Summary documentation of business cases

WP4 – Task 4.1
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BiogasHeat website: www.biogasheat.org
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1 Introduction
This report has been developed in the framework of BiogasHeat project that aims at development of sustainable heat markets for biogas plants in Europe and is supported by the Intelligent Energy Europe programme of the European Commission.

In the first step project partners have analysed framework conditions of the biogas heat use in project countries, have described good practice examples and have developed a Handbook on sustainable heat use from biogas plants. In the second step of the project promising strategies for heat utilization from biogas plants has been developed and 10 pre-feasibility studies for biogas heat use from biogas plants has been prepared in each project country. However, these actions alone may not be sufficient to trigger relevant investment in biogas heat projects, in particular in short and medium terms. Therefore, in each country the most promising projects from the pre-feasibility studies has been identified (1-3 projects per country) and for each of them a heat use concept has been further developed in a business case.

In a context of BiogasHeat project the business case describes the adoption of a specific strategy and business model for heat delivery from a biogas plant. It contains the cooperation partner’s (developer/ investor/ owner/ operator of the plant) specific background for adopting and marketing the service, its expected business benefits, the options considered, the expected costs, expected chances and risks. Business cases are based on the initial feasibility studies and on the developed strategies for heat utilisation from biogas plants.

For the identification and development of business cases, there should be considered both framework (e.g. national legislation) and also local specific conditions.

As the most important factor for definition of given business case is the long-term sustainability of which precondition is the economic effectiveness – for the cooperation partner and the other parties engaged in the given case. In addition, business cases shall be (ideally) designed in such a way, that they could function as models for a potentially larger range of cases and provide high chance of replicability.

All project partners were free to identify these business cases which from their specific point of view fulfil these common preconditions the best.

Below, there is provided a brief summary of a basic description of one to three business cases selected by project partners in their country.

2 Selected business cases in BiogasHeat project countries

2.1 Czech Republic

Business case: Heat supply to a health care facility

Name of cooperation partner: KAVEMA s.r.o. (liability limited company)

Contact person and position: Jiri Marek, Executive Manager
(Email: jirimarek@marekzt.cz, Tel.: +420 777 757 000)

Description of the business case:
From feasibility checks undertaken, as the most suitable for a field test has shown up to be the business case (BC) identified at biogas plant located close to the town of Žamberk in the north-eastern part of the country.

The cooperation partner to this shall be company named KAVEMA, s.r.o. (liability limited) which is the owner and operator of the plant.

The BC identified is to make use of suitable location of the plant, in which vicinity there are major heat consumers, and construct about 2-kilometre-long heat pipeline for heat supplies to a health-care facility called “Albertinum” located about 1.5 km west of the plant.

The facility currently for covering heat needs uses natural gas-fired boilers and there is a potential for annual heat supplies from the biogas plant amounting to 1.3-1.5 GWh.

The cooperation partner is seriously committed to implement this business case which, here, meets best criteria of being sustainable on a long term basis, beneficial for both parties, and has also ecological benefits.

The health-care facility is public entity in the ownership of Pardubicky kraj, one of 14 regions in the country (NUTS 3rd level) and, therefore, for implementation of envisioned BC negotiations with both the management of the facility and the representatives of the Regional Administration are necessary.

Since the health-care facility is actually located in the suburb area of Zamberk town and the pipeline will be laid down into the land which is predominantly owned by the town, there is also need to get into contact with the representatives of the city and get their consent to the project.

The basic precondition for BC realization is conclusion of the long-term heat purchase agreement, which will open the door for project design documentation preparation.

Basic parameters of BC:

The actual major parameters of the selected BC are as follows:

- Amount of heat effectively utilized – up to 1.5 GWh/year
- Environmental benefits (measured via CO₂ savings) – up to 300 tCO₂/year
- Expected investment costs – up to 440 thous. EUR
- Expected revenues – up to 55 thous. EUR/year
• Expected operational costs – up to 5.5 thous. EUR/year
• Pay-back period – 9 years

Assumed BC implementation: The following further actions/milestones and their timeframe are assumed:

• Preparatory works on negotiation of long-term purchase agreement contract and its conclusion (January to April/May 2014)
• Project design documentation preparation and award of building permit (June to December of 2014)
• Optionally, preparation and submission of application for investment grant (January to May 2015)
• Construction of heat pipeline and operational tests (March to July 2015)

Forms of support by Partner: With the cooperation partner, the following activities were agreed upon to be done by the Partner:

• Introductory letters sent to the health-care facility management and its owner Pardubicky kraj regional administration which justify the project and specify its benefits for all parties.
• Technical assistance in preparation of purchase agreement (namely developing proposal of contractual conditions according to which heat supplies are to be priced, expert help in preparation and organization of public tender which is needed for conclusion of the contract).
• Participation at meetings organized with the cooperation partner and stakeholders and preparation of minutes from them summarizing major conclusions.
• Technical assistance in project design documentation for heat pipeline construction and, eventually, selection of suppliers (e.g. definition of required technical parameters of the pipeline, preparation of call for bids, evaluation of bids etc.).
• Expert advice and information exchange via networking upon request (e.g. phone calls, emails etc.).
• Optionally, preparation of application for investment grant (to be decided later)
Business case: Heat supply to a residential DH system

Name of cooperation partner: Správa budov Žamberk s.r.o. (facility management, liability limited company)

Contact person and position: Stanislav Tajbr, Executive Manager
(Email: tajbr@sbzamberk.cz, Tel.: +420 465 614 609)

Description of BC followed: The town of Žamberk operates (through its 100% owned daughter company Správa budov Žamberk, further SBŽ) a medium sized district heating system with 2 centralized boiler plants and 13 smaller local boiler plants, all fired by natural gas, supplying about 7 GWh of heat to mostly residential and public buildings.

SBŽ is currently analyzing ways how to modernize both the heat production and sustainable in the long term perspective. SEVEn offered its assistance and based on mutual agreement worked out a study suggesting the measures for the district heating upgrade. The modernization comprises the following main principles:

1) The two currently isolated supply areas corresponding to the two centralized boiler plants will be interconnected. Also, several buildings with local boilers will be connected to the distribution system.

2) The old 4-pipe distribution lines in channels will be replaced by new 2-pipe lines and the buildings will be provided with individual heat substations which would also prepare domestic hot water.

3) Boilers at one of the boiler plants will be replaced by new condensing units, and

4) Alternative heat sources with lower production costs will be installed. The evaluated options are:

   a) natural gas co-generation unit installed by SBŽ, or
   b) by another entity
   c) biomass fired boilers, or
   d) heat purchased from the biogas plant.

The potential supplier of heat from biogas plant is the company KAVEMA, described in BC 1 above. This potential BC 2 is however practically independent from BC 1, as only about the first 500 meters of the connecting hot water piping route will be common, the remaining route length to the connection point in the district heating plant is about 2 km.

KAVEMA will bear the costs for the piping and for the heat exchanger station transferring heat to the district heating
system. The cooperation partner is seriously committed to implement this business case which, here, meets best criteria of being sustainable on a long term basis, beneficial for both parties, and has also ecological benefits.

Basic parameters of BC: The actual major parameters of the selected BC are as follows:

- The potential annual heat amount for the district heating is about 4,7 GWh, taking into account both actual heat demand of the system and the available heat from the biogas plant, after covering the BP’s own consumption and supply to Albertinum health facility.

- Environmental benefits (measured via CO₂ savings) – about 900 tCO₂/year

- Expected investment costs:
  - KAVEMA: about 800 440 thous. EUR (includes stand-by boiler at the biogas plant, 2,5 km hot water connecting piping, heat exchanger and pumping station)
  - SBŽ: about 110 thousand EUR for integrating the heat into the system (mainly costs for heat accumulators and piping in the boiler plant)

- Expected revenues:
  - KAVEMA: about 120 thous. EUR/year
  - SBŽ: about 30 thousand EUR/year compared to heat production from new boilers

- Expected operational costs
  - KAVEMA: about 13 thousand EUR/year
  - SBŽ: none

- Pay-back period – 8-10 years

Assumed BC implementation: The following further actions/milestones and their time-framework are assumed:

- Preparatory works on negotiation of long-term purchase agreement contract and its conclusion (June to November 2014)

- Decision on accepting the heat supply option from the biogas plant by the city council

- Project design documentation preparation and award of building permit (February to November of 2015)
• Optionally, preparation and submission of application for investment grant (December to April 2016)

• Construction of heat pipeline and operational tests (May to September 2016)

Forms of support by Partner: With the cooperation partner, the following activities were agreed upon to be done by the Partner:

• Analysis and design of technical solutions for the heat supply from KAVEMA to SBŽ, as part of technical assistance to SBŽ in modernization of the district heating system.

• Technical assistance in preparation of purchase agreement (namely developing proposal of contractual conditions according to which heat supplies are to be priced, expert help in preparation and organization of public tender which is needed for conclusion of the contract).

• Participation at meetings organized with the cooperation partner and stakeholders and preparation of minutes from them summarizing major conclusions.

• Technical assistance in project design documentation for heat pipeline construction and, eventually, selection of suppliers (e.g. definition of required technical parameters of the pipeline, preparation of call for bids, evaluation of bids etc.).

• Expert advice and information exchange via networking upon request (e.g. phone calls, emails etc.).

• Optionally, preparation of application for investment grant (to be decided later).

2.2 Germany

Business case: Heat supply to 31 households of the neighbouring village

Name of cooperation partner: Fischer & Jehle GmbH

Contact person and position: Hermann Fischer (owner and operator)  
(Peter Dörfler Str. 48, 87656 Germaringen, Tel: 08344 1365)

Description of BC followed: The biogas plant Fischer & Jehle GmbH, for which a feasibility check was conducted, showed to be the most promising plant for the implementation of a heat concept of the investigated
biogas plants in Germany. Therefore, it was selected as a business case (BC).

The plant operator, Hermann Fischer, is highly interested in the realisation of a small district heating grid. He has conducted several preparatory works. The plant operator implemented the heating network which was put in operation in August 2014.

As a second cooperation partner, the engineering office Planungsbüro MAGG Bautechnik, is involved, as the office made the planning for the heating grid and supported the plant operator.

Core of the concept is the connection of 31 households of the neighbouring village Untegermaringen. The length of the whole grid is about 1,280 m.

The cooperation partner is seriously committed to implement this business case which, here, meets best criteria of being sustainable on a long term basis, beneficial for both parties, and has also ecological benefits.

In the feasibility check, the two options of guaranteed heat supply versus base load heat supply were investigated. Both options were found to be feasible for the present situation.

The results of the feasibility check were presented by the plant operator to the municipality council and the county authorities issuing the permission to increase the capacity of the plant in order to convince the authorities.

Basic parameters of BC: The actual major parameters of the selected BC are as following:

- Total annual heat production: 3,682,056 kWh
- Additional heat demand of the connected households: 1,130,679 kWh
- Annual heat demand of fermenter and connected households: 2,235,296 kWh
- Expected investment costs: 286,060 EUR
- Expected investment support from national support programme (BAFA): 114,424 EURO
- Expected revenues 40,000 - 60,000 EUR/year

Assumed BC implementation: Following further actions/milestones and their time-framework is assumed:
• Start with construction of the heating network: February 2014
• Monitoring of the implementation process: continuous
• Meeting with the plant operator: 28 April 2014
• Next Meeting: Invitation of the plant operator as speaker to the 2nd national workshop of BiogasHeat project in November 2014
• Finalisation of construction: August 2014

Forms of support by Partner: With the cooperation partner, following activities were agreed upon to be done by the Partner:

• Consultation about the BC with all involved parties (plant operator, engineering company)
• Provision of the feasibility check and BiogasHeat promotional tools in order to convince the households that have not yet definitively confirmed the contracts, as well as the authorities.
• Expert advice and information exchange via networking upon request (e.g. phone calls, emails etc.).
• Meeting and interview with the plant operator, the planner and heat consumers on 28 April 2014.

2.3 Denmark

Business case: Optimising the overall heat balance of the biogas plant

Name of cooperation partner: BIGADAN A/S

Contact person and position: Henrik V. Laursen, Chief Project Manager, email hvl@bigadan.dk

Description of BC followed: This Business Case concerns improved utilization of the heat production from Limfjordens Bioenergi biogasplant. The plant is a centralized biogas plant which was established in 2009 at the island of Mors.

Today, the biogas is used in a cogeneration unit with an capacity of 1,4 MW_e and 1,65 MW_th. The total electricity production is sold directly to the public grid.

The heat production from the cogeneration is used for process heating and for district heating through Sdr. Herreds CHP plant, where also natural gas is used.
The focus of this business case has been changed, because the partner BIGADAN has described a challenge with heat balance of their biogas digester design.

BIGADAN has established biogas digesters at many plants, including Fangel, Horsens – and of course Limfjordens Bioenergi – biogas plants.

The design of all these digesters has been with more or less the same specifications regarding insulation – that is, the vertical side of the tank is insulated with 100mm, whereas the bottom and the top of the digester are without insulation. Part of the rationale has been that the gas-filled space at the top of the digester would serve as insulation between the biomass surface and the tank top. Furthermore, having to insulate the tank top would offer additional challenges when erecting the digesters.

However, BIGADAN technicians have now questioned (among themselves), whether this design with un-insulated bottom and top actually is sustainable.

BIGADAN has therefore asked BiogasHeat partner DTI to change the focus of the business case into calculating the heat balance of the BIGADAN digester and develop a model for optimized digester design and heat utilization.

This coincides with a decision at Limfjordens Bioenergi - at least for the moment – to “freeze” the plans for upgrading and injection of the biogas.

Anyways, considering the number of digesters and biogas plants BIGADAN has already established – and expects to establish in future - BIGADAN and DTI finds the perspectives of an optimized digester design to have a potentially much larger impact on future optimized heat utilization on BIGADAN biogas plants.

This also means that a new plan for the business case has been laid.

Assumed Business Case implementation: The plan for the implementation of the business case is as follows:

- Meeting between Henrik Laursen, BIGADAN and Jorgen Hinge DTI for planning the revised Business case: September 1st 2014
- Calculating heat balance for the BIGADAN digester at Limfjordens Bioenergi: October 2014
• Modelling digester design and optimizing heat consumption in the BIGADAN biogas plant concept, including heat exchanger systems, hygenization units etc.

Outcome of the Business Case: Documentation for optimized process heat consumption at BIGADAN biogas plants.

Forms of support by Partner: The following activities are assumed to be carried out by/with the partner - Assistance in the following tasks:

• Calculating the heat balance of the BIGADAN digester:
  o Input/output biomass temperature/amounts
  o Heat exchangers performance
  o Biogas output temperature, moisture

• Modelling and optimization of BIGADAN digester design

• All reporting for the BIOGASHEAT project

2.4 Latvia

From feasibility checks made in Latvia two options were selected as the most promising for proceeding with business cases and field testing. The first one is biogas plant “EcoZeta” and other one is “Piejūra Energy” biogas plant. Both biogas plants are owned and operated by the same company - EuroEnergy Biogāze Latvija (EEBL), Ltd. For “EcoZeta” biogas plant the feasibility check was initiated by biogas plant construction - a company Ecogen. However, since this company is part of the joint venture EEBL, further communication and work on this plant was done with EEBL.

Business case: Using heat for drying of woodchips

Name of cooperation partner: EuroEnergy Biogāze Latvija, Ltd., Biogas plant “EcoZeta”

Contact person and position: Theofanis Mermigkousis, Deputy CEO

Description of BC followed: “EcoZeta” biogas plant is located close to town Cesvaine in the northern-central part of Latvia. The owner and the operator of “EcoZeta” biogas plant is EuroEnergy Biogāze Latvija, Ltd.

EcoZeta biogas plant is located in a remote area. Feasibility check results indicated that the only feasible option for this plant is to create heat demand on site of the biogas plant. One of the options suggested by the feasibility check report was installation of a small wood pellets factory. However this option required high initial investment costs and biogas plant owner decided to proceed with a drying option.
Investigation of available drying technologies on the market was performed, meetings with potential technology providers was organised and drying technology provider was selected. The selected drying technology is drying of loose products in mobile containers with a double perforated floor. Containers are connected to the heat pipe of the heat exchanger.

A critical framework condition of this project is that EcoZeta biogas plant is obliged to use heat in order to qualify for the feed-in tariff of electricity under high-efficiency cogeneration definition. In the beginning it was planned to dry digestate, but in order to make the project economically feasible, drying services will be provided for external clients. Negotiations with wood processing companies in the region have started and drying services are promoted.

EEBL have started implementation of that business case. The technology provider was selected and installation of the drying unit was completed in March 2014. Drying facility is in operation (Figure 1).

Fig 1: Drying facility in EcoZeta biogas plant (photo: I.Dzene, Ekodoma)

Drying plant belongs to a subsidiary company of EEBL and will purchase heat from the biogas plant. All investment in the drying technology and works was made by the EEBL and its subsidiary company.

The main risk of the project is related to a lack of demand for drying services. BiogasHeat project partner will help the owner of the drying plant to search for companies in vicinity that have a need for drying. In the future company should think about investing in construction of storage building or area for the dried products. This will offer more flexibility for the operation
of drying plant and will provide more optimised logistics of drying containers.

Basic parameters of BC: The actual major parameters of the selected BC are as follows:

- The estimated available annual heat amount for drying is about 9.5 GWh
- Environmental benefits (measured via CO$_2$ savings) – up to 2000 tCO$_2$ /year if all available heat is used efficiently
- Investment costs: 129 thous. EUR (actual investment costs, including cost of heat exchanger, containers, connections and installation works)
- Pay-back period: 2 – 7 years depending on the amount of the heat that is used for drying (demand for drying services).

Assumed BC implementation: Following further actions/milestones and their time-framework is assumed for EcoZeta project:

- Negotiations with wood processing companies nearby the plant (at max 30 km distance from the plant) about providing wood drying services (planned January to May 2014, but are delayed due to the organisational changes of the plant ownership structure).
- Monitoring and optimizing the drying process, marketing of the drying services (until May 2015).

Forms of support by Partner: With the cooperation partner, following activities were agreed:

- Help in the identification and evaluation of potential drying service requests.
- Technical assistance in project design documentation.
- Expert advice and information exchange via networking upon request (e.g. phone calls, emails etc.).

Business case: Heat delivery to a fish processing factory and residential DH system

Name of cooperation partner: EuroEnergy Biogāze Latvija, Ltd., biogas plant “Piejūra Energy”

Contact person and position: Theofanis Mermigkousis, Deputy CEO
Description of BC followed: The owner and the operator of “Piejūra Energy” plant is EuroEnergy Biogāze Latvija, Ltd. and the plant is located in Nīca in the south-western part of Latvia.

Piejūra Energy biogas plant is located close to residential areas. Biogas plant was built right next to a fish processing and caning factory. This biogas plant is required to ensure efficient use of heat in order to fulfil the high-efficiency cogeneration requirements.

Results of the feasibility check suggested using part of the heat for fish factory and supplying remaining heat to the district heating system of Nīca village.

The fish factory is operating since 2010 and initially was using black coal in 1.5 MW steam boilers to provide steam and hot water for production purposes. Lately fish factory has replaced coal boilers with new wood pellet boiler (capacity 0.9 MW) and additionally have constructed boiler at the biogas plant where using heat from exhaust gases of biogas CHP engines additional steam is generated and supplied to the fish factory. Connection from biogas plant to the fish factory was made at the end of 2013 (see Figure 2).

Fig 2: Connection from Piejura Energy biogas plant to fish processing factory (photo: I.Dzene, Ekodoma)

In order to be able to use surplus heat from the biogas plant completely, there is an opportunity to build a heat pipe to connect biogas plant with the local district heating system. Heating to Nīca village is provided from one central heating plant. Wood logs as fuel is used. Boilers installed in the heating plant are obsolete and will need to be replaced soon.
Since the heating plant is owned by the local municipality, there is a need to negotiate with representatives of the town council and get their agreement to the project.

This business case will be successful only in the case if municipality will be interested in this solution and therefore preliminary negotiations on behalf of the cooperation partner should be started soon. For the moment a preliminary study about heating system in the village have started and press clips related to the public attitude to the particular biogas plant have been collected and analysed.

**Basic parameters of BC:**

The actual major parameters of the selected BC are as follows:

- The potential annual used heat amount for fish factory is about 5.2 GWh, 4.2 GWh could be supplied to the district heating system.

- Environmental benefits (measured via CO\(_2\) savings) – 1 753 tCO\(_2\)/year saved by supplying renewable heat to fish factory, 1 400 tCO\(_2\)/year are saved in the district heating.

- Investment costs: Investment cost for installation of heat pipes from the biogas plant to the central heating plant is estimated to be around 372 500 €.

- Pay-back period: if heat is delivered to the district heating plant in the heating season only, the simple payback time of the investment would be 2.5 years (with assumption that heat is sold for 40 €/MWh and extra heat is purchased for 60 €/MWh). However, additional investment probably would be needed for the installation of additional boiler to cover peak loads of the district heating system.

**Assumed BC implementation:** Following further actions/milestones and their time-framework is assumed for Piejūra Energy project:

- Commencing the steam boiler and start selling exhaust gas heat to the fish factory (planned January to June 2014, delayed due to the changes in the ownership of the plant)

- Negotiations with Nīca municipality about opportunity to provide heat to the district heating system of the village (planned January to April 2014, delayed due to the changes in the ownership of the plant)
• Heat pipes project design documentation preparation and award of building permit (February 2015)

• Construction of heat pipeline and operational tests (April to September 2015)

2.5 Austria

Business case: Using heat for drying of woodchips

Name of cooperation partner: Bluamahof Wohlgenannt

Contact person and position: Bernhard Maaß: son of Mr Wohlgenannt, plant operator and farmer
Tel. +43 664 15 128 50

Description of BC followed: In the year 2013 total heat consumption measured was 362,758 kWhth. However, the theoretical heat output would be 673,412 kWhth. Therefore about 46% of the heat was not used. Even in winter months they do not use the entire heat.

At the moment heat is used for:

• heating up and hot water use of their own multifamily house (300 m²);
• hot water production for cleaning the butcher room (96 m² and about 800 L of 65°C water twice a week);
• heating the swimming pool;
• heating the stable for mother cow production.

Their current heat use business plan is the obtainment of the CHP bonus, which they receive since 1 January 2014. However, this needs a transparent evidence scheme that the heat is used efficiently. e7 will help to find the best heat use model along the whole supply chain. An in-depth analysis is required since the administration requires clear evidence what is going to happen with the heat and that heat is used efficiently.

Due to the small size of the plant drying of wood chip was identified as the most realistic heat use option.

Tendering: The plant operator started to do some research on heat use in May 2014. However, he did not succeed well. Therefore the Austrian biogas association recommended that e7 could help him for development of the business case and with the verification process.

Basic parameters of BC: Installed capacity: 60 kWel / 80 kWth
Full load hours in 2013: 7,950

Additional heat use potential: 40-45% (~311,000 kWh)

Space for drying is available.

About 10,000 EUR for investment in heat is available.

According to expert opinions a market demand for dried wood chips is given in the local area.

Assumed BC implementation: As soon as possible

September/October 2014

Forms of support by Partner:

- Selection and detailed technical description of heat use models for comparison (done together onsite with Mr. Ilg)
- Analysis of heat use data (done – desktop research)
- Economics assessment and comparison of heat use model drying wood chip with a container vs. drying wood chip with a trailer (ongoing)
- Finding suppliers and customer and helping to set up contracts (ongoing)
- Screening of technical solutions and assistance with procurement (ongoing)
- Development of an evidence scheme for Mr. Wohlgenannt that the heat is used efficiently in order to obtain the CHP bonus (ongoing, several meetings and telephone support sessions)
- Co-ordination activities with the Austrian biogas association (ongoing)
- Several discussions with the administration required (not started, will start after technical solution is defined)

2.6 Romania

Business case: Using heat for drying sludge in WWTP

Name of cooperation partner: SC Compania de Apa SA Buzau – Statia de Epurarea Apei (Buzau Water Company – Waste Water Treatment Plant – joint-stock company)
Contact person and position: Cristea Dumitru, technical director
(email: dumitrucristea@yahoo.com, tel: +40744536226)

Miritescu Fanel, chief engineer
(email: fanelmiritescu@yahoo.com, tel: +40749196560)

Description of BC followed: From feasibility checks undertaken, as suitable for a field test, has shown up to be the business case (BC) identified at biogas plant located at the Waste Water Treatment Plant (WWTP), at the eastern city border of Buzau, in the south-eastern part of the country.

The cooperation partner to do this is Buzau Water Company (joint-stock company) which is the owner and operator of the biogas plant.

The BC identified is to use the produced heat within the location of the plant for a technological purpose (drying the sludge and/or the digestate), and/or eventually to provide domestic heat to the house district located in the vicinity of the plant, at a distance of more than 500m (in the limit of the excess heat produced).

There is no district heating here, domestic heat being produced by burning natural gas and/or firewood in individual (home size) boilers. The plant currently covers its heat needs (heating the digesters and in-site domestic hot water and heating) by biogas fired in a CHP unit and a boiler (alternately operated). The heat excess is lost.

The cooperation partner is committed to implement this business case which is sustainable on a long term basis, beneficial for both parties, and has also ecological benefits.

For the implementation of envisioned BC, negotiations with both the inhabitants and the representatives of the Local Administration are necessary.

Because the pipelines will be laid down into the land which is predominantly owned by the town, there is also needed to get into contact with representatives of the city and get their consent to the project.

The basic precondition for BC realization is a long-term agreement, which will open the door for project design documentation preparation.

There is also considered the possibility to extend in the more distant future heat supplies at a reasonable distance from the plant.
It is possible that an alternative solution of using the generated heat for drying the digestate to be implemented. Another prerequisite in order to actually implement the recommendations of the BC is to identify a financing source for the project. Hence, one important part of the solution is to assist the partner into identify and apply for a financing source, most probably a structural fund. In order to accomplish that Mangus Sol is able and willing to assist WWTP Buzau into application procedure.

Basic parameters of BC: The actual major parameters of the selected BC are as following:

- Total annual heat production: 667620 kWh/year
- Environmental benefits (measured via CO₂ savings) – 120 tCO₂/year
- Expected investment costs – 230 000 EUR
- Expected revenues – 30 000 EUR/year
- Expected operational costs – 2 000 EUR/year
- Pay-back period – 7-8 years

Forms of support by Partner: Discussions with the cooperation partner will be focused on:

- Agreeing upon a solution from the ones presented;
- Participation at meetings organized with the cooperation partner and local administrators and preparation of minutes from them summarizing major conclusions.
- Technical assistance in project design documentation for heat pipeline construction and, eventually, selection of suppliers.

Field tests:

Focus on an energy audit related with the heat energy balance between biogas processors and the utilisation of the excess heat. This test is projected in the autumn 2014 when the weather conditions for a thermal scan image will be optimal. This test will show the possible improvements in the biogas fermenters insulation and the improvement of the heat pipe to the sludge drying facility. This test will correct the initial assumptions on the thermal insulation system made in the initial BC.

The second part of the field test focuses on the sludge drying process that could be improved by implementing new sludge dryer equipment. Tests of the input and output sludge water content will guide the decision over the type of the new equipment. BiogasHeat project partner is actively looking for a solution to the funding problem for
this partner. The new scheme of structural funds is expected to be fully active at the end of 2014 and hence it is expected to identify the opportunity for the financing in order to help the implementation of the BC.

2.7 Croatia

Business case: Using heat for additional electricity generation via ORC

Name of cooperation partner: Landia d.o.o. Vukovarska 100, 32214 Tordinci

Contact person and position: Davor Becić, biogas plant operator
Mob +385 91 113 3557
bioplin.landia@gmail.com

Description of BC followed: The cooperation partner for BC is Landia d.o.o. which is the owner and operator of the biogas plant located in a village Tordinci in Vukovar-Syrmia County, in the north-eastern part of the country. From all feasibility checks undertaken, a business case (BC) made for Landia appeared to be most promising, primarily due to high interest of plant operator in the project and realisation of BC.

Biogas plant Landia is operational from October 2012. It is a beneficiary of subsidized price for produced electrical energy according to agreement with Croatian energy market operator (HROTE), which was due in year 2007. Input raw material for production of biogas comes from one’s own sources and it is mostly made up of liquid cow manure from nearby farm (25,000 t/y) and maize silage (15,000 t/y).

Even though in FC were considered three different scenarios for the use of excess heat energy (according to their inputs and desire), the cooperation partner has expressed its desire to proceed with the scenario of ORC implementation. Two possibilities for ORC implementation were initially considered. The first one included upgrading ORC system to existing cogeneration unit, what would resulted in increased overall installed power and change in feed in tariff. This option is evaluated as economically unfavourable, since it would result in the decrease of revenues from electricity sales due to lower feed in tariff. The second option considered embedding of ORC into existing cogeneration unit. In this case the overall installed power as well as feed it tariff would remain the same, while the demand for maize silage as feedstock would be reduced resulting in significant economic advantage. Calculations show that this option is economically viable with payback period of 8.5 years. The payback periods depends on the cost of ORC technology and the cost of substrates for biogas production.
Basic parameters of BC: The total electrical capacity of biogas plant is 1,000 kW$_{e}$, and the total thermal capacity is 1,070 kW$_{th}$.

The total annual production of useful heat energy, after deduction of own technological consumption for biogas plant, is expected to be 5,279,400 kWh$_{th}$ (based upon expected 8,200 working hours per year).

Assumed BC implementation: Implementation of BC remains uncertain. Operator needs more time for consideration of economic viability of the option because at the same time he is also evaluating other possibilities for heat use (mushrooms cultivation). It is most likely that realisation might occur after the project lifetime.

Forms of support by Partner: EIHP is providing, in the first line, technological, economical and legal advices to the operator. In order to facilitate better cooperation two meetings took place:

- 27 March, 2014, Tordinci
- 14 July, 2014, Tordinci

Since ORC technology is not developed in Croatia, EIHP made contacts with several producers and distributors of ORC technology outside Croatia in order to learn more about the technology and see how it can be applied in Landia.

With the cooperation partner, following activities were agreed upon to be done by the Partner:

- Consultation about the BC regarding ORC technology, economic aspects and law provisions.
- Landia and EIHP are planning to visit together the ORC producer from Czech Republic. This visit will allow better insight into ORC technology and possibilities (September/October 2014).
- Services of EIHP might be needed for analysis of integral approach to heat usage by combination of ORC technology and using extra heat for growing mushrooms. This is yet to be decided by plant operator.

2.8 Italy

Business case: Using heat for additional electricity generation via ORC

Name of cooperation partner: EnviTec Biogas (plus three dedicated companies: Baura Biogas sarl, Formignana Biogas sarl, Caldogno Biogas sarl)

Contact person and position: Franco Nardin. Plant Manager. F.nardin@envitec-biogas.com

Description of BC followed: Three plants, with the same technology but in different locations, 999 kW of installed power in a remote part of the
countryside in flatland. Currently about 15% of heat is used for heating up the fermenter, so a large amount of the heat is available. The following options for heat use resulted to be not very convenient: setting up of a district heating system resulted to be not so convenient due to the lack of users nearby; no companies resulted around in need to dry wood or agriculture products; digestate does not need to be dried as it is already separated solid/liquid. The best option resulted to be the installation of an ORC plant for recovering the heat for the production of electrical power. In order not to lose the 280 €/MWh feed-in tariff which the plant is benefitting currently, the installed co-generator will be downgraded to 750-800 kW of installed power and the overall installed power will remain 999 kW, but there will be a substantial economic benefit from the quantity of feedstock that will be bought.

Basic parameters of BC:

Additional heat use: 85% of 8000 MWh per year (6800 MWh

The ORC will be 100 kW of power installed, for an estimated cost of 220-260,000 €.

Annual savings for the purchasing of biomasses could be around 90,000 € per year, so the payback time could be under 3 years.

Space for installing an ORC module is available, as the plant was intended to be doubled.

Assumed BC implementation: A meeting for assessing the feasibility of the operation in the three plants was conducted in the cooperation Partners’ premises in February 27, 2014.

Layout plan of the biogas plant in DWG format was sent by CP on August 25, 2014.

Contacts and meeting with ORC Provider Electratherm was conducted on March 17, 2014.

ORC design in DWG was sent by Electratherm on September, 27 2014.

Elaboration about possible integration of the installation of the ORC in DWG format was provided to both parties at the beginning of October 2014. Feedback from CPs is awaited before presenting the document to the competent authority for the provision of authorization to proceed with the works, namely the province of Ferrara. That would work in the same manner for all the three plants: Baura, Caldogno, Formignana.

Forms of support by Partner: With the cooperation partner, following activities were agreed upon to be done by the Partner:
- Consultation about the BC with all involved parties, including Municipality and Province Authorities (providing authorization for emissions)
- Market research for the best ORC module to be installed
- Market search for the best financing option
- Production of the Technical preliminary document on potential integration of ORC in the biogas plant
- Conduction of the talks with the managing authority for electrical services (Gestore Servizi Elettrici) which manages the incentives

**Business case: Using heat for drying of digestate**

Name of cooperation partner: Municipality of San Martino Buonalbergo

Contact person and position: Eng. Raffaele Perissinotto, councillor

`perissinotto@studioperissinotto.eu`

Description of BC followed: The Municipality (around 14,000 inhabitants) aims at being as autonomous as possible in the management of municipal waste. The idea of setting up an anaerobic digestion plant with a digestate drying facility for the management of organic urban waste fraction was included as a measure in the Sustainable Energy Action Plan (SEAP) that the Municipality submitted to the Covenant of Mayors Office in July 2013.

Basic parameters of BC: The biogas plant is in the planning stage.

The biogas plant, being dimensioned on the Municipality needs for organic waste treatment, would be a 100 kW installed power with around 800 MWh available for digestate drying.

Availability of feedstock: 1,526,88 t/year

Cost for anaerobic digestion plant: 850,000 €

Cost for drier: 200,000 €

Current cost for organic waste treatment: around 110,000 €/year

The plant would be located in the industrial area of San Martino, which is very large (contiguous and functional to the city of Verona). The possibility of installing a larger plan will be investigated, together with the availability of industrial organic waste. In the case of an interest by a company to treat it waste, a district heating system for a nearby production site would be investigated.
Taking into account the fact that digestate from waste treatment is still considered waste, probably the drying option will be still the most profitable use of heat, abating the costs for waste disposal/treatment (always calculated on weight rather than on volume).

Assumed BC implementation: Following further actions/milestones and their time-framework is assumed:

- January - November 2014: Market search for appropriate technology
  - October 8th, 2014, meeting planned with SorTech, MT-Energie and Revis in a B2B event
- November 2014: consultation with productive site stakeholders
- November 2014 - March 2015: Consultation with superior authorities (Province/Region) for authorization

Forms of support by Partner: With the cooperation partner, following activities were agreed upon to be done by the Partner:

- Support for economic assessment
- Support for technology choice
- Support for stakeholders consultation and involvement

Business case: Delivery of heat to DH system of public and residential buildings

Name of cooperation partner: Comune di Merlara

Contact person and position: geom. Andrea Permunian, Chief of technical office.

Description of BC followed: a 999 MW biogas plant of Envitec set up a district heating line of 340 m as a compensation for the authorization of the plant, but the “last meter connection” is missing and support is needed to find the right way of funding it, and Este, which has a large composting and AD plant with DH system for public buildings but aims at enhancing the network reaching new private customers and wants to increase efficiency by installing absorbers for cooling.

Basic parameters of BC: 430 m of DH line already in place (requested by LG to the biogas plant operator as an environmental compensation). Connection (“last mile” missing for 13 buildings)

Assumed BC implementation: Calculation of heat demand for 13 buildings (it was requested to the municipality technical offices but still not received). Business plan. Search for financial resources.

Forms of support by Partner: Search and Support in talks with potential Service providers/ESCos
3 Conclusions

To summarize, a total of more than 10 business cases were ultimately selected by project consortium for further development and, if proved as viable, also for field-testing. They can be divided according to type of heat use and their status as follows:

- Heat supply outside farm (Czechia 2 times, Germany, Latvia, Romania, Italy)
- Heat use for drying of wood chips (Austria and Latvia)
- ORC installation (Croatia, Italy)
- Heat use for digestate drying (Italy)
- Lowering own heat consumption at biogas plant for possible supplies to external customers (Denmark)

<table>
<thead>
<tr>
<th>Partner/Country</th>
<th>Business Case</th>
<th>Amount of heat to be newly utilized [MWh/y]</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>e7/Austria</td>
<td>wood chips drying</td>
<td>up to ~ 300</td>
<td>UPP</td>
</tr>
<tr>
<td>EIHP/Croatia</td>
<td>ORC installation</td>
<td>Not yet specified</td>
<td>TBA</td>
</tr>
<tr>
<td>SEVEN/Czech Republic</td>
<td>No 1 - Heat supply to external customers</td>
<td>up to ~ 1,500</td>
<td>UPP</td>
</tr>
<tr>
<td></td>
<td>No 2 - Heat supply to external customers</td>
<td>up to ~ 4,700</td>
<td>TBA</td>
</tr>
<tr>
<td>DTI/Denmark</td>
<td>Lowering heat demand of fermenters (for possible heat supply to external customers)</td>
<td>Not yet specified</td>
<td>TBA</td>
</tr>
<tr>
<td>WIP/Germany</td>
<td>Heat supply to external customers</td>
<td>up to ~ 1,100</td>
<td>R</td>
</tr>
<tr>
<td>Sogesca/Italy</td>
<td>No 1 - ORC</td>
<td>up to ~ 6,800</td>
<td>TBA</td>
</tr>
<tr>
<td></td>
<td>No 2 – Digestate drying</td>
<td>~ 800</td>
<td>TBA</td>
</tr>
<tr>
<td></td>
<td>No 3 - Heat supply to external customers</td>
<td>Not yet specified</td>
<td>TBA</td>
</tr>
<tr>
<td>Ekodoma/Latvia</td>
<td>No 1 - Heat supply to external customers</td>
<td>up to ~ 9,400</td>
<td>TBA</td>
</tr>
<tr>
<td></td>
<td>No 2 - Wood chips drying (for pellet production)</td>
<td>up to ~ 9,500</td>
<td>R</td>
</tr>
<tr>
<td>Magnus Sol/Romania</td>
<td>Heat supply to external customers</td>
<td>Not yet specified</td>
<td>TBA</td>
</tr>
</tbody>
</table>

Note: R = realized, UPP = under project preparation, TBA = to be assessed in field test

As can be seen, the list of selected business cases is quite diverse – in terms of heat use, its volume as well as the status of implementation. At the time this report was finalized, two business cases were successfully realized already and put into operation. Two remaining ones commenced to project design development and the others were still subject of more detailed assessment in the field test phase.