The energy sector, energy policy and potential of biomass in the Czech Republic

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ABSTRACT

1. COUNTRY DESCRIPTION – CZECH REPUBLIC

1.1 General Information

The Czech Republic is located in the heart of Europe, close to most major Western European economic centres, and shares borders with Austria, Germany, Poland and Slovakia. The Republic consists of three distinct regions: Bohemia in the west, Moravia and part of Silesia in the east. Its area is 78,866 km2 and 10.3 million inhabitants, three quarters of which live in urban areas.
The Czech Republic consists of 14 administrative regions. The climate is continental with hot but brief summers and frequently cold winters. Rainfall is generally moderate. The Czech Republic was established as a sovereign state after disintegration of formel Czechoslovak Republic in 1993 and since that time leads its own foreign and economic policy.
In 2004 Czech Republic became a member state of European Union. In economic terms Czech Republic is a developed country with GDP of 112.6 billion € (18,700 € per capita in PPP) and real growth rate of more than 6% in 2006.
The agricultural area of the Czech Republic (54.2 % of total area) is 4.3 million hectaresv in total, of which 3.1 million hectares are arable land. About one half of the total agricultural area is located on less favourable land, and about one eighth is located in conservation areas (protecting water resources, landscapes and nature).
The forest areas (38.5 % of total area) cover an area of almost 2.7 million hectares where 52% of the total area belongs to the state, 5% are forests owned by the military, another 5% are divided between 4 national parks and the rest is privately owned. Large area of country has specific restriction due to the environmental protection (8.4 % agricultural land and 16,0 % of total area of Czech Republic).
State energetic policy of the Czech Republic regards biomass as an important source of energy and it assumes that it will participate on the total balance of usage of renewable resources by 80% in 2020 and by 85% in 2030.

Česká republika je významným samostatným ekonomickým centrem západní Evropy s rozvinutou ekonomikou a přírodními zdroji pro získávání biomasy pro energetické účely.
Státní energetická politika ČR považuje biomasu za významný energetický zdroj a předpokládá že se bude podílet v roce 2020 na cca 80% a v roce 2030 na cca 85% na celkové bilanci využívání obnovitelných zdrojů.

Keywords-klíčová slova:

Biomasa-Biomass, Energie biomasy-biomass energy, potenciál biomasy - biomass potential, biopaliva-biofuel, RES – podíl na čerpání primární energie

INTRODUCTION

1.2 The energy sector of the Czech Republic

The Czech Republic has significant reserves of coal (6300 million tons), which is its key locally available energy source. Despite the use of coal is decreasing, it still remains dominant in domestic energy production both regarding primary energy consumption and the electricity production. The local reserves of natural gas are negligible. Natural gas supplied 17.5% of the primary energy and accounted for 22.3% of final consumption in 2005. After an increase of share of natural gas in the previous decade, the current share is stagnating or growing only very slowly. Natural gas is imported from Russia and Norway.
The Czech Republic relies on imports for approximately 95% of its oil supplies. Most of oil is imported from Russia, however, the IKL pipeline, which links to the Mediterranean terminal of Trieste, reduces Czech dependence on Russian oil imports.
Although the current energy production from biomass comprises major part of the energy production from renewable sources (RES) in the Czech Republic (81.7% of all RES in 2005, according to IEA; 80.6% of all RES in 2006, according to Ministry of Industry and Trade statistics) the share of the biomass on the total primary energy sources in the Czech Republic is only around 1.5%.

1.3 The electricity market

Electricity production in the Czech Republic is mainly based on coal-fired plants using omestic brown coal (61% in 2006) and two nuclear power plants (Dukovany – 1,760 MW and Temelín – 2,000 MW) contributing also a significant share (21.5% in 2006).
Power and CHP (Combined Heat and Power) plants with natural gas combustion in 2006 covered only about 4.6%, hydroelectricity plants (including pumped hydro) in 2006 had a share of approximately 12.4%; the share of other sources (biomass wind, solar) was marginal.
The total production in 2006 was 84.4 TWh. A significant part of electricity is being exported from the Czech Republic (12.6 TWh in 2006).
The largest electricity producer is state-controlled power utility CEZ, a.s., whose share in the total production was 73.5% in 2006. It operates the two nuclear power plants, as well as 16 coal-fired plants, 13 large hydroelectric plants and 3 pumped storage hydroelectric plants.

Table 1: Structure of electricity generation capacity in the Czech Republic, December 2006

Installed Capacity on 30.11.2006 [MW]	Total	ČEZ	Independent power producers (IPPs)		
			installed capacity > 50 MW	installed capacity 5 - 50 MW	installed capacity < 5MW
Coal *	10,691.0	6,524.1	3,684.8	449.0	32.5
Combined cycle gas turbine	569.7	,	537.7	32.0	,
Gas	234.3	,	68.7	84.6	81.1
Hydro	1,028.5	722.8	,	181.0	124.7
Pumped storage	1,146.5	1,145.0	,	1.5	,
Nuclear	3,760.0	3,760.0	,	,	,
Wind	43.8	1.2	,	7.6	35.0
Other alternative sources**	33.9	0.01	,	12.3	21.6
Total	**17,507.6**	**12,153.0**	**4,291.2**	**767.9**	**294.9**

** Including power sources with co-firing of biomass (approx.1,182 MW in 2005 according to IEA statistics)*

** Mostly sewage gas, landfill gas, biogas and 100% biomass CHP.*

Source: Energy Regulatory Office

1.4 Share of RES in primary energy supply

The share of RES in primary energy supply in the Czech Republic after 2000 was stagnating slightly above 2%. The share has increased to 2.9% in 2004 based on the same statistical methodology.
Since 2005, an updated statistical methodology is used including more detailed estimate of biomass consumption, in particular in households.
Due to updated statistical methodology, the share of RES in primary energy has increased to approx. 4.12% in 2005 and 4.31% in 2006. In 2005, only biomass (including biogas and biodegradable waste) had 3.5% and in 2006 3.63% share in primary energy sources consumption. This share shows growing tendency.

Table 2: Total primary energy supply from RES (TJ)

	2004	2005	2006
Hydropower	7,269.8	8,567.7	9,182.5
Wind	35.5	77.2	176.4
Solar PV	approx.,1.0	1.4	1.9
Biomass except households	22,594.8	24,040.4	25,529.9
Biomass households	36,755.7	37,078.7	40,138.1
Biogas	2,102.4	2,335.4	2,241.3
Biodegradable communal waste	2,505.3	2,346.4	400.1
Biodegradable industrial waste	n/a	990.1	2,655.6
Liquid biofuels	1,212.0	117.6	798.6
Geothermal and ambient heat (heat pumps)	500.0	545.0	676.5
Solar thermal	84.0	103.0	127.6
TOTAL	**73,161.6**	**76,202.8**	**81,928.6**
Total primary energy sources (TJ)	**1,849,534**	**1,847,776**	**1,903,000***
Share of RES in TPES	**3.96%**	**4.12%**	**4.31%**

*Source: Ministry of Industry and Trade; * estimate*

The amount of electricity produced by RES has greatly increased during the past decade, but remains well under its potential. The current share of renewables in total primary energy resources consumption of the Czech Republic was 4.12% in 2005 according to the energy statistics of the Ministry of Industry and Trade (3.9% according to IEA; the difference is given by different statistical methodology used).
Electricity from renewables (including large hydro) had approx. 4,9% share in gross national electricity consumption in 2006 (the indicative target is 8% in 2010) and this share growing tendency.
The gross electricity production from RES was 3,518.8 GWh in 2006 and 3,133.5 GWh in 2005.
The gross electricity production from RES has increased by approx. 385 GWh, which is a similar increase as between 2004 and 2005.

Table 3: Electricity production from RES (GWh) and share in gross electricity consumption

Gross electricity production from RES (GWh)	2000	2004	2005	2006
Hydropower	2,313	2,019.40	2,379.91	2,550.70
Small hydro < 1 MW	503	286.10	342.98	333.00
Small hydro 1 - 10 MW		617.40	727.73	631.40
Large hydro > 10 MW	1,810	1,115.90	1,309.20	1,586.30
Biomass total	382	564.55	560.25	731.07
Biogas total	135	138.79	160.86	175.84
Biodegradable waste	n/a	10.03	10.61	11.26
Wind (> 100 kW)	0	9.87	21.44	49.40
Solar PV	0	0.30	0.39	0.54
Liquid biofuels	n/a	n/a	n/a	0.02
TOTAL	**2,481**	**2,743**	**3,133**	**3,519**
Share of biomass in RES-electricity	**22.7%**	**26.01%**	**23.36%**	**26.09%**
Gross electricity consumption (GWh)	**63,449**	**68,616**	**69,945**	**71,730**
Share of RES-E in gross electricity consumption (%)	**3.91%**	**4.00%**	**4.48%**	**4.91%**

Source: Ministry of industry and Trade [11]

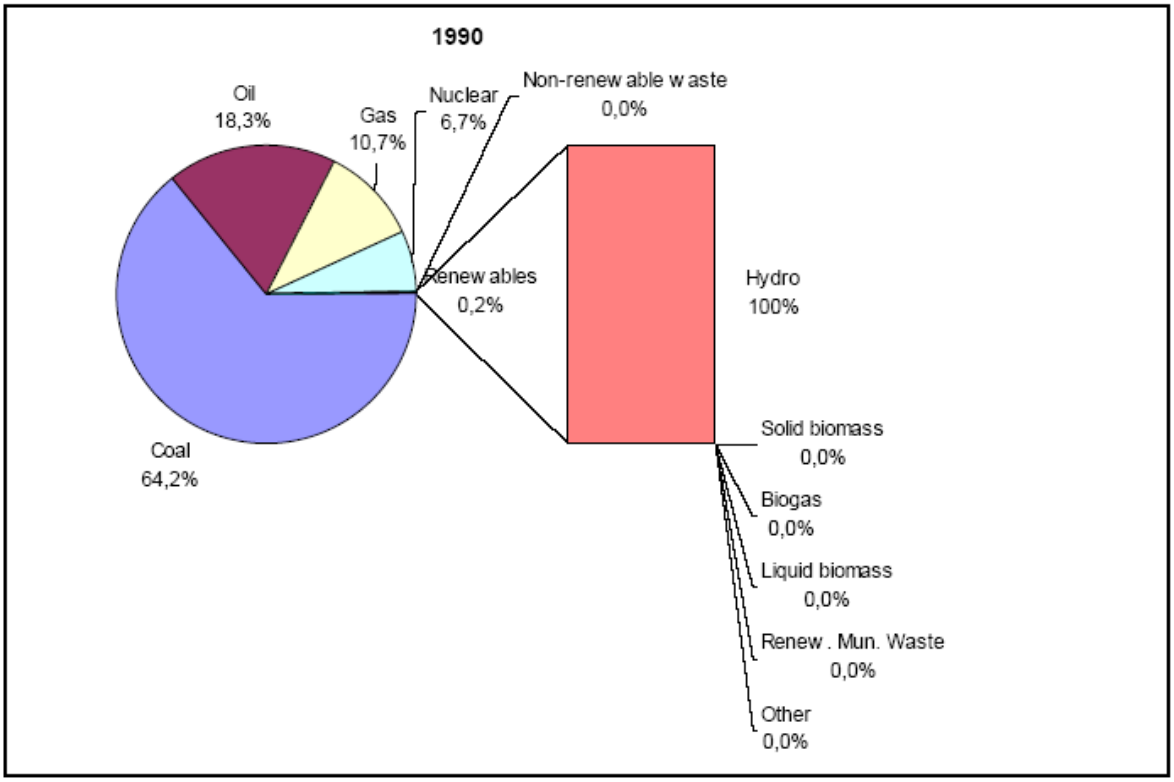
There was in total almost 46 PJ of heat produced from RES while biomass and biomas has key share in heat production from RES in the Czech Republic – approx. 91%. Heat production from biodegradable waste has approx. 5% share in heat production from RES.
Heat production from biogas is rather negligible – only approx. 2% of total heat production from RES. Heat production from other sources (solar, geothermal) is negligible.

Table 4: Gross heat production from RES in the Czech Republic (TJ)

	2004	2005	2006
Biomass TOTAL	**40,230**	**40,892**	**41,760**
- Biomass except households	16,980	17,437	16,370
- Biomass households	23,250	23,455	25,390
Biogas TOTAL	**968**	**1,010**	**919**
Biodegradable communal waste	**2,052**	**1,979**	**1,910**
Biodegradable industrial waste	**n/a**	**990**	**400**
Liquid biofuels	**n/a**	**n/a**	**0.2**
Geothermal and ambient heat (heat pumps)	500	545	676
Solar thermal	84	103	128
TOTAL	**43,835**	**45,519**	**45,792**

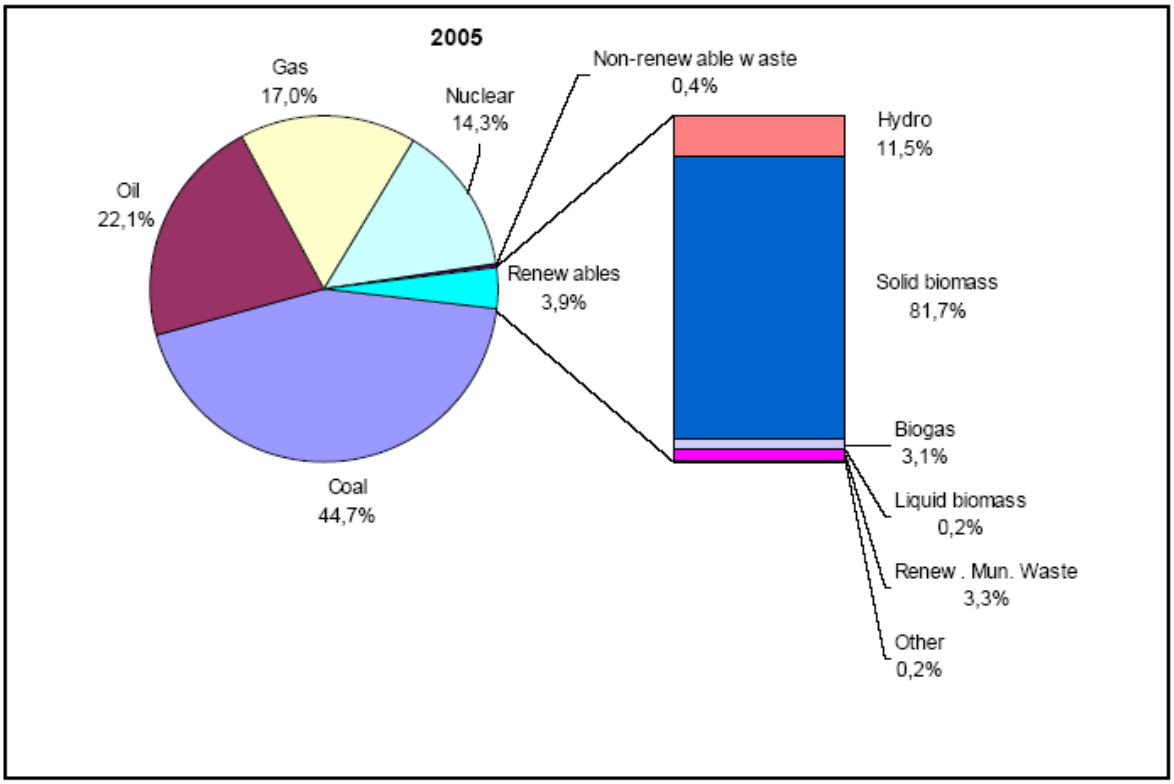
Source: Ministry of Industry and Trade

Figure 1: Total primary energy supply and contribution of renewables in 1990



Note: the zero share of biomass presented in 1990 is result of unavailability of statistical data.

Figure 2: Total primary energy supply and contribution of renewables in 2005



2. The energy policy of Czech Republic (legislation and policies)

2.1 Energy Policy

The energy policy framework in the Czech Republic is given by new State Energy Policy document formulated by the Ministry of Industry and Trade and approved by the Government in March 2004. The policy document focuses on requirements related to accession to the EU and some other international commitments, mainly speed-up of energy (electricity and gas) market opening, stronger requirements on protection of the environment and stronger requirements on security of energy supply.
The State Energy Policy defines the basic priorities for the long-term development of the Czech energy sector, which are: Independence (from foreign energy sources and from energy sources in risky regions), Safety (safety of energy sources, including nuclear safety, reliability of supply and reasonable decentralisation of all energy sources) and Sustainable development (environmental protection, economic and social development).
Among other issues, this policy document also indicates the support to production of electricity and heat from RES as one of top priorities and references to the newly prepared legislation related to RES and new RES-E (electricity from renewables) support scheme which should also implement the requirements of RES-E Directive 2001/77/EC.
The new energy policy also harmonises the political targets set in different policy documents and sets the indicative targets for RES and RES-E in 2010.
The proposed targets are rather ambitious if compared with the current share of RES and RES-E:

- Share of RES-electricity in gross electricity consumption: 5-6% in 2005 and 8% in 2010 (in 2006 approx. 4.9% incl. large hydro) - this target is implemented as 2001/77/EC Directive target.
- Share of RES in national energy balance: 6% in TPES in 2010 and 15-16% in TPES in 2030 (in 2005 approx. 4.4%) - this target is indicative.

There is currently no specific political target for biomass, wind energy or other specific renewable energy source.

2.2. Indicative target for the RES-E Directive 2007/77/EC

The indicative target of share of RES-E on gross electricity consumption in 2010 in the Czech Republic and adopted in line with implementation of RES-E Directive 2007/77/EC is **8%**. This target also corresponds to targets set by State energy Policy of 2004. The current (2006) share of RES-electricity is 4.9%.
According to approved Energy policy scenario reaching of 8% share of RES-E would require installation of up to approx. 610 MW in biomass, 280 MW in small hydro and 615 MW in wind until 2010.

2.3 Indicative target for biofuels

The use of biofuels is being encouraged through updated Air Pollution Control Act No. 86/2002 Coll., which requires that minimum amounts of biofuel (or other fuels produced from RES) are made available to the market.
Between 2007 and 2012, the Czech Republic is aiming for a total volume of 4.2 mill. Tons biofuels to be available on the Czech market.
National Indicative target for biofuels is 2% of energy contents of motor fuels in 2005 and 5.75% in 2010.

2.4 Key energy legislation related to renewable energie

The key energy legislative documents in place related to renewable energy include the following legislative provisions:
1. Energy Act 458/2000 Coll. (as amended - the full wording as Law 91/2005 Coll.) and accompanying implementation Decrees;
2. Energy Management Act 406/2000 Coll. and accompanying implementation Decrees;
3. Renewable Energy Act 180/2005 Coll. and accompanying implementation Decrees.

Ad. 1) Energy Act 458/2000 Coll. (in full wording incl. amendments 91/2005 Coll.)

Regarding RES, the updated Energy Act includes the following key provisions:
- When applying for a license for electricity/heat production, the operator of RES-E source has to provide evidence of having sufficient funds and technical background for operating the source with an electric capacity lower than 200 kW_e or a thermal capacity lower than 1 MW_t and evidence of having professional competence for operating sources with electric capacity lower than 20 kW_e.
- Electricity and heat produced from RES have priority right for transmission within the Czech Republic.
- Electricity generated from RES and CHP has priority access to the distribution and transmission grid on condition that operator of the source applies for it and meets conditions specified by implementation Decree and by Distribution network code. Deviation of capacity of RES resulting from their nature cannot be a reason for refusal of connection to the grid.

Ad. 2) Energy Management Act (406/2000 Coll.)

The Energy Management Act is implemented since 1st of January 2001 and drala specifically with the ways to promote energy efficiency such as minimum energy efficiency requirements, conditions for thermal and technical properties of buildings, energy efficiency labelling, local and regional energy planning, energy auditing and promotion of combined heat and power (CHP) generation.

Ad. 3) Renewable Energy Act (180/2005 Coll.) and its implementation Decrees

The Renewable Energy Act No. 180/2005 adopted in May 2005 is aimed at creating conditions for meeting the indicative target of the share of 8% of RES-electricity in gross electricity consumption of the Czech Republic in 2010 and implement the requirements of Directive 2001/77/EC.

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Biomass Action Plan

According to the ***Biomass Action Plan 2008 - 2010*** that has been drafted by the Agriculture Ministry in cooperation with Czech Biomass Association CZ BIOM in line with State Energy Policy and EU Biomass Action Plan EU COM(2005)628, up to 120 agricultural biogas stations could operate in the Czech Republic in 2010; these could have an installed output of 60 MW with annual production of 450 GWh of electricity.
Thein output will realistically increase to 150 – 370 MW by 2020 at which point annual production will total 1.2 – 3.0 TWh of electricity produced from biogas. Investors into new biogas stations will be able to draw subsidies from various EU programmes.

2.5 Key legislation related to Biofuels

production, biodegradable part of municipal solid waste etc.,
- products of animal origin – litter, manure etc.,
- sewage gas, landfill gas,
- liquid biofuels

In the last 10-15 years, there were a number of studies elaborated by domestic as well as foreign experts analysing and evaluating potential of biomass in the Czech Republic. The conclusions of these studies often quite differ from each other due to various reasons –purpose for which were elaborated, applied methodology etc. and their outputs are structured in different ways so that the results are not directly comparable. The common conclusion, however, is that the Czech Republic is a country with relatively high potential of biomass and that biomass plays a key role in the renewable energy mix in the Czech Republic.

Biomass in the form of forestry residues, waste wood, straw and other agricultural waste is expected to keep the key share in the future. A significant share of energy crops is also expected in the future.
One of key studies recently finalised - "Prognosticating the use of renewable energy sources in the Czech Republic until the year 2050" [3], elaborated for the Ministry of Environment in 2004 evaluates the available potential (in terms of energy production from biomass and biogas) from long-term perspective (until 2050) to approx. 239 PJ of heat and 14.6 TWh of electricity.

Table 5: Available potential of RES in the Czech Republic in long-term perspective

Renewable energy source	Current use (2006)		Available potential 2050 [3]		Technical potential 2050 [3]	
	electricity (GWh)	heat (PJ)	electricity (GWh)	heat (PJ)	electricity (GWh)	heat (PJ)
Wind,	49.40	-	4,000	-	16,324	-
Large hydro,(>10,MW)	2,550.70	-	40*	-	40*	-
Small hydro,(<10MW)			410	-	410	-
Solar thermal	-	0.128	-	17	-	25
Solar PV	0.54	-	5,500	-	23,000	-
Biomass,	731.52	43.35	12,500	215	16,950	291
Biodegradable waste	11.26	3.00	n/a	n/a	n/a	n/a
Biogas	174.69	0.875	2,130	24.03	3,420	26.3
Geothermal**	0	0.685**	14,000	36.2**	141,200	272.3**

Source: Ministry of Environment [3]

** repowering*

*** incl. heat pumps*

**** including biomass for heat production and including energy crops*

The energy potential of energy crops in the Czech Republic, analysed in the study [3], has been separately determined for all Czech districts as a sum of different productivities of currently grown energy plants at different ratios of land use. The same has been conducted for the production of foodstuffs and industrial crops.
The biomass potential consists of its direct energy use as well as of the production of biofuels.

Table 6: Potential of energy crops in the Czech Republic in long-term perspective

type of potential	biomass production (1000s tons)	energy (PJ)
economic (year 2004)	2,738	41
available	9,037	136
usable	13,693	205
technical	18,348	275
theoretical	27,385	411

Source: Ministry of Environment [3]

At present there is about 0.5 million ha of agricultural land as a set aside. Due to the reduced demand of production of food and feed it could be expected that available land for energy crops could rise up to 1 million ha in the near future. It is important to find alternative use of such land to maintain landscape, employment and to contribute to sustainable development.
To reach the aim for renewable electricity production in 2010 it would be sufficient to grow energy crops on half of set aside area (approx. 250,000 ha).

Long term proposal estimates that 1.5 million ha (approx. 35 % of agricultural land) could be use for energy crops with respect to crop rotation and good agronomic practice.
The potential of forest biomass analysed in the study [3], consists of wood residuem from the wood-processing industry, forestry thinning, pruning and firewood. With increased wood exploitation (from the current 14 mill. m_3 to an in the long-term sustainable level of 16 mill. m_3) an increase in the potential could be expected.

Table 7: Potential of forestry residues in the Czech Republic in long-term perspective

potential	energy (PJ)
technical	77.6
available	44.8

Source: Ministry of Environment [3]

The potential of biogas analysed in the study [3], was based on the most commonly used feedstocks in the production of biogas which are animal and plant wastes produced in the agricultural and food processing sector, as well as municipal and industrial organic waste.

Table 8: Potential of biogas in the Czech Republic in long-term perspectiv

potential		total
technical	biogas (thous. m^3)	1,510,600
	energy (PJ)	33
available	biogas (thous. m^3)	625,000,
	energy (PJ)	16
	electricity (GWh)	1,200

Source: Ministry of Environment [3]

According to detailed methodology assessing potential of biomass in medium term (2030) in the study [13], biomass could cover the domestic bio-energy demand of 250 PJ/year in 2030 and could be even exported as bio-fuels to other EU countries. This study assesses the CZ's biomass production potential on a regional level and provides cost–supply curves for biomass from energy crops and agricultural and forestry residues.

About 110 PJ/year, mostly from agricultural and forestry residues, can be provided from biomass when the present Czech agricultural productivity is maintained. About 195 PJ/year (105 PJ from energy crops) can be provided when production systems are optimised with regard to fertilizer regimes and 365 PJ/year (290 PJ from energy crops) when the yield level of Dutch agriculture is reached. Costs for woody biomass decrease with increasing plantation yield and range between 2.58 and 4.76 €/GJ.

It was concluded that Czech agriculture could provide enough biomass for domestic demand and for export if agricultural productivity is increased. The results of the study [13] are also roughly in line with other analyses and studies.

Table 9: Potential of solid biomass in the Czech Republic in medium-term perspective (2030)

	scenario 1 - actual yields (PJ)	scenario 5 – optimal yields + optimal allocation on country level (PJ)	Scenario 6 – actual yield level in NL (PJ)
Agricultural residues (straw)	90.0	74.6	59.4
Forestry residues	15.6	15.6	15.6
Energy crops	3.1	105.1	289.4
TOTAL	108.7	195.3	364.4

Source: [13]

The Czech Biomass Association CZ BIOM published its view on available biomass potential from short-term perspective (approx. until 2010-2015).
According to CZ BIOM, the available potential of biomass (in terms of energy contents of biomass as fuel) is expected to reach 134 PJ per year, which equals to approx. 7.2% of current primary energy consumption. A significant share in the identified potential is taken by energy crops.

Table 10: Available potential of biomass in the Czech Republic in short-term perspective (2010-2015)

Type of biomass	Energy total		Heat	electricity
	%	PJ	PJ	GWh
Wood, wood waste	24	33.1	25.2	427
Straw	11.7	15.7	11.9	224
Energy crops	47.1	63	47.7	945
Biogas	16.3	21.8	15.6	535
TOTAL	**100**	**133.6**	**100.4**	**2,231**

Source: CZ BIOM

Compared to view of previous studies the short term view on biomass potential by CZ BIOM is rather conservative, but sets a fair basis for realistic estimates of market development.
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