



The Biomass Option

Types of Biomass

Pellets market and products

Summary and Conclusions

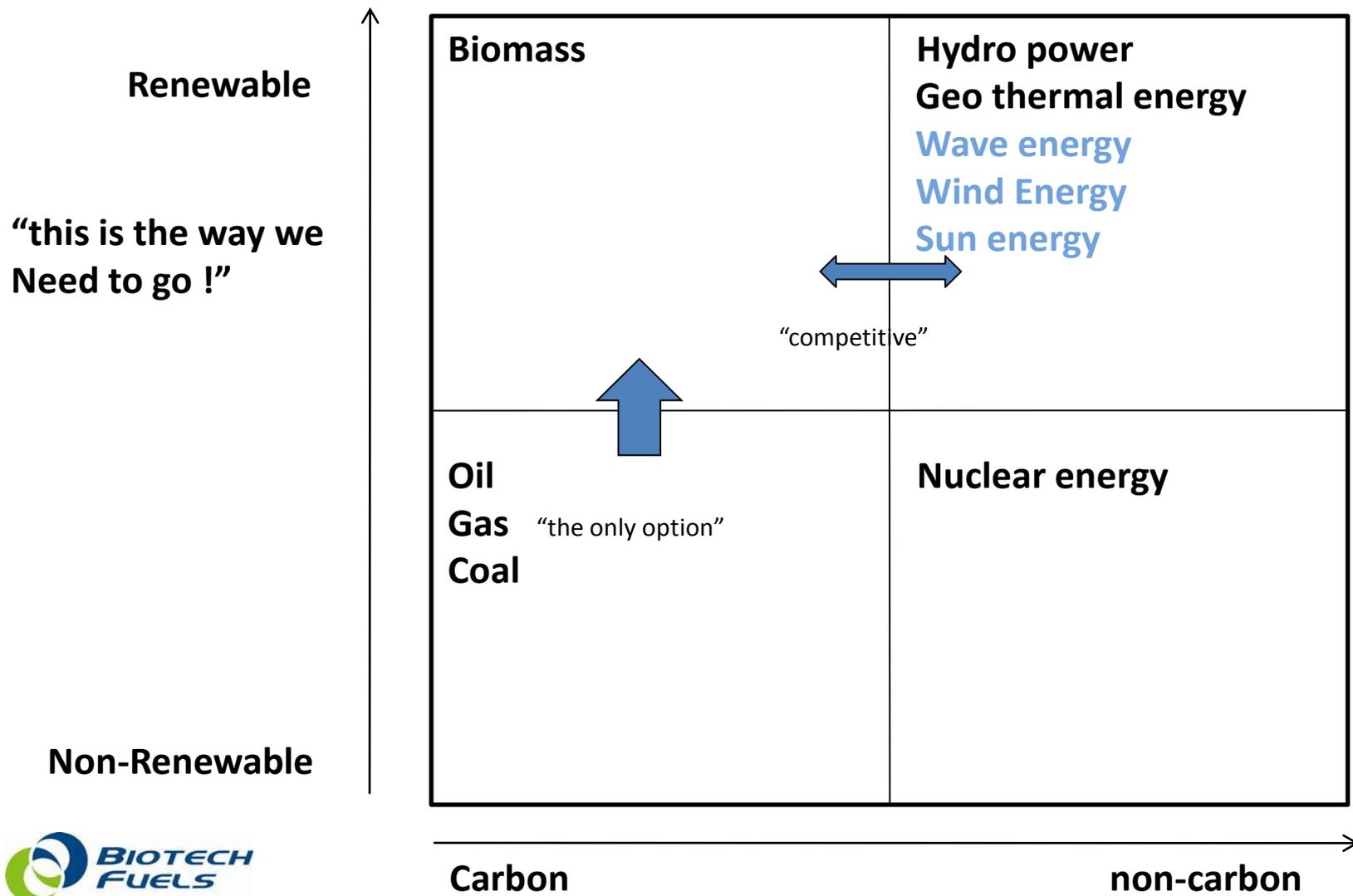


PROVIDING SUSTAINABLE ENERGY FOR A CLEANER PLANET

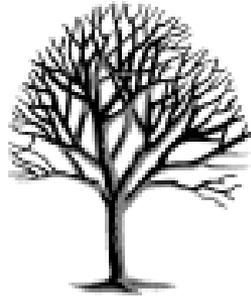


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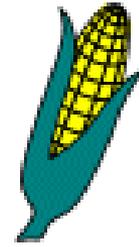
Why biomass?



Types of Biomass



Wood



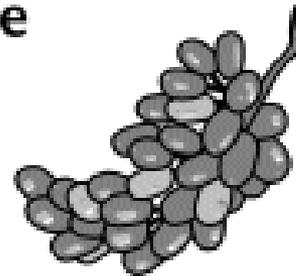
Crops



Garbage



Landfill Gas



Alcohol Fuels

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Typical calorific values of Biomass vs Fuel

	Moisture	kWh / kg	kcal / kg	Weight kg / m3	kg = 1liter fuel
Bark fir	50%	2,14	1,84	280	4,65
Pellets / Briquettes	10%	4,9	4,214	660	2,03
Forest wood chip dry	40%	2,89	2,511	240	3,44
Forest wood chip fresh	55%	2	1,72	310	4,98
Miscanthus	10%	4,4	3,78	140	2,26
Rapeseed	9%	6,83	5,87	700	1,46
Sawdust	6%	4,2	3,629	160	2,36
Stover rapeseed	15%	4,17	3,58	115	2,43
Sunflower	9%	5,56	4,78	600	1,79
Wheat	15%	4,17	3,58	700	2,4
Wheat Straw	15%	4	3,44	100	2,49
Wood chip	20%	4,22	3,629	175	2,36
Wood granulate	8%	4,44	3,81	600	2,24
Woodlogs ash	45%	2,61	2,245	650	3,81
Woodlogs ash dry	20%	4,08	3,509	400	2,44
Coal	10%	7	6,02	750	1,36
Fuel gasoil		11,8	11,2	840	0,84
Natural gas		10,83	9,314	0	0

Energy data for selected agricultural by-products

Product	Moisture	Approx. Ash content	LHV / Net CV
	(%, dry basis)	(%)	(MJ/kg)
Bagasse Sugarcane	18	4	17-18
Coconut husks	5-10	6	16,7
Coffee husks	13	8-10	16,7
Corn Stover	5-6	8	17-19
Corn cobs	15	1-2	19,3
Cotton husks	5-10	3	16,7
Groundnut shells	3-10	4-14	16,7
Miscnathus	14	1-3	19-20
Oil-palm fibres	55	10	7-8
Oil-palm husks	55	5	7-8
Poplar wood	5-15	1.2	17-19
Rice hulls	9-11	15-20	13-15
Rice straw and husk	15-30	15-20	17-18
Switchgrass	8-15	6	18-20
Wheat straw and husk	7-15	8-9	17-19
Willow wood	12	1-5	17-19

Biomass source	Biomass feedstock	kWh/kg	MJ/kg	toe/t
Agricultural residue	Fresh fruits	4.1	14.7	0.35
	Citrus fruits	4.1	14.7	0.35
	Dry fruits	4.1	14.7	0.35
	Olives	5.0	18.1	0.43
	Vineyard	4.9	17.8	0.42
	Wheat	4.8	17.1	0.40
	Maize	4.5	16.3	0.38
	Barley	4.5	16.2	0.38
	Oats	4.6	16.6	0.39

Pellets Advantages



- Quality:
- Higher heat profile in the boiler and lower smoke gas volumes (higher capacity in the power plants)
- Uniform quality (critical to optimize and stabilize the power production)
- Substantially lower ash content than alternatives
- The ash is clean
- Less contamination (such as stones and sand in the flow into the boiler)
- Lower content of non organic compounds
- Substantially lower fouling and corrosion in the boilers, especially at high temperatures
- Substantially lower deposits in the boiler and super heater sections and consequently higher operational efficiency
- Substantially lower maintenance need in the power plants (also increasing operational efficiency)

Pellets Advantages

- **Logistics and handling advantages:**
 1. Pellets have 4 times higher bulk energy density compared to wood chips
 2. Pellets are easier to handle due to a fluid behavior (more like liquor than solid material)
 3. Do not need any pretreatment at the power plant to obtain right properties (particle size etc)

⇒ In total, this means that pellets will use/need substantially less capacity in the system for feedstock supply to the boiler (storage, conveyers etc) and transportation to users
- **Feedstock standardization and certification**
(international standard emerging)

Future generations of pellets will be "charcoal hybrids" with a broader market than today's pellets



- Much higher bulk energy density
 - 2 generation close to coal
 - 3 generation better than coal
- Excellent physical properties
- Higher energy efficiency
- Much lower ash content than coal
- Much better environmental performance
- Water resistant
- Not self igniting
- Easier to grind
- Fluid behavior
- Broader use
 - Large scale gasification
 - Coking coal substitute
 - Steam coal substitute
 - Replacing oil, gas and coal as carbon source



These modern stoves use sophisticated clean burn methods and can be installed in houses that do not allow traditional open fires and are a much more efficient way to heat a room.

Pellet Stove Installation is not expensive and the Pellet Stoves are cheap to run. The **wood pellet fuel** they burn is a renewable, clean burning biomass fuel made from recycled wood waste or sawdust.



Modern Wood Pellet Stoves are now stylish home furnishings with contemporary portrait styling, large glass windows and ceramic cladding in attractive colours. Pellet stoves also have remote controls for electronic ignition and temperature control making them safe, attractive and easy to use.

Pellet Fired Heat Generator



Water Heating Calculation

1 litre = 1 kg

If the water temperature is 15°C to be heated to 90°C

Specific heat of water is 4.186 kJ/kg °C

It takes $4.186 \text{ kJ/kg } ^\circ\text{C} \times 4650 \text{ kg} \times 75 \text{ } ^\circ\text{C} = 1459868 \text{ kJ}$

1459868 kJ converts to 405 kW/hr

150 Litre Hot Water Geyser Comparisons

- 4650lt of water with Eskom in 2010 is R4185 (R0.90 kW/hr)

- 4650lt of water with Eskom in 2011 is R6231 (R1.34 kW/hr)

- 4650lt of water with Pellets in 2010 is R1256 (R0.27 kW/hr - €130/t)

- 4650lt of water with Pellets in 2011 is R2372 (R0.51 kW/hr - €250/t)

Sustainable Fuel

Unlike oil and gas boilers, wood pellet boilers run on a sustainable, renewable and controllable fuel source which also has the added advantage of being a lot nearer to Carbon Neutrality than oil fuel, gas fuel or coal fuel.

FOREST

- Branches / tops / stumps
- Chipping in the forest
- Logs





SAWMILL

- Debarking / Sawing
- Timber
- Secondary Wood Industry

WOOD PELLETING PLANT

- Chipping
- Boiler
- Dryer
- Grinding
- Pelletizing
- Cooling
- Sifting



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WAREHOUSE / DELIVERY



➤ Packing plant / Small Bags

Private customers / Individuals

➤ Packing plant / Big Bags

Private Institutions & Customers

➤ Bulk

Private Institutions, Large Customers, Heating Plants, Power Plants & Individuals

SUMMARY

- Biomass is the only renewable source that contains carbon
- Biomass is one of the most competitive renewable energy sources
- The current support mechanisms in Europe “boosts” the development
- The increase of prices for fossil carbon sources in combination with rapid development of pellets will make pellets highly competitive
- The new development will boost forestland profitability
- If the profitability is good there will be sufficient supply of biomass
- Generation 1,2 and 3 wood based pellets are superior to other sources of biomass and with a great improvement potential
- Wood based pellets will be used in the energy sector but also as a carbon source for chemicals, fuel and steel production
- A developed market for wood based pellets as a global commodity will gradually develop