



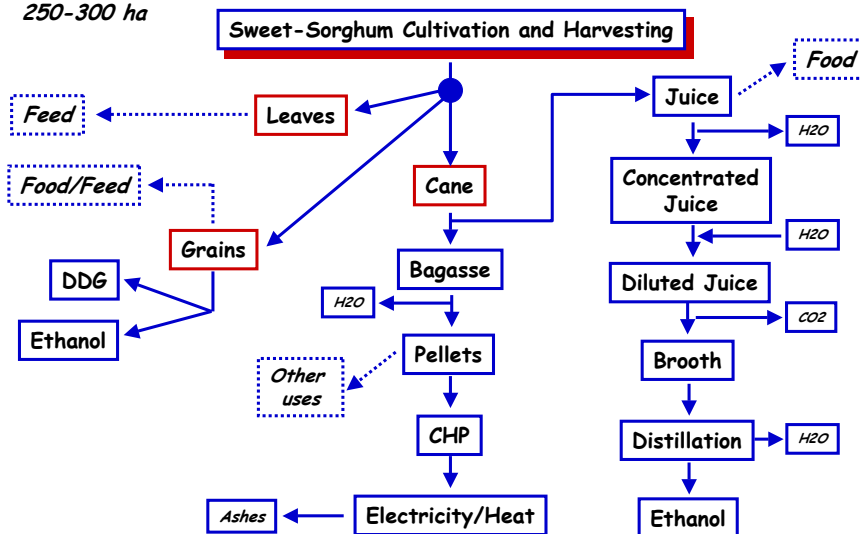
Integrated Co-production of Food-Animal Feed-Bioethanol-Power

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with the support of ETA-Renewable Energies

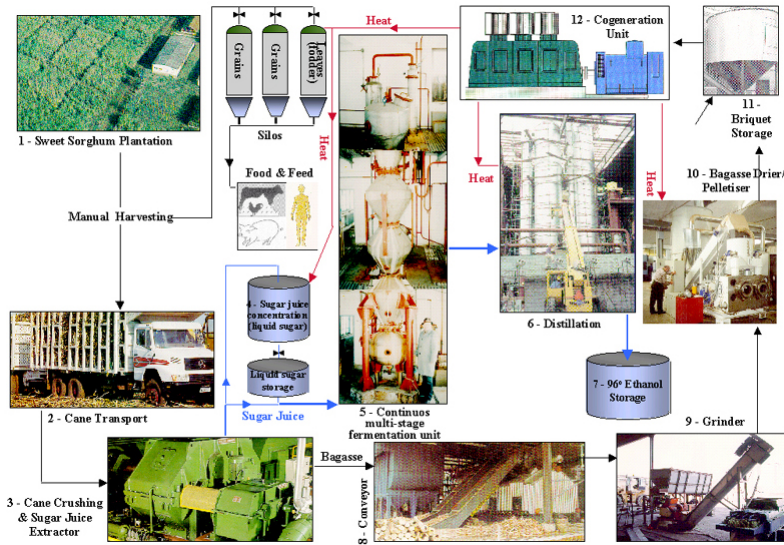


Concept of Village Complex

250-300 ha



Typical Scheme



Basic Configuration (1) 3000 inhabitants, 250 ha

Biomass production:

- ☞ Bagasse (15 % moist): 15.7 t/ha ⇒ 3925 t/y
- ☞ Grains (food-animal feed): 5.2 t/ha ⇒ 1300 t/y
- ☞ Sugar (bioethanol-food): 7.4 t/ha ⇒ 1850 t/y
- ☞ Leaves (forage): 1.88 t/ha ⇒ 470 t/y

End-use Product: Bioenergy

- ☞ Electricity: ~ 1.150 kWhel/y per capita (500 kWel, 2 MWth)
- ☞ Heat: 3.150 kWhth/y per capita
- ☞ Bioethanol: 1,168 t/y (~ 1,498 m3/y)
 - ☑ 437 t/y from grains, 731 t/y from juice
 - ☑ from 731 m3/y ⇒ 937 m3/y ⇒ ~ 300 l/y per capita (~ 100 l/y cooking, 200 l/y for sale)



Basic Configuration (2) 3000 inhabitants, 250 ha

End-use Product: Food and Feed

- ☞ From grains (~ 1300 t/y):
 - ☒ Cereal (food): 600 t/y ⇒ 200 kg/y per capita
 - ☒ Animal feed: 700 t/y + 470 t/y leaves
- ☞ Liquid sugar
- ☞ Milk: 100 l/y per capita (from animal feed)
- ☞ Meat: 20 kg/y per capita (from animal feed)

..... otherwise, if ethanol from grains

- ☞ 430 t/y ETOH
- ☞ 498 t/y DDG (market value 130 US\$/t)



Essential Needs and Available Products

	<u>Needed (per capita)</u>	<u>Available</u>
Grain	232 kg/y	200 kg/y
Sugar	5.6 kg/y (20.8 world avg. '91)	to be evaluated
Milk	4 kg/y (267 world avg. '90)	100 l/y
Protein	3 kg/y (25.878 world avg. '90)	20 kg/y meat
Cooking (ETOH)	-	100 l/y

Leaves (animal feed)		470 t/y
Grains (animal feed)		~ 700 t/y
Alcohol (transport, power, chemical, sale..)		~ 600 t/y
Electricity	1,150 kWhel/y	1,150 kWhel/y

Technologies

- 📄 Harvesting
- 📄 Cane crushing - sugar juice extraction
 - ↪ Large scale machines, mainly from Brasil
- 📄 Pelletisation
 - ↪ Advanced generation pelletisers
- 📄 CHP (from solid biomass)
 - ↪ Steam cycle
 - ↪ Gasification
- 📄 Ethanol production (for sale or for use as cooking jelly fuel)
- 📄 CHP by micro-gas turbine generator
- 📄 Syn-gas generation, pulp for paper production
- 📄 Other possible option: carbonisation, activated charcoal

New Pelletisation Technology



Double die - Pelletiser

500 Kw_e Steam Engine Power plant (1st generation)



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Steam Engine Power Plant (2nd generation)



Innovative steam engine

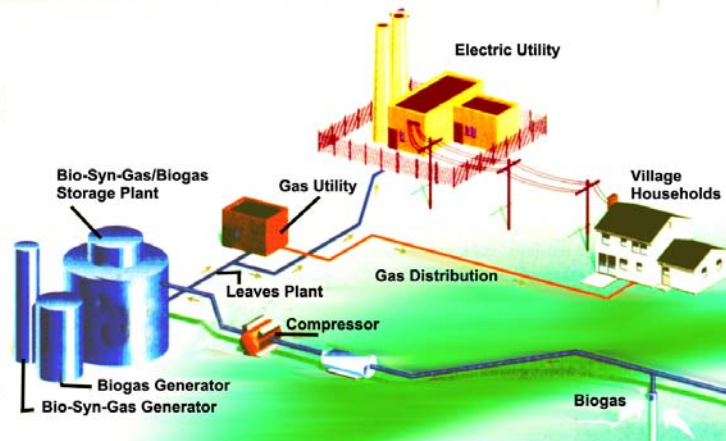
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Gasifier + Cogenerator (ET.Martezo)



Small Distillation Plant (10t/day)



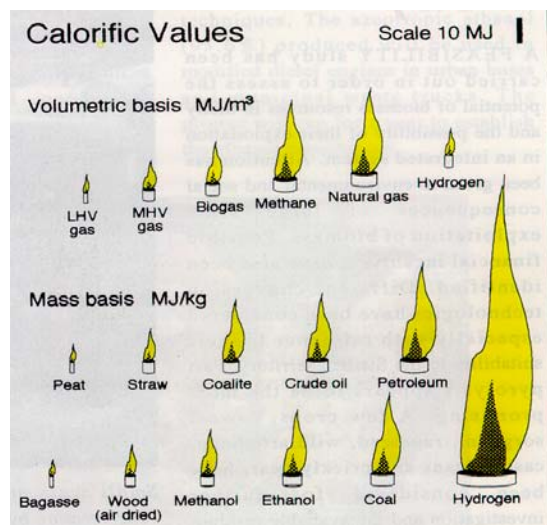
Biogas + Bio-syngas utilisation

Potential

- 📄 The concept has a high replication potential
- 📄 Considering China:
 - 🔗 Total nr of villages: 740,000
 - 🔗 Assuming only 6.7 % participating
 - ☑ 50,000 villages, 150 Mill.inhab .population (if 3,000 inh./vill.)
 - 🔗 Required land: 12.5 M.ha medium quality soil
 - 🔗 Contribution to rural energy: 25,000 MW, 200 TWh/y (gross), 150 TWh (net) ⇒ 100 MtonCO₂/y avoided emissions
 - 🔗 Bioethanol: 41.75 Mton/y
 - ☑ Cooking: 8.25 Mton
 - ☑ Transports in agriculture, tractors: 1.7 Mton
 - ☑ Sale: 31.8 Mton (if used for cooking: 410 Mill.people. Total: 515 Mill.people, 61 % of the total rural population)
 - 🔗 Food: 65 Mton grains, 92 Mton liquid sugar (if not ethanol from juice)
 - 🔗 Feed: 23.5 Mton leaves (2 mill.cows, 14.7 Mton/y milk)

CO2 impact

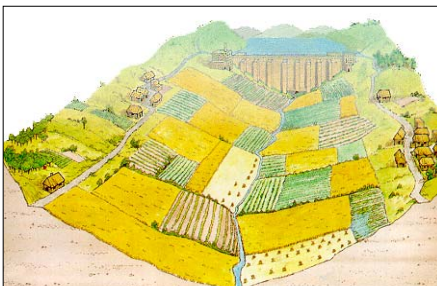
	<u>CO2 tons</u>
From fossil fuel (cultivation):	572
From biomass	7,360
Fermentation	533
Bagasse combustion	5,692
Alcohol combustion	1,135
Produced Energy GJ/y (net)	46,606
t _{CO2} /y (saved)	12,616



Conclusions

- ☞ It is possible to design bioenergy schemes in China based on Sweet Sorghum crop
 - ☞ These Integrated Complexes could provide a significant contribution to sustainable rural development
 - ☞ Technologies are available (but small range)
 - ☞ Economics are affected by the high cost of small scale bioenergy technologies produced in small number.
- ➔ The comprehensive utilisation of the resource in integrated complexes is essential for economics improvement.

Proposal:
COMMERCIAL DEMONSTRATION PROJECT ON
“MODERN BIOENERGY
VILLAGE COMPLEX FOR CHINA”



**Integrated production
of food-animal feed-energy**

Dr. Giuliano Grassi



MAIN OBJECTIVES OF THE PROJECT

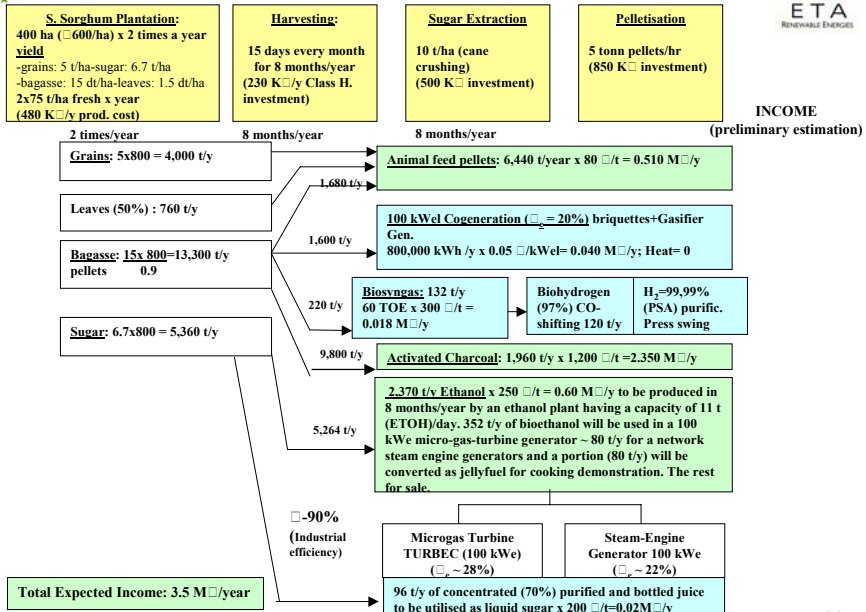
Small Commercial Bioenergy Project in China

Supply of:

1. **Animal feed pellets**
2. **Bioelectricity:**
 - 70 KWe Gasifier-Engine Generator (briquettes)
 - MicroGas Turbine Generator (Bioethanol 96°)
 - 20 kWe Steam Engine Generator (BioSynGAs/Bioethanol)
 - BioHydrogen – Fuelcell (? At later stage)
3. **Modern Cooking Biofuels**
 - BioSyn Gas (town Gas)
 - Gelfuel (jelly bioethanol)
4. **Liquid Sugar** (in small bottle)
5. **Activated Coal** (drinking water purification)
6. **CO₂-Solid Ice**(? At a larger stage)

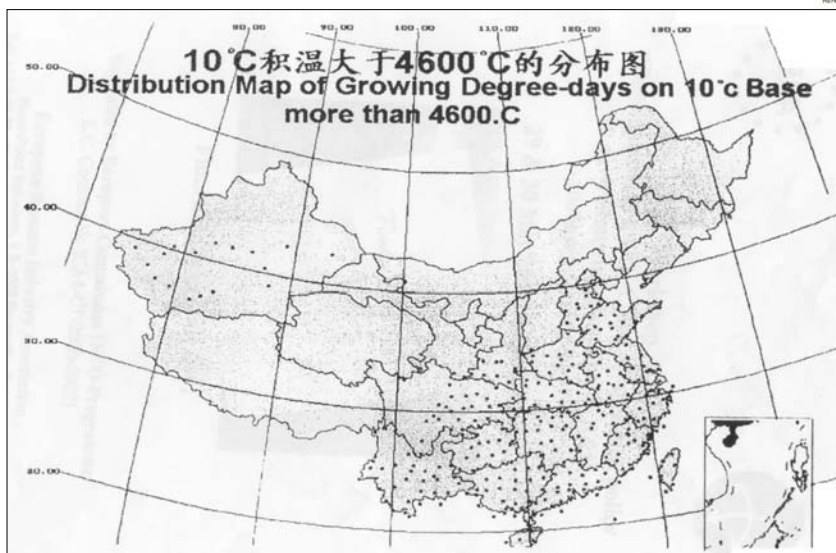


Integrated Project For Commercial Demonstration in China



COST FOR THE IMPLEMENTATION OF THE PROJECT IN CHINA

Preparatory Activity	100,00 €
Scientific Technology Support	
INFRA	
FAL	
ISMA	
Agro-consulting	1,180,000 €
Investment (enclosing civil work)	12,464,000 €
Management, Coordination, Engineering	1,450,000 €
Education & training / Project follow-up	200,000 € / 100,000 €
Set-up Commissioning	240,00 €
TOTAL	15,634,000 □



Coal resources in China

