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REPUBLIC OF HUNGARY
MINISTRY OF ECONOMY AND TRANSPORT

COUNTRY REPORT

on the status of electricity production based on renewable energy sources

(implementation of Directive 2001/77/EC)

Budapest, April, 2008

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This country report serves to provide compliance with Article 3 (3) of Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market.

1. Domestic strategy and EU Member States' views on increasing the use of renewable energy sources

Energy conservation and increasing the use of renewable energy sources has a prominent role in the European Union's energy policy, in keeping with the aims of strengthening environmental protection. A previously formulated objective of the European Union is to increase the previous 5.3% rate of renewable energy use to 12% and the utilisation rate of electricity produced from renewable energy to 22.1% by 2010 (Directive 2001/77/EC of 27 September 2001 of the European Parliament and the Council on the promotion of electricity produced from renewable energy sources in the internal electricity market). Following negotiations, a 3.6% ratio was set as a requirement by the EU for Hungary and this is established in Annex II Point 12 of Act XXX of 2004 on accession.

Directive 2003/30/EC of the European Parliament and the Council on the promotion of use of biofuels or other renewable fuels for transport provides for an increase in the use of biofuels in transport, with Member States expected to reach a rate of 5.75% by 2010.

In January 2007 the European Commission presented the “energy package” designed as a basis for the integrated European energy policy. This included the Commission Communication “Renewable energy roadmap” summarising the Commission's long-term visions. In line with proposals included therein, at its March session the European Council specified as a mandatory objective the increase of the proportion of renewable energy sources to 20% in all EU energy consumption by 2020, national objectives being determined by the Commission with the consent of the Member States concerned. Moreover, the Council specified the minimum ratio of biofuels in gasoline and diesel oil used in transportation at a mandatory level of 10%, which is to be achieved by 2020.

In the document titled “Proposal – Directive of the European Parliament and the Council on promotion of energy produced from renewable sources” published on 30 January 2008, the European Union specified a requirement of a 13% level of renewable energy sources by 2020 for Hungary. If all 25 Member States comply with EU expectations, a 20% ratio of renewable energy sources can be achieved at EU level by 2020.

Increasing the use of renewable energy sources is not only necessary on the basis of requirements regarding Member States, it has several advantages for the national economy:

- the condition of the environment may improve,
- as regards climate change, they do not represent a burden on the environment (or represent a significantly lesser burden than fossil energy sources), thus they contribute to compliance with the obligation undertaken in Kyoto, and CO_2 savings may also be created, which can be sold on international markets,

— they may replace fossil energy sources, thus, the dependency on energy import of traditional energy sources may be mitigated,
— import burdens are reduced, thereby, the payment balance can be improved,
— new jobs can be created,
— added value, GDP and exports can be increased,
— modification of the agricultural structure may be promoted, which has a favourable effect on improving the quality of rural life and preventing migration of the population,
— increasing the use of renewable energy sources facilitates the application of new, state-of-the-art technologies,
— by converting those materials into energy which would otherwise represent an environmental burden (e.g. wastewater sludge), the environmental burden can be significantly reduced.

2. Regulatory and support environment promoting increased use of renewable energy sources

2.1. Domestic legislative provision of electricity production based on renewable energy sources

Act CX of 2001 on electricity

The most important provisions of the Act of 2001 are as follows:

— Upon the sale of electricity produced from renewable energy sources, subsidies integrated in prices shall be applied in order to reduce competitive disadvantage. Upon specifying the subsidy, the natural characteristics of the country, as well as the different rates of return of technologies related to individual energy sources must be taken into account.
— Within the range of its responsibilities related to electricity supply, the Hungarian Energy Office (hereinafter: Office) shall determine and certify the quantity of electricity generated by the producer or the operator of a small power plant from renewable energy or energy obtained from waste.

Act LXXIX of 2005 on the amendment of Act CX of 2001 on electricity

Apart from upholding the provisions of Act CX of 2001, the 2005 amendment includes the following modifications:

— upon subsidising electricity based on renewable energy sources, the effect of the supported technology on the balanced operation of the electricity system must be taken into account,
— as regards mandatory acceptance, the previous power limit of 0.1 MW shall be abolished,
— a starting price of 23 HUF/kWh is provided for mandatory acceptance of electricity based on renewable energy sources, which shall be modified on an annual basis by a “k” factor according to the rate of inflation.

GKM Decree 56/2002 (XII. 29.) on the rules of acceptance and price-setting of electricity subject to mandatory acceptance (amended by GKM Decree 78/2005 (X. 7.) of the Ministry of Economy and Transport)

The ministerial decree collectively implements the provisions of Act CX of 2001 and Act LXXIX of 2005 concerning system safety and subsidies. The decree applies two different prices in order to take into account the effects on system security of energy produced by renewable energy sources as well as technological differences:

— in the case of technologies depending on weather circumstances and based on non-fossil energy sources – energy production based on solar and wind energy – a mandatory acceptance price of 23 HUF/kWh is implemented regardless of the season,
— in order to uphold considerations of system safety, in the case of technologies not dependent on the weather – electricity production based on biomass, water and geothermal energy – a seasonal price is established in such a way that their average shall be 23 HUF/kWh.

Government Decree 180/2002 (VIII. 23.) on Act CX of 2001 and its amendments (hereinafter: Vhr)

The Vhr. details the legislative provisions of mandatory acceptance. According to the Decree, the Office shall determine the quantity of electricity subject to mandatory acceptance and produced from electricity from renewable energy sources or waste with regard to the principle of equal treatment in the construction and operation license of the power plant as well as the integrated license of the small power plant. In the course of the latter procedure, the Office shall take the following in consideration:

— the national undertaking, according to which a green current ratio of 3.6% must be achieved in the use of electricity by 2010,
— achievement of competitiveness of green current,
— impact of the given technology on the balanced operation of the electricity system,
— load capacity of electricity consumers,
— amounts of other subsidies received for the given investment project,
— expected return on the investment and,
— it provides that upon specification of the price of acceptance and application of the acceptance system, the subsidy utilised by the power plant or small power plant may not exceed the sum of the depreciation write-off related to the efficiently operating power plant or small power plant investment project and the profit needed for operation.

Thus, the regulatory conditions – manifest in acts and other, subordinate legislation – satisfy the following main requirements:

— the time limit previously of concern to potential investors was abolished, according to which the pricing scheme was only effective up to 2010,

— legislation provides adequate security for investors,
— the pricing scheme takes into account the aspects of system security and technological deviations,
— finally, the subsidy achieves the goal of creating competitive conditions for green current and simultaneously excluding unwarranted extra profits.

Regulation effective as of 2008

As of 2008, the regulation presented above was replaced by Act LXXXVI of 2007, the new act on electricity. The main reason for the legislative amendment was that Hungary, as a Member State of the European Union had to implement a full market opening in the electricity market. Concerning the mandatory system of acceptance of electricity based on renewable sources, this means that public utility supply has been abolished, thus former public utility service providers may not be required to accept electricity produced from renewable energy sources.

The new act on electricity still maintains (under different conditions) the system of mandatory acceptance at subsidised prices of electricity based on renewable sources and co-generated electricity. Moreover, the Office is still responsible for determining the quality of electricity subject to the acceptance requirement with regard to the considerations set forth in the relevant act and the period of mandatory acceptance (which is valid for the return of the given investment at a price of acceptance specified on an annual basis pursuant to relevant legislation). The Office shall issue a subsequent certificate of origin to electricity producers on an annual basis. As regards co-generated electricity, a further condition of participation of the mandatory system of acceptance and issuance of the certificate of origin is compliance with the provisions of Directive 2004/8/EC on the promotion of cogeneration based on the useful heat demand.

In the mandatory acceptance system, electricity is delivered to the users in several steps: the transmission system manager cooperates in the “collection” and distribution of electricity subject to mandatory acceptance. Producers of electricity for mandatory acceptance join a balance group expressly created for this specific purpose by the transmission system operator, which will ensure account settlements. Subsequently, the transmission system operator shall receive the electricity produced in accordance with the resolution by the Office specifying mandatory acceptance eligibility. The transmission system operator shall settle accounts with the producers at prices specified in relevant legislation, and then it shall forward the electricity received to electricity traders and universal service providers. According to the provisions of VET (Act on Electricity), traders and universal service providers shall accept electricity sold in the mandatory acceptance system according to the proportion of electricity sold to users in legal relationship with said traders and providers and they shall forward its price to the end users. The basis for account settlement between the system operator and traders, universal service providers shall be determined by the average price calculated from prices paid to producers by the system operator. The mandatory acceptance system provides a security for purchasing the relevant electricity and in the end, the users of electricity are required to buy the subsidised electricity to an extent corresponding to the ratio of electricity utilised.

Relevant legislation specifies the energy production technology to be applied for energy marketable in the mandatory acceptance system and several price categories are formed with respect to electricity to be accepted. The aspects of distinction are represented by energy sources used, production procedures applied, the power plant performance capacity, the efficiency of energy conservation as well as (with regard to the time of return on investment) the date of establishment of the power plant. Mandatory acceptance may take place at a market or subsidised price. The highest starting value of the subsidised price is 24.71 HUF/kWh*k which was raised to 26.46 HUF/kWh from 1 January 2008 – pursuant to Govt. Decree 389/2007 (XII. 23.) ("k" is the consumer price index value for the previous year). The Act of the year 2007 ensures that the entitlements of power plants operating upon publication of said legislation and obtained pursuant to Act CX of 2001 on electricity as well as GKM Decree 56/2002 (XII. 29.) on the rules of acceptance and specification of prices of electricity subject to mandatory acceptance shall not be infringed in the new acceptance system. In the case of biomass power plants, the scheme shall be investigated by the Office by the end of 2009 and may be sustained up to the financial return.

The following are ineligible for subsidy through the system of mandatory subsidised acceptance: heat generation based on renewable sources, as well as electricity generation by the utilisation of trunks from the sawing industry or higher quality selection of wood (biomass-based power plants licensed according to the previous VET are exempted). As regards subsidy for wind energy, the limited technical opportunities of system-level services must be taken into account. In the event that new power capacities above 330 MW can be installed according to aspects of system operation, issuance of licenses shall also be possible in the case of projects assessed in a competitive procedure.

The new regulation complies with the provision set forth in Article 5 of Directive 2001/77/EC of the European Parliament and the Council which states that Member States shall issue a certificate of origin regarding the electricity produced from renewable energy sources (so far, it has been absent from the system). Similarly, compliance with the directive is reinforced by the fact that the new Regulation does not only make possible for the Government to introduce a green certificate – by evaluating international experiences regarding the green certificate system as well as the development of the domestic renewable energy market – but also provides that the Office shall inform the Government every two years (for the first time, at the end of 2008) on the conditions of introduction of the green certificate system.

Along with intensifying market conditions and further improvement of compliance with the Directive, an advantage of the new regulation is manifest in the provision that in the case of electricity production from biomass, the origin of solid biomass from sustainable production must be certified.

In summary: on one hand, the acceptance system only compensates for competitive disadvantage arising from technological characteristics upon establishment of power plants utilising renewable energy sources or waste, on the other hand, in accordance with priorities of Community law, it facilitates

conservation of primary energy sources by mandatory acceptance of co-generated electricity. For producers of electricity subject to mandatory acceptance, a positive economic effect is manifest by guaranteed sale as well as the price determined by relevant legislation to be applied during sale. The fundamental principles of the system include the requirement that upon determination of eligibility for mandatory acceptance, state subsidies received by the respective producer from other sources must be taken into account, moreover, eligibilities for energy produced in the same power plant unit may not be requested on the basis of two simultaneous entitlements, i.e. for acceptance of energy produced from renewable energy sources or waste or co-generated energy. For users, the economic effect of the system is directly manifest in the energy price, since the cost of electricity for mandatory acceptance will be integrated to the procurement costs of traders or universal service providers.

2.2. Investment subsidies for electricity production based on renewable energy sources in Hungary

The Energy Conservation Credit Fund applies loans with favourable interests to facilitate the implementation of investment projects aimed at improving energy efficiency and the utilisation of renewable energy sources. The credit fund was established in 1991, and at the end of 2006, the balance was 2.39 billion HUF. The fund manage is Energy Centre (Energia Központ) Kht., the extension of credit is performed by the Commercial and Credit (Kereskedelmi és Hitel) Bank Rt. Such favourable credits may be applied for by enterprises and local municipalities, the program is still in operation.

The legal predecessor of the Ministry of Economy and Transport elaborated the new energy conservation strategy in 1999, which was connected to an action program. In its Resolution No. 1107/1999 (X. 8.) the Government accepted the energy conservation and energy efficiency improvement strategy valid up to 2010 and the complex Action Program assisting implementation. The main objectives of the Program to be achieved by 2010 are as follows:

— Along with an assumed average 5% of annual GDP growth rate, energy use must not exceed the growth rate of 1.5%/year. In order to achieve this, energy demand must be reduced by 3.5% per year.
— By partially state-subsidised energy saving activities, the conservation of energy sources equalling to a caloric value of 75 PJ/year or their replacement with domestic renewable energy sources is needed by 2010.
— The utilisation of renewable energy sources must be increased from the level of 28 PJ/year relevant at the date of publication of the respective legislation to 50 PJ/year by 2010.

In order to achieve the relevant objectives, a long-term energy conservation program was launched in 1999, the competitive tender system of which was operated by GKM under the name of Energy Conservation Program in 2000, as part of the Széchenyi Plan (Széchenyi Terv) in 2001-2002 and National Energy

Conservation Program (Nemzeti Energiatakarékossági Program, NEP) in 2003-2006. The objective of the programs was to support energy conservation projects and those aimed at the use of renewable energy sources, for which it provided favourable credit schemes and non-refundable subsidy until 2000 and comprehensive non-refundable subsidy from 2001. The continuation of the program in 2007 was represented by the public tender application encouraging energy conservation and the use of renewable energy sources within the program titled “For a Successful Hungary” (Sikees Magyarországért), the balance of which was a non-refundable subsidy of 2.6 billion HUF for the year 2007, complemented by a credit limit of 16 billion HUF on favourable terms. The program is continued in 2008 with a total balance of 2 billion HUF.

Between 2000-2004, within the framework of the long-term energy conservation program, the range of those submitting tender applications with energy efficiency investment projects and those increasing the use of renewable energy sources essentially covered all areas of energy consumption. In 2005, the GKM did not announce a new call for tenders due to missing financial allowance and in 2006, due to the shortage of said allowance, the subsidy target group was confined to public tenderers. These programs mostly supported projects aimed at energy conservation and not directed to the increased utilisation of renewable energy sources, between 2001 and 2006, the subsidy ratio of projects involving renewable energy sources remained below 10% of the prevailing balance amount.

By Hungary’s accession to the European Union in 2004, the country became eligible for development assistance from the EU. Within the framework of the I. National Development Plant, the Environmental and Infrastructure Operative Program (KIOP) facilitated the implementation of developments in three sectors, in the field of environmental protection, energy and transportation by the use of EU co-financing, by utilising the resources of Structural Funds serving the objectives of regional policy. Within the framework of the KIOP, an allowance of 3.35 billion HUF is used for the subsidy of projects utilising renewable energy sources between 2004-2006, which was awarded to a total number of 18 tender applications involving renewable energy sources. The main figures related to investments implemented as a result of the respective subsidies are summarised in the following table:

Energy-related results of KIOP tender applications, 2004-2006	
Annual planned green energy production of subsidised projects	442968 GJ/year
Planned green energy production of subsidised projects during the whole lifetime	10,049,801 GJ

In the period between 2007-2013, Hungary will be entitled – on account of its European Union membership – to several thousands of billion HUF of EU subsidy which may be used for development purposes. From the total allowance of 4916 M EUR (1290 billion HUF) of Environmental and Energy Operative Program (Környezeti és Energia Operatív Program – KEOP) of the New Hungary Development Plan (Új Magyarország Fejlesztési Terv – ÚMFT), two priorities subsidies domestic projects with energy-related objectives: 5.15% of the total

allowance is available for the purposes of the priority axis named “Increasing use of renewable energy sources” and 3.14% is available for the purposes of the priority axis named “Efficient energy use” aimed at encouraging energy conservation.

The primary goal of the priority axis “Increasing use of renewable energy sources” is to influence the resource structure of domestic energy sources in a favourable direction, i.e. to facilitate the departure from fossil energy sources to renewable variants. In order to achieve a higher ratio of renewable energy sources, tender applications for the subsidy of heat and/or electric energy production are available in a total amount of 58 billion HUF up to 2013 and a 5 billion HUF allowance is available between 2007-2015 for the subsidy of construction of large and medium capacity bioethanol plants.

Activities subsidised within the heat and electric energy scheme are as follows: biomass utilisation, biogas production and utilisation based on biological waste, utilisation of geothermal energy, installation of heat pump systems, utilisation of solar and water energy, construction of wind power plants not producing energy for networks, establishment and modernisation of community distance heating systems utilising renewable energy sources and preparation of renewable-based solid fuel (e.g. production of pellet, or briquette). Considering the favourable prices of receipt of electricity produced by wind energy (even in international comparison) as well as the installable capacity limit established at 330 MW in the medium term for 2007-2013, KEOP offers investment subsidies only at very small capacities (up to 50 kW) for wind energy projects with network production opportunities, as well

Investors may access subsidies within a competitive tender application system. Subsidy intensity in the case of tenders aimed at utilisation of renewable energy sources may be between 10-50%, the final subsidy intensity is determined per project after a cost efficiency analysis. This analysis takes into account the subsidy received in the mandatory acceptance system of renewable based electricity production at a subsidised price and it awards support to those projects the return of which is not ensured even along with a mandatory price of acceptance.

Apart from KEOP, the measures of the New Hungary Rural Development Strategic Plan (Új Magyarország Vidékfejlesztési Stratégiai Terv – ÚMVST) also support the propagation of renewable energy use in Hungary. The objective of the ÚMVST is that the countryside be able to intensively participate in development of the bio energy segment apart from producing the necessary raw materials. ÚMVST supports the production of renewable energy sources along three strategic directions, these are liquid biomass (bioethanol and biodiesel), solid biomass (wooden and soft stemmed energy plantations) and biogas. The subsidy resources are provided by the European Agricultural Fund for Rural Development (EAFRD), which provides assistance to competitive production of biomass and its processing to primary semifinished products and the producer’s own energy supply.

3. Utilisation of renewable energy sources in Hungary

3.1 Hungarian characteristics of renewable energy sources

Biomass

Domestic analyses show that biomass represents the largest and still expandable energy source base in Hungary. Although, for the time being, targeted energy plant production is not at a significant level, biomass stocks can be significantly increased by the production of energy plants, which is also made possible by the measures of the New Hungary Development Plan. Another great potential is hidden in the energy-related utilisation of waste and biomass-like side products (so-called secondary and tertiary biomass), since technologies resulting in waste utilisation (e.g. biogas production) are achieving ever-increasing roles.

Energy-related use of biomass is an especially important issue for agriculture because this application may represent further sales channels. Through the production of plants for energy purposes and the use of biomass as a renewable energy source, it can ensure that producers continue to engage in agricultural activity and that energy-related utilisation of agricultural side-products and wastes represent supplementary sales revenue for agricultural producers, thereby improving profitability.

State-of-the-art combustion facilities are available for the energy-related utilisation of biomass with modern technologies, but further progress is needed with regard to encouraging adaptation to local conditions, provision of continuous base material supply, resolving the issues of transportation and storage and combined use with other renewable energy sources (e.g. bio-solar facilities).

Solid biomass

The solid biomass potential is determined by the quantity of available base materials or the quantity available for production with regard to the considerations of sustainability. Taking into account the aspects of sustainable forestry management, 9 million m^3 per year could be produced from Hungarian forests, from which the wood material actually produced has been 7 million m^3 per annum for several years. Of this, the wood quantity utilised is 5.5 million m^3, of which 3.5 million m^3 is stacked wood, which is utilised for fiberwood, firewood or paperwood. The receiving market of approximately 4 million m^3 of wooden material per year obtained as a sum of stacked wood and the 400-500 thousand m^3 of lumber industry waste created during processing is encompassed by the domestic wooden plank industry, public demand for firewood, export and energy-related utilisation.

Thanks to various subsidies and favourable financial conditions, several minor electricity production capacities have been implemented in the past years and energy-related investments based on smaller wood amounts (mostly sawing industry waste) created the competitive energy market of wood from sawing industry waste. In the hope of cheaper fuels, several domestic distance heating plants have switched to solid biomass operation and investment projects with substantial demand for wood have been implemented by converting power plant

blocks previously operated by coal combustion to biomass (a wood combustion block is operating in the power plants in Pécs, Kazincbarcika and Ajka, the power plants in Tiszapalkonya and Mátra utilise wooden materials by mixed combustion).

Assessments have shown that domestic forests are still capable of satisfying present demands – taking into account the considerations of sustainable forestry management – but the basic materials for new capacity of sufficient volume can only be ensured by creating a harmonised, diversified biomass mix (wood chips, side-products, energy plants under targeted production). Therefore, the condition for creating new biomass capacities is a program for efficient increase of energy plant production and agricultural waste utilisation and the promotion of energy plant production at a domestic level.

Biogas

Biogas is an energy source with an extremely wide range of applications. It is suitable for replacing natural gas, production of electric and thermal energy and utilisation as engine fuel.

The advantage of biogas technology is that several favourable environmental effects are manifest by its utilisation:

— biogas is a renewable energy source, which is available in a decentralised manner,
— biogas technology has favourable environmental effects; the emission of greenhouse gases (such as methane) is reduced by its use,
— the decomposition residue of biogas production is good-quality homogeneous fertiliser/sludge, which is highly suitable for improving the soils of wooden-stemmed and other energy plants due to its high organic matter content, thereby reducing the use of artificial fertilisers and ultimately fossil energy sources.

At present, biogas is used at 15 locations in Hungary for the production of thermal and electric energy. At most locations, the biogas utilisation plants have been installed at wastewater treatment plants. The electricity producing biogas plant (substantial in a European respect, as well) built in Nyírbátor commenced its operation at full capacity in 2003. Under favourable subsidy conditions, the number of plants engaged in fertiliser utilisation and the processing of various food industry wastes can undergo a significant growth, as well. This direction is facilitated by increasingly stringent environmental regulations, which prohibits the discharge of fertiliser liquids to waters, in order to reduce their agricultural nitrate contamination.[1]

Biofuels

[1] Pursuant to Government Decree 49/2001 (IV. 3.) on the protection of waters against nitrate contamination of agricultural origin and Government Decree 27/2006 (II.7.) replacing the latter, it is prohibited to discharge diluted fertilisers, fertiliser liquids as well as the seepage waters from fertiliser storage facilities into waters [Article 6 (1)], the activity violating the relevant regulations may be ordered to be suspended [Article 10 (2)].

As regards the production of basic materials, Hungary has favourable conditions for the production of bioethanol. On the average, 6-7 million tons of corn are produced per year, from which an increasingly minor quantity is used for the purpose of animal feed and at the same time, the quantity of corn for export and industrial processing is increasing. Domestically produced corn is available in a significantly greater order of magnitude than the amount which is expected to be used domestically in the near future. The quantity of corn-based ethanol may even reach 700-800 thousand tons per year, which is several times more than what the demand of Hungarian engine fuel manufacturers and distributors is expected to be by 2010. At the same time, in utilisation for the purpose of biofuel production, a strong economic limitation is manifest in a significant increase of the price of cereals.

Hungary's ecological characteristics are less favourable for the main base material of biodiesel – sunflowers are primarily used for food purposes – which is rape, the production area of which is limited to approximately 240-280 thousand hectares. Considering an average yield, 100-110 thousand tons of biodiesel may be obtained. This does not fully cover the expected domestic biodiesel fuel demand, which can be estimated at an annual quantity of 120-130 thousand tons.

Bioethanol can be used as a gasoline substitute or can be mixed with gasoline (in a pure or ETBE form) as an additive to increase the octane number. In Hungary, MOL Rt. has been substituting the previous MTBE by ETBE manufactured through the use of bioethanol since July 2005. In present gasoline fuelled automobiles (with Otto engines), bioethanol can be mixed at approximately 10-15%, at which no operational problems are manifest. For a greater ratio of utilisation, the engine must be converted or a vehicle must be specially manufactured for this purpose.

In the case of biodiesel, the base materials have a smaller base, in Hungary, sunflower and rape represents the widely applicable plant base of biodiesel. Biodiesel can be also mixed in various ratios into traditional diesel oils for Diesel engines. The B5 fuel containing maximum 5% of biodiesel can be essentially applied in any diesel engine without modification. A mixing ratio higher than this can be applied with slight modifications for the majority of modern diesel-powered cars.

The energy balance of biofuels and their environmental effect for the whole lifecycle is disputed. The utilisation of biofuels could only represent a real alternative energy source if renewable energy sources would be used for their production, as well. However, fossil energy is mostly used in the course of tillage, production of artificial fertiliser and herbicides, distillation and refinement as well as transportation, which worsens the energy balance of biofuels.

Wind energy

Fluctuating wind intensities pose a problem in the ability to regulate the electricity system by the connection of wind power plants to the electricity network. In the Hungarian system, where the majority of production capacities are represented by nuclear or fossil power plants, a serious concern is caused by ensuring the reserve of wind power plant capacities and some quality parameters of electricity distribution. In recognising this, the Office restricted the wind energy capacity that may be installed in the system in terms of 330 MW on the basis of the available international regulatory experiences, the technical state of the Hungarian electricity system and the professional opinion of the Transmission System Manager of the Hungarian Electricity Industry. In order to create a wind power plant capacity larger than 330 MW licensed at present, system regulation problems must be solved.

In Hungary, the first wind power plant has been operating since December 2000. At the end of 2007, the installed capacity was more than 80 MW, which is expected to reach the allowed 330 MW by 2010.

Geothermal energy

Hungary is a country with favourable geothermal characteristics. The geothermal gradient is nearly one and a half times the world average: the heat power exiting in a unit area from the depth of the earth is 90 mW/m^2 on the average, whereas in the area of the European continent, it is only 60 mW/m^2. According to this scheme, the temperature of the rock and the enclosed water is 60°C at a depth of 1 km and 110°C at 2 km. The geothermal gradient is greater in the Southern Transdanubia and the Great Plains and is less than the national average in the Small Plains and the mountainous territories.

The main field of utilisation of geothermal energy in Hungary is direct heat utilisation and balneology (application of medicinal springs, waters in spas). At present, there are more than 900 thermal wells (wells or springs warmer than 30°C at their outflow source), approximately 31% of which serve balneological purposes and nearly half serves for direct heat utilisation. The caloric content of the thermal water obtained is generally used in agriculture for heating hothouses, as well as in other areas for heating buildings and swimming pools, production of utility hot water and occasionally, in distance heating.

For the time being, no electricity production on the basis of geothermal energy takes place in Hungary. In Zala County, a 1 MW geothermal small power plant is under preparation and MOL Rt. is also in the process of examining the conditions for establishing a 2-5 MW experimental power plant.
The utilisation of geothermal energy for electricity production is limited by the relatively low temperature of heat sources (the characteristic temperature range of known thermal water wells is 40-95ºC), and due to this fact, the efficiency of energy production can only be very low. According to the currently known expert estimates, eight locations are known in Hungary which would in principle be suitable for cogeneration of heat and electric energy, with a total possible electric capacity of 80 MW. Out of the latter, only the capacity of Fábiánsebestyén is highly regarded (64 MW), the other locations are only suitable for the

establishment of small capacities (1-5 MW). In the course of practical implementation, stringent environmental regulations significantly increasing costs must be taken into account (requirement for reverse pressing concerning the fluid material, placement of salt formed).

In Hungary, the emergence of heat pumps is in an initial stage and their large-scale propagation is not to be anticipated in the foreseeable future. Apart from the high investment cost, this can primarily be explained by the composition of domestic power plant system as well as the price ratios of electricity and natural gas[2]. Due to this fact, the quantity of energy replaced in this manner is still relatively low in Hungary. The situation in Hungary differs from that in Sweden, where electricity for example is nearly exclusively produced in hydroelectric and nuclear power plants (at an approximately 50-50% ratio), and electricity plays a significant role in satisfying heating demands. Under such circumstances, the energetic-economic competitiveness and assessment of the heat pump is quite different.

Solar energy

From the aspect of utilisation of solar energy, Hungary's natural characteristics in Europe are relatively favourable, the number of annual sunny hours is 1900-2200. This is significantly higher than for example in Austria or Germany, but the extent of domestic use is still a fraction of that in these countries.

The utilisation of solar energy for heat energy purposes can be accelerated by Directive 2002/91/EC on the energy performance of building, which was adopted in Hungary by Decree 7/2006 (V.24.) by the Minister without Portfolio. The directive specifies that in the case of new buildings larger than 1000 m^2, the economic considerations of decentralised energy supply systems based on renewable energy sources as well as that of applying distance heat must be investigated.

For utilisation of solar energy for electricity production with solar cells or by a photoelectric path, the majority of domestic applications have been prepared for autonomous electricity supply by the use of suitable storage facilities. A more widespread propagation is impeded by the high price of solar cell installations (the return expected at present is around 100 years), thus the domestic potential will remain unused until the costs of solar cell manufacturing are reduced significantly. In the future, this solution could have a role in the energy supply of homesteads not provided by electricity, since in the case of longer distances, the establishment of solar cell-based autonomous electricity sources can be cheaper overall than constructing network connections.

Hydroelectric power

In Hungary, the total performance of the currently existing 31 hydroelectric power plants is 55 MW, the electricity production is 190 GWh/year, which is less than half percent of the total domestic electricity. Approximately 90% of the electricity generated is produced by four major hydroelectric power plants (Kisköre,

[2] The price of electricity is significantly greater than natural gas and a portion of the population receives "social" energy assistance in the price of natural gas.

Tiszalök, Kesznyéten and Ikervár). The hydroelectric power of small watercourses represents nearly 40 MW of theoretical power and 240 GWh/year of theoretical energy content. The hydroelectric power that can be utilised in practice is around 10 MW, which represents a production of approximately 60 GWh/year.

Hungary's characteristics in terms of hydroelectric power utilisation are not favourable. Due to high specific costs, significant development of lower capacity hydroelectric power plants is not expected. Following prevention of construction of the B• s-Nagymaros power plant, the construction of large-scale hydroelectric power plants is not to be realistically anticipated. However, barrage dams built on Hungary's rivers and watercourses without the utilisation of hydroelectric power can represent potential locations for the hydroelectric power plants.

3.2. Development of the utilisation of renewable energy sources between 2001-2007

Table 3-1 describes the composition of renewable energy use in Hungary in the years 2001-2007 (figures for 2007 are preliminary).

Within total domestic energy use, the utilisation of renewable energy resources was 55.2 PJ in 2007, the ratio amounted to 4.9%. The 1878.5 GWh of electricity produced on a renewable base in 2007 represented a ratio of 4.7% within the gross electricity utilisation figure of 43.87 TWh.

Table 3-1

Use of renewable energy sources and consumption from electricity based on renewable sources 2001-2007

Energy Source	Unit	2001	2002	2003	2004	2005	2006	preliminay 2007
Geothermal energy	TJ	3 600	3 600	3 600	3 600	3 627	3 600	3 600
Solar collector	TJ	60	70	76	76	81	83	105
Firewood	TJ	13 539	14 592	14 850	14 659	22 189	22 519	21 980
Firewood forestry estimated	TJ	4 600	4 550	3 326	2 805	2 902	3 012	3 200
From other source (wood waste + agricultural waste)	TJ	12 461	11 602	14 425	16 892	18 466	19 888	19 999
Biogas	TJ	126	133	191	274	297	512	603
electric energy from hydroelectric plants in TJ v (calculating with a physical equivalent c	TJ	669,6	698,4	615,6	739,8	728	670	756
wind	TJ	3,24	4,32	12,96	20,16	36	156	396
photoelectric	TJ	0,216	0,216	0,252	0,252	0,36	0,36	0,98
biofuels						214	450	844
In total renewable caloric value	TJ	**35 059**	**35 250**	**37 097**	**39 066**	**48 540**	**50 890**	**51 483**
In total renewable caloric value	**PJ**	35,1	35,2	37,1	39,1	48,5	50,9	51,5
Communal waste	TJ	2 597	1 995	1 507	1 373	2 764	**3 920**	**4 528**
Renewable+communal waste	**PJ**	**37,7**	**37,2**	**38,6**	**40,4**	**51,3**	**54,8**	**56,0**
Primary electricity								
hydroelectric power plant	GWh	186	194	171	205,5	202	186,0	210
wind power plant	GWh	0,9	1,2	3,6	5,6	10,1	43,4	110,0
photoelectric	GWh	0,06	0,06	0,07	0,1	0,1	0,1	0,3
Total	GWh	186,9	195,2	174,6	211,2	212,3	229,5	320,3
Electricity obtained from renewable sources by conversion								
from biomass	GWh	7	6	109	678	1585	1171,4	1373
from biogas	GWh	7,6	11,2	18	22	25	36,7	44
Total electricity produced from renewables by conversion	GWh	14,6	17,2	127	700	1610	1208	1417
Produced from communal waste	GWh	**112**	**59**	**67**	**54**	**118**	**187**	**283**
Renewable+communal waste half based electricity production	GWh	257,5	241,9	335,5	938	1881,3	1531,1	1878,5
Gross electricity use	GWh	39 588	40 414	41 084	41 180	41 982	43 066	43 969
Renewable+communal waste half based electricity production	GWh	**257,5**	**241,9**	335,5	938,0	1881,3	1531,1	**1878,5**
Renewable+communal waste half based production ratio in the gross electricity use	**%**	**0,65**	**0,6**	**0,82**	**2,28**	**4,48**	**3,55**	**4,27**
Primary energy use in the national economy	PJ	1087,2	1061,8	1091,6	1088,1	1153,2	1152,0	1120,0
Renewable+communal waste	PJ	37,7	37,2	38,6	40,4	51,3	54,8	56,0
Renewable+communal waste ratio in the total primary energy use	**%**	3,5	3,5	3,5	3,7	4,4	4,8	5,0

4. Development of electricity production based on renewable energy sources up to 2007 in Hungary

In the past 5 years, Hungarian electricity production through renewable energy sources increased to more than 5 and a half of the original figure. In 2003, electricity use was 41 TWh, of which, according to the statistics, 335.5 GWh was produced from renewable sources. Thus, the proportion of current produced from renewable sources in 2003 was 0.82% of the gross amount (in green current production, waste incineration is taken into account at a level of 50%).
Power plants converted to biomass adjusted to a normal operating condition by 2005. The three blocks fuelled with biomass with a total capacity of 100 MW – Ajka, Pécs, Kazincbarcika – were operating at full capacity. Green electricity production was further increased by the fact that two power plants – in Tiszapalkonya and Mátra – mixed coal or lignite fuel with renewable energy sources, so that by 2005 electricity production using biomass reached 1881.3 GWh (this meant a ratio around 4.48% already).

In 2006, a setback of approximately 18% was observed in renewable-based electricity production. The reason for this was that apart from firewood, power plants used various agricultural side-products (e.g. grape pomace, meat flour) as well, which base materials were not constantly available. Among others, the Hungarian Energy Office used this reason in 2006 to reduce the amount of "green electricity" subject to mandatory acceptance from the Mátra Power Plant and others using biomass. This restriction had financial reasons as well: a significant shortfall in the KÁP allowance for financing favourable green current tariffs of acceptance at the beginning of 2006 resulted in a reduction of the quota of acceptance.

In 2007, renewable-based electricity production – after a setback in 2006 – increased to 1878.5 GWh again, but since domestic electricity use in 2007 was nearly 1 TWh higher than in the previous year, the rate was lower than in 2005 at 4.27%.

The EU requirement for Hungary, in accordance with Directive 2001/77/EC, which was reinforced by Act XXX of 2004 (Accession Act), is that the ratio of electricity produced from renewable sources must reach 3.6% of electricity use by 2010. The EU requirement was satisfied by Hungary in 2005 and even the rate in 2007 was nearly 1% higher than 3.6%.
The fact that we performed beyond EU expectations should not mean a slackening of efforts. In order to increase the security of energy supply and obtain environmental and agricultural benefits, higher national goals should be set and the production of green electricity and the increase of renewable energy use for thermal energy purposes should be promoted and supported as priorities.

5. Time-rated status of compliance with the objective of the year 2010 undertaken in the Country Report of the year 2006

In February 2006, the country report sent to the EU considered the following increase targets (to be regarded as targeted national objectives) to be realistic for the period up to 2010:

- In the case of hydroelectric energy, on the basis of various initiatives, the establishment of approximately 5 MW of new capacity can be considered to be realistic, by which the current electricity production can be increased at an extent of 27.5 GWh/year.
- In the case of wind energy, several projects are currently under licensing, including projects licensed within the framework of the joint Kyoto mechanism of implementation. It is likely that new capacities exceeding 200 MW will be created by 2010.
- The ramp-up of electricity production with solar energy – due to the high cost price – can only be expected at a highly limited level.
- As regards electricity production with solid biomass (wood, wood waste, energy plant), a capacity increase of at least 30 MW can be safely assumed by 2010 apart from already existing power plant developments. The 30 MW growth assumed according to current conditions may increase electricity production to an extent of 180 GWh/year. It is important to note that by the agricultural energy plant production program operated by the FVM, the growth of available biomass quantity may even make possible a capacity investment of up to 100-150 MW.
- Due to EU requirements and regulations, the treatment of communal and animal husbandry wastewaters is coming to the foreground and wastewater treatment plants are being continuously built. Biogas containing methane is suitable for energy-related utilisation and electricity production. In 2004, 20 GWh of energy was already produced and utilised on a biogas basis. Wastewater treatment systems to be built by 2010 can serve as a basis for installation of further biogas production and utilisation installations and thereby, nearly 55 GWh of electricity can be produced.
- In the case of geothermal energy, the establishment of a 5 MW capacity can be expected by 2010, under appropriate assistance and technological development.
- In the case of waste incineration, a production level around 165 GWh accepted according to EU terminology can be regarded as realistic in 2010, taking into account the difficulties of selective waste collection, as well.

The projected national target for the year 2006 prognosed a growth of 750 GWh/year by 2010.

Projected national target of 2006 up to 2010

	2005		2010			
			New capacity 2005-2010	Produced by new capacity	Total production	
	GWh/year	TJ/year	MW	GWh/year	GWh/year	TJ/year**
Water energy	195	702	5	27,5	222,5	801
Wind energy	5,5	20	200	400	405,5	1 459
Photoelectric	0,06	0,2	0,16	0,16	0,4	1,4
Firewood, wood waste, energy plant	1 550	18 600	30	180	1 730	20 760
Biogas from landfills	2	24	-	-	2	24
Community wastewater sludge biogas	20	240	10	55	75	900
Geothermal	-	-	5	32,5	32,5	390
Waste incineration	110	1320		55	165	1 980
TOTAL	**1 882**	**20 906**	**250,16**	**750**	**2 632**	**26 315**

According to developments expected by 2010, it is likely that the former national target figure will be exceeded by 2010. The reasons for this are as follows:

- The wind power plant licenses issued cover the 330 MW capacity limit nearly completely. Taking that into account, a capacity of 330 MW can be taken into account for 2010 instead of 200 MW (which was previously considered to be realistic), the electricity production of which is expected to be around 660 GWh/year instead of 405 GWh/year.
- The preparation of new capacity significantly larger than the originally planned 30 MW was started on the basis of biomass, thus, by 2010, the new capacity will likely be to be between 100-300 MW.

Taking all these aspects into consideration, a capacity increase of 450-650 MW based on renewable energy sources can be expected by 2010, a result of which by 2010 may be that the production of green

** In the case of water energy, wind energy and photoelectric production, conversion to TJ/year is performed by a heat equivalent of 3600 KJ/kWh. In the case of the other renewable energy sources, where electricity is produced by a heat drop, conversion was performed by a specific value of 12 000 KJ/kWh (30%).

electricity reaches an amount of 3300-4500 GWh/year, increasing to an extent of 1400-2600 GWh/year (as a function of developments based on solid biomass) instead of the value around 263 GWh/year earlier considered to be realistic. This more dynamic growth may give the result that when converted to caloric value, green electricity production may have a share of 32-46 PJ/year instead of 26.3 PJ/year in the total domestic renewable energy utilisation.

6. Further increase of the total renewable energy source utilisation by 2010

For Member States, Directive 2001/77/EC of the European Parliament and the Council contains a recommendation concerning the mandatory growth in utilisation of all other renewable energy sources. Member States must observe the EU recommendation, moreover, according to the foregoing, increasing use of renewable energy sources has several domestic advantages, apart from the fact that further state subsidy is clearly needed for the process.

In the following section, the extent of estimated growth in other areas not aimed at electricity production is presented.

6.1. Increased use of biofuels

The other, most intensive effect on the development of national-level renewable energy use – apart from increasing electricity production with renewable energy sources – is represented by Directive 2003/30/EC on biofuel, which states that by 2010, the ratio of biofuel use must be increased to 5.75%. When calculating with data according to the prognoses, the use of renewable energy sources in transportation is expected to be around 10.46 PJ at a ratio of 5.75%.

6.2. Increased use of biogas

In Hungary, the quantity of biogas that can be economically produced corresponds to a natural gas equivalent of approximately 750 million m^3 (25 PJ). For the time being, the use of biogas is limited to the cogeneration of electricity and heat, but the new natural gas bill currently before Parliament will create the technical options of feeding biogas into the natural gas system. The incentives to promote fuel use of biogas are also being examined.

6.3. Solar collector program

Point 14 of the Action Program of Govt. Decree 1107/1999 (X. 8.) – which launched the currently operating long-term energy conservation program – planned the implementation of 20 000 roofs with solar collectors. Despite the fact that the program has been supporting this area since the year 2000, this

process is still at an initial stage (heat supply with solar collectors has so far been implemented for 500-600 detached houses).

6.4. Increased use of renewable energy sources for other purposes of heat utilisation

Apart from the developments assessed, further developments concerning thermal energy production are also possible in the future. The greatest results can be achieved in the following areas:

- according to investigations, heat generation from solid biomass can be further increased by at least 8-15 PJ with new heating installations,
- due to the strict environmental regulation of geothermal heat utilisation (requirement for reverse pressing, geothermal-related wastewater fine, water stock contribution), utilisation is only expected to be higher by 1-2 PJ/year at most up to 2010.
- the National Development Plant treated the biogas program as a prominent priority in the period between 2007-2013, biogas use for heat production may increase at an extend of nearly 2 PJ/year by 2010 at animal husbandry plants and wastewater treatment plants,
- in the field of waste incineration, a further increase of heat energy production around 0.5 PJ can be considered likely.

As a result of assessed options, the utilisation of renewable energy sources may increase at an extend of 10-22 PJ/year by 2010.

7. National-level summary of the increased use of renewable energy sources achievable by 2010

Taking into account Hungarian characteristics, the opportunities for increasing renewable energy source utilisation to be considered realistic are summarised in Table 7-1.

Summarising the foregoing, along with an increase of electricity production based on renewable energy sources at the extent of 1430-2630 GWh/year by 2010, the total renewable energy source utilisation can be increased to 82-104 PJ/year by implementation of the program. The target values shown may result in the fact that the ratio of green current may grow to 7.3-9.9% and that of the total renewable energy sources may grow to 7.0-8.9% by 2010.

Table 7-1.

Nationwide use of renewable energy sources achievable by 2010 according to Hungarian characteristics

	Electricity production				**Heat energy production**		**Use of renewable energy sources – 2010**
	2005	**Increase between 2005-2010**	**2010**		**2005**	**2010**	
	GWh	**GWh**	**GWh**	**PJ**	**PJ**	**PJ**	**PJ**
Total electricity production	1 882	1430-2630	3312-4512	32,3-46,7			32,3-46,7
Biofuel use					0,2	10,46	10,46
Solar collector program					0,08	0,3	0,3
Heat production from biomass					24,0	32,0-39,0	32,0-39,0
Geothermal energy, heat pumps					3,6	5,0	5,0
Biogas					0,007	1,8	1,8
Waste incineration					0,83	1,0	1,0
TOTAL	**1 882**	**1430-2630**	**3312-4512**	**32,3-46,7**	**28,71**	**50,56-57,56**	**82,8-104,2**

* Not included renewable energy sources quantities used for electricity production

8. Outlook up to 2020

Hungary's previous energy policy was accepted by Parliament in 1993. The energy policy was updated in several steps, but despite this fact, the creation of a new energy policy has become unavoidable, mostly for the following reasons:

— Hungary has become an EU Member State, therefore, EU energy-related directives, resolutions have become mandatory and have to be logically manifest in an energy policy,

— in the past more than 10 years, amendments have occurred in the European energy legislation to such an extent that partial harmonisation has proven to be insufficient.

The new energy policy was accepted by the Government on 28 November 2007 and is being discussed by the Parliament at the time of preparing the Country Report. Two important strategic documents have been created in relation to the energy policy:

— in compliance with the provisions of Directive 2006/32/EC, Hungary's National Energy Efficiency Action Plan was completed. The action plan was accepted by the Hungarian government on 13 February, 2008, and the document was subsequently sent to the EU,
— Hungary's renewable energy source strategy for the period between 2008-2020 was worked out, which has not been accepted by the Government as of yet, but its acceptance is expected in the first half of 2008.

The strategy concerning renewable energy resources takes into account the resolutions of the European Council in March 2007, as well as the proposals of the EU document titled "Proposal – Directive of the European Parliament and the Council on the promotion of energy generated from renewable energy sources" published on 30 January 2008. The objective of the strategy is to reinforce Hungary's compliance with EU requirements by specifying stringent objectives which are nevertheless achievable along with suitable assistance.

The strategy examines two alternatives:

— the alternative regarded to be pessimistic outline a path of development which does not satisfy EU requirements, Hungary will adopt this developmental path if the state or EU assistance required for increasing the use of renewable energy sources cannot be provided,
— the optimistic alternative (considered to be strategic) includes the following objectives:
    - by 2020, the achievement of a 10% biofuel ratio is targeted,

- by 2020, a renewable energy source share exceeding 13% is aimed at and
- by 2020, the ratio of electricity production based on renewable sources within the amount of electricity consumption is to be increased to a level above 20%.

According to preliminary estimates, in order to achieve the strategic objectives, investments in the amount of about 2300 billion HUF (8.5-9 billion EU) must be implemented along with the start of their commercial operation by 2020, and a subsidy demand of 410-420 billion HUF (1.5-1.6 billion EUR) can be considered likely for these projects.