



Clean RE and Bioenergy supply for the Tourist Sector:

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Francesco Cariello, ETA-Renewable Energies, Ghangzhou China 28-30 September 2003

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COMMON NEEDS in the Hotel sector

- Space heating
- Water heating
- Space cooling
- Freezing (food preserving)
- Electricity
- Small sea-water/brakish-water desalination/purification

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Biofuels that are already on the market and object of international trade:



Solid biomass
pellets
(6÷10 mm diam.)



Vegetal-oil



Bioethanol

Solid bio-fuels

Biomass chips can be used, but:

Low density

High humidity
content



The use of "pellets" is recommended because their handling
and use can be assimilated to conventional fuel-oil

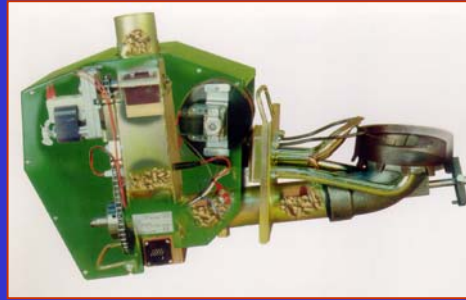
- Diameter: 6 to 8 mm
- Humidity: 8 % to 10 %
- Cal. Value: 3,800 to 4,100 kcal/kg
- Density: 600 to 620 kg/m³
- Price: store 0.13 to 0.17 €/kg, retail 0.25 to 0.27 €/kg

Space Heating

Pellet stoves



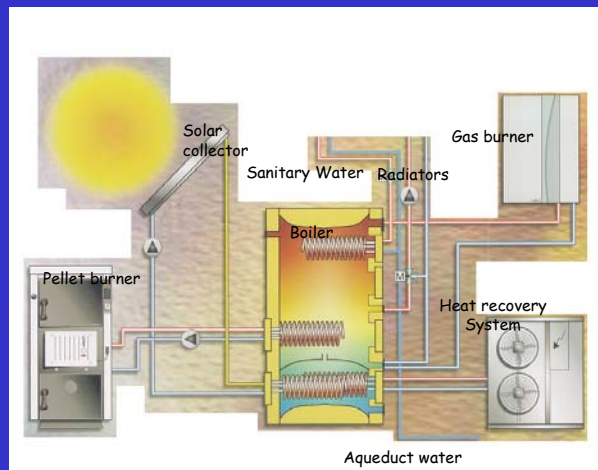
Pellet burners



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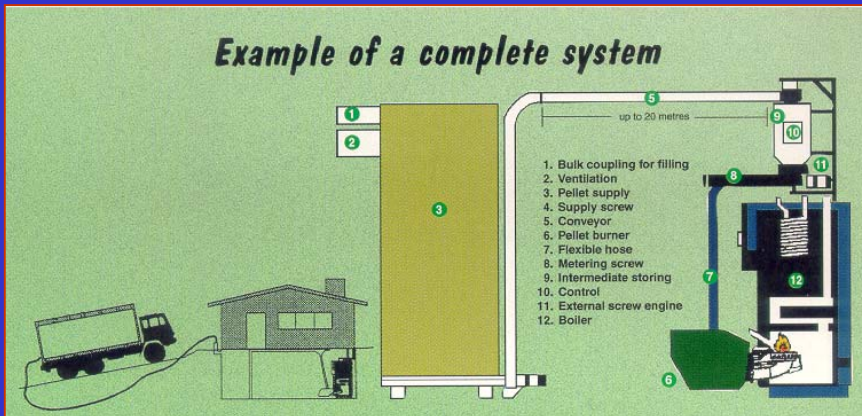
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Water Heating Pellet burners + boilers



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100 kW boiler working for 1500 h/y

Cost estimation realized following German methodology VDI 2067 in respect to European EN 832 – no subsidies considered!

	Unit	Wood Chips	Pellets	Heating oil	Methane
Boiler cost	€	10,000	10,000	4,000	3,000
Install.	€	2,500	2,500	1,500	1,500
Civil works	€	10,000	8,500	4,500	4,000
Total	€	22,500	21,000	10,000	8,500

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	Unit	Wood Chips	Pellets	Heating oil	Methane
Fuel	€/y	5,000	6,000	15,000	12,000
Power	€/y	120	80	60	50
Mainten.	€/y	180	160	80	70
Personnel	€/y	1,000	750	0	0
Chimney	€/y	250	200	150	80
Assuranc + Other	€/y	650	600	300	300
Total O&M	€/y	8,310	8,839	16,294	13,094
MWh cost	€/y	55	59	109	87

Vegetal-oils

- The EC production of bio-diesel has reached the level of ~ 1 mio t/year
In particular the esterification of rape-seed oil as substitution of conventional diesel-fuel is promoted
- 1 ton grains gives 0.392 tons oil
- specific weight: 1.136 ton/m³
- heating value: 9,400 kcal/kg ~ 39 MJ/kg



Bio-ethanol

World production of more than 20 billion li/year, mostly concentrated in Brazil (12 billion li/yr) from sugar cane and USA (5 billion li/yr) from corn

Most interesting crops for bioethanol at the present are:

- sugar cane
- sweet-sorghum
- corn
- sugar-beet



Small capacity biomass cogeneration systems

- Sanitary and services water heating
- Space cooling
- Food storage and preserving by cooling and freezing
- Electricity supply for all uses
- Drinking-water supply utilising the heat or power from the co-generation unit for sea-water desalination

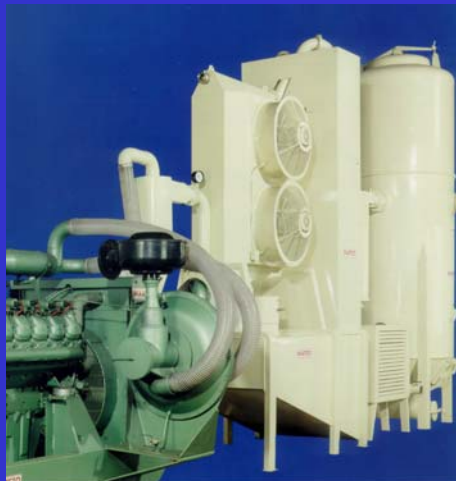


Different solutions, not fully developed yet

- Steam engine + cogenerator
- Microturbine + cogenerator
- Gasifier + cogenerator

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Gasifier + Cogenerator

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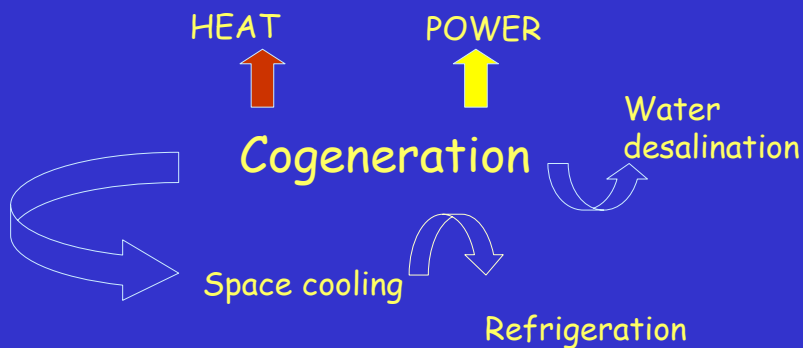


Innovative steam engine

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Small scale cogeneration would open several scenarios



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Space cooling

Absorption refrigeration plants for air-conditioning

- Concept: $\text{H}_2\text{O-LiBr}$, water refr.
- Air cool down: $+ 5\text{ }^\circ\text{C}$
- Thermal energy input: Steam or hot gases
- Coefficient of performance: C.O.P. ~ 0.45
- Maintenance: almost maintenance free thanks to high reliability

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Small scale plants far from commercial state of development

www.colibri-stork.nl

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Conclusions

-Pellets fed heating systems:

fully commercially available, excellent solution to substitute heating oil systems, or for area with no methane grid.

-Small scale Biomass fed CHP:

Not yet fully developed; would allow to address several needs: heat, power, drinking water in the short term, cooling and refrigeration in the medium-long term.



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