Biomass Production, Supply and Quality Control in Hungary

as seen by

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Selected Data of Hungary

Area 93.000 km² (9.3 m ha, 1% of Europe)
 Cultivated area 77.210 km² (7.721 m ha)

58.4% land (4.5 million ha)
23.6% forest (1.8 million ha)
13.2% field (1 million ha)
4.1 % others (fruits, grapes etc.)
0.7% cane plantation (57,000 ha)

Population is 10.4 million (2% of Europe)

Production of Primary Biomass

Wood

5 – 6 million t/year

- Wheat
- Corn
- Cereals (rye, barley ..)
 1.6 2.4 million t/year
- Sunflower seed
- Rape seed

- 5 6 million t/year
- 4 9 million t/year
- 1 1.2 million t/year
- 0.5 million t/year
- Mass ratio of Secondary (straw, stems, ..)/ Primary ≈ 1
- Biomass used in power generation

1.6 million t/year

Biomass Energy Content in Primary Products of Agriculture (2007)

	PJ/year	GJ/y/person	W/person
Wood	60	5.8	183
Wheat	83	7.9	250
Corn	98	9.4	297
Cereals	30	2.8	91
Sunflower	26	2.5	80
Rape	12	1.2	37
Sum	309	30	938
Total energy consumed	1126	108	3432
Energy cons. by people	236	23	718
Biomass in P_stations	19.3	1.86	58.8

Biomass in Power Stations Energy Consumptions (in 2007)

Power Stations	Capacity	Actual	Biomass
	PJ	PJ	PJ
Mátra	77.1	61.2	4.03
Pannon	4.84	4.67	4.66
Kazincbarcika	12.56	7.41	3.77
Tiszapalkonya	23.1	5.37	0.094
Bakonyi Bio	3.86	3.01	2.85
Bakonyi Erő	6.95	5.9	1.14
Oroszlány	26.95	17.76	1.8
Dorog	1.7	0.27	0.04
Bunge	2.31	0.96	0.958
SUM \	159.3	106.6	19.34

Locations of Biomass Firing Power Stations and Forestry in Hungary



Motivations of Power Stations for Biomass Combustion

- Market of the electrical energy produced by biomass is state guaranteed.
- Selling price (96 €/MWh) of biomass based electrical energy is set much higher than the average market price (58 €/MWh), but a yearly updated energy quota is given for every power station.
- CO₂ emission is regressively regulated for 3 three years ahead (2008-2011) for each power station.

Biomass in Power Stations CO₂ Emissions and Biomass Consumptions (in 2007)

Power Stations	Allocated CO ₂ (t/year)	Actual CO ₂ (t/year)	Subsidized Bio (PJ/year)	Actual Bio (PJ/year)
Mátra	5 072 888	6 387 466	5.48	4.03
Pannon	232 308	258 480	4.82	4.66
Kazincbarcika	204 552	346 519	5.04	3.77
Tiszapalkonya	191 610	465 675	3.24	0.094
Bakonyi Bio	53 043	53 000	2.81	2.85
Bakonyi Erő	377 954	378 000	0.99	1.14
Oroszlány	1 564 784	1 630 500	4.78	1.8
Dorog	79 631	78 851	0.0	0.04
SUM	7 776 770	9 598 491	27.16	18.38

Types of Biomass Used in Power Stations (2007)

Power Stations	Types	Quantity t/y	LHV GJ/t	Actual Bio (PJ/year)
Mátra	wood-chips, saw-dust, chopped straw and corn stems, bio-mix	310 000	13	4.03
Pannon	wood-chips	440 000	10.6	4.66
Kazincbarcika	timber, wood-chips, saw-dust	340 000	11.1	3.77
Tiszapalkonya	timber, wood-chips, saw-dust	9 400	10	0.094
Bakonyi Bio	timber ,wood-chips	216 000	13.2	2.85
Bakony Erő	timber, wood-chips	86 000	13.2	1.14
Oroszlány	timber, wood-chips, cane, straw	155 000	11.6	1.8
Dorog	wood-chips, saw-dust, sunflower shell, sunflower seed	3 000	13.3	0.04
Bunge	sunflower shell	61 400	15.6	0.958
SUM		1 620 800	11.9	19.342

Main Woody Biomass Suppliers

	Kazincbarcika		
	Egererdő Forestry Co.	73 000 ha	
	Északerdő Forestry Co.	103 000 ha	
	Import from Ukraine and Slovakia		
-	Tiszapalkonya		
	DALERD Délalföldi Forestry Co.	28 000 ha	
	Nyirerdő Forestry Co.	61 000 ha	
	Import from Ukraine and Slovakia		
-	Pannon		
	Mecseki Forestry Co.	100 000 ha	
	Sefag Forestry and Wood Co.	80 700 ha	
	Gemenci Forestry Co.	37 500 ha	
	Oroszlány		
	Vérteserdő Forestry.	43 000 ha	
	Kisalföldi Forestry Co.	25 000 ha	
	Bakony Bio and Erő		
	Bakonverdő Forestry and Wood Co.	62 500 ha	
	Zalaerdő Forestry Co.	56 000 ha	
	Szombathelvi Forestry Co.	45 400 ha	
	HM Verga Veszprémi Forestry Co.	50 000 ha	
_\	Mátra		
_ \	Inoly Frdő Forestry Co. 64 000 ha		
	NFFAG Nagykunsági Forestry Co.	31 000 ha	
	Import from Ukraine and Slovakia		
	Dorog		
	Pilisi Park Forestry Co	60 000 ha	

Biomass Transportation

- Timber is transported mainly on rail, but within 100 km radius also on trucks.
- Wood-chips, saw-dust and other agricultural biomass (sunflower shell, etc.) are transported via special trucks of 90 m³ capacity (max 25 t).
- Price of transportation within 100 km radius of the target varies between 4-6 €/ton.

Important Prices for Biomass Market (2008)

- Price of biomass delivered to power stations varies between 3 – 4 €/GJ (coal 4 - 5 €/GJ, natural gas 9 - 10 €/GJ).
- In 2008, the market price of CO₂ varied between 10 -20 €/t CO₂ (now 11.7 €/t), providing a credit of 1 -2 €/GJ for biomass.

Due to low cycle efficiency (25-35%), the cost of fuel energy conversion to electric energy based on biomass varies between 12 – 16 €/GJ, that is 43 – 58 €/MWh (note the guaranteed price is 96 €/MWh)

In-house Technology of Biomass Handling and Combustion

Power	Handling and Combustion		
Stations			
Mátra	Only truck transport, automated feeding to the coal feeding line, tangentially fired boiler		
Pannon	Timber on rail and trucks, in-house cutting , automated feeding to fluidized bed boiler		
Kazincbarcika	Timber on rail and trucks, in-house cutting , automated feeding to hybrid fluidized bed boiler, saw-dust is transported via belt conveyors into coal bunkers		
Tiszapalkonya	Timber on rail and trucks, in-house cutting , automated feeding to hybrid fluidized bed boiler, saw-dust is transported via belt conveyors into coal bunkers		
Bakonyi Bio	Timber on rail and trucks, in-house cutting, automated feeding to hybrid fluidized bed boiler		
Bakony Erő	Timber on rail and trucks, in-house cutting, automated feeding to hybrid fluidized bed and tangentially fired boiler		
Oroszlány	Timber on rail and trucks, in-house cutting, automated feeding to hybrid fluidized bed boiler, cut biomass is directly blown into the furnace		
Dorog	Only truck transport, transported via belt conveyors into coal bunkers and to the tangentially fired boiler		
Bunge	In-house transport by screw-type feeder into a grate fired boiler		

Selected Properties of Co-fired Coal and Biomass

	Coal	Lignite	Wood- chips	Agricultur al Biomass
LHV(MJ/kg)	14-18	7 - 9	10 - 12	16 - 20
Bulk density (kg/m ³)	850 - 950	750 – 850	250 - 300	100 - 200
Moisture (m%)	5 - 10	40 - 45	35 - 50	8 - 15
Ash (m%)	10 - 15	15 - 18	2 - 4	1 - 8
Ash fusibility (°C)	1100-1150	950 - 1000	1000-1100	600 -700

Conclusions

- Presently, the primary source of biomass energy (~ 20 PJ/year, 8.2% of consumed energy by the people) used in power stations is wood from the Hungarian forests.
- Power stations are motivated to use more biomass by guaranteed market of electric energy on biomass and by gradually (~16%) reduced CO₂ quotas, however electric power on biomass is state controlled by yearly quota of subsidy.

Power stations designed for low quality coal (8-12 MJ/kg) have been successfully modified to fire wood derived biomass (chips, saw-dust, etc.) using the biomass fuel in a heat fraction ranging between 10 – 80 % of the total fuel heat input.

 Approximately, 1.6 million tons of biomass (~ 1.9 GJ/year/person) is sold to the power stations by either the Forestry Co. or by independent biomass merchants.

- Preparation (cutting, mixing ... etc.) of woody material (timbers, branches etc.) is either carried out at the power stations or at the source of biomass, the quality of biomass is determined at the power stations.
- The Hungarian forests may support some (30%) increase in biomass consumption by the present power stations, however major advance (2-3 folds) can only be reached by using the secondary biomass products in the agricultural sector.

 The quality and availability of agricultural biomass require further modifications in the supply chain (collection, storage, transport ... etc.) and of the present combustion system (feeding, internal transport and ash deposition).

 With these new algorithms, a significant rise (~ 60 PJ/y, 24.6 % of consumed energy by the people) in agricultural biomass utilization can be reached in the existing but modified and in the newly designed power stations.