Baltic Sea Region
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Bioenergy Promotion

IHK Potsdam

Potsdam Chamber of Industry and Commerce

Task 4.5 Pilot Projects

Final Report
- Draft Version -

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Sub-regions and partners in task 4.5

In Task 4.5 the following sub-regions and partners were in involved:

- Denmark - Zealand
  - Region Zealand (Partner 09)
  - Roskilde University (Partner 34)
  - Institute of Food and Resource Economics Copenhagen University (Partner 35)
- Estonia - Saare county
  - Foundation Private Forest Centre (Partner 13)
- Finland - North Karelia
  - University of Eastern Finland (University of Joensuu) (Partner 11)
- Germany - Rotenburg (W) county
  - Chamber of Agriculture Lower Saxony (Partner 04)
- Germany - North-west Mecklenburg county
  - County of North-west Mecklenburg (Partner 06)
  - University of Rostock (Partner 08)
- Germany - West Brandenburg
  - Chamber of Industry and Commerce Potsdam (Partner 07)
- Latvia - Tukums municipality
  - Latvian State Forest Research Institute *Silava* (Partner 16)
- Latvia - Jelgava municipality
  - Latvia University of Agriculture (Partner 18)
- Lithunia - Kaunas county
  - Lithuanian Institute of Agriculture (Partner 21)
- Norway - Inland region
  - Norwegian Forest and Landscape Institute (Partner 28)
  - The Energy Farm (Partner 30)
- Poland - Pomerania voivodeship
  - Szewalski Institute of Fluid-Flow Machinery Polish Academy of Sciences/Baltic EcoEnergy Cluster (Partner 22)
- Poland - West Pomerania voivodeship
  - Koszalin University of Technology (Partner 23)
- Sweden - Jämtland and Västernorrland
  - JiLU – Institute of Forestry (Partner 02)
- Sweden - Västra Götaland
  - Västra Götalandregionen, naturbruksförvaltningen (Partner 32)
- Belarus - Grodno county
  - Volkovisk Forestry Enterprise (Partner 26)
  - Grodno Region Forestry Board (Partner 27)

Summary

Task 4.5 was about the initiation, prearrangement and preparation of pilot projects. Each involved sub-region had to propose one or several pilot projects. The pilot projects should consider either the production and use of bioenergy, the acquisition of bioenergy resources as well as transport and logistics of those. It is expected that pilot projects could be technically implemented. In order to evaluate the implementation opportunities it was necessary to assess the available biomass resources of the sub-region and the framework for investment opportunities on national as well sub-regional level. Further it was necessary to make pre-feasibility studies for the implementation of the pilot projects. The work of task 4.5 is linked to task 4.2 due to biomass assessments of sub-regions, task 4.4 providing a business and industry analysis on sub-regional level and to task 5.2 which also investigates business opportunities but rather on a on national than a sub-regional level.

The proposed pilot projects were evaluated according to the following criteria:

- novelty (innovation) — innovative level of the project
- sustainability — as defined in the WCED 1987, Brundtland report
- transferability — is it transferable to all countries/sub-regions
- marketability — is there a market potential
- accessibility — is there access to visit
- coverage — vertical - value added chain; horizontal - regional spread
- implementation status — is it close to being established or just an idea
- responsible bodies — for implementation - big business or small companies or regional administration

The evaluation led to three good practice examples over all regions as well as one particular good practice example for each sub-region.

In the end the partners were asked to give an update on the implementation status, the obstacles for implementation and changes of the pilot projects.

The main findings of the task were:

- All sub-regions have reasonable resources of bioenergy. There is clear division of sub-regions forestry dominated and others being dominated by agriculture.
- While in the Eastern European sub-regions there is is still a quite traditional use of bioenergy, the sub-regions from Western and Northern Europe reveal in many case a more sophisticated use of bioenergy, e.g. biogas and Fischer-Tropsch biodiesel.
- Nevertheless the more sophisticated the bioenergy resources are the higher is the demand on distribution network, e.g. wood briquettes can be sold at local shops, biogas needs a gas grid.
- Local actors play an important role for the implementation, technically and socially. Authorities and administrations are important for setting the legal framework and for the implementation of demonstration projects. Big players can act as a market opener but can also cause sustainability problems.
- Bioenergy still is a competition to fossil energy because of prices and distribution. And in areas with already high density of bioenergy projects there is already resistance growing according to 'not in my backyard'.
- Transferability of pilot projects to other sub-regions would be improved if there is an honest description of weak points and failures.

The large variety of pilot projects built a good base for the development and the implementation of comparable projects in other sub-regions on all levels of complexity and a large variety of bioenergy resources.

1 Introduction

The identification of Pilot Projects is one of the central tasks of the Interreg IVB Project **Bioenergy Promotion,** a joint project of 33 participating partners from the ten countries around the Baltic Sea.

The identification of pilot projects followed the assumed course: The partners had to name and describe possible pilot projects based on the assessment of the regional potentials of bioenergy resources, the economic opportunities and the political and societal framework conditions. These pilot project proposals were evaluated in order to provide 1 good example for each sub-region as well as 3 good examples over all sub-regions together.

The pilot projects should contribute to the development of bioenergy provision or use within the particular sub-region but they should also be a role model for the development within other sub-regions. There was no factual demand on the state of development of the project. So they can be in a very beginning stage of action, i.e. that there is still a large demand for research and development, or can be in the middle of implementation. At least they shouldn't be an already realized project. The projects could cover a single bioenergy resource as well as a whole range of resources.

In order to evaluate the pilot projects in their sub-regional context we will give a brief overview on the inventory of resources in the sub-regions according to the assessment reports of the partners. A more comprehensive presentation of the regional potentials has been done in Task 4.2 and presented in its final report[1]. Then we give a synopsis of the suggested pilot projects. We compare the different bioenergy types, their sources and their applications which were described by the partners. We further analyse the purpose of the projects in context with the state of application and the framework this projects should

1 Rosenberg, A. (2010). Final Report for Task 4.2. Regional Bioenergy Potential. 39 p + annex. Publ. June 17, 2010. http://www.bioenergypromotion.net/project/publications/the-final-report-on-task-4.2-titled-regional-bioenergy-potential-is-now-available-for-download

apply. The partners were also asked to do pre-feasibility studies on their proposals which also should contribute to the evaluation of the proposals. Finally there will be a brief overview on decision tools for investors, i.e. availability of auxiliary means from politics as well as financing institutions, in order to implement bioenergy projects into real operation. This decision tool is a brief version of the framework of investment business options assessed in task 4.4[2] (sub-regional level) as well as in task 5.2 (national level). The task was concluded with an update on the pilot projects indicating the current state of implementation, obstacles to implementation and changes during implementation.

2 Potentials of bioenergy in the sub-regions

This section describes the potentials of bioenergy of each sub-region gathered by questionnaires to the particular partners. Hence, specific data may reflect rather the view of the respondent than the general view in the specified country or partner institution. In a final conclusion of this chapter we give an overview on existing and potential bioenergy supply as far as available from provided data.

2.1 Denmark - Zealand (Partner 09/34/35)

The Danish sub-region Zealand is the result from restructuring the administrative units of Denmark and comprises the former counties of Roskilde, Storstrøm, and Vestsjælland. The main bioenergy resources of the sub-region are municipal solid waste, waste and produce from agriculture as liquid manure, straw and grain, wood waste as well as waste from food industry e.g. bagasse from sugar production. Two thirds of the available straw are already used in regional CHPs. A recently established bioethanol plant is going to use 30,000 t/a of biomass.

2 Gärds, G. (2010). Task 4.4 Business and Industry Analysis Summary Report. 22 p + annex. Publ. January 30, 2010. http://www.bioenergypromotion.net/project/publications/summary-report-task-4.4-business-and-industry-analysis

2.2 Estonia – Leisi/Saarema (Partner 13)

Saarema belongs to a number of islands in the Baltic Sea. It covers an area of 2,922 km² of which 570 km² is arable land, the major part is covered by forests. The municipality Leisi covers 348 km² and has a total population of 2137. Leisi is divided into 45 villages.

Forests are to 90 % in small holder ownership, 23 % of the forest is nature protected and 40 % is Natura 2000 area. The forests are dominated by pine (75 % of state forest, 56 % of private forests) and has a considerable amount of oaks (1 % state forest, 4 % private forest). The annual wood harvest delivers 478,400 m³, of which 78,400 m³ are used as fuel wood. There is a potential of 87,100 m³ of non-used residues. There are further 2,500 ha below power lines which could be potentially used to produce 3,200 tons of short rotation wood. The application of these potential resources would imply to install new combustion technology, traditionally round wood is used as fuel wood.

The sub-region cold supply approx. 59 TJ solid fuels which would cover the entire heat energy demand.

Further bioenergy potentials are manure, which is already partly used for anaerobic digestion, and reed would be a considerable resource if harvesting could be done more economically.

2.3 Finland – North Karelia (Partner 11)

The sub-region is sparsely populated. It covers an area of 21,585 km² of which 17 % are lakes, 4 % are agricultural land and almost 70 % are forests. The dominance of forests is also given by an average of 8 ha of forest per head. The total volume of growing stock is 168 M m³ of which 91 % or 158 M m³ can be used for wood supply (Table 1).

Table 1: Growing stock volumes on forest and scrub land by tree species in North Karelia

Tree species	Standing volume (M m³)
Pine	91
Spruce	15
Birch	27
Other broadleaves	5
Total volume	**168**
Growing stock on Land available for wood supply (%)	

Source: 10th National Forest Inventory (2004-2008)- Finnish Forest Research Institute, 2009

The average stock density of North Karelian forests is 114 m³/ha. The highest density have mature stands with 237 m³/ha, followed by advanced thinning stands with 168 m³/ha. The total biomass of trees in North Karelia is 124 Mt, of which stems are 72 Mt and branches and roots each deliver 26 Mt.

Regional politics and bioenergy development is fostered by the North Karelian Bioenergy Programme 2015, released in 2006/07.

The programme aims to decrease total energy consumption and to increase energy efficiency, the share bioenergy and other renewable energies shall be increased to 85 % of production, while consumption of oil and other fossils should be reduced by 40 to 50 %. The the degree of self-sufficiency for electrical production to 92% and the share of renewable energy sources to 85% of production. The measures to improve bioenergy utilisation are e.g.: improving the efficiency of energy tree harvesting; developing and maintaining the delivery logistics infrastructure; initiating stump removal and extensive thinning of peat lands; developing energy wood markets; and improving the quality and moisture control of solid biofuels within the delivery chain.

There is also seen a considerable potential in the development of biogas plants and the conversion of wood into Fischer-Tropsch (FT) biodiesel, in order to provide renewable car fuels as well.

The current development was cut back by the Global economic crisis.

2.4 Germany – Rotenburg County (Partner 04)

The sub-region is dominated by agriculture (approx. $^2/_3$), further important landscapes are forests ($^1/_6$) and bogs ($^1/_7$). Opposite to many other German sub-regions bioenergy is less developed while wind, solar and hydro power are well developed. Further development aims to implement a regional wood energy concept and to increase biogas production from grass from permanent grasslands by implementing co-operative central biogas plants. In addition digestate will be treated to reduce water content and increase transportability. At current there are 65 biogas plants running with 28,000 kW electrical powerage, i.e. an average of 431 kW_{el}.

2.5 Germany – Northwest Mecklenburg (Partner 06/08)

The sub-region is dominated by agriculture. There are 152,300 ha arable land of which 126,000 are agricultural land and 16,500 ha are grassland. In comparison only 27,000 ha are forested. The median size of agricultural enterprises ranges from 200 to 500 ha. Soil fertility is usually high and enables to grow wheat, rape and other cash crops. Nevertheless there are also many dairy farms.

Current bioenergy provision concentrates on biogas and vegetable oil from rape seed. The latter has decreased due to German legislation of increased energy taxes on vegetable oil and biodiesel as well as to mandatory blending of mineral diesel. There are 11 biogas plants with a total powerage of 4.8 MW_{el}. These are mainly fed with liquid manure and energy crops like maize silage and whole crop silages. Approx. 10 % of the crop production is used as input for biogas plants. The potential of liquid and solid manure is approx. 680,700 t per year which could increase the number of biogas plants to 195 with a total powerage of 97.5 MW_{el}, but there is not enough economic strength of the enterprises to implement these.

2.6 Germany – West Brandenburg (Partner 07)

The sub-region is characterized by large-scale agricultural enterprises. 75 % of arable land is agricultural land and 25 % is grassland. The average productivity of arable land is low compared to German average. The main agricultural business is dairy cattle husbandry. The median size of these farms is several hundred hectares. The largest farms have an area of 3,000 to 4,000 hectares and 2,000 to 3,000 heads of dairy cattle. Further farm produce is rye (22 %), other grains (30 %), oil seed (14 %), feed crops (22 %). More than 5 % is still set aside land. Approx. ¼ of rye and silo maize production is used as energy crop (bioethanol and biogas).

Approximately 20 % of the sub-region is forested, dominated by pine, with mainly small holder ownership. Because of this ownership structure most of these forests are badly thinned with a large reservoir of waste wood but a low rate of regrowth. Large forest areas with single ownership produce mainly wood for the paper industry and the particle board industry.

Bioenergy production is dominated by wood burning in 8 large-scale heat and power plants of 5 to 20 MW_{el} and 5 small to medium heat plants of 1 to 5 MW_{th}. The large-scale heat and power plants are mainly in company or investor ownership. Wood resources are mainly old wood from construction demolition and, to a smaller fraction, fresh wood chips from local production. The small scale heat plants are mainly in cooperative ownership and obtain their input (wood chips) mainly from local and own resources. These wood based plants produce all together approx. 1,600 GWh bioenergy per year.

There are 46 biogas plants in the area with a total energy supply of approx. 135 GWh. Most of the supplied energy is electricity while the heat can rarely be used due to the remote placement of the biogas plants. Current policy intends to provide a basis for enhanced heat utilization. The average size of biogas plants is approx. 500 kW_{el}. Most of the biogas plants are owned by farms or are

part of a sub-company of the farm. But there are also a few biogas plants owned by investment groups.

Liquid biofuels are mainly biodiesel from three plants producing 42,000 t per year. These plants are owned by nation-wide companies. They obtain there resources either from own mills for vegetable oil or cover there need from international market. In addition there is a small capacity (approx. 150 t/a) for farm-produced vegetable oil from own resources (rape seed).

2.7 Latvia - Tukums municipality (Partner 16)

The sub-region covers 1,198 km² and is dominated by forests. There are many companies working in the forests and with forest products of which 17 have a reasonable size with international trade. Wood is a traditional resource for heating in private homes as well as in district heating. One can either purchase 3 m logs directly from the forest or smaller logs from a local wood trader. Most of the wood is exported.

Ought to less agricultural activity large areas of agricultural land, approx. 7,000 ha, have been naturally afforested again. From those naturally afforested farmlands (NAF) approx. 70 GWh of bioenergy could be extracted in form of wood chips (17 GWh), firewood (6 GWh), harvesting residues (9 GWh), stumps (15 GWh), and residue from industrial processing (22 GWh). The wood from NAF could replace fossil fuels (58 GWh) currently used in district heating in Tukums area.

About half of the NAF could be turned into managed forests. Those forests would contribute 53 GWh of primary energy annually only from final fellings (42 % roundwood processing residues, 28 % stumps, 18 % harvesting residues and 12 % firewood). Commercial thinning of forests would increase this amount by approx. 30 %.

2.8 Latvia – Jelgava municipality (Partner 18)

The sub-region covers 1,358 km² of which 66.7 % is agricultural land. Jelgava sub-region has fertile soils - the quality index was evaluated within the range of 50 - 64 points compared to 38 points average in Latvia. Annual harvest amounts 140,000 tons grain with an average yield of 3.7 t/ha. Part of the cereals (wheat, rye and triticale grains) is used for bioethanol production and rapeseed for biodiesel production. In 2010 there was provided a subsidized biodiesel production of 1,364,704 litres in the cooperative factory Latraps. Domestic consumption of biodiesel has rapidly increased since October 2009 due to the government regulation on obligatory blending of 4.5 – 5.0 % of bio-fuel into fossil diesel.

Ought to to the increase in World market prices on food produce national prices for grains or rapeseed increase as well. Thus resulting in a lowering of profitability of liquid biofuels production enterprises.

Important resources for bioenergy production are straw (80 000 t/a), usable both for solid briquettes production, for litter manure and/or biogas production.

In 2010 approximately 6,000 t of straw was utilized for solid briquettes production by two enterprises in Jelgava sub-region. Payback period of these production units is 2 to 3 years.

Jelgava sub-region has the following biomass resources for biogas production: manure - 6,000 t_{DM}/a, biomass from set-aside agricultural land (2,837 ha): 10,000 t_{DM}/a, slaughterhouse waste: 1,000 t_{DM}/a, waste water sludge: 288 t_{DM}/a and biodegradable part of municipal solid wastes: 824 t_{DM}/a .

There are running 4 biogas plants in Jelgava sub-region with a total electric powerage of 2.88 MW_{el} in June 2011.

Electricity from biomass is purchased by state company „Latvenergo" with guaranteed feed-in tariff up to 0.233 €/kWh depending on powerage of co-

generation unit. According to the proposed Law on Alternative Energy (project) subsidised purchase of electricity will decrease, especially for biogas plants using feedstock not regarded as waste biomass.

2.9 Norway – Inland region (Partner 28/30)

The Norwegian Inland region, comprising the two counties Hedmark and Oppland, covering 52,600 km^2. The region is dominated by forests, with approx. 50 % of the area forested. Most of this is productive, coniferous forests. The main resource for bioenergy is naturally from forestry. When taking only area classified as forest or outlying field into account, and excluding parks, gardens, and restricted areas such as nature reserves, the total volume living trees is 245 M m^3. The estimated annual increment is about 7 M m^3. Annual harvest today is about 3.3 M m^3. Of this approx. 0.5 M m^3 are used as fuel wood. There is not political accept for harvest levels above annual increment. However, the numbers still show that there are potential for increased utilization. Maximum volume of wood used for bioenergy provision could be extended to 4.86 Mt from different sources including short rotation plantation below power lines, largest fraction (1.9 Mt) would derive from tops and branches.

The region is known also as an important source of agricultural produce. The region consists of approx. 2,050 km^2 agriculture land, which is approx. 20 % of the agricultural land of Norway. In addition to a high amount of the cereal production of the nation, the region also has a significant production of dairy products and meat, and also a significant food processing industry. Still the input into bioenergy is very low with a few straw combustions and a few biodiesel productions using this for heating as well. Agriculture could provide large potential for biogas from manure and waste of approx. 300 GWh in Hedmark as well as in Oppland. There is currently operating one commercial biogas plant providing 2.5 GWh electricity and heat. There are continuous

developments in this field. The latest plant was opened in August 2011, and will produce 200 GWh/year based on municipal waste.

Regional biomass action plans aim for doubling bioenergy supply from 2002 to 2010. Even if forestry is the main resource, important goals is also regarded the production of biodiesel from straw, slaughterhouse wastes and similar sources via biogas and Fischer-Tropsch synthesis.

2.10 Poland – West Pomerania (Partner 23)

The sub-region is dominated by agriculture. Approx. 36 % of the area forested while the share of agriculture ranges from 60 to 80 at municipal level. The sub-region has a considerable potential of extending its bioenergy provision. Bioethanol production from rye could be increased by 50 % from 24,900 t/a to 38,600 t/a; biodiesel from rape seed oil could be doubled from 52,600 t/a to 105,100 t/a. The total potential of biogas would be 305,630,000 m³/a produced from maize silage, manure, waste water and slaughterhouse wastes. There is a further potential of 41.6 TJ solid waste biomass and 12,873 TJ solid energy crops (grains, short rotation plantations, grassland) which could be used.

There is a deficit in infrastructure especially in rural areas, i.e. there is a strong gradient in heat grids, gas grids and electricity grids from towns to villages. This hinders the further development of bioenergy provision. Local authorities in the west and north-west of the sub-region are most active in taking opportunities of development.

2.11 Sweden – Jämtland and Västernorrland (Partner 02)

The sub-region is dominated by forestry, approx. 95 % of biomass resources are wood. Farmland is often abandoned. 50 % of these lands could be turned into short rotation plantations of hybrid aspen and would deliver approx. 400 GWh within the next 20 years. Waste would be a considerable further

bioenergy resource not yet exploited to a great extent. Currently there are a few biogas plants using municipal waste and one biodiesel plant produces based on wood residue from forestry. The extension of bioenergy would have positive effects on employment and hence on the population in the sub-region.

2.12 Sweden – Västra Götaland (Partner 32)

The sub-region is quite balanced between forest and agricultural resources. There are 6.0 TWh which could derive from forestry and 3.8 TWh from agriculture, 1.4 TWh from grains currently exported, 1.7 TWh from cultivating set aside land and 0.7 TWh from straw.

The major problems of applying these potentials is the strong competition with world market prices for goods to be exported and second one is the marketing itself. Each provider of bioenergy has to find his own customers.

There are existing biogas plants but upgrading biogas to car fuel is to expensive for the small sizes of these plants. Therefore it used mainly for the provision of heat (15 % of consumption) and of electricity (8 % of consumption). The aim is to increase the number of filling stations and to make upgrading more attractive, also to increase the number of customers.

2.13 Belarus – Grodno Region (Partner 26/27)

The sub-region is forestry dominated, 977,900 ha are forested. The annual harvest amounts 1.3 M m³ of which 0.6 M m³ is used as fuel wood, which actually does not cover the current consumption 0.7 M m³. But the annual increase in forest resources is assumed to reach 3.37 M m³, so that an increased thinning could cover the current demand and supply to further purposes, e.g. liquid fuels via Fischer-Tropsch synthesis.

2.14 Overview of current and potential bioenergy supply

The 11 sub-regions considered here differ remarkably in size. There are some like West Brandenburg divided into 6 counties and 2 independent cities or the Norwegian Inland region covering 52,600 km² while on the other side there are sub-regions like Leisi/Saaremaa which is a municipality on an island covering 348 km², nevertheless it is divided in 45 villages.

Six sub-regions have more than 60 % of the area forested, while the other five sub-regions have more than 60 % agricultural land. This difference can also be seen in the main focus on bioenergy resources. While in sub-regions with high shares in agriculture crops and manure are considered as source, in forested areas mainly the provision of wood but also municipal and industrial waste is considered as resource. The difference in forest or agriculture dominated sub-region manifests also in the perspective to produce biodiesel. While in forested areas the production of FT-Diesel either from wood or from waste is considered, in agricultural sub-regions it is preferred to obtain biodiesel from oil seed plants via esterification of vegetable oils.

Depending on the current use of bioenergy the provision of it can be doubled or exceed the present level several times. The provision of bioenergy is most advanced in West Brandenburg, there are 46 biogas plants delivering approx. 500 TJ, several large and small wood-based CHPs with 5,760 TJ, further 42,000 t/a biodiesel and a farm based production of rape-seed oil with 200 t/a. Although there is already a considerable provision of bioethanol and biodiesel in West Pomerania, the capacity of producing liquid biofuels could be almost doubled (approx. 4,000 TJ). The potential to provide solid biofuels and feedstock for biogas production from agriculture and waste is assumed to reach 23,000 TJ of which nothing is used yet.

3 Pilot Projects

3.1 Overview and time frame

All Partners were asked to identify up to ten so called pilot projects in their area. These projects had to fulfil several criteria: they should be innovative, be a role model for other sub-regions, a practical demonstration of either provision or use of bioenergy. Innovation is meant not only in a technological but also in social sense. The projects could include opportunities of transport and logistics, process chains, site analysis, cluster formation and matter cycles. Out of these pilot projects at least 3 good practice examples had to be chosen in the mid-term of the Bioenergy Promotion project. The intention was to develop these good practice examples during the remaining time period. It was agreed to consider both finished as well as completely new projects, due to much longer time frames necessary for the actual implementation of such projects – regarding investment decisions, time for planning and construction, legal permissions etc. The focus then should be on the new projects considering the availability of necessary biomass potentials and the feasibility of the project. These parameters should be gathered in so called pre-feasibility studies. Further a close collaboration with Tasks 4.2 and 4.4 would deliver necessary information and finally to figure out one good practice example in each sub-region.

16 Partners provided 1 to 9 suggestions for pilot projects, so we ended up with finally 44 pilot project. In Table 2 we give a summarize of the pilot projects according to partners and sub-regions.

Table 2: Overview of pilot projects, partners and sub-regions

Sub-region	#P	#PP	Title of pilot project
Denmark, Zealand Region	09/ 34/ 35	1	Biogas in Solrød area
		2	Biodiesel – FT-biodiesel in Køge City
		3	Biodiesel – FT-biodiesel in Lolland

Sub-region	#P	#PP	Title of pilot project
		4	Biogas in the city of Ringsted
		5	Biogas in Kalundborg
		6	Upgrading of waste incineration plants as waste refinery
		7	Development of energy producing farms
Estonia, Saaremaa county	13	1	Bioenergy village Kääpa
		2	Bioenergy village Leisi
Finland, North Karelia	11	1	PELLETime
		2	MicrE-Micro Energy
		3	Eno Energy Cooperative
Germany, Rotenburg (W) County	04	1	Assessment methods for woody bioenergy from removal of black cherry undergrowth
		2	Assessment methods for woody bioenergy from hedge rows
		3	Assessment methods for woody bioenergy from slash after thinnings or final cuttings
Germany, County of North-west Mecklenburg	06/ 08	1	Expansion of the share of bioenergy in district heating and electricity supply network of the city Grevesmühlen
		2	Conversion of energy in public buildings with bioenergy
Germany, West Brandenburg	07	1	Energy independent village Feldheim
		2	Biomass heat and power plant Hennigsdorf
		3	Bioenergy Region Ludwigsfelde
Latvia, Tukums region	16	1	Decision support for management of naturally afforested farmland in the pilot sub-region
Latvia, Auce municipality	18	1	Investigations on Production and utilization of biogas in Study and Research Farm Vecauce
Latvia, Jelgava region		2	Investigations on growing of energy crops, conversion and utilization technologies for bioenergy production in LUA
		3	Production of straw briquettes for energy production in farm Rožkalni, parish Sesava
		4	Production of biogas from energy crops and manure in farm Mežacīruļi, parish Zaļenieki
Lithunia, Kaunas region	21	1	Grasses for energy: demonstration of species
Norway, Inland region	28/ 30	1	EnerTree a management tool for forest owners
		2	Production of biogas and organic fertilizer from domestic waste-water and organic household waste
		3	Recycling of impregnated wood waste for energy purpose
		4	Production of biodiesel from organic waste with focus on 2nd generation biofuels
		5	Research project: Biogas and organic fertilizer – mobile biogas plant (container) from household waste

Sub-region	#P	#PP	Title of pilot project
		6	Bioenergy tourism
		7	Pellet Park – small scale study of the wood pellet stove BIONORDIC
		8	Improving the extraction of biomass from difficult terrain
		9	Sub-regional networks – a tool for bioenergy promotion
Poland, Pomerania voivodeship	22	1	From sewage sludge to green fuel – enrichment of low calorific waste in the thermal treatment process in the Pomerania Voivodeship
Poland, West Pomerania	23	1	Energy willow – the new way of energetic and economic development of the sub-region
Sweden, Jämtland and Västernorrland	02	1	Holistic approach Stömsund municipality for production and use of bioenergy in combination with recycling of ash and waste water
		2	Establishment of a bioenergy demo-site in Bispgården, Ragunda District
Sweden, Västra Götaland	32	1	Fossil free Uddetorp
		2	Fossil free school
Belarus, Grodno	26	1	Production of fuel chips from logging residues (Volkovisk)
	27	1	Assessment methods for woody bioenergy from removal of grey alder (Grodno)
		2	Manufacture of fuel briquettes (Grodno)

3.2 Bioenergy resources requested in pilot projects

The suggested pilot projects request quite different resources:

- fuel wood from forestry and short rotation plantations as well as from landscape maintaining
- grain, whole crops and straw from agriculture
- grass, cultivated as well as from permanent grassland and from landscape maintaining
- agricultural waste like liquid and solid manure, residue from crop processing
- organic fraction municipal and household waste
- industrial waste from food processing
- industrial waste from house demolition and similar polluted waste

In Table 3 we give an overview of the resources used in the different pilot projects. All these resources are used to generate either solid fuel, liquid fuels or biogas as final bioenergy source. Although the final use of the particular bioenergy source again varies from project to project.

Table 3: Bioenergy type and bioenergy resource in pilot projects

Sub-region	#P	#PP	Bioenergy type			Bioenergy resource				
			Solid	Liquid	biogas	forest	agric.	agric. waste	munic. waste	indust. waste
DK, Zealand Region	09/ 34/ 35	1			X			sea weed	X	waste
		2		X		X				
		3		X		X		straw		sugar prod.
		4			X				X	slaughter house
		5			X				X	bioethanol residue
		6		?	X				X	
		7			X		crops	X		
EE, Saaremaa county	13	1	X			X	Debushing of grassland			
		2	X			X				
Fin, North Karelia	11	1	X			X				
		2	X			X				
		3	X			X				
Ger, Rotenburg (W) County	04	1	X			X				
		2	X				hedge rows			
		3	X			X				
Ger, County of North-west Mecklenburg	06/ 08	1	X		X		crops SRP	X	X	
		2	X		X		SRP	X		
Ger, West Brandenburg	07	1	X				crops SRP	X		
		2	X		X		SRP			
		3	X		X		crops SRP	X	X	
LV, Tukums region	16	1	X			X				

Sub-region	#P	#PP	Bioenergy type			Bioenergy resource				
			Solid	Liquid	biogas	forest	agric.	agric. waste	munic. waste	indust. waste
SRP = short rotation plantation; agric. = agricultural; munic. = municipal; indust. = industrial										
LV, Auce municipality	18	1			X	X	crops	X		
LV, Jelgava region		2			X		crops grass			
		3	X					straw		
		4			X		crops	X		
LT, Kaunas region	21	1			X		grass			
N, Inland region	28/ 30	1	X			X				
		2			X				X	
		3	X							impregnated wood
		4		X					X	
		5			X				X	
		6	X	?	?	X	?	?	?	?
		7	X			X				
		8	X			difficult terrain				
		9	X	X	X	X	X	X	X	X
PL, Pomerania voivodeship	22	1			X				X	
PL, West Pomerania	23	1	X				SRP			
S, Jämtland and Västernorrland	02	1	X			X	SRP			
		2	X			X				
S, Västra Götaland	32	1		X			crops			
		2		X			crops			
BY, Grodno	26	1	X			X				
	27	1	X			X				
		2	X							wood
SRP = short rotation plantation; agric. = agricultural; munic. = municipal; indust. = industrial										

Most pilot projects concentrate on one bioenergy type but often from several sources. 22 projects refer to solid fuels only, 4 projects refer to solid fuels and biogas as well. 5 projects aim for liquid biofuels and 12 projects focus only on

biogas. One of the Norwegian projects actually wants to produce biodiesel but along the pathway of first producing biogas and then convert this via a Fischer-Tropsch synthesis to biodiesel.

The sources of which bioenergy provision are related to are manifold as well. 17 of the projects on solid fuels request their resources from forestry, 3 of these also require additional resources like short rotation wood, material from de-bushing and crops and straw. The other projects on solid fuels require short rotation wood, straw, wood residue from processing or waste wood from house demolition which is actually polluted with chemicals. In the latter project it shall be tested if this material can be handled by waste incineration. 2 of the liquid fuel projects refer to 1st generation fuels, i.e. biodiesel from rape seed, the other three look for Fischer-Tropsch synthesis of the pyrolysis gas from either wood and/or straw as well as the transformation of biogas from household waste to biodiesel. The biogas related projects usually refer to a mixture of agricultural produce, like whole crop silages, agricultural waste, like manure and residue from crop processing, and the organic fraction of municipal waste collection. There are 4 projects considering industrial waste as input, slaughterhouse waste, the residue from bioethanol fermentation, the residue from sugar production, and industrial waste without further detail. One of the Danish projects considers among this industrial waste organic residue like sea weeds and the output from cleaning water streams.

3.3 Purposes of pilot projects

The proposed pilot projects cover a very wide range of purposes, not only in terms of useful energy but also in terms of secondary implications:

- bioenergy community
- energy farm
- landscape maintenance or formation

- research
- demonstration
- network building

The application of bioenergy sources target the following useful energies:

- heating in general
- district heating
- co-generation of electricity and heat
- car fuels

In addition to targeting useful energies a few projects also aim to provide new bioenergy carriers which enable better storability or transportation:

- biomethane to gas grid
- biogas and hydrogen
- solid fuel briquettes and pellets

Finally a few projects are on harvesting itself.

Table 4: Useful energies and secondary purposes of pilot projects

Sub-region	#P	#PP	useful energy	harvesting	bioenergy community	energy farm	landscape	research	demonstration	network
DK, Zealand Region	09/34/35	1	cogen					X		
		2	c/f						X	
		3	c/f						X	
		4	cogen		X				X	
		5	b/m						X	
		6	cogen							
		7	cogen		X	X			X	
EE, Saaremaa county	13	1	heat		X					
		2	heat		X					

Sub-region	#P	#PP	useful energy	harvesting	bioenergy community	energy farm	landscape	research	demonstration	network
Fin, North Karelia	11	1	pellets							
		2								
		3	d/h		X					
Ger, Rotenburg (W) County	04	1		X			X	X		
		2		X			X	X		
		3		X				X		
Ger, County of North-west Mecklenburg	06/08	1	h / cog		X			X		
		2	heat		X			X		
Ger, West Brandenburg	07	1	cogen		X					
		2	cogen							
		3	cogen		X			X		X
LV, Tukums region	16	1					X	X		
LV, Auce municipality	18	1	cogen			X		X		
LV, Jelgava region		2						X		
		3	briqu.					X		
		4	cogen					X	X	
LT, Kaunas region	21	1						X		
N, Inland region	28/30	1		X				X		
		2	cogen					X	X	
		3	cogen					X	X	
		4	c/f					X	X	
		5	biogas					X	X	
		6				X		X		
		7	heat					X		
		8		X			X	X	X	
		9								X
PL, Pomerania voivodeship	22	1	cogen					X		
PL, West Pomerania	23	1	cogen					X	X	
S, Jämtland and Västernorrland	02	1	d/h		X			X		
		2	cogen			X		X		
S, Västra	32	1	c/f		X					

Sub-region	#P	#PP	useful energy	harvesting	bioenergy community	energy farm	landscape	research	demonstration	network
Götaland		2	c/f		X					
BY, Grodno	26	1	w/ch						X	
	27	1		X			X	X		
		2	briq					X	X	

There are several similar projects across the sub-regions: Rotenburg(W) and Grodno will both work on the removal of invasive species; Rotenburg (W), North-west Mecklenburg, and Jelgava will work on assessment methods and potential analysis; at Tukums and Inland regions they want to develop in decision support tools for optimizing harvest; at Jelgava and Grodno they work on briquetting different solid fuels.

3.4 Evaluation of pilot projects

The criteria for evaluation were:

- novelty (innovation) — innovative level of the project
- sustainability — as defined in the WCED 1987, Brundtland report
- transferability — is it transferable to all countries/sub-regions
- marketability — is there a market potential
- accessibility — is there access to visit
- coverage — vertical - value added chain; horizontal - regional spread
- implementation status — is it close to being established or just an idea
- responsible bodies — for implementation - big business or small companies or regional administration

Every partner was asked to judge every project for the above criteria with 1, 2, or 3 points. These points were summed up and delivered the evaluation of one partner for all projects. Finally the sums per project were summed up of all partners and delivered the final evaluation for each project. From this procedure the projects 28.4 (EnerTree), 07.1 (Feldheim) and 28.1 (Waste> Biogas>Biodiesel) obtained the highest scores. Within the evaluation procedure the pilot projects were also categorized for

- Utilisation of biomass
- Mobilisation of biomass potentials
- Sensibilisation for bioenergy
- Management of bioenergy
- logistics of bioenergy

Table 5 gives the overview on the results of evaluation.

Sub-region	#P	#PP	category	points	rank
DK, Zealand Region	09/ 34/ 35	1	management	**185**	**28**
		2	utilisation	**212**	**16**
		3*	utilisation	**218**	**11**
		4	management	**211**	**17**
		5	management	**189**	**27**
		6	utilisation	**217**	**12**
		7	sensibilisation	**192**	**26**
EE, Saaremaa county	13	1*	sensibilisation	**195**	**24**
		2	management	**138**	**33**
Fin, North Karelia	11	1*	utilisation	**189**	**27**
		2	mobilisation	**159**	**32**
		3	management	**124**	**34**
Ger, Rotenburg (W) County	04	1*	mobilisation	**202**	**21**
		2	mobilisation	**216**	**13**
		3	mobilisation	**176**	**31**
Ger, County of North-west Mecklenburg	06/ 08	1*	utilisation	**217**	**12**
		2	utilisation	**197**	**23**
Ger, West Brandenburg	07	1*	management	**242**	**2**
		2	utilisation	**210**	**18**
		3	sensibilisation	**232**	**4**
LV, Tukums munic.	16	1*	mobilisation	**199**	**22**

Sub-region	#P	#PP	category	points	rank
LV, Auce munic.	18	1*	mobilisation	**226**	**8**
LV, Jelgava munic.		2	sensibilisation	**215**	**14**
		3	utilisation	**217**	**12**
		4	utilisation	**185**	**28**
LT, Kaunas region	21	1*	mobilisation	**212**	**16**
N, Inland region	28/ 30	1	mobilisation	**234**	**3**
		2	mobilisation	**215**	**14**
		3	mobilisation	**222**	**9**
		4*	utilisation	**245**	**1**
		5	mobilisation	**231**	**5**
		6	sensibilisation	**221**	**10**
		7	logistics	**221**	**10**
		8	logistics	**229**	**7**
		9	sensibilisation	**230**	**6**
PL, Pomerania voivodeship	22	1*	management	**213**	**15**
PL, West Pomerania	23	1*	sensibilisation	**159**	**32**
S, Jämtland and Västernorrland	02	1	utilisation	**206**	**20**
		2*	sensibilisation	**209**	**19**
S, Västra Götaland	32	1*	utilisation	**193**	**25**
		2	sensibilisation	**147**	**33**
BY, Volkovisk	26	1*	utilisation	**179**	**29**
BY, Grodno	27	1	mobilisation	**178**	**30**
		2*	mobilisation	**179**	**29**

* good practice example of particular sub-region

3.5 Sub-regional good practice examples

The best practice examples of the sub-regions are:

Denmark - Aim of the project (Partner 09/35/36, Pilot Project 3) is to produce biodiesel via pyrolysis and Fischer-Tropsch synthesis from several resources: straw, wood waste and residue from local forests and mainly bagasse from the sub-regional sugar industry. Although the technology is still on a

demonstration level it is expected that with the implementation local know-how can be built up.

Estonia - The village Kääpa shall be developed to a bioenergy community (P 13, PP 1). The first step is the refurnishing of the boiler house in order to switch from coal and trimmed timber to wood chips. The local forest owners shall be involved in the project. The local authorities support the installations of heat control in the houses in order to optimize heat supply and demand.

Finland - Under the coordination of the North Karelia University of Applied Sciences a package of tools shall be developed designing the production and supply chain of pellets (P 11, PP 1). The projects aims for small-scale producers which currently face both technological limitations and lack of knowledge.

Germany, Rotenburg county - The project (P 04, PP 2) focuses on the assessment of the quantity and the economy of bioenergy resources from hedgerow maintenance. It shall integrate the private and public owners of hedgerows, consumers for wood chips and nature conservationists. The latter shall contribute with targets of future hedgerow structures.

Germany, North-west Mecklenburg - The local utilities company, Stadtwerke Grevesmühlen, is going to operate a second biogas plant. Public buildings in the city centre can be supplied with the excess heat of the CHP of this plant. Therefore it becomes necessary to extend the existing heating grid. The project (P 06/08, PP 1) involves the administration, the utilities company, biomass supliers and private house owners which may connect to the district heating in the future.

Germany, West Brandenburg - The village Feldheim is the first village that tends to become completely independent from external energy supply. Heat comes from the local biogas plant, the electricity from the local wind turbine park. The village has its own district heating and its own electricity grid. The

project (P 07, PP 1) aims to disseminate the example of Feldheim in order to persuade other villages to become a bioenergy village.

Latvia, Tukums municipality - The pilot project of this sub-region (P 16, PP 1) aims to develop a decision support model for the management of afforested farmland. This model shall support in the sustainable utilisation of forests on former farmland, production of fuel wood and the sequestration of carbon.

Latvia, Jelgava municipality - Within this pilot project (P 18, PP 1) a the operation of a demonstration biogas plant will be secured. The biogas plant is situated at the study and research farm Vecauce and will be fed with cattle manure, maize silage and other agricultural input. The project also includes the investigation on using the digestate as fertilizer to establish nutrient recycling and to restructure sowing areas to improve provision of animal food and biogas feedstock.

Lithunia - The aim of this pilot project (P 21, PP 1) is to demonstrate the use of different grass species as bioenergy resource. The grasses can be used either as biofuel for combustion or as feedstock for anaerobic digestion. The suitability of the biomass for either purpose can be assessed by analyses of the material. From the results one can conclude for efficient and sustainable bioenergy production from grasslands.

Norway - The idea in this pilot project (P28/30, PP 4) is to produce biodiesel from household waste. From the waste should be first produced biogas by anaerobic digestion which then is converted to biodiesel via Fischer-Tropsch synthesis. The project would link the companies collecting and processing the waste at present and a new company for biodiesel production. The digestate after mixing with garden waste and composting can be redistributed as organic fertilizer.

Poland, Pomerania voivodeship - In this pilot project (P 22, PP 1) it will be investigated the potential of improving sewage sludge as feedstock for either anaerobic digestion or combustion. The investigation will be done in two steps:

1. in a lab-scale installation
2. a full-scale installation

The project is supposed as demonstration unit to be disseminated in the sub-region and Poland.

Poland, West Pomerania - In this sub-region the use of short rotation wood in particular willow shall be established (P 23, PP 1). The project includes the identification of sufficient organic fertilizing according to available soil qualities and the use of the biomass. Among other uses it is intended to co-combust the wood with fine coal at Kozsalin heat and power plant. It further shall be investigated to produce pellets instead of wood chips.

Sweden, Jämtland and Västernorrland - The aim of this pilot project (P 02, PP 2) is to establish a bioenergy demo-site at Bispgården. The institution shall be comparable to Norwegian Energy Farm. The project includes the feasibility study, the assessment of local resources, the financing and the final proposal for the demo-site. It will integrate municipalities, forest owners and research.

Sweden, Västra Götaland - The project (P 32, PP 1) is called fossil free Uddetorp and aims for replacing fossil fuels with biofuels. In a first step a local secondary school will try to operate completely without fossil fuels. Heating of the school already works with bioenergy. The next step is to run the school vehicles (mainly farm machinery) with biodiesel. Within the project the vehicles operated with biodiesel shall be checked regularly to prevent damage of the engines. If the project is successful it can be transferred to other local schools.

Belarus, Grodno (Volkovisk) - The aim of the pilot project (P 26, PP 1) is to explore the potential to use logging residue for wood chip production. At present the logging residue remains mostly in the forest. Within the project it shall be investigated which packaging and transportation technology can be used or adapted and to develop recommendations for the use of the wood

chips. Target groups are the authorities to change current regulations, foresters, entrepreneurs and nature conservationists for a sustainable use of the logging residue.

Belarus, Grodno (Grodno) - Briquettes from different wood waste sources represent a simple form for bioenergy which can be easily distributed. In the Grodno sub-region the potential of producing such briquettes from the locally available resources (P 27, PP 2). Within the project a production and supply chain will be implemented. This includes the identification and adaptation of the appropriate technology and the dissemination of the advantages of the bioenergy use.

4 Pre-feasibility studies

The purpose of the pre-feasibility studies is twofold:

1. it should have been shown how valuable the implementation of a pilot project could be and hence, to deliver an assessment tool for the decision to go further and
2. to introduce further options for pilot projects or specify particular projects within the named pilot projects.

The partners chose both options. Hence the responses to the questionnaires on pre-feasibility studies is very diverse. In the following we will give an overview on the output per partner and finally the exercise of a synopsis with the aim to suggest how to proceed further.

4.1 Finland (Partner 11)

The pre-feasibility study is about bioenergy tourism and hence an interesting complement to the Norwegian study. The main objective of the study was to explore the expert opinions on the scope of bioenergy tourism in North Karelia.

Currently 21% of Finland's primary energy consumption derives from wood fuels. Renewable energy accounts for approx. 50 % of the total energy production in eastern Finland and bioenergy plays a key role in it. The region of North Karelia in is a European leader in the use of wood for energy production from forests. Bioenergy from wood accounts for almost 70% of all fuels used for heat and electricity generation in North Karelia and regional expertise covers all aspects of forestry and wood energy.

The Regional Council of North Karelia owns 90 % of the regional tourism marketing enterprise, North Karelia Tourist Service Ltd. The private tourism industry composed of more than 200 enterprises (hotels, camping sites, small holiday centres, and farm enterprises). There are about 20000 holiday cottages in North Karelia. There are also three national parks in North Karelia:– Koli National Park, Petkeljärvi National Park, and Patvinsuo National Park.

Integrating sustainable energy in tourism activities is a new concept. Although a partly EU funded project SETCOM – Sustainable energies in tourism dominated communities (www. setcom-project.eu) has recently finished its work in a number of countries in Europe. The final results from North Karelia showed its plans to develop energy tours to describe the wood energy chain from procurement to final use of wood energy and provide easily accessible information for tourism businesses on energy saving practices.

In the framework of Task 4.5 an expert survey had been carried out with the following four objectives:

- the attractiveness of bioenergy tourism

- the expert opinions on the economic aspects of bioenergy tourism
- the relevant policy measures to promote bioenergy tourism
- the effective promotional strategies for bioenegy tourism

All respondents agreed that bioenergy tourism is attractive in general and also particularly in North Karelia. Although half of them think that the sub-region is not well known as bioenergy region abroad, while 72 % think it is widely known as such in Finland.

About 46% of the respondents considered that bioenergy tourism would be profitable in north Karelia compared to 18% who did not think so. Only about 45% of the respondents considered the present infrastructure in North Karelia were well developed for bioenergy tourism while a sizeable 32% did not agree with.

About 23% of the respondents reported that the bioenergy sector in the region would benefit from bioenergy tourism and 18% thought that the tourism sector would benefit. However, the majority (61%) considered both the sector to benefit from this activity.

About 32% of the respondents considered that bioenergy tourism would improve the economy in North Karelia while 64% considered that it would improve the environment in the region. It appeared that the respondents considered the public authorities to benefit more than the small and medium-large enterprises from the bioenergy tourism activities in the region. Some of the respondents also indicated that research institutes in the bioenergy sector and eco-tourism agencies in the tourism business would also benefit from the bioenergy tourism activities in the region.

The majority of the respondents (64 %) also agreed that promotion bioenergy tourism would be able to bring more visitors particularly from abroad into this region. Almost all the respondents agreed that bioenergy tourism could develop positive attitudes towards bioenergy among the visitors. It was quite

clear (72 %) that bioenergy tourism needs much public support for its development in the region. It has strong policy implications since there will be need for coherent bioenergy and tourism policies to promote this new activity as a viable business opportunity in North Karelia. Public awareness building is also necessary so that tourists and local stakeholder become aware of the benefits from such new type of activity. Promotional measures should be target oriented and efforts should be made to expand this concept beyond North Karelia.

4.2 Germany - Rotenburg (Partner 04)

The pre-feasibility study focusses on assessing the biofuel potential from hedgerow maintenance and residue from forestry, mainly crown wood. The potentials were assessed at two hedgerows, one dominated by bushes the other one by trees, and one pine forest stand in winter 2010/2011. In order to estimate the cost for biofuel from those three typical examples the time lines of the various work steps of the harvest chain have been taken and compared to the yield of fuel wood.

The bush dominated hedgerow showed the shortest time for the entire process chain (20 minutes) but also the lowest yield (4 loose cubic metre; lcm) resulting in specific costs for wood chip production of 18 €/lcm. From the tree dominated hedgerow one could harvest 75 lcm in 2 hours thus resulting in costs of 6 €/lcm. Finally the crown wood from pine forest gave 488 lcm in 10 hours. The cost of the wood chips were 5 €/lcm.

The cost for wood chip production is rather clearly dependent on the wood density of the particular source. Furthermore it is crucial in which kind the area is accessible and if there is appropriate technology available. In hedgerow maintenance it becomes necessary to manually harvest parts of it which would increase cost in a disproportionate way.

Furthermore there is a manifold of responsibilities from property owners, foresters, machine association, machine service companies, and forest cooperatives thus hindering a fast execution of the project. Therefore it is crucial to clarify who is responsible and to define communication pathways beforehand.

4.3 Germany - West Brandenburg (Partner 07)

This partner delivered seven pre-feasibility studies which are partly the specification of the pilot project Ludwigsfelde (PP07.03) and also the introduction of new proposals:

1. construction of a cooperative biogas plant (Ludwigsfelde)
2. improvement of an existing wood gasifier (50 kW) and the heat supply within a small heat grid (Ludwigsfelde)
3. establishment of a supply chain and the installation of a wood chip heating unit for a primary school
4. establishment and construction of a heat supply in a listed building district with the aim to decrease greenhouse gas emissions
5. establishment of an Energy Farm with the aim to demonstrate a wide range of bioenergy provisions and applications
6. construction of a biogas plant with satellite CHP including heating grid for school, day care and public swimming pool
7. increasing the output of an existing biogas plant and installation of an absorption refrigeration (240 kW) to replace an electrical driven system

The construction of a cooperative biogas plant would involve several farmers as well as the village people as recipients of the heat. The target is to establish an energy cooperative responsible for the operation of the biogas plant and the heat grid. This could be an example for other villages and other sub-regions.

It is very difficult to save greenhouse gas emissions in listed building complexes. In order to maintain the house-fronts as well as the character of such an ensemble it is not possible to insulate such buildings. The only way to save greenhouse gas emissions seems to be to change heat supply from fossil sources to renewables. The actual supply can be with single stoves or with small district heating systems fed with heat from biogas CHPs and wood boilers. Listed building complexes are manifold around the Baltic Sea, such that this could be a role model for the development at many other places.

The main target of many CHPs operated with biogas is to provide electricity and heat is often regarded as waste. Nevertheless it is a common aim to find useful applications for this excess heat. One option is to convert heat into cold. Adsorption refrigeration systems are well known in many industries but not very well distributed in agricultural context. One reason is that most of the known installations have sizes of several MW, while in agriculture refrigeration demand is less than 500 kW and often less than 100 kW. Therefore the range of appropriate technology is very limited. The implementation of this project could lead to a broad recognition of the advantages of this technology.

The proposed projects are all close the implementation but would need further support for the demonstration of its benefits.

4.4 Latvia - Tukums municipality (Partner 16)

Large areas of former agricultural land has have naturally regrowth of trees. Those naturally afforested farmlands (NAF) can be turned to managed forests in order secure long-term supply with bioenergy. Aim of the project is to assess the potential and the input, labour and investment, of this conversion as well as the current output of those areas.

The technological solutions evaluated within the scope of the pilot project were:

- re-establishing forest stands

- continuous removal of vegetation with on-site mulch production and without biomass collection
- continuous removal of vegetation and production of solid biofuel with multi-harvester
- continuous removal of vegetation and production of biofuel with a whole-tree harvesting head
- continuous removal of vegetation and production of biofuel with a round-wood harvesters

- thinning of stand
  - mechanized thinning and biofuel production with a whole-tree harvesting head;
  - mechanized thinning and biofuel production with round-wood harvester

There was also a non-technical solution with leaving existing stands untouched as long as basal area is between critical and minimal threshold values according to the national regulations.

The evaluation of the different options of management of the NAF areas in the sub-region demonstrated that removal of woody vegetation without fuel wood production and with following regeneration of managed forest stands is the most feasible way in about half of the NAF area (3,636 ha).

In early management of the NAF areas total short-term potential of solid biofuel production is 89,000 m³. The most of the biomass can be extracted using multi-harvesters. Total investment necessary to secure formation of high quality forest stands in the NAF areas are 2.8 million € or 690 €/ha. The actual costs might be considerably higher, because of low density of biomass in the NAF areas, which leads to higher moving costs compared to managed forests.

4.5 Norway - Inland region (Partner 28/30)

This partner focusses in their pre-feasibility study on the option to develop bioenergy tourism. Starting from the Norwegian point of view on tourism as such and the combination of existing tourism programmes with bioenergy the study spans to the proposal of a new Interreg project integrating points of interest around the Baltic Sea.

Tourism is an important factor of the Norwegian economy, but it can be assumed that it is or will become an important factor in many of the other sub-regions involved in this project. There is a central institution called Innovation Norway which develops together with responsible institutions on county and local level concepts which adopt the regional specialities and transfer these in appropriate marketing strategies.

Hedmark and Oppland are both known as family-friendly and recreational vacation areas. In addition the concept of vacation on farm is successful in many countries over decades. Therefore the coupling of holidays on farm and learning about bioenergy could be an ideal combination. This would also lead to further diversification of farm business and hence stabilize farm income. Nevertheless other tourism programmes already showed that the success depends very strongly on the engagement of local people and stakeholders.

Concepts for bioenergy tourism have been successful yet at two sites: in Finland the Wenet and in Germany the Jühnde bioenergy village. Wenet offers holidays and courses mainly to professionals from other World regions who want to be informed on new technologies and management. Jühnde is the first bioenergy village in Germany and has become a hotspot for everyone who is engaged in the development of another bioenergy village, such that there are several thousand visitors per year in Jühnde. At present there are about 100 villages in Germany already being or soon becoming a bioenergy village, i.e. that at least most of the heat comes from local renewable sources and that most of the electricity consumed is produced in the sub-region, at least on

calculatory basis. Producing and using its own electricity is the "trademark" of Feldheim, which belongs to the West Brandenburg sub-region and which will develop in a hotspot like Jühnde. Bispgården may become another hot spot in Sweden and the Energy Farm in Hadeland can develop to one as well.

So there would be the potential of developing an Interreg project on bioenergy tourism which may lead to a network of sites for demonstration and education linked with recreation around the Baltic Sea.

4.6 Poland - West Pomerania (Partner 23)

The pre-feasibility study puts together the entire range of options already described in the assessment report. As mentioned there, it exists a very large potential to be developed. The sub-region was also affected by the economic crisis and the development on liquid biofuels market. Hence, the existing biodiesel and bioethanol plants had to be reactivated. The sub-region would need a strategy for the development as bioenergy resource region but therefore EU-funding seems to be essential.

4.7 Sweden - Jämtland and Västernorrland (Partner 02)

The pre-feasibility study specifies the pilot project on the development of a bioenergy demo-site Bispgården (PP02.02). With the Älggårdsberget Conference Centre exists a point of accumulating the activities. The reconstruction of the boiler plant can be a focus for realizing training courses of the entire supply and application chain of wood chip based heating. The project would include the management of forest, harvesting, fuel processing, the technology of combustion, and of the heat distribution. The work that has to be done includes the reconstruction of the boiler plant in order to meet the future demands and to develop the educational framework.

5 Current status of pilot projects

5.1 Estonia - Saare Municipality (Partner 13)

The objective of the Estonian pilot project 13.1 was to develop Kääpa eco-village in Saare Municipality. Up to now a preliminary concept has been set up. The general idea of eco-villages as well as the particular concept and implementation plan was presented to inhabitants and authorities of Saare Municipality. There is a general aloofness among inhabitants to such new ideas and questioning its functionality in future. Furthermore it lacks entrepreneurs to get in the lead of such a development. Next steps will include the further information of inhabitants and the activation of entrepreneurs by introducing good practice examples of foreign eco-villages.

In the second pilot project 13.2 It is aimed to reconstruct the boiler house of Leisi school and to switch from a mixed hard coal and wood burning to new wood boilers. Up to now a detailed feasibility study and planning has been set up. Further action requires municipal decisions and input.

5.2 Germany - Rotenburg county (Partner 04)

The aim of the pilot project 04.2 is to assess the biomass potential from hedgerow maintenance. The detailed technical study revealed that the costs for such bioenergy resource would be high and even exceed the costs of hedgerow maintenance without use of the biomass in some cases. The report was presented to stakeholders and published in the internet, the local press as well as at conferences. Despite of costs use of biomass from hedgerow maintenance has been implemented in some cases. Nevertheless, obstacles for large-scale implementation are manifold: Lack of large-scale end-consumers due to high transportation costs, not well adapted technology, use of the biomass for open fires in the neighbourhood and especially in so-called Easter fires, unclear maintenance strategies from nature conservationists, and not yet

developed joint maintenance operations of public and private. The project will be be further promoted through the county bioenergy initiative, presentation of the project should be improved also to attract investors for CHP units and to involve private hedge owners.

The second pilot project 04.3 updated is the use of biomass from slash after thinning. The current work focusses on a technical study, results from wood chip analyses, and a scenario estimation of the sub-regional potential although there are difficulties in the availability of technology and reliable data. Further obstacles are the lack of large-scale local consumers of wood chips, additional staff for operation and recycling system for the wood ash in order to maintain the nutrient cycle. Next steps include the mapping of soil properties, gaining of species and growth specific parameters of slash shares, the search for investors and the improvement of the technology.

5.3 Germany - North-west Mecklenburg (Partner 06/08)

In the city of Grevesmühlen the existing district heating should be extended in order to integrate public buildings (PP 06/08.1). Additional heat should come from the second biogas plant of the local utilities supplier Stadtwerke Grevesmühlen. The project has been presented to a broad range of audience including press releases. The extension of the heating grid has been carried out after the start of operation of the second biogas plant in 2009. The pipeline through the city centre connects a school, the district court and the county administration building to the district heating. Next steps will be to connect private houses and to disseminate the project as well as to be recognized as good example in sub-regional institutions. Main obstacles have been securing local input to biogas plant, financing of the project and to convince private house owners.

~~There are no update informations on the pilot project 06/08.2. Instead~~ Partner 08 updated ~~on two further pilot projects:~~

1. The aim is to expand the share of bioenergy in the district heating of the prelacy Lützow-Lübsdorf. The existing district heating is based on natural gas. The expansion should relate on wood chips from local resources as energy source. The project has been presented at a scientific conference and a pre-feasability study has been performed. Further development of the project is questionable due to high investment compared to low fossil fuel savings. In addition the local sources of wood chips are rare. Further promotion of the project will occur through information and discussion with stakeholders.

2. On county level municipal solid waste should be separated into an organic and a non-organic fraction. The organic fraction should be further treated to deliver energy and compost. The project has been published on several conferences, local, national and international. A feasibility study revealed that a small-scale treatment plant could operate economically. Further proceeding has to include an amendment of the county regulations of waste treatment and the discussion with stakeholders. The project can be incorporated an a State topic on biowaste management. Obstacles are the long distances for collection in rural areas, the unknown willingness of the house owners and the potential of misthrows in separated collections.

5.4 Germany - West Brandenburg (Partner 07)

Among the proposed pilot projects the energy independent village Feldheim (PP 07.1) is most advanced and update focusses on this one. In order to promote the project Feldheim received a Bioenergy Promotion reward and it is listed in the ECO-Region database. Information about the the project is well disseminated in the local and national press and there are several information events for interested people. Feldheim has reached energy independence, i.e. complete self-sufficient supply of heat and power of the inhabitants at low and stable prices. During the starting phase it was difficult to obtain subsidies and incentives and to deal with the existing local/sub-regional supplier for electricity. Feldheim will improve the reliability of power supply by installing

appropriate batteries (NaS). An information centre is under construction. A further step involving other communities will be to build up an electric vehicle network especially for public transport.

5.5 Latvia - Tukums municipality (Partner 16)

The pilot project (P 16, PP 01) could contribute to a sub-regional assessment of biofuel potential while in general there are usually only nation-wide figures. Approx. half of the available naturally afforested farmlands (NAF) could be regrown to managed forests economically if the harvest residues remain in the forests. Otherwise approx. 70 GWh or 89,000 m³ could be extracted as fuel wood. The costs of the fuel wood extraction would amount to 2.9 million Euro. On the long-term a proper management of the NAF areas would lead to an annual fuel wood production of 58 GWh, i.e. it could replace 90 % of fossil fuels used in the sub-region at present.

5.6 Latvia - Jelgava municipality (Partner 18)

The pilot project 18.3 is on the production of straw briquettes at the farm Rožkalni. Approx. 1.5 t/ha straw are available for briquettes production, the other 1.5 t/ha are used as fertilizer. In 2010 the farmer could implement the project in a small scale (0.14 t/ha) with own financial resources. The project has been disseminated in seminars and meetings with stakeholders. Before implementation the project was demonstrated using demonstration equipment from a local dealer. The capacity of the briquetting will be increased with newly available financial resources to 1 t/ha. But this also involves improved storage of the straw preventing quality losses due to weather events. Further investigations of soil conditions should help to find the optimal ratio of straw removed and straw remaining.

The pilot project 18.4 had the aim to implement biogas production at the farm Mežacīruļi using maize and sunflower silage, milk whey and cattle manure as

feedstock. In 2010 the biogas plant was installed providing in the end 0.96 MW electricity and 1.44 MW heat. 80 % of the power was reached in the end of 2010. The dissemination of the project included information of the public via press releases, TV information and internet website as well as the presentation to stakeholders at seminars and meetings in the sub-region. Ought the financial crisis the project was difficult to finance. Biogas process has to be optimized in order to reach the planned capacity. In future the option to upgrade biogas to biomethane will be investigated with the aim to use the biomethane as fuel for the agricultural machinery.

5.7 Norway - Inland region (Partner 28/30)

The aim of the pilot project 28/30.1 was to adapt and adjust the Finnish management tool EnerTree to sub-regional conditions in order to assess the environmental consequences of biomass production from forests. The project could not be implemented. Because the Finnish side also did not continue its work with EnerTree it becomes necessary to find a new approach.

The pilot project 28/30.4 was on the production of biodiesel from household waste via anaerobic digestion of the waste and Fischer-Tropsch synthesis of the biogas. This concept has been changed to use the biogas directly and to drop the the biodiesel production.

The partners 28/30 provided a very comprehensive pre-feasibility study for bioenergy tourism. The work on this project has been continued. There are a few case models for further consideration. Interviews and literature survey have built up a theoretical background for further promotion of the project. A serious obstacle is the identification of a commercial partner who could take the lead. Further work would also focus on the definition of products, e.g. an energy map, the search for financial support and the cooperation with partners in the Baltic Sea region.

5.8 Sweden - Jämtland and Västernorrland (Partner 02)

The pilot project proposals from partner 02 were focused on the production and use of bioenergy resources at Stömsund municipality and to establish a demo site at Bispgården. The focus of the partner has moved from those sites to a broader goal: the establishment of a network for using the available bioenergy resources in the entire sub-region including the attached Norwegian Trøndelag. The network involves the Trøndelag Research and Development, the Institute of Paper and Fibre, the Mid Sweden University and JiLU. They applied for EU funding.

5.9 Sweden - Västra Götaland (Partner 32)

The pilot project 32.1 aimed for a fossil free Uddetorp with making a secondary school a first step to by running all vehicles with biodiesel. The project has been promoted by the Swedish Board of Agriculture and could be demonstrated on a nation-wide seminar to many stakeholders. The experiences of this school will be spread to others in order to start biodiesel use there as well. They had problems to run the tractors with biodiesel as the manufacturers withdraw their warranty. Therefore the partners search for manufacturers of tractors providing suitable vehicles.

6 Decision tool for a company/investor

The partners were asked to compile the information which would build the factors for investors or companies to decide whether they would start a business on bioenergy in the particular sub-region or not. These factors include:

- the general infrastructure of the sub-region
- its accessibility

- the legal framework to found a business
- tax regulations and social security
- work force and educational level
- incentives on national, regional and local level which would foster the business activities

The involved sub-regions are very diverse in size, there are large areas of several tens of thousands square kilometres and a few sub-regions of only a few hundreds to a few thousand square kilometres. Population density varies from less than 5 per km² to 100 per km². All sub-regions have a considerable road network and electricity grid. Reasonable gas grids exist only in the German sub-regions, here we also can find district heating grids (based on fossil fuel heat) in larger cities. The administrative structure is, in general, that the sub-region is equivalent to an administrative body, but the Inland region (Norway) as well as the Swedish Jämtland and Västernorrland comprise two counties, West Brandenburg covers 6 counties and two independent cities, each with its own administration and the next level is the state government. The Polish voivodeships are equal to German states. West Pomerania comprises 18 counties and 3 independent cities, while Pomerania comprises 16 counties and 4 independent cities. The Belarus sub-region Grodno also covers a larger administrative unit and comprises 17 counties.

The set of enterprises which can be founded for doing business seems to be similar in all countries, although there are differences for registration and structure of management boards. In general there is the possibility to act as an single entrepreneur (sometimes also several individuals together) with full liability for debts, limited liability companies which only are liable with the paid-in capital stock and stock companies liable with their stock capital, which can be treated at stock exchange. And finally exist in all countries the option to build an cooperative, which seems to be very common in agricultural and forestry business. Cooperatives can have different targets, they can target on a

common marketing of the product, on a common production or on a common trade, i.e. purchasing and selling of products.

Tax system is also similar across the sub-regions. In general there is a system of value added tax (VAT) with two or three different rates: one general rate, one for food and similar and sometimes one for information and cultural items. Income tax differentiates mostly between personal income and income of companies. The latter has usually a fixed rate, while personal income tax rate depends on the height of income. In some of the Eastern European countries Income tax is generally at a fixed rate which can be quite low in order to attract foreign companies to start business in these countries. In addition to VAT and income tax there are various systems of property taxes. These are sometimes state taxes but mostly on a local or county base. Their level range from a some tenths of a percent to 3 % of property value. Social security includes usually health insurance, insurance for unemployment and a pension scheme. In some countries it is financed from taxes, in others there is a separate public insurance system for social security.

In general rural areas tend to have higher unemployment rates than urban structures. Therefore in most of the involved sub-regions the provision of bioenergy is regarded as a factor to increase employment. Nevertheless the educational level of the available workforce is high. There are usually several university level institutions situated within the sub-regions.

Within EU-countries free movement of persons, services and capital is guaranteed. Countries belonging to the EEA usually give residence permit to citizens of the EU and citizens of the EEA have no problem to obtain residence permit in EU countries.

All member states of the EU have to fulfil the 20-20-20 Renewable Energy Directive of the EU, which means that until 2020 the EU has to achieve a reduction in greenhouse gas emissions of 20 %, a reduction in energy consumption of 20 % and an increase in renewable energies of 20 %. This

directive demands each member country to establish a national action plan in order to contribute to this targets with national specific targets. In some sub-regions these national action plans have been complemented by regional and/or local action plans. Table 6 will give an overview of existing regional and local action plans concerning use and provision of biomass, bioenergy or renewable energy.

Table 6: National, sub-regional and local Action Plans or initiatives

Country	Action Plans	
Estonia	national:	National Initiative to remove environmental damage and to reinstall a sound environment support local and business initiatives via Environmental Investment Fund of Estonia
Finland	national: sub-regional:	38 % renewables until 2020 very differentiated; target 85 % renewables of 92 % self-sufficiency
Germany	national: North-west Mecklenburg: Rotenburg: Brandenburg:	16 % renewables until 2020 11 % of PEC bioenergy until 2020 8 % of electricity from bioenergy until 2020 Initiative to found a network for the development of with the aim to coach and support local initiatives County-level initiative to foster bioenergy business (fuel wood and biogas on a local/regional sustainable level 49 PJ from bioenergy = 8.2 % of PEC until 2020
Norway	national: sub-regional:	50.4 PJ bioenergy until 2020 bioenergy increase from 180 TJ in 2002 to 360 TJ in 2010
Sweden	national: Västra Götaland: Jämtland and Västernorrland:	>50 % renewables until 2020 100 % fossil free until 2030 local initiatives to improve rural development
Belarus	national: sub-regional:	Increasing interest in developing use of biofuels; UN Development Programme "Biomass Energy for Heating and Hot Water Supply in Belarus" Grodno one of the target regions for developing fuel wood business with foreign partners

PEC = Primary Energy Consumption

The national regional authorities put numerous incentives into force in order to reach the goals summarized in Table 6. These are mainly investment programmes, tax reductions and special feed-in tariffs for electricity from renewable resources, e.g. the German Act on Renewable Energy Sources (http://www.bmu.de/files/pdfs/allgemein/application/pdf/res-act.pdf).

7 Summary and Conclusions

The crucial questions are: what are the lessons learned and are the results from the sub-regions transferable either into the rest of the country or into other subregions. In order to find the answers to those questions we have to answer first a number of more detailed questions:

1. What are the bioenergy sources of the various sub-regions?

First all sub-regions considered in this task have reasonable potentials of bioenergy. The status of using those resources is quite diverse. Nevertheless there are enough resources available for further exploitation, i.e. the resource availability is not the limit for new pilot projects.

2. What is the main bioenergy type of the various sub-regions?

There is more or less a clear distinction between regions clearly dominated by agricultural resources like those in Germany and Poland and forest dominated sub-regions like North-Karelia in Finland or Tukums municipality in Latvia. This has clear effect on the bioenergy pathway considered in the sub region. In agricultural areas the main focus is on biogas production while in forest regions fuel wood and Fischer-Tropsch biodiesel is the main focus. Nevertheless, also in the agricultural areas mostly fuel wood is the dominating bioenergy resource.

3. How is the bioenergy used at present?

Mainly in the sub-regions from Eastern Europe there is a lack of new technologies due to lack of investment and private entrepreneurship. In addition there is a lack of knowledge among the consumers leading to either a rejection of new technologies out of mistrust or choosing the cheapest (fossil or less efficient) technology instead of more environmental friendly one.

There is a clear difference in how sophisticated is a technology and how easy it is to distribute the product. Producing biogas is rather efficient and

environmental friendly but one needs a gas grid or a functional power grid to distribute the bioenergy. Producing wood briquettes is a simple technique and it is easy to distribute the bioenergy. But burning the briquettes in family house heatings is certainly one of the least efficient ways of using bioenergy.

4. How is the structure of implementation?

Local actors play crucial role in all countries, i.e. there is a need for a bottom-up approach to succeed. In addition the authorities (local/regional, and national) play an important role for implementation. They can be the driving force (e.g. requirements for new buildings/constructions to use bioenergy), and also provide economic incentives (by buying bioenergy heat for own buildings, or by providing subsidies). In the Eastern countries implementing a new bioenergy technology first by a public institution might be necessary to proof its functionality and to open the view for private investors. In general public-private partnership is in many cases very important for the implementation of new projects.

5. Should implementation rest on local and regional actors or on big players?

Local and regional actors should be the main force for the sustainable bioenergy production. Big actors might be important as drivers of technology development (R&D), as small actors often do not have financial resources for R&D. The big players might compete both on the resources and in the product market, and might be devastating for smaller actors. However, the bigger actors might also open market possibilities for the smaller ones.

The involvement of big players arises the question of sustainability. They are often based purely on profit with a lot of transport both of resources to a production site and also the transport of the final bioenergy product to the consumers, e.g. international pellet market with resources from Scandinavia and Russia, production in Scandinavia and consumers in the rest of Europe.

There can be a need for directives from the authorities to regulate the market situation for small *vs.* big actors.

6. What is the role of authorities and administration?

In a general (national level) there are often much nice words and not too much of action. Nevertheless it is necessary to have legal directives and incentives in order to develop bioenergy market, production and use. On a local level authorities can be a driving force for the development of bioenergy use, e.g. by demonstration projects in public buildings etc. Also public private partnership play an important role.

7. Problems, obstacles, public support or resistance?

In many cases the financing of bioenergy projects is a problem. Bioenergy is often not yet competitive to fossil fuels or to traditional but less efficient bioenergy techniques (e.g. old wood burners or stoves). The knowledge of the lay people is often quite marginal and hence, obstacle for the implementation of bioenergy projects. Especially in sub-regions with high degree of bioenergy implementation, e.g. biogas in Germany, experience already resistance against new bioenergy projects which is often linked to lacks in information and prejudices. In general the statement is: yes, I see the necessity but not in my backyard.

8. Are the results from sub-regions transferable?

The identified pilot projects cover a wide variety of approaches and topics as well as their state of implementation - hence general key findings are hardly to be determined. There is also still a discussion existing what pilot projects should represent. Are they show cases of technologies a represent a certain status of the invention curve? The partners within the project agreed in the majority that pilot projects also represent the status of social and political framework.

In order to enable the transferability of pilot projects it would be necessary to deliver a honest description of the entire project and especially to document the weak points, the failures and wrong tracks of development and implementation rather than only the strengths of a project. If this last point is considered it is expected that the transfer of projects from one sub-region into other parts of the country or into other sub-regions will be successful.

The large variety of pilot projects built a good base for the development and the implementation of comparable projects in other sub-regions on all levels of complexity and a large variety of bioenergy resources.