Raising Awareness on Sustainable Energy through Development of Agro-Energetic Chain Models

Radar Project Monthly Newsletter

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REGIONE MARCHE
Servizio Agricoltura, Forestazione e Pesca

Main Results of RADAR Project: Feasibility Studies realized by project partners on the agro-energy chain model

Last edition !!!

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Raising Awareness
on Sustainable Energy through Development of Agro-Energetic Chain Models

Dear Reader,

This is the last edition of RADAR Project Newsletter.
In order to show you the main results of RADAR Project, this edition contains the Feasibility Studies realized by all the Partners on the Agro-Energetic Chain Model elaborated in each Pilot Area.
We warmly invite you to follow the next RADAR Project Activities, and to know more about the RADAR Project results, products and possible follow up on the renewed project website: www.radarproject.eu

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Best Wishes from RADAR MANAGEMENT UNIT

Italian Feasibility Study

The feasibility study of the Italian partner, developed by the RADAR project, have been made by the scientific project partners on the basis of the previous research phase on the territories covered in the project, aimed at presenting the energy balance of the pilot areas and at identifying the availability of agro-forestry resources for green energy production. The feasibility study has been developed on the basis of most suitable agro-energy chain model and for the structural and agronomic characteristics of the pilot area have been proposed to the members of each rural sustainable energy community (SEC) and discussed by the key actors, which enabled them to improve and choose the most appropriate project on the agricultural and economic realities of the local area.
The agro-energy chain model chosen for the pilot area Alta Vallesina provides a bipolar system, with two plants, located in Mergo and Fabriano, which allow the use of ligno-cellulosic materials derived respectively from agriculture and forestry. In particular, in Fabriano, the biomass supply derives from agricultural wood biomass derived from SRF and forest waste of forest clearing activities, while in Mergo, the agricultural residues derive from the pruning activities collected by the most important farms in the area should be used. The wood processing can be done in the same place where the biomass is collected, thus avoiding additional transport costs. Both plants provide chip-based boilers with mobile grid steam turbine for an installed capacity of 500 KWe and 2,2MWt in Mergo, and 141 kWe and 611 kWt in Fabriano. The plant in Mergo will serve industrial buildings, while the plant in Fabriano could be used for a new school district. The school project is takes up an area of around 17.000 mq, where the heating district between school buildings is 300 m, for a total amount of biomass estimated at around 2.000 t/year. In Mergo the biomass could be used for a heating district entailing two industrial buildings located within 200 meters of one another and placed to the industrial area of the Mergo's municipality. Thermal energy will be used by these buildings, while the electricity produced will be sold to the national network through the mechanism of green certificates.

The managing of the wood-energy chain needs a company for biomass management in Italy; in particular, the forest consortium and agricultural local company will oversee to biomass collecting , while a new company will have to be created to mange both the biomass power plant and energy production.
Even so, the distance between biomass production area and where is used has been taken in consideration. In this case the distance is less than 20 kilometers; therefore the gas pollutions can be considered negligible. In according to the GWP evaluation, the CO_2 equivalent avoided deriving from gas combustion avoided from industrial buildings complex of the Mergo's municipality is estimated around 980 t/y and 128 t/y for school district of Fabriano. In other words could be translated as less consumption of TOE - Tons Oil Equivalent estimated 430 t/y and 57 t/y respectively.
After a first technical evaluation, the financial analysis has developed in order to estimate the economic feasibility of both projects.
For each analysis, the total investment cost and operating cost have been considered including in the analysis the probable type of sources of financing which could be available for a possible co-financing of each project. On the basis of all financial input-data, the financial return of investment has been calculated, evidencing the respective financial sustainability.
Several advantages could arrive to the whole pilot area at industrial, public administrations and agricultural sectors. In fact a fully automated wood-chip heating system to the Industrial area of Mergo would decreases the annual heating budget at the facility by about 14%, a economic

savings of more than 44.575 €/y in the first year. At the same time, the Public Administration of Mergo, owns the power plant, would has an incomes. More in detail, all cash inflows/outflows have been calculated and the financial indexes are taken in consideration, as: "*Net Present Value*, "*Internal Rate of Return", "Return of Investment", "Regular Payback Period", "Discounted Payback Time".* At twentieth year NPV would be over 3 million €, with 5% of Interest rate of banking loan taken as assumption, while the IRR and ROI would be 20,93% and 1,42 respectively. While if the inflation rate is assumed around 3% the DPT would be 5,6 years, not so far away from PBP value that is 4,3 years.

For Fabriano's project, would decreases the annual heating budget at the facility by about 57% and 65% respectively, with a economic saving of more than 25.000 €/y in the case of pellet is chosen as fuel, or 33.000 €/y of economic saving in the case of wood-chip is used as alternative fuel during the first year of operation for local school buildings of Fabriano district, and the Public Administration involved as owner of the power plant would has an incomes.

If the forestal wood-chip is considered as principal fuel. At twentieth year NPV of savings would be over 310.000€, with 5% of Interest rate of banking loan taken as assumption, while the IRR and ROI would be 10,94% and 0,41 respectively. While if the inflation rate is assumed around 3% the DPT would be 8 years, not so far away from PBP value that is 6,5 years.

The economic analysis appraises the project's contribution to the economic welfare of the region or country.

In particular, the contribution produced by financial analysis shows as the feasibility study proposed could be a positive occasion for the local area, and the virtuous cycle of the renewable energy use could be strengthened. It would be confirmed from a strengthening of the "*Agricultural Income*". In fact, the advantages of this virtuous cycle are not directed toward industrial and public administration but also the agricultural sector.

The biomass production derived from this last sector represents a "*key role*" for all renewable chain. The virtuous cycle will be primed if the agricultural farmers involved in the system will have a more stable incomes. In this case the biomass production step would produces a total agricultural income around 560.000 €/year for 9.500 tons/y of biomass sold.

The economic analysis is made on behalf of the whole of society instead of just the owners of the infrastructure, in fact other energetic benefits could weight upon on whole local area are large: the percentage of the renewable energy could be added by the total project to energy balance of pilot area is around 89% with an cost energy saving of around 80.000 €/y and a quantity of avoided greenhouse gases of around 1.000 t/y.

English Feasibility Study

The UK Pilot Area's 'Sustainable Energy Community' group formed in the town of Cleobury Mortimer in South Shropshire are looking at a wide range of renewable technologies appropriate to the area, including wind and micro-hydro, to serve and/or be owned by local occupants. However, for the purposes of the RADAR project (which is concerned only with agro-energetic chains) they have chosen to look at the feasibility of an anaerobic digestion facility based on a 200 head dairy farm. In order for this to be technically and financially viable it is likely to be necessary for it to take in other forms of biodegradable waste from elsewhere; particularly commercial premises. The main aim of the project is to increase the quantity of renewable energy produced in the locality whilst hopefully providing an income stream and/or savings to local investors/stakeholders and/or sustaining a local organization to implement further such initiatives. This will also have the benefits of increasing the local utilization of renewable energy, reducing CO_2 emissions and making use of/enhancing local (waste) resources. It will also increase understanding and awareness of RES & RUE as well as waste issues amongst the local community.

The chosen method of utilizing the biogas generated is through using it to run a Combined Heat and Power unit (a standard spark-ignition Internal Combustion engine driving an alternator with heat recovery). The potential for piping the gas to neighbouring premises (currently heated on LPG) was analysed as an option as it would be easier to extend this into serving a wider area and there would be lower energy losses. However, the value of the

gas in this form would be lower than running it through a CHP engine and supplying hot water instead. This would have a significant bearing on the cost of the plant as the gas would have to be cleaned up to a sufficiently high standard (an important safety consideration if being combusted in 'domestic' appliances).

Up to 22,000 tonnes of waste including Farm Yard Manure from other local farms and up to 20% of which is non-farm waste (including waste from food processors and commercial catering premises) has been identified within a 10 mile radius of the location. The feasibility analysis suggests that this (if all can be diverted into the plant) could generate some 6.55 GWh of biogas per annum. A 500kWe CHP unit producing electricity and heat at respective efficiencies of 40.4% and 43.5% is available. The plant itself would require an estimated 8% of the electrical power and 18% of the heat generated by the CHP unit.

The greatest value income stream will be in the electricity generated – every unit generated is likely to receive 11.5p/kWh under proposed 'feed in tariffs (FIT's)' (starting in April 2010 and guaranteed for 20 years) and 5p/kWh as 'export value' or as the value of displacing electricity used on the farm. This could be worth over £500,000 per annum. The maximum value of the heat produced is the value of the fuels it can 'displace' locally which are predominately heating fuel with a value of around 5p/kWh. Whilst utilizing the heat only makes a difference to income of around £170,000 between 100% utilization and 0% utilization it will be essential to use a good proportion of it in order to be eligible for the proposed FIT rate. Furthermore, this may change if a Renewable Heat Incentive, for supplying hot water generated from renewable sources to premises, is introduced into UK energy strategy (legislation for this is in place and it is expected to be implemented from April 2011. It could be worth an additional ~2p/kWh).

The proposed location has the distinct advantage of having a relatively high (mainly process) heat demand on site and from neighbouring premises (including a golf clubhouse, holiday cottages and an outdoor activity centre with residential accommodation) totaling some 1.5 GWh per annum; this in addition to the heat required by the plant amounts to 62% of the heat generated being utilised. Whilst it will significantly increase capital costs to service these premises it is likely to be essential if the plant is to meet the 'good quality CHP' standards likely to be required in order to receive the higher FIT. Further to this the availability of a 'district heat main' could lead to future development or expansion in the immediate locality further increasing the utilization of the heat.

Additional income could arise from charging a 'gate fee' that is competitive with the land fill tax of £58/tonne or other disposal options (although this will inevitably incur additional operating costs for collection etc. This may not last the whole duration of the project (as the technology becomes more widespread). The 'digestate' would need to be returned to the farmers supplying the facility on the basis of nutritional value and the costs of transporting their waste to the site could, perhaps, be covered by the receipt of additional quantities of 'digestate' (i.e. from the non-farm waste). There may remain additional digestate which is estimated to have a displacement value of around £6.50 per m^3 against mineral fertilizer. However, there needs to be further evidence of nutritional values of the digestate and further analysis of the cost of this route of processing to the local farmers.

The figures used in the feasibility study need to be further verified by further consultation with the community and other stakeholders; particularly as there will be many regulatory issues to resolve. However, a theoretical capital investment of £2.75 million and annual operating cost of £200,000 with annual income of £600,000 would result in an Internal Rate of Return of 12.9% and NPV of £1.427 million at a discount rate of 8%. In order to finance this the group will be seeking a combination of grant funding, bank loan and investment from individuals through an innovative 'community share offer' as pioneered in the UK by the co-operative company, 'Energy 4 All'.

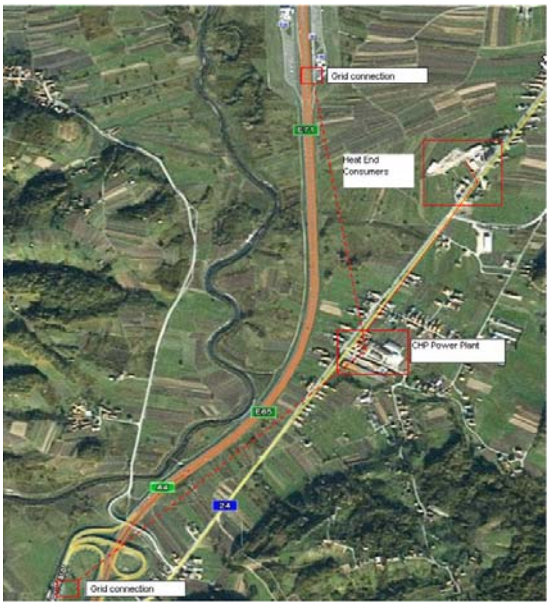
The efficient use of heat and power is particularly pertinent to a RES project under the RADAR project as it was identified during the 'pilot area description' exercise that as a whole the area had sufficient resources to be self-sufficient in its heat and power requirements if NET energy consumption were used in estimating demand (i.e. not accounting for heat losses at power stations providing electricity to the area). In order to be energy efficient, therefore, it is essential to maximize the utilization of heat generated as part of the electricity generation process.

Croatian Feasibility Study

Type of Agro-Energetic Chain Model for which the Feasibility Study was made and which will be realized in the RADAR Project Pilot Area in Croatia is the **Wood-cellulosic heat and electricity chain**. Wood-cellulosic heat and electricity chain is the agroenergetic system that produces thermal and electrical power from locally available, renewable energy sources. A primary material source used in the Chain is biomass from local forests and wood processing industry. Main technological concept which is involved in the energetic utilisation of biomass is using it as a fuel for stationary CHP's (combined heat and power plant) to produce both electricity and heat. Electrical energy produced is fed to the grid and thermal energy produced is distributed among the different end users who belong to Industrial, Agricultural, Tertiary, Domestic and Civil Sector.

Feasibility Study was made for the Project which main objective is to build a CHP plant to produce electrical and thermal energy. General Project objectives are energy costs saving, decentralized energy production, implementation of innovative, clean and environmentally friendly technology, production of high quality wood products, high standard working conditions, sustainable family business tradition, development of Kircek Ltd. company and development of Municipality of Ljubescica in Croatia.

CHP power plant will be realized on the premises of Kircek Ltd. private company, situated in the Municipality of Ljubešćica, Varaždinska County in Croatia. Kircek Ltd. company is producer of solid wood panels and has a constant heat energy demand during production process. The quantity of energy produced will be enough to satisfy both annual energy demand of Kircek Ltd. company and energy demand of a few public buildings in the Municipality of Ljubešćica.



Planned CHP plant will have an electrical output of 900 kW_{el} and thermal output of 1.570 kW_t. Total investment cost of the Project amounts to 4.741.800,00 EUR. Investment includes project planning, documentation preparation, permits, project management, training and commissioning, combined heat and power plant facility, land purchase and construction of production hall and a warehouse, heat pipeline construction (2 kilometers) and operational capital. Total annual expenses of the Project include expenses for raw material (biomass) and other material costs, maintenance, employee costs, depreciation and loan interest. In the first year of operation, total annual expenses of the Project are calculated to 768.858,16 EUR. Economical lifetime of the project is 15 years.

According to results of the Project financial analysis, Internal rate of return (IRR) amounts to 16,18%, Net present value (NPV) amounts to 5.057.481,00 EUR and Discounted payback period is 7 years. Interest rate (IR) taken for calculations is 4%.

Project will be financed from 3 main sources of financing – private capital, bank loan and EU grant. Kircek Ltd. company will finance 10% of the total investment (private capital). A bank loan with 4% annual interest rate will be received from Croatian Bank for Reconstruction and Development and EU grant for the rest of 50% of the total investment will be received from the WeBSEDFF, an EBRD's Western Balkans Sustainable Energy Direct Financing Facility.

Main risks of the Project's implementation are major changes in feed-in-tariff system (the price for electrical energy produced), changes in price for thermal energy produced, changes in the bank loan interest rate and operational costs changes. These changes could positively or negatively affect Internal rate of return, Net present value, Investment's payback time and Investment's discounted payback time of the Project.

Apart from the above mentioned economical indicators, it is necessary to emphasize that realization of the Project will lead to new employment of seven people directly in Kircek Ltd. company to operate the plant and another ten people will be employed indirectly in other companies to fulfil the personnel need of Agro-energetic Chain functioning. Thanks to Project implementation, more than 1,3 mil. EUR will remain in Croatia each year, because local resources (biomass) will be used to produce power and heat, instead of importing fossil fuels from abroad. According to calculations and statistical data, percentage of renewable energy added by the Project implementation to the energy balance of Pilot Area in Croatia will amount to 80%. Because of technology used, a 215 tons equivalent CO_2 (greenhouse gases) will be avoided each year and the total amount of avoided greenhouse gases in the Project's lifetime will amount to 3.225 tons equivalent CO_2. Considering all the stated economical, social and environmental indicators, it is obvious that Project is feasible to be implemented in Croatia and the next phase is to start with realization of the Project.

Latvian Feasibility Study

The most popular technology of using local agro-energetic resources in the pilot region currently is a direct digestion of biomass (mainly cut wood) in the individual houses of rural area and this situation will remain the same in the nearest years as soon as rural individual houses are located rather far from each other and centralised provision of heat energy is not possible in such conditions. Other opportunities could be considered along with the change of individual heating boilers to modern ones working on wood and peat pellets. But the implementation of modern technologies in the individual householdings is limited with the limited access to the financial resources.

The system of centralised heating in Vilani with its total capacity of 7 MW is working on wood chips and peat. The boilers of this system **could be also replaced into more efficiemnt ones with integration into co-generation scheme**. Such modernisation needs considerable financial investment and currently local municipality is lacking both financial resources and a concurrent plan of energetic development of the whole system of heat supply.
One of the option how to overcome this difficulties is introduction of **private-public-partnership scheme.** The town of Vilani does not accept this scheme as soon as the municipality will receive only the most problematic function - collection of payments of heating.
Also the **local municipalities are not used to such forms of partnership as local politicians are afraid that these forms might reduce their power.** This problem to a certain extent is a psychological one issueing from the short-term motivation of local authorities. Being elected for 4 years a lot of them are concentrated on the short-term tactical tasks and ignore long-term strategic ones. The most prospective chance to improve the energetic supply situation in the region is to include local entrepreneurs in this process as they naturally have got more influence to the decision taking by local authorities. Their projects on the modernisation of local energetic system might be supported by the European Structural funds as up to 50% of the expenditures of successful projects might be covered from these funds.

In these **conditions the most realistic in the nearest time in the pilot region of Vilani seems to be the introduction of a network consisting of small (up to 1 MW) biogas combined heat and power (CHP) stations on the base of existing relatively large farms.**
Introduction of **biogas stations working on wastes** would not be efficient in the piot region because the population as very dispersed, so it would be very difficult to collect enough raw material for efficient production of energy.
Combined use of wind power stations together with solar batteries also seems not to be very efficient as soon as wind is rather slow in the region and solar batteries require initial investment which are too high for the region.
Other options of using energetic cultures such as **CHP station working on chips** which may be received from short rotation crops have been also considered. But such options still need further researches for Latvian climate conditions and the investments in such technologies seem to be of high risk at the moment in Latvia.

As mentioned above **the most prospective model of the energetic development of the pilot region is the creation of a network of**

CHP stations working on biogas which may be received from agricultural energetic cultures and organic waste (manure) from cattle.

In addition to 50% co-financing from the European Structural funds of the expenditures for the projects which include arrangement of cogeneration power stations, local entrepreneurs might use the favouable local law conditions when the electric energy produced in the CHP station might be sold to the operator on approximately 2-times-higher-tariff than electricity produced by conventinal methods – in case such station is working no less than 8000 hours. per year and no less than 60% of sold energy is heat energy. These conditions seem to be very attractive for local entrepreneurs to investment in CHP stations. The most important task they should resolve to make the project most efficient is how to use heat energy especially in summer time. The organization of auxiliary enterprise using this energy could be considered as one of the optimum option.

Estonian Feasibility Study

Estonian Pilot Area is the territory of five rural municipalities of South- Estonia. There are Meremäe, Mikitamäe, Misso, Värska and Vassteliina Rural Municipalities. Four of these (exept Vastseliina) municipalities are as Seto cultural municipalities.

In economic sector most common fields are forest and furniture, industry agriculture and tourism.

In our Pilot Area electrical energy is not produced. All power energy by Estonian national power company Estonian Energy Ltd is distributed. This company owns transmission grids as well. In Estonia power produced from oil-shale 98% and 2% from different renewable resources (wind, hydro, biogas etc).

Today researches about one biogas station for cogeneration from agricultural waste and biomass are ongoing.

Project idea is to build up biogas agro-energetic chain which use local resources like agricultural waste (manure) and herbaceous biomass (green silage) supplied by local farmers. Aim is to operate all chain by local actors.

Location of the project: Meremäe village, Meremäe commune (rural municipality). Developer is agricultural company Kimeko OÜ, the owner of piggery farm in Meremäe.

Main source of biogas are manure from Kimeko piggery (one in Meremäe village and new one in Obinitsa village, 7 km from Meremäe) and herbaceous biomass supplied by local farmers (landowners). Biomass will cut from agricultural lands (energy crops like maize, reed canary grass or galega) and from semi-natural grasslands. Amounts of manure and potential biogas production can see in the Table 1.

Table 1. Potential biogas production from animal manure

Location	Number of animals per year	Type of biomass	Amount of manure*	Amount of manure	Dry matter, DM	Organic part, OM	Biogas/ OM	Biogas
	unit/year		t/unit	t/year	%	%	m^3/t	m^3
Meremäe village	13 000	pig manure	0,8	10 400	28,5	82,1	197	479 388
Obinitsa village	14 000	pig manure	0,8	11 200	28,5	82,1	197	516 265
Meremäe village	100	cow manure**	21,4	1 070	25	80	380	81 320
Sum:				**22 670**				**1 076 973**

*with sawdust, peat (50%) for pig manure

** 6 month cow are in the barn, 50% will be used for biogas

In Table 2 Potential biogas production from green biomass, in the distance max 7 km from Kimeko Farm (Meremäe village) is given.

Table 2. Potential biogas production from green biomass

Location	Source of biomass	Land	Biomass	Bio-mass	Biomass		DM	OM	Biogas / OM	Biogas
		ha		t/ha	t/a	t/day	%	%	m^3/t	m^3
Meremäe village	Kimeko Farm	140	galega	35	4 900	13	30	90	550	646 800
Meremäe village area	Rent from other farms	200	galega	35	7 000	19	30	90	550	924 000
Sum:					**11 900**	**33**				**1 570 800**

Transportation of raw material for biogas plant can organize by two ways:

1. Landowners and other farmers deliver. It means that price of biomass in plant may vary often and in large scale.

2. Self-supplying. It means that the members (owners) of company harvest biomass from fields belong to them and supply the biogas station. In calculations will taken variant 2.

Transportation cost related mainly with herbaceous biomass because manure storage will be close to plant. Herbaceous biomasses (silo) will storage in silo tanks (special silo storages) next to plant.

From storages the biomass, manure and herbaceous biomass, transported to mixing tank. Then the biomass directed from the mixing tanks to the biogas reactor, where an anaerobic process takes place, which for the most part is mesophilic, with the temperature in the range of 35 -38° C. During the process (it takes 28- 32 days), biogas is produced from organic substances in an oxygen poor environment, which is comprised primarily of carbon dioxide.

The produced gas is directed for the most part to the gas storage tanks at the head of the biogas reactor and from there to the heat and power station where the chemical energy of the biogas is transformed into heat and electricity. The waste material coming from the biogas reactor is directed towards the fermenting waste storage tanks and is used for the fertilisation of fields where grow energy plant. Data about estimated power and heat production in Table 3 are given.

Table 3. Potential production of electricity and heat from biogas

Type of biomass	Biogas production	Power production	Electrical capacity	Heat production	Thermal capacity
	m^3	**MWh**	**MW**	**MWh**	**MW**
Pig manure from Meremäe Village	479 388	1 162	0,15	1 234	0,15
Pig manure from Obinitsa Village	516 265	1 251	0,16	1 329	0,17
Cow manure	81 320	197	0,02	209	0,03
Galeega from Kimeko farm (140 ha)	646 800	1 568	0,20	1 665	0,21
Galeega from rented land (200 ha)	924 000	2 240	0,28	2 378	0,30
Sum	**2 647 773**	**6 418**	**0,80**	**6 815**	**0,85**

We plan biogas plant with capacity 0.8 MW. Investments needed to build CHP biogas plant ca 2.5 MEUR.

In this CHP biogas plant we plan produce in year:

- power ca 6.4 GWh

Power will sold to national grid. Grid owned by state and operated by national company Estonian Energy Ltd. Price is fixed by law and it is 1.15 EEK/kWh (0.073 EUR/kWh).

- heat 6.8 GWh

Heat will sell out to newly built central heating system and used in greenhouses by agricultural company.

- waste matter of biogas production is good fertilizer.

The concentration of unpleasant odours in the waste from fermenting is therefore reduced, as well as the level of pathogens, weed seeds and pests. Whereas the nutrients in the created organic fertilizer are, for the most part, in mineralised form, and more easily accessible by plants. Waste is possible to sell back to farmers or use it on owner's fields.

Project results

Build up 0.8 MW_{el} biogas plant with CHP.

Production of plant is ca 6.4 GWh of power and 6.8 GWh of heat in year from renewable resources.

Developing of cogeneration total energy efficiency (in production side) in Estonia will improve.

CO_2 emission in energy production is reduced.

Local methane emission is avoided.

4 new jobs directly are created.

Ca 60 apartments will switch to central heating system.

Schoolhouse will connect to central heating system.

At least 200 ha abandoned land will taken to active use.

In Estonia the price for electricity is still low 7.4 €cent/kWh (even if we would use heat). Electricity price might grow because market will be open in few years. The price must be 11.5 €cent/kWh. Results of calculations are given in (Table 4), accounted that we will get 50% grant.

Table 4 Results of economical calculations

Price of Electricity	IRR	NPV	Discounted pay-back
EUR cent/kwh	%	EUR	years
7,4	9,5	282 032	9,3

Bulgarian Feasibility Study

Preliminary energy studies in Bulgarian Pilot area, Pazardjik region, have shown that the main share in the municipal energy expenses belongs to the heating base on black oil. Increase in the black oil price makes impossible to maintain a normal microclimate in public buildings (schools, hospitals, etc). There is a huge need to find alternative solutions based on local resources. Thus, the agro-energetic chain chosen for the project is the direct use of wood chips for heat production.

The agro-energetic plant will be localized in the municipality of Panagyurishte. The available wood residues in the municipality are mainly of broad-leaved trees. The forests of state property represent 83 % of the total afforested area in the municipality, 6,5 % represent municipal property. The wood residues produced are estimated at 33 794 dense cubic meters which equals approximately to 60 GWh, more than 7 times higher than the needs of public buildings in the municipality.

The general aim of the project is to help in short period to the smaller municipalities not having perspectives for gasification to settle upper mentioned problems. Besides the ecological effects of the substitution of liquid fuels with local resources, the reduction of energy costs for public buildings will make possible their renovation with keeping standard living conditions.

Project is aiming in reduction of CO_2 emissions at local level trough substitution of oil fuel with wasted wooden biomass for heating and hot water in the public buildings and parallel implementation of energy savings measures in the Region of Pazardjik.

The objective of this agro-energetic chain model is the substitution of black oil with residual biomass will contribute to reducing heating costs and improving environmental conditions. Another economic advantage of the chosen Agro-energetic model is the possibility for reduction of fossil fuels' import through its substitution by local produced wood residues.

Establishment of agro energetic chain should bring in the municipality creation of new employment and improvement of living standard. The utilization of forest and agricultural residues and waste on one hand contributes to improvement of environmental conditions, by decreasing the quantity of deposed waste and hence the rescue of contamination, and on the other - by reducing the area of dunghills.

The availability of wood residues in considerable quantity (about 50% of the quantity of lumbered wood) with relatively sustainable supply defines final choice of Agro-energetic chain – use of plant residues for energy production. Most suitable technology for energy production in the region is heat production, where wood chips will substitute the used at present black oil. An additional advantage of agro-energetic chain would be the cogeneration of electricity. The main obstacle to the technology of cogeneration is the fact that in Bulgarian Pilot Area the ratio between big towns and villages is approximately 1:3. This makes the cogeneration ineffective because summertime there are not consumers for generated heat.

For sustainable and cheap heat production the basic requirements that the plant should satisfy include short distance between the place of wood-residues source and the boiler.

During the first phase of the harvest system, the usual mechanization is necessary, transportation being fulfilled by trucks. This phase is realizable all over the year, but preferably during spring, summer and autumn.

The wood residues could be stored at the place of their use, close to the boiler.

Before the use wood residues should be chopped. There are producers of Bulgarian chopping machines as well as boilers offering affordable prices for its equipment.

After a number of discussions with the representatives of regional and municipal authorities it was considered the agro-energetic plant to be localized in the municipality of Panagyurishte. The available wood residues in the municipality are mainly from broad-leaved trees. The wood residues produced are estimated at 33 794 dense cubic meters which equals approximately to 60 GWh, more than 7 times higher than the needs of public buildings in the municipality.

Sustainability and feasibility of agro energetic chain depends strongly on the availability of agricultural residues and a gro-industrial wastes. Another aspect of the sustainability of biomass-for-energy chain is related to its ecological influence on the environment. The utilization of forest and agricultural residues and waste contributes on one hand to improvement of environmental conditions, by decreasing the quantity of deposed waste and hence the rescue of contamination, and on the other hand - by reducing the area of dunghills.

Municipality of Panagyurishte is located in the central part of Sredna Gora Mountain, in Panagyurishte valley down the river Luda Yana. The average altitude is 683 m. Afforested area – 46,69%, is the biggest part of municipal territory. Municipality of Panagyurishte has an important geographic-transport position; various relief and climate, mineral springs, abundant flora and fauna, which represent serious potential for development of tourism; rich forest resources, giving possibilities for strongly developed forest farming, wood and timber industry and woodworking.

In addition project implementation has:

- Social effect expressed in the number of created new jobs in the region - nine direct positions and 250 indirect ones.
- Environment effect expressed in reduction of about 1 500 CO2 equivalent.