



RESIPE:

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

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

Brussels , February 26th, 2009

Theotokis PAFELIAS
Project Manager
EXERGIA S.A.

RESIPE: Reform of the European Sugar Industry based on
Polygeneration with the use of Energy Crops
TREN/07/FP6/EN/S07.71205/038667

exergia ENERGY & ENVIRONMENT
CONSULTANTS



Sugar Beet and Wheat or Sweet Sorghum only as a feedstock for the production of bioethanol and green power in Greece

**RESIPE: Reform of the European Sugar Industry based on
Polygeneration with the use of Energy Crops**
TREN/07/FP6/EN/S07.71205/038667

exergia ENERGY & ENVIRONMENT
CONSULTANTS



Pre-feasibility Study for the Production of Bioethanol from Sugar Beet and Wheat at Larissa region, Greece

- Bioethanol production from
 - Sugar beet and
 - Wheat
- Discounted production cost

RESIPE: Reform of the European Sugar Industry based on Polygeneration with the use of Energy Crops
TREN/07/FP6/EN/S07.71205/038667



Pre-feasibility Study in Greece (sugar beet & wheat)

1. Basic Characteristics
2. Simplified Process Flow Diagram of the Plant
3. Bioethanol production, feedstock needs
4. Energy System / Facilities
5. Energy Production
6. Economic Parameters
7. Discounted Production Cost



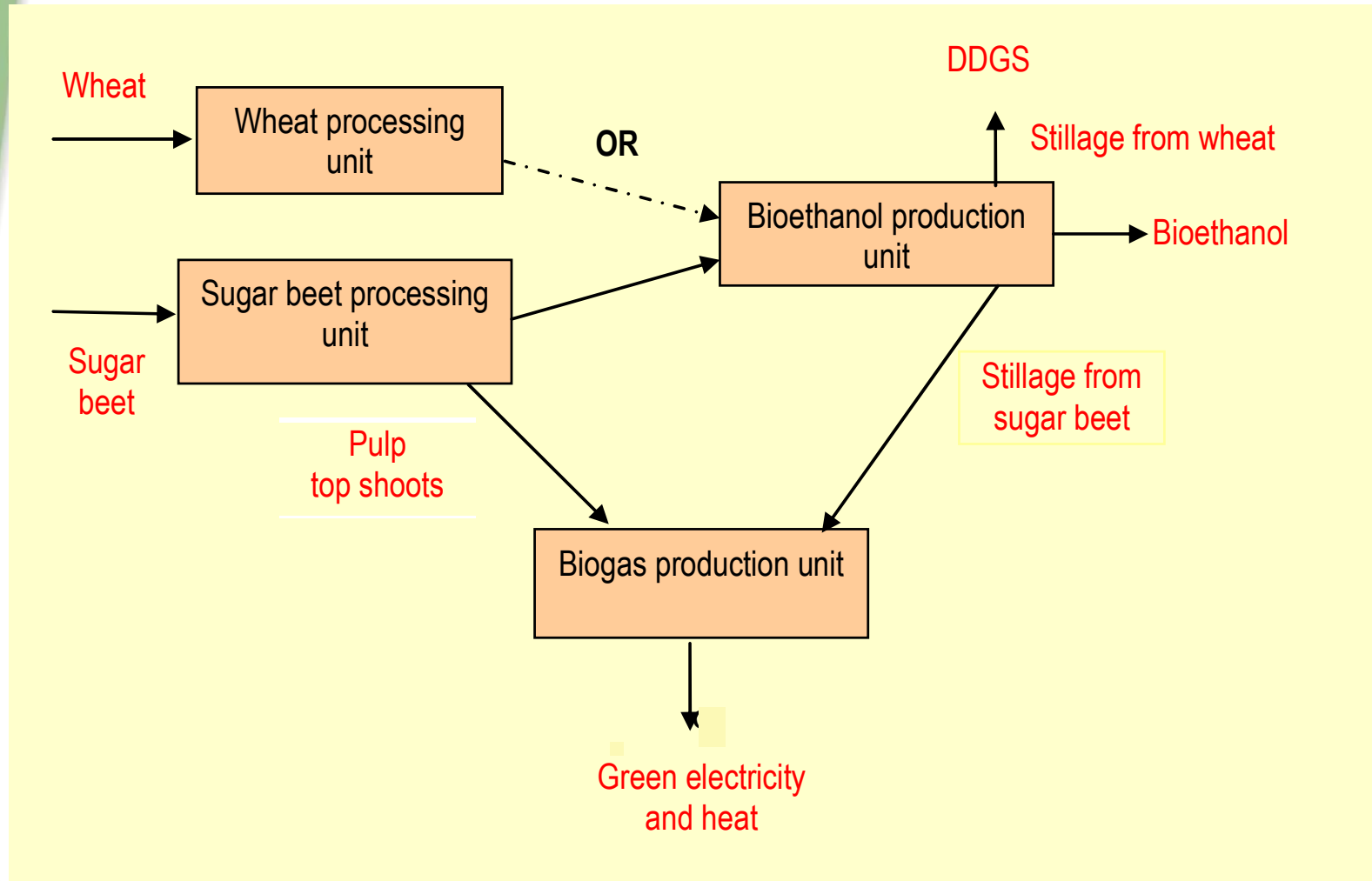
1. Basic Characteristics

- Location of the plant: Larissa, Greece
- Feedstock
 - Sugar beet for 100 days/y
 - Wheat for 230 days/year
- Biogas Production from sugar beet
 - Pulp and top shoots
 - Stillage

RESIPE: Reform of the European Sugar Industry based on
Polygeneration with the use of Energy Crops
TREN/07/FP6/EN/S07.71205/038667



2. Simplified Process Flow Diagram of the Plant



RESIPE: Reform of the European Sugar Industry based on Polygeneration with the use of Energy Crops
TREN/07/FP6/EN/S07.71205/038667



3. Bioethanol production, feedstock needs

- **Bioethanol production capacity: 350 tonnes/y**
- **Annual bioethanol production from**
 - **Sugar beet:** 35.000 tonnes/y
 - **Wheat:** 80.500 tonnes/y

Total: 115.500 tonnes/y (146.500 m³/y)
- **Feedstock requirements**
 - **Sugar beet:** 500.000 tonnes/y
 - **Wheat** : 270.000 tonnes /y



4. Energy System / Facilities

- Biogas production (**sugar beet** processing)
 - Feedstock: Pulp, top shoots, stillage
 - Capacity: 330.000 m³/day
- Steam boiler & Turbine + Generator (CHP)
 - Electricity capacity: 7,5 MW
 - Thermal capacity: 63 MW
 - Steam production capacity: 81 tonnes/h



5. Energy Production

- **Sugar beet Processing (100 days/y)**
 - Use of biogas: 310.000 m³/day
 - Biogas covers all thermal needs
 - Electricity capacity: 6,43 MW
 - Green electricity production: 15.421 MWh
- **Wheat Processing (230 days/y)**
 - Use of natural gas by the CHP
 - Thermal capacity: 55 MW
 - Electricity capacity: 6,5 MW
 - Need for additional electricity capacity: 0,8 MW



6. Economic Parameters

- Investment cost (no buildings, no land)
 - Bioethanol: 58,0 million €
 - Energy facilities: 51,3 million €
- Green electricity price: 80,00 €/MWh
- Capital expenses (discount rate 12,0 %:
period 15 years):
0,14 €/kg



7. Discounted Production Cost

- Cost of bioethanol (average)
 - Feedstock: 0,53 €/kg
 - Energy: 0,09 €/kg
 - Other: 0,08 €/kg
 - Income (DDGS wheat): 0,12 €/kg
 - Subtotal :0,58 €/kg
- Discounted production cost (discount rate 12,0 %, 15 years)
0,72 €/kg (0,57 €/l)



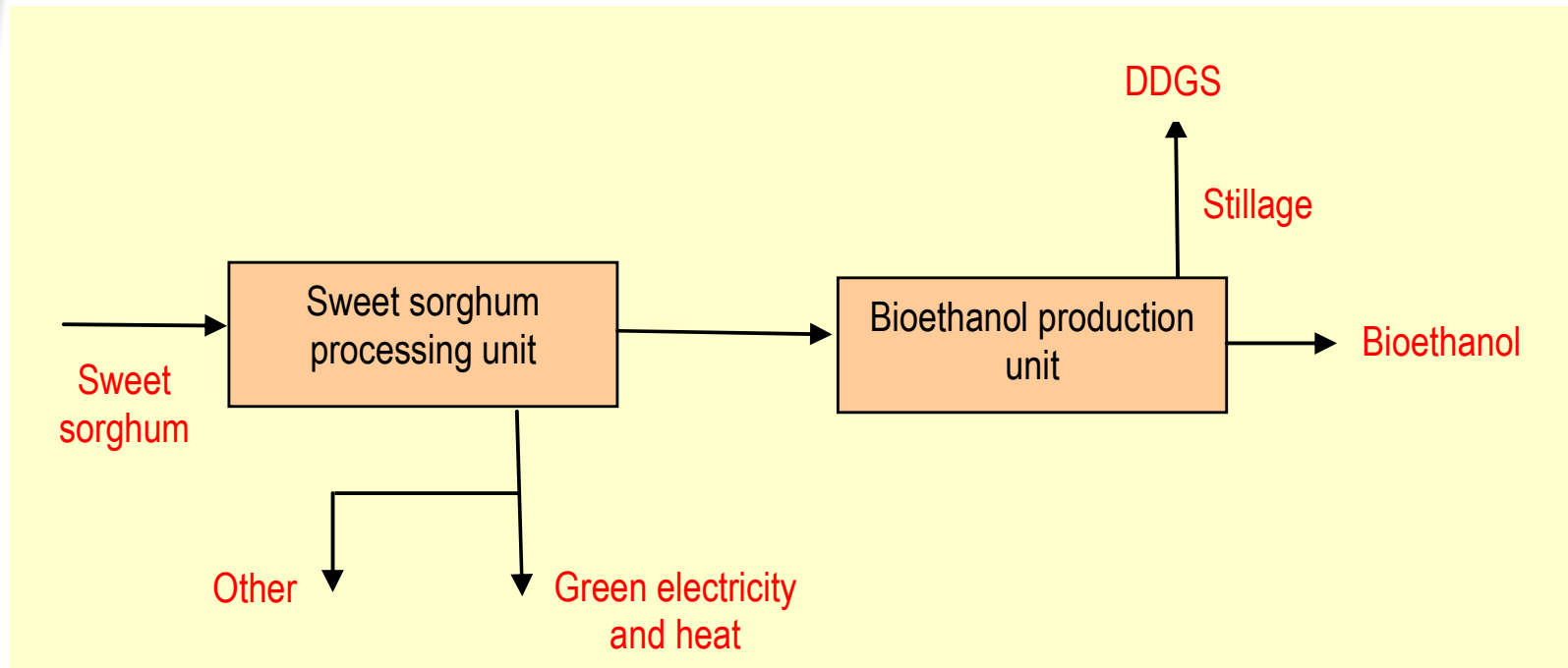
Pre-feasibility Study for the Production of Bioethanol from Sweet Sorghum in Greece

- Bioethanol production from **Sweet Sorghum**
- Discounted production cost

RESIPE: Reform of the European Sugar Industry based on Polygeneration with the use of Energy Crops
TREN/07/FP6/EN/S07.71205/038667



Simplified Process Flow Diagram of the Plant (SS)



RESIPE: Reform of the European Sugar Industry based on Polygeneration with the use of Energy Crops
TREN/07/FP6/EN/S07.71205/038667



Bioethanol production, feedstock needs (SS)

- **Bioethanol production capacity:**
325 tonnes/y
- **Annual bioethanol production:**
100.000 tonnes/y (126.700 m³/y)
- **Feedstock requirements**
1.180.000 tonnes/y



Economic Parameters (SS)

- Investment cost:
95,0 million €
- Capital expenses (discount rate 12,0 %, period 15 years):
0,14 €/kg



Discounted Production Cost (SS)

- Cost of bioethanol production
 - Feedstock: 0,36 €/kg
 - Energy: 0,17 €/kg
 - Other: 0,14 €/kg
 - Subtotal: 0,67 €/kg
- Discounted production cost (discount rate 12,0 %, 15 years):
0,81 €/kg (0,64 €/l)



Sugar Beet & Wheat or Sweet Sorghum only

- Discounted production cost (discount rate 12,0 %, 15 years)
 - Sugar beet & wheat: 0,57 €/l
 - Sweet sorghum: 0,64 €/l



Thank you for your Attention

**RESIPE: Reform of the European Sugar Industry based on
Polygeneration with the use of Energy Crops**
TREN/07/FP6/EN/S07.71205/038667

exergia ENERGY & ENVIRONMENT
CONSULTANTS