

The Danish Energy Crop Research and Development Project – results and conclusions

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Background

The current Danish Energy Policy is based on 4 political main targets:

- *Stabilization of the annual energy consumption at 800 PJ. *Maintaining continued economic growth.
- * Reduce CO₂ emissions – 50% by year 2030. * Sustainable development.

Several means are in operation in order to full fill the political targets within the planning period (2030) of which the most important in this context is a conversion from coal in the central power plants to NG and renewables at a rate of 1% annually from a total of 8% in 1996 to approx 30% in 2030.

Table 1 shows the targeted shares of the different renewable energy sources within the planning period.

Table 1. Targets for the use of renewable energy in Denmark (PJ). "Energy – 21"

	1996	2000	2005	2010	2030
Wind power	4.4	9	14	23	60
Other	3.5	1	3	4	29
Biomass	61.4	77	85	96	146
- solid municipal waste	25.4	23	23	23	22
- straw	13.7	25	27	28	34
- wood chips	20.3	24	26	27	24
- energy crops	0	0	0	5	46
- biogas	2.0	5	9	13	20
Total	69.3	87	102	123	235
% of total consumption	8	10-11	12-14	17-19	35

As can be seen from table 1 the current biomass resources for energy purposes almost exclusively stems from agricultural and forestry byproducts and municipal waste. However by the year 2005 it can be foreseen that these resources will be almost fully utilized and new resources should be found if the "Energy 21" targets should be met. Energy crops are seen as the most important new resource in order to create a balanced input mix of renewables in the energy system.

The energy crops are mainly seen as fuel in small and medium sized CHP plants and in the centralized power plants.

The Danish Energy Crop Project

Production of energy crops is more or less non-existent in Denmark at the time being. However, as the need for biomass on the other side of year 2005 exceeds the existing biomass resources and a substantial amount of energy crops will be necessary in order to full fill the goals in "Energy 21". Given an average yield of 10 tonnes of dry matter per hectare the necessary acreage of energy crops in Denmark will be close to 300,000 hectares in year 2030.

To aid this development, a "Demonstration and Development project concerning production and utilization of energy crops" with a duration of 4 years, was set up and have been finalized. The overall purpose of the project has been to develop and demonstrate an economic optimal and environmentally

sustainable production of energy crops, and thereby collect and create a comprehensive knowledge base for decision making and advise concerning energy crops.

Content of the project

The project contains three main parts - a demonstration part, - a research part and a development part together with an overall assessment part.

The project has been carried out as a number of interrelated and coordinated subprojects, covering the entire production chain from growing to end use for selected representative energy crops (including afforestation schemes).

	Afforestation	Willow coppice	Mischantus	Reed Canary Grass	Hemp	Rye	Triticale
Demonstration part							
Establishment/growing	*	+	+	+	+	*	*
Harvest/storage and transport	+	+	+	+	+	*	*
Research and Development part							
The influence of variety on fuel quality and yield	+	+	*	*	*	*	*
Fuel characteristics of potential biofuels	+	+	*	*	*	*	*
Fuel analysis and burning tests	+	+	*	*	*	*	*
The effects on surface and ground water from growing energy crops			*	+	+	*	*
The effects on surface and ground water from energy forestry	*	+					
Harvest, pelletizing and storage of Michantus		*	*				
The effects of perennial energy crops on flora and fauna			*				
Visualization of the influence of energy crops in landscape	*	* +					
Carbon balances in energy forestry	*						
Coordination and assessment							
Planning and coordinating fuel deliveries and end use	* +	* +	* +	* +	* +	* +	* +
Technical and fuel related follow up	*	*	*	*	*	*	*
Assessment and economic evaluation of annual and perennial energy crops	* +	* +	* +	* +	* +	* +	* +

* Activity in the project.
+ Published material is used.

The overall assessment covers economic, technical and environmental aspects and the individual energy crop production chains are compared on their relative advantages and disadvantages.

Conclusions

Seen from a strictly economic point of view energy crops will not be competitive in a foreseeable future, neither as a production for farmers nor as a fuel at the utility companies.

Therefore energy crops must be seen as a part of an overall environmental scheme covering both agriculture and the energy sector.

Adding the potential sustainability benefits like reduced nutrient leakage and reduced CO₂ emissions energy crops seems to be a sensible and sustainable solution.

There are not any serious agronomic or technical barriers for production and use of energy crops in the energy system, it is judged that practice will find the necessary solution and adaptations for large scale implementations.

