RENEWABLE ENERGY IN HUNGARY
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</table>
RENEWABLE ENERGY IN HUNGARY

Did you know that...?

- Hungary receives as much as 2,200 hours of sunshine a year;
- Regarding geothermal energy, the geothermal gradient in Hungary is almost one and a half times as high as the world average, and represents one of the country’s natural treasures.
- Hungary’s renewable energy potential is more than 2200 PJ/year;
- Hungary’s photovoltaic potential is about 480 billion kWh (based on potentially installable solar modules);
- Hungary is among the top five high-tech exporters in Europe;
- The National Development Plan has earmarked EUR 280 M to support renewable energy and energy efficiency-related investments;
- Hungary’s highway network is the most developed among the new EU member states;

Why in Hungary?

- Many resources and unused capacities
- Made in EU tag
- Logistics hub: excellent transport system
- Highly skilled, innovative labor force, talents
- Exceptional cost/quality ratio
- World-class quality of life
- Tailor-made incentive system
- Well developed infrastructure
- Emerging renewable energy market
- Preferred and supported sector by the government
- Extensive investment opportunities
- Over 200 industrial and technology parks of international quality

Hungarian tax system to attract foreign investments

The Hungarian tax system has been focusing on attracting inbound investments geared towards regional activities, such as holding and licensing, and local manufacturing. In order to achieve this, Hungary has implemented one of the lowest corporate income tax rates in all of Europe (10% /19%) and has offered a number of tax holidays and special tax incentives for collecting dividends and royalty income. In addition, attractive in-centives and cash grants are available for both greenfield investments and for the development of existing establishments. Hungary has also constantly made efforts to reduce the burden on employment and to reduce administration for employees. From 2011, a flat personal income tax of 16% has been introduced.
LOGISTIC AND OTHER ADVANTAGES

Availability of ideal locations for manufacturing

- Over 200 industrial parks
- Large areas of shovel-ready sites
- Quick ramp-up phase
- Perfect transportation access, logistics centers
- Easy access to public utilities
- Technology parks of international quality

Hungary’s central role in transportation and logistics in the CEE region is based on several clear strengths:

- Four vital European transport corridors pass through Hungary;
- Unparalleled access to all parts of Europe, including major European ports, the Balkans and the fast-growing CIS market;
- Belt of innovation and logistics around Budapest;
- Záhony is the freight reloading centre for European standard- and Asian widegauge railway networks;
- Hungary’s 11 logistics districts and 13 logistical centers are located at focal points for the international movement of goods;
- Lowest freight costs in the CEE region;
- 190 well equipped industrial parks;
- Intensive foreign trade with other EU members;
- Excellent relations with states in the Far East;
- Hungary was ranked third in Cushman and Wakefield’s European Distribution Report, which evaluated the logistics sector of 25 European countries;
- Hungary offers a large supply of land-, and a healthy supply of available properties
Cushman & Wakefield evaluated the logistics sector of 25 European countries based on factors like rents, labour force, road congestion and road freight.

■ Hungary ranked number 3 in the survey

Helsinki Corridors

**Corridor IV** runs from west to east, linking Berlin, Vienna, Budapest, Constanta and Istanbul and following the route of the M1 and M5 motorways in Hungary.

**Corridor V** runs south-west to north-east, through Venice, Trieste, Ljubljana, Budapest, Uzhgorod and Lviv to Kiev, utilising the MZ and M3 motorways in Hungary.

**Corridor V/B** runs from Budapest to Rijeka via Zagreb.

**Corridor V/C** runs from Budapest to Ploce via Osijek and Sarajevo.

**Corridor VII** is the Danube waterway.

<table>
<thead>
<tr>
<th>Overall score and ranking</th>
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<tbody>
<tr>
<td>1 Belgium</td>
<td>8.45</td>
<td>10 Italy</td>
<td>11.37</td>
<td>20 Ukraine</td>
<td>13.91</td>
</tr>
<tr>
<td>2 Netherlands</td>
<td>9.54</td>
<td>11 UK</td>
<td>12.25</td>
<td>21 Finland</td>
<td>14.44</td>
</tr>
<tr>
<td>3 Hungary</td>
<td><strong>9.56</strong></td>
<td>12 Denmark</td>
<td>12.31</td>
<td>22 Russia</td>
<td>14.93</td>
</tr>
<tr>
<td>4 Czech Republic</td>
<td>9.57</td>
<td>13 Romania</td>
<td>12.49</td>
<td>23 Bulgaria</td>
<td>15.27</td>
</tr>
<tr>
<td>5 Poland</td>
<td>9.76</td>
<td>14 Lithuania</td>
<td>12.56</td>
<td>24 Ireland</td>
<td>15.70</td>
</tr>
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<td>6 France</td>
<td>10.25</td>
<td>15 Portugal</td>
<td>11.13</td>
<td>25 Sweden</td>
<td>16.41</td>
</tr>
<tr>
<td>7 Austria</td>
<td>10.82w1</td>
<td>16 Latvia</td>
<td>13.24</td>
<td></td>
<td></td>
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<tr>
<td>8 Germany</td>
<td>10.82</td>
<td>17 Spain</td>
<td>13.44</td>
<td></td>
<td></td>
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<tr>
<td>9 Slovakia</td>
<td>10.85</td>
<td>18 Estonia</td>
<td>13.81</td>
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</table>
THE RENEWABLE SECTOR IN HUNGARY

Small summary

The utilisation and spreading of renewable energy sources could represent one of the breakthrough points for Hungary’s economy. Hungary has excellent comparative assets in certain areas of energy sources. By 2020, gross renewable energy source usage will double in comparison to the 2010 levels. Significant progress can be expected in all segments of renewable energy sources.
(Source: Hungary’s Renewable Energy Utilisation Action Plan)

### Amount of renewable energy

![Forecast of renewable energy](Source: Hungary’s Renewable Energy Utilisation Action Plan)

### Renewable energy potential in Hungary

<table>
<thead>
<tr>
<th>Maximum potential renewable energy in Hungary</th>
<th>Potential (PJ) (theoretical)</th>
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<tbody>
<tr>
<td>Solar photovoltaic (based on potentially installable solar modules)</td>
<td>1750</td>
</tr>
<tr>
<td>Biomass</td>
<td>300</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>102.5</td>
</tr>
<tr>
<td>Geothermal</td>
<td>63.5</td>
</tr>
<tr>
<td>Water</td>
<td>14.4</td>
</tr>
<tr>
<td>Wind</td>
<td>532.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2600–2700</strong></td>
</tr>
</tbody>
</table>

(Source: Hungarian Academy of Sciences, Renewable Energy Subcommittee)
The trends and volume of changes in renewable energy sources

Distribution of renewable energy sources used in the electricity, heating and cooling and transport sectors (2010 and 2020)

2010 TOTAL: 55,25 PJ

2020 TOTAL: 120,57 PJ
The new feed in tariff system (METÁR) is set to be implemented soon. It was formed taking into consideration well functioning models used in countries such as, Gemany, Czech Republic and Austria. The METÁR system is structured in a way that it provides long term support for the production and usage of renewable energy, as well as creating an attractive and competitive environment for investors. It will also be a more stable and predictable arrangement, allowing for long-term planning.

The support scheme is a combination of different factors and primarily supports effective heat production (along with electricity production).

The feed in tariff system is based on four pillars:
- basic electricity tariff
- green heat bonus price
- other bonus prices
- in the case of energy production based on biomass, these are supplemented with a brown tariff

METÁR will give support to the following components:

- In case of cogenerationable technologies, METÁR provides a green heat bonus price over the basic electricity tariff, encouraging effective heat production
- The degree of the basic electricity tariff differs by technology type and size, according to the various operational and investment costs
- More bonus prices are available in case of performance of defined conditions (establishment in LHH area, eminent efficiency, innovative technology, etc)
- Brown tariffs are available for investments where the operating cost are not covered by market prices

The feed in tariffs are available uniformly for 15 years

<table>
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<tr>
<th>Current feed-in tariff system</th>
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<tr>
<td></td>
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<tr>
<td>Peak rate</td>
</tr>
<tr>
<td>Off-peak rate 1</td>
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<tr>
<td>Off-peak rate 2</td>
</tr>
</tbody>
</table>

*Plus hydro power stations larger than 5 MW
The use of solar energy in Hungary doesn’t reach 1 percent in the total usage of renewable energy. Additionally, most of this is through solar collectors.

Compared to 70 MW in the Czech Republic, and 1000 MW in Germany, the Hungarian 1 MW of installed pv-systems is insignificant.

Most of the pv-panels and collectors are bought by private individuals, not by the public institutions or establishments. EU competition laws, KEOP (Environment and Energy Operative Program) tenders and other incentives are trying to change this tendency. State and Union-level support plays a central role in the spread of solar energy systems.

Materialization of supported pv-projects will increase by thirteen-fold in the coming years.

Why invest in Hungary’s PV sector?

Notable solar potential in Hungary, but up to present only little solar capacity was built up, therefore the solar market is poised for major growth in the coming years

High potential of emerging CEE/SEE PV markets

A new feed in tariff system (METÁR) is set to be implemented, which will entail the spread of solar energy (heat and pv) usage. Besides the support of public solar projects, the new system will encourage the building of solar power plants with bigger capacities (over 50 MW)

Investors can benefit from government incentive packages which may exceed 50% of the total value of the investment

Follow in the footsteps of companies such as Sanyo and Semilab and make the most of the expertise and knowledge of Hungarian professionals introducing and developing state-of-the-art technologies

Build a presence close to your major solar markets, and benefit from Hungary’s excellent logistics infrastructure

Areas of financial support by the government used to promote the spread of solar energy: production support, indirect incentives, investment support
**Irradiation in Hungary – over 1300 kWh/m²**

<table>
<thead>
<tr>
<th>kWh/m²·év</th>
<th>Exploit solar energy (MJ)</th>
<th>Average temperature in Hungary - daytime</th>
</tr>
</thead>
<tbody>
<tr>
<td>1325</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1310</td>
<td></td>
<td></td>
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<tr>
<td>1295</td>
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<tr>
<td>1288</td>
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<tr>
<td>1265</td>
<td></td>
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<tr>
<td>1250</td>
<td></td>
<td></td>
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<tr>
<td>1235</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1220</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Daily average solar energy potential/m²/month**

**Average Temperature During Daytime [°C]**

Average temperature in Hungary - daytime
SOLAR ENERGY IN HUNGARY 2

Highlights of Hungary’s solar industry – Solar-related companies in Hungary

PV-module manufacturing
– Sanyo from 2005 in Dorog (land area: 170,000 m² – annual sales: EUR 301 M – number of employees: 1195)
– Korax from 2006 in Ráckeve (one of the biggest Central European pv-module manufacturers, with 18 MW/year capacity)
– Manz Automation, (production of innovative and highly efficient systems for solar cell manufacturing)

Solar technology, R&D
– Greensolar Equipment Manufacturing Ltd. in Budapest (fluorine-less thin film technologies, amorphous silicon technology, as well as microcrystalline technology)
– Semilab Semiconductor Physics Laboratory Co. Ltd. in Budapest (market leader in the front-end electrical characterization of the solar cell manufacturing process in the silicon-based photovoltaic market)

Inverters
Phoenix Mecano (manufacturer of inverter transformers, used in solar collectors for the global market – currently employs more than 1500 people)

New PV-module manufacturing establishments
Jülich Glas Holding in Székesfehérvár
EcoSolifer AG in Csorna
Solar Energy Systems in Komló
Orient Solar in Berettyóújfalu
Agulhas-Solar in Szolnok

Bigger hungarian solar power plants
One of the first (2005): Szent István University in Gödöllő – capacity: mini power plant, 10 kW
The biggest (2011 November): Újszilvás - 400 kW
Under construction: PV-module park in Haláp (near by Debrecen) – Hyundai Heavy Industries – capacity: 600 kW
Solar related education and R&D

- Technical University of Budapest – Graduate education and R&D in solar PV technology.
- Research Institute for Physics and Materials Science, Budapest – R&D on efficiency of A-Si thin film modules and design of manufacturing lines.
- Szent István University, Gödöllő – Technology transfer, demonstration and scientific exchange action for a strong European PV sector. R&D and modeling of solar power plants.
- University of Debrecen – R&D on the efficiency of a pilot solar power plant.
- University of Miskolc – Courses on renewable energies with special emphasis on solar energy for mechanical engineering students.
- University of Pécs – R&D on the efficiency of different solar modules.
- University of Veszprém - R&D on efficiency and storage of solar energy.
According to preliminary data, in 2010 the share of electricity from the renewable energy sources reached 7.56%. The participation of large-scale wind turbines from Hungarian installed power plant capacity was approximately 3.2%.

Based on surveys conducted in the past years, we have determined the sites where larger wind turbines could be installed cost-effectively, taking into account environmental protection and nature conservation considerations. Based on this, Hungary has a total wind energy potential of several thousand MWe.

The national target for 2020 is thus aligned, in respect to wind energy, to the limit of controllability of the electricity system, which is, to our present knowledge, capable of receiving wind energy up to an approximate total output of 740 MWe.

(Source: Hungary’s Renewable Energy Utilisation Action Plan)

Currently Hungary uses a feed-in tariff system for wind energy, but this support scheme will change in the near future, after 2012.

<table>
<thead>
<tr>
<th>Current feed-in tariff system</th>
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</thead>
<tbody>
<tr>
<td>Photovoltaic/ Wind</td>
</tr>
<tr>
<td>Peak rate</td>
</tr>
<tr>
<td>Off-peak rate 1</td>
</tr>
<tr>
<td>Off-peak rate 2</td>
</tr>
</tbody>
</table>

*Plus hydro power stations larger than 5 MW

The current wind energy capacity will double by 2020, which is important for the development of a green economy. The market is apprehensively waiting for the new tenders (410 MW). The new system (METÁR) will be more clear, with a stable and predictable regulatory system and therefore will help the development of wind market of Hungary.
Wind potential

43% of country’s area is suitable for the economical utilization of wind power. In areas that are 75 m above sea level, the annual average wind speed is above 5.5 m/s. The opportunities are even more promising in higher altitudes.
Licensing procedure for wind energy projects in Hungary with tendering process

The Hungarian licensing procedure follows the European scheme in its main elements.

Participation of manufacturers of wind turbines

- Enercon 6%
- Fuhrlander 1%
- Gamessa 55%
- Vestas 31%
- Repower 7%

Participation of manufacturers of wind turbines in Hungarian wind energy market in spring of 2011
(Source: Hungarian Wind Energy Association)
Wind turbine innovations

- Vertical wind turbine, with a patent and a working demonstrative turbine in Felcsút (5.5 m in diameter, 29 m height), inventor-engineer: Viktor Györgyi

- New wind turbine types (5kW and 49 kW) for special local circumstances – R&D with Department of Electric Power Engineering in Budapest University of Technology, developer: Gábor Horváth, Horváth Engineering Office 2003

- Wind machine with pneumatic power transmission – developer: Dr. Endre Mucsy, Mucsy Endre Engineering Office
BIOMASS & BIOGAS IN HUNGARY

Hungary possesses excellent agro-ecological conditions for a competitive production of biomass. Hungarian agriculture is capable of sustainably producing biomass in excess of food and feed demands, and at the same time there is a significant biogas production potential. The theoretical potential of energy sources of biological origin (bioenergy) could exceed, by as much as 20% of the energy source demand estimated for 2020, and bioenergy-based electricity production can be planned well in advance, and is also controllable. Therefore, the limitations of the production of bioenergy mainly lie in competitiveness. Bioenergy can primarily play a more important part in fulfilling local heating demands in the future, but there is also an intent to place emphasis on the spread of small and medium-capacity combined electricity and heat generating systems. (Source: Hungary’s Renewable Energy Utilisation Action Plan)

Biomass potential in Hungary

- Total feasible resource potential: 145-188 PJ/year, 20 million tons
- Only a small part is used
- Most important resource: agriculture

- It is the most significant source of renewable energy that can be realistically used in the medium term.
- High potential in agriculture and forestry create outstanding opportunities for regional and local biomass burning and the utilization of biogas.
- Solid biomass potential available in the medium term is between 145–188 PJ; the strategy is based on the minimum value.

Feasible biomass potential in Hungary:

<table>
<thead>
<tr>
<th></th>
<th>Volume, thousand tons/year</th>
<th>Energy, content in PJ/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid biomass</td>
<td></td>
<td>145–188 PJ</td>
</tr>
<tr>
<td>Bio-ethanol</td>
<td>1330 kt/year</td>
<td>70 PJ</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>250 kt/year</td>
<td>20 PJ</td>
</tr>
<tr>
<td>Biogas</td>
<td></td>
<td>25 PJ</td>
</tr>
</tbody>
</table>
The potential volume of biomass, which can be realistically produced or collected in the individual categories in the medium term (7–15 years), as well as the amount of energy which can be generated:

<table>
<thead>
<tr>
<th>Description</th>
<th>Realistically produced/collected (million t/year)</th>
<th>Energy content (PJ/year)</th>
<th>Electricity* (GWh/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From forestry</td>
<td>3.25</td>
<td>45.5</td>
<td>2.275</td>
</tr>
<tr>
<td>Produced for this purpose</td>
<td>5.6</td>
<td>74.16</td>
<td>6.180</td>
</tr>
<tr>
<td>Agric. by-product, waste</td>
<td>5.4</td>
<td>62</td>
<td>5.100</td>
</tr>
<tr>
<td>Other by-product, waste</td>
<td>0.55</td>
<td>6.6</td>
<td>550</td>
</tr>
<tr>
<td>Total</td>
<td>14.8</td>
<td>188.26</td>
<td>14.105</td>
</tr>
</tbody>
</table>

Quantities of biomass which can potentially be secured for energy generation in the medium Term (Source: Hungary’s Renewable Energy Utilisation Action Plan)

*A note on the methodology: for the purpose of calculating electricity potential, 60% of forestry resources and of ligneous energy plantations grown for this purpose were considered to be potentially useful for electricity generation; the corresponding figure for the other categories was 30%.

<table>
<thead>
<tr>
<th>Biomass type</th>
<th>Volume (thousand t/year)</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forestry product</td>
<td>2.114</td>
<td>27.17%</td>
</tr>
<tr>
<td>Wood processing byproducts used for energy generation</td>
<td>231</td>
<td>2.97%</td>
</tr>
<tr>
<td>Energy crops</td>
<td>1.914</td>
<td>24.60%</td>
</tr>
<tr>
<td>Agricultural by-products and waste</td>
<td>3.522</td>
<td>45.26%</td>
</tr>
<tr>
<td>Total</td>
<td>7.781</td>
<td>100%</td>
</tr>
</tbody>
</table>

The biogas market is set to grow:

■ Only 10% of potential is currently being used
■ Feasible potential is 24-48 PJ
■ Share of total electricity production 2%
■ Will grow to 8% by 2020
■ The strategy supports the channeling of clean biogas to the natural gas pipeline network and the development of decentralized biogas plants
■ Biogas production is expected to double by 2020

Biogas production

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th></th>
<th>2012</th>
<th></th>
<th>2015</th>
<th></th>
<th>2020</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MW</td>
<td>14</td>
<td>GWh</td>
<td>85</td>
<td>MW</td>
<td>21</td>
<td>GWh</td>
<td>125</td>
<td>MW</td>
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<td></td>
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<td></td>
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</table>

Estimation of total contribution (installed capacity, gross electricity generation) expected from biogas in Hungary
(Source: Hungary’s Renewable Energy Utilisation Action Plan)

Case study – Szarvas

4.2 megawatt plant was set up in Szarvas by investment of Aufwind Neue Energien GmbH. The plant can satisfy the demand of 18–20 thousand people in the town. The biogas produced is used by Gallicoop for electricity and heating generation in the poultry industry.

Up until now the biggest biogas plant is: – Pálhalma

■ A joint implementation project with Austria
■ Received EU grants (50%)
■ Uses agricultural byproducts and liquid manure
■ Produces 6 million m³ biogas; capacity: 1.7 MW
Pellets

Directions of development

The Hungarian pellets market is in its initial development period. This sector is expected to grow exponentially in the near future. Hungary is very strong in regards to the production of agro biomass, which is needed for agripellet production.

Pellets are able to satisfy 7% of all Hungarian demand for heating and production of domestic hot water for nearly 250,000 households. This translates to nearly 250,000 pellet boilers. The requisite amount of pellets can be produced in 41 factories (calculated with 5 ton/year). Presently there are 10 pellet factories in Hungary.

(Source: Hungarian Pellet Association)
BIOETHANOL/BIODIESEL IN HUNGARY

- Still an emerging market, as evidenced by recent investments
- Large potential in biofuel production, supported by agricultural products
- In the past few years more than 30 new projects were announced, including SEKAB, Rossi Biofuel, United BioFuels
- New investments in biomass R&D: Monsanto, Pioneer HiBred and Agritrade SRL

On the basis of an estimate by experts, more than 10% of the estimated consumption for 2020 can be fulfilled just from first generation biofuels, while at the same time ensuring the fulfilment of food and feed provision objectives. With the emergence of second generation biofuels, through the expansion of the scope of raw materials, this volume can be increased even further depending on the seasonal variations in the amounts of agricultural produce. The use of biofuels is thus limited mainly by factors relating to motor technology, since due to their construction, current vehicles can only operate reliably on fuel that contains only limited amounts of biofuel. Therefore, the increased spread of this technology will require the proliferation of vehicles that can operate on engine fuel with higher amounts of biofuel components or purely on biofuel. In order for this to occur there is an intent by the government to provide incentives by way of financing, mainly in the area of public transportation.

Regarding biofuels, Hungary is in a different situation in respect to bioethanol and biodiesel.
(Source: Hungary’s Renewable Energy Utilisation Action Plan)
Bigger factories

Agricultural background
A market of biofuels is emerging in Hungary, as evidenced by recent investments but there is still a huge potential for growth in biofuel production supported by agricultural products.

Announced project already in planning
Pannónia Ethanol in Dunaföldvár: the EUR 120 M bioethanol plant is creating 77 new jobs and will process 500,000 tons of maize per year to produce 240 million liters of ethanol, as well as 170,000 tons of protein for animal feed purposes.

Existing capacities

Bio-ethanol
- Hungrana Kft. in Szabadegyháza
- Győri Szeszgyár Rt. in Győr

Biodiesel
- Közép Tiszai MG Rt. in Kunhegyes
- Inter-Tram Kft. in Mátészalka (total capacity: 12,000 tonnes)
- Rossi Biofuel Zrt, Komárom (total capacity: 150,000 tons)
HYDROPOWER/FUEL CELLS IN HUNGARY

Hydropower

The National Action Plan calculated taking into account so-called dwarf hydroelectrical plants having an output of less than 10 MWe – which already play an important part in the regulation of smaller rivers and can be installed into existing weirs – and with so called flow-through turbines with an output between 100 and 500 kWe, which are installed in river beds.

Potentials

Consequently, the national target for 2020 takes into account installation potential in the field of hydroelectric power. The possibilities and sites for the installation of dwarf hydroelectric plants have been assessed, indicating that a total of 16 to 17 MWe of installed electrical power could realistically be installed until 2020.

Remarkable fuel cell R&D and production activity in Hungary

- Hydrogen Battery - production-storage of hydrogen by solar panels – developed by Accusealed Ltd. The equipment generates hydrogen through the decomposition of water, which will be stored in the same vessel and if necessary, can be expanded. The system operates in room without using pressure. The storage is completely fire- and explosion proof.
- 100W STACK - energy source for fuel cells – developed by the Kontakt-Elektro Ltd.
- Biohydrogen R&D using solar energy in DEAK University of Szeged and the Biological Research Center, Hungarian Academy of Sciences
- Fuel cell development, testing and manufacturing – Fuel Cell Hungary Ltd.
- An innovation: electric & fuel cell powered commuting vehicle – HY-GO™
GEOTHERMAL ENERGY IN HUNGARY

- Good potential for geothermal energy
- Average heat energy: 90 MW/m2
- Over 3000 thermal springs countrywide

Regarding geothermal energy, the geothermal gradient in Hungary significantly exceeds the global average, and represents one of the natural treasures of the country. In accordance with sustainable resource management, special attention must be paid to the preservation of this natural asset when establishing new capacities, which usually necessitates re-injection or recovery for the appropriate purposes.

There is significant potential in increasing the role of geothermal energy in the supply of heat, which at this time is already a widespread method of heating in certain sectors (e.g. in horticulture) in Hungary. In addition to the direct costs of the construction of wells and re-injection (which would not be necessary in all cases), the most important limiting factor in the case of geothermal energy is the provision of funding, which is due to the costs associated with the establishment of a heat supply and distribution systems.

(Source: Hungary’s Renewable Energy Utilisation Action Plan)
PannErgy: a major player in geothermal utilization

Founded in March 2008, as the legal successor of Pannonplast Plc, PannErgy’s mission is to become the leading geothermal company in the Carpathian basin. The company intends to use Hungary’s exceptionally favorable position in terms of geothermal energy. Significant amounts of heat and electricity can be produced from these geothermal resources. The company’s aim is to produce a minimum 60-70 MW net built-in capacity by building several geothermal plants, thus providing 0.8% of all the electrical capacity of Hungary. It plans to invest EUR 350 to 500 M to heat at least 70,000 flats (3.5 million GJ) with geothermal energy using district heating systems of cities and towns.

Heat pumps in Hungary

Heat pumps – one of the most used renewable energy sources in Hungary

In respect to heat pumps, the theoretical potential could amount to several hundred PJ (Source: Hungary’s Renewable Energy Utilisation Action Plan)

The heat pump market stands before a boom

The Hungarian geothermal potential would be able to provide 6% of the total renewable energy commitment of Hungary (14.7% until 2020). Heat pumps can provide 1% of the total, which at present is 0.01%. The next few years should bring a dynamic increase in their usage and the heat pump capacity stands to increase threefold. (Béla Ádám, president of Hungarian Heat Pump Association)
### Europe’s top heat pump system implementation

<table>
<thead>
<tr>
<th>Europe</th>
<th>Country</th>
<th>City/project name</th>
<th>No. BHE*</th>
<th>Depth BHE</th>
<th>Total BHE length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Norway</td>
<td>Loerensko, SIAhospital</td>
<td>ca.300</td>
<td>150 m</td>
<td>ca. 45 000 m</td>
</tr>
<tr>
<td>2.</td>
<td>Norway</td>
<td>Oslo, Nydalen discrit</td>
<td>180</td>
<td>200 m</td>
<td>36 000 m</td>
</tr>
<tr>
<td>3.</td>
<td>Sweden</td>
<td>Lund, IKDC</td>
<td>153</td>
<td>230 m</td>
<td>35 190 m</td>
</tr>
<tr>
<td>4.</td>
<td>Sweden</td>
<td>Stockholm, Vällingby Centr.**</td>
<td>133</td>
<td>200 m</td>
<td>26 600 m</td>
</tr>
<tr>
<td>5.</td>
<td>Sweden</td>
<td>Kista, Klsta Galleria**</td>
<td>125</td>
<td>200 m</td>
<td>25 000 m</td>
</tr>
<tr>
<td>6.</td>
<td>Hungary</td>
<td>Budapest, Pillangó street Tesco</td>
<td>150</td>
<td>150 m</td>
<td>22 500 m</td>
</tr>
<tr>
<td>7.</td>
<td>Turkey</td>
<td>Iстamul, Metro market</td>
<td>168</td>
<td>107 m</td>
<td>18 000 m</td>
</tr>
<tr>
<td>8.</td>
<td>Hungary</td>
<td>Törökbálint, Telenor House</td>
<td>180</td>
<td>100 m</td>
<td>18 000 m</td>
</tr>
<tr>
<td>9.</td>
<td>Germany</td>
<td>Golm near Postdam, MPI</td>
<td>160</td>
<td>100 m</td>
<td>16 000 m</td>
</tr>
<tr>
<td>10.</td>
<td>Sweden</td>
<td>Stockholm, Blackeberg area</td>
<td>90</td>
<td>150 m</td>
<td>13 500 m</td>
</tr>
<tr>
<td>11.</td>
<td>Hungary</td>
<td>Budapest, Pesti street Tesco</td>
<td>130</td>
<td>100 m</td>
<td>13 000 m</td>
</tr>
<tr>
<td>12.</td>
<td>Sweden</td>
<td>Örebo, Misikhögskolan</td>
<td>60</td>
<td>200 m</td>
<td>12 000 m</td>
</tr>
<tr>
<td>13.</td>
<td>Germany</td>
<td>Langen, DFS</td>
<td>154</td>
<td>70 m</td>
<td>10 780 m</td>
</tr>
<tr>
<td>14.</td>
<td>Switzerland</td>
<td>Zürich, Grand Hotel Dolder</td>
<td>70</td>
<td>150 m</td>
<td>10 500 m</td>
</tr>
</tbody>
</table>

* BHE: Borehole Heat Exchanger  **under construction

6. Hungary Budapest, Pillangó Street, Tesco 150 150m 22 500 m
8. Hungary Törökbálint, Telenor House 180 100m 18 000 m
8. Hungary Törökbálint, School and Sport Centrum** 180 100 m 18 000 m
11. Hungary Budapest, Pesti street Tesco 130 100 m 13 000m

### GEO tariff

A GEO tariff is a separately measured favorable power tariff (35% less than the normal rate), which has been introduced for heat pump utilization. The costs are reduced by this system, therefore the payback period of heat pump investments are shortened.

- For private individuals: 32,28 HUF/kWh
- For public establishments: 32,66 HUF/kWh (in ELMĐ-ÉMÁSZ service area)
Incentives in Hungary

Cost efficiency, high human capital productivity and a business-friendly environment. In times of a crisis these phrases are more important than ever. Even a minor advantage can lead to major economic gains and to the gain of a new market. Cost efficiency, high human capital productivity and a business-friendly environment are typical characteristics of the Hungarian market.

What can Hungary offer you?

Skilled, cost efficient labor which is the most productive in Central and Eastern Europe. Excellent infrastructure, as well as the extensive financial assistance of the Hungarian government that it provides to investors.

As the member of the European Union, Hungary can offer a broad scale of subsidies. An investment of a large enterprise – depending on the location – can be entitled to receive state subsidies of up to 50% of the eligible costs of the investment. The legal basis for all investment subsidies within Hungary is provided by the common legal framework of the European Union.

The following maximum regional subsidy intensity ratios have been set by the European Commission:

For investments not exceeding EUR 50 M, the maximum intensity ratio is increased by 10 percentage points for medium sized and by 20 percentage points for small enterprises. For criteria determining SME categories see table below:

<table>
<thead>
<tr>
<th>Size</th>
<th>Headcount</th>
<th>Turnover</th>
<th>OR</th>
<th>Balance Sheet</th>
</tr>
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<tr>
<td>Small</td>
<td>&lt; 50</td>
<td>&lt;= EUR 10M</td>
<td>OR</td>
<td>&lt;= EUR 10M</td>
</tr>
<tr>
<td>Medium</td>
<td>&lt; 250</td>
<td>&lt;= EUR 50M</td>
<td>OR</td>
<td>&lt;= EUR 43M</td>
</tr>
<tr>
<td>Large</td>
<td>&gt;=250</td>
<td>&gt; EUR 50M</td>
<td>OR</td>
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INCENTIVES IN HUNGARY

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</table>

Subsidy for large investment projects is also subject to an adjusted regional aid ceiling, on the basis of the following scale:

<table>
<thead>
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<th>Eligible expenditure</th>
<th>Adjusted aid ceiling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to EUR 50M</td>
<td>100 % of regional ceiling</td>
</tr>
<tr>
<td>For part between EUR 50-100M</td>
<td>50 % of regional ceiling</td>
</tr>
<tr>
<td>For part exceeding EUR 100M</td>
<td>34 % of regional ceiling</td>
</tr>
</tbody>
</table>

What can the Hungarian Investment and Trade Agency offer you?

The Hungarian Investment and Trade Agency (HITA) supports investments aiming to establish new facilities with a one-stop-shop service.

Tailor-made incentive solutions covering various granting authorities

Negotiations and processes with all relevant authorities coordinated by HITA
RENEWABLE ENERGY PROFESSIONAL ORGANIZATIONS

Solar professional organizations
MANAP – PV Industrial Association - www.manap.hu
Hungarian PV and Solar Collector Association - www.mnnsz.hu

Wind professional organizations
Hungarian Wind Energy Association – www.mszet.hu
Hungarian Wind Energy Industrial Association - www.mszit.hu

Geothermal professional organizations
Hungarian Geothermal Association – www.mgte.hu
Hungarian Thermal Energy Association - www.thermalenergia.hu
Hungarian Heat Pump Association – www.hoszisz.hu

Biomass professional organizations
Hungarian Pellet Association – www.mapellet.hu
Hungarian Biogas Association – www.biogas.hu
Hungarian Bioethanol Association - www.etanol.info.hu/

Regulatory bodies
Ministry for National Development and Economy – energy strategy, energy pricing
   www.kormany.hu/hu/nemzeti-fejlesztesi-miniszterium
Hungarian Energy Authority – Regulation and monitoring of Hungarian energy market, licensing
   www.eh.gov.hu
Energy Center – National and international subsidization of energy production, energy statistics
   www.energiakozpont.hu
MAVIR Inc. – Monitoring of grid and securement of energy supply
   www.mavir.hu