of the amount of heat energy reported, according to a fixed heat energy tariff of €/MWh against the estimated area representing the heat energy price of €/m^2. Defined service – **"Heating"** with applied VAT rate of 12% and **"Water heating"** calculated in accordance to the hot water meter in m^3, with applied VAT rate of 12%. In addition, the community shall prepare individual monthly invoices that consist of services (*management, utilities, heat energy supply, hot water heating*) for each apartment
The community decides and concludes an agreement with ESCO for granular boiler installation/ maintenance	On the basis of the concluded agreement, ESCO invests money in installation and maintenance of granular boiler. The fixed base price of heating energy is calculated in €/MWh, which includes investments and profits for services provided by ESCO. The tariff can be adjusted according to the fluctuating price of granule. Each month, following the indications of the heat energy meter, ESCO shall prepare an invoice for the services provided. If ESCO is cooperating with the association or the existing administrator for invoicing. ESCO shall invoice the administrator/association for the services provided in the building, in this specific case for the supply of heat energy. Defined service – **"Heat energy supply"** with applied VAT rate 12% The administrator/association shall prepare individual monthly invoices for apartments (*management, utilities + heat supply*). The administrator/association for the administration of invoices shall deduct 2-7% (*mutually approved rate*) from the invoice prepared by ESCO to cover administrative costs for the administration of invoices, debt collection, etc.

GROUND HEAT PUMP TO PROVIDE HEAT ENERGY FOR PRIVATE HOMES

1. Legal aspects of energy production

Trade issues of energy production

In this project, as well the above-mentioned, Cabinet Regulation No. 1227, *"Noteikumi par regulējamiem sabiedrisko pakalpojumu veidiem" (Regulations regarding regulated types of public services)*, the production, marketing and supply of heat energy doesn't need to be regulated. In particular, the heat energy supply of this project is only for self-consumption of the private homes. Service isn't regulated thus the tariff rate is decided by the energy producer.

Table 10, the most appropriate legal model for the specific project

		Maintenance	Accounting
1	The developer has set the objective of installing a common heat pump (HP) system	The community of new building owners (association or foundation) shall maintain heat pump, as well hire a responsible specialist who shall ensure the operation and maintenance of heat pump.	The cost of heat energy production is calculated by the heating area €/m^2. The investments are covered along with the purchase of home.
2	Association or foundation of building owners decides and concludes an agreement with ESCO for heat pump installation	ESCO invests money in heat pump installation and provides heat energy production. The tariff of heat energy is fixed each year, by calculating the cost of supplied solid fuel.	Heat energy production cost and investments are included in the heat energy tariff, which has been coordinated with the building's residents or association, €/MWh

2. Technical aspects of energy production

Assumptions, technical specifications and solutions

Geothermal vertical heat pumps using water from subterranean depths as a source of heat – groundwater or deep water is a common source for the heat pumps. In the event of installing such heat pump system, it is necessary to drill two deep boreholes or filtration boreholes each at the depth of approximately 70 m, one serving as water abstraction (geothermal borehole), the other for the "processed" water to be released back into the depths of the ground. Suggested distance between of two such boreholes is 15 to 20 m. This option often requires increased borehole capacity (up to 3 l/s), which prevents the use of filtration boreholes at relatively cheaper costs. From a 1 meter deep borehole you can achieve ~50-60 W of heat energy. Therefore, to install a heat pump with a capacity of 10 kW, you would need borehole with a depth of 170-200 m.

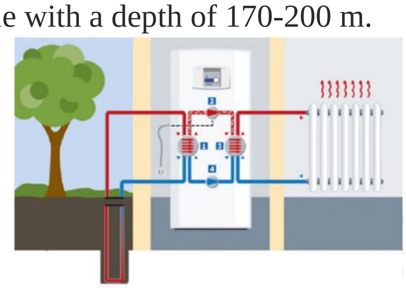


Figure 4, basic heat pump scheme[5]

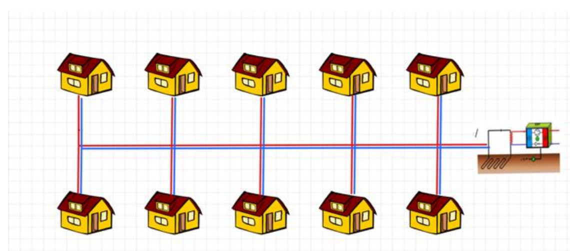


Figure2 5, project selected technology scheme

[5] http://www.bef.lv/fileadmin/media/Publikacijas_Klimats/2011_Kastaniitis_publikacija.pdf

Figure 4, basic heat pump scheme, consists of: 1 – evaporator; 2 – compressor; 3 – condenser; 4 – expansion valve.

Description of the selected technology

The third pilot project is intended for installation of a deep borehole heat pump (60 m probe ground) in one case for 4 private homes and, in the other, 10 private homes to provide for heating and hot water needs. The space that needs to be heated of each private home is 160 m^2 and the average heat energy consumption of each private home for heating purposes is 80 kWh/m^2 per year and for hot water consumption is 20 kWh/m^2 per year. Each building is set on $1200m^2$ large land.

Provisional time schedule for the implementation of the project

Table 11, provisional time schedule for the implementation of the project

Stage	Period	Characteristic
Procurement	2 months	*Technical specifications, procurement regulation, preparation of contract drafts.*
Development of technical project	6 months	*In accordance to design tasks*
Coordination and obtaining permits	2 months	*utilities, water supply, central heat supplier*
Document coordination with building authority	1 months	*Clarification, response to deficiencies*
Assembly and delivery of equipment	3 months	*Logistics, storage, assembly*
Conclusion of works contract	1-2 weeks	*Coordination and signing of the agreement*
Construction	6 months	*Work meeting, performance of work*
Commissioning	1 months	*System check-up, tests. Signing the p/n act*
Document coordination with building authority	3 weeks	*Coordination of all executive documentation with building authority*

Base line

The defined consumption of private homes requires buildings to have a heated area of 160 m^2 and their required heat energy for heating is 80 kWh/m^2 per year. 20 kWh/m^2 in year are needed to provide hot water. Given that ground heat pumps are efficient at lower supply temperatures, having a hot water at 55 ^oC through the year is uneconomical, that is why ground heat pumps are used only for heating. For 10 such buildings we would require approximately 128 MWh/year for heating and 32 MWh/year for providing hot water other heat sources are, e.g. electric boilers.

Description of the required project documentation

For the development of project documentation, the standards and documents in force in Latvia, the construction standards, as well as the design task of the commissioning party are used as a basis. Engineering communications shall be designed in the premises specified by the contracting party. The project is designed on the basis of the architectural design of the premises and their functional application.

For such project you must also obtain an initial environmental impact assessment, as there going to be an geothermal deep borehole. It is also necessary to create deep boreholes contracting an operator, thereby you will gain a licence.

Technical risk analysis

Table 12, technical risk analysis[6]

PROS	CONS
▪ Higher energy efficiency of the overall system ▪ During the production of heat energy there are no pollution which is usually created from burning process	▪ High costs, to implement the project a support is required from state or local government
OPPORTUNITIES	**RISKS**
▪ Decrease of heat energy tariff ▪ Independence of centralized heating supply ▪ Decrease in the volume of GHG emissions ▪ Energy generated from renewable energy sources	▪ Limited options to acquire financial support ▪ Heat pump compressors are sensitive to fluctuation of system pressure

3. Financial aspects of energy production

Financial and economic analysis

The economic analysis has been carried out using the following input data:

- Economic lifetime: 20 years
- Inflation: 2%
- Discount rate: 6%
- Electric energy tariff: 0.15 €/kWh
- Maintenance costs: 20 €/h
- Maintenance time: 15 h
- Heat energy consumption of the building: 128 MWh/t
- Energy quantity generated from heat pump: 128 MWh/year
- Energy quantity flowing through heat pump: 37 MWh/year
- Heat energy tariff: 56 €/MWh
- Maintenance costs: 100 €/year

Table 13, assessment of costs

No	POSITION	Unit	PRICE, €
1	System optimization and project development		5,886.07
2	Heat pump heating system	40 kW	86,014.00
3	Transportation		3,676.01
4	Unforeseen expenditure – 5%		4,778.81
	SUBTOTAL		**100,355**
	VAT 21%		21,074.55
	TOTAL INVESTMENT		**121,429.55**

Accounting and analysis of potential sources of financing

For heat pump projects, funding can be obtained on the same basis as in the previous project. An analysis of the cash flow for the project has been completed to assess the situation for possible financing from the financial institution. In regards to the financing of the project, the following assumption has been taken into account:

- *interest rate: 3.5%*
- *own funds invested: 25%*
- *loan conditions: 17 years*

Table 14 shows the cash flow of the first years and the calculation of cost-efficiency of the project, the table shows also the revenue of the project. For analysis of cost-efficiency, the net present value (NPV) of the investment has been calculated on the basis of a simple analysis of the cash flow of the project for 20 years, taking into account that 25% of the project costs are self-financed and 75% covered by a bank loan.

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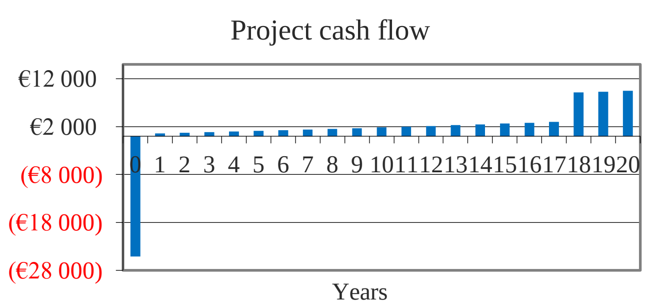
[6] https://akademiai.com/doi/pdf/10.1556/IRASE.3.2012.2.2

Table 14, heat energy provision using heat exchanger

Cash flow model		**2020**	**2021**	**2022**
Operating life of equipment	Years	0	1	2
Total investment	€	100,355.00		
Loan	€	75,266.00		
Own funding	€	25,089.00		
Loan payment	€/year		5,949.28	5,949.28
Savings				
End consumer tariff	€/MWh	95.89	97.81	99.76
Energy quantity generated from heat pump	MWh/year		128.00	128.00
Gross margin, €/year	*€/year*		*12,519.18*	*12,769.56*
Costs				
Energy consumed while operating heat pump	MWh/year		36.57	36.57
Electric energy tariff	€/year	150	153.00	156.06
Cost of operating heat pump	€/year		5,595.43	5,707.34
Cost of maintenance	€/year	400.00	408.00	416.16
Total cost of heat energy provision	*€/year*		*6,003.43*	*6,123.50*
EBITDA	€/year		6,515.75	6,646.06
Project cash flow				
Net cash flow	€/year	-25,089.00	566.00	697.00
Accumulated cash flow	€/year	-25,089.00	-24,522.00	-23,826.00
Discount factor – 6%	6%	1.00	0.94	0.89
NPV 6%	0.00			
IRR	-1%			



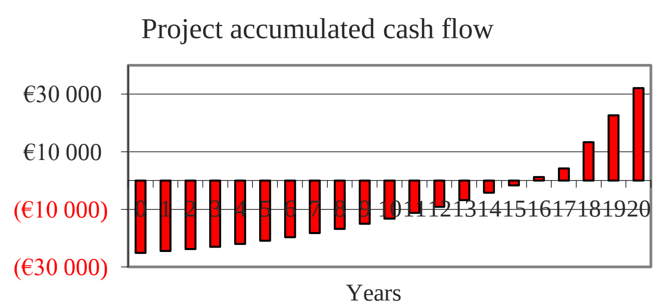


Figure 6 shows project cash flow and accumulated cash flow with the financing of the project

In this analysis, you can see that the project is cost-effective, i.e. its NPV value is positive if the end consumer's heat energy tariff is a minimum of **95.89 €/MWh**, in which case the IRR is **-1%**.

Risk and sensitivity analysis for critical variables

The following conclusions were reached:

- If the end consumer's tariff decreases below 96 €/MWh, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the end consumer's tariff increases by 5%, NPV value increases by 8,398.00 €.
- If the electric energy tariff increases over 150 €/MWh, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the electric energy tariff decreases by 5%, NPV value increases by 3,754.00 €.

- If the necessary investment falls below 100,355.00 €, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the necessary investment increases by 5%, NPV value decreases by 4,371.00 €. If the investment is reduced by 5%, the minimum heat energy tariff, which makes the project beneficial, is already 93.39 €/MWh, which is by 2,495.00 €/MWh less.
- If the self-financing proportion is over 75%, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the self-financing proportion increases by 5%, NPV value decreases by 862.00 €.
- If the discount rate exceeds 6%, the NPV value becomes negative, so it is no longer beneficial to implement the project. If the discount rate decreases from 6% to 5%, NPV value increases by 3,395.00€.

Description of payment procedures.

The developer installs a common heat pump system and ensure its operation together with the sold newly built buildings.	Financing source – bank loan/developers funding. For the maintenance of ground heat pump station a specialist is hired that is responsible for service and maintenance of the system. Each month residents pay a fixed heat energy tariff of EUR/MWh to the developer for the supplied heating energy after the consumed MWh are reported. Defined service – **"Heating"** with applied VAT rate 12%
ESCO installs a common heat pump system and ensure its operation	On the basis of the concluded agreement, ESCO invests money in installation and maintenance of ground heat pump station, and ensuring its proper functioning. The fixed price of heating energy is calculated in €/MWh, which includes investments and profits for services provided by ESCO. Each month, following the MWh indications of the heat energy meter, ESCO shall prepare an invoice for the services provided and forwards it to the building owners. Defined service – **"Heat energy supply"** with applied VAT rate 12%

CONCLUSIONS

1. When the investment amount is 85,091.43 € (excluding VAT) and 75% of the investment is covered by a loan from the bank, as well the economic lifetime is 20 years and the electric energy tariff is 0.15 €/kWh, the multiple household building project with solar collectors is beneficial if the heat energy tariff doesn't fall below the minimum of **129.68 €/MWh**.
2. When the investment amount is 85,699.13 € (excluding VAT) and 75% of the investment is covered by a loan from the bank, as well the economic lifetime is 15 years, electric energy tariff is 0.15 €/kWh and granule price is 182 €/t, the multiple household building project with container-type boiler room, is beneficial if the heat energy tariff doesn't fall below the minimum of **63.09 €/MWh**.
3. When the investment amount is 100,355 € (excluding VAT) and 75% of the investment is covered by a loan from the bank, as well the economic lifetime is 20 years and the electric energy tariff is 0.15 €/kWh, the deep borehole heat pump project to provide heat energy for private homes is beneficial if the heat energy tariff doesn't fall below the minimum of **95.89 €/MWh**.
4. Due to the fact that it is more economically beneficial to operate a ground heat pump at a lower supply temperature, the justification of it would increase if the end customers of private homes, would have almost zero-energy or even have passive buildings with low energy consumption.
5. At the moment, the highest heat energy tariff is for customers of SIA "Saulkrastu komunālserviss" – 69.98 €/MWh (excluding VAT), while the lowest tariff is for customers of SIA "Dobeles enerģija" –

45.01 €/MWh (excluding VAT). In Riga according to the announcement of AS "Rīgas siltums", starting from 1st August, 2019, heat energy tariff will be 51.90 €/MWh (excluding VAT)[7]. Comparing the existing tariffs with the provided results of the projects, at the current rates none of the projects is economically viable, however the project with the installation of container-type granular boiler room is closest to the tariffs.

6. In order to facilitate the implementation of such projects in Latvia and to make them more economically advantageous, it is essential to introduce aid schemes in relation to funding. It proves itself after an analysis is carried out in terms of financial sensitivity. By reducing the necessary funding by 50% in the case of a solar collector project, so that the project would be beneficial, the minimum heat energy tariff would be 60.96 €/MWh, or 46.5% less than previously. By reducing the necessary funding by 50% in the case of a granular boiler project, so that the project would be beneficial, the minimum heat energy tariff would be 57.42 €/MWh, or 14.8% less than previously. However, in case of a heat pump project, so that the project would be beneficial, the minimum heat energy tariff would be 70.94 €/MWh, or 26% less than previously.

SUGGESTIONS

1. At the present time, local governments, associations and foundations (such as NGOs) and cooperatives can introduce energy projects from the legislative framework in Latvia as legal persons. Currently, Latvian legislation does not foresee the activities of energy cooperatives.
2. In Latvia, associations and foundations or NGOs are governed by the Law on Associations and Foundations, which states that, the association is a voluntary association established by persons to achieve the purpose specified in the Statute, which does not have the nature of profit-making. Secondly, the foundation, including the fund, is a set of assets that is separate from the purpose pursued by the founder, which does not have the nature of profit-making. Associations are the ones with the greatest potential, the most commonly used term, when it comes to implementing a community energy-type project, in general what comes to mind is this term, namely the associations of house residents or apartment owners.
3. The main obstacles for the development of communities in Latvia are:
   - 3.1. Lack of a sound policy on investment in renewable resource projects.
   - 3.2. There are no long-term and low-interest investment financing schemes.
   - 3.3. Existing regulatory hurdles.
   - 3.4. There is lack of understanding of the overall benefits of Community energy projects.
   - 3.5. No available training or education and scarcity of accessible information.
   - 3.6. Cultural barriers and a certain sceptical stance towards collective team work, that prevents the promotion of initiatives.
4. In order for the residents of the building to carry out the project as a community, Latvian legislation provides for a potential cooperation model. Energy cooperatives offer help to mobilise funding to meet renewable energy source goals, at the same time involving residents and other stakeholders in the production and use of renewable energy.

[7] https://sprk.gov.lv/content/tarifi-4

5. The assessment of the economic benefits of the project should take into account the action plans and measurements identified in the Latvian National Energy and Climate Plan for 2030, which includes support for renewable energy (hereinafter RE) communities. One of action plans of the National Energy and Climate Plan (NEKP) 2030 is "Promoting economically justified energy self-generating, self-consuming and RE communities". To broaden and widen range of stakeholders, that would be willing to participate in electric energy production. One of the measures in this direction is the "Promote the creation of energy cooperative and RE communities", which includes the development of regulation of energy communities and RE communities (year of implementation 01.07.2021), the development of a framework for the inclusion of RE communities in support of renewable energy, conducting studies on at least one viable business model for the functioning of the Energy Community and the RE Community (year of implementation 31.12.2026).
6. The National Energy and Climate Plan proposes to set up a RE Promotion and Energy Efficiency Improvement Fund, in which could be channelled financial resources from the income generated from energy-related activities.
7. Other recommendations for policy-making regarding community development:
   7.1. Allocation of sufficient human and financial resources to implement the requirements of the amended Directives and to integrate them as best as possible into national and regional legislation, taking into account national circumstances.
   7.2. To analyse and define the role of municipalities as an instrument for the development and implementation of RE projects and to promote cooperation between cities and community energy projects at a municipal level:
   7.3. Introduce such changes in the tax regulation in order to encourage the development of such projects.
   7.4. Add exceptions in the electricity grid regulation, which makes it possible to divide electricity between adjacent properties.
   7.5. Ensuring access to long-term and low-interest investment financing schemes.
   7.6. In order to support RE initiatives, independent and professional consultations about the organisation of the community as a legal person and technical advices to promote community initiatives.
8. Trading the produced heat energy to other end consumers (neighbours), we must follow the Cabinet Regulation No 1227, "*Noteikumi par regulējamiem sabiedrisko pakalpojumu veidiem" (Regulations regarding regulated types of public services),* which states that:
   8.1. heat energy production must be regulated, as the total set heat capacity is above 1 MW and the amount of heat transferred to the centralised heating system the heat energy exceeds 5000 MWh/year;
   8.2. the transmission and distribution of heat energy must be regulated if the total amount of heat transferred and distributed exceeds 5000 MWh, and if the produced heat energy is delivered to the heating networks of the regulated heating system operator.
   8.3. In a project with deep borehole heat pumps for the provision of heat energy in private homes, the production, transmission and distribution of heat energy isn't possible to regulate, as the installed capacity is 40 kW and the amount of heat energy transferred is 128 MWh/year.

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