



Financing Large bio-ethanol projects in China and Italy



Francesco Cariello
ETA-Renewable Energies



Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it



Outline



- **The project: short overview**
- **Project objectives**
- **Site description: location of cultivation and industrial areas**
- **Configuration and schemes**
- **Possible financing schemes**

Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it

The project: short overview



ETA (I)	EUBIA (B)
COTEI (I)	Energidalen (S)
SIEMENS (D)	Berwin Leighton Paisner (B)
WIP (D)	China Rural Energy Industry
BAFF (S)	Association C.A.R.E.I. (C)
DeltaT (US)	Beijing E&E Biomass
ISCI (I)	Development L.t.d. (C)
Sorghal (B)	

Feasibility of Sweet Sorghum into ethanol, DDG's, CO₂, energy, charcoal, etc., with the aim of attracting private capital investors



Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it



Regions under study



Basilicata Region, Southern Italy

Dongying, Shandong Province, China

Huhhot, inner Mongolia, China

Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it





Main objectives



- **Sweet Sorghum variety selections, and evaluation of productivity**
- **Possible configuration (lay-out) and preliminary characteristics of the three complexes**
- **Available commercial technologies**
- **Prelim. main characteristics and dimensions**
- **Prelim. investment costs**
- **Logistics needed by the integrated complexes**
- **Costs associated to the Sweet Sorghum production**
- **Co-product values**
- **Techno-economic assessment in China and Italy**

Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it



The bioenergy products



- ✓ **Bio-Ethanol**
- ✓ **CO2**
- ✓ **Heat**
- ✓ **Power**
- ✓ **Pulp for paper**
- ✓ **Syngas**
- ✓ **Biomethanol**
- ✓ **DDGs**

Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it



Dongying: Kenli refinery



Present capacity

- 500,000 t/y crude oil
- Diesel: 37 % of prod.
- Gasoline: 17 % of prod.

Plan for extension

- Increase to 1,500,000 t/y
- 100,000 t/y ETOH



Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it



Dongying: cogen plant



Present capacity

- 6 MWeI
- Coal
 - 150 t/d
 - 200 RMB/t

Plan for extension to 12MWeI



Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it



Hohhot: Refinery



Present capacity

- 1,500,000 t/y crude oil
- Gasoline, Diesel, LPG, bitumen

Plans

- 100,000 t/y ETOH



Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it

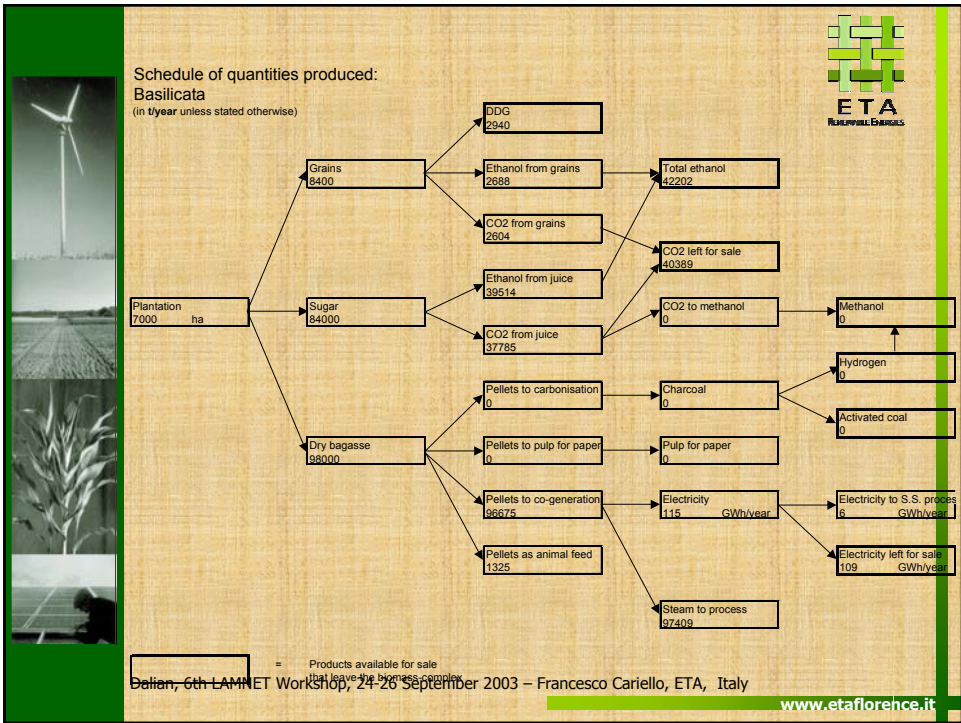
Configurations



<i>Product:</i>	<i>Basilicata</i>	<i>Dongying</i>	<i>Hohhot</i>
<i>Grains as animal feed</i>			
<i>DDG</i>	x	x	x
<i>Ethanol from sugar juice/grains</i>	x	x	x
<i>CO2 recovery</i>	x	x	x
<i>Bagasse pellets as animal feed</i>	x	x	x
<i>Electricity</i>	x	x	
<i>Heat</i>	x	x	x
<i>Charcoal</i>			
<i>Activated coal</i>			
<i>Hydrogen</i>			
<i>Methanol</i>			
<i>Pulp for paper</i>			
<i>Animal feed pellets mixture</i>			

Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it



Sweet Sorghum yields, cultivation areas

HEJP
Harvesting Extraction
Juice-to-ethanol-
Pelletisation

CG
Cultivation of SS
Grain-to-ethanol

	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Basilicata												
Dongying												
Huhot harvesting												
Huhot other												

Level of activity

HE JP CG

One year ☰

Site	Basilicata	Dongying	Huhot
Variety	Chinese 1, At623xRoma	M-81E	Tianpin 2
Grain yield (t/ha)	5	5.25	6
Fresh stem yield (t/ha)	70	75	60
Sugar yield (t/ha)	7	7.65	7.2
Brix (%)	16	17	20
Bagasse yield (t dm/ha)	17	15	10.2
Size (ha)	7.000	19.000	20.000
Harvesting	Aug., Sep., 2 months	Sep., Oct., 2 months	Oct., Nov., 2 months

Products



Cultivated area and Feedstock				
	Basilicata	Dongying	Huhhot (1x10)	Huhhot (10 units)
Plantation (ha)	7,000	19,000	2,000	20,000
Grains (t/y)	8,400	99,750	12,000	120,000
Sugar (t/y)	84,000	145,350	14,400	144,000
Bagasse (t/y)	98,000	285,000	20,400	204,000
Product:	Basilicata	Dongying	Huhhot (1x10)	Huhhot (10 units)
Grains as animal feed				
DDG	2,940 t/y	34,913 t/y	4,200 t/y	42,000 t/y
Ethanol from sugar juice/grains	42,202 t/y	101,688 t/y	10,614 t/y	106,140 t/y
CO2	40,389 t/y	97,638 t/y	10,197 t/y	101,970 t/y
Bagasse pellets as animal feed	1,325 t/y	101,056 t/y	11,548 t/y	115,480 t/y
Electricity	106 GWh/y 9.5 SS proc 93 for sale	176 GWh/y 90 refin 35 SS proc 73 for sale 22 from grid	- 3.5 GWh/y	- 35 GWh/y
Heat	Process 66-1 t/h	Process 116-16 t/h	Process 10-2 t/h	Process -

Technologies



Technology	Supplier	Capacity per unit	Investment per unit (Euro)
Harvesting	CLAAS Venter	84 t/h	130,000
Extraction	Brazilian	50 t/h	135,600
Pelletisation	various	7 t/h (in) - 4 t/h (out)	672,000
Ethanol/DDG	Delta-T	<u>Ethanol prod. from juice and grain – t/y</u>	Basilicata: 96,383,800
		Basilicata: 42,202	Dongying: 137,663,000
		Dongying: 101,688	Huhhot (1x10): 30,855,500
		Huhhot (1x10): 10,614	
		<u>DDG production – t/y</u>	
		Basilicata: 2,940	
		Dongying: 34,913	
		Huhhot (1x10): 4,200	
		<u>CO2 prod. from juice and grain – t/y</u>	
		Basilicata: 40,389	
Dongying: 97,638			
Huhhot (1x10): 10,197			
Co-generation	Siemens	Basilicata: 16.6 MweI,	Basilicata: 30,000,000
		Dongying: 28.2 MweI	Dongying: 50,000,000
		Huhhot (1x10): 10.26 steam flow	Huhhot (1x10): 3-5,000,000
		t/h	

Financing Framework



Italy

- ✓ Ministry of Environment
- ✓ Regional Governments
- ✓ Kyoto commitments (Green Certificates)

China

- ✓ Ninth Five Year Plan
- ✓ Electric Power act
- ✓ Energy Conservation act

Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it

Private Investments



- Project Financing

Technically feasible in China thanks to "Guarantee law" 1995

Mortgage must be judged by a Chinese court

- Carbon emission credits

Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it



Non Private Investments Grants and subsidies



- **European Structural funds for Italy (objective1 regions):** Up to 40%
- **Global environmental Facility (GEF)**
- **International/regional Development bank (ADB, European Investment bank,...)**

Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it

Conclusions



- **The scheme is feasible both from technical and financial point of view**
- **Integration with other crops to extend bioethanol production time and reduce investments**
- **Economics under evaluation**
 - **Most difficult for small capacity unit**

Dalian, 6th LAMNET Workshop, 24-26 September 2003 – Francesco Cariello, ETA, Italy

www.etaflorence.it