



RESIPE:

Reform of the European Sugar Industry based on Polygeneration with the use of Energy Crops

TREN/07/FP6/EN/S07.71205/038667

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exergia ENERGY & ENVIRONMENT
CONSULTANTS



The partners

1. **EXERGIA S.A.**, Energy & Environment Consultants - Greece
2. **KSC**, Krajowa Spółka Cukrowa S.A. - Poland
3. **ETA**, Renewable Energies S.A. - Italy
4. **ECBREC/IPIEO**, EC Baltic Renewable Energy Centre - Poland
5. **BAFF**, The BioAlcohol Fuel Foundation - Sweden

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The project

- **Title:** Reform of the European Sugar Industry based on Polygeneration with the use of Energy Crops
- **Acronym:** RESIPE
- **Financed:** through the EC/FP6
- **Aim:** to assist the take-off of polygeneration in the sugar industry. The targeted sector of the sugar industry is that of Greece, Italy, Poland and Sweden.

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Main activities

1. Sectoral and Technology update
2. Technology Transfer
3. Elaboration of pre-feasibility studies
4. Dissemination of the Project's Results

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TREN/07/FP6/EN/S07.71205/038667



Sectoral and Technology update (1)

- Analysis of the targeted sugar sectors
- Technology review

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TREN/07/FP6/EN/S07.71205/038667



Sectoral and Technology update (2)

- Review of the targeted sugar sectors

Polish case

Sugar Producer	Factories in each group	Nr of working factories			Nr of withdrawn factories		
		2006/07	2007/08	2008/09	2006/07	2007/08	2008/09
BSO	10	2	2	1	8	8	9
KSC	27	13	11	7	14	16	20
Nordzucker	6	2	2	2	4	4	4
Pfeifer & Langen	11	4	4	3	7	7	8
Suedzucker	22	10	10	6	12	12	16
TOTAL	76	31	29	19	45	47	57



Sectoral and Technology update (3)

• Review of the targeted sugar sectors

Swedish case

- Since 2006 Örtofta Sugar factory is the only factory producing sugar in Sweden.
- Process around 18,000 tons of sugar beet per day = a daily sugar production of around 2,900 ton.
- Production of ethanol from lignocellulosic biomass
 - Example: Örtofta sugar mill
 - 825 ton dry pulp per day → 100 m³ ethanol from C6 sugars
125 m³ ethanol from C5 sugars



Sectoral and Technology update (4)

- **Review of the targeted sugar sectors**

Italian case

- The number of sugar plants in Italy has been decreased from 19 units before the Reform to only 6 sugar plants after the reform
- All decommissioned plants should be reconverted to different productions; the most part of reconversion projects involve the production of some forms of bioenergy, from biogas plants, to CHP made with wood fuel and short rotation crops, to bioethanol production.



Sectoral and Technology update (5)

- **Review of the targeted sugar sectors**

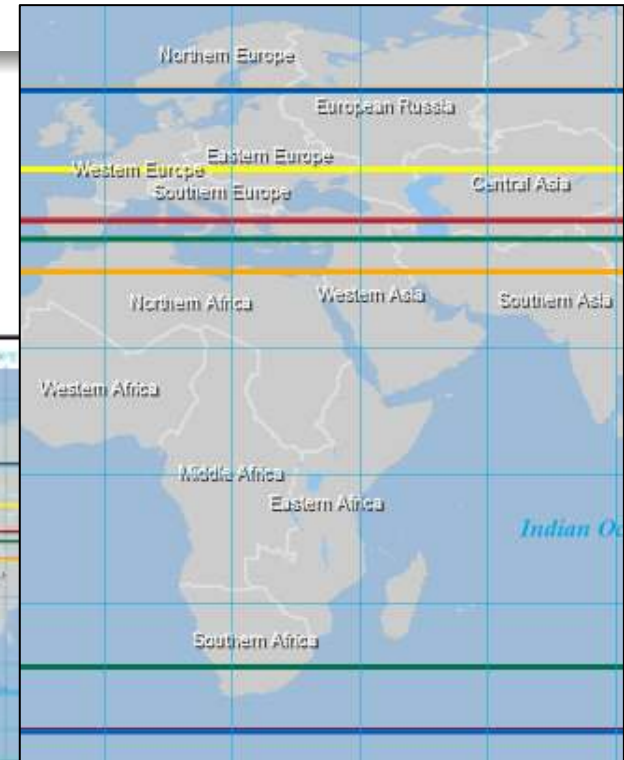
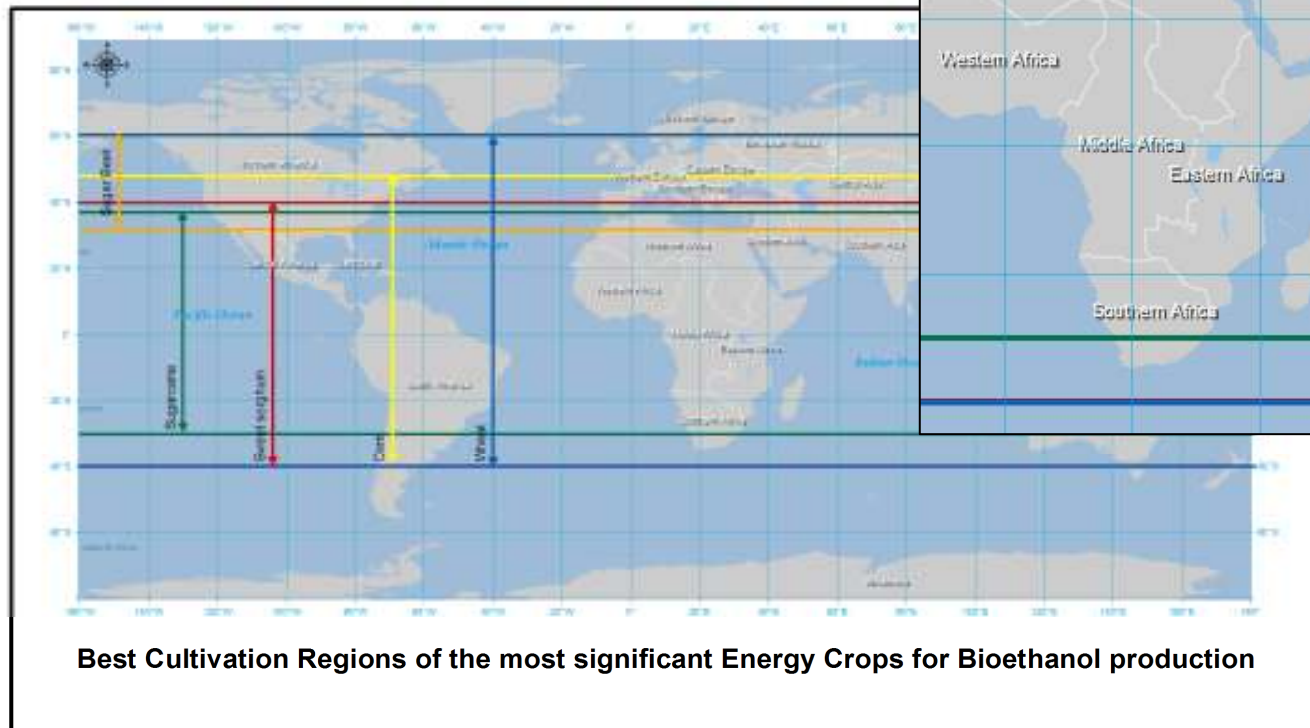
Greek case

- The Hellenic Sugar Industry is the sole sugar producer since 1960.
- Before the reform the maximum sugar quota was 319,000 tonnes
- For the market year 2007/2008 the company renounced the 50,1% of its national sugar quota (i.e. 158,800 tons)
- Obtained restructuring aid of 86 million Euros for the reconstruction of its two plants into bioethanol production units.
- Negotiations with Renew Energy & Cal West Ethanol and with Motor Oil (Hellas) ended in November 2008



Sectoral and Technology update (6)

- Technology review
 - Basic energy crops/characteristics



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Sectoral and Technology update (7)

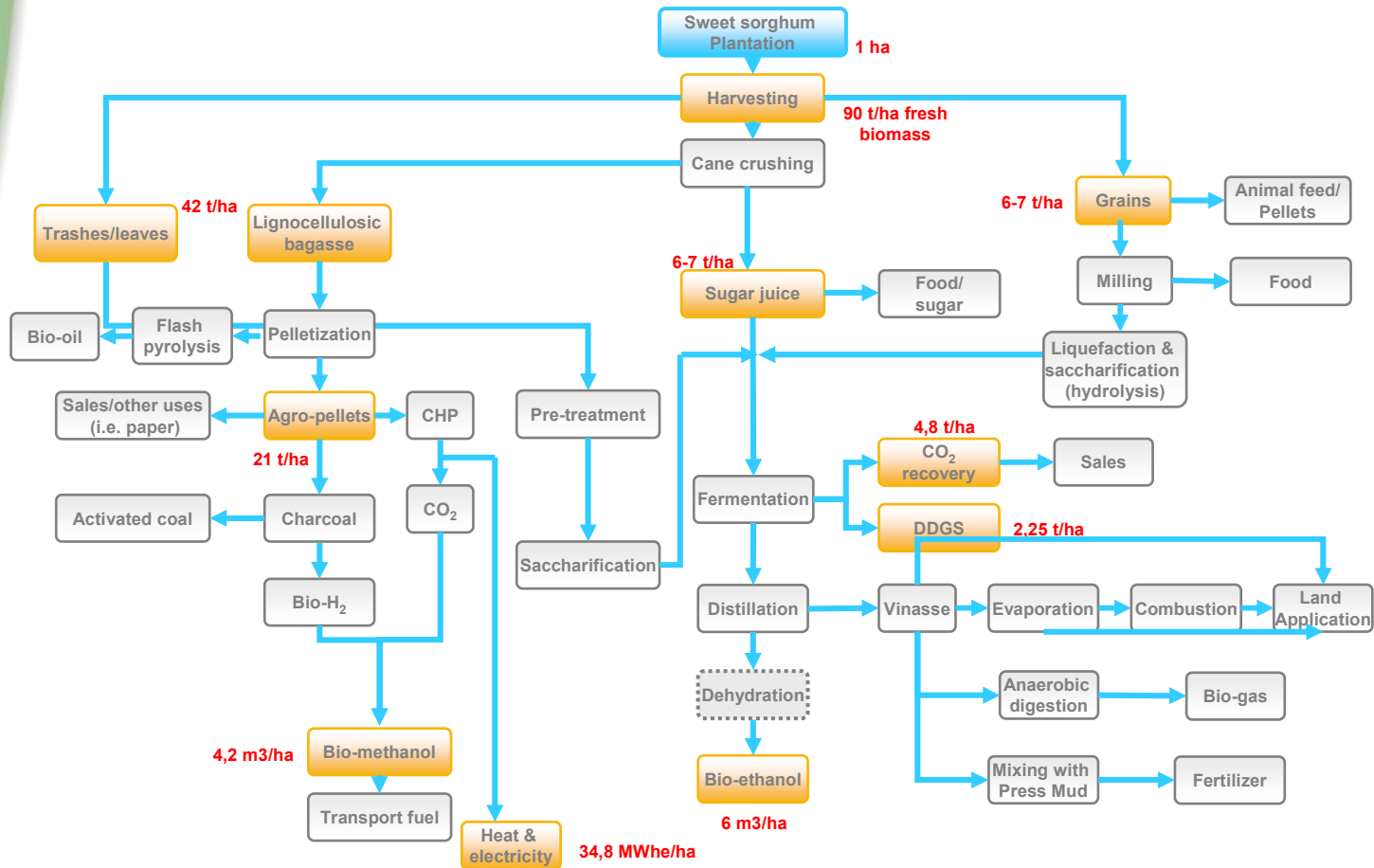
Technology review

- **Biorefinery concept-platforms/general description**
- **Biorefinery concept for sweet sorghum/sugar beet/ wheat,maize/ sugar cane**

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Biorefinery concept-Sweet sorghum



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Sectoral and Technology update (8)

Technology review

- Applicability of the technology in Greece, Italy, Sweden, Poland
- Case studies from EU and international experience
- EU technology providers



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Applicability of the biorefinery concept in EU sugar industry-SWOT analysis



- ✓ Benefit from the restructuring aid provided by the new CMO for the engagement of sugar industries in alternative business (i.e. bioethanol);
- ✓ Availability of the existing technical infrastructure of the sugar industry (the technological line for the processing of sugar beet into thick juice is used to prepare the raw material for the bioethanol production);
- ✓ EU experience in applying the biorefinery concept in the sugar industry (successful case studies of France, Germany etc.);
- ✓ The energy crops that can be cultivated in Europe for bioethanol production (sugar beet, sweet sorghum, maize and cereals) present long term tradition, good adaptability and high bioethanol yielding potential;
- ✓ The new CAP promotes the cultivation of energy crops for biofuel production, by giving financial incentives (45 €/ha);
- ✓ Sufficient land availability for the cultivation of energy crops for bioethanol production especially in the regions where the closed sugar plants are located.

- ✓ The new RES Directive creates opportunities for the market penetration of bioethanol for all Member States since it sets obligatory targets for 10% renewable fuels consumption in road transport fuels by 2020;
- ✓ Reduction in CO2 emissions;
- ✓ Commercially available technology with short-term implementation;
- ✓ Contribute to the sustainability of the EU sugar industry by engaging in alternative business and also maintaining the work-force;
- ✓ Promote research for second and third generation biofuels including bioethanol from pulp;
- ✓ The use of advanced biorefineries based on Sweet Sorghum could prevent competition with food and animal feed.

- ✓ The investment costs for the implementation of bioethanol plants are high;
- ✓ Time needed for the implementation of new technological solution into industrial production scale for the sugar industry but also for the training of engineers to become capable of operating the biorefineries;
- ✓ Some potential energy crops like sweet sorghum demand a significant change in crop harvesting process;
- ✓ The farmers lack in technical expertise concerning the future cultivations of energy crops such as sweet sorghum.

- ✓ Limited infrastructure for bioethanol distribution;
- ✓ Lower cost of imported bioethanol (i.e. Brazil);
- ✓ Increasing trends in the amount of cars with DIESEL engine on the European market;
- ✓ Feedstock production for bioethanol in conventional biorefineries is in competition with food production;



Technology Transfer

- Four **training workshops** in each of the participating countries addressed to the sugar industry
- Organization of **study tours** to an existing application of the technology in Europe



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Organization of two study tours – 1

- **Study tour in the ethanol research and pilot plant in Örnsköldsvik, Sweden** (Date: 13.01.2009)
 - Owned together with holding companies of **Umeå University** and **Luleå University of Technology**. Developed and operated by **SEKAB E-technology**
 - In operation since 2005
 - Research facility producing **2nd generation bioethanol**
 - Raw material: wood chips (**softwood**) from spruce
 - **Future interest** is to process wheat, bagasse, corn stover, energy grass, recycled grass
 - Feedstock capacity: **2 tonnes of dry wood chips/ 24 h**
 - Bioethanol production capacity: **300-400 litres / day** (used for testing)
 - The plant is one of its kind since it is **running continuously by shifts** (uninterrupted operation ~10 days)
 - Plans to scale up the pilot plant into an Industrial Development Unit by 2014. This unit will produce 6000 m³/year of ethanol (feedstock: softwood & sugarcane bagasse)



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Organization of two study tours – 2

- **Study tour in the ethanol plant of Cristanol and the sugar factory of Cristal Union in Bazancourt, France** (Date: 17.02.2009)
 - Cristanol is a joint venture of **Cristal Union (55%)** and **Blétanol (45%)**
 - In operation since June **2007**
 - Production of **ethanol, alcohol and pulp**
 - Raw material: Initially **sugar beet**, since 2009: **sugar beet + wheat**
 - Annual feedstock capacity:
 - **1.5 million tonnes of sugar beet**
 - **570,000 tonnes of wheat (in 2008)**
 - Total agricultural area: **94,000 ha**
 - Annual bioethanol production capacity:
 - **150,000 m3 from sugar beet**
 - **200,000 m3 from wheat**
 - Investment cost: **more than 200 million €**



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Elaboration of pre-feasibility studies

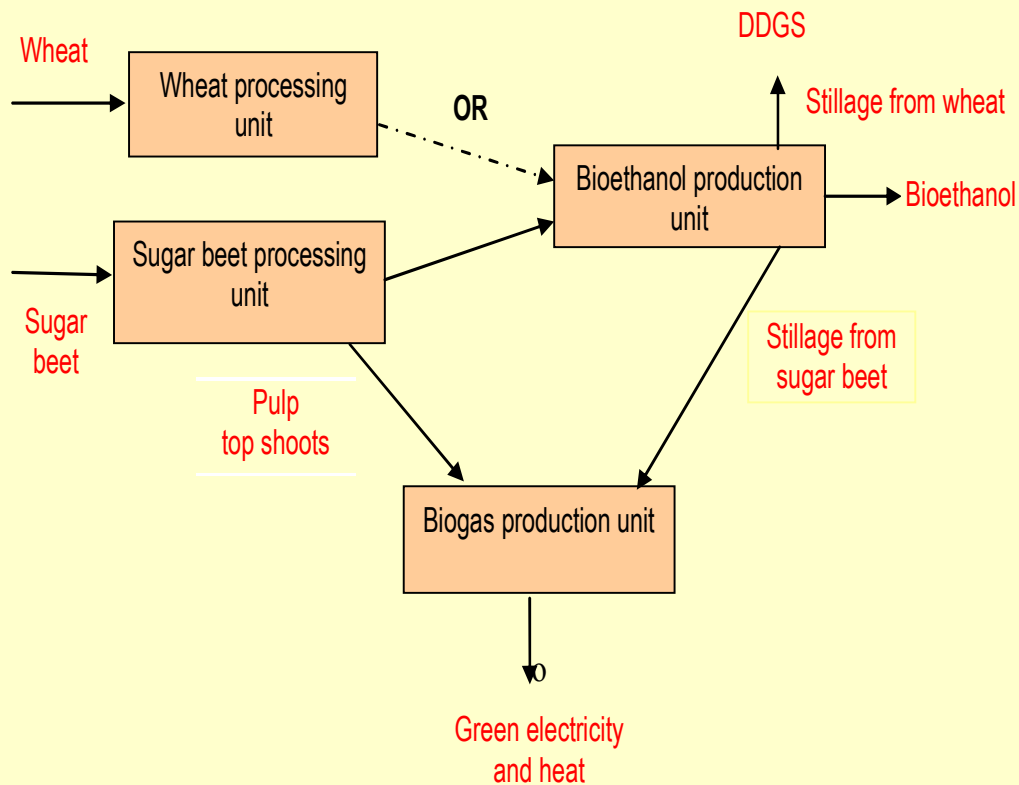
- To demonstrate that polygeneration with the use of energy crops (sugar beet or sweet sorghum) is a viable investment in technical and economic terms
- To prove the applicability of the technology in different technical and socioeconomic environments
- To promote polygeneration among sugar plant operators using market terms

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Prefeasibility Study in Greece

- Bioethanol production from sugar beet and wheat, integrated with “green” heat and electricity cogeneration from biogas



Technical Factors:		Economic Factors:	
Feedstock		Investment costs:	
Sugar beets (tonnes/y)	500.000 (100 days/y)	- Bioethanol	58,0 m €
		- Energy	51,3.m €
		- Total	109,3 m €
Wheat (tonnes/y)	270.000 (230 days/y)	Operation costs (average):	
		- raw material:	0,53 €/kg
		- energy	0,09 €/kg
		- other:	0,08 €/kg
Bioethanol production (tonnes/y)		Income (DDGS, wheat).	0,12 €/kg
- From sugar beet)	35.000	Capital expenses (rate 8,0%, 15 years)	0,11 €/kg
- From wheat	80.500	Bioethanol discounted production costs:	0,69 €/kg or 0,55 €/l
- Total	115.500		
- Per day (tonnes)	350		
Energy data		Green electricity price:	80,0 €/MWh
Biogas (pulp, stillage) (m ³ /d)	310.000 (100 days/y)		
“Green” electricity	6,43 MW		



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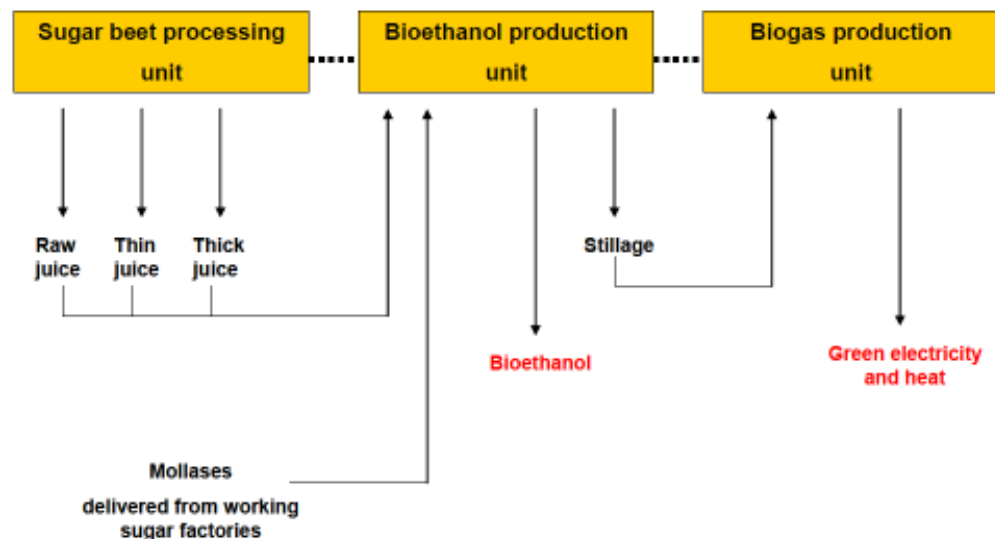




Prefeasibility Study in Poland

- Bioethanol production from sugar juice and molasses integrated with “green” heat and electricity cogeneration from biogas

Technical Factors:		Economic Factors:	
Sugar beets	170,000 t	Investment costs:	17.70 M €
Thick Juice production (68° Bx):	43,000 t	Operation costs:	
		- raw material:	0.28 €/dm ³
		- other operation costs:	0.21 €/dm ³
Possible molasses supply:	56,000 t	‘Green’ electricity:	105.70 €/MWh
		which constitutes:	0.09 €/dm ³
Bioethanol production	17,250 m ³ /year, 50 m ³ /day	Bioethanol production costs:	0.40 €/dm ³
“Green” electricity, capacity	1.5 MW	Bioethanol selling price:	0.54 €/dm ³
		Internal Rate of Return (IRR):	13.70 %
		Simple return period:	7 years



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Prefeasibility Study in Italy

- **Utilization of sweet sorghum as a potential feedstock in the current context of the reform of the Italian sugar industry**
 - Multiple production of different raw materials for industrial use from a single crop (lignocellulosic biomass, sugar juice, grains)
 - Reduced use of arable lands, reduced irrigation needs
 - Potential reduction of fertilizer use
 - Reduction of the energy intensity of the plantations and the correlated contribution to GHG emissions.



Prefeasibility Study in Sweden

- **Production of second generation bioethanol from sugar beet pulp**

- Production of ethanol from lignocellulosic biomass (pre-treatment, hydrolysis, fermentation)
- Sugar beet pulp easy to hydrolysis, hence no pre-treatment needed \implies simple and less expensive process
- Example: Örtofta sugar mill
 - 825 tons dry pulp per day \implies 100 m³ ethanol from C6 sugars
125 m³ ethanol from C5 sugars



Dissemination of the Project's Results

- **Development and maintenance of the project website**
- **Information brochure containing project results and technology related information**
- **Technology implementation guide containing technology related information as well as data regarding the applicability of the technology in sugar plants**
- **Organisation of the final workshop**

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► Reform of the European Sugar Industry based on Polygeneration with the use of Energy Crops

An initiative of 5 EU organisations

RESIPE is a co-financed project by the European Commission through the Sixth Framework Programme (2002-2006) for research, technological development and demonstration (RTD). A consortium of 5 partners from Northern, Central Europe and Mediterranean countries proposed to overhaul the EU sugar sector and contribute to the reform of the European sugar industry assigning them the role of supplier of low-cost heat and electricity via cogeneration and bioethanol for the transport sector as well as other valuable materials, using polygeneration technology.

[More Information](#)

► Sugar Platform Biorefineries

Fostering the use of agricultural biomass to reduce the dependence from fossil fuels, R&D community made efforts for developing the technological concept of biorefinery. A biorefinery Facility integrates biomass conversion processes and equipment to produce biofuels, power, and value-added chemicals from biomass.

Industries converting lignocellulosic

www.re-si-pe.com/...

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The RESIPE partners area.

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► Latest News

7th February, 2008

1st RESIPE workshop in Verona, Italy.

[More Information](#)

8th October, 2007

RESIPE kick-off meeting in Athens.

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Thank You

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