Pannonia Ring wind farm
Joint Implementation Project

Baseline Study
&
Monitoring Plan

DRAFT

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Abbreviations

CO₂ Carbon Dioxide
CO₂e Carbon Dioxide Equivalents
EF Emission Factor
e.g. example given
ERU Emission Reduction Unit
EU European Union
G Giga
GHG Greenhouse Gas
GWh Gigawatt hours
GWP Global Warming Potential
h hours
HPP Hydro Power Plant
IPCC Intergovernmental Panel for Climate Change
IRR Internal Rate of Return
Jl Joint Implementation
Kft. = Ltd; Limited Company
kg Kilogram
km Kilometer
kV Kilovolt
kWh Kilowatt hours
MW Megawatt
MWh Megawatt hours
No Number
NPP Nuclear Power Plant
NPV Net Present Value
PCF Prototype Carbon Fund
PDD Project Design Document
PIN Project Idea Note
Rt. Public limited company
t tons
TWh Terrawatt hours
UNFCCC United Nations Framework Convention on Climate Change
1 Project Information

1.1 Title of the Project Activity

Pannonia Ring wind farm JI project

1.2 Project Abstract

The project consists of the development of a wind based generation facility with a nominal power capacity rated at 49.45MW (24 Vestas V90 with 2MW each, 1 Vestas V52 with 0.85MW, 1 Enercon E40 with 0.6MW). The project is located in Ostffyasszonyfa, near Celldömölk in Western Transdanubia of Hungary. Once construction is completed in 2006, the wind generators will be delivering around 105 GWh/year to the Hungarian electrical grid. The durability of the wind turbines is expected to be 20 years.

The project’s aim is to stimulate the use of renewable energy sources in Hungary by building a zero GHG emission power plant and to show the feasibility of this new technology.

The generated electrical power is dedicated to displace grid electricity from fossil power plants contributing to GHG reduction of 81.690tCO$_2$e per year during the operation life. During the first commitment period the project is expected to reduce approximately 408.450tCO$_2$e, creating the equivalent Emission Reduction Units (ERUs).

The following table illustrates the provisional time schedule of the Pannonia Ring wind farm JI-project.
### Table 1: Time Schedule Pannonia Ring wind farm

This time schedule has been calculated according to the actual information of the approval procedure (09/2004). It can be adopted due to unexpected site-related factors or yet unknown problems of the authorization process.
1.3 Project Participants

1.3.1 Applicant

PANNONIA SZEL KFT.
Vizőntő u. 28
HU-9700 Sombathely
Contact Persons: DI Johannes Trautmannsdorf or DI Stephan Parrer
Phone: +43/2742/43 208
Fax: +43/2742/43 509
E-mail: sp@imwind.at

1.3.2 Project Developer

WINDPOWER HUNGARIA KFT
Hűvősvölgyi út 33
HU-1026 Budapest
Contact Person: Erik Groniewsky
Phone: +36/1394 6064
E-mail: groerik@freemail.hu

The project developer is Windpower Hungaria Kft. The owner of the company provide a broad range of products and services in the wind farm development sector and with this knowledge they developed several wind farms in Germany and Hungary. The founders of the company have regional, country specific experience in this field since they have been working in Hungary for many years.

1.3.3 Project Partners

VEREIN ENERGIEWERKSTATT
Technical consultant
Heiligenstatt 24
A-5211 Freiburg
Contact Person: Mag. Hans Winkelmeier
Phone:+43/7746/28212
fax: +43/7745/28212-21
E-mail: h.winkelmeier@ewv.at
The Energiewerkstatt has been founded in the year 1987 with the aim to support new concepts and activities for an environmental friendly production and use of energy. This organisation has been planning and developing wind farms for 17 years and was the first consultant in Austria in this field. They have consulted about 50% of all Austrian Wind farms. It has gained an excellent know how about Middle European meteorological conditions in respect with wind energy utilisation.

ETV-ERŐTERV RT¹
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HU-1450 Budapest
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Phone: +36/1/4553639
Fax. +36/1/4553617
e-mail: zsolt.padar@fortum.com

ETV-Erőterv Rt. is an experienced technical consultant in Hungary in the field of electricity planning. The applicant cooperates with this company in planning of the grid connection of the Wind farm project. The company’s activities focus on two areas: Nuclear Engineering and Conventional Engineering Business Areas. ETV-Erőterv Rt. provides expertise and experience in the whole field of energy services, ranging from power generation, power transmission and distribution to power system control and telecommunication.

UVATERV - ÚT-, VASÚTTERVEZŐ RÉSZVÉNYTÁRSASÁG²
Technical consultants
Dombóvári út 17-19
HU-1117 Budapest,
Phone: +36/1/2042967
Fax. +36/1/2042969
e-mail: uvaterv1@mail.datanet.hu

Uvaterv is an experienced technical consultant in Hungary in the field of building construction and civil engineering. The applicant cooperates with this company in all aspects of technical planning of the Wind farm project. The experts of UVATERV can look back on long time experience in the field of planning and designing of office buildings, shopping centers, hotels, sport and education facilities. The company is divided into three divisions. The first division covers the design of roads, motorways, railways and airports. The second division deals with bridges, technology and structural design. The third division is responsible for underground structures, metro systems, architecture and installation engineering design.

¹ Source: http://www.etv.hu/english/index.php
² Source: http://www.uvaterv.hu/english/cegism.php
1.3.4 Technical Description of the Project Activity

The Project consists of a 49.45 MW wind power project, expected to produce 105 GWh electrical power per year. The expected operational lifetime is 20 years.

The Pannonia Ring Wind Power Joint Implementation Project foresees the installation of a wind power plant with 24 wind mills each generating 2 MW (Vestas V90), one wind mill generating 850 kW (Vestas V52) and another one generating 600 kW (Enercon E40) of electrical power.

1.3.5 Location of the Project Activity

The planned wind farm project is located approximately 50 km east of Szombathely, in Ostffyasszonyfa, Celldömölk, Western Transdanubia around the Pannonia Ring racing circuit.

1.3.6 Detail on the Physical Location

According to wind measurements in the past, the location shows an appropriate potential for a wind power plant. In Austria, about 60 km away from the Pannonia Ring wind farm Project, several Wind Farms went into operation some years ago. These experiences in Austria and also in Germany proved good performance of grid connected Wind Power Plants.

The positive results of an analysis of the grid connection in Hungary led to an application to the Hungarian Authorities for wind energy utilization at the site.

In addition, criterias like distance to settlements, buildings, terrain, etc. have been positively evaluated. The public opinion in Hungary as well as the local population show wide acceptance for the planned Wind Power Project und Wind Farm Projects in general.
The next figure shows the exact locations of each turbine in relation to each other and the adjacent settlement.

Figure 1: Map of the Location of the Pannonia Ring wind farm in Ostffyasszonya

http://www.gisinfo.hu/index.asp
Figure 2: Site plan of the Pannonia Ring wind farm

Source: Windpower Hungaria Kft
1.4 Hungary’s Experience in JI and Baselines

Hungary ratified the Kyoto Protocol on the 28th of August 2002.

In 2003, Hungary and Austria signed a Memorandum of Understanding (MoU) on cooperation in reducing GHG emissions under article 6 of the Kyoto Protocol (http://www.jicdm-austria.at/images/download/mou_hungary.pdf).

In September 2000, the Hungarian Government issued a Governmental Decree on Hungary’s Strategy on Climate Protection. The Ministry of Environment and Water is the responsible authority to meet the Kyoto commitment in cooperation with other ministries and agencies. The Decree requires elaboration of the domestic institutional and regulatory framework of JI. The main sources of greenhouse gas emissions are energy production, some industrial activities, transport and the intensive agricultural production.

Hungary has set up the national greenhouse gas inventory – GHG of anthropogenic emissions by sources and removals by sinks of greenhouse gases and submitted it to the Secretariat of the Framework Convention on Climate Change. The Ministry of Environment and Water is responsible for Hungary’s Kyoto related issues:

Ministry of Environment and Water
1011 Budapest, Fo u. 44-50, Hungary

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5 Source: Pálhalma Biogas Joint Implementation Project
2 Description of the Electricity Market

Hungary started restructuring, liberalizing and privatizing its energy sector in 1991. The majority of the country's energy industry is presently privately owned.

The new EU-conform Electricity Act was passed by Parliament in December 2001. It is designed to give an introduction to open the market. The first step was taken on January 1st, 2003 when eligible customers with a yearly consumption of 6,5GWh or more have the right to choose their own electricity suppliers and were granted network access. The new regulation simplifies the licensing activity and makes it possible to implement power-plant projects on market base. An important change is that the new Act has partly eliminated the regulated price of electricity sold between producers and traders as well as between traders and eligible consumers. Regulated prices remain in the fields of transmission, distribution, system operation and in the field of public utilities.

After January 1st 2004, regulated prices remain in force only for public-utility consumers. Electricity produced from renewable energy sources with the utilization of waste materials receive a so-called "green certificate". Export and import activity is mainly liberalized: the eligible customers have import rights of up to 50% of their needs. Export/import activities are allowed for electricity traders, public utility wholesalers, the independent system operator (to such an extent that is essential to its tasks) and achieve eligible consumers for their own consumption. Though eligible consumers were obliged to purchase at least half of their consumption from domestic production before EU accession. The present Act created new concepts like eligible consumers and removed with the monopoly rights for export/import activity. Further it took measures for separating different activities in accounting that companies should create different balance sheets, profit and loss statements as if the different activities were made by different companies. The other fundamental principle is to ensure a minimum negative environmental impact in the new Electricity Act. The opening has been a gradual development in Hungary and it has not been determined when the process will be finished completely.

MVM (Hungarian Electricity Board), the former public monopolist, preserved the property of the transmission network as well as the one of the single nuclear power plant of the country. MVM is responsible for the imports and exports of electricity and plays the role of a single buyer in the Hungarian electricity system. MVM has been restructured into a public company with commercial activities. In 2001, the distributors were faced with rising selling prices (+14%) and therefore asked the regulator for the authorization of importing electricity directly. The increase of capacities is controlled by MVM, which proceeds by calls for tender for 2 categories of power plants (200 MW and <200 MW).

Electricity is produced by power plants and goes to the great nodes via 400 kV networks, from there it is delivered by regional distribution companies through 120 kV networks.

Sources: Energieverwertungsagentur Austria, http://www.eva.ac.at/
          MAVIR Rt., www.mavir.hu
lines, and after its distribution on 20 kV and 10 kV lines it is used by most of the consumers on 400/230 Voltage. This process is harmonised by the national dispatching center MAVIR Rt. It ensures that the energy is delivered to the consumers according to international standards.

MAVIR guarantees the uninterrupte[d] operation of the electricity market, its further extension, summarizes the data received from the participants in the electricity supply, informs the market players not to make unrealisable contracts, ensures the safe power supply and reserves in the power plants and on the network, harmonises the operation of the Hungarian electricity system with the neighbouring networks and makes proposals for the development of the network and power plants for the future.

As the National Dispatching Centre MAVIR continuously monitors the operation of the electricity system and based on measurements, signals and information via computer or verbally, it observes the course of production, transmission and distribution. The purpose of the operation control is to interfere in the operation of the system in a way that the consumer shall receive electricity with appropriate quality.

Also the settlement of electricity is included in the obligations of MAVIR: based on the measurements of the quantity of electricity arrived on international lines, accepted from power plants and delivered to consumers, MAVIR determines who purchased and delivered the electricity from whom and how much.

The electricity sector is composed of 12 production companies and 6 regional distribution companies. The majority is owned completely or partly by foreign companies.

Hungary intends to introduce regulated TPA (third party access to the electricity system, necessary for the liberalization of the electricity market) to the network – for Regulator Parallel activities in the area of public supply and for those of the competitive market, which are to be licensed by the Hungarian Energy Office (HEO, staff 83). License-holders may then establish a power plant, a transmission or a distribution network according to the concrete type of license.
Current License-holders\textsuperscript{7} are as follows:

**Generation Licenses**\textsuperscript{7}

- AES Borsodi Energetikai Kft. Borsodi Hőerőmű
  3704 Kazincbarcika, Ipari u. 7. Tel.: (49) 311-251
- AES Borsodi Energetikai Kft. Tiszapalkonyai Hőerőmű
  3704 Kazincbarcika, Ipari u. 7. Tel.: (49) 547-202
- AES Tisza Erőmű Kft.  www.aes.hu
- Bakonyi Erőmű Rt.  www.bakonyi.hu
- Budapesti Erőmű Rt.  www.budapestieromu.hu
- Csepeli Áramtermelő Kft.  www.atel.hu
- EMA-POWER Kft.  www.emapower.hu
- Dunamenti Erőmű Rt. 2440 Százhalombatta, Erőmű u. 2. Tel.: (23) 544-150
- Mátrai Erőmű Rt.  www.mert.hu
- Paksi Atomerőmű Rt.  www.npp.hu
- PANNONPOWER Rt.  www.pannonpower.hu
- Vértesi Erőmű Rt.  www.vert.hu

**Distribution and Public Service Supply Licenses**\textsuperscript{7}

- Budapesti Elektromos Művek Rt.  www.elmu.hu
- Déldunántúli Áramszolgáltató Rt.  www.dedasz.hu
- Délmagyarországi Áramszolgáltató Rt.  www.demasz.hu
- Észak-dunántúli Áramszolgáltató Rt.  www.edasz.hu
- Észak-magyarországi Áramszolgáltató Rt.  www.emasz.hu
- Tiszántúli Áramszolgáltató Rt.  www.titasz.hu

**Transmission and Public Service Wholesale License**\textsuperscript{7}

- Magyar Villamos Művek Rt.  www.mvm.hu

**System Operation License**\textsuperscript{7}

- Magyar Villamosenergia-ipari Rendszerirányító Rt.  www.mavir.hu

Electricity Trade Licenses

- Entrade Hungary Kft.  www.entrade.hu
- MVM Partner Rt.  www.mvmpartner.hu
- E.ON Energiakereskedő Kft.  www.eon-energiakereskedo.com
- D-Energia Kereskedelmi Kft.  www.d-energia.hu
- Electrabel Magyarország Kft.  2440 Százhalombatta, Csentrics u. 6. (23)-359-133
- Magyar Áramszolgáltató Kft.  1132 Budapest, Váci u. 72-74. 238-1150
- Mátrai Erőmű Rt.  3272 Visonta, Erőmű u. 11. (37)-328-020
- System Consulting Rt.  1026 Budapest, Béla király út 30/c 395-1467
- Atel Energia Tanácsadó Kft.  1053 Budapest, Károlyi Mihály u. 12. 486-2200
  Tel.: 223-1540
- ENKER-TEAM Kft.  1117 Budapest, Budafoki út 111., I. em. 205-3310
- EFT Budapest Rt.,  1011 Budapest, Szilágyi D. tér 2. Tel.: 201-7296
- PANNONTRADING Kft.,  7630 Pécs, Edison u. 1. Tel.: (72) 534-240
- ENERGOMARK Kft.,  1146 Budapest, Szabó József u. 14/B Tel.: 30- 931- 7660
- Sempra Energy Europe Kft.,  1122 Budapest, Magyar Jakobinusok tere 2-3., IV.
  emelet Tel.: 214-8204

Figure 3 provides an overview of the model of the current Hungarian electricity market.

Figure 3: Electricity Market Model

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The next figure illustrates the ownership structure of the Hungarian power industry.

\[ \text{Figure 4: Ownership structure of the Hungarian power industry}^{9} \]

The electricity generation is dominated by MVM (33% of the installed capacity), followed by Tractebel (25%), AES (15%) and RWE (10%) (2000).

- The American Xcek (NRG Energy group) which purchased Csepel in 2001 (two thermal power plants of 390MW and 190MW)
- PowerGen sold its Hungarian participations to the Swiss electrician Atel in September 2002.
- AES owns the majority of the company of Tiszai production.
- The largest production company Powerfin-Tractebel possess 49% of the capital of Dunamenti, with a total capacity of 2220MW.
- RWE and EnBW own the power plant of Matrai.
- EDF bought the shares of Fortum (45.39%) and Tomen Corporation (34%) in the cogeneration plant Eromu (BERt) in Budapest in December 2000. EDF recently

\[ 9 \text{ Source: MVM; Statistical Data 2003, http://www.mvm.hu/} \]
invested 30 billion forints (123 million euros) in the new power plant Ujpest (cogeneration) and has just signed an agreement to invest 30 billion forints (123 million euros) in the project Kispest of BERt (cogeneration plant).

- Only three production companies are still in public hands (Pecsi, Vertesi, Bakonyi), due to failed privatization. Their total capacity accounts for 1100MW.

The electricity distributors and the interconnections of the Hungarian grid are mapped in Figure 5.

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2.1 Power Plant Expansion Plan by 2002

- The MVM Rt., the Hungarian Power Utility Ltd., is planning a retrofit of 300-700MWe of existing capacity and originally planned to construct new plants of 1000-1100MWe capacity by the year 2006. This new capacity expansion was internationally tendered in 1997 by MVM, but pending privatization and breakup of MVM has resulted in these plans being put on hold.

- The Újpest power plant (70MWe, 33MWth), consists of a Gas Turbine with a Steam and is in the status of being commissioned.

- The Debrecen power plant (170MWe combined cycle gas turbine), built by the TITASZ supply company, recently went online.

- Two other combined cycle plants are being built resulting from capacity tenders originally announced in 1997,
  - a 191MWe plant of AES FONIX is under construction at the Tisza II power plant site, and
  - Budapest Power Plant Ltd is constructing a 110MWe plant at the Power Plant Kispest site.

- EMA-Power is considering constructing a combined cycle gas turbine power plant at their site in Dunaújváros that could be as large as 120MWe.

- Two other gas turbine combined cycle power plants reportedly under development are to be located at Pécs and Ajka;
  - the Pécs facility could have a generating capacity of as much as 270MWe, while
  - the Ajka facility would probably have a capacity of about 110MWe.

- MOL has taken a 30% stake in a joint venture with BorsodChem Ltd., which is in the final stages of constructing a gas turbine power plant that will have a capacity of 50MWe and about 130 megawatts of thermal capacity.

- Finally, the Russian-owned Central European Steel group is planning to open a joint venture with an American power developer to build a 590MWe coal-fueled power plant close to the Ukrainian border.

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11 Source: Department of Energy of the USA, http://www.fe.doe.gov/international/CentralEastern%20Europe/hungover.html#Gas
Figure 6 illustrates the latest map of power plants in operation by 2003.


**Figure 6:** Power Plants by 2003

---

The operating power plants by 2003 are shown in Table 2, accordingly to Figure 6

### Power plants by 2003

<table>
<thead>
<tr>
<th>Company</th>
<th>Power Plant</th>
<th>Fuel</th>
<th>Total Capacity [MWₑ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakony Power Plant Ltd.</td>
<td>Ajka Power Plant</td>
<td>coal</td>
<td>102</td>
</tr>
<tr>
<td>Budapesti Power Plant Ltd.</td>
<td>Kelenföld, Ujpest, ...</td>
<td>hydrocarbon (natural gas &amp; fuel oil)</td>
<td>371</td>
</tr>
<tr>
<td>Dunamenti Power Plant Ltd.</td>
<td>Dunamenti Power Plant</td>
<td>hydrocarbon (natural gas &amp; heavy fuel oil)</td>
<td>1740</td>
</tr>
<tr>
<td>EMA Power</td>
<td>Dunaujváros</td>
<td>hydrocarbon (fuel oil, natural gas, blast furnace and coke oven gases)</td>
<td>69</td>
</tr>
<tr>
<td>Mátra Power Plant Ltd.</td>
<td></td>
<td>coal</td>
<td>836</td>
</tr>
<tr>
<td>MVM reserve power plants</td>
<td>Litér</td>
<td>fuel oil</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>Lőrinci</td>
<td>fuel oil</td>
<td>170</td>
</tr>
<tr>
<td></td>
<td>Sajószöged</td>
<td>fuel oil</td>
<td>120</td>
</tr>
<tr>
<td>Pannonpower Plant Ltd.</td>
<td>Pécs</td>
<td>coal</td>
<td>190</td>
</tr>
<tr>
<td>Csepel PG Energy Ltd.</td>
<td>Csepel I. Power Plant</td>
<td>hydrocarbon (natural gas &amp; fuel oil)</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Csepel II. Power Plant</td>
<td>hydrocarbon (natural gas &amp; fuel oil)</td>
<td>396</td>
</tr>
<tr>
<td>AES Borsod Energetic Ltd.</td>
<td>Borsod Power Plant</td>
<td>coal</td>
<td>137</td>
</tr>
<tr>
<td></td>
<td>Tiszapalkonya P.P.</td>
<td>coal</td>
<td>200</td>
</tr>
<tr>
<td>AES Tisza Power Plant Ltd.</td>
<td>Tisza</td>
<td>hydrocarbon (heavy fuel oil &amp; natural gas)</td>
<td>860</td>
</tr>
<tr>
<td>Vértes Power Plant Ltd.</td>
<td>Bánhida Power Plant</td>
<td>coal</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Oroszlány Power Plant</td>
<td>coal</td>
<td>235</td>
</tr>
<tr>
<td>East Hungarian Electricity Supply Company</td>
<td>Debrecen GT</td>
<td>hydrocarbon (natural gas)</td>
<td>95</td>
</tr>
<tr>
<td>Pécs Power Company</td>
<td>Paks</td>
<td>nuclear</td>
<td>1866</td>
</tr>
</tbody>
</table>

*Table 2: Commissioned power plants by 2002*
2.2 Capacities and Generation

An overview of the generation capacities of the Hungarian public power plants 2000 – 2002 is shown in the table below. The commissioned capacity is the sum of electricity of the commissioned units in the power plants at the generator terminals (in MW) and these amounted to 8311MW in 2002. The available capacity is the sum of the maximum electric capacities generated by the power plants in normal operation, taking into consideration the constant and temporary losses and excesses. In Hungary the Available Capacity of power plants amounted to 7927MW in 2002. The peak load of power plants slightly decreased to 6726MW whereas the contracted import increased to 600MW in 2002.

**Generation Capacities**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioned Capacity of power plants</td>
<td>8.282</td>
<td>8.392</td>
<td>8.311</td>
<td>-81</td>
</tr>
<tr>
<td>Available Capacity of power plants</td>
<td>7.813</td>
<td>7.892</td>
<td>7.927</td>
<td>35</td>
</tr>
<tr>
<td>Peak load of power plants</td>
<td>5.394</td>
<td>5.761</td>
<td>5.726</td>
<td>-35</td>
</tr>
<tr>
<td>Contracted import</td>
<td>400</td>
<td>400</td>
<td>600</td>
<td>200</td>
</tr>
</tbody>
</table>

Table 3: Generation Capacities 2000-2002

Table 4 shows the plant categories and the corresponding Commissioned Capacities of the Hungarian power plants. The Commissioned Capacities of thermal power plants amount to 6270MW, the Commissioned Capacity of the nuclear power plant amounts to 1866MW. Hydro power plants are providing a capacity of about 48MW. In conclusion the Hungarian generation capacities are notably dominated by thermal power plants, in fact the generation capacity of fossil fueled plants equals about 76.6%.

**Categories of Commissioned Capacities of power plants**

<table>
<thead>
<tr>
<th>Item</th>
<th>Commissioned Capacity</th>
<th>Capacity [MW]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro power plants</td>
<td>&lt; 30 MW</td>
<td>48</td>
</tr>
<tr>
<td>Thermal Power plants</td>
<td>&lt; 20 MW</td>
<td>375</td>
</tr>
<tr>
<td></td>
<td>20 – 50 MW</td>
<td>326</td>
</tr>
<tr>
<td></td>
<td>51-100 MW</td>
<td>680</td>
</tr>
<tr>
<td></td>
<td>&gt; 100 MW</td>
<td>4,889</td>
</tr>
<tr>
<td><strong>Total of thermal power plants</strong></td>
<td></td>
<td><strong>6,270</strong></td>
</tr>
<tr>
<td>Nuclear power plants</td>
<td>&gt; 200 MW</td>
<td><strong>1,866</strong></td>
</tr>
</tbody>
</table>

Table 4: Categories of commissioned capacities of power plants

An overview of the generated electricity of the Hungarian public power plants 1999 – 2002 is shown on the table below. The total consumption amounted to 40,41TWh and comprises the gross consumption and the self consumption of the power plants, whereas the gross consumption amounted to 36,87TWh and represents the net generation including the network losses. Finally, the net generation slightly decreased to 33,47TWh which is the total amount of electricity generated in Hungary that can be sold to the consumer.
Electricity generation and consumption

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>Change [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total consumption</td>
<td>38,22</td>
<td>38,63</td>
<td>39,59</td>
<td>40,41</td>
<td>2,1</td>
</tr>
<tr>
<td>Gross consumption</td>
<td>38,07</td>
<td>35,29</td>
<td>35,88</td>
<td>36,87</td>
<td>2,3</td>
</tr>
<tr>
<td>Net generation</td>
<td>34,23</td>
<td>32,44</td>
<td>33,7</td>
<td>33,47</td>
<td>-0,7</td>
</tr>
<tr>
<td>Import / export balance</td>
<td>1,06</td>
<td>3,44</td>
<td>3,17</td>
<td>4,3</td>
<td>35,6</td>
</tr>
</tbody>
</table>

Table 5: Electricity generation and consumption (1999 – 2002)

In the table below the fuel consumption for 2000 - 2002 is illustrated. On the basis of these three years the total average fuel consumption of Hungarian power plants is about 391TJ. 61,5% of that amount was used by thermal power plants and 38,5% by the nuclear power plant. Obviously, fossil fueled power plants are prevailing in the Hungarian electrical power system.

Fuel Consumption

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>Average</th>
<th>Share [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lignite</td>
<td>54,134</td>
<td>57,009</td>
<td>54,492</td>
<td>55,212</td>
<td>14,1</td>
</tr>
<tr>
<td>Brown Coal</td>
<td>49,918</td>
<td>45,728</td>
<td>44,688</td>
<td>46,778</td>
<td>12,0</td>
</tr>
<tr>
<td>Hard Coal</td>
<td>10,659</td>
<td>8,776</td>
<td>8,692</td>
<td>9,376</td>
<td>2,4</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>43,046</td>
<td>43,300</td>
<td>22,769</td>
<td>36,372</td>
<td>9,3</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>76,989</td>
<td>94,618</td>
<td>106,461</td>
<td>92,689</td>
<td>23,7</td>
</tr>
<tr>
<td>Nuclear</td>
<td>151,904</td>
<td>150,708</td>
<td>148,785</td>
<td>150,466</td>
<td>38,5</td>
</tr>
<tr>
<td>Total</td>
<td>386,650</td>
<td>400,139</td>
<td>385,887</td>
<td>390,892</td>
<td>100,0</td>
</tr>
</tbody>
</table>


The Hungarian public power plants generated 34.928GWh of electrical energy in 2002. 59,5% of the electrical energy was generated by fossil fueled thermal power stations. About 28,8% of the electricity produced in Hungary was generated by natural gas, 24,8% by coal and 5,9% by fuel oil. An amount of 39,9% of the generated electricity was produced by the Paks nuclear power plant. Renewables, mainly small run-of-river hydro power stations, amounted to about 0,6% of power generation. The following table gives an overview of the gross electricity generation in the years 2000 – 2002 and is the basis to determine the Operation Margin in sector 3.3.5.

Electricity production by energy sources

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>GWh</td>
<td>%</td>
<td>GWh</td>
</tr>
<tr>
<td>Coal</td>
<td>8,888</td>
<td>25,82</td>
<td>8,835</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>4,267</td>
<td>12,40</td>
<td>4,196</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>6,907</td>
<td>20,07</td>
<td>8,345</td>
</tr>
<tr>
<td>Hydro Power</td>
<td>178</td>
<td>0,52</td>
<td>184</td>
</tr>
<tr>
<td>Nuclear Power</td>
<td>14,180</td>
<td>41,20</td>
<td>14,126</td>
</tr>
<tr>
<td>Total</td>
<td>34,420</td>
<td>100,00</td>
<td>35,686</td>
</tr>
</tbody>
</table>

Table 7: Hungarian Electricity Production (2000-2002)
Electricity imports reached 12.605GWh in 2002, while exports from Hungary amounted to 8.349GWh, as a result of 4.256GWh of net imports. The following table shows the electricity measured on the border crossing lines, including the transit deliveries. The contractual export / import values differ significantly from the physical values as shown in Table 9. But the contracted and the net import are the same. The contracted net imports increased by 7% in average during the last 5 years.

**Import / Export - Physical Deliveries**

<table>
<thead>
<tr>
<th>Item</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export [GWh]</td>
<td>6.083</td>
<td>7.232</td>
<td>8.349</td>
</tr>
<tr>
<td>Balance [GWh]</td>
<td>3.440</td>
<td>3.171</td>
<td>4.256</td>
</tr>
</tbody>
</table>

*Table 8: Physical Import / Export Deliveries*

**Import / Export - Contracted**

<table>
<thead>
<tr>
<th>Item</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross production [GWh]</td>
<td>37.188</td>
<td>37.154</td>
<td>35.191</td>
<td>36.417</td>
<td>36.158</td>
<td>36.422</td>
</tr>
<tr>
<td>Share of net import [%]</td>
<td>1.99</td>
<td>2.86</td>
<td>9.78</td>
<td>8.71</td>
<td>11.77</td>
<td>7.0</td>
</tr>
<tr>
<td>Share of total import [%]</td>
<td>10.87</td>
<td>9.16</td>
<td>17.61</td>
<td>19.07</td>
<td>21.09</td>
<td>15.6</td>
</tr>
</tbody>
</table>

*Table 9: Contracted Export-Import (1998 – 2002)*
3 Baseline Methodology

This section serves to determine the Baseline Methodology which is to be applied, justify its selection and describe its application. Below, a theoretical explanation is given, how the emission factor and the resulting emission reduction will be calculated. Finally, the issues for the environmentally and the economically additionality will be discussed.

The actual emission reduction units are calculated in section 4. The determined calculation method used in the Pannonia Ring wind farm JI Project complies with the Baseline Methodology described below.

3.1 Title and Reference of the Methodology Applied

There are currently only methodologies for grid-connected zero-emissions renewable electricity generation approved by the CDM Executive Board but no approved methodology specifically for Grid-connected wind power generation.

The following two baseline methodologies are applicable to the Pannonia Ring wind farm JI Project:

- Approved consolidated baseline methodology ACM0002 (“Consolidated baseline methodology for grid-connected electricity generation from renewable sources”)
- Approved baseline methodology AM0005 (“Baseline methodology for small grid-connected zero-emissions renewable electricity generation”)

The necessary steps and conditions for application of both methodologies to the Pannonia Ring wind farm JI Project are exactly the same. Since ACM0002 is the more detailed and comprehensive one, it is chosen to be applied to this project.

As there are no standard methodologies for JI Projects yet and the requirements for implementation of CDM projects are in general stricter than for JI projects, the above named CDM methodology is used for this JI Project.

Below, the most important steps for the calculation of the Baseline Emission Factor of a project according to ACM0002 are shortly outlined. For detailed information refer to Annex 6.1.

**STEP 1. Calculate the Operating Margin Emission Factor(s) \( (EF_{OM,y}) \)** based on one of the four following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM.
Dispatch data analysis should be the first methodological choice. Where this option is not selected, project participants shall justify why and can use the simple OM, the simple adjusted OM or the average emission rate method taking into account the provisions outlined hereafter.

The Simple OM method (a) can only be used where low-cost/must run resources constitute less than 50% of the total grid generation in:

1) average of the five most recent years, or
2) based on long-term normals for hydroelectricity production.

The average emission rate method (d) can only be used
- where low-cost/must run resources constitute more than 50% of the total grid generation and detailed data to apply option (b) is not available, and
- where detailed data to apply option (c) above is unavailable.

**STEP 2. Calculate the Build Margin Emission Factor (EF_{BM,y})** as the generation-weighted average emission factor (tCO2/MWh) of a stated amount of power plants.

**STEP 3. Calculate the Baseline Emission Factor EF_y** as the weighted average of the Operating Margin emission factor (EF_{OM,y}) and the Build Margin emission factor (EF_{BM,y}).

The weights for EF_{OM,y} and EF_{BM,y} are by default 50%.

### 3.2 Justification of the Choice of the Methodology

This wind power project is connected to a predominantly coal, oil and natural gas fuelled grid, which is likely to affect the operating margin and in long term the build margin as will be discussed below. The chosen methodology requires a predominantly fossil fuelled grid and it therefore was applied to the Pannonia Ring wind farm JI Project.

### 3.3 Description of How the Methodology is Applied

To determine the baseline scenario the steps provided in the methodology are to be applied in context with the Pannonia Ring wind farm JI Project.

**3.3.1 Additionality**
(Explanation of how and why this project is additional and therefore not the baseline scenario)

Wind Power plants in general are zero emission energy sources. The Project is a grid-connected wind power generation project and will displace fossil fuel-based electricity generation within the Hungarian electricity grid. This will reduce carbon dioxide
emissions associated with the combustion of fossil fuels, and therefore no additional carbon dioxide emissions occur from the proposed JI Project.

Furthermore, there are several critical factors preventing this Project from being implemented as a business as usual project. These factors are mentioned below.

3.3.2 Investment Barriers

Basically there are two crucial barriers for the investment in the Pannonia Ring wind farm project:

(1) Financial considerations (without the additional funding by the ERU’s, the project is not economically viable)
(2) Risks due to contract-length of the national feed-in tariffs (The feed-in tariffs, necessary for the profitable operation of the wind farm, are not guaranteed during the whole planned lifetime)

Below, these barriers will be discussed in detail.

3.3.2.1 Investment Barrier 1: Financial Considerations

This chapter is not available for the public.

3.3.2.2 Investment Barrier 2: Risks due to contract-length of the feed-in-tariffs

This chapter is not available for the public.

3.3.3 Operating Margin

Unless there are specific circumstances to indicate otherwise, it is considered that grid connected power plants in general affect the operation margin as described in the methodology in Annex 6.1. Wind power plants are considered must-run power supplies, because the operating costs are very low, consequently they will be used when ever wind energy is available. In the case that the wind power plants are generating electricity, production capacity of marginal power plants will be reduced, and therefore the operation margin is affected.

The energy demand during the day varies significantly. The base load capacity, which is the minimum electricity capacity amount during the day, is provided by low-cost and must-run power plants. The Peak load during the peak hours is generated by immediately available and easily adjustable power plants. At present there is no dispatch plan available, due to lacking experience with the grid connection of wind power plants.
3.3.4 Build Margin

The plant’s effect on the Build Margin will be considered on the basis of its nominal capacity of 49.45 MW. For the most conservative approach all recorded capacities for the grid, based on the recent 5 years, are included.

The Built Margin is considered to be effected, when a significant part of the increase of capacities of the connected electricity grid is covered by the proposed Wind farm project.

The annual average of total available capacity increase, including the imports, amounts to about 233MW as shown in Table 10. The capacity of the Wind power plant is equal to 21.4% of the above mentioned total grid capacity rise. This percentage is a significant contribution to the average yearly capacity increase in Hungary. Therefore, the Pannonia Ring wind farm is considered to have an affect on the Build Margin.

<table>
<thead>
<tr>
<th>Increase of capacity</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available Capacity (A.C.) [MW]</td>
<td>6943</td>
<td>7309</td>
<td>7369</td>
<td>7813</td>
<td>7892</td>
<td>7927</td>
<td></td>
</tr>
<tr>
<td>Increase of capacity [MW]</td>
<td>366</td>
<td>60</td>
<td>444</td>
<td>79</td>
<td>35</td>
<td>35</td>
<td>196.8</td>
</tr>
<tr>
<td>Commissioned Capacity (C.C.) [MW]</td>
<td>7534</td>
<td>7847</td>
<td>7842</td>
<td>8282</td>
<td>8392</td>
<td>8311</td>
<td></td>
</tr>
<tr>
<td>Increase of capacity [MW]</td>
<td>313</td>
<td>-5</td>
<td>440</td>
<td>110</td>
<td>-81</td>
<td>-81</td>
<td>155.4</td>
</tr>
<tr>
<td>Total Available Capacity (+ import ) [MW]</td>
<td>7132</td>
<td>7227</td>
<td>7620</td>
<td>8120</td>
<td>8087</td>
<td>8299</td>
<td></td>
</tr>
<tr>
<td>Increase of capacity [MW]</td>
<td>95</td>
<td>393</td>
<td>500</td>
<td>-33</td>
<td>212</td>
<td>212</td>
<td>233.4</td>
</tr>
</tbody>
</table>

Table 10: Increase of capacity of the Hungarian grid

3.3.5 Determining the Operating Margin

As pointed out in paragraph 2.2 the Hungarian electricity grid is predominated by fossil fueled thermal power stations, generating 59,5% of the electrical energy. An amount of about 40% is produced by the Paks nuclear power plant. Renewables amount to less than 1% of the power production.

Some types of power plants have zero or very low operating costs especially in comparison to their installation costs. Therefore, their marginal costs for producing another unit of power are negligible and makes no sense in economic terms to reduce their output. Consequently, such units are considered must-run units, i.e. their output will not change when a new power plant is connected to the grid.

Such power plants are hydro power plants in non-hydropower-dominated grids and also nuclear power stations will never be replaced due to technical reasons. These facilities

---

are basically providing base load capacity and the provided energy will be used whenever it is available, therefore both facilities are not considered marginal.

In the context of the baseline determination, this circumstance is in agreement with the approach to exclude hydropower and nuclear power, as the Project will not affect the power generated from hydropower and nuclear power facilities.

The remaining facilities in the operating margin are gas turbines, steam turbines and combined cycle units fuelled by coal, fuel oil and natural gas. This is a more accurate representation of the actual Operating Margin, instead of taking the average of all power plants. This approach is in accordance with the approved consolidated methodology ACM0002.

3.3.6 Determining the Calculation Method of the Operating Margin Emission Factor

In Hungary no representative data of the individual power plants hourly generation-weighted average emissions by single power plants are available. Therefore the Dispatch Data Operation Margin emission factor can not be calculated, and the application of the Dispatch Data Analysis Operation Margin is not possible.

In accordance with the approved baseline methodology ACM0002 (Annex 6.1) the Simple Operation Margin can be used where low-cost/must run (hydro power plant, nuclear power plants) resources constitute less than 50% of total grid generation on an average of the five most recent years on the long-term normals for hydroelectricity production basis. They amount to about 41% of the total grid generation.

Figure 7 shows the categorization of the electricity production by energy sources. Within the recent 12 years the fossil fuel power plants always provided a lot more than 50% of the total grid generation and it is very likely to retain this production characteristic during the whole project period. Hydro power plants are generating less than 1% of the electricity and have a negligible impact on the amount of electrical production.

The Emission Factor of the Operation Margin is calculated as follows:

\[
\text{EF Operation Margin} = \frac{\sum \text{Fuel Consumption} \times \text{Emission Factor}}{\sum \text{Generated Power}}
\]
3.3.7 Determining the Build Margin

Concerning the approved baseline methodology ACM0002 (Annex 6.1), the Build Margin emission factor is based on the most recent information available on plants recently commissioned, under construction or intended to being built at the time of PDD submission.

The Budapest University of Economics carried out a study on the situation of the Hungarian electricity system. In this study published on the homepage of the Environmental Ministry of Hungary\textsuperscript{15} it is stated, that coal power plants with a considerable amount of capacity were and will be shut down within 1999 – 2012 due to the more restrictive environmental laws.

Additional new power plants will have to be built to cover the future electricity demand and the losses due to the closure of the old coal power plants. Most of these plants will be Combined Cycle Gas Turbines (CCGT).

Due to these facts it is very likely, that the capacity of the Pannonia Ring wind farm will be used also to replace part of the electrical capacity of the decommissioned coal power plants.

\textsuperscript{14} MVM; Statistical Data 2003, http://www.mvm.hu/
\textsuperscript{15} Environmental Ministry of Hungary, http://www.ktm.hu/
But in the above cited study, no detailed data regarding the Hungarian power plant expansion plan for the calculation of the Build Margin is stated.

The most recent information useful for the determination of the Build Margin according to the approved baseline methodology ACM0002 (Annex 6.1) is the Power Plant Expansion Plan of Hungary, published by the US Department of Energy (http://www.fe.doe.gov/international/CentralEastern%20Europe/hungover.html#Gas).

According to this Power plant expansion plan (which is described in detail in 2.1) the following power plants are representative for the Built Margin:

<table>
<thead>
<tr>
<th>Power Plant</th>
<th>Type of power plant</th>
<th>Power Capacity</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ujpest</td>
<td>combined cycle GT</td>
<td>70 MWe</td>
<td>being commissioned</td>
</tr>
<tr>
<td>Debrecen</td>
<td>combined cycle GT</td>
<td>170 MWe</td>
<td>under construction</td>
</tr>
<tr>
<td>Tisza II</td>
<td>combined cycle GT</td>
<td>191 MWe</td>
<td>under construction</td>
</tr>
<tr>
<td>Kispest</td>
<td>combined cycle GT</td>
<td>110 MWe</td>
<td>under construction</td>
</tr>
<tr>
<td>Dunaújváros</td>
<td>combined cycle GT</td>
<td>120 MWe</td>
<td>considered construction</td>
</tr>
<tr>
<td>Pécs</td>
<td>combined cycle GT</td>
<td>270 MWe</td>
<td>under development</td>
</tr>
<tr>
<td>Ajka</td>
<td>combined cycle GT</td>
<td>110 MWe</td>
<td>under development</td>
</tr>
<tr>
<td>Borsod Chem Ltd.</td>
<td>combined cycle GT</td>
<td>50 MWe</td>
<td>final stage of construction</td>
</tr>
<tr>
<td>Central European Steel</td>
<td>coal-fueled</td>
<td>590 MWe</td>
<td>planned</td>
</tr>
</tbody>
</table>

Table 11: Power plant expansion plan

The Emission Factor of the Built Margin is calculated as follows:

\[
\text{EF Built Margin} = \frac{\sum \text{Fuel Consumption} \times \text{Emission Factor}}{\sum \text{Generated Power}}
\]

3.3.8 Determining the Combined Margin

As required in the approved consolidated methodology ACM0002 (Annex 6.1), the Combined Margin is calculated by combining the Operation Margin and the Built Margin. By default the weights for the Operation Margin and the Built Margin are 50%, consequently the Combined Margin is calculated as follows:

\[
\text{EF Combined Margin} = \frac{\text{Operating Margin} + \text{Build Margin}}{2}
\]

16 http://www.fe.doe.gov/international/CentralEastern%20Europe/hungover.html#Gas
3.4 Description of How the Definition of the Project Boundary Related to the Baseline Methodology is Applied to the Project Activity

The physical borderline is defined as the plant site of the Pannonia Ring Power Plant. The gases and sources related to the baseline as given in the approved consolidated baseline methodology ACM0002 (Annex 6.1) is shown below.

<table>
<thead>
<tr>
<th>Source</th>
<th>Gas</th>
<th>Included in Emission calculation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>electricity generation of the grid</td>
<td>CO₂</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N₂O</td>
</tr>
</tbody>
</table>

3.5 Project Boundary

The project boundary is defined in terms of the system influenced by the operation of the proposed project. As shown in Figure 8, the project boundary includes the anthropogenic and significant GHG emission sources that are affected by the proposed project.

![Figure 8: Project Boundary](image)
For the baseline determination only CO₂ emissions from electricity generation in fossil fuel fired power is accounted, that is displaced due to the project activity. The spatial extent of the project boundary includes the project site, all power plants and the Pannonia Ring wind farm, that are physically connected to the Hungarian electricity system.

3.6 Details of Baseline Development

3.6.1 Date of Completing the Final Draft of this Baseline Section

24/09/2004

completed by:

ALLPLAN GmbH
Schwindgasse 10
A-1040 Vienna
Austria

3.6.2 Name of Person/Entity Determining the Baseline

TÜV Süddeutschland Holding AG
Westendstraße 19
D-80686 München
Tel: +49/89/5791-0
Fax: +49/89/5791-1551
4 Calculation of GHG Emissions by Sources

4.1 Emissions of the Project Activity Within the Project Boundary

Wind power is a zero-emission source of electricity. Emissions related to construction will occur, but are likely to be less than emissions from the construction of common power plants constructed in the baseline scenario. Accordingly, this source will not be taken into account.

Therefore, there are no emissions associated with the Pannonia Ring Wind Power Project.

4.2 Leakage

Defined as: the net change of anthropogenic emissions by sources of greenhouse gases which occur outside the project boundary, and that is measurable and attributable to the project activity: (for each gas, source, formula/algorithm, emissions in units of CO2 equivalent)

There are emissions arising due to activities such as power plant construction and transport. In accordance with the approved consolidated methodology ACM0002 in the Annex 6.1, these emissions do not need to be considered. Project activities using this baseline methodology shall not claim any credit for the project on account of reducing these emissions below the level of the baseline scenario.

Therefore, no leakage issues arise for wind power generation.

4.3 The Project Activity Emissions

Given that neither direct project emission nor leakage are present, the project activity emission is zero (0).

4.4 The Baseline Emissions
(for each gas, source, formula/algorithm, emissions in units of CO2 equivalent)

Based on the proposed methodology ACM0002 in Annex 6.1, the baseline is the combined margin approach of the grid using the average of the most recent three years of available statistical data. The emission factor was calculated based on the formula provided in the mentioned baseline methodology.
4.4.1 Calculation of the Operation Margin

In Table 12 the average fuel consumption of the recent three years was calculated. The IPCC emission factors and the Fraction of Oxidation factors were used to determine the carbon dioxide emission of the Operation Margin.

The emission factor of the Operation Margin was calculated using the following historical data (excluding the low cost and must run power plants):

### Carbon dioxide Emission

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>average</th>
<th>EF (IPCC) [tCO₂/TJ]</th>
<th>Fraction of Oxidation</th>
<th>tCO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lignite</td>
<td>54.134</td>
<td>57.009</td>
<td>54.492</td>
<td>55.212</td>
<td>96.07</td>
<td>0.98</td>
<td>5.198.101</td>
</tr>
<tr>
<td>Brown Coal</td>
<td>49.918</td>
<td>45.728</td>
<td>44.688</td>
<td>46.778</td>
<td>101.40</td>
<td>0.99</td>
<td>4.648.423</td>
</tr>
<tr>
<td>Hard Coal</td>
<td>10.659</td>
<td>8.776</td>
<td>8.692</td>
<td>9.376</td>
<td>94.60</td>
<td>0.98</td>
<td>869.199</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>43.046</td>
<td>43.300</td>
<td>22.769</td>
<td>36.372</td>
<td>73.33</td>
<td>0.99</td>
<td>2.640.463</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>76.989</td>
<td>94.618</td>
<td>106.461</td>
<td>92.689</td>
<td>56.10</td>
<td>0.995</td>
<td>5.173.872</td>
</tr>
<tr>
<td><strong>total</strong></td>
<td><strong>240.426</strong></td>
<td><strong>18.530.059</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Table 12: Average baseline emission

The average electricity generation of the recent three years amounts to 20.739GWh on the basis of fossil fuels as seen in the table below.

### Electricity Generation

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>fossile fuels</strong></td>
<td>20.062</td>
<td>21.376</td>
<td>20.780</td>
<td>20.739</td>
</tr>
</tbody>
</table>

Table 13: Average electricity generation amount

The Emission Factor of the Operation Margin can be calculated combining the data from Table 12 and Table 13. According to the following formula the Emission Factor of the Operation Margin is 0.893tCO₂/MWh.

\[
EF_{\text{Operation Margin}} = \frac{\sum \text{Fuel Consumption} \times \text{Emission Factor}}{\sum \text{Generated Power}} = \frac{18.530.059 \ tCO₂}{20.739.000 \ MWh} = 0.893 \ tCO₂ / MWh
\]

In addition, the electricity imports also affect the operating margin. According to Figure 9, the main amount was imported from the Slovak Rep. and the Ukraine. The Ukraine delivered 2950GWh (23.3% of total imports) and the transfers from the Slovak Rep. amounted to 9163.7GWh (72.7% of total imports). On the basis of both countries the
Ukraine exported electricity to Hungary in a share of 24.35% and the Slovak Republic in a share of 75.65% as shown in Table 14.

### Figure 9: Import / Export 2002

<table>
<thead>
<tr>
<th>Item</th>
<th>[GWh]</th>
<th>[%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovak</td>
<td>9.164</td>
<td>75.65</td>
</tr>
<tr>
<td>Ukraine</td>
<td>2.950</td>
<td>24.35</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12.114</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Table 14: Import Shares

In Table 15 the Slovakian and the Ukrainian fossil fuel grid mix is compared to the Hungarian fossil fuel grid mix. The Slovakian and the Ukrainian electricity production is predominated by coal fueled power plants. The Hungarian fossil fuel grid mix is dominated by natural gas and coal. For a precise comparison of both the Hungarian and the import fossil fuel grid mix, the generation-weighted import grid mix has to be calculated.
Comparison of the Hungarian grid mix with the Slovakian and Ukrainian grid mix

<table>
<thead>
<tr>
<th></th>
<th>Slovak 2000</th>
<th>Ukraine 2001</th>
<th>Hungary 2002</th>
<th>Slovak Share [%]</th>
<th>Ukraine Share [%]</th>
<th>Hungary Share [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>9.200</td>
<td>47.601</td>
<td>8.663</td>
<td>61,33</td>
<td>56,28</td>
<td>41,69</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>5.600</td>
<td>6.956</td>
<td>2.074</td>
<td>37,33</td>
<td>8,22</td>
<td>9,98</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>200</td>
<td>30.029</td>
<td>10.043</td>
<td>1,33</td>
<td>35,50</td>
<td>48,33</td>
</tr>
<tr>
<td>Total</td>
<td>15.000</td>
<td>84.586</td>
<td>20.780</td>
<td>100,00</td>
<td>100,00</td>
<td>100,00</td>
</tr>
</tbody>
</table>

Table 15: The Slovakian and Ukraine grid mix

Using the data from Table 15 and the above mentioned import shares, the fossil fuel grid mix of the imports can be calculated for Slovakia und the Ukraine. In the following it is shown how the weighted import share of coal was calculated:

weighted factor for Slovakia $= \frac{75.65 \%}{24.35 \%} = 3.1$
weighted factor for Ukraine $= 1$

Calculation of the weighted import share for coal:

Imported weighted share for coal $= \frac{61,33 \% \times 3.1}{4.1} + \frac{56,28 \%}{4.1} = 60,1 \%$

As shown in Table 16, the import is highly dominated by coal (60,1%) and fuel oil (30,24%) in comparison to the Hungarian fossil fuel grid mix which is dominated by natural gas (48,33%) and coal (41,69%).

Import-weighted grid mix

<table>
<thead>
<tr>
<th></th>
<th>Import-weighted Share [%]</th>
<th>Hungary Share [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>60,10</td>
<td>41,69</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>30,24</td>
<td>9,98</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>9,65</td>
<td>48,33</td>
</tr>
<tr>
<td>Total</td>
<td>100,00</td>
<td>100,00</td>
</tr>
</tbody>
</table>

Table 16: Import-weighted grid mix

The emission factor of the import is very likely to be considerably higher than the calculated emission factor for the Operation Margin in Hungary. In consideration of that fact it is conservative to use the Hungarian emission factor of the Operation Margin (0,893tCO₂/MWh) for the imports.

17 IEA Statistical Data 2001, 2002
4.4.2 Calculation of the Built Margin

The emission factor of the Built Margin was calculated using the following data comprising of the expansion plan in section 2.1:

**Power plant expansion plan**

<table>
<thead>
<tr>
<th>Power Plant</th>
<th>Fuel</th>
<th>Power Capacity [MWe]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ujpest</td>
<td>natural gas</td>
<td>70</td>
</tr>
<tr>
<td>Debrecen</td>
<td>natural gas</td>
<td>170</td>
</tr>
<tr>
<td>Tisza II</td>
<td>natural gas</td>
<td>191</td>
</tr>
<tr>
<td>Kispest</td>
<td>natural gas</td>
<td>110</td>
</tr>
<tr>
<td>Dunaujváros</td>
<td>natural gas</td>
<td>120</td>
</tr>
<tr>
<td>Pécs</td>
<td>natural gas</td>
<td>270</td>
</tr>
<tr>
<td>Ajka</td>
<td>natural gas</td>
<td>110</td>
</tr>
<tr>
<td>Borsod Chem Ltd.</td>
<td>natural gas</td>
<td>50</td>
</tr>
<tr>
<td>Central European Steel</td>
<td>coal</td>
<td>590</td>
</tr>
</tbody>
</table>

**Table 17:** Representative power plants

In Table 18 the carbondioxide emissions for the Built Margin are calculated. The capacity of natural gas fired power plants amount to 1091MW and the capacity of coal fired power plants equal to 590MW as shown in Table 17.

Coal power plants are generally considered to be base load power plants whereas the gas power plants are rather peak load power plants. Acknowledging these facts the yearly hours of operation were estimated with 4000 hours for gas power plants and 7000 hours for coal power plants.

Furthermore the efficiencies for new state of the art power plants are used to calculate the fuel consumption.

Finally, the carbondioxide emissions are obtained by applying the IPCC emission factors as shown in the table below.

**Carbondioxide Emission**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>1.091</td>
<td>4.000</td>
<td>4.364</td>
<td>0.45</td>
<td>34.912</td>
<td>56.10</td>
<td>0.995</td>
<td>1.948.770</td>
</tr>
<tr>
<td>Coal</td>
<td>590</td>
<td>7.000</td>
<td>4.130</td>
<td>0.38</td>
<td>39.126</td>
<td>96.07</td>
<td>0.98</td>
<td>3.683.688</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.681</strong></td>
<td><strong>8.494</strong></td>
<td><strong>74.038</strong></td>
<td></td>
<td><strong>56.01</strong></td>
<td><strong>96.07</strong></td>
<td></td>
<td><strong>5.632.458</strong></td>
</tr>
</tbody>
</table>

**Table 18:** Carbondioxide emission for the Built Margin
With the data from Table 18 the Emission Factor of the Built Margin can be calculated. The Emission Factor of the Built Margin equals 0,663 tCO₂/MWh according to the following formula.

\[
EF \text{ Built Margin} = \frac{\sum \text{Fuel Consumption} \times \text{Emission Factor}}{\sum \text{Generated Power}} = \frac{5,632,458,24 \ t_{\text{CO}_2}}{8,494,000 \ MWh} = 0,663 \ t\text{CO}_2/\text{MWh}
\]

4.4.3 Calculation of the Combined Margin

Using the following formula the Emission Factor of the Combined Margin can be calculated by combining the Emission Factor of the Operation Margin and the Emission Factor of the Built Margin. The Emission Factor of the Built Margin equals to 0,778 tCO₂/MWh.

\[
EF \text{ Combined Margin} = \frac{\text{Operating Margin} + \text{Build Margin}}{2} = \frac{0,893 + 0,663}{2} = 0,778 \ t\text{CO}_2/\text{MWh}
\]
4.4.4 Avoided Carbon Dioxide Emission

Finally, the avoided carbon dioxide emissions derive as difference between baseline emission and proposed project emission as tabulated below. The resulting Emission Reduction Units (ERUs) within 2008 - 2012 amount to 408.603 tons of carbon dioxide, as shown in Table 19.

### Emission Reduction Units

<table>
<thead>
<tr>
<th>Year</th>
<th>Generated electricity [MWh]</th>
<th>Emission factor combined margin [t CO₂ / MWh]</th>
<th>Baseline emission [t CO₂]</th>
<th>Project emission [t CO₂]</th>
<th>Emission reduction [t CO₂]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2008</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2009</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2010</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2011</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2012</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2013</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2014</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2015</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2016</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2017</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2018</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2019</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2020</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2021</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2022</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2023</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2024</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2025</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td>2026</td>
<td>105.000</td>
<td>0.778</td>
<td>81.690</td>
<td>0</td>
<td>81.690</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2.520.000</strong></td>
<td><strong>1.960.560</strong></td>
<td><strong>0</strong></td>
<td><strong>1.960.560</strong></td>
<td></td>
</tr>
</tbody>
</table>

ERU 2007 105.000 81.690 0 81.690
ERU 2008-2012 525.000 408.450 0 408.450
ERU 2013-2026 1.470.000 1.143.660 0 1.143.660

**Table 19:** Avoided Carbon dioxide Emission
5 Monitoring Methodology and Plan

5.1 Name and Reference of Approved Methodology Applied

There are currently only approved methodologies for grid-connected zero-emissions renewable electricity generation but no approved methodologies specifically for Grid-connected wind power generation.

Therefore, the approved consolidated monitoring methodology ACM0002 (Annex 6.1), is applied for the proposed Pannonia Ring Wind Power JI project, which is in direct conjunction with the applied approved baseline methodology (chapter 3 and 4).

The above mentioned methodology is designed to be applicable for JI/CDM Projects with grid-connected wind power plants. As there are no standard methodologies for JI Projects yet and the requirements for implementation of CDM projects are in general stricter than for JI projects, the above named CDM methodology is chosen for this JI Project.

5.2 Justification of the Choice of Methodology and Why It Is Applicable to the Project Activity

The chosen methodology requires a predominantly fossil fuelled grid and it therefore was applied to the Pannonia Ring wind farm JI Project.

Related to the project, Wind Power Plants are generally zero emission energy sources and only emissions of baseline grid electricity production will be emanated.

The only activity level that according to the baseline requires monitoring is electricity produced by the Pannonia Ring wind farm JI Project. This variable is monitored with appropriate quality control procedures and is applicable to the Project.

5.3 Data to Be Collected in Order to Monitor Emissions from the Project Activity

There are no emissions to be monitored for the project activity.
5.4 Potential Sources of Emissions Which Are Significant and Reasonably Attributable to the Project Activity, but Which are Not Included in the Project Boundary

There are no leakage issues associated with the Project.

5.5 Relevant Data Necessary for Determining the Baseline of Anthropogenic Emissions by Sources of GHG Within the Project Boundary

The baseline emission will be monitored through the amount of electricity produced by the project and fed into the Hungarian grid. The amount of avoided CO\textsubscript{2} emission is calculated by multiplying the amount of produced electricity with the baseline emission factor in 4.4.4.

**Required Monitoring elements**

<table>
<thead>
<tr>
<th>ID number</th>
<th>Data type</th>
<th>Data unit</th>
<th>Data variable</th>
<th>Recording frequency</th>
<th>Will data be collected on this item?</th>
<th>How is data archived?</th>
<th>For how long is archived data kept?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Generated Electricity</td>
<td>MWh</td>
<td>Electricity fed into the national grid</td>
<td>yearly</td>
<td>yes</td>
<td>electronic</td>
<td>During the first commitment period and two years after</td>
</tr>
</tbody>
</table>

*Table 20: Required Monitoring elements*
A template for reporting this data is shown on the table below. This template is part of the monitoring plan.

<table>
<thead>
<tr>
<th>General Data</th>
<th></th>
<th></th>
<th>Email address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepared by</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approved by</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity feed-in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[MWh]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emission factor</td>
<td>0,778</td>
<td>0,778</td>
<td>0,778</td>
<td>0,778</td>
<td>0,778</td>
<td>0,778</td>
<td>0,778</td>
</tr>
<tr>
<td>[tCO₂ / MWh]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total emission reduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[tCO₂]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 21: Template for reporting the reduced carbon dioxide emissions

The amount of electricity produced by the project is obtained from meter readings, whereas the recording is done once a year. The data has to be archived during the first commitment period and for additional two years.
5.6 Quality Control (QC) and Quality Assurance (QA) Procedures are Being Undertaken With Monitored Data

Quality control (QC) and quality assurance (QA)

<table>
<thead>
<tr>
<th>Data</th>
<th>Uncertainty level of data (High, Medium, Low)</th>
<th>Are QA and QC procedures planned for the data</th>
<th>Outline explanation why QA/QC procedures are or are not being planned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low</td>
<td>yes</td>
<td>Meters will undergo maintenance subject to appropriate industry standards. The meter readings will be checked against power purchase receipts. As there needs to be a consensus between parties with opposing interests on the amount of electricity produced, the probability of error is seen as low.</td>
</tr>
</tbody>
</table>

Table 22: Quality control (QC) and quality assurance (QA)

To guarantee the necessary quality control and quality assurance the following procedures will be established:

The type of meters comply with the international standards. The survey in accordance with the quality control procedure and quality assurance will be performed by the Hungarian Federal office for Calibration and Measurement.

An additional, independent federal agency, the OMH (ORSZÁGOS MÉRÉSÜGYI HIVATAL, National Office of Measures of Hungary, www.omh.hu) is in charge with the controlling of the meters and guaranteeing their operation within close, officially set parameters.

MAVIR, the Hungarian Power System Operator Company (www.mavir.hu), will have to purchase the electricity produced by the Pannonia Wind Farm, and will therefore as a party with opposing interests to Pannonia Szel pay close attention to the correct functioning of the meters.

The manufacturer of the meters has established and applied the quality management accordingly to the ISO 9000:2000.

The meter readings are regularly read off by an employee of Pannonia Szel and will be recorded in the template (Table 21) in section 5.5. A further different person of Pannonia Szel will be in charge of comparing the meter readings of the wind power plants with the accounted electricity by Edasz. Additionally the meter readings are being sent to the relevant officials of the Hungarian Power System.
5.7 Name of Person/Entity Determining the Monitoring Methodology

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6 Annex

6.1 Annex – Approved Consolidated Baseline and Monitoring Methodology ACM0002


6.4 Annex - An Energy Overview of the Republic of Hungary

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