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Biomass Gasification activities in Thessaly Region

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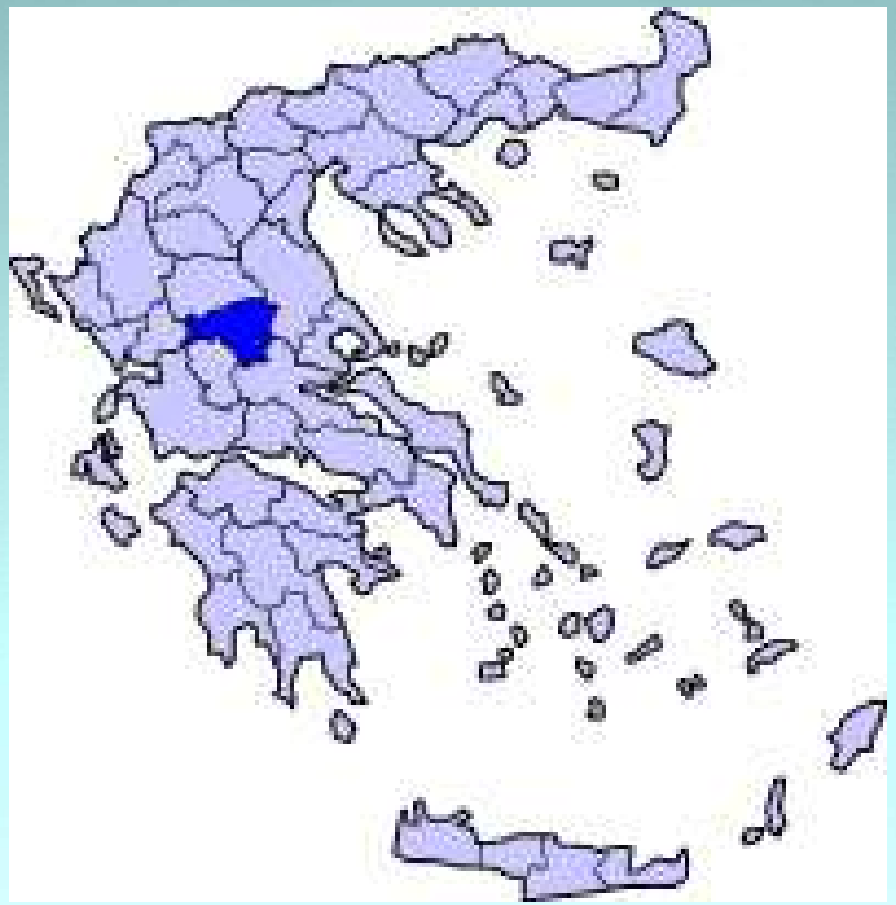
The present and the future of biomass use

	Use of biomass	Technology
Present	Heat production	Combustion
Future	Heat production	Combustion
	Power production	
	Chemicals	Gasification

The area of intervention:
Thessaly Region, Karditsa Prefecture



The characteristics of Karditsa

- Area: 2.576 Km2,
- Arable farmland: 1.100 Km2
- Remaining area: forests, pasturelands or woodlands
- Cotton: 50% of cultivated land (3 t/ha biomass)
- Corn: 5-10% (10 t/ha biomass)
- Cereal: 15%
- Set aside: 10%,
- Rest of cultivations: 15-20%

The sources of biomass and especially of agro-biomass are significant!

The cooperative approach

The Energy Cooperative of Karditsa (ESEK) is the first organized effort at country level for the exploitation of biomass and especially of agro-biomass. Its foundation contributes both to find and implement practical solutions that can lead to energy self-sufficiency at the local level, and to the restructuring of the primary sector which is in crisis, unable to choose conclusive strategic direction

What is ESEK

- It is a civic cooperative, permitting the participation of all residents of Karditsa's prefecture (or originating from it) and sharing a common vision of an energy independent prefecture
- It is supported by local authorities:
  - Chamber of Commerce,
  - Regional Authority,
  - Municipalities,
  - Development Agency,
  - Cooperative bank

Sources of biomass

- Agro-biomass. There are two categories of it: cultivated (mainly wild artichoke, cardoon) and residual (cotton or corn stalks, straw). Estimated potential at 150.000 – 200.000 ton/year
- Forest. Also divided into two categories: timber products and by-products (branches). Estimated potential at 50.000 – 100.000 ton/year
- Urban biomass. It is the product of pruning parks or gardens. It is gathered by municipalities. Estimated at 1.000 – 2.000 ton/year and it is immediately available.

The first investment of ESEK

- Small power plant 500 kW
- During the last General Assembly (23 of October 2012) it was decided to divide the project into two phases:
  - **Phase 1:** Construction of the biomass processing unit. It will produce standardized products from biomass (like briquettes) directed to the market. The processed quantities will gradually increase, depending on the organization and the development of the supply chain (cultivation, harvesting collecting and processing of biomass) to the level required by the power plant (5 - 6 thousand tons of appropriate biomass annually).
  - **Phase 2:** Construction of the power plant.

Results until now

- A capital of 420.000 is gathered
- A piece of land 2,2 hectares has been bought
- A dossier - application submitted by ESEK to the competent authority to get the authorization for the connection with the public power network.
- There is an open invitation to farmers to co-sign contract for the cultivation of cardoon.
- The technical evaluation of the bids submitted by suppliers of electromechanical equipment has been completed. Five bids received after a public call for tenders. The evaluation process of the financial aspects of the bids is continuing.
- The discussion and negotiation with interest groups (farmers, forest cooperatives, municipalities) is continuing
- The call for civil works is planned.

The experience of ESEK (1)

- **The vicious circle:** The construction of a biomass power plant (especially using agro-biomass) strikes the following vicious circle: The preposition for the unit operation is the signing of biomass supply contracts. The involved interest groups are not willing to commit until they see the construction of the plant, which is delayed for this reason!
- **The supply chain:** The biomass supply chain (especially agro-biomass) is not completed. There are many weak links, unsolved problems and research objects, including (indicatively):
  - Design of suitable harvesting and transport equipment of biomass.
  - Cultivation of appropriate energy plants that will produce biomass suitable for predefined uses. In particular, it is necessary to investigate the cultivation of plants for the production of woody biomass
  - The optimization of the cost and quality of biomass which will be delivered in the biomass process units

The experience of ESEK (2)

- **The ash:** The composition of the biomass ash (and especially agro-biomass) is a critical parameter for use in power production. The melting temperature, which is low compared with that of a woody biomass, prevents its exposure to high temperatures. So the performance in electricity is reduced (if the technology is based on combustion) or the efficiency in syn-gas is limited, if gasification is the technology. Hence, the processing of the biomass before its use for the above purpose is necessary in order to improve its specifications. The potential process includes (indicatively):
  - Removal of materials such as stones, metals, soil. Especially the last lowers the melting point of ash. The process has been adequately researched and it is recommended.
  - Separation and classification of biomass parts. For example the leaves, which contain metals (such as Mg), contribute to the formation of fusible mixtures. The process has not been sufficiently explored from the feasibility or optimization point of view.
  - Addition of special materials in the biomass (as $CaCO_3$ or CaO), to produce biomass products with increased ash melting point. The impact of these compounds to the ash melting point has not investigated sufficiently.

The experience of ESEK (3)

- **Combustion?** The power production technologies based on combustion, in relation with the unit's size planned by ESEK, have the following characteristics:
  - There is an implementation experience in thermal power systems, but not (yet) of electricity.
  - They have a relatively high cost.
  - They require biomass with ash melting point over the 920 ^{o}C
  - If they use biomass containing ash with lower melting point, their efficiency is reduced.
- **Fluidized bed?** The fluidized bed gasification technologies for the unit's size planned by ESEK have the following characteristics:
  - No application experience exists in the country.
  - They have a relatively low cost.
  - They require grinding of biomass (pieces <10mm)
  - If they use biomass containing ash with lower melting point, the biomass to syn-gas conversion efficiency is reduced.
  - The syn-gas contains a significant amount of tar

The experience of ESEK (4)

- **Down draft gasification?** The power production technologies based on gasification (Down draft) for the unit's size planned by ESEK have the following characteristics:
  - No application experience exists in the country.
  - They have an average cost.
  - They imply the briquetting of biomass (briquette with a density of 1.2g/cm3)
  - The biomass to syn-gas conversion efficiency is higher
  - The syn-gas is free from tar

Final conclusion

- The innovative - at country level - project undertaken by ESEK has many risks. Because there are many objects that have not been adequately investigated, it is necessary to divide the project into two phases in order to:
  - To give time for arranging and organizing the logistics and supply chain. This choice will prevent the installation of expensive power production equipment, which, during the first years, will remain inactive for a significant period.
  - To organize the processing of biomass in order to classify it into fractions with specific properties
  - To explore the possibility of improving the properties of some fractions with different techniques
  - To investigate the suitability of the fractions for further exploitation (heat production of low temperatures or the production of electricity, where there is a requirement for higher temperatures).
  - To select more safely optimal power production technologies, depending on the properties of the available biomass.

… Thank you