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Hungary

Country Study on Political Framework and Availability of Biomass



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General Country Description

Geographical Profile

Hungary is located in the Carpathian Basin between latitudes 45°45' and 48°35' North and longitudes 16°05'to 22°58' East. Total land area is 93 033 km². Hungary is a landlocked country, with the nearest sea (the Adriatic) some 200 kms from the border. The country is strategically located along main land routes between Western Europe and the Balkan Peninsula as well as between the Ukraine and Mediterranean basin. The country neighbours with Austria, Croatia, Romania, Serbia, Slovakia, Slovenia and the Ukraine. The terrain is characterised by limited relief (minor differences in elevation), the highest point being 1014 m above sea level, the lowest at 75.5 m. The majority of the land is lowland, with 84% of the total area lying below 200 m above sea level. The two major rivers, the Danube and Tisza divide the country into three large regions.



Figure 1 Geographical location and elevation map of Hungary

Climate

Hungary has an atypical continental climate, characterised by four distinct seasons, and large diurnal and inter-annual variations in temperature. The average annual temperature was 9.96°C in Hungary for the period 1961-1990. The annual average temperatures were very similar to the global temperature trends since the beginning of the 20th century. Average warming for the period 1901-2004 exceeded 0.76°C, with a minimum value of 0.38°C. The largest warming is in the summer period. The summer temperature increase for the period 1901-2005 was approximately 1°C. The mean summer temperature between 1961-1990 was 19.61°C. Hungary experienced many hot summers in the last 15 years, while cooler summers dominated the first half of the 20th century.

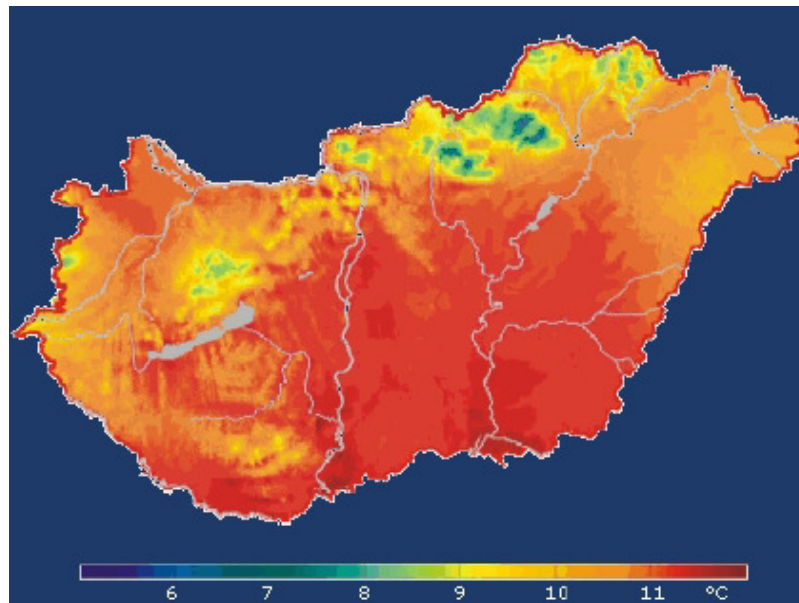


Figure 2 *Spatial variation in annual mean temperatures*

(Source: Hungarian Meteorological Service - OMSZ)

The national average precipitation for the period 1961-1990 was 612 mm. Wet years occurred mostly in the first part of the 20th century, and the annual average decreased by almost 11% during the period 1901-2004. The seasonal mean precipitation in the Spring for the period 1961-1990 was 145 mm. The largest drop in seasonal cumulative precipitation was observed in the Spring, on the whole by 25%. Dry springs dominated the end of the observed period. The seasonal mean of the Summer precipitation for the period 1961-1990 was 208 mm. Drought events (warm and dry months in summer) regularly evolve under the local climatic conditions prevailing in Hungary. There were no significant changes in the cumulative summer precipitation for the period 1901-2004. The seasonal mean of the autumn precipitation for the 1961-1990 period is 143 mm. Although precipitation decreased by almost 14% for the period 1901-2004, dry autumns were evenly distributed in the last century. Winter is the driest season in Hungary (the 1960-1990 seasonal average was 115 mm), the precipitation in this period of the year is especially important for vegetation, hence negative anomalies can disrupt agricultural production. Hence a 12% drop in winter precipitation observed in the period 1901-2004 is significant.

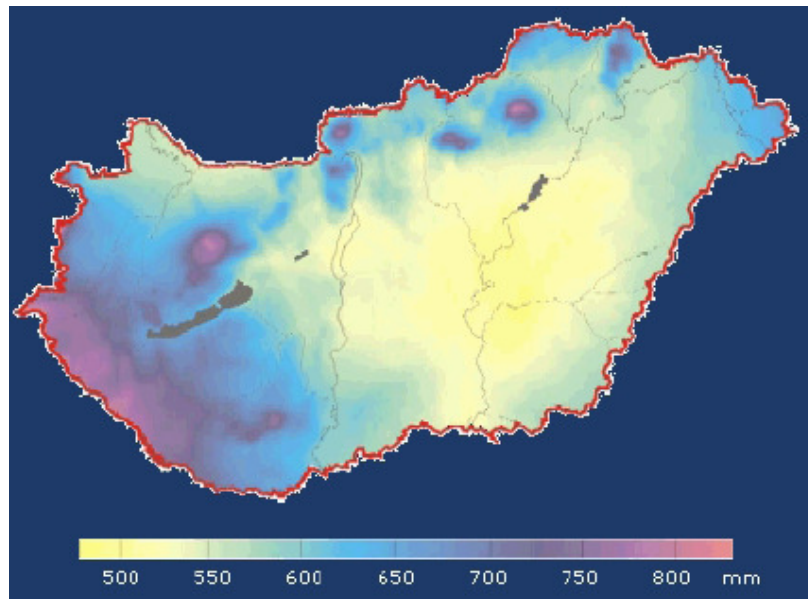


Figure 3 Average annual precipitation

(Source: Hungarian Meteorological Service)

The prevailing wind direction is North-western, wind velocities are modest, the average velocity being between 2-4 m/s. The frequency of the wind from the typical direction, however is low, between 15-35%. Wind features demonstrate seasonal characteristics, the first half of spring being the windiest season, while wind is most rare in early autumn.

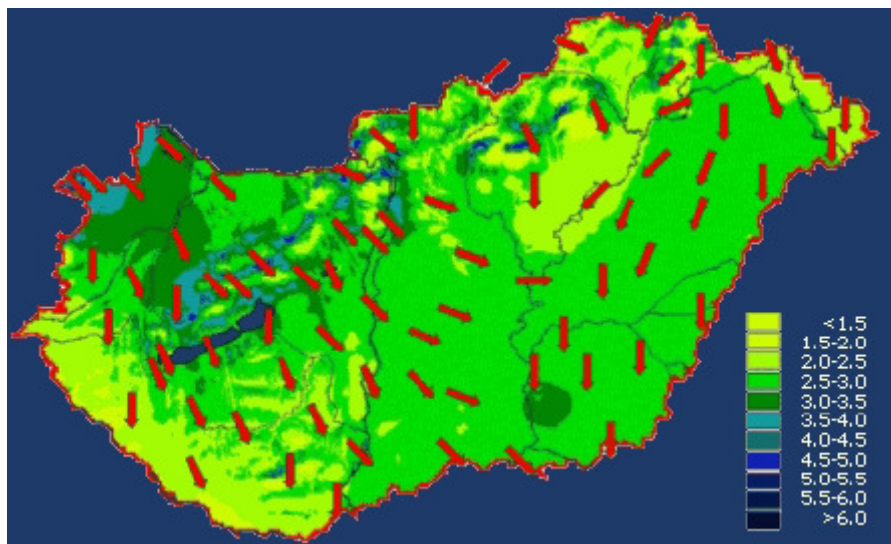


Figure 4 Prevailing winds and average wind velocities

(Source: Hungarian Meteorological Service)

Global solar irradiation (global irradiation is the sum of direct and diffuse irradiation) is high, showing some variation mostly due to different levels of cloudiness. The highest level of irradiation is in the south-eastern part of the country. Irradiation values are the highest in July, as this is when overcast skies are the rarest.

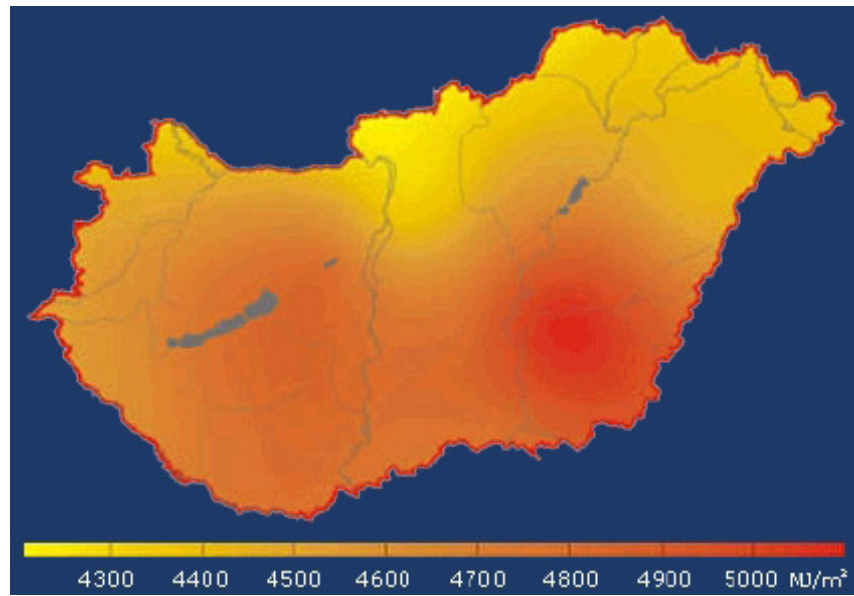


Figure 5 Global Irradiation Values
(Source: Hungarian Meteorological Service)

Country Indicators: Hungary 2007

Size of country	<ul style="list-style-type: none"> • Total land area: 9 303 300 ha • Utilised agricultural area: 63% • Utilised forest area: 21% • Nature protection area: 9%
Population indicators	<ul style="list-style-type: none"> • Inhabitants: 10.06 million • Inhabitants per km²: 108 inhabitants/km²
Economic indicators	<ul style="list-style-type: none"> • Gross Domestic Product in 2007: 67 422 million € (exchange rate: 2000) • Gross Domestic Product per capita: 6702 € (exchange rate: 2000)
Energy indicators	<ul style="list-style-type: none"> • Gross inland consumption: 1125 PJ • Total production of primary energy: 427 PJ (thereof renewable energy¹: 13.9 %) • Primary production of renewable energy and waste: 59.4 PJ (thereof biomass and waste: 88.7%) • Final energy consumption²: 706 PJ • RES shares of final energy consumption: 4,8 % • Share of RES within electricity consumption : 3.9 % • Net energy imports: 62 % • CO₂ emissions per capita: 5.36 tonnes
Availability of biomass resources	<ul style="list-style-type: none"> • Theoretical potential: 1 million ha • Technical potential³: 100-190 PJ

(1) Renewables include waste.

(2) Final energy consumption does not include non-energy use.

(3) In 2020. Base and Policy scenario based on the realization or cancelling prospected political measures.

Table 1 Country Indicators of Hungary (2007)

Agriculture

Agriculture and forestry have been amongst the decisive branches of the Hungarian economy for a long time. Hungary's natural endowments, the climate, the quality of soil as well as long-time tradition and expertise can provide for excellent production results both in terms of quality and quantity. The Hungarian agriculture and food industry is traditionally export-oriented. Despite all the favourable conditions, however, due to the unavoidable restructuring of the economy in the early 1990s and the loss of traditional markets, agriculture lost much of its importance in terms of economic output. While in 1989 agriculture accounted for 13.7% of GDP, provided employment for 17.4% of the workforce and generated 22.8% of the Hungarian export revenues, its share in the GDP production dropped to some 3% by today.

Share of agriculture in					
Year	GDP production	consumption	export	investment	employment
	at current prices				
1995	5,9%	32,4%	22,0%		8,0%
1998	4,9%	30,3%	10,5%	5,5%	7,5%
2000	3,7%	27,7%	6,9%	5,0%	6,5%
2002	3,3%	27,5%	6,8%	6,3%	6,2%
2004	3,3%	25,8%	6,0%	4,3%	5,2%
2005	3,0%	25,0%	6,1%	4,6%	5,0%

Table 2. Share of Agriculture

Out of the total 9.3 million hectares of the total area of Hungary, 7.7 million hectares are productive land (including forests, fish ponds etc.), 5.9 million hectares of which are agricultural land – a share which is uncommonly high in Europe. Of this, 77% is arable land and 18% is grassland. Kitchen gardens, orchards and vineyards accounted for 5% of the agricultural land area.

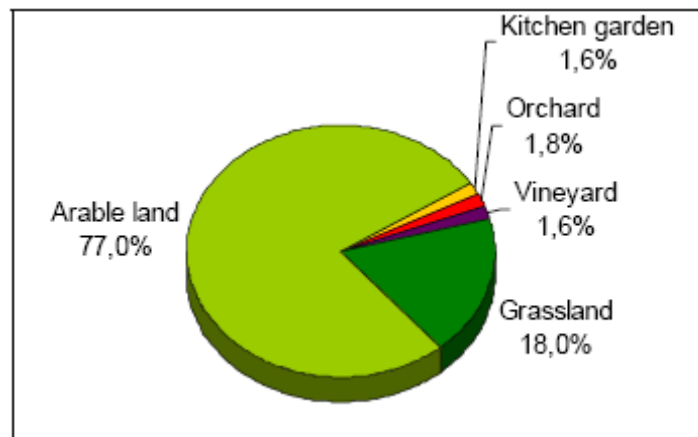


Figure 6 Types of Agricultural Land

(Source: Ministry of Agriculture and Rural Development)

Regarding agricultural land use, the role of individual farmers remains decisive although their landholding has slightly decreased. This means that almost 45% of domestic land is cultivated by private farmers, and 41% is cultivated by companies and other economic

organizations. The remaining 14% is used for other, non-agricultural purposes or consists of non-fertile areas.

Forestry

The Hungarian forestry policy provides a basis for the economic utilisation of forests, as well as conserving and improving their ecological, protection and welfare roles. The main principle and objective of national forest management is to implement a long-term, sustainable management of forests as a natural resource, which should satisfy the forest-related consumption of the society, the protection of the environment as well as social, leisure and cultural needs.

Introduced in 1996, the long-term „forestation programme” estimated the size of agricultural areas eligible for long-term forestation (35-50 years) at 778,000 hectares, increasing the percentage of forested areas in Hungary to 27%, an “optimal” figure. For the period between 2001-2010 the government has targeted the forestation of 15,000 hectares per year, roughly 80% of which should be planted on agricultural land in accordance with the objectives of the National Regional Development Plan. A similar target figure was set for 1991-2000 when 150,000 hectares of new forest were planned. By 2000 44% of this target figure was met (66 000 hectares) as a consequence of the delayed clarification of land ownership and the lack of financial resources. Between 2000 and 2007 forestland has grown by 53,000 hectares in Hungary, falling short of the targeted figure again (50%).

Of the total land area of the country, more than one fifth (1,983,000 hectares) is involved in forest management (i.e. planned forest), of which 93.3% (1,853,000 hectares) are covered by woods. In Hungary, forests represent the second biggest sector after arable land in terms of area. The ownership of the areas with planned forests is as follows:

State-owned: 1,148,000 hectares (58%)
Community-owned: 18,000 hectares (1%)
Privately-owned: 817,000 hectares (41%)

The last decade can be characterised by the continuous expansion of privately-owned forest areas with new stock, while the size of the state and community forests has stabilized. With the increase in forest area, the total standing wood resources of forests have grown as well, accounting for 341 million cubic metres. Compared to general European conditions, 85% of all forest areas are covered by deciduous trees while the area of pine forests is only 15%. Indigenous deciduous tree species occupy 55% of the area covered by woods. The most valuable species of trees comprising the stock are beech and oak. The forests consist of a mixture of different tree varieties. Due to their composition, Hungary’s forests are diverse and ecologically stable.

Areas classified national nature reserves currently occupy 820,628 hectares, accounting for 9,2% of the area of Hungary. Since 1994 nature reserves have expanded by approximately 150,000 hectares. The northern region of Hungary has the highest share of national nature reserves and the South-Transdanubian part the lowest. As per the situation on January 1, 2003 the proportion of protected forestland is outstanding in a European context as well: 375,180 hectares, representing 20% of the total forested areas and 4% of the entire area of Hungary.

General Energy Profile

Although total energy consumption has decreased by 7% between 1990 and 2004 in Hungary the 20% increase in gas consumption means that the share of imported fossil resources exceeds 60%. Together with nuclear fuel imports primary energy dependency is over 70%. The overall trends of energy consumption, its volume and the increasing import dependency are clearly demonstrated by the total unaccumulated sources in the following figure. Average growth was 0.6% per year between 2000 and 2007, the share of imports increased to 62% from 54%. The trend of growing imports is foreseen to continue as Hungary's proven energy reserves are small. Hungary has various energy sources, the most important ones being coal and lignite. Proven reserves of hard coal are estimated at some 5,000 PJ; reserves of lignite and subbituminous coals total 45,000-50,000 PJ. Unfortunately, Hungarian coal is high in sulphur and ash content and production is decreasing. Hungary has also proven oil reserves of between 120-770 PJ. The estimates for the country's natural gas reserves range between 300 and 2200 PJ (Source: EIA).

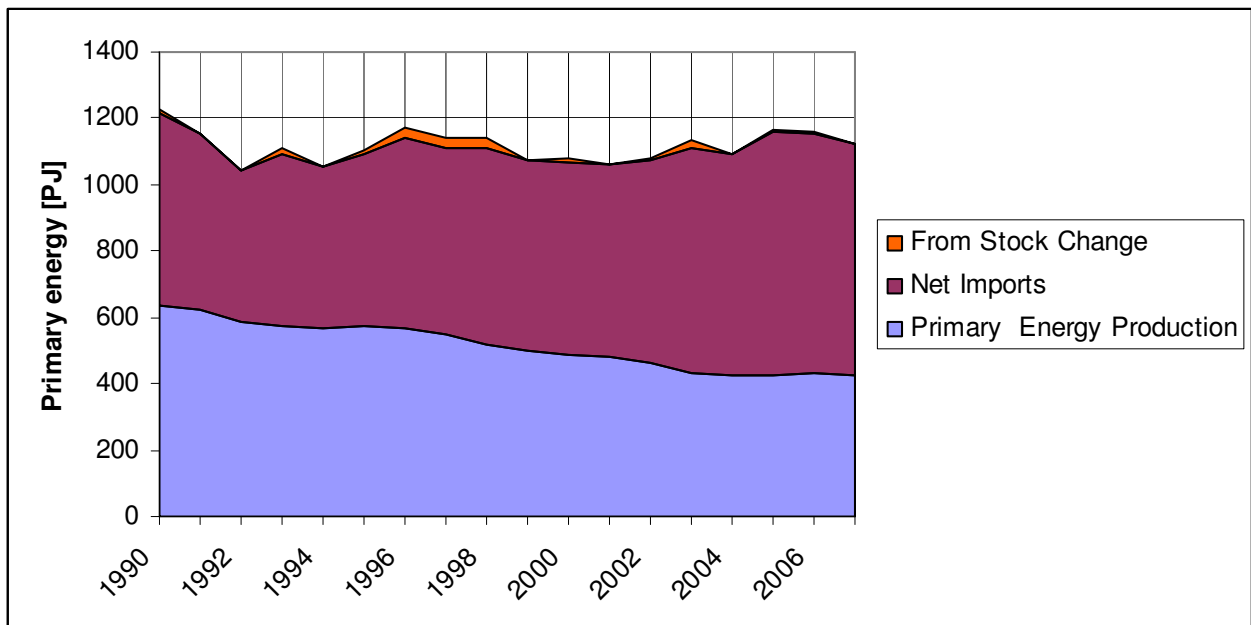


Figure 7 Changes in the Unaccumulated Sources of Total Primary Energy Supply (1990-2007)

(Source: Energy Centre)

GHG emissions depend predominantly on the mix of energy sources of primary energy production and even more on consumption. The trend of these is presented below:

Figure 8 Energy Source Mix of Energy Production

(Source: Energy Centre)

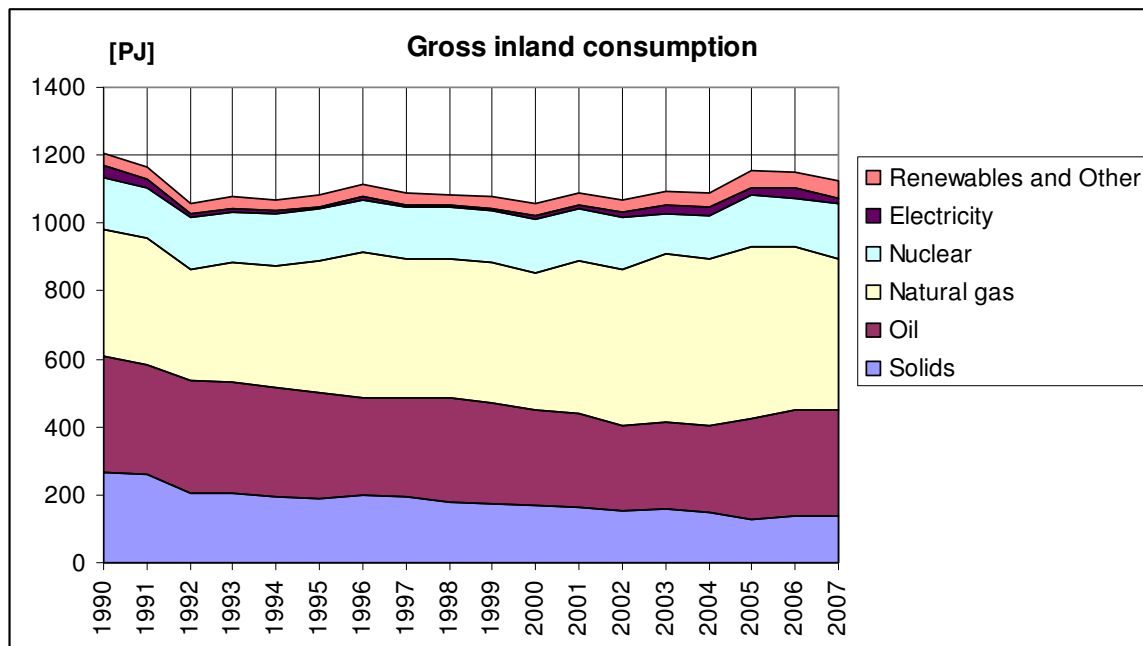


Figure 9 Energy Source Mix of Energy Consumption

(Source: Energy Centre)

Most of the trends and features of the Hungarian energy sector that have a crucial influence on GHG emissions are apparent from the charts. Coal and oil, although to a lesser extent, have been losing importance throughout the time span investigated, whereas natural gas has gained considerable importance. As nuclear energy has been fairly constant due to technical reasons, it is seen that the roughly 7% increase in gross inland consumption from 2000 to 2007 was supplied almost exclusively by natural gas. Within overall energy use, electricity generation has a dominant influence on GHG emissions. As to the trend of power consumption, the increase of the maximum daily load, as presented in the following chart, well characterises the situation:

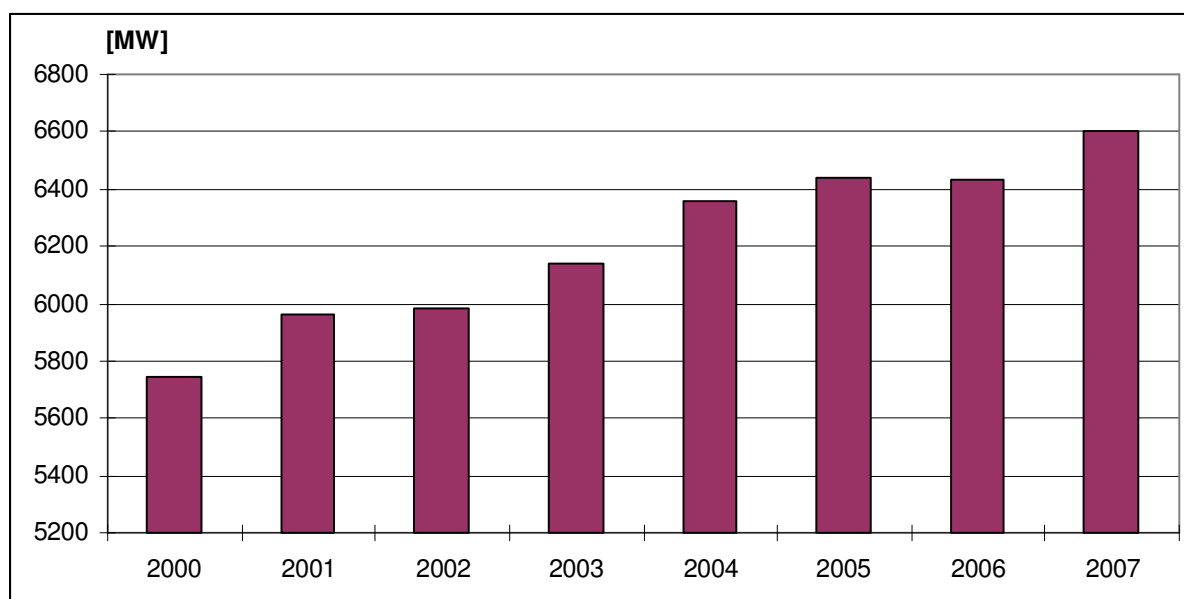


Figure 10 Maximum Daily Load of the Hungarian Power System

(Source: Energy Centre)

The average increase of demand was 2,1% per year over the seven years between 2000 and 2007. Capacity plans of the power system calculate with a steady 2%/year increase of both consumption and peak demand, but recent updates suggest that 3% would more safely describe the trend. Natural gas plays an increasingly important role in power generation, too. The new generation capacities installed recently exclusively use natural gas too, or, to a lesser extent, renewable energy. Although not reflected by the figures so far, due to the subsidy system and other encouraging conditions, the share of renewable power has also grown rapidly in the past 3 years.

Primary energy use in Hungary was 1125 PJ in 2007 with the following break-down by sector:

	[PJ]	[%]
Industry Sector	142	12,6
Non-energy use of Industry Sector	88	7,8
Transport sector	192	17,0
Residential sector	232	20,7
Commercial and Public Services	119	10,6
Agriculture/Forestry	21	1,9
Transformation Sector	256	22,8
Energy Sector	49	4,4
Distribution Losses	25	2,2
Total Energy Consumption by Sector	1125	100

Table 3.Total Energy Consumption by Sector 2007

(Source: Energy Centre)

These data show that the residential sector has one of the highest shares in energy use in Hungary, representing approximately 30% of the energy consumption together with the services sector.

Energy used for the heating of buildings has a large share in the total residential consumption. The energy quality of the building stock in Hungary is way below the European average, providing considerable potential for energy savings in this sector. The

improvement of the energy quality of buildings (modernization of existing building stock, setting stricter criteria for new buildings) is also needed because natural gas accounts for 69% in the energy consumption of the services sector and 70% in the households and institutions sector, which means that this sector greatly contributes the energy dependency of Hungary.

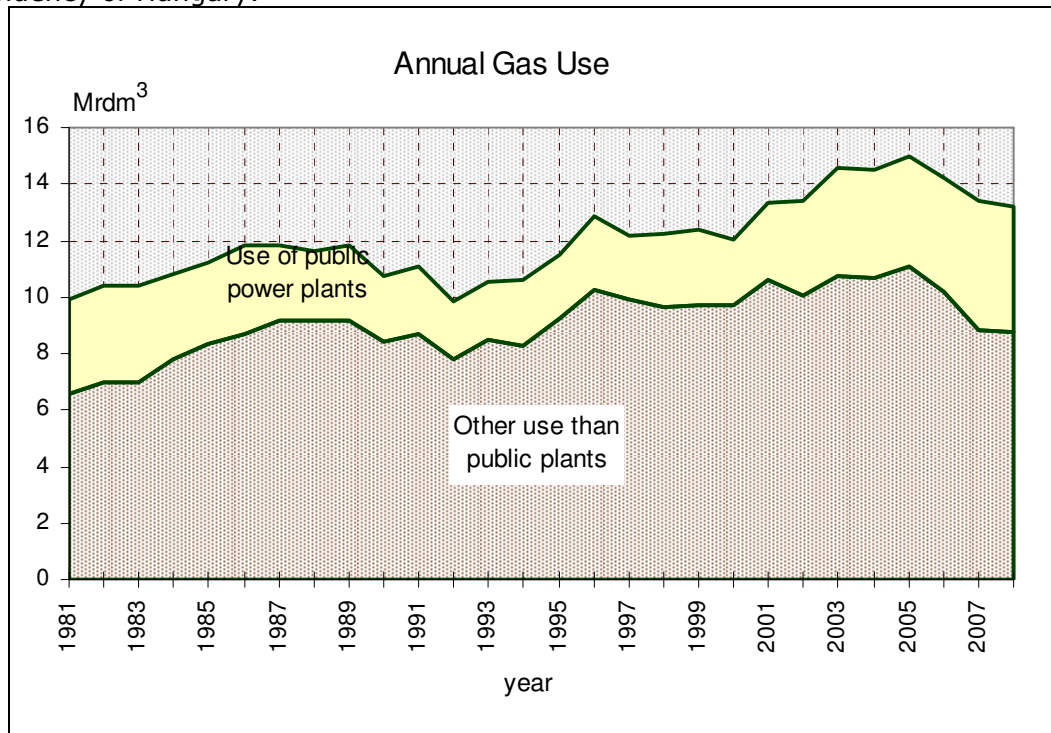


Figure 11 Annual Gas Use in Hungary 2007

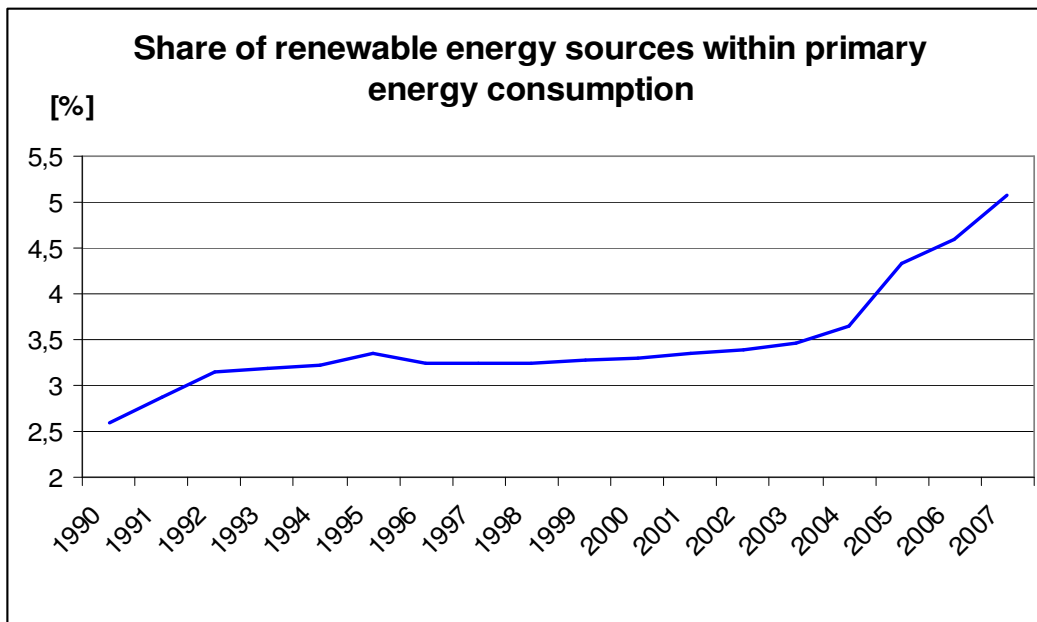
(Source: Energy Centre)

Share and Mixture of Renewable Energy Sources

In accordance with Directive 2001/77/EC¹ Hungary undertook to increase the share of its electricity production from renewable energy sources to 3,6% by 2010 (at the time of the undertaking its share was less than 1%). Among the member states Hungary targeted the lowest figure and was the first member state to fulfil it at 4,4% in 2005. The target figure was achieved by converting some power plant blocks from coal into biomass-fired or mixed fired using renewable energy sources. In Hungary the trends in the composition of energy use are even less favourable than the average of the European Union.

The share of renewable energy sources has considerably grown in recent years in Hungarian energy supply. While in 2000 they accounted for 3,3% in primary energy use, in 2005 they represented 4,3% and in 2007 they had a share of 5,1%. A period of stagnation in the middle of the nineties was followed by more intense growth, chiefly resulting from a boost in electricity production from biomass, promoted by a favourable subsidy scheme. Hungarian experts, however, have severe doubts whether a similar growth path can be sustained in the future.

¹ The Appendix to Act XXIX/2004. (on amendments and repeals of legal regulations and other legislative changes related to Hungary's accession to the European Union) contains the target for Hungary.

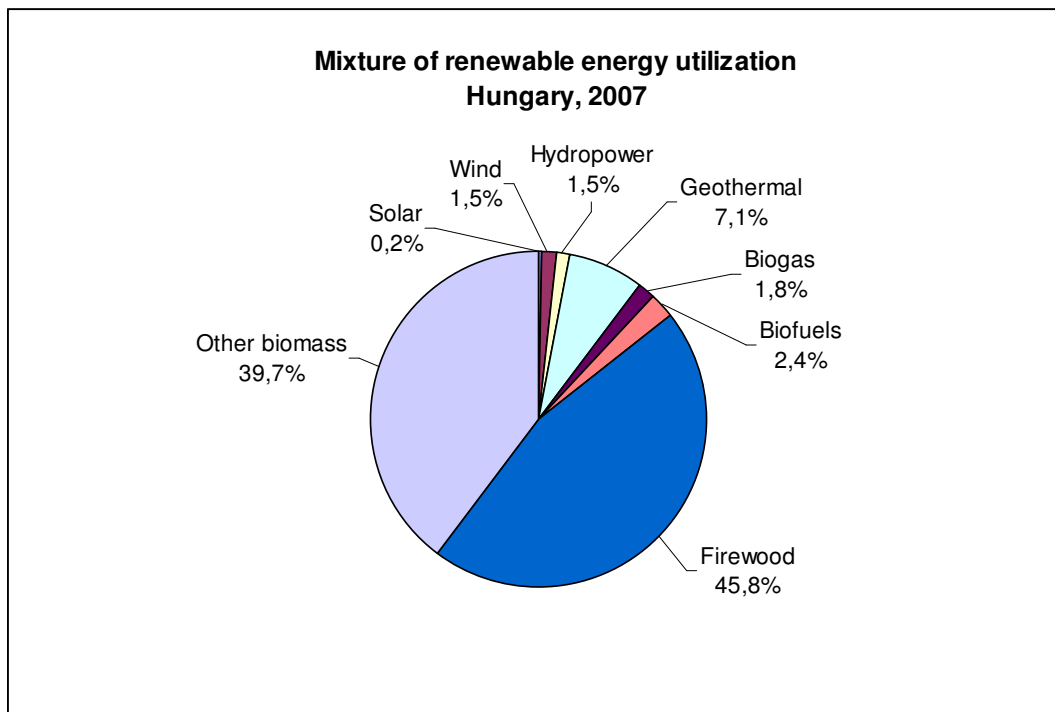


Note: Renewables include half of all municipal waste.

Figure 12 Share of Renewable Energy Sources Within Primary Energy Consumption

(Source: Energy Centre)

In Hungary the most important renewable energy source is biomass, accounting for nearly 90% of all renewable energies in 2006. Biomass is followed by geothermal energy, renewable waste and hydro power but these sources significantly fall behind biomass use.



Note: excludes communal and other waste.

Figure 13 Mixture of Renewable Energy Utilization in Hungary, 2007

(Source: Energy Centre)

Hungary mostly uses firewood for heat and electricity production from biomass. It is burnt directly or occasionally co-combusted to generate heat or electricity to a smaller extent. In 2006 the majority of renewable energy sources was utilized for the production of heat, especially for heating households. This fact is unfairly little mentioned owing to the lack of a separate support system even though electricity produced from renewable energy sources was the driving force behind the growing use of renewables. The share of renewables used in heat production (64%) continued to be higher even in 2007 than the share of green power generation (34%) in the total use of renewable energy sources (calculated at a heat equivalent). Hungary set a target for a blending level of 4,7% for biofuels for 2010. This target is expected to be met without difficulties as in the neighbouring countries the number of biofuel factories has greatly increased. It is desirable, however, that expensive imports should be replaced by factories based in Hungary producing the required volume of biofuel. The necessary agricultural crops are available but the number and the capacity of biofuel plants should be substantially boosted. There were plans and initiatives to facilitate such a boost but the majority of these projects were cancelled and most of the biofuel factories were ultimately built in the neighbouring countries.

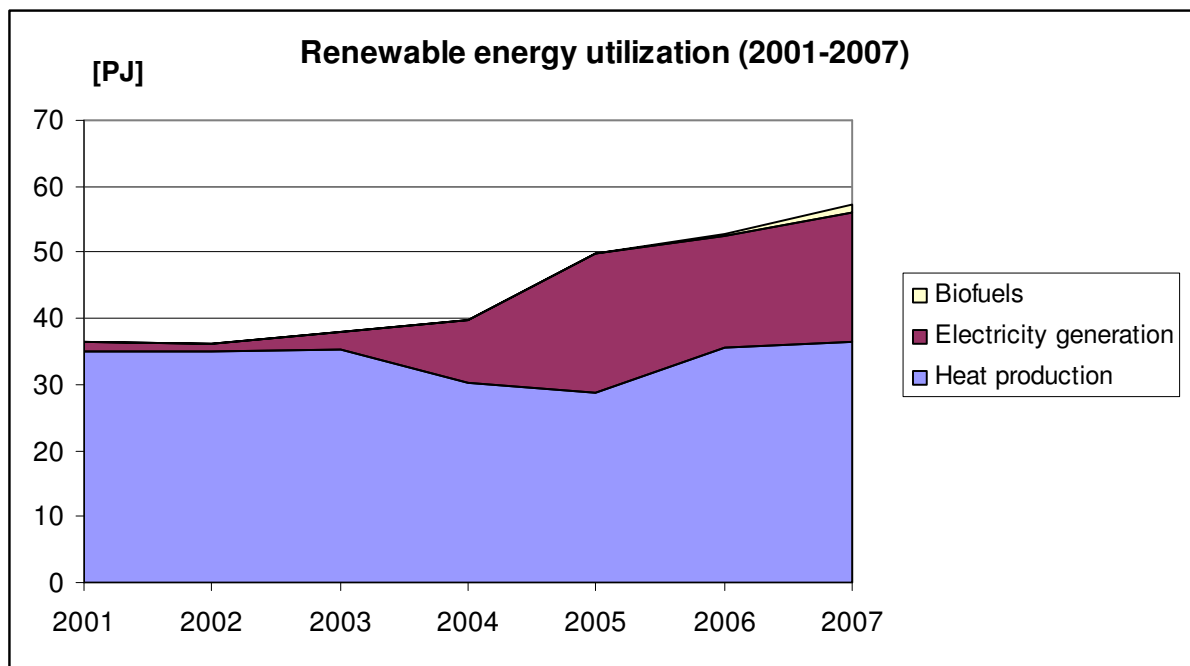


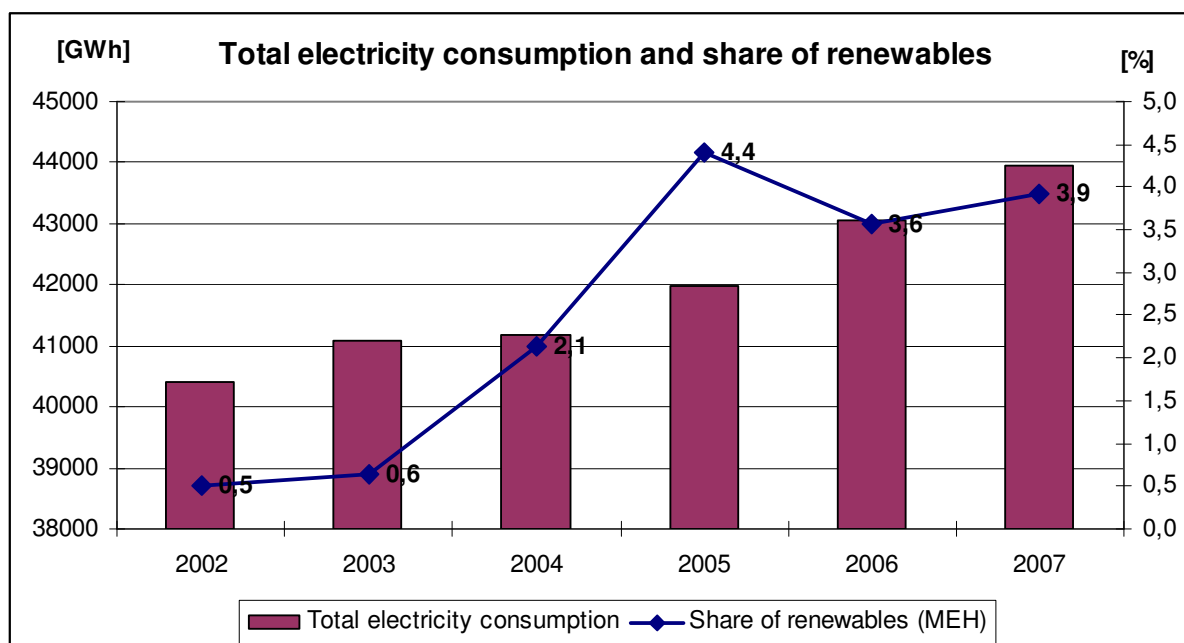
Figure 14: Renewable energy utilization (2001-2007)

(Source: Energy Centre)

It needs mentioning that Hungarian energy statistics have no exact data about the residential sector's consumption of energy sources (e.g. firewood, other biomass) other than network energies. A statistical survey conducted in 2009 found that the residential sector's use of biomass for heating (mainly firewood and other wood waste) considerably exceeds the estimates, implying that the share of renewable energy sources used in Hungary is probably higher than the statistical figure and the dominance of renewable-based heat is somewhat more pronounced.

Renewable-based Electricity Generation

As a result of the subsidy scheme the use of renewable energy use sources (particularly biomass) for electricity generation has robustly grown in Hungary since 2003. In 2005 power generated from renewable energy sources accounted for 4,4% of the total electricity produced. In 2006 there was a major decline with the share of renewables falling to 3,6% but since then a continuously growing tendency has been confirmed. By 2007 the share of renewables climbed back to 3,9%. Hungary therefore managed to meet its target of 3,6% before the deadline in 2010 in accordance with Directive 2001/77/EC. This target, however, is quite low compared to the undertakings of other EU member states (when this target was set renewable energy sources represented less than 1% of electricity production).



Note: Data exclude electricity produced from communal waste collected non-selectively

Figure 15: Total electricity consumption and share of renewable sources in Hungary

(Source: Energy Centre)

Electricity production from renewable energy sources was given a boost after 2003 by the conversion of existing power plant capacities into biomass-fired (Pécs Power Plant – 49 MW, Kazincbarcika Power Plant – 30 MW, Ajka Power Plant – 20 MW) and a switch in coal-fired power stations to the co-burning of coal with firewood and other agricultural crops (but with no conversion - Tiszapalkonya and Mátra Power Plants). These two technologies constitute the cheapest and most easily implemented ways of renewable energy use. With a few exceptions, however, these technologies have a very low efficiency: the average efficiency of electricity production in converted power plants is below 30%. The previously mentioned high-capacity plants generally fail to utilize heat, created as a by-product of power generation, although in numerous cases there is a district heating system in the near vicinity requiring large amounts of heat. The explanation lies in the existing support system which only subsidizes electricity production from renewable energy sources with the result that power plants are not interested in utilizing heat, the by-product of power generation. In addition, concerns of sustainability and environment protection have also arisen relating to these solutions. High-capacity power plants have a relatively high demand for raw materials, requiring

them to obtain the necessary amounts of biomass from more distant areas than their immediate neighbourhood. Biomass is transported from large distances by rail or road, considerably impacting the energy balance and sustainability of the activity in a negative way. The high raw material demand of power plants takes up the majority of sustainably logged timber capacities in Hungarian forests. A large number of the contracts concluded between power plants and forest companies will become ineffective between 2010 and 2015. The regulatory and support environment should be changed before this period in a way that favours the creation of decentralized systems. In addition, to remedy the above discussed problems of sustainability, the sustainability criteria established by Directive 28/2009/EC will likely be included in the Hungarian regulations in the coming years .

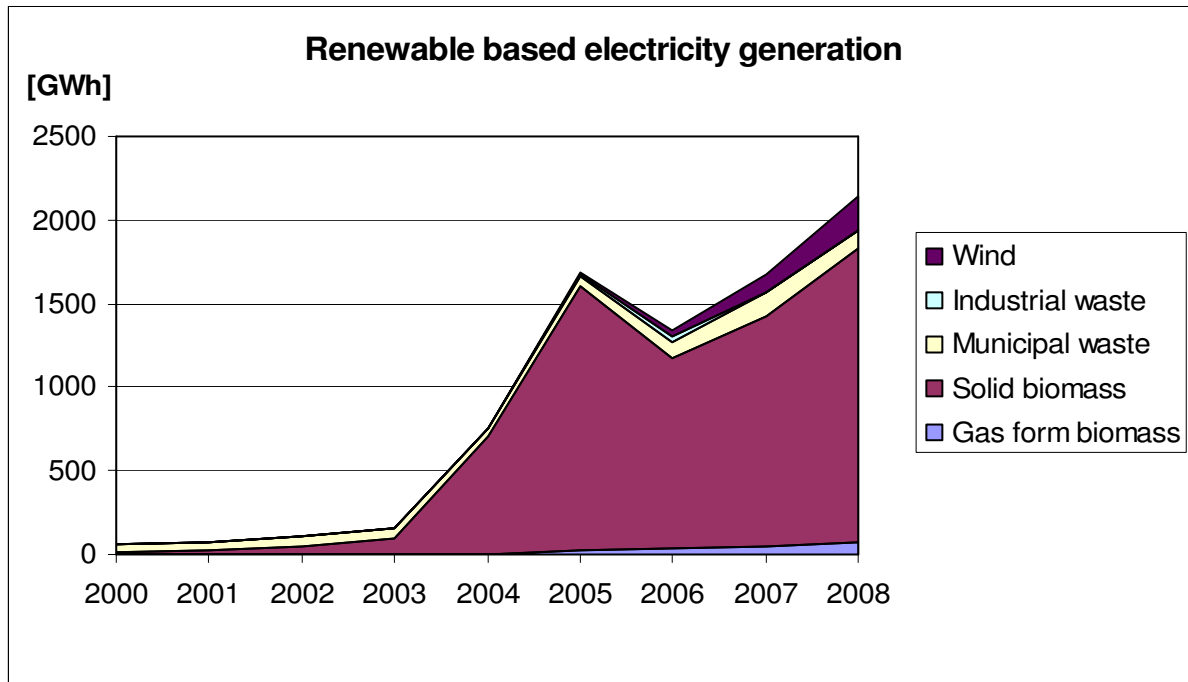


Figure 16 Share of Renewable Energy Sources Within Primary Energy Consumption.

(Source: Energy Centre)

Renewable-based Heat Production

Even though the recently increasing share of renewable energy use in the total electricity production was the result of the conversion of power plants to biomass burning, renewable-based heat production continues to represent a higher share than renewable-based power generation. Hungary consumed approximately 3,5 - 4 million cubic metres of firewood in 2008 which were mostly burnt in old, low-efficiency stoves and boilers. Having no statistics about the consumers (statistics are available only about district heating and electricity power plants) only the quantity of firewood used allows us to draw conclusions about their number. Expert estimates put their number between 200,000 and 350,000.

Prior to giving an overview of the situation of renewable-based heat production in Hungary the characteristics of the heat market, still not enjoying a high priority in energy policy, will be briefly presented. The heat market is worth a special examination because in Hungary over half (roughly 415 PJ) of the final energy use (706 PJ) in 2005 was used to supply heat demands. The majority of Hungarian heat consumption (approximately 270 PJ) is used for heating buildings, a necessity under the climatic conditions, and for

domestic hot water production, of which 235 PJ is consumed on the decentralized heat market (i.e. for individual heating and domestic hot water production) and about 35 PJ on the centralized market of district heat. Industry accounts for a technological consumption of almost 92 PJ, uninfluenced by the weather and requiring a much higher temperature compared to the previous uses.

Despite the heat market having a considerable size in terms of volume thermal energy continues to be a statistically „hidden“ segment of final energy use as heat production mainly (approximately 65%) takes place in a decentralized way, locally at the end users. Statistics, however, only include separate categories for district heat and technological heat consumption and do not show energy locally used in the form of heat, only the energy sources required for its production.

It is natural gas, however, that plays a key role among energy sources for heat production. In the decentralized heat market (excluding cooking) the extensive gas network, the high comfort of gas-based heat production and favourable prices (in Hungary residential gas tariffs are partly subsidized by the state) lead to the overwhelming use of natural gas, accounting for 70% of heat production.

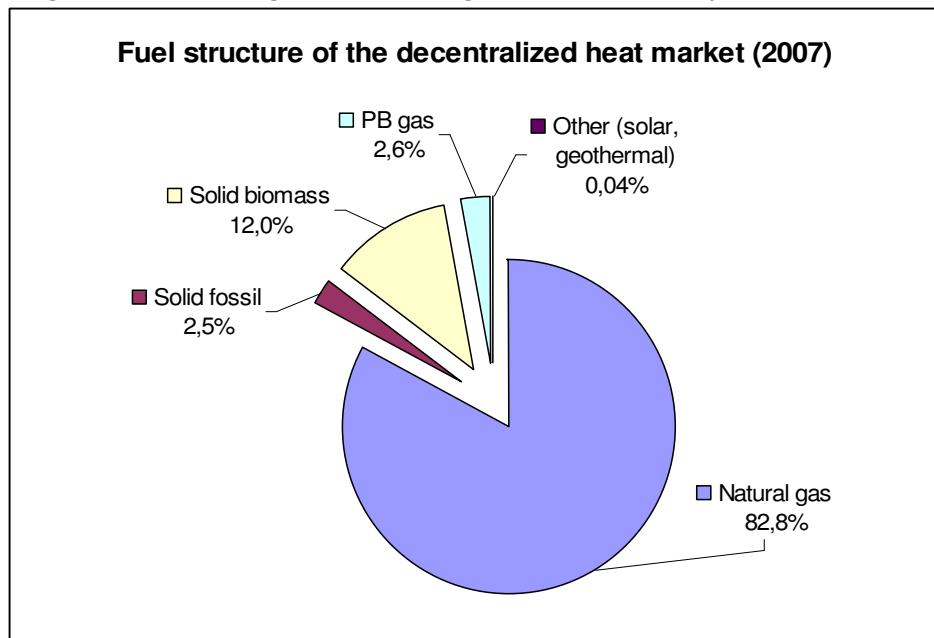


Figure 17 Fuel structure of the decentralized heat market (without cooking) in 2005

(Sources: Estimates based on the data of the Energy Centre)

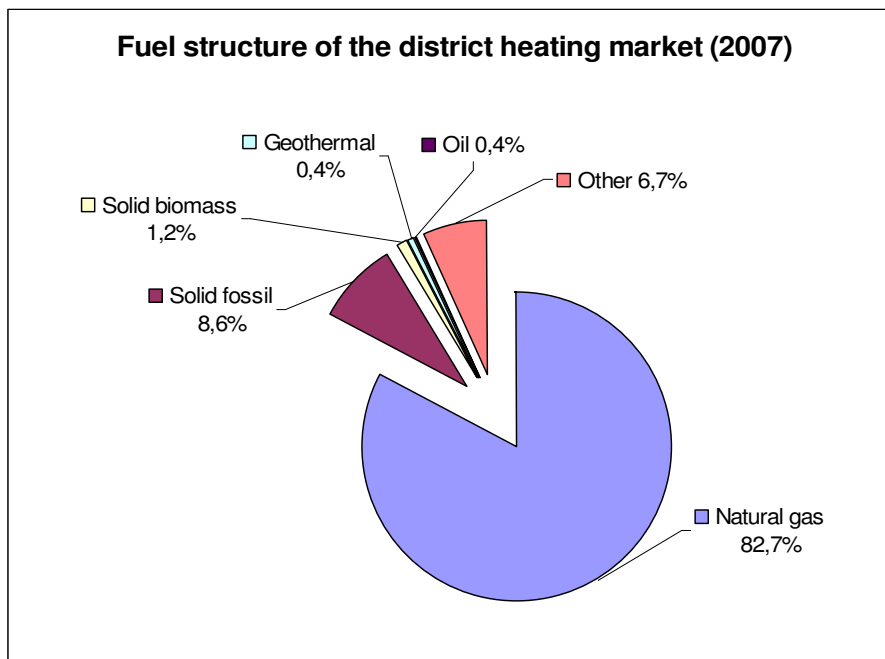


Figure 18 Fuel structure of the district heating market in 2007

(Sources: Estimates based on the data of the Energy Centre)

The centralized way of meeting heat demands is to provide district heating by supplying end users with centrally produced heat through the district heating network. The district heating market, representing approximately 35 PJ in Hungary, accounts for a relatively small share (around 8%) of the total heat demand. About 75% of the district heating plants are equipped with CHP units supplying partly the heat demand co-generated with electricity (the CHP units are commonly designed based on the heat demand of the domestic hot water system). The majority of fuels (over 82,7%) used for district heating is natural gas while renewable energy sources only account for 1,7% (in 2007). The breakdown of the 36 PJ used for heat production in the total renewable consumption of nearly 55 PJ in 2006 is shown in the following figure.

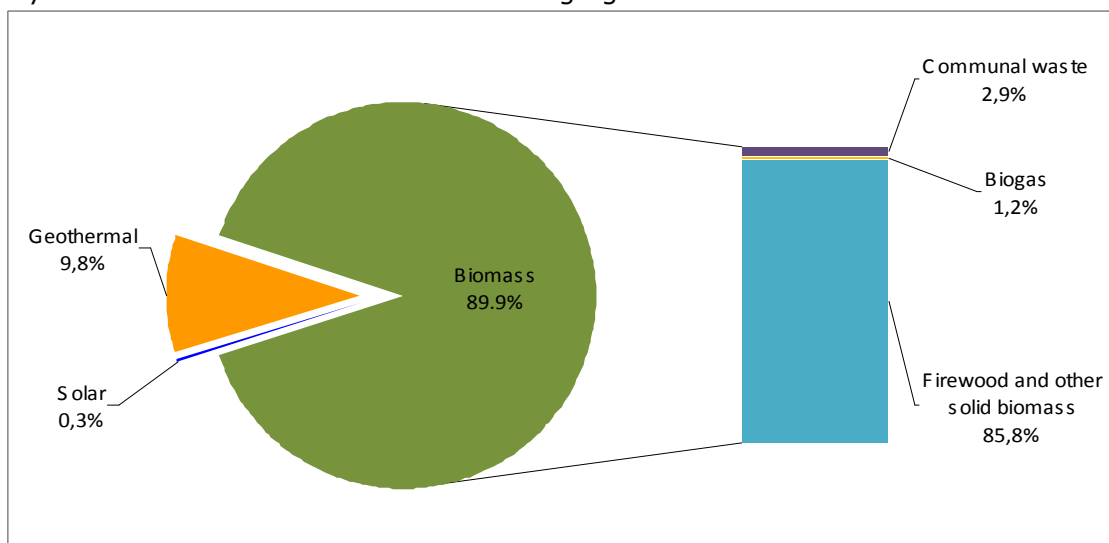


Figure 19 Share of renewable resources in heat production

(Sources: Estimates based on the data of the Energy Centre)

In renewable-based heat production, similarly to green power generation, biomass has the highest volume and share. In addition, geothermal heat has a relatively significant share. The overall share of renewable energy sources did not reach 10% in the total heat production therefore on the demand side there is a relatively high volume of heat could be theoretically produced through the utilization of renewable energy sources. The actual utilization, however, is prevented by several factors. The most important ones are the following:

The investment costs of renewable-based heat production projects are often very high with a long period for a return on investment. The average periods for some typical projects² are shown below.

Solar collectors: 20-25 years

Geothermal energy (thermal water): 12-15 years

Heat pump (soil heat): 15-20 years

Biomass (wood shavings): 10-12 years

In Hungary only electricity produced through the utilization of renewable energy sources is subsidized. Heat consumption, however, has a potential to justify the adequate subsidization of the heat market and a support system for renewable-based heat production and cooling should be developed.

In the majority of Hungarian district heating systems modern cogeneration technologies are used. Renewable-based heat production (unless cogeneration is replaced) would be relatively little utilized in certain cases, further lowering the rate of return for the expensive investment.

In the case of biomass, the most promising energy source for heat production, transport and tanks requiring a lot of space cause serious problems. For instance flats in multi-storey blocks are less suitable to use solid renewable-based individual heat. Another impediment is that district heating bases are often surrounded by buildings.

In the existing support structure centralized district heating does not have a high enough potential to ensure the utilization of renewables therefore they should be given a major role in decentralized heat production, the other important segment of the heat market. Residential gas tariffs subsidized by the state, however, place a massive obstacle to the wider use of technologies based on renewable energy sources.

Residential customers are unaware of these new technologies and their benefits and in many cases such technologies are met with scepticism.

Liquid Biofuel Consumption

One of the key objectives of international and Hungarian energy and climate policy is to introduce and research environment-friendly and low carbon-intensity solutions for the energy use for transport. Liquid motor fuels produced from biomass is one of the main areas of research. The use of biofuels is primarily necessitated by transport being one of the largest energy consumers: goods and passenger transport accounts for nearly 17% of the final energy consumption in Hungary. Transport (mainly road transport) is also responsible for approximately 20% of Hungarian CO₂ emissions. Biofuels are also needed because the energy demand of transport and its CO₂ emissions have been increasing to the highest extent among the sectors using energy. EU Directive 2003/30/EC on biofuels set a target of 5,75 %, calculated on the basis of energy content, for a share within all fuel consumption for transport. Directive 2009/28/EC established a mandatory target of 10% for member states by 2020. To achieve the target of 5,75%, calculated on the basis

² The calculation uses the full price for natural gas (without social subsidies). Under subsidized gas tariffs the periods for an investment to yield a return may be even doubled.

of energy content, by 2010, 145-150,000 tons of bioethanol should be used in petrol. If petrol is blended with ETBE 106,000 tons of bioethanol is expected to be used in the form of ETBE in 2010. For a blending level of 4,7 % 180-200,000 tons of biodiesel needs to be blended. Pursuant to Government Decree 2058/2006 the target is to produce 80,000 tons/year in ethanol and 17-20,000 tons/year in biodiesel. According to the Ministry of Agriculture and Rural Development the production of the required volume of raw materials causes no difficulties. Moreover, the current overproduction of grains makes it completely necessary to process the surplus as fuels. The existing capacities for bioethanol and biodiesel production in Hungary are low, with an improvement expected in 2009 when a non-refundable grant becomes available for the setting up of bioethanol and biodiesel factories.

Current Status of Biomass in Hungary

Solid Biomass

Solid biomass used for energy purposes is available from the by-products or waste of agriculture, forest management or timber industry, or from energy crops produced for energy generation. The amount of biomass can be considerably increased through the production of non-ligneous and ligneous energy crops and especially through the use of by-products and waste provided an appropriate incentive scheme is in place. According to estimates up to 8 million tons of biomass could be available for energy production through co-ordinated measures.

Hungary's solid biomass potential is based on the volume of raw materials available or producible under the criteria of sustainability. In recent years 7 million m³ timber were annually logged, of which 5,5 million m³ were actually used, 3,5 million m³ were laminated timber including fibre wood, firewood and pulpwood. Taking into account the criteria of forest management and the results of forest planting objectives 9 million m³ can be logged in Hungarian forests each year between 2015-2020, of which roughly 5 million m³ can be used for energy production.

Thanks to the various concessions and subsidies several lower capacity plants of electricity production have been set up in recent years and these energy projects, mainly based on wood waste from the timber industry, have created a market for timber waste. In the hope of cheaper fuel numerous Hungarian district heating plants have switched to biomass and projects with a substantial timber demand have been implemented i.e. the conversion of previously coal-fired power plant blocks into biomass (the power plants in Pécs, Kazincbarcika and Ajka now all have wood-burning blocks. The Tiszapalkonya and Mátra Power Plant uses wood for mixed combustion).

These new energy projects have substantially increased timber use for energy production in Hungary. Higher demands led to a rise in timber prices, causing tension among fibreboard producers, residential demands and the supply of power and district heating plants. Energy demands will be curbed by a section of the new Act on Electricity (established with the aim of also serving the criteria of sustainability) stipulating that no subsidies can be granted for electricity production from wood stumps or other higher degree timber in the subsidizes green power feed-in system. According to surveys forests can still yield the required volumes under the criteria of sustainable forest management but raw materials for new and higher capacities could only be provided to the detriment of the needs of the traditional customers. The prerequisite for the setting up of new biomass capacities is therefore the development of a programme to encourage the efficient production of energy crops and the recycling of agricultural waste for energy generation. To this end the existing national incentive system already contains components that not only support the use of biomass for energy production but also the planting of energy crops.

The use of ligneous and non-ligneous plants for energy production should represent a major share in electricity production from renewable energy sources as confirmed by the advantageous technical features of these technologies, its benefits (creation of jobs, regional development) and the favourable agricultural conditions of Hungary. The technology based on ligneous plants is already available but the usability of fuels produced from energy crops should be further developed. There is no well-tested technology for the use of non-ligneous plants, by-products and waste (e.g. straw, stalks, canes etc.) but this area also shows serious potential in the long term.

Biogas

Biogas is a very widely used energy source, capable of replacing natural gas, producing electricity and heat and usable as motor fuel. Biomethane, created by cleaning biogas up to natural gas quality can be fed into the gas network. The legal background to the feeding of cleaned biogas and gas produced from biomass into the national gas network was provided by an amendment to the Natural Gas Act in 2005 (Act LXIII/2003 amending Act XLII/2003 on natural gas). In practice, however, it is not yet possible. In the absence of specific regulations, Hungarian national standard MSZ ISO 13686 on the quality designation of natural gas is applied as the criteria for feeding biomethane into the natural gas grid. Biomethane, however, can hardly meet the reference values contained in this standard or do not meet them at all, highlighting the necessity of developing biomethane's own standard.

Another hindering factor to the wider use of biomethane is the existing gas tariffs for small consumers which, due to state subsidies, are still much lower than Western European prices, making biomass-based biomethane production in agricultural plants unprofitable. The agricultural materials required for biomethane production are available and provided the adequate regulatory background is in place some of the Hungarian natural gas consumption could be replaced by biomethane.

Biogas can also be used for combined heat and power generation in modern block heat power plants. In Hungary there are 20 plants using biogas for co-generation. Initially such biogas plants were constructed at waste water treatment facilities but recently the number of plants using manure has expanded. Given appropriate support, these manure plants can become much more widely-spread and the number of plants using waste from the food industry can also considerably rise. This is underlined by the increasingly stricter environmental regulations prohibiting the flushing of liquid manure into waters to reduce the agricultural nitrate pollution of water³.

The methane-rich biogas, biomethane, created by thoroughly cleaning biogas and capturing CO₂, can power vehicles too. In terms of the cleanness of methane and other materials, the quality of upgraded biogas must comply with standards to become suitable for use in vehicles. In the absence of specific regulations, Hungarian national standard MSZ ISO 13686 on the quality designation of natural gas is applied to biomethane as well. Biomethane, however, can hardly meet the reference values contained in this standard or not at all, highlighting the necessity of developing a standard for biomethane.

³ *Government Decree 49/2001. (IV. 3.) on protection against the nitrate contamination of waters from agricultural sources and Government Decree 27/2006. (II.7.) repealing the earlier decree establishes that it is prohibited to let liquid manure, manure waste and leakage from manure tanks into waters [section 6.§ (1). Activities violating this stipulation may be suspended [section 10.§ (2)]. According to the decree insulated storage tanks must be built by 2009 on animal farms using liquid manure technology (this date replaces the earlier deadline of December 31, 2005).*

There are several factors preventing the wide-spread use of biomethane, especially high investment costs: equipment to produce and clean biogas are expensive and building gas pumps are also costly. Also hindering biogas projects is the obligatory feed-in system governing renewable energy that does not differentiate according to raw material and size of plant. And still another impediment: this is the single fuel type still subject to excise duty in the regulatory framework, making the specific price of biomethane even higher. The relevant legislation in this area should be amended.

Thanks to the preferential support system, numerous new biogas plants have been built in the last few years. In the framework of the New Hungary Programme the construction of 44 biogas plants was financed by a total subsidy of over HUF 33 billion in 2007. The general legislative background, however, does not favour biogas even though it offers great possibilities through its feed-in into the natural gas network. Moreover, Hungary has outstanding biomass potential. It is more effective to feed biomethane into the network in Hungary, a country with a nationwide gas grid, than use it as liquefied fuel which requires major investments.

Biofuels

Raw materials used for bioethanol production include plants with high sugar content (e.g. sugar beet, sugarcane) or crops that can be converted to sugar (e.g. maize, wheat, potatoes with starch etc., or trees, grasses, grain stalks, straw containing cellulose). Bioethanol production can be based on a wide range of raw materials including existing agricultural by-products and waste. In Hungary the main raw materials used in first-generation bioethanol production are maize, wheat, Jerusalem artichoke and sugar beet. In addition several cultures are being tested (e.g. sweet sorghum). The technology of the near future, however, is a second-generation bioethanol production based on cellulose, currently under development. Its wider dissemination in factories is expected to take place after 2012-2015.

In terms of raw materials Hungary is in a favourable position to produce bioethanol. 6-7 million tons of maize are annually harvested, of which increasingly less is used as fodder while the amount exported and industrially processed is rising. Locally grown maize is available in much larger quantities than the estimated demand in the near future. The volume of maize and cereal-based ethanol can go up to 700-800,000 tons/year, exceeding the expected needs of Hungarian motor fuel producers and sellers multiple times by 2020. To achieve this aim bioethanol plants must be set up at a different rate than the current disappointing one.

The ecological conditions of Hungary are less favourable in terms of rape and sunflower, the raw materials for the production of biodiesel. According to the estimates of Ministry of Agriculture and Rural Development roughly 300,000 hectares can be used to produce oil crops for biodiesel and cracked vegetable oil taking into account the ecological conditions and the market of food oil manufacturing. Under average yields 120-130,000 tons of biodiesel can be produced each year, just about meeting the expected domestic demand for biofuel. If the collection of used cooking oil was more organized another 15-25,000 tons of biodiesel could be produced from the collected amount.

Bioethanol can be used as a substitute for petrol (as ETBE) or be blended into petrol as octane enhancer. In Hungary the Hungarian Oil and Gas Company (MOL Rt.) has been using ETBE, produced with bioethanol, to replace MTBE since July 2005. A blending of maximum 5% is currently allowed for conventional Otto-engines, a level that causes no problems in vehicles.

There is much debate about the energy balance of biofuels and their environmental impact throughout their life-cycle. Biofuels could only be considered true alternative energy sources if their production was also based on renewable energies. In reality, crop farming, the manufacturing of chemical fertilizers, distillation and refining as well as transport mostly use fossil energy sources, lowering the energy balance of biofuels. To

improve this ratio some of the energy needs of production and manufacturing should come from renewable energy sources. Hungary is committed to meet the sustainability targets established by section 17-19 of the Directive 2009/28/EC. Already installed plants can achieve the target for reducing CO₂ emissions set in the Directive and new plants will be built to with a renewable energy block. As a result, their energy balance will contain 50% CO₂ savings calculated by the methodology included in the Directive.

Policy Assessment

Key Actors of Biomass Policy and Utilization

Authorities, Public Sector

Ministry of Transportation, Telecommunication and Energy (KHEM) is the ministry responsible for policy making with regard to energy. It is responsible for transportation, energy policies, mining affairs, electronic telecommunication and postal service related issues. It oversees the energy industry, the regulator, and is responsible for security of supply and for the implementation of the EU's market directives. The Department of Energy within the ministry has a small permanent staff and there are two divisions of the department controlling the overall implementation and formulation of the energy policies. One is the Division of Energy Economy and Regulation, the other one is the Division of Environment, Renewable Energy and Energy Efficiency. (www.khem.gov.hu)

Hungarian Energy Office is a national public administration body with independent powers and competence, acting under Government control and under the supervision of the Minister of Transportation, Telecommunication and Energy. It is also the authority for the licensing of the establishment and operation of heat producing plants falling under the scope of the Electricity Act (VET), as well as for the protection of consumer interests connected with heat supply. The Office's major tasks are to issue and amend the licenses for the generation, distribution, trade and public utility supply of electric energy, for the production of district heat in the authorized power plants, as well as for the distribution, supply, trade and public utility supply of gas. (www.eh.gov.hu)

Energy Centre Non-profit Limited Company

"Energy Centre" Energy Efficiency, Environment and Energy Information Agency Non-Profit Company is owned by the Ministry of Transport, Telecommunication and Energy and it is the national energy agency responsible for the improvement of energy efficiency and renewable energy utilization.

The Energy Centre manages most of the statistical issues related to energy, manages subsidies and loans for energy efficiency and renewables, and prepares the government strategy concerning energy efficiency and renewable energy sources, and carries out the energy agency activities.

It manages programmes in the field of energy, environment and innovation for the national government, the European Union, the International Energy Agency (IEA) and the United Nations. (www.energiakozpont.hu)

Ministry of Environmental Protection and Water Management (KvVM) is responsible for environmental policies to reduce pollutants and other adverse environmental impacts from the energy industry. The Ministry also has a principal responsibility on climate change policy issues, including the EU Emissions Trading Scheme (EU-ETS). It is dealing with some aspects of sustainable energy management, namely energy efficiency, energy saving and renewables issues. (www.kvvm.gov.hu)

Ministry of Agriculture and Rural Development (FVM) is the governmental body that provides central governance for agriculture, game management and fisheries, the food sector, forest management and forest conservation, primary timber production, and the associated services, research and development, agricultural product turnover, agro-environmental management, plant protection, plant health, animal health, conservation of the quality of agricultural lands, cartography and land issues, as well as agricultural

water management. The Ministry also prepares and implements the Agricultural and Rural Development Operative Program of the National Development Plan. The regulatory and directing tasks are performed by a separate unit within the Ministry, the Department of Natural Resources and the Department of Agricultural Affairs. (www.fvm.gov.hu)

Ministry of Agriculture and Rural Development - Hungarian Institute of Agricultural Engineering

The institute was established for the promotion of agricultural mechanization. It is a research centre dealing with technical, technological development. Their main activities are mechanization of animal husbandry and fodder processing and mechanization of plant production. They are also involved in significant research projects in the field of renewable energy. One of their recent projects deals with Hungarian bioenergy sources for domestic and foreign utilization. Technical control measurement and documentation takes place in their accredited laboratory. (www.fvmmi.hu)

Central Agricultural Office (CAO), is a central budgetary organization working under the direct control of the Ministry of Agriculture and Rural Development. The organisation comprises nineteen (county-level) regional offices and a headquarters. The CAO has a Forestry Directorate in the headquarters and 10 regional Forestry Directorates as part of the county offices. The major purpose of the CAO is the facilitation of purposeful and controlled forest management. Its main tasks are the management of the forest inventory on the whole forested area of the country regardless of proprietary relations, and the development of 10-year-recovery middle-term management plans, so called district forest plans. They also perform primary and secondary forestry authority tasks and manage the National Forest Stand Database. (www.ommi.hu)

National Development Agency

The government set up the Agency by merging the National Development Office and authorities managing the implementation of the National Development Plan, in order to support the efficient use of European Union funding. Around HUF 1000 billion is going to be invested in developing the country and closing the development gap during 2007-2013. It is the agency responsible for the implementation of the New Hungary Development Plan. (www.nfu.gov.hu)

Hungarian Public Nonprofit Limited Liability Company for Regional Development and Town Planning (VÁTI)

The activity of VÁTI, a non-profit company, covers the full scope of research, planning and consultation activities related to regional development, the protection and reshaping of the built environment. The company is responsible for the implementation of the regional development Phare programs and participates as a cooperating organization in the realization of the Regional Development Operative Program and of the INTERREG Community Initiative programs. VÁTI operates a specialized portal called Térport (terport.hu) as well as the Regional Information System (TeIR). The company manages a national level regional and community development, architectural - technical documentation center as well. Another strength of the company - especially in respect of the implementation of the EU programs - is the unique national network consisting of 12 regional representation offices.

Associations and Competence Centres

Hungarian Renewable Energy Association represents all actors within the sector and takes an active part in the control of the policy making processes. Established in 2005, it

has been actively involved in the development of the Hungarian renewable energy sector. (www.mmesz.hu)

Hungarian Biomass Association

The main objective of the Association is to develop and foresee the production and utilization technologies of biomass. They are facilitating innovation through the organisation of events, conferences, exhibitions where experts can exchange their knowledge. (www.mgmt.hu)

Hungarian Bioethanol Association was established in 2007 and its goal is to unite bioethanol producers, distributors, raw material producers, and the related commercial, financial and advisory companies. It acts for its members and lobbies for the development of the bioethanol industry in Hungary and within the region. (www.etanol.info.hu)

Hungarian Pellet Association

The association was established in 2008 June and it pools most of the Hungarian pellet producers, boiler and fireplace producers, distributors. Together with the Visegrád 4 countries and Austria they have created the CE Pellet, which is a Regional Pellet Cluster representing the interests of Central Europe. Their main goals are awareness raising and the development of a standard for pellet. They believe that the future of the domestic production and utilization of pellet is controlled market development. (www.mapellet.hu)

National Biomass Cluster

It was established in 2006 by ten founding members from private companies and organizations led by the Innostart national business and innovation centre. The Cluster is in contact with other biomass clusters abroad and helps its members by providing access to up-to-date databases regarding suppliers, logistics, innovation and production. The Cluster runs a demonstration agro centre to educate experts and other interested parties about environment protection and technology. (www.biomasszaklaszter.hu)

Hungary Bioenergy Competence Centre

The institute was established by universities, research organizations and businesses. It is a national umbrella organization (Limited Company) that promotes the increased use of renewables, mainly energy from biomass.

The objectives are to accelerate the development of energy technologies towards cost-effectiveness, to participate in a pan-European bioenergy innovation and knowledge transfer process initiated by the European Bioenergy Research Institute at Aston University (EBRI-Aston), to develop technologies for production and utilization of renewable energy, focusing on biomass without compromising food supply, to promote environment-friendly conversion of agricultural co-products and waste to energy, integrate a network of regional competence centres and to assist the development of farms that are energy independent and have zero net emissions. These goals will be pursued at a local, regional and national level, building on the cooperation with international R&D partnerships. (www.obekk.szie.hu)

Union of Biomass Product Line

In 2007 the founders of the union decided to establish an organization that covers the whole life of biomass from production to the final consumer. Its main goal is to help achieve the highest possible percentage of biomass utilization from energy plants as well as from residues of agricultural production. The Union wishes to aid the government's work through the development of new bills and their contribution to the implementation of the New Hungary Rural Development Programme. (www.bitesz.hu)

Hungarian Federation of Forestry and Wood Industries

The Federation promotes the interests of entrepreneurs and enterprises in their professional field and as employers. Founded in 1990, the Federation has 155 members. Its field of activities covers forest management, wood industries, and timber trade. It runs an online wood directory of Hungary with companies in the wood industry and forest management including all actors on the field. (www.fagosz.hu)

Hungarian Chamber of Agriculture (HCA)

Founded in 1994 as a national public body performing public duties, HCA is an umbrella-organization with 20 territorial chambers. Their eleven thousand members are economic organizations with agricultural, forestry, fishery and hunting activity including the related processing, trading and servicing enterprises and representing 60% of the total agricultural output. HCA performs duties related to development, subsidies, the representation of the general interests of the agricultural sector, the European Union's Common Agricultural Policy and rural development. HCA takes part in the process of legislation and sends representatives to all committees of national interest. (www.agrarkamara.hu)

Inter-ministerial Committees

- **Inter-ministerial Committee on Energy Saving** (co-ordinated by the Ministry of Transportation, Telecommunication and Energy) – allocates funds to energy saving projects.
- **Inter-ministerial Committee on Renewable Energy** (co-ordinated by the Ministry of Transportation, Telecommunication and Energy) – prepares and implements the Renewable Energy Strategy.
- **Inter-ministerial Committee on Kyoto Mechanisms** (co-chaired by the Ministry of Environmental Protection and Water Management and the Ministry of Transportation, Telecommunication and Energy) – primarily in charge of co-ordinating policies relating to joint implementation projects and emissions trading.
- **National Council for Sustainable Development** was created by the Hungarian Parliament as a conciliatory, consultative and advisory organisation for issues in the field of sustainable development. Chair of the Council is the current Speaker of the Hungarian Parliament. The Council has four Co-Chairs, delegated by the Government, the Hungarian Academy of Sciences, MP Groups of the Opposition Parties in Parliament, and non-governmental organisations.

National Bioenergy Policy

Hungary's energy policy has changed in a positive direction in the last decade. It is balanced on three main pillars: security of supply, competitiveness and sustainability. The long term priorities of the government are secure and cost effective energy supply of the economy and the population based on their needs and the protection of the environment.

The government has taken measures towards enhancing energy security through supply-side actions, such as oil and gas storage as well as increased electricity interconnections, and centrally directed emergency actions. To further improve security of supply, the government is supporting the development of new gas pipelines to Hungary, such as the Nabucco pipeline, or the construction of a liquefied natural gas (LNG) terminal on the Croatian island of Krk. These projects could contribute to diversify the routes and sources of gas imports in the future.

Besides improved security of supply for fossil energy sources measures encouraging improved energy efficiency and the use of renewables have become increasingly pronounced. Compared to the European average, however, these issues are not given a

high enough priority in Hungary. Taking into account that the improvement of energy efficiency and the use of renewable energy sources simultaneously contribute to a higher security of supply, a decline in environmental pollution and sustainable development, these fields should be given more definite attention.

According to Hungarian analyses the largest expandable base of energy sources in Hungary is biomass. Targeted energy crop production is presently quite low but biomass stocks can be considerably increased through the planting of energy crops as established by the measures of the New Hungary Development Plan and the New Hungary Rural Development Plan. There is also huge potential in utilizing biomass-like by-products and waste (so-called secondary and tertiary biomass) for energy production as technologies for waste recycling (e.g. biomass production) have been gaining a lot of ground.

The use of biomass for energy production is a priority issue for agriculture. Changed intervention rules and WTO negotiations require the member states including Hungary to substantially reduce their food production. According to some estimates roughly 20%, up to 1 million hectares of the total Hungarian agricultural land can be affected, influencing the incomes of 80-120,000 farmers. Crop production for energy generation and the use of biomass as a renewable energy source can provide a way out of this problem. Farmers are given a choice to continue with agricultural production and crops grown can be sold in the market without large subsidies from the government.

National Bioenergy Strategies and Action Plans

The increased utilization of biomass takes an important role in the renewable energy strategy within the development of the national energy policy. Although in Hungary bioenergy has the largest potential among all renewable sources there is no specific policy focusing on biomass.

Hungary has adopted some important documents laying down the basic principles and future targets of the national energy policy relating to biomass utilization as well. These policies are in line with the European Union policies. These strategic Hungarian documents are the following:

The New Hungary Development Plan for 2007-2013

It is the National Strategic Reference Framework of Hungary for the utilization of cohesion and structural funds. It was approved by the Hungarian government and the European Commission.

The most important objective of the New Hungary Development Plan (NHDP) is to expand employment and to create the conditions for long term growth. For this purpose it launches co-ordinated state and European Union developments in six priority areas: the economy, transport, for the renewal of the society, environment and energy, regional development and state reform. The priority of environmental and energy developments is aimed at the fulfilment of objectives defined in the horizontal policy of sustainability.

Strategic considerations related to energy supply require the reduction of fossil fuel utilisation, with regard to the security of supply (cutting import dependence), cost-effectiveness (replacing increasingly expensive energy sources), as well as environment and climate protection. The main tool to achieve the above is improving energy efficiency, better energy saving, and increasing the share of renewable energy.

New Hungary Rural Development Program

The New Hungary Rural Development Programme is the National Rural Development Programme prepared for the 2007-2013 period pursuant to Art. 15 (1) of Council Regulation (EC) 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development, to be officially submitted by Hungary to the

European Commission after its adoption by the Government. It has been prepared by the Ministry of Agriculture and Rural Development.

One of the four axes of the program, the general objective of Axis II is to improve the environment and the countryside by supporting landscape management which includes the use of biomass for energetic purposes.

National Action Programme for Growth and Employment 2008-2010 Compiled for the European Union Lisbon Strategy

The reviewed National Action Programme, approved by the Government in October 2006 and presenting the implementation of the targets established by the Lisbon Strategy, lists energy production among its microeconomic interventions and calls for liberalization in the energy sector, for the improvement of energy efficiency and the increased use of renewable energy sources as necessary measures.

Energy Policy for 2007-2020

The framework document behind the Hungarian strategy for increasing renewable use is called „Hungarian Energy Policy 2007-2020“. Hungarian energy policy is based on the pillars of security of supply, competitiveness and sustainability. Under the section on sustainability the policy deals especially with increasing the share of renewable energy sources as an instrument that is suitable to reduce the import dependency of Hungary and improve the conditions of sustainable development including the fulfilment of the environmental and climate targets.

The objective of the energy policy is to ensure that the share of renewable energy use in Hungary increases to promote the competitiveness of the Hungarian economy depending on the conditions of the country and its actual financial capacity.

The strategic document establishes that „in Hungary there is great potential in the use of biomass but planning and implementation should always be extensively based on the observation of all key environmental and sustainability criteria, especially relating to the use of dendro mass for energy production. Special attention needs to be paid to biomass production from extensive meadow and forest management to guarantee that the criteria of environment and nature protection and sustainability are enforced at a higher level. This reference system should be the basis for planning the energy use of the continuously accumulating by-products from farming and food industry, (bio)waste and biomass from waste water treatment.“

Renewable Energy Strategy: Strategy for the Increased Utilization of Renewable Energy in Hungary 2007-2020

The objective of the renewable energy strategy is to ensure that Hungary fulfils the requirements the EU set for its member states and to achieve (taking into account the Hungarian renewable potential) the economic benefits resulting from the use of renewable energy sources (reducing Hungary's dependence on imports, improving the environment, increasing the employment rate).

Another objective of the renewable energy strategy 2007-2020 is to provide a conceptual framework for the targeted increase in renewable energy use in Hungary, to contribute to the dissemination of renewable technologies and their use, to improve the efficiency of such technologies and promote their awareness and popularity in society. The documents seeks to set a realistic target for Hungary's renewable energy use (in accordance with the European Union's package of January 2007 on climate protection and energy) for the period of 2007- 2020.

To implement the strategy the Renewable Energy Programme (the National Action Plan) will be drawn up containing two-year action plans to increase the use of renewable energy sources.

The key strategic aim is to increase the use of renewable energy sources in Hungary to 186,4 PJ by 2020 from 55 PJ in 2005. No specific target values, however, have been set for biomass with the exception of biofuels.

National Climate Change Strategy

The National Climate Change Strategy was developed pursuant to section of Act LX/2007 (V. 28.) on the implementation of the UN Framework Convention on Climate Change and the Kyoto Protocol.

The mission of the National Climate Change Strategy is to provide a policy framework for a chain of actions which, when implemented, can efficiently and effectively put Hungary in a position in terms of society and economy to reduce gas emissions responsible for climate change and to adapt to the inevitable changes.

The National Climate Change Strategy complies with and adopts the targets established by the Renewable Energy Strategy of Hungary.

National Renewable Energy and Bioenergy Targets

Indicative target set by the Renewable Energy Strategy directive, 2009/28/EC:

- 13% share of RES in the final energy consumption 2020.
- At least 10% share of renewable energy in the final energy consumption of transport by 2020.

Indicative Target set by the Renewable Energy Strategy - European Electricity Directive 2001/77/EC:

- 3.6 % share of RES in gross electricity consumption by 2010

Indicative Target set by the European Biofuels Directive 2003/30/EC :

- Biofuels consumption of 5.75 % of petrol and diesel use for transport in 2010.

In the framework of the "Renewable Energy Strategy: Strategy for the Increased Utilization of Renewable Energy in Hungary 2007-2020" two scenarios were established to set target figures, calculated as the share of renewable consumption to gross final energy consumption. The vital difference between the base case (BAU – Business As Usual scenario) and the strategic scenario (Policy scenario) is that the BAU scenario is based on existing or planned measures whereas the Policy scenario takes into account other measures aimed at encouraging the utilization of renewable energy sources. Both scenarios were developed for two cases: if the measures for the improvement of energy efficiency succeed (BAU, Policy) or if they fail (BAU EVHAT, Policy EVHAT).

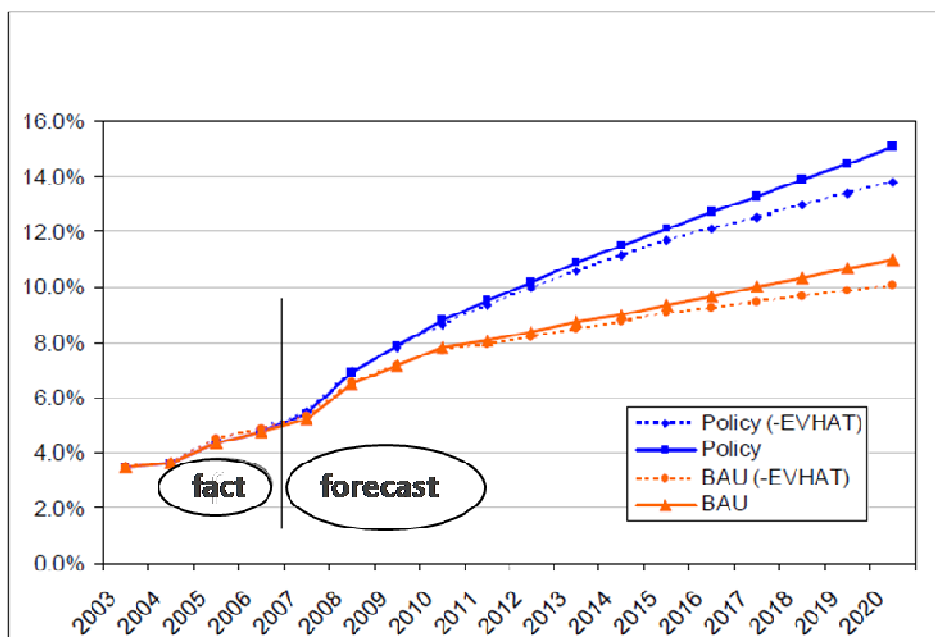


Figure 20 Expected Share of Renewable Resources in BAU and Policy Scenarios

(Source: Renewable Energy Strategy of Hungary)

The BAU scenario leads to a share of renewable energy sources of 11% by 2020 if the necessary energy saving measures are implemented. If such measures fail the share is expected to reach 10%. If the proposed measures are realized the strategic (Policy) scenario leads to a share of renewables of 15% by 2020. Without the implementation of the energy saving measures a share of 13,8 % is anticipated provided the share of biofuels goes up to 5,75% by 2010 and 10% by 2020. According to the BAU scenario renewable energy use increases from 55 PJ in 2006 to 136 PJ or to 186 PJ in the Policy scenario. Within the total use consumption for heat production slightly falls while green power generation and the share of biofuels increase.

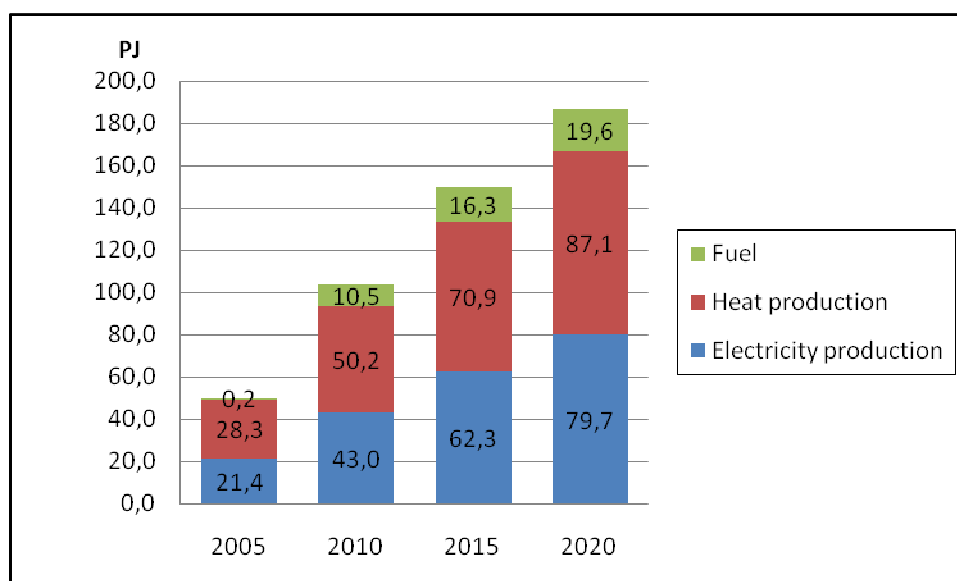
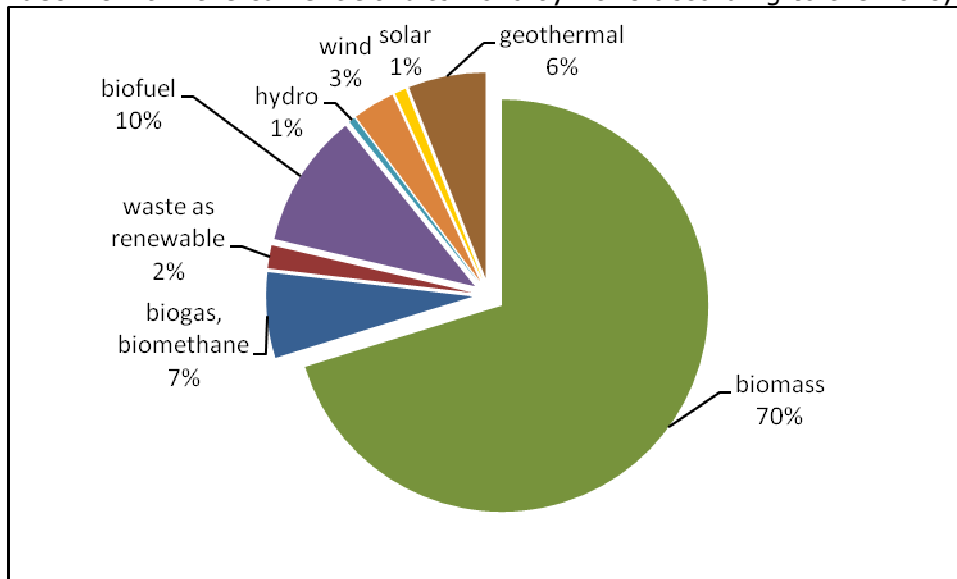


Figure 21 Projection of Renewable Energy Use Based on Utilization (Policy Scenario)

(Source: Renewable Energy Strategy of Hungary)

In the structure of renewable energy use biomass will play a key role in 2020 too but its share will decline from the current 90% to 70% by 2020 according to the Policy Scenario.



22. Figure: Expected Consumption of Renewable Energy in 2020 (Policy Scenario)

(Source: Renewable Energy Strategy of Hungary)

The share of electricity production from renewable energy sources in the total electricity consumption is expected to grow to 14,5% in the BAU scenario and 18% in the Policy scenario by 2020 if the growth rate of electricity use, based on the statistical data of the last years, is assumed at 1,4%. If the growth rate of electricity consumption is assumed to be 3% the share of electricity production in the total electricity consumption is expected to increase to 11,8% in the BAU scenario and 14,5% in the Policy scenario.

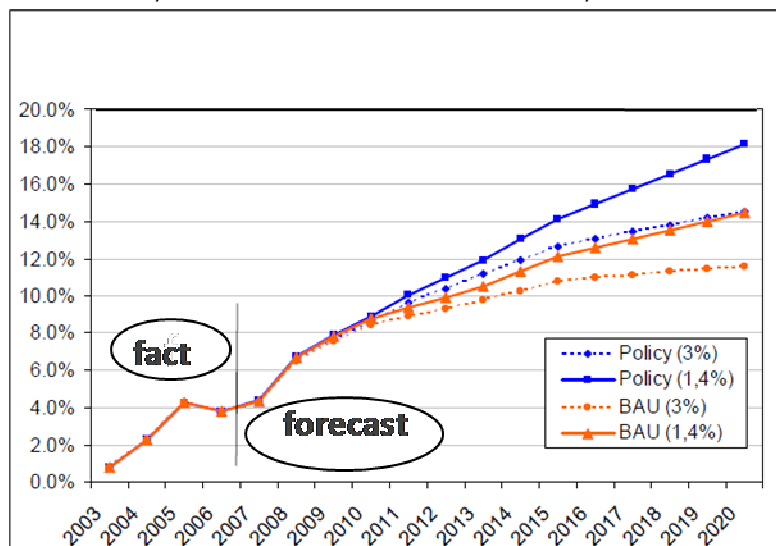


Figure 23 Expected Shares of Electricity Generation from Renewable Sources

(Source: Renewable Energy Strategy of Hungary)

In the strategic scenario green power generation should go up to 9470 GWh in 2002 from 1630 GWh in 2006 and to 7557 GWh in the BAU scenario thanks to biomass production. The existing one-sided use of this energy source will considerably decline, however, with the share of solid biomass falling from its current share of over 80% in green power generation to 63% by 2002 in the Policy scenario. This scenario anticipates the implementation of new green power generation capacities of 1910 MW between 2007 and 2020 while in the BAU scenario this figure is calculated at 1355 MW, resulting from the realization of wind power and biomass projects (total capacity of 1000 MW and 925 MW respectively by 2020 in the Policy scenario).

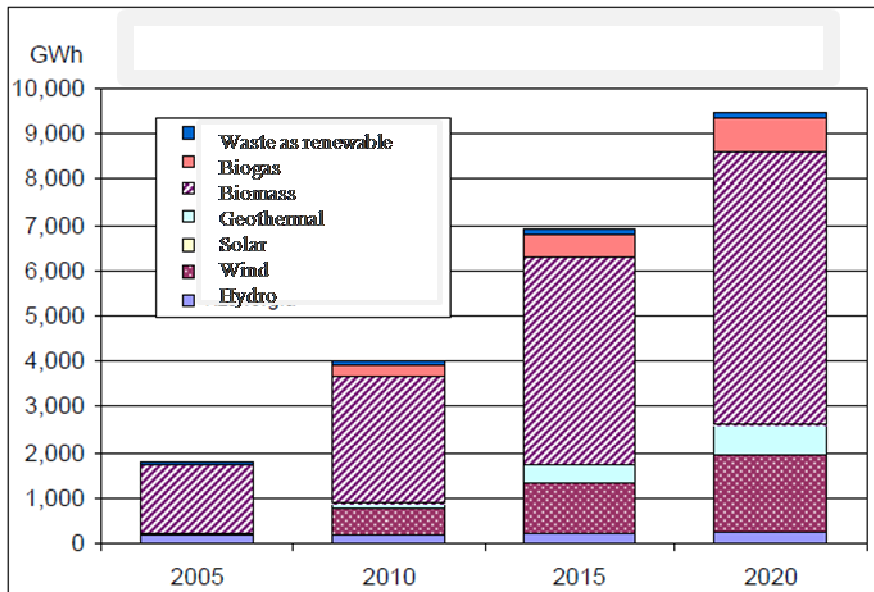


Figure 24 Projection of Electricity Generation from Renewable Resources Based on Source

(Source: Renewable Energy Strategy of Hungary)

Renewable energy use in the heat market is expected to increase from the current 36 PJ to 87 PJ by 2020 in the Policy scenario and 51 PJ in the BAU scenario. Its share in the total renewable energy use is expected to be 47% in 2020 in the Policy scenario, a figure somewhat lower than the current one. Heat production, however, will continue to have the highest volume in the total use. Similarly to green power generation the structure of renewable energy sources in the heat market will become more balanced through the decline in solid biomass use (down to 79% from 85% in the Policy) and an increase in biogas, biomethane and solar energy use.

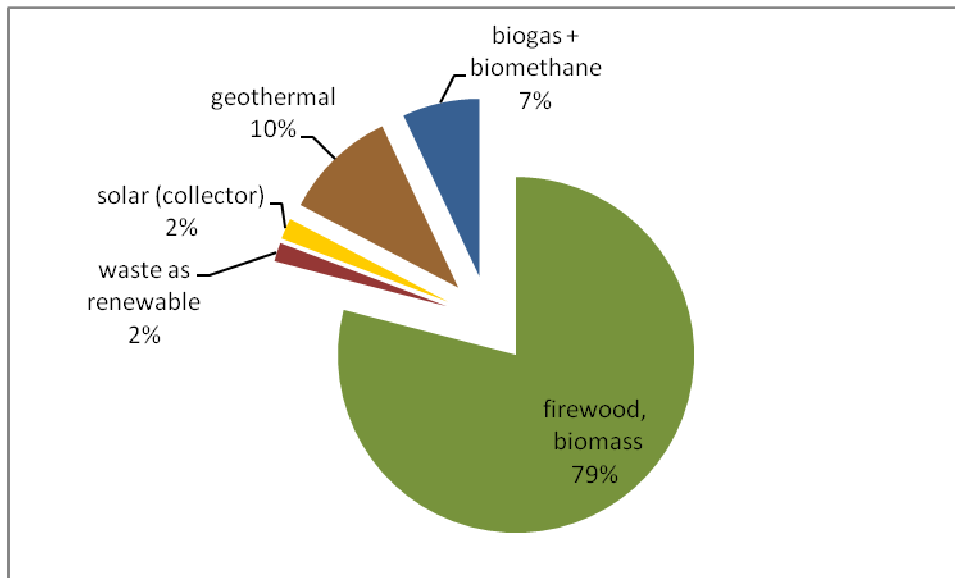


Figure 25 Expected Share of Renewable Resources in 2020 (Policy Scenario)

(Source: Renewable Energy Strategy of Hungary)

Within solid biomass use the share of district heat and industrial and agricultural use is expected to rise significantly while consumption for individual heating and domestic hot water production in the residential and services markets is anticipated to decline from 90% to 60%. This means that renewable energy sources will be used more diversely in power generation for heating and domestic hot water production.

Regulation - Mandatory Policy Instruments

RES Directive, 2009/28/EC

After a long preparatory and negotiating period the European Parliament adopted the European Union's climate and energy package in December 2008. The new Directive on Renewable Energy (2009/28/EC), passed in April 2009, forms part of this package. The new directive amends and will repeal Directive 2001/77/EC on electricity production from renewable energy sources and Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport in 2012.

The new directive establishes that EU member states should jointly reach a 20% share of renewable energy in their gross final energy consumption by 2020. In Hungary this means a share of 13%, added up from electricity, energy used for heating and cooling, produced from renewable sources, as well as energy used for transport.

Growing Energy Crops

Government Decree 71/2007. (IV. 14.) on ligneous energy crops

The decree defines the method of planting and rooting out ligneous energy crops as well as the types of producible energy crops. It also designates the responsible authority.

Promoting Electricity Production from Renewable Energy Sources

Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market

Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market, adopted by the European Parliament and the Council in 2001, establishes that all member states should set national targets, develop a national support system for renewable energy sources, a certification procedure of origin for electricity produced from renewable energy sources and that member states should simplify their relevant public administration systems.

Act LXXXVI/2007 on electricity

Act LXXXVI/2007 on electricity was adopted in line with Directive 2001/77/EC. This the Electricity Act currently in force.

The Act establishes the legislative framework for the obligatory feed-in of electricity produced from renewable energy sources at a subsidized tariff.

The introduction of certificates of origin in Hungary is also stipulated by Act LXXXVI/2007 on electricity.

Government Decree 389/2007 (XII.23.) on feed-in obligation and price of electricity produced from renewable energy sources or waste or co-generation

Government Decree 389/2007 (XII.23.) on feed-in obligation and price of electricity produced from renewable energy sources or waste or co-generation stipulates that the certificate of origin is a certificate recording the quantity (in MWh) of electricity generated from renewable energy sources, waste or co-generation in the given calendar year, in accordance with the provisions of Decree 110/2007 (XII. 23.) of the Ministry of Economics on the calculation of co-generated electricity and the determination of the volume of useful heat generated at high efficiency. The certificate of origin chiefly serves the purpose of supervision in Hungary. The seller in the obligatory feed-in system proves through the certificate of origin following the relevant year that the volume of electricity generated and sold in the obligatory feed-in system complies with this decree, or in case of co-generation with the provisions of Decree 110/2007 (XII. 23.) of the Ministry of Economics.

Biofuels

Directive 2003/30/EC of the European Parliament and of the Council on the promotion of the use of biofuels or other renewable fuels for transport

Directive 2003/30/EC of the European Parliament and of the Council on the promotion of the use of biofuels or other renewable fuels for transport stipulates that EU member states should ensure that biofuels and other renewable fuels sold on the market reach a certain share at least. For this purpose national indicative targets should be set.

The government defined the targets and tasks relating to the promotion of biofuels in Government Decree 2233/2004. (IX. 22.) on the national targets for the use of biofuels and other renewable fuels for transport and in Government Decree 2058/2006. (III. 27.) on the development of the production of biofuels and promotion of their use for transport.

Government Decree 2058/2006. (III. 27.) on the development of the production of biofuels and promotion of their use for transport

In Government Decree 2058/2006. (III. 27.) the Government of Hungary implements measures to meet the target for the use of biofuels for transport as specified by Directive 2003/30/EC; biofuels used for transport sold in the market should reach a share of 5,75% at the minimum.

For this purpose and in the absence of EU legislation to the contrary, provisions of the Act CXXVII/2003 on excise duty and specific rules on the sale of products subject to excise duty shall provide economic incentives to ensure that the 5,75% share of biofuels

in terms of energy content shall be gradually achieved. The continuous transposition of changes in European fuel standards should ensure that there is consistency between the share of biofuel to be attained by means of incentives and the provisions governing biocomponents which can be blended with fuel.

The Government also proposes that a national standard should be introduced in respect of E-85 fuel.

In accordance with the decree, in the interest of allowing the use of biodiesel made from sunflower oil, an examination must be made of whether partial use of sunflower oil as a base material (blended with rape seed oil) can meet the EN 14 214:2003 standard requirements, and further, a national standard must be drawn up for biodiesel to allow sunflower oil to be used as a raw material.

An examination must be made of whether the use of biofuels produced from used cooking oil and subject to exemption from or reduction of excise duty can be extended to motorised vehicles providing a local bus transport service, in accordance with technical, economic and environment.

Government Decree 2233/2004. (IX. 22.) on national objectives relating to the use of biofuels and other renewable fuels for transport

Pursuant to Government Decree 2233/2004. (IX.22.) the Government of Hungary agrees that taking national circumstances into account, the national biofuel content target required by Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport should reach 0.4%-0.6% by 2005, expressed as a percentage of the energy content of the fuels sold in Hungary.

In the interest of increasing the percentage of biofuel used, an excise-duty refund will be applied until 31 December 2010 to the ETBE (ethyl-tertio-butyl-ether) produced on the basis of bioethanol blended with automotive petrol and to regulation quality biodiesel mixed with diesel. This tax concession will promote the blending of biofuels with standard motor fuels in the interest of achieving a 2% share of biofuel in fuels sold, as a percentage of the energy content, by 2010.

Biogas

Directive 98/30/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas and Directive 03/55/EC on gas

Directive 98/30/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas establishes the purpose of opening up the natural gas market, the method and schedule of implementation and the criteria and procedures applicable to the implementation.

The European Parliament adopted Directive 03/55/EC on gas on July 26, 2003, as an amendment to Directive 98/30/EC. The new directive calls for security of supply for consumers in all member states, measures to protect weak players, measures to safeguard the rights of energy consumers, public information about prices, and simple, low-cost and transparent procedures to deal with consumer complaints.

Act XLII/2003 on natural gas supply (hereinafter: old GSA) and Act XL/2008 (hereinafter: new GSA)

Hungary undertook the obligation to the European Union to comply with Directive 98/30/EC by opening up its internal natural gas market as of January 1st, 2004.

Act XLII/2003 on natural gas supply and Act XL/2008 provide a definition for biogas. Also, both the old and the new GSA authorize the relevant Minister and the Government to specify in a decree the criteria for introducing biogas and other gases of natural gas quality as well as natural gas extracted by mining into the existing gas system, the quality regulations for gas feed-ins and the rules for takeover and measurement. These detailed rules are still missing and should be drawn up.

Administrative Procedures

Government Decree 314/2005. (XII. 25.) on environmental impact studies and integrated environment use permits

Pursuant to Directive 2001/77/EC of the European Parliament and of the Council on the promotion of electricity produced from renewable energy sources in the internal electricity market the member states should ensure that the rules for approval, classification and obtaining of permits relating to the production and transformation of renewables are in proportion and necessary.

The Directive led to the adoption of Government Decree 314/2005. (XII. 25.) on environmental impact studies and integrated environment use permits, establishing the procedure for obtaining permits and providing guidelines to determine when environmental or integrated environment use permits are necessary.

Despite Government Decree A 314/2005. (XII. 25.) the currently existing permit system does not fully meet the criteria set forth in the Directive. Changes in legislation and the problems relating to scope of authority do not favour investors. As a consequence the permit procedures should be further reviewed and the consistency of the relevant legislation needs to be mapped.

Other

Act LIII/1995 on the general rules of environment protection and Act LXXXIX/2003 on environmental pollution charges

Various charges levied in connection with the use of fossil energy sources facilitate the utilization of renewable energy sources, if only indirectly. Such charges include the environmental pollution charge which is regulated by Act LIII/1995 on the general rules of environment protection and Act LXXXIX/2003 on environmental pollution charges.

Financial support and economic incentives

The Hungarian support system is fairly visible until 2015. The following support instruments will be in place:

- Supporting green power through the obligatory feed-in system and later, through the green certification system, which may be introduced in the future.
- Investment subsidies financed by the European Union and Hungary promote the use of renewable energy sources.
- The use of biofuels is promoted by the state through tax exemption, duty refund and tax differentiation.

Feed-in tariff for green electricity (national fund)

Hungary has introduced a sustainable (non-central-budget-based) feed-in-tariff scheme which is guaranteed until 2020. The obligatory feed-in and purchase price of electricity generated from waste or from renewable energy sources or by combined heat and power production are regulated by Government Decree 389/2007 (XII.23.).

A licence from the Hungarian Energy Office (HEO) is required to receive the feed-in tariff. The volume of electricity for which it is paid, as well as the duration of the feed-in tariff in the licence is limited by the HEO, based on the project payback period. The HEO as the energy sector regulator has set up maximum limits beyond which the feed-in tariff is not applied.

In addition to the obligatory feed-in system the other solution favoured by member states is the introduction of green certificates. Pursuant to Act LXXXVI/2007 on electricity 'green certificate' shall mean an exchangeable certificate verifying – based on a guarantee of origin – the quantity of electricity produced by energy from renewable energy sources or waste. As authorized by the Act the Government shall perform the tasks relating to the introduction of green certificates. When the required criteria are met the Government shall make a decision whether to introduce the green certificate and combined certificate system, specified by law, to replace the existing obligatory feed-in system. Hungary has not yet introduced a support system based on green certificates.

Subsidy - NEP (National Energy Saving Plan)

The subsidy entitled NEP-2009-4, announced in the framework of the National Energy Saving Plan, provides non-refundable grants to private individuals, blocks of flats and building societies to increase the use of renewable energy sources. Such grants can cover up to 35% of the costs but cannot exceed the amount of HUF 1,470,000.

Subsidy - Panel Programme for Prefabricated Houses (national fund)

In the Hungarian support system the other major subsidy available for the residential sector is the Panel Programme managed by the Ministry of Local Government and Regional Development. The programme promotes the modernization and renovation of pre-fabricated buildings with the aim of saving energy. From the targeted appropriation of supporting the renovation of residential dwellings and their environment, subsidies can be granted to increase the use of renewable energy sources, to replace traditional energy sources with renewables, to promote energy production, storage, transport and possible feed-back to the network.

Subsidy - EEOP (EU fund)

The increased use of renewable energy sources is chiefly financed by two EU funds, the European Regional Development Fund and the European Agricultural Fund for Rural Development.

The Environment and Energy Operational Programme (EEOP) of the New Hungary Development Plan has a total budget of EUR 4916 M to support Hungarian energy projects falling into two priorities in the period of 2007-2013. Within the scope of the priority axis „Increasing the Use of Renewable Energy Sources” 5,15% of the total budget can be allocated while the priority axis „Efficient Energy Use” to promote energy conservation has 1,58% of the total budget.

EEOP 2009-4.2.0/B Local heat and cooling supply from renewable sources

- Amount of subsidy: HUF 1-1,000 million, 10-70% of eligible costs
- Beneficiaries: enterprises, public administration and institutions, NGOs and other companies
- Supported activities:
 - solar energy
 - biomass

- development and enlargement of systems generating and using biogas from solid and/or liquid material, landfill gas for heat consumption
- geothermal energy utilization
- installation of heat pump systems
- renewable energy utilization for cooling
- combining renewable energy sources
- establishment of communal district heating systems using renewable energy sources, total or partial replacement with renewable sources

EEOP 2009/4.4.0 Heat and/or electricity production from renewable sources and bio-methane production

- Amount of subsidy: HUF 1-1,000 million, 10-70% of eligible costs
- Beneficiaries: enterprises, public administration and institutions, NGOs and other companies
- Supported activities:
 - electricity generation from solar energy
 - biomass utilization for electricity or combined heat and power
 - utilization of hydropower: establishment or renovation of hydropower plants below 5MW
 - production and utilization of biogas
 - utilization of geothermal energy
 - utilization of wind energy
 - combining renewable energy sources

EEOP-2009-4.6-0.: Supporting the establishment of low and medium-capacity bio ethanol factories

The key aim of the scheme is to subsidize projects aimed at establishing high and medium capacity bioethanol factories in the form of non-refundable grants.

Implemented projects contribute to a growing share of biological motor fuels including bioethanol and the spread of renewable energy sources through the energy supply of manufacturing capacities by renewables.

Applicants are invited to submit their tender bids in a single-round tender.

Applicants should submit a detailed project description (data form, feasibility study and other required documents) which will provide the basis for the decision-making process. If the tender bid is approved the project shall be implemented in line with this project proposal.

In the framework of the scheme the following activities can be subsidized:

1. Establishing high capacity bioethanol factories.

Establishing bioethanol factories of 80 kt/year capacity at the minimum. Purchasing the necessary technological equipment to receive, prepare, manufacture bioethanol and manage by-products. Constructing the buildings and facilities necessary to house such equipment and setting up the production and supply systems providing energy for the factory.

2. Establishing medium capacity bioethanol factories.

Establishing bioethanol factories of 30 kt/year capacity at the minimum and 60 kt/year at the maximum. Purchasing the necessary technological equipment to receive, prepare, manufacture bioethanol and manage by-products. Constructing the buildings and

facilities necessary to house such equipment and setting up the production and supply systems providing energy for the factory.

According to the call for tender all beneficiaries are deemed enterprises as per the acquis communautaire and the subsidy is deemed a state subsidy.

EEOP-2009-5.2.0/B: Third party financing (ESCO): energy modernization of buildings combined with renewable energy utilization

The aim of the scheme is to modernise electric, lightning and heating systems in the buildings of central and local budget authorities, foundations, and churches, and combine these systems with renewable resources so that energy costs of these institutions and greenhouse gas emissions can be reduced. Taking into account the low ability and willingness of institutions to provide their own funds, the beneficiary of the tender is not the institute directly, but a private enterprise that wins the tender in public procurement procedure (third party, ESCO - Energy service company). In this scheme the funding rate of eligible costs is 35%.

- Budget: HUF 4 billion
- Intensity of subsidy: combined projects: 35 %
- Amount of the subsidy: HUF 3,5- 200 million
- Supported activities:
 - modernization of equipment producing, transporting and converting heat and electricity combined with renewable energy sources (solar panel, biomass, geothermal, heat-pump)
 - modernization of lighting and electrical system excluding public lighting, combined with renewable energy sources (PV for grid or separate)
 - promotion of remote monitoring system of electricity and gas, it must be combined with one of the previous.
- Beneficiaries: ESCO companies

EEOP-2009-5.3-0/B: Energy modernization of buildings combined with renewable energy utilization

In the framework of the tender scheme, mainly projects aiming for the decrease and/or rationalization of energy use in buildings of the central and local budgetary authorities and in technological and office buildings of companies may be supported, which also use energy generated from renewable energy resources. The tender favours small and medium cost projects, providing funding in the range of 10-70%.

- Budget: HUF 6 billion
- Intensity of subsidy: 10-70 % (depending on the location (region) in Hungary and the legal status of the applicant)
- Amount of the subsidy: 1-500 million HUF
- Supported activities:
 - Supporting energy conscious architecture, reduction of heat loss during renovation combined with renewable energy (solar panel, biomass, geothermal, heat-pump)
 - modernization of heating, cooling and domestic hot water systems in institutions combined with renewable energy (solar panel, biomass, geothermal, heat-pump)
 - modernization of lighting system combined with renewable energy sources (PV for grid or separate)
- Beneficiaries: enterprises, public administration and institutions, NGOs and other companies

Subsidy - EAFRD (European Agricultural Fund for Rural Development) (EU fund)

The measures of the New Hungary National Regional Development Strategic Plan (NARDP) promote the utilization of renewable energy sources in Hungary. The objective of NARDP is to ensure that the countryside, in addition to producing the required basic commodities, can intensively participate in the development of the bioenergy segment. The competitive production of commodities includes the special subsidization of energy crops. NARDP supports the production of renewable energy sources in three strategic categories: liquid biomass (bioethanol and biodiesel), solid biomass (ligneous and non-ligneous energy crops) and biogas. The subsidies are financed by the European Agricultural Fund for Rural Development (EAFRD) that provides funding for the competitive production of biomass and its processing into a primary half finished product and for the producers' own energy supply.

Decree 27/2007. (IV.17.) of the Ministry of Agriculture and Rural Development regulates the detailed criteria of subsidies granted from the European Agricultural Fund for Rural Development for the modernization of animal farms. Under the decree livestock farms eligible for funding aim to manage their manure disposal in biogas plants instead of insulated manure storage tanks, in accordance with the Nitrate Directive. The intensity of the subsidy is 50-60% on average for the power plant. The subsidy can be used for built and in-built technology, energy peripheries and logistics machinery.

Decree 44/2009. (IV. 11.) of the Ministry of Agriculture and Rural Development establishes the criteria for subsidies for the manufacturing of liquid biomass. This decree contains the detailed terms and conditions of subsidies for the setting up of non-food low capacity factories to produce crop-based raw spirits and raw oil from the European Agricultural Fund for Rural Development. The intensity of the non-refundable subsidy is 40-60%.

Decree 78/2007. (VII. 30.) of the Ministry of Agriculture and Rural Development establishes the detailed criteria for the use of renewable energy sources to produce energy for agricultural consumption from the European Agricultural Fund for Rural Development. The objective of the subsidy is to promote the wide-spread use of renewable energy sources in agriculture and reduce crop producers' dependence on fossil fuels. Agricultural applicants can submit tender bids for biomass-fired boilers to use for agricultural purposes. The intensity of the non-refundable subsidy is 35%.

Decree 72/2007. (VII. 27.) of the Ministry of Agriculture and Rural Development regulates the subsidies and detailed criteria for planting ligneous energy crops. Pursuant to the decree the planting and nurturing of ligneous energy crops multiplied by root suckers until their first harvest are deemed an activity eligible for subsidization. The intensity of the non-refundable subsidy is 40-60%. As a consequence it is assumed that the size of Hungarian energy crop plants will grow from 300 hectares in 2006 to 2,700 hectares by 2009. The target for 2013 has been set at 49,000 hectares.

Decree 71/2007. (VII. 27.) of the Ministry of Agriculture and Rural Development regulates the detailed criteria of subsidies granted for planting non-ligneous perennial energy crops from the European Agricultural Fund for Rural Development. Pursuant to the decree the planting of non-ligneous energy crops existing for a minimum of 5 years without re-planting is deemed an activity eligible for subsidization. Currently the planting of energy grass and Chinese reed are subsidized, with the anticipated addition of Virginia fanpetals (*Sida Hermphrodita L. Rusby*) in the future. The intensity of the subsidy is 40-60% of the total costs.

Revolving Soft Loan – Energy Saving Credit Fund

The credit with preferential interest supporting energy saving, increase of energy efficiency and the utilization of renewable energy sources can be requested from the Energy Saving Credit Fund (German coal grant). This credit scheme operating continuously from 1991 is available for building societies as well as economic enterprises.

Soft Loan – Residential Energy Saving Credit programme

Since 2007 the „For A Successful Hungary“ Residential Energy Saving Credit Programme has been offering preferential loans to implement residential projects aimed at improving energy efficiency and the use of renewable energy sources. The preferential loan can be used together with a subsidy from the Energy Saving Program (NEP) or independently and can provide up to 100% of the project costs to eligible applicants.

Tax exemption for biofuels

Pursuant to Act CXXVII/2003 on Excise Taxes and the Special Regulation of Excise Goods the domestic production and importing of excise goods are subject to excise duties. The Act, however, includes tax concessions related to ETBE (ethyl-tertio-butyl-ether) and bioethanol. In addition, HUF 79 per litre off the tax included in the taxed price of biodiesel produced in a biofuel tax warehouse authorized by the customs office, purchased for mining use in a mining area or for the operation of non-road machinery and mechanical equipment can be refunded.

Soft Support Measures

In Hungary several universities and research institutes are involved in biomass research, mainly focusing on growing crops for energy production from biomass and processing raw materials for biomass.

Associations, competence centres and non-profit organizations operating in Hungary lay great emphasis on awareness raising. The small number of such organizations and their low budget, however, do not allow for a wider dissemination of information relating to biomass production and utilization.

Although several strategic documents highlight the importance of soft incentives and stress their promotion political decision-makers usually focus on hard measures (regulation, financial incentives).

Among soft measures the example set by state institutions should be especially emphasized but the lack of the necessary financial resources usually thwarts these actions.

Spatial Planning and Policy Coherence

Hungary is a mainly centrally governed country with the same regulations and financial incentives in place for the entire country. In the field of bioenergy and others, however, specific rules and incentives should be implemented to ensure that raw materials best fitted to the local characteristics of a given area are produced and that the use of biomass for energy production also takes into account the local possibilities and peculiarities. Area-specific regulations and incentives have not been adopted in Hungary yet. Though recently becoming more intense regional planning is still in its initial phase regarding the utilization of biomass for energy production.

The strategic planning for the utilization of biomass for energy production and the prioritising of financial incentives fall under the responsibility of FVM (Ministry of Agriculture and Rural Development), KHEM (Ministry of Transportation, Telecommunication and Energy) and KvVM (Ministry of Environmental Protection and Water Management) and their authority bodies. Regional planning is done by VÁTI NKft

(Hungarian Public Nonprofit Limited Liability Company for Regional Development and Town Planning) and RFÜ (Regional Development Agency). Regional data required for the drawing up of area-specific rules and incentives are owned by FÖMI (Institute of Geodesy, Cartography and Remote Sensing). To achieve effective regional organization and regulation there must be communication and cooperation between the ministries and the competent organizations. Considerable progress has been made in this field but regular talks and ongoing cooperation need to be further strengthened in the future.

Certification

In terms of utilizing biomass for energy production only some of the organizations dealing with forest management, logging and timber processing are involved in a certification programme. Currently 27 Hungarian organizations are entitled to use the international certificate of FSC. Three certified forestlands operate in Hungary, making approximately 10% of Hungarian forests certified.

No Hungarian certification system is in place regarding the use of biomass for energy purposes.

Assessment of Available Biomass Resources

Calculations for the Hungarian biomass potential are one of the most disputed issues among the estimates for Hungarian renewable potential. Estimates widely differ and there are also problems with statistical classification. (Hungarian statistics do not differentiate between biological and non-biological by-products and waste and in some cases by-products and main products are given different assessments.)

Primary biomass from forest management and agriculture is relatively easy to estimate because there are ongoing analyses to determine the ratio of main products to by-products. The volume of secondary biomass is more difficult to define as researchers collect data in various categories. The most difficult task is to determine the base for tertiary biomass.

The large variations in results clearly show that there are issues of calculation methodology to be clarified (discussed).

Based on the estimates for Hungarian biomass potential a share of 8-15% (100-190 PJ) in the total national energy use can be achieved in the period between 2015 and 2020.

The following sections propose to present in detail three estimates for the biomass potential, their calculation methodologies and assumptions.

Biomass potential in the Estimates of INNTEK Center of Innovation and Technology Non-Profit Limited Kft

Agreed annual estimates for energy produced from renewable energy sources:

- from primary biomass, agricultural by-products 251 PJ
- from secondary biomass (waste from animal farming) 91 PJ
- from tertiary biomass (processing waste) 75 PJ

This potential could be increased by the amount of waste from forestry and wood industry, approximately 4,9 million tons with an energy content of roughly 30 PJ. It has been theoretically proved that on farmed lands primary energy sources of 25 GJ/ha are annually produced. Depending on farming culture and the method of cultivation this

figure can range between 10-100 GJ/ha from by-products and waste, produced every year by necessity. The energy content of biomass theoretically producible in Hungary is surprisingly high (942 PJ, Bai 2004) of which the energy content of the total available agricultural waste and by-products is quite considerable 304,1 PJ as well (see Figure 27 for its breakdown by energy source). Energy produced from biomass therefore accounts for 25-17% of the total energy use in Hungary. Of this the **energy content of biomass for realistic energy utilization is 96,7 PJ** (see Figure 28 for regional breakdown). The volume produced from by-products and waste that can be realistically used for energy production represents **8% of the annual energy demand**.

	PJ/year
Forestry and wood industry by-products + firewood	53,1
forestry main and by-products (firewood, wood chips)	45,3
by-products from wood industry	7,8
Agricultural by-products	37,9
straw	27,7
sunflower cod	1,4
cuttings from fruit trees	4,4
stem from vineyards	1,4
other	3,0
Biogas production	3,2
by-products from animal husbandry	1,7
sewage sludge	0,9
landfill gas	0,6
Municipal organic waste	2,5
TOTAL	96,7

Table 4 *Volume of by-products for realistic energy utilization by Fenyvesi-Peczник (2004)*

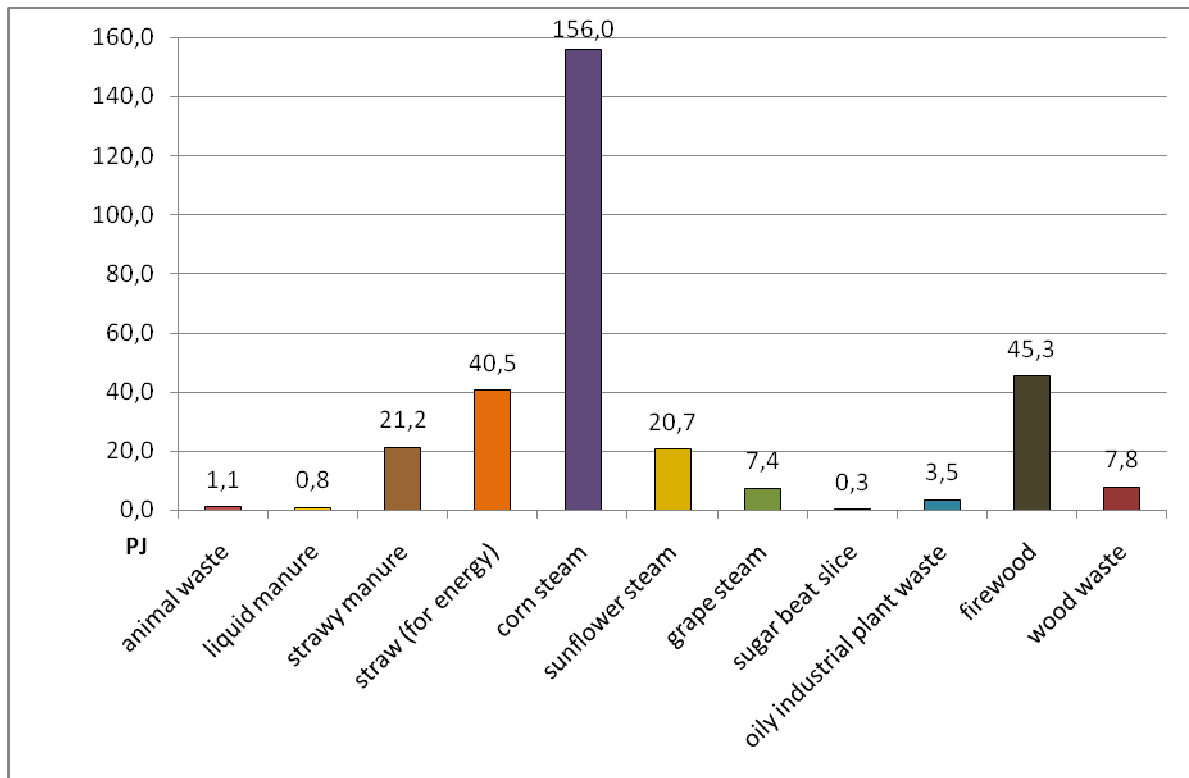


Figure 26 Energy content of main by-products and waste (PJ)

(Source: Tar-Marosvölgyi 2003)

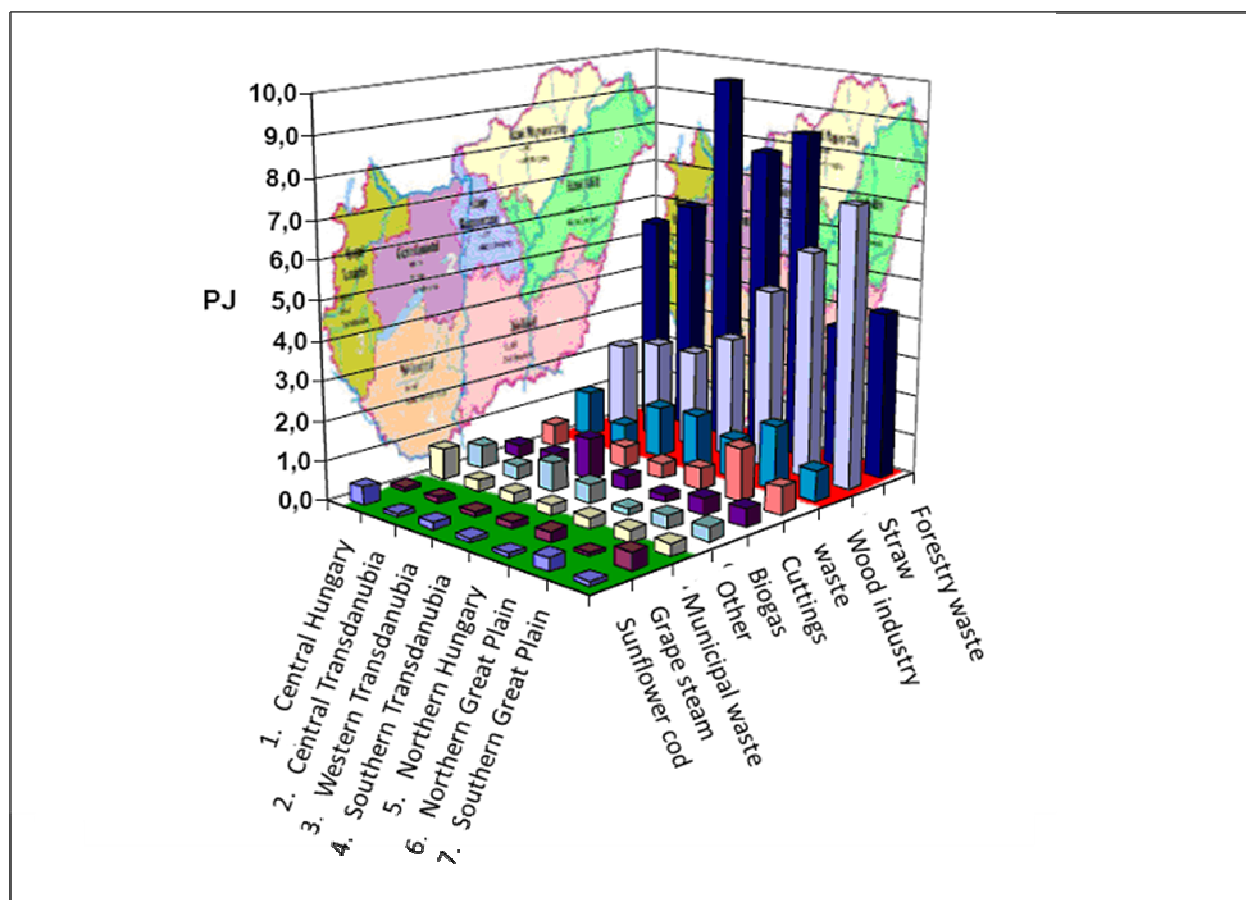


Figure 27 Breakdown of by-products for realistic energy utilization, by biomass type and region

(Source: Fenyvesi-Peczник, 2004)

Estimates of the Ministry of Agriculture and Rural Development on the Hungarian Biomass Potential

In May 2007 the Ministry of Agriculture and Rural Development (FVM) made estimates on the biomass potential available and producible in the middle run (7-15 years). These estimates were focusing on three areas of bioenergy:

National Biomass Potential for Energy Utilization Estimates of the Ministry of Agriculture and Rural Development, May 2007	
Biofuels	
·bioethanol	1330 kt/year=36 PJ
·biodiesel	250 kt/year=9,5 PJ
Solid biomass	188,26 PJ
Biogas	25 PJ
Total	~260 PJ

Table 5 Hungarian biomass potential according to the Ministry of Agriculture and Rural Development

The FVM estimates refer to the volume of produced and producible biomass but do not include the costs of collection, transport and logistics. **This figure therefore can be interpreted as an upper estimate for biomass potential.**

Biomass Potentials from the Study Prepared by the Renewable Energy Sub-committee of the Hungarian Academy of Sciences

The following table contains the estimates for biomass potential based on several surveys or as forecast by competent organizations :

Raw materials	Type	Potential energy content (PJ/year)
Dendromass		56,5-63
	firewood	20-22
	energy wood (plantation)	30-32
	cutting waste	5-7
	primary wood waste	1,5-2
Plant main and by-products, waste		74-108
	by-products of grain	10-12
	other plant by-products (stem, leaves, etc.)	30-50
	energy plants	30-40
	by-products coming from biofuel production	4-6
Secondary biomass		18,7-23
	liquid manure	0,7-1
	animal waste, by-products	13-15
	wood-processing waste	5-7
Tertiary biomass		54-134
	industrial food waste	3-5
	food waste	6-9
	sewage sludge	15-40
	communal biowaste	30-80
TOTAL		203,2-328

Table 6 Biomass potential in Hungary according to the Academy of Sciences

(Source: Dr. Marosvölgyi (2003) (2004) * dendromass = wood biomass)

The above figures do not include biofuels and the volume of biomass used for their production. Biofuel production is based on demand rather than on potential. The energy content of biofuels is estimated at 6-7 PJ/year. Whether there are extra biomass by-products (rape stems, straw, carrot heads) derived from biofuel production depends on the type of plants used: energy crops (rape, wheat, maize, carrot) produced specifically for this purpose or surplus crops produced by traditional agricultural activities. The study assumes that biofuel production uses crops from traditional farming and no

extra biomass is produced. If energy crops are grown for this purpose they replace traditional crops and the by-products of traditional farming are exchanged for the residues of energy crops used for biofuel production. In our view the biomass base remains unchanged.

In the biomass estimates it was assumed that alternative (energy) crops would be planted on arable land that cannot be farmed profitably or their use is restricted by EU quotas in Hungary. It was also assumed that in the future sewage treatment capacities would substantially increase and selective waste collection would be introduced. Part of the organic waste would then be composted instead of being transported to the spoil-area and another part would be converted by rotting (biogas production).

Utilization of 30% of the potential would mean that **5-9% (60-108 PJ) of the Hungarian national energy demand** could be met by biomass-based energy production in 2015 and the **share of 12% (144 PJ) expected by 2015 can be achieved** through using 40 – 70 % of the potential.

Biomass Potential in the Estimates of GKI Energy Research and Consulting

GKI Energy Research and Consulting commissioned a team of Hungarian professionals to analyze the domestic biomass potential and prepare a forecast about the energy politics of agriculture and the available sources until 2030. The analysis estimated the total biomass stock of Hungary at 350-360 million tons, of which primary biomass of 105-110 million tons is annually reproduced and mostly utilized. **According to the report 171 - 193 PJ can be produced from biomass on the supply side in 2020, representing 14-16% of the existing energy use.**

The report stresses that the long-term and sustainable operation of biomass-based energy systems requires a complex, system-level approach compared to other systems based on renewable raw materials. Logistics, the right choice of site, the ratio of main products to by-products and final use all play a particularly important role.

Conflicts and Obstacles to Utilization of Biomass

- Electricity generated from the utilization of renewable energy sources exceeded 1600 GWh (a share of 3,6%) by 2005 though this figure was forecast for only 2010. This accelerated growth stemmed from the conversion of some coal-fired power plants operating with poor efficiency and causing high environment pollution into biomass co-burning. The average power generation efficiency of converted power plants, however, remains low and these plants continue to use outdated technologies in terms of energy.
- In the majority of converted power plants biomass use mostly means the use of wood, reserving significant part of the logging potential in Hungarian forests. The rapid growth of renewable-based energy production, supported from various sources, however, did not bring about the simultaneous growth in biomass supply. No considerable increase took place in the production of energy crops nor in the quantity of waste from forest management, leading to the creation of a demand market with high prices and causing tension among the industrial players, the residential consumers and power and district heating plants.
- One of key problems associated with the electricity pricing system is the so-called KÁP fund, meant to finance the subsidized feed-in tariff of electricity from renewable-based co-generation, and its recently increasing deficit (KÁP fund: a financial compensation instrument connected to electricity sold in the obligatory feed-in

system. The fund, managed by the system operator, is used to pay out subsidies to public utility wholesalers, obligated to take over the renewable-based electricity, and public utility providers.). The volume of electricity purchased at the subsidized feed-in tariffs has considerably grown and along with it, the associated financial burdens. The bigger part of the subsidies, however, was given to fossil-based cogeneration rather than electricity production from renewable energy sources.

- The legal framework to the support system of electricity production from renewable energy sources is also subject to debate. The regulatory background gives too wide a scope for intervention by the authorities, making electricity generation unpredictable and increasing investors' risk.
- In the majority of Hungarian district heating systems modern cogeneration technologies are used. Renewable-based heat production (unless cogeneration is replaced) would be relatively little utilized in certain cases, further lowering the rate of return for the expensive investment.
- Generally speaking about the profitability of renewable-based energy production it is typically characterized by longer periods for the return on investment for heat production technologies compared to technologies of electricity generation. While the supported feed-in tariffs and the obligatory takeover of electricity enable a relatively good rate of return with a 10-year period, heat production technologies take 12-20 years and sometimes even 50 years (at subsidized gas tariffs) to reach a return on the investment, periods considerably exceeding the lifetime of the technologies (i.e. these projects sometimes do not yield a return on investment at all). Whereas renewable-based electricity generation is subsidized on the output side no subsidies are offered to heat production from renewable energy sources. Heat production projects are therefore usually unprofitable and are not expected to be widely implemented under these conditions.
- The wider use of renewable energy sources on the decentralized heat market is prevented by the financial situation of its biggest customers, the residential and services sectors, and the scant resources available for such a purpose.
- Each year Hungary subsidizes residential gas consumption by billions of Hungarian forints, putting renewable energy sources at a competitive disadvantage. A decline in gas subsidies has recently begun but instead of including the external costs of the utilization of fossil energy sources (full inclusion of the energy tax and air pollution charge into individual residential gas tariff as well) into their prices fossil sources continue to enjoy much higher subsidies than renewables.
- Pursuant to the proposal of the Directive of the European Parliament and of the Council on supporting energy production from renewable energy sources should ensure that the rules for approval, classification and obtaining of permits relating to the production and transformation of renewables are in proportion and necessary. The currently existing Hungarian permit system does not fully meet the criteria set forth in the Directive. Changes in legislation and the problems relating to scope of authority do not favour investors. As a consequence the permit procedures should be further reviewed and the consistency of the relevant legislation needs to be mapped.
- The legal background to the feeding of cleaned biogas and gas produced from biomass into the national gas network was provided by an amendment to the Natural Gas Act in 2005 (Act LXIII/2003 amending Act XLII/2003 on natural gas). In practice, however, it is not yet possible. In the absence of specific regulations, Hungarian national standard MSZ ISO 13686 on the quality designation of natural gas is applied as the criteria for feeding biomethane into the natural gas grid. Biomethane, however, can hardly meet the reference values contained in this

standard or do not meet them at all, highlighting the necessity of developing biomethane's own standard.

- Biogas projects are hindered by the fact that the obligatory feed-in system governing renewable energy that does not differentiate according to raw material and size of plant.
- The use of biogas as fuel is prevented by its being the single fuel type still subject to excise duty in the regulatory framework, making the specific price of biomethane even higher. The relevant legislation in this area should be amended.

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