Study Tour to Central and Eastern Europe, August 2013
In the framework of
"Engaging Citizens in Sustainable Energy to improve environment and local Economy”
ECSE Project in 2012-14.

Characteristics of a Sustainable Energy Future in Hungary

By
dr. Béla Munkácsy

More about the Project:
http://www.inforse.org/europe/ECSE.htm
http://inforse.org/europe/ECSE_RU.htm

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Characteristics of a Sustainable Energy Future in Hungary
Technical and Socio-Economic Potentials

Vision 2040 Hungary

dr. Béla Munkácsy
ELTE University, Budapest and Hungarian Educational Network Association Hungary
Consequences of the Technology and Economy Based Energy Management

 Humanity's ecological footprint

Energy

Built-up land

Food, fibre, and timber

WWF, 2004
The 4 main elements of sustainable energy management

- **Technological aspect**
  - Improvements on efficiency

- **Human aspect (Responsible consumption)**
  - Internal pressure (raising awareness)
  - External pressure (economical regulation)

- **Sustainable utilisation of renewable energy sources**
  - 1100-1200 PJ
  - 300-320 PJ

- **Cross-sectoral interconnections**
  - Interdisciplinary approach - focusing on locality

Reduced consumption

Optimized production
Interconnections of Energy Planning

Source: Béla Munkácsy: The importance of holistic approach in energy planning
In: Bokor László, Csapó János, Szelesi Tamás, Wilhelm Zoltán (editor)
3 main steps of creating the Vision 2040 Hungary sustainable energy scenario

1) **Calculating potentials** - partly with GIS methods:
   - Technical potentials of RES;
   - Socio-economic potentials of RES;
   - Potentials in energy efficiency.

2) **Creating a scenario** – with INFORSE’s MS Excel application:
   - for production and consumption;
   - by 2050 in five-year steps (production and consumption).

3) **Checking and setting balance** - with EnergyPLAN:
   - storage + demand side management.
Methodology of Calculating Technical RE Potentials (the example of wind energy)

- Legal and infrastructural limitations
  a) protected natural areas (local, national and international level);
  b) protected landscapes (national and county level);
  c) Environmentally Sensitive Areas (ESA);
  d) forests;
  e) hydrographical elements;
  f) roads, railways and airports;
  g) transmission lines (as vulnerable elements of the infrastructure).

- present technological level (8-10 MW/km²)
Results of the Screening: Potential Areas for RE Applications
(examples of 2 Hungarian counties in the field of wind energy)
Methodology of Calculating Socio-Economical RE Potentials (the example of solar energy)

- Finding a region (→ Bavaria)
  - with the most outstanding performance in the field;
  - with similar natural conditions.
- Calculating specific indicators:
  - for 1000 inhabitants (750,69 kW/1000 cap);
  - for km$^2$ (134,65 kW/km$^2$).
- Apply the resulted figures for the Hungarian conditions
- Use a correction with the GDP (3 times lower GDP means 3 times longer realization)
## Socio-Economic Potential

*(an example of the international comparison in the field of solar PV)*

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>Total Solar PV (MW)</th>
<th>Population (Million)</th>
<th>Area (km²)</th>
<th>Population Density (Euro/cap)</th>
<th>Density (kW/km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAVARIA</td>
<td>2000-2012</td>
<td>9500</td>
<td>12.65</td>
<td>70551</td>
<td>35600</td>
<td>750,69 kW/ 1000 cap</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>134,65 kW/ km2</td>
</tr>
<tr>
<td>HUNGARY</td>
<td>2013-2025</td>
<td>4</td>
<td>9.95</td>
<td>93030</td>
<td>12800</td>
<td>0,40 kW/ 1000 cap</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0,04 kW/ km2</td>
</tr>
</tbody>
</table>

**BAVARIA**
- Years: 2000-2012
- Total Solar PV: 9500 MW
- Population: 12.65 million inhabitants
- Area: 70551 km²
- Population Density: 35600 Euro/cap
- Solar PV Density: 750,69 kW/1000 cap
- Solar PV Density: 134,65 kW/km²

**HUNGARY**
- Years: 2013-2025
- Total Solar PV: 4 MW
- Population: 9.95 million inhabitants
- Area: 93030 km²
- Population Density: 12800 Euro/cap
- Solar PV Density: 0,40 kW/1000 cap
- Solar PV Density: 0,04 kW/km²

**Source:** [http://www.foederal-erneuerbar.de](http://www.foederal-erneuerbar.de)
## Sustainable Utilisation of Renewable Energy Sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Technical Potential (PJ/year)</th>
<th>Socio-Economical Potential (PJ/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>268 (157 power + 111 heat) (33500 MW hybrid collector)</td>
<td>37-56 (28-47 power + 9 heat) (in comp. with Bavaria and Austria)</td>
</tr>
<tr>
<td>Wind</td>
<td>350-450 (50000-60000 MW)</td>
<td>90-100 (12000-13000 MW) - in comp. with Eastern-Germany</td>
</tr>
<tr>
<td>Biofuel (EU Directive)</td>
<td>12</td>
<td>90 (in comparison with data from MeckPomm and Sweden)</td>
</tr>
<tr>
<td>Sustainable biomass</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy crops</td>
<td>65 (5000 km2)</td>
<td></td>
</tr>
<tr>
<td>Biogas</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Ambient heat</td>
<td>100 ??</td>
<td>85 (in comp. with Sweden)</td>
</tr>
<tr>
<td>Hydro</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Σ</strong></td>
<td>~980-1080</td>
<td>~300-320</td>
</tr>
</tbody>
</table>
“This Way Ahead”
Vision 2040 Hungary 1.0
Sustainable Energy Scenario

- **First version published 2011**;
- a best case scenario;
- **by 2050 (100% renewable energy ratio by 2040)**;
- for 10 million inhabitants;
- with stable living standards;
  - due to efficiency measures;
  - with limited consideration of sufficiency.

More in English:
www.inforse.org/europe/VisionHU.htm
The Biggest Challenge: Reshaping Transportation
Energy Consumption of the Transportation Sector by Sources

[Chart showing energy consumption in PJ from 2000 to 2050, with contributions from hydrogen, electricity, biofuel, and petroleum products reducing over time.]
Energy Efficiency of Methods in Freight (energy use/km in %)
Activity of Freight (running distance in %)
Activity in Personal Transportation (running distance in %)
Primary Energy Supply between 2000-2050