Integration of more Renewable electricity in the CEE region: network or support


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- **Göran Koreneff**  Technical Research Centre of Finland (VTT )
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- **Harry Lehmann**  Federal Environmental Agency
- **István Pataki**  Vice President of Hungarian Energy Office , Environmental Planning and Sustainable Strategies
- **Jorge Vasconcelos**  Director of European Renewable Energy Investment Portfolio; Former President Council of European Energy Regulators
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Information on the co-organiser

The Regional Centre for Energy Policy Research (REKK) was founded in January 2004 at the Corvinus University of Budapest (formerly known as the Budapest University of Economic Sciences and Public Administration). Its staff includes university teachers from the field of interest of the Centre, a research fellow of the Institute of Economics (Hungarian Academy of Sciences), full-time research fellows and graduate scholarship students. Apart from scientific and methodological experience, the staff possesses considerable regulatory and public administration expertise.

REKK is an independent non-governmental organization financed by cooperative agreements and commercial contracts.

The purpose of REKK is to provide professional analysis and advice on networked energy markets that are sustainable both commercially and environmentally. We believe that the Hungarian experience of the last decade on restructuring and regulating energy markets and the related research are applicable to other CEE countries as well, therefore our aim is to operate on the regional level.

The aims of REKK are twofold:

- carry out high standard policy oriented research for the energy market actors focused on energy policy, regulations and investment needs; and
- use these research results for educational purposes.

Our partners:

- central and local governmental organizations
- international organizations
- energy companies
- non-profit organisations

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Integration of more Renewable electricity in the CEE region: network or support problem?

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- Organisers:
  - Joint Research Centre (JRC) of the European Commission, Institute of Energy, Renewable Energy Unit
  - Regional Centre for Energy Policy Research (REKK)

Proceedings of the roundtable on:
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Preface to the proceedings
Introduction
Crosscutting issues discussed at the roundtable
Communication of RES benefits
Political framework conditions for RES acceptance
Developing legal background for RES-E deployment
Balancing costs and the reserve capacity requirement
Financing reserve capacities: the case for hydro pumping storage
The effects of financial structures on RES investment
The effects of the expected rate of returns
Feed-back on the proposed questionnaire
Related EU projects
Enhancement of sustainable electricity supply through improvements of the regulatory framework of the distribution network for distributed generation (DG-GRID)
Solid-Der
Barriers and recommendations identified by the project

Presentations:

Harry Lehmann  Necessary policy elements to overcome barriers that prevent the integration of RES-E
Jorge Vasconcelos  Renewable energy: new challenges for regulators and network operators
István Pataki  The new RES regulation: the Green Package in Hungary
András Mezősi  Economic analysis of energy storage requirements in connection with RES-E
Christos Protogeropoulos  New Legislative and Regulatory Measures for the Development of RES Technologies & Applications in Greece and Experiences Encountered after Two Years of Programme Activity
Göran Koreneff  Effects of large-scale increase of RES-E with the focus on the spot market price levels in the Nordic Power system
Tamás Tóth  Specific economic details of the RES regulation (penalties for wind generators due to production outside the schedule)
Vaida Tamašauskaitė  Wind Projects integration in Lithuanian Electricity Network
Vaclavas Kveselis  Renewable Energy Sources for electricity production: status in Lithuania
Hanna Bartoszewicz-Burczy  Renewable Energy Sources in Poland—Evolution, Current State and Possibilities of development
Dan Teodoreanu  The Renewable Energy Sources in Romania – Elements of the proposed RES legislation
Corneliu Radulescu  Renewable Energy Sources and Energy Efficiency in Romania in the light of the EU legislation
Rostislav Krejcar  The latest issues with RES-E development in the Czech Republic
Preface to the proceedings

Introduction

The European Commission has the task and the mandate to continuously monitor and evaluate the progress achieved in implementing Renewable Energies and Energy End-Use Efficiency. Therefore it is indispensable to have up-to-date references in this important field of sustainable development. It stimulates common and harmonised socio-economic tools for energy strategy concerning the implementation of new and emerging energy technologies.

The Renewable Energy Unit (Scientific Technical Reference System) aims to increase the common understanding and to give unbiased, reliable and organised information on Renewable Energy and Energy End-Use Efficiency. This is done by generating better up-to-date input required for monitoring of existing European policies and legislation and by collecting data from statistical offices and other relevant institutions.

In this respect the analysis of diverging trends in Renewable Energy Sources (RES) application in the various Member States, and identification of the driving forces behind the different trends is an important mission of the Renewable Energy Unit (REU). This can reveal which policy approaches perform better in the various socio-economic environment and by their comparison and dissemination it can foster the selection of the most appropriate policy tool for decision makers. Within this framework the Renewable Energy Unit has organised a roundtable with experts in the field from the different Member States.

Renewable energy use and the projected shares of the renewable energy sources (RES) in the final energy mix show positive tendencies all over Europe. Beyond the positive impression one can draw from the increase, there are signs that there are some diverging tendencies among different groups of countries. The first impression from the target shares in the final energy demand is that the more and less ambitious RES targets are distributed more or less evenly between the groups of the EU 12 and EU 15 countries (Figure 1). Targets vary significantly across the countries but from both groups (indicated with red and blue columns) one can find high and moderate RES shares in final energy demand targets. The first presumption is that these targets are not influenced by which group a country belongs to but there are other factors behind these differences.
By taking a closer look at the RES-E distribution and 2010 targets one can recognize that the countries with high RES-E shares from the EU12 group all heavily rely on the hydro sources, so the high Latvian, Slovenian and Slovakian RES figures indicate that the other renewable sources are utilised at a low level (Figure 2). The utilisation level of hydro sources are the most difficult ones to increase: both the expansion of utilisation rate and finding sites for new capacities are limited. This has further implication: the increase of the target level compared to the existing utilisation level is much less within the EU12 country group. Those countries that already had gained experience with higher shares of RES in their electricity generation portfolio use accelerated RES deployment in their projections. This suggests that instead of positive spillover from the countries with extensive experience the gap opens up wider between these two country groups. An efficient policy aiming at a harmonisation of European RES development has to address this potential problem.
In this context the roundtable had a twofold objective. First it aimed at classifying and ranking the most important factors in CEE countries impeding a more rapid deployment of renewable energy sources for electricity production (RES-E). We used the following problem classification:

- Financial
  - Regulative – support measures

- Institutional
  - Network management - infrastructure
    - Trans-Boundary Power Exchange (Cross-Border Issues)
    - Power Systems Interconnection / Fair third party access rules
  - Market structure/concentration

The second objective was to identify efficient ways to overcome these barriers from demonstrations of successful examples from Member States with longer RES-E integration experience. Some of the best available techniques and country experience with the different policies were presented at the roundtable. The invited experts shared their experiences gained at various institutions: energy regulation offices, grid operating entities, energy production units and quite a few in energy related research organisations. Beside the positive examples, the barriers that exist in the various member states were also discussed.

The roundtable proceeding may help the stakeholders in the identification of their strategic benefits from RES integration.

The more rapid development of RES can offer advantages for all stakeholder groups: this win-win situation can be realised if all stakeholders of the market and regulation would be informed better how to benefit from the increased diversification offered by RES. The major benefits can be identified as the following for the stakeholders.

- Regulators can get a better understanding how the problems of larger scale integration the RES sources were overcome in different countries. More sophisticated regulatory mechanisms and
better information systems can strengthen the position of regulatory bodies. Improving market conditions, bidding procedures, (ie. day and hour ahead market instead of the monthly schedule), embedding forecasting systems will lead to enhanced regulatory regimes.

- Grid operators are interested in the DER integration challenges, system loss reduction, access conditions, integrating output forecast from intermittent generators that can contribute to improved grid operation methods.
- Power production investors seek low volatility, secure cash flow (feed in tariff), diversification, immunity from oil price changes and carbon prices.
- Researchers quest for innovation and cost reduction by technological learning.

The current proceedings of the roundtable focus on the crosscutting issues that were discussed in more presentations or were emphasised by many participants rather than summing up the country presentations. Those interested in the country specific topics can search for the required information in the attached presentations.

**Crosscutting issues discussed at the roundtable**

**Communication of RES benefits**

Primary task to secure RES development is to inform all stakeholders about its advantages. Only by communicating and understanding the benefits of higher RES shares in the energy mix can trigger their deployment. Without awareness of the benefits it is impossible to raise the willingness to pay to the adequate level: the consumers should be conscious that RES will pay back the money they invest in it. They key factors of benefits to communicate are:

- Climate protection
- Independence of fossil fuel imports
- Reduction of (international) conflicts
- Low risks for humans and environment
- Local economic and social development especially for poor countries
- Fostering industrial development and export opportunities

**Political framework conditions for RES acceptance**

All stakeholders have to have consented to the targets: without a well-established political will the support will not be sustained long enough to deliver the expected benefits and results (like cost reduction from learning etc.). The presentations identified the following indispensable elements of the political support:

- long-term and binding development targets, and
- respective long-term legislative projects and planning (e.g. IKEP in Germany)

**Developing legal background for RES-E deployment**

The presentations were planned to cover the RES status in the different countries from different viewpoints. In the meeting the issues of legal, regulatory and network improvement challenges, price and financial effects were covered. Among the presentations from the EU15 countries there were two that had discussed in details the structural elements of the legal background of RES. They highlighted both the strength and the weaknesses of their national legislation for the RES support. The experiences in Germany and Greece are completely different.
In the design of the legal system Germany could build on the consensus agreed earlier by the political stakeholders. This political agreement created the basis for a sustained renewable energy policy that fostered the unprecedented growth of the sector in Germany.

The initial RES legislation in Greece proved to be insufficient: dozen additional laws, common ministerial and circular decisions etc. were put in place to resolve important processing and technical issues. The regulatory and legislative environment was confusing and extremely bureaucratic, restraining the development of RES in the country. The cap on RES deployment introduced in the former legislation caused lot of problems. The new law of 2006 constitutes the legislative and regulatory framework basis for the initiation of sustainable RES activities in the country. The Feed–in–Tariff system that has been introduced includes favourable conditions for grid-connected Photovoltaic (PV) application. One major change in the legal frameworks of Greece concerning PV applications is that new law does not introduce a cap; there is reference to targets expected to be achieved by 2020.

Balancing costs and the reserve capacity requirement

The different solutions to system imbalances caused by the changing electricity output of certain renewable energy production (wind and solar) has been discussed in many presentations. It was the main focus of the presentation on the NordPool experience and of the presentation from the Regional Centre for Energy Policy Research (REKK).

For the NordPool system the effects of large-scale increase of RES-E on the electricity prices is a critical issue. In the NordPool system the RES electricity share already reached unprecedented levels in the electricity mix and the fulfilment of ambitious plans for the future development which will have major effects on the balancing and reserve system as well as on future price levels.

The NordPool experience shows that combining wind imbalances with other existing production units (hydro, heat and power etc.) significantly reduces the balancing cost. The smaller the wind proportion is to the other capacities the higher the cost reduction potential of these combinations. The presentation of the Technical Research Centre of Finland (VTT) calculations show that only small change in the use of the existing hydro capacities can cover balance requirements of large scale RE capacities; 80-90 % of of wind power imbalances can be regulated using the existing hydro capacities. Since in the NordPool region the RES-E share is estimated to expand much further, the balance requirement and the associated costs are considered as a very important part of the future functioning of the electricity market.

The price model (one price model vs. two price model see the presentation on NordPool) used in regulating power imbalances has significant impact on the wind capacities: as long as wind power is not dominating the power system imbalance one-price model is very good for wind power producers since the deviation will be about half and half towards inbalance and balance, there will be no extra cost for the wind capacities.

The presentation discussed the modelling results for RES-E shares and wholesale price effects of the different CO2 prices concluding that the system regulation requirements (balancing and reserves) have negligible effect on the prices compared to the effects that carbon pricing.

Financing reserve capacities: the case for hydro pumping storage
In addition to analysis on the price and balancing effects of a large scale grid integration of wind capacities, in the roundtable the Hungarian co-organising institute (REKK) has also presented an economic analysis of hydro pumping storage as an energy storage option in connection with RES-E integration. The calculations - using the data of Table 1 – suggested that building such system is not very attractive to private investors. Another important conclusion of this research was that the profitability of such investment depends on the price of balancing energy that suppose transparent balancing markets.

<table>
<thead>
<tr>
<th>Input category</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak off-peak margin</td>
<td>(€/MWh)</td>
<td>20</td>
</tr>
<tr>
<td>Overnight cost</td>
<td>(€)</td>
<td>600 000 000</td>
</tr>
<tr>
<td>Installed capacity</td>
<td>(MW)</td>
<td>600</td>
</tr>
<tr>
<td>Daily production</td>
<td>(MWh)</td>
<td>3 000</td>
</tr>
<tr>
<td>Net efficiency</td>
<td>(%)</td>
<td>80%</td>
</tr>
<tr>
<td>Yearly production</td>
<td>(MWh)</td>
<td>876 000</td>
</tr>
<tr>
<td>Yearly income</td>
<td>(€)</td>
<td>17 520 000</td>
</tr>
<tr>
<td>Payback period with 0 discount rate</td>
<td>year</td>
<td>34.2</td>
</tr>
</tbody>
</table>

In the roundtable discussion this presentation attracted lot of attention from the participants and stimulated the most intensive discussion. Therefore we invited the speaker to prepare similar analysis on an Austrian example for which the Renewable Energy Unit (REU) has collected some input data (from publicly available information sources for a similar capacity project), in order to facilitate some comparison. The Austrian case study shows the data for a 20 % lower capacity hydro pumping storage. The costs connected to the project is lower than for the other case (with 39%) because it is not a completely new plant but an extension and upgrading of an already existing capacity. The peak off-peak margins (that takes account of the efficiency losses as well) are similar (20 and 22 €/MWh). The projected operation hours and therefore the yearly income are also very similar for the two cases. The analysis did not calculate with O&M costs.

<table>
<thead>
<tr>
<th>Input category</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed capacity (MW)</td>
<td>480</td>
<td>Verbund</td>
</tr>
<tr>
<td>Overnight cost (€)</td>
<td>365.000.000</td>
<td>Verbund</td>
</tr>
<tr>
<td>Operation hours per year (h/a)</td>
<td>2,000</td>
<td>Verbund</td>
</tr>
<tr>
<td>Efficiency (%)</td>
<td>80%</td>
<td>own estimation</td>
</tr>
<tr>
<td>Off-peak price (€/MWh)</td>
<td>50</td>
<td>EEX</td>
</tr>
<tr>
<td>Peak price (€/MWh)</td>
<td>90</td>
<td>EEX</td>
</tr>
<tr>
<td>Peak-off-peak margin (€/MWh)</td>
<td>22</td>
<td>EEX</td>
</tr>
<tr>
<td>Yearly income (€)</td>
<td>21.120.000</td>
<td></td>
</tr>
<tr>
<td>Payback period with 0 discount rate</td>
<td>17.28</td>
<td></td>
</tr>
<tr>
<td>Payback period with 3 % discount rate</td>
<td>33.97</td>
<td></td>
</tr>
<tr>
<td>Payback period with 5 % discount rate</td>
<td>40.91</td>
<td></td>
</tr>
</tbody>
</table>

The following conclusions can be derived from the two analyses. The most important conclusion is that the returns to the hydro pumping stations produced by the most recent peak-off-peak margins on the European electricity markets are not adequate to attract investors on pure financial basis. Even if calculated with low expected rate of returns, the pay back time for these type of projects is more than 40 years. We identified four possible factors that can justify the willingness of investors to initiate such projects.

The peak - off peak margins

The peak off peak margins are assumed to be constant in the analysis, however the very recent tendencies show that the peak electricity prices tend to be grow faster, and more volatile than the base
load prices. The following EEX figure shows a gradually increasing gap between the peak-load and base-load prices (the red line is the peak-load, the black is the base-load price and their 200 day averages are also shown by the trend lines). More reliable, longer term trend is difficult to establish because of there were structural changes in the electricity markets were organised so the data are often not comparable.

Source:

The effects of regional trade on the benefits

In addition as the hydro pumping power plants can sell electricity abroad (and buy the base-load from domestic sources) so their margins can be much higher as the peak-load base-load price margins experienced on the national exchange. Assuming perfect competition the price difference can be sustained only if there is capacity shortage at the border. The existing price difference is partly due to the existing market imperfections and the capacity shortages. (Table 3).

<table>
<thead>
<tr>
<th></th>
<th>Price €/MWh</th>
<th>One month Change (June-July)</th>
<th>Year-to-Year Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPEX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base-Load</td>
<td>97,32</td>
<td>16,6%</td>
<td>16,1%</td>
</tr>
<tr>
<td>Peak</td>
<td>138,08</td>
<td>18,9%</td>
<td>2,6%</td>
</tr>
<tr>
<td>Off-Peak</td>
<td>66,46</td>
<td>8,5%</td>
<td>32,3%</td>
</tr>
<tr>
<td>Holiday</td>
<td>83,08</td>
<td>13,7%</td>
<td>32,1%</td>
</tr>
<tr>
<td>EEX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base-Load</td>
<td>69,94</td>
<td>-4,5%</td>
<td>138,6%</td>
</tr>
<tr>
<td>Peak</td>
<td>92,35</td>
<td>-10,7%</td>
<td>117,6%</td>
</tr>
<tr>
<td>Off-Peak</td>
<td>58,18</td>
<td>-2,0%</td>
<td>156,6%</td>
</tr>
<tr>
<td>Holiday</td>
<td>54,65</td>
<td>-4,1%</td>
<td>155,9%</td>
</tr>
<tr>
<td>Powernext</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base-Load</td>
<td>70,27</td>
<td>-3,5%</td>
<td>135,9%</td>
</tr>
<tr>
<td>Peak</td>
<td>95,54</td>
<td>-12,5%</td>
<td>116,0%</td>
</tr>
</tbody>
</table>
Table 3 Various prices of European power exchanges  
Source: GME’s Newsletter – Issue no. 8 – August 2008

The effects of financial structures on RES investment

Quite a few experts touched upon the importance of the financing environment. In the presentation covering the German experiences a very interesting comparison was presented on the possible link between the effectiveness of RES policy measures and the expected profits for wind energy projects (see slide 10. titled "Effectiveness versus expected profit" of the presentation). The tentative conclusion is that effective support can be reached with much lower expected annual profit if the feed-in-tariff type of mechanism is used than in the case of quota type of measures.

The effects of the expected rate of returns

The expected rate of return plays important role in financial decisions not only in the case of the hydro pumping plants but also on how the investors select their power portfolio elements. In this chapter first we show the projections made by European Transmission System Operators on how the increasing wind generation is likely to change the flow and the future production capacities of electricity. A research project was carried out in the REU in 2007 which also projects the capacity changes in Europe due to changing return expectations of the investors. We compare projected capacity changes of ETSO to the results of this financial analysis that assessed the capacity effects of the changing financial structure.
The latest investment data shows that Renewable Energy Sources has arrived at a new stage of development worldwide (PV Status Report 2007, 2008, Dexia Bank communication) by moving out of the 'niche market' position they occupied before. This favourable performance is partly due to the booming price of traditional – fossil - fuels and also the improvements of the RES based technologies. These changes will take place throughout Europe so the individual states has to consider effects of the developments on their neighbouring countries even if their decision makers on the electricity sectors are conservative about their potential.

Intensive wind deployment increase in the Northern part of Europe (Denmark, The Netherlands, North Germany) affect practically the electricity flows in Central Europe as well as in Southern countries as far as Portugal (Figure 4,5 and 6). Similar map was drawn for the effects of the Spanish wind development. And these effects are not confined to the national electricity transport infrastructure but also affect through substitution the generation portfolio as well. When the stakeholders in a Member States make the decisions on the future changes of the power production portfolios they have to be aware this substitution effects on the electricity generation capacities of these developments.

Figure 4 Changes of electrical power transmission in UCTE Scenario North
A research project carried out in the REU in 2007 projects similar capacity changes due to changing relative paybacks (see Figure 7).
The effects on the overall European electricity generation mix are summarised in Figure 8 that show the changes in the capacities and utilisation of the various portfolio elements. The first graph shows the historic portfolio, the second shows the projected 2030 portfolio under two different return expectations. Scenario B (business-as-usual) calculates with the sustained high return expectations that prevail today in Europe to result in the slowdown of RES technology deployment. The historical return-on-investment (ROI) data used to approximate the expected rate reveals a huge gap between the European and other OECD countries (USA; Japan, Australia) in this respect (Figure 9). In Scenario B gas based capacity increase would crowd out almost entirely the traditional sources (oil, coal, nuclear). In contrast, in the competitive finance scenario (Scenario C) suppose that the expected rate of returns decreases to the level closer to the current US one, part of the substitution would be borne by wind, biomass and later by solar technologies. The dominance of gas technology will be still apparent but more limited.
Both Scenarios assume that learning takes place over time but suggests different cost reduction potential for the various technologies (Figure 10). There are technologies like gas turbines for which the steep cost reduction phase has already taken place, so only lower learning rate can be achieved with the capacity increase. The photovoltaic (PV) technology however can still be characterised by the steep learning potential.

Using geographically differentiated input parameters for the four regions of Europe (Western Europe, Noordpool, CENTREL and Mediterranean countries) also revealed some remarkable results on the
regional portfolios. The higher financial costs in the CENTREL countries (because of the additional risk premiums applied to these countries) together with the initial portfolio mix can result in slower rate of RES-E development in the CENTREL region (Figure 11). It can have serious implication on how to achieve a harmonised European policy on RES deployment.

![Graph showing RES-E deployment in various regions of Europe](image)

**Figure 11** RES-E deployment in the various regions of Europe (the % are for 2030) (see source reference in Figure 7)

**Feed-back on the proposed questionnaire**

An expert survey was designed in the REU with the objective to identify the areas/focus points of the policy discussion among decision makers in the renewable energy field.

As the official statistics and the country presentations of the present proceeding show the EU member states have achieved very different level of RES presentation in their electricity generation portfolios. These differences are pointed out not only in the absolute levels of RES penetrations, but also in attained levels relative to the national targets. The expert discussion showed that while the regional differences of the resource potential explains some of the differences between the regional penetrations, the key factor to explain the lower penetration of RES into the electricity generation
portfolio is more perceptional problem of the various stakeholders than physical or technical barriers. Obviously these technical barriers do exist in the countries but the positive examples from some Member States show that these can be overcome without entailing excessive costs to the system. When these technical changes are designed carefully these even can decrease the losses. The questionnaire discussed in the roundtable was designed to point out and measure the above mentioned perceptional differences among the stakeholders.

The expert survey will identify those statements which are agreed by all stakeholders to be top priority, and also those that principally divide them. The identification of the gap between the stakeholder groups may help in the further refinement of the already accepted policies and targets.

We have categorized the stakeholders into the following groups:

- Regulator/Government
- TSO/Distribution
- Investor
- Research Institute

We will also analyse whether the preferences are significantly differ in the various geographical areas:

- EU 15
- EU 12
- Candidate countries.

We initiated this expert survey because already a small number of answers from a balanced group of stakeholders can result in a meaningful picture of the strategic discussion. The answers of the expert are treated anonymously. In the result we will refer only to the group/stakeholder categories mentioned above. There was a noticeable disagreement among the experts who should pay for the grid connection and for the necessary network upgrades. This issue is addressed in the questionnaire. We had made the changes proposed by the participants of the roundtable and the questionnaires are being sent out to the experts. The result will be communicated when sufficient number of filled in questionnaire will be sent back and analysed.

**Related EU projects**

The stakeholders' growing interest is also shown by the growing number of conferences connected to the topic (Renewable Energy: Grid Integration Summit on the 24-25\textsuperscript{th} June 2008 London, energy generators, project developers and grid operators view; Smart Electric Power Distribution Summit 21-22 April Amsterdam).

A number of electricity projects were carried out within the 6\textsuperscript{th} Framework Programme of the European Commission in connection with RES integration. One can find further information on them in the publication titled "European Electricity Projects 2002 – 2006" (available online on the following link: http://ec.europa.eu/research/energy/pdf/synopses_electricity_en.pdf )

Among them there are two that have to be mentioned, because of the close relation of their topics.

**Enhancement of sustainable electricity supply through improvements of the regulatory framework of the distribution network for distributed generation (DG-GRID)**

The DG-GRID project is aimed at a better deployment of distributed generation (renewables, CHP and other small generation) by improving the coordination between distributed generation (DG) and the
electricity distribution network. Improved coordination can be realised by a more adequate framework that regulates the distribution network operators business and determines regulatory arrangements between DG and electricity distribution networks. New innovative approaches in network planning and operations will provide opportunities for larger DG deployment at relatively low costs. Based on several studies, the DG-GRID project will develop guidelines for improved regulation, network planning and the enhancement of integration of DG in the electricity supply system in both the short and long term. Improvement of regulatory arrangements between distributed generation and the electricity distribution network

**Benefits:** Larger deployment of distributed generation at lower costs and secured reliable electricity supply

**Expected and/or achieved results**
- Review of the current electricity network regulation in 15 EU Member States.
- Analysis of possible innovations and long-term development of electricity grids.
- Assessment of the costs and benefits for the electricity network in the case of large penetration of DG.
- Analysis of new regulatory arrangements for economically viable grid system operations by operators of the electricity distribution grids.

**Solid-Der**

The SOLID-DER Sixth Framework project has been set up to specifically assess the economic, policy and regulatory drivers and barriers influencing the further integration of Distributed Energy Resources (DER) in the electricity supply system of the new Member States (NMS) and Candidate Countries of Central and Eastern Europe.

The integration of DER in the European electricity networks has become a key issue for energy producers, network operators, policy makers and the R&D community. In some countries it created already a number of challenges for the stability of the electricity supply system, thereby creating new barriers for further expansion of the share of DER in supply.

On the other hand in many Member States there exists still a lack of awareness and understanding of the possible benefits and role of DER in the electricity system, while environmental goals and security of supply issues ask more and more for solutions that DER could provide in the future.

The project SOLID-DER, a Coordination Action, will assess the barriers for further integration of DER, overcome both the lack of awareness of benefits of DER solutions and fragmentation in EU R&D results by consolidating all European DER research activities and report on its common findings.

In particular awareness of DER solutions and benefits will be raised in the new Member States, thereby addressing their specific issues and barriers and incorporate them in the existing EU DER R&D community.

**Barriers and recommendations identified by the project**

When comparing the barriers to increasing DER shares into the electricity network in the old and new Member States, we can conclude that they are quite similar. Main barriers identified are:
- Lengthy and complicated administrative procedures, by investors in DER power plants in many countries often considered as the most severe barrier.
- Dominant position of DSOs in negotiating network access in combination with non-transparent connection procedures.
- Unstable support mechanisms making it difficult to plan long-term projects. This is a barrier that is more seriously considered in the new Member States where support for DER has been introduced very recently only.
- Lack of knowledge about advantages of DER generated power leading to opposition of local communities to new DER projects.
Annex 1: Workshop participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution/Position</th>
<th>Topic</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jorge Vasconcelos</td>
<td>Director of European Renewable Energy Investment Portfolio; Former President Council of European Energy Regulators</td>
<td>Renewable energy: new challenges for regulators and network operators</td>
<td>Portugal/Spain</td>
</tr>
<tr>
<td>István Pataki</td>
<td>Vice President of Hungarian Energy Office</td>
<td>The new RES regulation: the Green Package in Hungary</td>
<td>Hungary</td>
</tr>
<tr>
<td>Harry Lehmann</td>
<td>Federal Environmental Agency Environmental Planning and Sustainable Strategies</td>
<td>Necessary policy elements to overcome barriers that prevent the integration of RES-E</td>
<td>Germany</td>
</tr>
<tr>
<td>Christos Protogeropoulos</td>
<td>RENI</td>
<td>New Legislative and Regulatory Measures for the Development of RES Technologies &amp; Applications in Greece and Experiences Encountered after Two Years of Programme Activity</td>
<td>Greece</td>
</tr>
<tr>
<td>Göran Koreneff</td>
<td>Technical Research Centre of Finland (VTT )</td>
<td>Effects of large-scale increase of RES-E with the focus on the spot market price levels in the Nordic Power system</td>
<td>NordPool/Finland</td>
</tr>
<tr>
<td>Tamás Tóth</td>
<td>Hungarian Energy Office Economic Analyst</td>
<td>Specific economic details of the RES regulation (penalties for wind generators due to production outside the schedule)</td>
<td>Hungary</td>
</tr>
<tr>
<td>András Mezősi</td>
<td>Regional Centre for Energy Policy Research</td>
<td>Economic analysis of energy storage requirements in connection with RES-E</td>
<td>Hungary</td>
</tr>
<tr>
<td>Vaida Tamašauskaitė</td>
<td>Energy Development Department Lietuvos energija AB (TSO)</td>
<td>Wind Projects integration in Lithuanian Electricity Network</td>
<td>Lithuania</td>
</tr>
<tr>
<td>Vaclavas Kveselis</td>
<td>Head of Laboratory of Regional Energy Development Lithuanian Energy Institute</td>
<td>Renewable Energy Sources for electricity production: status in Lithuania</td>
<td>Lithuania</td>
</tr>
<tr>
<td>Hanna Bartoszewicz-Burczy</td>
<td>IEN Poland</td>
<td>Renewable Energy Sources in Poland–Evolution, Current State and Possibilities of development</td>
<td>Poland</td>
</tr>
<tr>
<td>Dan Teodoreanu</td>
<td>Research Institute for Electrical Engineering (ICPE)</td>
<td>The Renewable Energy Sources in Romania – Elements of the proposed RES legislation</td>
<td>Romania</td>
</tr>
<tr>
<td>Corneliu Radulescu</td>
<td>ARCE- Romanian Agency for Energy Conservation</td>
<td>Renewable Energy Sources and Energy Efficiency in Romania in the light of the EU legislation</td>
<td>Romania</td>
</tr>
<tr>
<td>Rostislav Krejcar</td>
<td>Head of Generation and Network Regulation Unit Electricity Department Energy regulatory office ERU</td>
<td>The latest issues with RES-E development in the Czech Republic</td>
<td>Czech Republic</td>
</tr>
<tr>
<td>Péter Kaderják</td>
<td>REKK</td>
<td></td>
<td>Hungary</td>
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<tr>
<td>Zsuzsanna Pató</td>
<td>REKK</td>
<td></td>
<td>Hungary</td>
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</tbody>
</table>
Annex 2: The list of statements of the expert survey

| Resources, security of supply | 1) The New Member States of the EU (NMS, countries that joined the EU after 2004) countries have less endowments for renewable energy than that of the old member states.  
2) Higher RES (Renewable Energy Sources) mean more secure electricity system.  
3) If we assume that the information on the renewable potentials is less reliable for the NMS, then NMS targets must be based on the lower bound of these estimates.  
4) As member states have very different levels of RES penetration, target setting should be based on the technically achievable RES option rather than on absolute target levels.  
5) Due to the higher fossil fuel prices the RES-E options become more favourable in the merit order of electricity generation.  
6) As the various RES technologies have different costs, countries with lower potentials in the less expensive options should be compensated by differentiating the target (in level or timing).  
7) Differentiating RES targets by member states have higher transaction costs (e.g. controllability, negotiation costs) than the overall gains.  
8) In CEE the financing costs are higher. The financing institutions have risk premiums and higher return expectations in the region that adds on the financing costs.  
9) When there is a high proportion of nuclear there is less extent for the less flexible/adjustable generation therefore the integration of RES is more expensive.  
10) The co-generation and RES-E has to be clearly distinguished in order to prevent giving financial support to activities that would be profitable on their own.  
11) The upgrade of system and network that is necessary due to the RES integration should be financed exclusively by the RES companies not to be spread over to all the consumers.  
12) There are high external costs associated to the fossil fuel sources. Supporting RES up to the level of these externalities always pay back.  
13) Undifferentiated support is an efficient tool for supporting RES: it gives a proper indication/incentive to invest in the cheapest RES sources. |
| Costs |  |
| Regional cooperation, market | 14) NMS countries do not act as suppliers for the renewable technologies, so they are disadvantaged compared to the EU15.  
15) Improving regional integration or deeper cooperation of the electricity systems will play a vital role in the achievement of higher share of RES-E (e.g. adjustable power plants or storage in one country could be used to integrate more intermittent RE sources in another).  
16) The small size of a given market is a barrier to RES-E. |
<table>
<thead>
<tr>
<th></th>
<th>17) The non-existence of liquid wholesale electricity markets blocks the integration of higher shares of RES into the electricity portfolio.</th>
<th>18) Both electricity supply and demand are variable. The issue, therefore, is not one of variability or intermittency per se, but how to predict, manage and ameliorate variability and what tools can be utilised to improve efficiency.</th>
<th>19) The shortage of cross-border transmission links prevents the new producers, including RES producers as well, from entering the markets.</th>
<th>20) The existence of dominant, vertically integrated power companies create barriers to the RES because it can increase the cost of entrance to prohibitive levels.</th>
<th>21) Technological Learning through increasing production can make RES a significant portfolio element in electricity generation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network upgrade</strong></td>
<td>22) The capacity of the European power systems to absorb significant amounts of wind power is determined more by economics and regulatory rules than by technical or practical constraints.</td>
<td>23) Irrespective of whatever policy is chosen by the EU, massive investments in generation plants and grids are required.</td>
<td>24) The new power developments in RES and other distributed generation require a new grid infrastructure.</td>
<td>25) The third party access rules to the new grid lines play an important part in the market access as well as boosting investment in developing the infrastructure.</td>
<td></td>
</tr>
<tr>
<td><strong>System services</strong></td>
<td>26) The increasing share of distributed generation has to be taken into account in the system level requirements (primary/secondary/tercier reserves, stability).</td>
<td>27) In NMS there is an already existing but untapped system reserve capacity that could be utilised with the regulation and if proper incentive system would be put in place.</td>
<td></td>
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</tbody>
</table>
Necessary policy elements to overcome barriers that prevent the integration of RES-E

Dr. Harry Lehmann
German Federal Environmental Agency (UBA)

- German RES-E deployment, ...
- ... important boundary conditions and
- ... economic impacts and effects
- RES in Germany – yesterday and tomorrow

Benefits of using renewable energies

- Climate protection
- Independence of fossil fuel imports
- Reduction of (international) conflicts
- Low risks for humans and environment
- Local economic and social development especially for poor countries
- Fostering industrial development and export opportunities

RES promotion should harvest all benefits
Necessary policy elements to overcome barriers that prevent the integration of RES-E

UBA Scenario - 2020 - German CO2 Emissions

Structure of PEC in Germany 1990

Source: BMU

Necessary policy elements to overcome barriers that prevent the integration of RES-E

Structure of primary energy consumption in Germany in 2006
Total: 14,464 PJ

- Mineral oils 35.0%
- Lignite 10.8%
- Hard coal 12.8%
- Nuclear energy 12.5%
- Natural gas 22.6%
- Renewables 5.7%
- Electricity imports/export -0.5%
- Other < 0.1%

* Imports are recognized as a negative consumption value
Source: BMU-Brochure "Renewable energy: sources in figures – national and international development" version: June 2007
All figures provisional
Source: BMU

Development of RES-E in Germany
1990 - 2007

- Hydropower
- Wind energy
- Biomass*
- Photovoltaics

* solid, liquid, gaseous biomass, biogenic share of waste, sewage gas; electricity from geothermal energy is not presented due to the low volumes of electricity
Source: BMU according to Working Group on Renewable Energies / Statistics (AGEE-Stat)

Necessary policy elements to overcome barriers that prevent the integration of RES-E

**Renewable Energy Sources Act - EEG**

**basic and necessary features**

- **priority connection of installations**
- **priority purchase and distribution of electricity**
- **guaranteed feed-in tariffs**
  - covering extra technology cost and sufficient profit
  - support timeframe long enough to ensure investment security
  - decrease over time (for new installations) enforces cost reduction
- **independence of public budgets -- low transfer costs**
  - nation-wide proportional distribution of electricity purchased and corresponding fees to all electricity customers ("EEG-Quota")
  - EEG defines a legal relationship between private bodies
- **"Exclusive-use" principle**
- **Experience and Impact Report to German Parliament**

---

**Important boundary conditions**

- **Well-established political will**
  - long-term and binding development targets
  - respective long-term legislative projects und planning (e.g. IKEP)
- **Grid access conditions**
  - Germany’s EEG, Energy Economics Act, Federal Net Agency
- **Spatial and community planning processes**
  - provision of specific areas and conditions with "national interest"
  - privileged projects in non-constructed community areas
- **Effectiveness of plant authorization**
  - one-stop authorization including all partial licenses
  - clear license conditions with limited lead time
- **others**
  - sustainability (that’s understood !?)
  - public awareness and participation
  - Research (at the right time)
  - Training (all levels)
  - community profit-sharing
  - …

Necessary policy elements to overcome barriers that prevent the integration of RES-E

Renewable Energy Sources Act – goals

General
- climate and environmental protection,
- sustainable energy system,
- integration of external cost
- fostering of technology development

share of RES-E on electricity use

§1 EEG 2000
- substantial increase of RES-E
  (foster the German RES deployment goals)

§1 EEG 2004
- until 2010: increase to at least 12.5% of electricity consumption
- until 2020: increase to at least 20% of electricity consumption

§1 EEG 2009
- until 2020: increase to at least 25 to 30% of electricity consumption
- continuous further increase

Effectiveness versus expected profit

wind energy - 2004

Annual expected profit [€ Cent/kWh]

Effectiveness indicator

Source: [Diagram source information]

Necessary policy elements to overcome barriers that prevent the integration of RES-E

**Policies for RES support - EU27**

Feed-in Tariff

- CZ
- HU
- SK
- DE
- GR
- LV
- CY
- RO
- BG
- SI
- EE
- LT
- LU
- PT
- ES
- FR
- NL
- SE
- UK
- IT
- BE
- NL
- FI
- SL
- MT

Quota

Certificate Systems


---

**EEG2009-supported RES-E – forecast**

Source: BMU

Necessary policy elements to overcome barriers that prevent the integration of RES-E

**PV-electricity generation costs and market price**

<table>
<thead>
<tr>
<th>Year</th>
<th>€/kWh</th>
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<tbody>
<tr>
<td>1990</td>
<td>0,00</td>
</tr>
<tr>
<td>2000</td>
<td>0,00</td>
</tr>
<tr>
<td>2010</td>
<td>0,00</td>
</tr>
<tr>
<td>2020</td>
<td>0,00</td>
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<tr>
<td>2030</td>
<td>0,00</td>
</tr>
<tr>
<td>2040</td>
<td>0,00</td>
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</table>

**Source:** RWE Energie AG and RSS GmbH

---

**Necessary policy elements to overcome barriers that prevent the integration of RES-E**

**EEG2009 - monthly cost/consumer - forecast**

**Source:** BMU

---

Roundtable on: "Integration of more Renewable electricity in the CEE region: network or support problem?", Budapest, Hungary, 20-21 May 2008
Necessary policy elements to overcome barriers that prevent the integration of RES-E

Renewable Energy Shares in Germany

<table>
<thead>
<tr>
<th>Year</th>
<th>Renewable Energy Sources</th>
<th>Source: BMU according to Working Group on Renewable Energies / Statistics (AGEE-Stat)</th>
<th>Version: March 2008; all figures provisional</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>Share of RE in Total Primary Energy Consumption: 5%</td>
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<tr>
<td>2000</td>
<td>6.7%</td>
<td></td>
<td></td>
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<tr>
<td>2002</td>
<td>6.5%</td>
<td></td>
<td></td>
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<tr>
<td>2004</td>
<td>14.2%</td>
<td></td>
<td></td>
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<tr>
<td>2006</td>
<td>14.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>6.9%</td>
<td></td>
<td></td>
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<tr>
<td>2020</td>
<td>8.5%</td>
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</table>

German Government Targets 25% – 30%

Contribution of renewable energy sources to Germany’s energy supply

<table>
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<tr>
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<tbody>
<tr>
<td>1998</td>
<td>2.1%</td>
<td></td>
<td>2.5%</td>
<td></td>
<td>5%</td>
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<tr>
<td>2000</td>
<td>6.7%</td>
<td></td>
<td>4.6%</td>
<td></td>
<td>6.6%</td>
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<tr>
<td>2002</td>
<td>3.5%</td>
<td></td>
<td>3.5%</td>
<td></td>
<td>6.6%</td>
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<tr>
<td>2004</td>
<td>6.6%</td>
<td></td>
<td>6.6%</td>
<td></td>
<td>6.6%</td>
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<tr>
<td>2006</td>
<td>14.1%</td>
<td></td>
<td>14.1%</td>
<td></td>
<td>14.1%</td>
</tr>
<tr>
<td>2007</td>
<td>8.5%</td>
<td></td>
<td>8.5%</td>
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<td>8.5%</td>
</tr>
</tbody>
</table>

Emissions avoided through the use of renewable energy sources in Germany in 2007

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>CO2 Avoidance [million t]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>22.5 million t</td>
</tr>
<tr>
<td>Heat</td>
<td>19.3 million t</td>
</tr>
<tr>
<td>Fuels</td>
<td>14.3 million t</td>
</tr>
<tr>
<td>Wind energy</td>
<td>34.0 million t</td>
</tr>
<tr>
<td>Biomass</td>
<td>20.1 million t</td>
</tr>
<tr>
<td>Solar thermal energy</td>
<td>2.4 million t</td>
</tr>
<tr>
<td>Photovoltaics</td>
<td>0.9 million t</td>
</tr>
<tr>
<td>Geothermal energy</td>
<td>0.5 million t</td>
</tr>
<tr>
<td>Biofuels</td>
<td>14.3 million t</td>
</tr>
</tbody>
</table>

Total: approx. 114 million t

From this approx. 57 million t through the EEG

Source: BMU according to Working Group on Renewable Energies / Statistics (AGEE-Stat)
Necessary policy elements to overcome barriers that prevent the integration of RES-E

Turnover related to RES use - total

- **Wind energy**: EUR 5,699 m (23.1%)
- **Biomass**: EUR 9,871 m (40.1%)
- **Solar energy**: EUR 7,255 m (29.5%)
- **Hydropower**: EUR 1,200 m (4.9%)
- **Geothermal energy**: EUR 601 m (2.4%)

Total: approx. € 24.6 bn

---

Employment related to Renewable Energy use

- **Wind energy**: 3,400 employees in 2004, 9,500 employees in 2006, 4,300 employees in 2007
- **Biomass**: 25,100 employees in 2004, 40,200 employees in 2006, 24,900 employees in 2007
- **Geothermal energy**: 4,500 employees in 2004, 4,500 employees in 2006, 3,500 employees in 2007

Increase: approx. 55%

Source: BMU Projekt "Kurz- und langfristige Auswirkungen des Ausbaus der erneuerbaren Energien auf den deutschen Arbeitsmarkt", interim report March 2008

Source: BMU
Necessary policy elements to overcome barriers that prevent the integration of RES-E

UBA Long Term Scenarios

Langfristige Entwicklungstendenzen von REN und REG

OECD Country 100% - Electricity system

Source: ERJ, info@energyrichjapan.info

Necessary policy elements to overcome barriers that prevent the integration of RES-E

Dr. Harry Lehmann
German Federal Environmental Agency (UBA)

- German RES-E deployment, ...  
- ... important boundary conditions and economic impacts and effects
- RES in Germany – yesterday and tomorrow

Thank you for your attention!
RENEWABLE ENERGY: NEW CHALLENGES FOR REGULATORS AND NETWORK OPERATORS

Jorge Vasconcelos
NEWES, New Energy Solutions

INTEGRATION OF MORE RENEWABLE ELECTRICITY IN THE CEE REGION: NETWORK OR SUPPORT PROBLEM?
Budapest, Corvinus University
May 20, 2008

1. INTRODUCTION
2. RENEWABLE ENERGY IN THE EU
3. RENEWABLE ENERGY IN PORTUGAL AND SPAIN
4. CHALLENGES FOR NETWORK OPERATORS
5. CHALLENGES FOR REGULATORS
6. CONCLUSIONS
1. INTRODUCTION

RENEWABLE ENERGY IN CONTEXT

- ENERGY AND CLIMATE CHANGE POLICY
- SECURITY OF SUPPLY

EU ENERGY POLICY

“Given that energy production and use are the main sources for greenhouse gas emissions, an integrated approach to climate and energy policy is needed to realise this objective. Integration should be achieved in a mutually supportive way.”

-European Council, March 2007
Figure SPS: Net imports of energy, 2004 (1) (million tonnes of oil equivalent)

EUROPEAN FIGURES — Eurostat yearbook 2006-07

Share of Renewables to final (%) ENERGY CONSUMPTION WITH NORMALISED UNITS

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<tr>
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<td>EU-27</td>
<td>7.6%</td>
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<td>7.4%</td>
<td>7.3%</td>
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<td>6.9%</td>
<td>6.8%</td>
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<td>2007</td>
<td>ES-25</td>
<td>7.4%</td>
<td>7.3%</td>
<td>7.2%</td>
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<td>6.9%</td>
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<td>2008</td>
<td>IT</td>
<td>7.3%</td>
<td>7.2%</td>
<td>7.1%</td>
<td>7.0%</td>
<td>6.9%</td>
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<td>2009</td>
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<td>7.2%</td>
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<td>7.0%</td>
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<td>6.8%</td>
<td>6.7%</td>
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<td>CZ</td>
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<td>6.7%</td>
<td>6.6%</td>
<td>6.5%</td>
<td>6.4%</td>
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<td>2013</td>
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<td>6.4%</td>
<td>6.3%</td>
<td>6.2%</td>
<td>6.1%</td>
<td>6.0%</td>
<td>5.9%</td>
<td>5.8%</td>
</tr>
<tr>
<td>2015</td>
<td>DE</td>
<td>6.6%</td>
<td>6.5%</td>
<td>6.4%</td>
<td>6.3%</td>
<td>6.2%</td>
<td>6.1%</td>
<td>6.0%</td>
<td>5.9%</td>
<td>5.8%</td>
<td>5.7%</td>
</tr>
</tbody>
</table>

EU ENERGY AND TRANSPORT IN FIGURES — Eurostat yearbook 2006-07

33
2. RENEWABLE ENERGY IN THE EU

- ENERGY PRODUCTION
- GROSS INLAND ENERGY CONSUMPTION
- ELECTRICITY GENERATION (2005 ... 2020)

Figure 5.1: Production of primary energy, EU-25, 2004
(\% of total, based on 1,000 tonnes of oil equivalent)
Roundtable on: "Integration of more Renewable electricity in the CEE region: network or support problem?", Budapest, Hungary, 20-21 May 2008
Fig. 2a: Average annual growth rates 1990-2004 and 2003-2004

Data source: Eurostat

European Environment Agency
**Fig 1:** Renewable electricity as a percentage of gross electricity consumption, 2004

Data source: Eurostat

Note: The electricity directive (2001/77/EC) defines renewable electricity as the share of electricity produced from renewable energy sources in gross electricity consumption. The latter includes imports and exports of electricity. The electricity generated from pumping in hydroelectric plants is included in gross electricity consumption but it is not included as a renewable source of energy. Large hydroelectric plants have a declared net capacity of more than 10 MW. No data is available for Liechtenstein or Switzerland from Eurostat.

---

**Annex I – National overall targets for the share of energy from renewable sources in final consumption of energy in 2020**

A. National overall targets

<table>
<thead>
<tr>
<th>Country</th>
<th>Share of energy from renewable sources in final consumption of energy, 2005 (%)</th>
<th>Target for share of energy from renewable sources in final consumption of energy, 2020 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>2.2%</td>
<td>13%</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>6.4%</td>
<td>16%</td>
</tr>
<tr>
<td>The Czech Republic</td>
<td>6.1%</td>
<td>13%</td>
</tr>
<tr>
<td>Denmark</td>
<td>17.0%</td>
<td>30%</td>
</tr>
<tr>
<td>Germany</td>
<td>5.9%</td>
<td>18%</td>
</tr>
<tr>
<td>Estonia</td>
<td>18.9%</td>
<td>23%</td>
</tr>
<tr>
<td>Iceland</td>
<td>1.1%</td>
<td>16%</td>
</tr>
<tr>
<td>Greece</td>
<td>6.9%</td>
<td>18%</td>
</tr>
<tr>
<td>Spain</td>
<td>8.7%</td>
<td>20%</td>
</tr>
<tr>
<td>France</td>
<td>10.3%</td>
<td>23%</td>
</tr>
<tr>
<td>Italy</td>
<td>5.2%</td>
<td>17%</td>
</tr>
<tr>
<td>Cyprus</td>
<td>2.9%</td>
<td>13%</td>
</tr>
<tr>
<td>Latvia</td>
<td>34.9%</td>
<td>42%</td>
</tr>
<tr>
<td>Lithuania</td>
<td>15.0%</td>
<td>23%</td>
</tr>
<tr>
<td>Lithuania</td>
<td>0.9%</td>
<td>11%</td>
</tr>
<tr>
<td>Hungary</td>
<td>4.3%</td>
<td>13%</td>
</tr>
<tr>
<td>Malta</td>
<td>0.8%</td>
<td>10%</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>7.4%</td>
<td>14%</td>
</tr>
<tr>
<td>Austria</td>
<td>29.3%</td>
<td>34%</td>
</tr>
<tr>
<td>Belgium</td>
<td>7.2%</td>
<td>13%</td>
</tr>
<tr>
<td>Portugal</td>
<td>20.3%</td>
<td>31%</td>
</tr>
<tr>
<td>Romania</td>
<td>17.8%</td>
<td>28%</td>
</tr>
<tr>
<td>Slovenia</td>
<td>16.9%</td>
<td>21%</td>
</tr>
<tr>
<td>The Slovak Republic</td>
<td>6.7%</td>
<td>14%</td>
</tr>
<tr>
<td>Finland</td>
<td>26.5%</td>
<td>18%</td>
</tr>
<tr>
<td>Sweden</td>
<td>39.8%</td>
<td>49%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1.7%</td>
<td>15%</td>
</tr>
</tbody>
</table>
3. RENEWABLE ENERGY IN PORTUGAL AND SPAIN

- PORTUGAL
- SPAIN

Notes:
- Electricity consumption by source
- Thermal-imported-cogeneration
- Hydro-renewable

Source: http://www.apren.pt/
Notes:
Renewable electricity production in the Special regime (renewables, exc. large hydro and cogeneration)

Renewable electricity production in the Special regime as percentage of annual electricity consumption

Source: [http://www.apren.pt/](http://www.apren.pt/)

Notes:
Special regime electricity production by source

Wind-small hydro (under 10 MW)-biomass-municipal solid waste-photovoltaic-cogeneration

Source: [http://www.apren.pt/](http://www.apren.pt/)
Roundtable on: "Integration of more Renewable electricity in the CEE region: network or support problem?", Budapest, Hungary, 20-21 May 2008

Source: http://www.ersa.pt/vpt/entrada/factosenumeros/sectorelectric/portugalcontinental/producaogeneration/d/producaogeneration.htm

Spain
In 2006 the share of renewable energy (including large hydro) reached 6.6% of consumption against the objective of 12% by 2010.

Source: [http://www.cne.es/cne/Publicaciones](http://www.cne.es/cne/Publicaciones)

Notes:

Evolution of installed capacity (mainland Spain)

Oil and gas-coal-nuclear-hydro-renewables-cogeneration

En 2007 las ventas de energía eléctrica por los productores en régimen especial en España han cubierto el 20% de la demanda bruta. Las ventas de electricidad procedente de energías renovables durante 2007 teniendo en cuenta la gran hidráulica, han supuesto el 20% de la demanda eléctrica bruta, existiendo el objetivo comunitario de conseguir en España una participación de las energías renovables del 29,4% en el consumo de electricidad en el año 2010.
**Estructura de la producción del Régimen Especial del año 2007 (%)**

| Source:  http://www.unesa.es/ |

<table>
<thead>
<tr>
<th>Energy balance</th>
<th>Miliones de kWh</th>
<th>% difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mainland gross production</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydro</td>
<td>11.303</td>
<td>5.820</td>
</tr>
<tr>
<td>Thermal</td>
<td>41.879</td>
<td>48.255</td>
</tr>
<tr>
<td>Nuclear</td>
<td>20.260</td>
<td>20.720</td>
</tr>
<tr>
<td>TOTAL GROSS PRODUCTION</td>
<td>73.442</td>
<td>74.795</td>
</tr>
<tr>
<td>Self consumption</td>
<td>2.771</td>
<td>2.797</td>
</tr>
<tr>
<td>Pumps’ consumption</td>
<td>1.419</td>
<td>1.441</td>
</tr>
<tr>
<td>Electricity sold</td>
<td>69.252</td>
<td>70.557</td>
</tr>
<tr>
<td>Interconnection balance</td>
<td>-645</td>
<td>-3.573</td>
</tr>
<tr>
<td>Electricity purchased by the special regime</td>
<td>18.177</td>
<td>20.721</td>
</tr>
<tr>
<td>TOTAL DEMAND (mainland)</td>
<td>87.104</td>
<td>87.784</td>
</tr>
</tbody>
</table>

**Notes:**
The structure of production in the Special regime (2007) Renewables and waste Solar Biomass Waste (municipal, industrial etc.) Hydro Wind Cogeneration and waste incineration

Source:  http://www.unesa.es/
4. CHALLENGES FOR NETWORK OPERATORS

- **SYSTEM CONTROL**
- **GRID INVESTMENT**

Source: http://www.cne.es/cne/doc/publicaciones/PA008_07.pdf
NETWORK OPERATORS HAVE DELAYED INTRODUCTION OF NEW TECHNOLOGIES

The cost of IT on an annual basis would appear to be in the range of 1% to 2% with Utilities engaged in the Distribution & Supply business having a higher penetration in general than those in the Generation and Transmission business.

This is low in comparison to a survey published by IEEE Power Engineering Review in February 1996 where investor-owned Electric Utilities in the United States tend to show an average investment into IT of close to 3% of revenues. This might confirm that a further growth of IT is to be expected.

Source: EURELECTRIC 1997

NETWORK OPERATORS DO NOT TAKE ADVANTAGE OF NEW ICT
5. CHALLENGES FOR REGULATORS

- INCENTIVES FOR NETWORK OPERATORS
- TARIFF INCREASE
- MARKET LIQUIDITY
- DEMAND RESPONSE
Notes: The evolution of tariff structure since 1999

**Quadro 0-11 - Diferencial de custo com a aquisição de energia elétrica à Produção em Regime Especial em 2008**

<table>
<thead>
<tr>
<th>Tarifa 2008</th>
<th>GWh</th>
<th>Preço médio de aquisição (GWh)</th>
<th>Custo Total (GWh)</th>
<th>Preço médio de referência (GWh)</th>
<th>Diferencial de custo (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total de Produção em regime especial</td>
<td>12 145</td>
<td>10 002</td>
<td>1 227 613</td>
<td>1 227 613</td>
<td>0</td>
</tr>
<tr>
<td>Produção em regime especial incentivada nos termos do Decretal-Let n.o 50/2006</td>
<td>7 649</td>
<td>73 528</td>
<td>720 805</td>
<td>720 800</td>
<td>50</td>
</tr>
<tr>
<td>Gás</td>
<td>8 647</td>
<td>73 528</td>
<td>621 000</td>
<td>621 000</td>
<td>0</td>
</tr>
<tr>
<td>Varetas</td>
<td>1 764</td>
<td>73 528</td>
<td>107 800</td>
<td>107 800</td>
<td>0</td>
</tr>
<tr>
<td>Índice</td>
<td>5</td>
<td>73 528</td>
<td>3 660</td>
<td>3 660</td>
<td>0</td>
</tr>
<tr>
<td>Biomassa</td>
<td>34</td>
<td>73 528</td>
<td>2 520</td>
<td>2 520</td>
<td>0</td>
</tr>
<tr>
<td>Resíduos</td>
<td>69</td>
<td>73 528</td>
<td>5 000</td>
<td>5 000</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>12 145</td>
<td>73 528</td>
<td>1 227 613</td>
<td>1 227 613</td>
<td>0</td>
</tr>
</tbody>
</table>

Fonte: ERSE

Diference between Special regime and reference power purchases in 2008

GWh-average purchase price/GWh-average reference price ± cost difference

Total production in the Special regime

Production in the special regime under Act 90/2006

Wind

Hydro

Biogas

Biomass

PV

Municipal solid waste

Production in the special regime M/ST under Act 90/2006

Cogeneration

Other thermal production

Notes: Average network access tariffs in 2008 by components
MAT very-high voltage
AT high-voltage
MT medium-voltage
BT low-voltage


Figura 8-22: Preço médio das tarifas de Acesso às Redes em 2008, decomposto por actividade

Figura 8-23: Estruturas de preço médio das tarifas de Acesso às Redes em 2008 nas componentes de Uso de Redes e Gestão de Sistema e Custos de Interesse Económico Geral

Notes: Evolution of network access tariffs (at 2007 constant prices)
MAT very-high voltage
AT high-voltage
MT medium-voltage
BT low-voltage, large consumers
BTH low-voltage, small consumers

GERMANY

Merit-Order Effect of Power Supply through EEG

Total volume merit-order effect (2006): € 4.98 billions


THE SUPPLY-SIDE IS ONLY HALF OF THE MARKET. WE NEED NEW IDEAS ABOUT THE DEMAND-SIDE
DEMAND PARTICIPATION IMPROVES MARKET EFFICIENCY

WHOLESALE MARKET PRICE

different prices corresponding to different generation technologies

price without demand response

price with demand response

inelastic demand

peak demand

DEMAND PARTICIPATION IMPROVES MARKET EFFICIENCY

"PROSUMER"

SMART METER - THE CORNERSTONE OF SMART ELECTRICITY GRIDS

Roundtable on: "Integration of more Renewable electricity in the CEE region: network or support problem?", Budapest, Hungary, 20-21 May 2008
4. CONCLUSIONS

- RENEWABLE ENERGY PART OF EU POLICY
- TARGETS ACHIEVABLE
- NETWORK MODERNIZATION URGENTLY NEEDED (ICT)
The New RES Regulation: Green Package in Hungary

István Pataki
Vice President
Hungarian Energy Office

„Integration of more RES-E in the CEE region”

Policy background (1)

- Growing concern about security and continuity of oil and gas supplies; rising energy prices, despite the increased efficiency resulting from EU market liberalisation
- Climate change
- EU competitiveness policy: need for innovative industrial development and leadership
Policy background (2) - European “green package”

- A new EU emissions trading scheme with a European (not national) cap, auctioning of allowances: to generate reductions in GHG of 21%
- New national targets to achieve a 10% GHG reduction in non ETS sectors
- A framework to promote the development of CO2 capture and storage
- New guidelines on state aid for environmental protection
- An assessment of national Energy Efficiency Action Plans
- New directive to reach the 20% renewable energy target and 10% biofuels target

RES Directive (1)

- Sets mandatory national targets for renewable energy shares, including
  - 10% biofuels share, in 2020 (Articles 3 and 5)
- Requires national action plans (Article 4)
- Requires reduction of administrative and regulatory barriers (Article 12), improvements in provision of information and training (Article 13) and improves renewables’ access to the electricity grid (Article 14)
- Creates a sustainability regime for biofuels (Articles 15-18)
- Standardises “guarantees of origin” (certifying the renewable origin of electricity or heat) and enables the transfer of these to provide flexibility to Member States (Articles 6, 7, 8, 9 and 10)
RES Directive (2) - EU-27 efforts in Renewables

**Shares of renewable energy, 2005 and 2020**

New support scheme in Hungary (1)

- **Investment subsidy**
- **Production support**
- **Tax exemption**

- **KIOP (2004-2006)**
- **KEOP (2007-2013)**
- **Obligatory taking over of RES-E and feed-in-tariff**
- **Green Certificate**
- **Renewable Energy Sources**
  - Bio fuels
  - Heat generation
  - RES-E generation
KIOP (Operative Programme for Environmental Protection and Infrastructure)
2. Financed by EU Funds
3. 3 main fields: environmental protection, energetics and transport
4. For Renewable Energies: 15 million EUR
   - Supported projects: 18
   - Planned total RES-E generation / year: 442 TJ
   - Installed capacity: 19.4 MW
   - Saved CO2: 2 million tons (for a whole life cycle)

KEOP (Operative Programme for Environment and Energy)
1. Period: 2007-2013
2. Financed by EU Funds
3. 2 main fields for Energetics: Energy savings and Renewables
4. For Renewable Energies (RES-E and heat generation): 250 million EUR
   - Supported projects: biomass, biogas, geothermal, small scale wind turbines
5. For Biofuels: 45 million EUR
   - Supported projects: biofuel factories middle- and large scale capacities

New support scheme in Hungary (2) – Investment subsidy

• For new wind turbines >> tendering
  Price (fixed by the Electricity act)
  Period of support (? year)
  Security of the grid (can be regulated)
  Local employment/ local positive side effects

Roundtable on: "Integration of more Renewable electricity in the CEE region: network or support problem?", Budapest, Hungary, 20-21 May 2008
New support scheme in Hungary (4) – Production support (Feed-in-tariff)

EU expectation (2001/77 EU) and achievement
Future development (1)

**Hungarian RES-E potential up to 2020**

<table>
<thead>
<tr>
<th>Source</th>
<th>Purchased electricity</th>
<th>Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td>0</td>
<td>550</td>
</tr>
<tr>
<td>Wind</td>
<td>107</td>
<td>1890</td>
</tr>
<tr>
<td>Small hydro</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>Large hydro</td>
<td>195</td>
<td>200</td>
</tr>
<tr>
<td>Geothermal</td>
<td>0</td>
<td>600</td>
</tr>
<tr>
<td>Biogas</td>
<td>13</td>
<td>6840</td>
</tr>
<tr>
<td>Biomass</td>
<td>1136</td>
<td>3250</td>
</tr>
</tbody>
</table>

Future development (2)

**Expected RES-E share of Hungary (according to RES-E strategy)**

[Graph showing expected RES-E share from 2003 to 2020]
Thank You for your Attention!

István PATAKI
Vice President
Hungarian Energy Office
New Legislative and Regulatory Measures for the Development of RES Technologies & Applications in Greece and Experiences Encountered after Two Years of Programme Activity

Dr C Protogeropoulos
Mechanical Engineer

RENI, member of Solar Cells Hellas Group
Some Background Information

**Act 2244 of 1994:** established the legislative environment in Greece for the development of RES, providing access to the grid to individual energy producers.

**Act 2773 of 1999:** established the RAE (Regulatory Authority for Energy) and initiated deregulation of the electricity energy market.

**Operational Programme for Competitiveness (OPC):** major support scheme for RE investments. For PV systems, OPC subsidies varied between 40% and 50% in the period 2000–2006.

**Act 2244/1994 proved to be insufficient:** some 13 additional laws, common ministerial and circular decisions etc. were put in place to resolve important processing and technical issues. The regulatory and legislative environment was confusing and extremely bureaucratic, restraining the development of RES in the country.
Rational: why PVs in Greece?

- The **potential** for PV applications is huge; high solar resource in combination with increasing energy needs. **Public awareness** on solar energy is positive; the success of solar thermal could be repeated.

- PV integration on **island grids** is several ×10MWp. PV electricity is **cost-competitive** on small/medium size islands.

- **Enforcement of the Utility Grid** during peak load demand is of high value, especially during summer periods.

- **Minimisation of Grid Losses** (energy production close to consumption), **transmission lines relief** and **re-scheduling of new investments** for the Grid.

- PV industry is already activated in Greece. Favourable **market conditions** and an **appropriate framework** environment is the driving force for further industrial development.
The Legislation: Law 3468/2006 (1/2)

- The new Law 3468/06 constitutes the legislative and regulatory framework basis for the initiation of sustainable RES activities in the country, PV included.
- The Feed-in-Tariff (FiT) model that has been introduced includes favourable conditions for grid-connected PV application.
- For PV applications, Law 3468 does not introduce a cap; there is reference to targets expected to be achieved by 2020, i.e. 500MW in the mainland and 200MW on islands.
- A PV Programme has been established to monitor progress, targets achieved and suggest rescheduling if necessary.
- Licensing procedures include the Energy Production License (EPL), Environmental Impact studies and approvals and the Installation and Operation permits. The maximum time to obtain all licenses for a fully-licensed PV station is calculated 305 working days.
The Legislation: Law 3468/2006 (2/2)

<table>
<thead>
<tr>
<th>Power Supply Source</th>
<th>Feed-in Tariff, [Euro cent/kWh]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interconnected System</td>
</tr>
<tr>
<td>Wind, Small Hydro, Biomass, Geothermal, other RES, he–CHP</td>
<td>7.30</td>
</tr>
<tr>
<td>Wind, off-shore</td>
<td>9.00</td>
</tr>
<tr>
<td><strong>PV Solar</strong> &lt;100kW&lt;sub&gt;p&lt;/sub&gt;</td>
<td>45.00</td>
</tr>
<tr>
<td><strong>PV Solar</strong> ≥100kW&lt;sub&gt;p&lt;/sub&gt;</td>
<td>40.00</td>
</tr>
<tr>
<td>Other Solar &lt;5MWe</td>
<td>25.00</td>
</tr>
<tr>
<td>Other Solar ≥5MWe</td>
<td>23.00</td>
</tr>
</tbody>
</table>

**Validity of Contracts:** 10 years (+10y renewal depending on the producer).

**Prices:** modified every year according to the inflation.
The Ministries

Ministry of Development (MoD)

- Energy planning of the country.
- Main legislative/regulatory measures, etc.
- OPCE (Operational Programme for Competitiveness and Enterprise): to be announced within 2008, with subsidies for RES (PV-residential?).

Ministry of Environment, Land planning and Public Works

- A common ministerial decision is expected for the zoning and conditions of land positioning of RES.

Ministry of Economy and Economics

- Subsidisation through the Development Law 3299/2004. The whole process is on a competitive basis and subject to governmental budgets available. The minimum budget of a project to be considered as an investment is 100,000Euro.
The Authorities

**Regulatory Authority for Energy (RAE)**
- Evaluation of proposals and consultation to MoD for issuing Energy Production Licences (EPL)
- Fine tuning of PV Programme development in short/medium-term horizon.

**Hellenic Transmission System Operator (HTSO, in Greek DESMIE)**
- Contract for conditions of feeding energy to the grid and tariffs.

**Town/Urban Planning Authorities**
- Approval of a building licence; communication in done on a local level.

**Centre for Renewable Energy Sources (CRES)**
- Final approval and delivery of installations.

**Other Authorities:** Direction of Environment & Land Planning (DELP), 3 Archaeology Departments, 6 other authorities, Prefecture Council etc.
PV System Categorisation

Small systems of capacity \( \leq 20\text{kWp} \)
These systems are exempted from an EPL process. Application for grid connection is done directly to the local utility office. Subsidisation possible for systems close to the 20kWp threshold, establishment of company required.

Medium size systems \( 20\text{kWp} < P \leq 150\text{kWp} \)
Applications for exemptions from an EPL are submitted to RAE. In September 2007, RAE discontinued the process due to the large amount of applications received.

Large systems \( > 150\text{kWp} \)
In the last summers’ regional planning for the development of PV applications, RAE introduced 2 sub-groups in this category: \( 150\text{kWp} < P \leq 2\text{MWp} \) and \( P > 2\text{MWp} \). Submission of proposals for evaluation is taking place during the first 10 calendar of each even month. In March 2008, RAE discontinued the process due to the large amount of applications received.
Planning of PV Installations

- Capacity planning of PV is based on a regional distribution in the country.
- In total, 14 regions have been identified in Greece.
- Determining the limitation of PV in each region is based mainly on the demand needs, the grid infrastructure and the planning of other RES in the region.
- The first phase of the PV Programme has been introduced for years 2007–2010.
- Applications received so far cover the planned capacity by an average factor of 400%.
- First results of applications received for each system category are shown in the following slides.
Applications’ Register: 20kWp<P≤150kWp

<table>
<thead>
<tr>
<th>Region</th>
<th>Planned MWp</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15.00</td>
</tr>
<tr>
<td>2</td>
<td>24.00</td>
</tr>
<tr>
<td>3</td>
<td>3.00</td>
</tr>
<tr>
<td>4</td>
<td>5.40</td>
</tr>
<tr>
<td>5</td>
<td>16.50</td>
</tr>
<tr>
<td>6</td>
<td>4.50</td>
</tr>
<tr>
<td>7</td>
<td>18.00</td>
</tr>
<tr>
<td>8</td>
<td>18.00</td>
</tr>
<tr>
<td>9</td>
<td>36.60</td>
</tr>
<tr>
<td>10</td>
<td>12.00</td>
</tr>
<tr>
<td>11</td>
<td>4.50</td>
</tr>
<tr>
<td>Total:</td>
<td><strong>157.50</strong></td>
</tr>
</tbody>
</table>

Numbers on map indicate capacity coverage.
### Applications’ Register: $150\text{kWp} < P \leq 2\text{MWp}$

<table>
<thead>
<tr>
<th>Region</th>
<th>Planned MW$_p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13.00</td>
</tr>
<tr>
<td>2</td>
<td>15.00</td>
</tr>
<tr>
<td>3</td>
<td>3.00</td>
</tr>
<tr>
<td>4</td>
<td>5.40</td>
</tr>
<tr>
<td>5</td>
<td>16.50</td>
</tr>
<tr>
<td>6</td>
<td>4.50</td>
</tr>
<tr>
<td>7</td>
<td>18.00</td>
</tr>
<tr>
<td>8</td>
<td>18.00</td>
</tr>
<tr>
<td>9</td>
<td>36.60</td>
</tr>
<tr>
<td>10</td>
<td>12.00</td>
</tr>
<tr>
<td>11</td>
<td>4.50</td>
</tr>
</tbody>
</table>

Total: **146.50**

Numbers on map indicate capacity coverage.
Applications’ Register: P>2MWp

<table>
<thead>
<tr>
<th>Region</th>
<th>Planned MW</th>
<th>Region</th>
<th>Planned MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12.50</td>
<td>2</td>
<td>15.00</td>
</tr>
<tr>
<td>3</td>
<td>3.00</td>
<td>4</td>
<td>5.40</td>
</tr>
<tr>
<td>5</td>
<td>16.50</td>
<td>6</td>
<td>4.50</td>
</tr>
<tr>
<td>7</td>
<td>18.00</td>
<td>8</td>
<td>18.00</td>
</tr>
<tr>
<td>9</td>
<td>36.60</td>
<td>10</td>
<td>12.00</td>
</tr>
<tr>
<td>11</td>
<td>4.50</td>
<td>Total:</td>
<td>146.00</td>
</tr>
</tbody>
</table>

Numbers on map indicate capacity coverage.
Latest Update on PV Development in Greece (1/4)

Exemptions: $20\text{kWp} < P \leq 150\text{kWp}$, Interconnected Systems \(^{(source: \text{RAE, 13.02.2008})}\)

<table>
<thead>
<tr>
<th>Status of Applications</th>
<th>No of Applications</th>
<th>PV Power, [kWp]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Decision (after 2006)</td>
<td>979</td>
<td>100,846</td>
</tr>
<tr>
<td>Negative Decision</td>
<td>71</td>
<td>7,955</td>
</tr>
<tr>
<td>Recalled</td>
<td>3</td>
<td>298</td>
</tr>
<tr>
<td>Withdrawn</td>
<td>93</td>
<td>9,354</td>
</tr>
<tr>
<td>Under Evaluation</td>
<td>2,626</td>
<td>280,322</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,772</strong></td>
<td><strong>398,775</strong></td>
</tr>
</tbody>
</table>

Exemptions: $20\text{kWp} < P \leq 150\text{kWp}$, Non-interconnected Islands \(^{(source: \text{RAE, 15.12.2007})}\)

<table>
<thead>
<tr>
<th>Island Region</th>
<th>No of Applications</th>
<th>PV Power, [kWp]</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Aegean Sea</td>
<td>632</td>
<td>70,623</td>
</tr>
<tr>
<td>Ionian Sea</td>
<td>18</td>
<td>2,194</td>
</tr>
<tr>
<td>Crete</td>
<td>1,623</td>
<td>180,631</td>
</tr>
<tr>
<td>South Aegean Sea</td>
<td>727</td>
<td>75,077</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,000</strong></td>
<td><strong>328,525</strong></td>
</tr>
</tbody>
</table>
Latest Update on PV Development in Greece (2/4)

**EPL Licences: P>150kWp, Interconnected Systems** *(source: RAE, updated 15.02.2008)*

<table>
<thead>
<tr>
<th>Status of Applications</th>
<th>No of Applications</th>
<th>PV Power, [kWp]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Decision (after 2006)</td>
<td>36</td>
<td>89,090</td>
</tr>
<tr>
<td>Under Evaluation</td>
<td>1,203</td>
<td>2,619,390</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,239</strong></td>
<td><strong>2,708,480</strong></td>
</tr>
</tbody>
</table>

Overall so far (small system below 20kWp not accounted):
- 8,011 applications
- 3,436MW equivalent PV capacity
### Latest Update on PV Development in Greece (3/4)

#### Photovoltaic stations of the interconnected system 2008
(Article 9, Law 3468/2006)

<table>
<thead>
<tr>
<th>Month</th>
<th>Energy generated (MWh)</th>
<th>Capacity (kW)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>With PPA</td>
<td>In operation</td>
</tr>
<tr>
<td>January</td>
<td>77,38</td>
<td>4,880,50</td>
<td>829,80</td>
</tr>
<tr>
<td>February</td>
<td>40,26</td>
<td>6,361,96</td>
<td>1,076,50</td>
</tr>
<tr>
<td>March</td>
<td>97,29</td>
<td>6,851,50</td>
<td>1,193,99</td>
</tr>
<tr>
<td>April</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>July</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>September</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>October</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>November</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy generated in 2008 (MWh)</td>
<td>214,92</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*In Low Voltage the energy generated is metered every 4 months (Law 3468/2006)*

Source: HTSO, report on RES March 2008
Latest Update on PV Development in Greece (4/4)

Photovoltaic stations in operation per region (kW)

Source: HTSO, report on RES March 2008
Potential for PV Development in Greece (1/2)

- As of the end of 2007, the total PV installed capacity in Greece was 6.5–7.0 MW.
- The PV market in Greece is expected to explode in the next 3–5 years, especially for medium size and larger capacity PV systems.
- In the February’s applications for Energy Production Licence, submissions to RAE were a lot fewer compared to previous openings in 2007.
- Speeding-up the evaluation process will resolve the long awaiting list issue and will create sustainable conditions for market development.
- Applications for interconnected islands are expected to open in Sept./Oct. 2008.
- Power applied for and capacity of real systems installed should not be confused.

Part of the 94.5kWp PV system in Thessalia
### Potential for PV Development in Greece (2/2)

<table>
<thead>
<tr>
<th></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>Germany</td>
<td>850</td>
<td>1100</td>
<td>1500</td>
<td>1500-1750</td>
<td>1500-2000</td>
<td>1650-2200</td>
<td>1800-2400</td>
</tr>
<tr>
<td>Spain</td>
<td>97</td>
<td>300</td>
<td>300-500</td>
<td>300-500</td>
<td>400-600</td>
<td>400-600</td>
<td>400-600</td>
</tr>
<tr>
<td>Italy</td>
<td>12</td>
<td>40</td>
<td>80-150</td>
<td>130-300</td>
<td>200-400</td>
<td>270-540</td>
<td>360-730</td>
</tr>
<tr>
<td>Greece</td>
<td>1,2</td>
<td>2</td>
<td>10-20</td>
<td>50-100</td>
<td>100-200</td>
<td>130-270</td>
<td>180-360</td>
</tr>
<tr>
<td>France</td>
<td>14</td>
<td>45</td>
<td>60-150</td>
<td>120-250</td>
<td>200-300</td>
<td>270-400</td>
<td>360-540</td>
</tr>
<tr>
<td>Portugal</td>
<td>2</td>
<td>10</td>
<td>15-20</td>
<td>20-40</td>
<td>30-50</td>
<td>40-70</td>
<td>50-90</td>
</tr>
<tr>
<td>USA</td>
<td>141</td>
<td>259</td>
<td>350-400</td>
<td>600-800</td>
<td>1000-1400</td>
<td>1350-1900</td>
<td>1800-2550</td>
</tr>
<tr>
<td>China</td>
<td>12</td>
<td>20</td>
<td>25-35</td>
<td>35-70</td>
<td>50-100</td>
<td>70-140</td>
<td>90-180</td>
</tr>
<tr>
<td>Japan</td>
<td>286</td>
<td>230</td>
<td>200-300</td>
<td>200-400</td>
<td>200-500</td>
<td>270-680</td>
<td>360-910</td>
</tr>
<tr>
<td>South Korea</td>
<td>21</td>
<td>50</td>
<td>100-150</td>
<td>250-300</td>
<td>400-500</td>
<td>540-680</td>
<td>730-910</td>
</tr>
<tr>
<td>India</td>
<td>12</td>
<td>20</td>
<td>100-150</td>
<td>200-300</td>
<td>300-400</td>
<td>410-540</td>
<td>545-730</td>
</tr>
<tr>
<td>Rest of the World</td>
<td>150</td>
<td>170</td>
<td>200-250</td>
<td>250-350</td>
<td>300-500</td>
<td>410-680</td>
<td>545-910</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1598</td>
<td>2246</td>
<td>2940-3625</td>
<td>3655-5160</td>
<td>4680-6950</td>
<td>5810-8700</td>
<td>7220-10910</td>
</tr>
</tbody>
</table>

**Source:** EPIA X-mas Workshop 2007
Solar Cells Hellas Group of Companies

1. Production of Si Wafers, Cells and Modules
   Solar Cells Hellas, SolTech and Energy Solutions

2. Services, Marketing & Construction of Power Supply Systems
   RENI – Renewable Energy Innovations

3. Development of Photovoltaic Projects
   Solar Datum, 4E Energy, Solar Concept, Spes Solaris etc.
Solar Cells Hellas SA – Company Overview

- The company was found in 2005.
- Factory now under development in the industrial zone of Patras.
- Production of crystalline silicon wafers, cells and modules.
- Final annual capacity 60MW.
- First 30MW production: July 2008.
- Full capacity: end 2008.

- Facilities: buildings 14.000m², land 37.000m².
- Working Positions: 230
- [www.schellas.gr](http://www.schellas.gr)
Recommendations / Conclusions

- The **FiT** process has proven to be the most appropriate tool for PV support; tariffs have to be wisely set in each country to initiate a sustainable market and meanwhile avoid profiteering.

- **Subsidisation**: cash on the table disorientates the investors, prolongs project finalisation and diminishes the benefits of the FiT mechanism.

- Better to avoid a **cup** in a new PV Programme. The desired PV capacity should be reached gradually and smoothly, not in a very short time period.

- After a first period of a PV Programme, **fine-tuning** of the legislative and regulatory framework maybe necessary. The role of local authorities is important but should not become a barrier to PV development.

- A successful PV Programme should include the **household sector** as a priority. Licensing and other financial procedures for the implementation of solar PV systems in buildings should be simplified.

- **Research** on new solar technologies and the **PV industry** should develop in parallel to applications in a country and vice – versa.
Thank You for Your attention
Economic analysis of energy storage requirements in connection with RES-E

András Mezősi

JRC-REKK Conference

May 20-21th 2008, Budapest

Presentation outline

• Energy storage systems
• Benefits of a pumped storage
  › Peak – off-peak arbitrage
  › Ancillary service
• Best practice regulation
• Conclusion
Energy storage systems

- Pumped Hydroelectric Storage (PHS)
  - 90 GW worldwide
  - Efficiency from 60% to 80%
  - 100-1000 MW

- Compressed Air Energy Storage
  - Below 0.5 GW worldwide
  - Efficiency around 70-75%
  - 50-100 MW

- Other energy storage systems
  - Flywheel, Conventional batteries, Flow batteries, Hydrogen fuel cells

- Demand side management
  - Real physical storage
  - Reduce peak consumption

Cost and Benefits of PHSs

- Benefits
  - Peak vs. off-peak arbitrage, reduce peak – off-peak generation margin
    and/or (?)
  - Ancillary service

- Costs
  - Overnight cost
  - O&M costs
  - Social costs (e.g. external cost of the building)
Is this a real arbitrage?

Without state support PHS is not profitable in Hungary!

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak off-peak margin (€/MWh)</td>
<td>20</td>
</tr>
<tr>
<td>Overnight cost (€)</td>
<td>600 000 000</td>
</tr>
<tr>
<td>Installed capacity (MW)</td>
<td>600</td>
</tr>
<tr>
<td>Daily production (MWh)</td>
<td>3 000</td>
</tr>
<tr>
<td>Net efficiency (%)</td>
<td>80%</td>
</tr>
<tr>
<td>Yearly production (MWh)</td>
<td>876 000</td>
</tr>
<tr>
<td>Yearly income (€)</td>
<td>17 520 000</td>
</tr>
<tr>
<td>Payback period with 0 discount rate (year)</td>
<td>34.2</td>
</tr>
</tbody>
</table>

The effect of differentiated FIT I.

Net output/average output in workday, 2007

- Weather dependent RES-E
- Non-weather dependent RES-E
- Consumption

Roundtable on: "Integration of more Renewable electricity in the CEE region: network or support problem?", Budapest, Hungary, 20-21 May 2008
The effect of differentiated FIT II.

- More than 90% of the non-weather dependent RES-E is biomass
- Biomass can be stored, so these PPs can give and keep their schedule

Getting price signals, they can react to the changing electricity price
But this price is set by administrative way not evaluated in the market! ("second best" regulation)

Ancillary service

- PHPs can be used as secondary and tertiary reserve too
- Wind producers MC is around zero -> they will always produce, when they can
- The amount of electricity production at a wind farm can not be forecast with absolute certainty
- "Could we increase wind energy penetration only by building pumped storages?"
Wind energy I.

Forecast error in flat terrain

10.00%
9.00%
8.00%
7.00%
6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
0 6 12 18 24 30 36 42 48
Forecast Length (hours)

Wind Power Error (% of installed capacity)

Source: Giebel et al.: Forecast error of aggregated wind power, 2007

Wind energy II.

• If they should give a schedule then in $t - 3$ hour
  1000 MW installed wind capacity in Hungary needs
  only 60 MW secondary reserves
• These reserve should be bought in a transparent, competetive market

Pumped storage is only one participant in this market
and not sure that it is the cheapest one
Best practice regulation

- Non-weather dependent producers can give and keep a generation schedule -> can react flexible to energy price
- Gate closure: As close to the real time as it possible (t – 1 hour)
- Wind generators also have to give a generation schedule
- Wind generators have to pay the balancing energy cost, which motivates them to keep the schedule

It needs a balancing market!

- The cost of the extra secondary reserve requirement should not be paid by wind producers (e.g. Paks does not pay the tertiary reserve)

Conclusion

- If introducing best practice regulations, there will be no such system problems that need the building of pumped storages
- If there is a transparent balancing market, reserve market and a day-ahead market, and pumped storages are profitable (if the balancing energy price is high enough), then PHSs will be built by private investors
- The state has no reason to support such pumped storages
THANK YOU FOR YOUR ATTENTION!

REKK was established at the Corvinus University of Budapest in December, 2003. The mission of REKK is to contribute to the creation of working energy markets and the establishment of efficient regulation by carrying out applied research, training and quality consultancy activities for all those interested persons and organizations that are active in the field.

We think that the experiences that Hungary and some other Central and Eastern European countries have gained through the restructuring and re-regulation of their energy markets are valuable and relevant for all transition economies. This is why the Centre intends to put a special emphasis on the research and dissemination of the regional experience and intends to become a regional research and training centre.

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Web: http://www.rekk.eu, E-mail: andras.mezosi@uni-corvinus.hu
Effects of large-scale increase of RES-E with the focus on the spot market price levels in the Nordic Power system

Göran Koreneff
Hannele Holtinen
Tiina Koljonen

VTT TECHNICAL RESEARCH CENTRE OF FINLAND

Effects of large-scale increase of RES-E with the focus on the spot market price levels in the Nordic Power system

- VTT very briefly
- Nordic Power System (http://www.nordel.org/Content/Default.asp)
  - Nordic area
  - transmission lines, exports and imports
  - capacities and productions
- Nordic spot market (NordPool Elspot http://www.nordpool.com/)
- Regulating power market and balance settlement
  - wind power and balance settlement, case calculations
- Large-scale increase of renewables to the Nordic market
  - EU 20% renewables by 2020
  - Effect on spot price level, NEP –modelling results
    (http://www.nordicenergyperspectives.org/)
VTT Technical Research Centre of Finland

VTT IS
- the biggest multitechnological applied research organisation in Northern Europe

VTT HAS
- polytechnic R&D covering different fields of technology from electronics to building technology
- clients and partners: industrial and business enterprises, organisations, universities and research institutes

VTT CREATES
- new technology and science-based innovations in co-operation with domestic and foreign partners

Facts about the Nordic countries 2006

<table>
<thead>
<tr>
<th></th>
<th>Denmark</th>
<th>Finland</th>
<th>Iceland</th>
<th>Norway</th>
<th>Sweden</th>
<th>Nordic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total area</strong> (mil. km²)</td>
<td>43</td>
<td>338</td>
<td>103</td>
<td>324</td>
<td>460</td>
<td>1208</td>
</tr>
<tr>
<td><strong>Average population</strong> (mil. inh.)</td>
<td>5.4</td>
<td>5.3</td>
<td>0.3</td>
<td>4.7</td>
<td>9.7</td>
<td>24.5</td>
</tr>
<tr>
<td><strong>Gross domestic product</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total 2006 (bil. USD)</td>
<td>178.5</td>
<td>145.7</td>
<td>10.7</td>
<td>190.2</td>
<td>283.9</td>
<td>807.0</td>
</tr>
<tr>
<td>Per capita (USD)</td>
<td>32,685</td>
<td>27,491</td>
<td>35,687</td>
<td>40,468</td>
<td>31,198</td>
<td>32,540</td>
</tr>
<tr>
<td><strong>Total consumption</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total 2006 (GWh)</td>
<td>38,392</td>
<td>90,311</td>
<td>9,925</td>
<td>122,572</td>
<td>146,366</td>
<td>405,366</td>
</tr>
<tr>
<td>Per capita (kWh)</td>
<td>6,479</td>
<td>17,032</td>
<td>33,833</td>
<td>26,879</td>
<td>16,084</td>
<td>16,345</td>
</tr>
</tbody>
</table>

*) Estimation by OECD.
Source: Nordel annual statistics 2006
Nordic area and cross-border transmissions
(Nordel = organisation of Nordic TSOs)

Imports and exports 2006 in GWh

Planned and potential new cross-border transmission lines

- Coming improvements to the market
- Germany
- Reducing congestions
Installed net capacity by production types on 31 December 2006, MW
(source: Nordel)

<table>
<thead>
<tr>
<th></th>
<th>Denmark</th>
<th>Finland</th>
<th>Iceland</th>
<th>Norway</th>
<th>Sweden</th>
<th>Nordel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed capacity total</td>
<td>12 689</td>
<td>16 544</td>
<td>7 261</td>
<td>29 268</td>
<td>33 819</td>
<td>94 037</td>
</tr>
<tr>
<td>Nuclear power</td>
<td>-</td>
<td>2 671</td>
<td>-</td>
<td>-</td>
<td>8 965</td>
<td>11 636</td>
</tr>
<tr>
<td>Other thermal power</td>
<td>9 564</td>
<td>10 743</td>
<td>113</td>
<td>244</td>
<td>8 094</td>
<td>28 748</td>
</tr>
<tr>
<td>- Condensing power</td>
<td>963</td>
<td>3 301</td>
<td>-</td>
<td>0</td>
<td>2 298</td>
<td>6 592</td>
</tr>
<tr>
<td>- CHP, district heating</td>
<td>7 687</td>
<td>3 737</td>
<td>-</td>
<td>131</td>
<td>2 954</td>
<td>14 509</td>
</tr>
<tr>
<td>- CHP, industry</td>
<td>567</td>
<td>2 924</td>
<td>-</td>
<td>49</td>
<td>1 229</td>
<td>4 769</td>
</tr>
<tr>
<td>- Gas turbines etc.</td>
<td>307</td>
<td>781</td>
<td>113</td>
<td>64</td>
<td>1 613</td>
<td>2 978</td>
</tr>
<tr>
<td>Hydro power</td>
<td>10</td>
<td>3 044</td>
<td>1 162</td>
<td>28 691</td>
<td>16 185</td>
<td>49 087</td>
</tr>
<tr>
<td>Wind power</td>
<td>3 135</td>
<td>86</td>
<td>-</td>
<td>333</td>
<td>580</td>
<td>4 134</td>
</tr>
<tr>
<td>Geothermal power</td>
<td>-</td>
<td>-</td>
<td>432</td>
<td>-</td>
<td>-</td>
<td>432</td>
</tr>
<tr>
<td>mothballed</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>500</td>
<td>500</td>
</tr>
</tbody>
</table>
Power balance in the Nordic countries
(source: Nordel)


Total electricity generation by energy source and net exchange of electricity 2006, TWh
(source: Nordel)

<table>
<thead>
<tr>
<th>Year</th>
<th>Denmark</th>
<th>Finland</th>
<th>Norway</th>
<th>Sweden</th>
<th>Nordic</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>43.2</td>
<td>78.6</td>
<td>121.7</td>
<td>140.3</td>
<td>383.8</td>
</tr>
<tr>
<td>Total generation</td>
<td>34.6</td>
<td>55.9</td>
<td>0.4</td>
<td>68.8</td>
<td>159.7</td>
</tr>
<tr>
<td>Total thermal power</td>
<td>34.6</td>
<td>33.9</td>
<td>0.4</td>
<td>3.8</td>
<td>72.7</td>
</tr>
<tr>
<td>- Nuclear power</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>42.9</td>
<td></td>
</tr>
<tr>
<td>- Other thermal (fossil)</td>
<td>34.6</td>
<td>33.9</td>
<td>0.4</td>
<td>3.8</td>
<td>72.7</td>
</tr>
<tr>
<td>- Coal</td>
<td>25.8</td>
<td>16.1</td>
<td>-</td>
<td>1</td>
<td>42.9</td>
</tr>
<tr>
<td>- Oil</td>
<td>0.1</td>
<td>1.8</td>
<td>-</td>
<td>1.2</td>
<td>3.1</td>
</tr>
<tr>
<td>- Peat</td>
<td>-</td>
<td>6.2</td>
<td>-</td>
<td>0.1</td>
<td>6.3</td>
</tr>
<tr>
<td>- Natural gas</td>
<td>8.5</td>
<td>9.8</td>
<td>0.4</td>
<td>0.9</td>
<td>10.6</td>
</tr>
<tr>
<td>- Others</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Total renewable power</td>
<td>8.6</td>
<td>22.7</td>
<td>121.3</td>
<td>71.5</td>
<td>224.1</td>
</tr>
<tr>
<td>- Hydro power</td>
<td>0</td>
<td>11.3</td>
<td>119.9</td>
<td>61.2</td>
<td>192.4</td>
</tr>
<tr>
<td>- Other renewable power</td>
<td>8.6</td>
<td>11.4</td>
<td>1.4</td>
<td>10.3</td>
<td>31.7</td>
</tr>
<tr>
<td>- Wind power</td>
<td>0.7</td>
<td>7.8</td>
<td>1.4</td>
<td>10.3</td>
<td>31.7</td>
</tr>
<tr>
<td>- Biofuel</td>
<td>0.8</td>
<td>16.1</td>
<td>0.4</td>
<td>8.2</td>
<td>19.5</td>
</tr>
<tr>
<td>- Waste</td>
<td>-</td>
<td>1.1</td>
<td>0.3</td>
<td>1.1</td>
<td>4.2</td>
</tr>
<tr>
<td>- Geothermal power</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Net imports</td>
<td>-6.9</td>
<td>11.5</td>
<td>0.9</td>
<td>6.1</td>
<td>11.5</td>
</tr>
</tbody>
</table>

Energy balance in the Nordic countries
(source: Nordel)

Nordic power market

- Historically hundreds of utilities in Norway, Sweden and Finland
- Plenitude of producers: hydro, DH-CHP, ind-CHP
- Generation, distribution, and retail sales separate entities
- Markets opened for end-users in the 90’s, Elspot started in mid-90’s
- Common market place in Nordic countries => NordPool, Europe’s largest and leading marketplace for power
  - spot market Elspot
    - 291 TWh, 69% market share
    - congestion => split into price areas
  - aftermarket Elbas (after spot, up until 1 hour before)
  - fiscal contracts Eltermin, based on spot price notations
  - intra-Nordic transmission, cross-border commercially managed by NordPool
- Common balance market in Nordic countries
NordPool Elspot

- day-ahead market
- producers and consumers give bids 12 to 36 hours in advance
  - quantities (in steps)
  - corresponding price for the steps
- for each hour, the price that equals supply with demand is determined => all trade is done to this price

Elspot price development, elspot price areas

- Congestion => split into price areas
  - Helsinki (Finland)
  - Stockholm (Sweden)
  - Copenhagen (Denmark East)
  - Arhus (Denmark West)
  - Oslo, Trondheim,... in Norway
Regulating power market

- Common Nordic regulating power market unless congestions
- TSO responsible, always the other party in each deal
- Secondary reserves (15 min)
- Minimum bids 10 MW
- Highest accepted upregulation bid => upregulation price for that hour

In Nordel, two systems in use:
- Two-price model (used e.g. in Finland and Sweden, and in the examples later). No one is allowed to profit from imbalance compared to area spot price.
- One-price model (in use in Norway)
- Difference in how the producers are paid during the hours when the error has been opposite to the net imbalance of the power system: one-price model lets the producer gain extra during those hours

- One-price model very good for wind power producers:
  - As long as wind power is not dominating the power system imbalance, the error will be about half and half contributing to the imbalance and helping the system \( \rightarrow \) one-price model: no extra cost!
  - When wind power penetration level is high (Denmark), wind power producers will start to pay penalties when they start to influence the system net imbalance

Balance settlement rules - example

- Regulating power market is used to cover the system net imbalance \( \rightarrow \) price for imbalances of that hour
- System operator charges regulating power price for imbalances from all producers that have had their imbalance in the same direction as the regulation need
- The producers that have had their imbalance in the opposite direction
  - pay/receive the spot market price for the imbalance (two-price model)
  - pay/receive the regulating market price (balancing fees are circulated; one-price model)
Market prices in 2004

- Average spot price
  - Finland 27.70 €/MWh (System price 28.95 €/MWh if no bottlenecks)

- Prices for regulation power market
  - no extra price for 25% of time in 2004
  - Additional price for up-regulation 2.87€/MWh (for the hours when up-regulation price differs from spot price)
  - Price reduction for down-regulation 4.65€/MWh (for the differing hours)

Duration curves of price differences between up-regulation and down-regulation prices and Finnish area spot prices

![Duration curves](image)

Electricity market - calculating income for wind producer

- Bids to the spot market at noon the previous day:
  - Income = spot price x predicted production

- Imbalance due to misprediction settled at regulation market prices: cost or income for imbalances = regulation price times prediction error
  - price for regulation only for direction of system imbalance
  - If wind imbalance to opposite direction → paid according to spot price

<table>
<thead>
<tr>
<th>Predicted</th>
<th>System imbalance same direction as wind imbalance</th>
<th>System imbalance opposite direction as wind imbalance</th>
</tr>
</thead>
<tbody>
<tr>
<td>greater than realised, $P &gt; P_0$</td>
<td>Net income: $P \times \text{spotprice} - (P - P_0) \times \text{upreg.price}$</td>
<td>Net income: $P \times \text{spotprice} - \text{spotprice} \times \text{spotprice} = P \times \text{spotprice}$</td>
</tr>
<tr>
<td>less than realised, $P &lt; P_0$</td>
<td>Net income: $P \times \text{spotprice} + (P - P_0) \times \text{downreg.price}$</td>
<td>Net income: $P \times \text{spotprice} + (P - P_0) \times \text{spotprice} = P \times \text{spotprice}$</td>
</tr>
</tbody>
</table>
Impact of wind power to the balancing settlement of the actor

- Comparisons made:
  - Combine wind power and load imbalances
  - Combine wind and hydro power imbalances
  - Combine wind and thermal power imbalances
  - Combine wind and the whole imbalance of the actor

- How different amounts of wind power show in the imbalances

- Roughly half the time the imbalances compensate each other reducing the net balance requirements
- wind power 10 % of peak load → wind power balancing costs would reduce to about 36 %
- wind power 10 % of thermal capacity → wind power balancing costs would reduce to about 60 %
Combining wind imbalances with other production and load

<table>
<thead>
<tr>
<th>VTT 12-36h forecast</th>
<th>VTT 12-36h forecast</th>
<th>NET Balance cost for 4 sites</th>
<th>NET Balance cost for 4 sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>€/MWh prod 9 MW</td>
<td>€/MWh prod 200 MW</td>
<td>€/MWh prod 400 MW</td>
<td>€/MWh prod 9 MW</td>
</tr>
<tr>
<td>Hydro power 400 MW</td>
<td>0.06</td>
<td>0.55</td>
<td>0.65</td>
</tr>
<tr>
<td>Heat power plants 2800 MW</td>
<td>0.14</td>
<td>0.49</td>
<td>0.59</td>
</tr>
<tr>
<td>Consumption 4000 MW</td>
<td>0.01</td>
<td>0.15</td>
<td>0.30</td>
</tr>
<tr>
<td>Consumption+prod excl. wind</td>
<td>0.03</td>
<td>0.15</td>
<td>0.30</td>
</tr>
<tr>
<td>Balance costs solo</td>
<td>0.93</td>
<td>0.84</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Wind power balance cost reduction when combining with other production and consumption

<table>
<thead>
<tr>
<th>VTT 12-36h forecast</th>
<th>VTT 12-36h forecast</th>
<th>NET Balance cost for 12 sites</th>
<th>NET Balance cost for 12 sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>€/MWh prod 9 MW</td>
<td>€/MWh prod 200 MW</td>
<td>€/MWh prod 400 MW</td>
<td>€/MWh prod 9 MW</td>
</tr>
<tr>
<td>Hydro power 400 MW</td>
<td>0.01</td>
<td>0.36</td>
<td>0.45</td>
</tr>
<tr>
<td>Heat power plants 2800 MW</td>
<td>0.30</td>
<td>0.39</td>
<td>0.39</td>
</tr>
<tr>
<td>Consumption 4000 MW</td>
<td>0.06</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>Consumption+prod excl. wind</td>
<td>0.06</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>Balance costs solo</td>
<td>0.62</td>
<td>0.62</td>
<td>0.62</td>
</tr>
</tbody>
</table>

101
Using the hydro power regulating capacity of the producer

- Estimating the flexibility of the hydro power
  - Taking the daily Pmax, Pmin for the hydro power production – regulating capacity within Pmin and Pmax
  - Checking that daily production do not differ from schedule

- Result:
  - 80-90% of wind power imbalances can be regulated using these limits

---

### Ability of hydro power to balance wind power unbalances:

Wind according to 12 sites, hydro use for regulating power uses daily measured Pmin, Pmax as hydro reg. borders

<table>
<thead>
<tr>
<th></th>
<th>200MW</th>
<th>400MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>down-reg</td>
<td>90.0%</td>
<td>90.0%</td>
</tr>
<tr>
<td>up-reg</td>
<td>80.0%</td>
<td>80.0%</td>
</tr>
<tr>
<td>reg</td>
<td>70.0%</td>
<td>70.0%</td>
</tr>
</tbody>
</table>
Using the hydro power regulating capacity of the producer

Large-scale increase of RES-E in the Nordic power system

- EU Renewable energy sources (RES) 20% by 2020
  - Finland RES share from 28.5% to 38% by 2020
  - Sweden
  - Denmark

- Nordic Energy Perspectives – project
  - several models, with both exogenous and endogenous new capacity
  - results from VTT’s Electricity market model (VTT-EMM)
    - exogenous capacity development
    - result is spot price (NOT production price, or average cost, ...)

- Electricity from RES (RES-E), targets?
  - three scenarios for increase in RES-E
    - 6%, 12% and 18% => increased RES-E share respectively of 2, 6, and 9.5 %-points
VTT EMM (Nordic system price model) in action: price estimate 2005-2009, compared to realised system price and forward prices (from fall 2007)

High prices fall 2006: VTT EMM at loss

Renewables in the Nordic system 2008 -> 2020
• Other general NEP2 assumptions
  - Sweden nuclear capacity factor 91%, a significant increase from roughly 81%–85%

• Hydro, wind capacity increases roughly from ECON Classic model results (endogenous model)

• Demand 440 TWh by 2020, a 10% increase

---

<table>
<thead>
<tr>
<th>GW</th>
<th>2007</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear power</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swe</td>
<td>9,2</td>
<td>9,5</td>
<td>10,1</td>
<td>10,1</td>
</tr>
<tr>
<td>Fin</td>
<td>2,7</td>
<td>2,7</td>
<td>5,9</td>
<td>5,9</td>
</tr>
<tr>
<td>Gas power</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nor</td>
<td>0</td>
<td>0,904</td>
<td>0,904</td>
<td>0,904</td>
</tr>
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</table>

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<table>
<thead>
<tr>
<th>Energy Type</th>
<th>2007</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUR/MWh Swe</td>
<td>18</td>
<td>24,2</td>
<td>19,2</td>
<td>20,2</td>
</tr>
<tr>
<td>EUR/MWh Nor</td>
<td>14</td>
<td>20,2</td>
<td>15,2</td>
<td>16,2</td>
</tr>
<tr>
<td>EUR/MWh Den</td>
<td>18,1</td>
<td>24,2</td>
<td>19,2</td>
<td>20,2</td>
</tr>
<tr>
<td>EUR/MWh Fin</td>
<td>16,1</td>
<td>22,3</td>
<td>17,3</td>
<td>18,3</td>
</tr>
<tr>
<td>Coal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUR/MWh</td>
<td>8,88</td>
<td>8,09</td>
<td>6,63</td>
<td>6,22</td>
</tr>
<tr>
<td>Crude oil $/barrel</td>
<td>57,7</td>
<td>62,4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light fuel oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUR/MWh</td>
<td>37,7</td>
<td>41,8</td>
<td>32</td>
<td>33,3</td>
</tr>
<tr>
<td>Heavy fuel oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUR/MWh</td>
<td>19</td>
<td>20,7</td>
<td>16,6</td>
<td>17,2</td>
</tr>
<tr>
<td>Wood chips</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUR/MWh Swe</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>EUR/MWh Nor</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>EUR/MWh Den</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>EUR/MWh Fin</td>
<td>12</td>
<td>15</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Peat</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>EUR/MWh Swe</td>
<td>13</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>EUR/MWh Fin</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>
VTT EMM: Nordic countries, 30 euro/tCO2

Renewables share increases with:
- 2.3% - units
- 5.9% - units
- 9.2% - units

Fossil electricity decreases from 2006 with:
- 25%
- 38%
- 51%

12% scenario 2020:
Finnish electricity production by share of consumption
[Numbers on bars are TWh]

- Hydro
- Biomass
- Import
- Nuclear
- Fossil

Price of CO2

15 euro/tCO2
30 euro/tCO2
45 euro/tCO2
2005
2006
Wholesale electricity price in the Nordic market vs. the EUA price (results from four different models).

Wholesale electricity price in the Nordic market vs. the increase in renewable electricity generation (results from three different models).
VTT extra scenarios for assessing the influence of renewables on the Nordic system price

- Capacity development is congruent with NEP2 6% scenario, but:
  - Norway wind 1400 MW, thus 600 MW more
  - Swedish nuclear still 10 100 MW, but capacity factor is lower, on the level of recent years
- Partly different fuel prices than in NEP2, among others:
  - coal 10 €/MWh
  - biomass (not black liquor) 15 €/MWh
  - stable real fuel prices
The latest issue with RES-E development in the Czech Republic

Rostislav Krejcar
The Czech Energy Regulatory Office
Electricity Department

21st May 2008, Budapest

Main principles of renewable energy support

Act No. 180/2005 Coll. on renewable energy support
- renewable energy producers have priority access right to electricity grid
- producer can choose between two types of support

Fixed feed in tariff
- buyer is a distribution or a transmission company
- 15 years payback period of investments is guaranteed
- price adjustments related to inflation
- not apply to electricity from combined fossil fuel and biomass combustion

Green bonuses
- buyer is a trader or a customer
- distribution or transmission company pays green bonus to producer
- no long-term price guarantees
- higher risk for producer but higher profit possible

21st May 2008, Budapest
Main support scheme for RES-E
Other Legal Provisions I

Decree No. 475/2005 Coll., (revision in 2007)
- sets procedures and timeframes for producers to choose between feed-in tariff and bonus
- contains main typical technical and economical parameters as an input for price calculations:
  - Specific investment costs of technologies per kW
  - Utilization period at maximum capacity of the unit
  - Typical lifetime of each technology
  - Last revision of parameters in 2007 for new installations

Decree No. 150/2007 Coll., about price regulation procedures
- prices for RES-E are adjusted annually according to the inflation from 2% up to 4%
- Prices are guaranteed for typical lifetime of each technology

Price decisions
Feed-in tariff system in price decisions has been employed since 2001 (before RES-E act in 2005)
- Feed in tariffs are set as minimum electricity purchase prices
  - no price reduction with regard to deviations - responsibility of deviation is transferred to a distribution or transmission company
- Bonuses are set as fixed prices
  - responsibility for deviations is subject of an agreement between producer and trader – no bonus reduction either
- Prices are published in the ERO Price Decision:
  - annual update of minimum prices
  - prices are differentiated by the type of a renewable source and its commissioning date
  - more than 30 categories of prices exist in 2008
- Extra bonus for renewable cogeneration electricity
**EU Indicative Targets for Power Generation from Renewables in 2010**


<table>
<thead>
<tr>
<th>Czech Republic</th>
<th>Share of renewable electricity on gross national consumption %</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2,67</td>
<td>3,97</td>
<td>4,34</td>
<td>4,97</td>
<td>4,69</td>
</tr>
</tbody>
</table>

21st May 2008, Budapest

**Share of different types of Renewables in 2006 in CR**

- **Hydro above 10 MWe**: 45%
- **Small hydro to 10 MWe**: 28%
- **Biomass**: 21%
- **Biogas, Landfill & Sewage gas**: 5%
- **Wind**: 1%
- **Solar**: 0%

21st May 2008, Budapest
Share of different types of Renewables in 2007 in CR

- Hydro above 10 MWe: 32%
- Small hydro to 10 MWe: 28%
- Wind: 4%
- Biomass: 29%
- Biogas, Landfill & Sewage gas: 5%
- Solar: 0%

Impact of RES support on end customers

Share of price components on average household price in 2008 (without VAT)

- Electricity: 71.31%
- Distribution: 16.29%
- Transmission: 3.57%
- Market operator: 0.21%
- Decentralized generation: 0.42%
- System services: 6.44%
- Renewables and CHP support: 1.77%

21st May 2008, Budapest
Problems resulting from RES-E development

Impact on prices paid by end customers
- increasing costs for end customers (difference between market price and support)
  - 2002 24mil. EUR
  - 2008 76 mil. EUR

Security and reliability of supplies
- increasing deviations and cost for deviation management
  - influences structure and utilization of balancing energy
- need for new reserve capacities
  - estimated extra cost in 2010 (800 MW in wind) 115mil EUR
Influence of wind power distribution on international tradable capacities

Physical Transit Flow - 8th week 2008

MW

Source: ČEPS (Czech TSO)

Export from Czech Rep. to Austria

MW

Source: ČEPS (Czech TSO)
Thank you for your attention
Renewable Energy Sources in Romania  
– Elements of the proposed RES legislation  
Dan I. Teodoreanu

Summary

I. RES Potential Romania  
II. Legal framework in the field of RES  
   Present and future  
III. R&D Programs/Structural and Cohesion funds  
IV. Practical aspects – wind energy  
V. NESL–ICPE Romanian RES Working Group
I. RES Potential (1)

<table>
<thead>
<tr>
<th>RES Type</th>
<th>Potential Annual (kToe)</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar energy</td>
<td>3430 516</td>
<td>Thermal Electric</td>
</tr>
<tr>
<td>Wind energy</td>
<td>1978</td>
<td>Electric</td>
</tr>
<tr>
<td>Hydro Total: P&lt; 10MW</td>
<td>3448 310</td>
<td>Electric Electric</td>
</tr>
<tr>
<td>Biomass</td>
<td>7814</td>
<td>Thermal Electric</td>
</tr>
<tr>
<td>Geothermal energy</td>
<td>215</td>
<td>Thermal</td>
</tr>
</tbody>
</table>

Technical Potential of RES in Romania (2006)
"Integration of more Renewable electricity in the CEE region: network or support problem?" Budapest, Hungary, 20 – 21 May 2008

I. RES Potential (2)

"Integration of more Renewable electricity in the CEE region: network or support problem?" Budapest, Hungary, 20 – 21 May 2008
I. RES Potential (3)

II. Legal framework in the field of RES (1)

Primary legislation:

- “The Electricity Law” No.13/2007
- GD No. 443/2004 – “Promotion of the electricity produced from RES” (similar with EU Directive 177/2001)
II. Legal framework in the field of RES (2)

Quota/green certificates:

- GD No. 1429/2004: “Certification rules for the origin of power supply produced by RES”

- GD No. 1892/2004 and No. 958/2005: regarding the “System established to promote electricity generated from renewable energy sources”

II. Draft proposal for RES Law: “The system for RES promotion” (1)

Approved by Parliament (Senate) on 8.04.2008

Some important differences compared to GD 1892/2004:

- Values of the 1 Green Certificate (GC)
- Duration of the validity of the regulation
- Private persons considered as RES producers
- International participation to the market
II. Draft proposal for RES Law:  
“The system for RES promotion” (2)

1. All new installed RES: 1 GC ⇒ 1 MWh  
   For PV applications: 1 MWh ⇒ 3 GC  
   For old RES hydro generators 1 MWh ⇒ ½ GC  
2. The duration of the present law regulations: 15 years  
3. Maximum value for 1 GC ⇒ 60 Euro, instead of 42 Euro  
4. Proposed time of application: 1 May 2008

II. Draft proposal for RES Law:  
“The system for RES promotion” (3)

The other quotas (without big (>10 MW) hydro):  

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</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>Quota</td>
<td>0.7</td>
<td>2.22</td>
<td>3.74</td>
<td>5.26</td>
<td>6.78</td>
<td>8.3</td>
<td>8.3</td>
<td>8.3</td>
</tr>
</tbody>
</table>

For the period 2012 - 2020 the formula will be used:  
Q= (Eres1 + ½ • Eres2 + 3 • Eres3)/EE •100/year  
where:  
Eres1 = energy from new installed RES  
Eres2 = energy from old RES  
Eres3 = energy from solar E - RES  
EE = total electric energy production

*Integration of more Renewable electricity in the CEE region: network or support problem?*, Budapest, Hungary, 20 – 21 May 2008
II. Romanian Energy Strategy for 2007 – 2020 (1)

The main objectives:
• Sustainable development
• Competitiveness
• Security of Supply

II. Romanian Energy Strategy for 2007 – 2020 (2)

Sustainable development
• Promotion of RES - E: from total energy consumption
  – 33% - 2010
  – 35% - 2015
  – 38% - 2020
• Promotion of: biofuels, biogas
• Promotion of R&D in RES fields
• Promotion of green RES
II. Romanian Energy Strategy for 2007 – 2020 (3)

Competitiveness:
• Development of market instruments for:
  electrical energy, natural gas, coal, oil, uranium
• Development of instruments like: green certificates, certificates for Green House Gas Emission and for energy efficiency
• Extension of the activities of the Romanian Operator of Central Market for electrical energy - OPCOM at regional and European level
• Increased capacity of interconnection to international electricity transport networks (from 10 to 15 – 20%) in 2020

II. Romanian Energy Strategy for 2007 – 2020 (4)

<table>
<thead>
<tr>
<th>Electricity production</th>
<th>TWh/year</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro+RES</td>
<td>16.</td>
<td>25.5</td>
</tr>
<tr>
<td>Nuclear</td>
<td>7.0</td>
<td>11.1</td>
</tr>
<tr>
<td>Coal</td>
<td>28.7</td>
<td>45.8</td>
</tr>
<tr>
<td>Gas</td>
<td>9.5</td>
<td>15.1</td>
</tr>
<tr>
<td>Oil</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>63.2</td>
<td>100</td>
</tr>
</tbody>
</table>

*Integration of more Renewable electricity in the CEE region: network or support problem?* Budapest, Hungary, 20 – 21 May 2008
II. NEW TARGETS

Present situation: 2007: Primary energy consumption = 30MToe, Electrical energy total = 5.44MToe = 63.2TWh, RES = 3MToe, 10% from the total consumption

RES Technical Potential = 17.71MToe (60% from 2007 consumption)


✔ The contribution of the RES in the total Energy consumption in Romania will grow from 17.8% in 2005 to 24% in 2020

Correlation with the hydropower energy

*Integration of more Renewable electricity in the CEE region: network or support problem?* Budapest, Hungary, 20 – 21 May 2008

NEW TARGET

*Integration of more Renewable electricity in the CEE region: network or support problem?* Budapest, Hungary, 20 – 21 May 2008
**III. Wind energy – Integration into the grid**

**Topics:**

- Wind energy perspectives
- Existence of many projects of wind parks
- Time variation of the parameters of electricity generated in wind parks
- Problems for the transport company *Transelectrica*:
  - hourly integration of the wind energy
  - good average system integration

*Integration of more Renewable electricity in the CEE region: network or support problem?*, Budapest, Hungary, 20 – 21 May 2008

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**III. Wind energy – Integration into the grid**

- **Capacity of connection**
  - Number of annual hours of standard generation: 1500 - 2500
  - Variable distance to the consumers
  - Wind speed variable in time - difficulty for maintenance
  - Time for installation of a new transport network – usually higher than for wind park installation.

*Integration of more Renewable electricity in the CEE region: network or support problem?*, Budapest, Hungary, 20 – 21 May 2008
III. Wind energy – Integration into the grid

Present status of wind projects
Installed power: 8 MW
Wind energy projects: 3650 MW
- Dobrogea: 3017.5 MW
- Moldova: 532.5 MW
Transelectrica approvals:
  Connection to the High Voltage: 600 MW
ENEL - Dobrogea approvals:
  Connection to the medium voltage: 310 MW

*Integration of more Renewable electricity in the CEE region: network or support problem?* Budapest, Hungary, 20 – 21 May 2008
IV. Research & Development Program (1)

Research & Development Programs funded by Romanian Government – Ministry of Education and Research:

National Program: “Research for Excellence”- based on “Collaborative research” and the EU Technology Platforms already established.

*Integration of more Renewable electricity in the CEE region: network or support problem?* Budapest, Hungary, 20 – 21 May 2008

IV. Research & Development Programs (2)

Research activities in the field of RES National Programm:
- Biofuels
- Hydrogen and fuel cells
- Biomass (crops, wood, waste, s.o)
- Marine energy
- Wind technology for small and medium turbines
- Renewable heating
- 2008 Competition: Total number of projects: more than 50
- Total public funding budget: more than 5 million of Euro/year and private - 30% of the total funds.

*Integration of more Renewable electricity in the CEE region: network or support problem?* Budapest, Hungary, 20 – 21 May 2008
**IV. Structural and cohesion funds (2008 – 2013)**

**Priority 2:** R&DI Projects for investment in infrastructure, innovation and centers of excellence-platforms for research, demonstration and dissemination at EU level

EU Funds (Program Draft): ~ 500 Mill. Euro; Local funds ~ 250 Mill.Euro

**Priority 4:** Projects based on RES applications/energy efficiency: Co-financed by EU - European Regional Development Fund (max. 50% of the total eligible costs) and Romanian Government/Private Companies for the rest.

Total EU funds (Program Draft): ~700Mil.Euro (RES ~ 200 Mill. Euro)

*Integration of more Renewable electricity in the CEE region: network or support problem?* Budapest, Hungary, 20 – 21 May 2008

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**IV. EU funds for rural development & environment**

Funds for factory development of RES system components:

**2008 -2013: 240 mil.Euro**

Value per project = 100 000 – 20 000 000 Euro

*Integration of more Renewable electricity in the CEE region: network or support problem?* Budapest, Hungary, 20 – 21 May 2008
V. NESL – ICPE
Center of Excellence for Solar and Wind Energy

• Before 1989, NESL – ICPE (founded in 1981) had the leading position in solar and wind energy in Romania, official partner in joint projects financed and organized at national and international level

• After 1989 NESL - ICPE participated in European co-operation projects: PECO, JOULE THERMIE, INCO-COPERNICUS, FP5 and FP6 Programs (14 EU projects)

• NESL - ICPE is member of EU PV Technology Platform and of the EU TP “Smart Grid” - Networks of the Future

"Integration of more Renewable electricity in the CEE region: network or support problem?" Budapest, Hungary, 20 – 21 May 2008

Feasibility studies for solar thermal hybrid systems

Solar thermal systems

"Integration of more Renewable electricity in the CEE region: network or support problem?" Budapest, Hungary, 20 – 21 May 2008
Quality assessment: indoor and outdoor tests:

- NESL – ICPE has the capability to perform field tests for RES systems and components.
- There are three test site facilities: at Agigea and Costinesti on the Black Sea coast, and at Anghelus - in the Carpathian mountains.
Feasibility studies for wind parks

Installation of wind measuring systems in Dobrogea and Moldova counties

Contact:

Dr. Dan I. Teodoreanu
Director of New Energy Sources Laboratory (NESL) - Research Institute for Electrical Engineering (ICPE)

Phone/fax: +40 21 5893472; mobile: +40 745122863
e-mail: danteo@icpe.ro; pv-platform@icpe.ro
Address:
313, Splaiul Unirii
030138, Bucharest, Romania
Romanian representative of in the Mirror Group of the EU Technology Platform Photovoltaics

"Integration of more Renewable electricity in the CEE region: network or support problem?" Budapest, Hungary, 20 – 21 May 2008
Renewable Energy Sources and Energy Efficiency in Romania in the light of the EU legislation

Corneliu Radulescu
Romanian Agency for Energy Conservation

EU ENERGY POLICY TARGETS

- Directive 2006/32/EC (ESD)

**Purpose**

Energy efficiency increase in energy end-use sectors, by:

- providing the indicative targets as well as mechanisms, incentives and institutional, financial and legal framework necessary for the promotion of efficient energy end-use;
- creating the conditions for the development and promotion of the market for energy services

**Target**

- Energy savings of 9% for the end of the period 2008-2016, respectively 1% per year, of the annual average of the final energy consumption in the last 5 years (period 2001-2005) (the companies under emission trading scheme are excluded)

National Energy Efficiency Action Plans

**Deadlines**: 30th June 2007; 30th June 2011; 30th June 2014
Integrated Energy and Climate Change Package, January 2007

**Target**

- Reducing GHG by 20% by 2020 comparatively with 1990;
- Energy savings of 20% of the EU total primary energy supply by 2020;
- Share of the renewable energy of 20% in overall energy mix by 2020, and a minimum target of 10% for biofuels.

**Legislative proposals:**

- Modifying the ETS Directive (2003/87/EC)
- Directive proposal on the use of the renewable energy sources
- Proposal for establishing the GHG targets for the non-ETS sectors


**Targets by 2020 for each EU Member State regarding:**

- GHG emission cut;
- Share of the renewable energies in the final energy consumption

**Proposal for Romania:**

- +19% Target on GHG emission for non-ETS sectors
- -21% Target on GHG emission for ETS sectors
- 24% Share of RES in final energy consumption
Evolution of the final energy consumption

Structure of final energy industrial consumption in 2006

Evolution of final energy intensity
• Strategy for Renewable Energy Sources use (GD 1535/2003) and the promotion of electricity generation from RES (GD 958/2005, updated):

Targets:
– RES share in the total primary energy supply: 11% by 2010;
– RES share in the gross electricity consumption: 33% by 2010;

35% by 2015;
38% by 2020.


Targets:
- minimum share: 2% in total in 2007;
- minimum share: 5,75% in total in 2010.

Renewable Energy Sources in Romania
Within the “STRATEGY FOR THE UTILISATION OF RENEWABLE ENERGY SOURCES” is highlighted the energy potential of RES in Romania.

<table>
<thead>
<tr>
<th>RES</th>
<th>Potential (tthm toe/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLAR ENERGY</td>
<td></td>
</tr>
<tr>
<td>- thermal energy</td>
<td>1,433</td>
</tr>
<tr>
<td>- photovoltaic system</td>
<td>103</td>
</tr>
<tr>
<td>WIND ENERGY</td>
<td>1,978</td>
</tr>
<tr>
<td>MICRO HYDRO ENERGY</td>
<td>516</td>
</tr>
<tr>
<td>BIOMASS</td>
<td>7,597</td>
</tr>
<tr>
<td>GEOTHERMAL ENERGY</td>
<td>167</td>
</tr>
<tr>
<td>TOTAL</td>
<td>11,795</td>
</tr>
</tbody>
</table>

National TARGETS

2010: 33% on the total generated electricity produced from renewable energy sources

2015: 35% target concerning the share of electricity produced from renewable in the gross internal electricity consumption is:

2020: 38% 2,22% for 2006, 3,74% for 2007, 5,26% for 2008, 6,78% for 2009 and 8,35% since 2010.

2010: 11% on the total primary energy sources
The present share of RES in total energy production

For each MWh of renewable electricity delivered to the grid, producers receive from the System and Transport Operator, 1 green certificate which can be traded for prices between established limits of EUR 24-42 certificate.
**Renewable Energy Sources eligible to receive GC**

**Draft Project for a G.D.**

- **a.** For each MWh of renewable electricity delivered to the grid from a *new or refurbish plant*, producers receive **1 green certificate**

- **b.** For each MWh of renewable electricity delivered to the grid from *Solar energy*, producers receive **3 green certificates**

- **c.** For each 2 MWh of renewable electricity delivered to the grid from *Hydro power plant ≤ 10 MW*, producers receive **1 green certificate** (which don't correspond conditions to letter a.)

1 green certificate can be traded for prices between established limits of EUR 26,2 - 46,2/ certificate

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**SOLAR ENERGY**

- Polytechnic University of Bucharest (30 kW)
- Valahia University (10 kW)

**Romanian Solar Radiation Map**

- Giurgiu
- Mangalia

---
The hydro power is the most important RES in Romania.
Biomass

The biomass energy potential amounts to 318 PJ/year,
- 49.2 PJ waste materials from wood processing industries and fuel wood,
- 20.4 PJ sawdust and other wood wastes,
- 200.9 PJ agricultural wastes,
- 22.8 PJ municipal wastes
- 24.6 PJ biogas.

Project “Sawdust 2000”

Vatra Dornei
12 MW

Vlăhiţa
6 MW

Huedin
4 MW

Gheorgheni
6 MW

Întorsura Buzăului
**BIODIESEL**

Investments:

- **Auto Elite Baia Mare** – 50,000 t biodiesel/year
- **Lehliu Gara** - Martifer Portugal - refinery and oil processing plant, 100,000 t biodiesel/year, capacity: 50,000 ha rape seed crop
- **Ultex Țăndărei** - processes 175,000 tones of grains soy, 4,500 t biodiesel/year
- **Ulerom Vaslui** - 60,000 t biodiesel/year, with further possibilities to attain 120,000 t biodiesel/year.
- **Rompetrol Rafinary** – 60,000 t/year capacity
- **Expur Urziceni** - swiss firm ALIMENTA
- **ATEL, LOAMNES** – Sibiu - MAN Ferrostaal Germany, 400 t/day

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**GEOTHERMAL POTENTIAL IN ROMANIA**

At Ministry of Administration and Interior there is PILOT PROGRAM:
10 schools will be equipped with heat pump that replace stoves and decrease pollution.

- Oradea
- Calimanesti – Caciulata
- North Bucharest (Otopeni)

Applications:
Financial schemes to support energy efficiency and renewable projects

- The National program for the reduction of energy costs for the population, by increasing energy efficiency and using renewable sources of energy
  
  - **2006** - the utilization of geothermal energy in housing from Livada and Săcueni.
  - commissioning of the micro hydro power plants to power the public lighting in the city of Geoagiu.

- **FREE** (Romanian Energy Efficiency Fund) is a revolving fund established by World Bank.

- **Environmental Fund** is a fund supplied by penalties for pollution and state budget. Only renewable projects could be financed from this fund, not energy efficiency

- **ESCO in Romania**

- **Third Party Financing (TPF)**

- **Long Term Agreement (LTA)**

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THANK YOU FOR YOUR ATTENTION!
1. BASIC INFORMATION ON POLAND

- Poland is a medium size country: the population - 38.1 million, area - 312,7 th km².
- From 1990 Poland survived the economic and political transformation from the centrally planned to the marked economy.
- During the last years Poland has strong economic growth - GDP rate reached 4-7% per year.
- Since 1996 Poland is a member of OECD, in 1999 joined to the North Atlantic Treaty Organisation (NATO) and since 1 May 2004 Poland is a member of the European Union.
- In 1995 the electric system of Poland was interconnected with the Westerns European System (UCTE).
- In 1997 the Parliament has passed the basic legal act: The Energy Law.
2. GENERAL FEATURES OF ENERGY ECONOMY

- Poland has relatively large resources of hard coal and brown coal, modest reserves of natural gas, insignificant of crude oil and small hydro potential.
- Poland still is a significant producer and exporter of coal but large importer of oil and natural gas.
- Primary energy consumption – 96,7 Mtoe in 2006, 2,38 toe/capita.
- Electricity consumption – 136,7 TWh, 3588 kWh/capita in 2006.
  Electricity production is based on big producers use fossil fuels
- RES production was 228 PJ (6.5% of primary energy production) in 2006.
- Renewable energy is applied in Poland in power sector (hydro electricity, wind) and in small scale, especially in small towns, individual houses.

Gross electricity production- export + import – network losses

3. RES INSTALLED CAPACITY AND NUMBER OF INSTALATIONS

<table>
<thead>
<tr>
<th>Installed capacity MW</th>
<th>Number of installations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005</td>
</tr>
<tr>
<td>Biomass</td>
<td>51,0</td>
</tr>
<tr>
<td>Biogas</td>
<td>32,7</td>
</tr>
<tr>
<td>Wind</td>
<td>123,5</td>
</tr>
<tr>
<td>Hydro</td>
<td>921,7</td>
</tr>
<tr>
<td>Co-firing</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>1128,9</td>
</tr>
</tbody>
</table>

- Since 2005 wind power capacity has increased by ca. 200% in Poland.
- Since 2006 rapidly growth in biomass co-firing in conventional power plants.

Source: [6], [7].
4. GROSS ELECTRICITY PRODUCTION BY KIND OF RES GWh

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>Growth %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>163.1</td>
<td>180.1</td>
<td>110</td>
</tr>
<tr>
<td>Biogas</td>
<td>110.2</td>
<td>115.7</td>
<td>105</td>
</tr>
<tr>
<td>Wind</td>
<td>135.5</td>
<td>256.1</td>
<td>189</td>
</tr>
<tr>
<td>Hydro</td>
<td>2201.1</td>
<td>2042.3</td>
<td>93</td>
</tr>
<tr>
<td>Co-firing</td>
<td>1237.3</td>
<td>1645.2</td>
<td>133</td>
</tr>
</tbody>
</table>
  - biomass         | 1236.7| 1644.6| 133      |
| TOTAL             | 3847.2| 4239.5| 111      |

- RES production has continued to increase in recent years.
- High growth rates are being for wind and biomass.

Source: [6], [7].

5. EUROPEAN UNION POLICY AND LOW

- RES obligations result from Poland membership in the EU and from other international agreements.

- The obligation are:
  - achieving 6% reduction of CO2 emission in 2008-2012 comparing the 1988 level – Kyoto Protocol in 2002,
  - achieving 7,5% share of electricity produced from RES in the gross electricity consumption – implementation Directive 2001/77/EU,

- Those obligations are included in the strategic documents that shape Polish ecological policy and energy policy and in the main legal act– Act on Environment Protection, the Energy Law and Ordinances to this acts.
6. TARGETS FOR ELECTRICITY FROM RES

- The obligation of buying or producing electricity from RES is fulfilled if in each enterprise the share of electricity with the certificates of origin in the total sale of electricity in a given year is not lower than:

- Ordinances of Ministry of Economy

<table>
<thead>
<tr>
<th>Year</th>
<th>New</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>7,0%</td>
<td>7,0%</td>
</tr>
<tr>
<td>2008</td>
<td>7,0%</td>
<td>8,7%</td>
</tr>
<tr>
<td>2009</td>
<td>8,7%</td>
<td>10,4%</td>
</tr>
<tr>
<td>2010</td>
<td>10,4%</td>
<td>10,9%</td>
</tr>
<tr>
<td>2013</td>
<td>10,9%</td>
<td>11,4%</td>
</tr>
<tr>
<td>2014</td>
<td>11,9%</td>
<td>12,4%</td>
</tr>
<tr>
<td>2015</td>
<td>12,4%</td>
<td>12,9%</td>
</tr>
<tr>
<td>2016</td>
<td>12,4%</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>12,9%</td>
<td></td>
</tr>
</tbody>
</table>

In 2005 and 2006 the obligation has been fulfilled with a surplus and hasn’t in 2007.

7. INSTRUMENTS TO SUPPORT RES IN POLAND

- The Energy Law together with the Ordinance of Ministry of Economy create the incentives for promotion electricity production from RES in particular:
  - quota obligation system - obligation on electricity suppliers with targets specified from 2005,
  - system of penalties for non-compliance the obligations,
  - directing the funds achieved from substitute payments and fines to financial support of investments in RES,
  - the obligation to buy all the electricity produced from RES,
  - decrease by 50% the costs of connecting RES to the grid,
  - facilitation of wind power plants,
  - priority of transmission services for the energy from RES.
8. RES TECHNICAL POTENTIAL AND UTILISATION

<table>
<thead>
<tr>
<th>Technical potential</th>
<th>Share</th>
<th>Utilisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PJ/a</td>
<td>%</td>
</tr>
<tr>
<td>1. Biomass</td>
<td>755</td>
<td>43,1</td>
</tr>
<tr>
<td>2. Water</td>
<td>49</td>
<td>2,8</td>
</tr>
<tr>
<td>3. Geothermal</td>
<td>220</td>
<td>12,6</td>
</tr>
<tr>
<td>4. Wind</td>
<td>281</td>
<td>16,1</td>
</tr>
<tr>
<td>5. Sun</td>
<td>445</td>
<td>25,4</td>
</tr>
<tr>
<td>6. TOTAL</td>
<td>1750</td>
<td>100</td>
</tr>
</tbody>
</table>

- Biomass is the dominant source and has large share of utilisation.
- The potential of wind energy and geothermal are also high but there are used in small scale.
- The potential of water is low but it used in 16%.

Source: [4], [5].

9. BIOMAS POTENTIAL

- The biomass economic potential is 600 PJ/a in this:
  - solid dry biowest 166 PJ/a,
  - biogas 123 PJ/a,
  - forestry products 24 PJ/a,
  - agricultural residues 287a.

- It’s expected further increase of biomass use for electricity,
  - high growth rates of co-firing in CHP.
- There exists a huge potential of the increase the energy crops plantations.
- Biogas for electricity - further development gas from waste dumps, sewage and from plantation as well as.
  - foreseen capacity 2-3 GW in 2020.
## 10. WIND POTENTIAL

- Economic potential - 445 PJ/a in this:
  - 377 PJ/a on land and 67 PJ/a off-shore.
- Most favourable conditions for wind energy are in the northern and eastern parts of Poland.

**Current situation:**
- installed capacity 269 MW 8 farms
- forecast capacity 3723 MW 81 farms

**TOTAL** 3992 MW 89 farms

- A rapid development of the installed capacity based on wind energy is foreseen in the nearest future.
- The planned projects to 2020: 7-8 GW mainly in the north part of Poland.

Source [9]

## 11. HYDROENERGY

- Economic potential of hydroenergy in Poland are not high, they are estimated to about 18 PJ/a.

**Current situation:**
- ca. 700 small hydropower stations.

**Hydropower still remains the largest RES source in the electricity:**
- total electricity production – ca. 4 TWh.

**Forecast:**
- to 2020 is foreseen development of small hydro power stations to ca. 11 PJ.
- building new big hydropower plants are not expected in the nearest future.
12. SOLAR AND GHEOTHERMAL ENERGY

- Solar energy
  - The economic potential of solar energy in Poland are relatively high (83 PJ/a), but with high irregularity of solar radiation.
  - The photovoltaic installations produce electricity used for supplying telecommunications devices, lighting road signs, and a few installations are used by individual users or by local societies.

- Geothermal water
  - Majority of the water is characterised by low enthalpy and high mineralization.
  - Geothermal water and solar will not be significant in electricity production to 2020, but there exist the possibility to increase utilisation of those sources.
  - The wider application of this technologies will be possible as their costs come down.

13. Warsaw University of Technology Centre for Photovoltaics
14. CONCLUSIONS

- Poland has a considerable potential of biomass.
- Potential of other RES resources are relatively poor, because we have limited hydro and wind potential as well.
- In spite of limited RES resource we expected faster and significant growth of renewables energy utilisation for electricity generation due to:
  - security of supply,
  - decrease of dependence from primary energy sources,
  - reducing the atmospheric pollution,
  - counteracting the climate change,
  - developments of agricultural regions.
- It is necessary to stress that achievement of 15% electricity from RES in 2020 according to EU Council Decision will rather difficult task.

14. CONCLUSIONS cont.

- Additional efforts are needed to reach this target:
  - increase of financial support for new RES,
  - development of grid connections and available capacity,
  - improvement of administrative procedures for new RES,
  - increase social awareness of the benefits of RES.

THANK YOU FOR YOUR ATTENTION
hanna.burczy@ien.com.pl
REFERENCES


REFERENCES cont.


[12] Ustawa z dnia 10 kwietnia 1997 r. – Prawo energetyczne (Energy Law)

[13] Rozporządzenie Ministra Gospodarki z dnia 19 grudnia 2005 r. w sprawie szczegółowego zakresu obowiązku uzyskania i przedstawienia do umorzenia świadectw pochodzenia, uiszczienia opłaty zastępczej oraz zakupu energii elektrycznej i ciepła wytworzonych w odnawialnych źródłach energii (Ordinance of Ministry of Economy...) (Dz. U. 05.261.2187)


National targets (NES)

Lithuania will implement its commitments to the EU on the use of renewable energy resources for generating electricity. With wind power plants, small hydropower plants and bio fuel burning CHP plants being constructed within the next five years, the share of renewable energy resources in the total electricity generation balance will account for over 7% in 2010, while at the end of the forecasting period their input should increase to 10%. The possibilities of constructing hydropower plants complying with environmental requirements will be considered, exploiting the potential of the River Neris and its basin.

Efforts will be made to increase the share of renewable energy resources in the primary energy balance by 1.5% each year until 2012 and by 2025 to reach 20%.

The share of renewable energy resources in the national balance of primary energy increased in 2005 up to 8.7%, and in 2010 one of the country’s strategic objectives will be attained – the share of renewable energy resources will increase up to 12%. With the construction of all the wind power plants whose construction has already begun and the power plants working on biofuel, over 7% of electricity will be generated in 2010 by using renewable energy resources.
Fiscal Measures to Promote Use of Renewable Energy Sources in Lithuania (1)

- **Purchasing obligation** - Pursuant to the Regulations for Public Service Obligations holders of the supply license and public supply license are obliged to purchase all electricity generated using renewable energy sources from its producers at the established prices and sell it to their customers.

- **Transportation priority** - The Regulations for Public Service Obligations provide for the obligation for the supply network operator to ensure priority transportation of electricity generated from renewable energy sources via electricity transmission networks in the situation when the grid has limited conductivity.

- **Feed-in tariffs** - As from 2002 feed-in tariffs have been applied for the purchasing of electricity generated using renewable energy sources:
  - hydro power plants - 20 ct/kWh (5.8 €cent/kWh)
  - wind power plants - 22 ct/kWh (6.4 €cent/kWh). (30 ct/kWh (8.7 €cent/kWh) since 2009)
  - Since 2008 a new tariffs have been applied for the purchasing of electricity generated using biofuel:
    - biofuel power plants, the operation of which was started before 2008 - 22 ct/kWh
    - biofuel power plants, the operation of which will be started after 2008 - 24 ct/kWh.
  - These tariffs will be maintained until 31 December 2020.

Fiscal Measures to Promote Use of Renewable Energy Sources in Lithuania (2)

- **Discount on the fee of connection of power plants to the network** - Generators whose power plants are using renewable energy sources for electricity generation are subject to a 40 % discount for the connection to the network of operating energy plants.

- **Exemption from excise tax** - The electricity shall be exempted from excise if electricity is generated from renewable energy sources (This provision will come into force since 1 January 2010).

- **EU Structural Funds** - In order to enhance the use of the renewables in Lithuania it is expedient to build a new boiler-houses or to modernize a part of the old ones for the use of the renewables (ES Structural assistance for Lithuania for the period 2007-2013 will be allocated in accordance with National Strategic Reference Framework for Lithuania for 2007-2013 and with operational programs. The funds from Operational Program for Promotion of Cohesion for 2007-2013 will be budgeted for mentioned activity).

- **Exemption from the pollution charge** - Physical and legal persons, upon presentation of documents proving consumption of biofuel in mobile pollution sources shall be exempted from the payment of the pollution charge for emission of air pollutants which emerge during combustion of biofuel.
### RES consumption and potential

**Source:** [www.avei.lt](http://www.avei.lt)

<table>
<thead>
<tr>
<th>Sort of RES sources</th>
<th>Consumption, TWh</th>
<th>Potential, TWh/year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In 2006</td>
<td>In 2010</td>
</tr>
<tr>
<td>Wood</td>
<td>8.46</td>
<td>9.50</td>
</tr>
<tr>
<td>Straw</td>
<td>0.019</td>
<td>0.50</td>
</tr>
<tr>
<td>Municipal waste</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Landfill gas</td>
<td>0.023</td>
<td>0.14</td>
</tr>
<tr>
<td>Biogas</td>
<td>0.0097</td>
<td>0.11</td>
</tr>
<tr>
<td>Geothermal energy</td>
<td>0.397</td>
<td>0.46</td>
</tr>
<tr>
<td>Small HPP</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Large HPP</td>
<td>0.0137</td>
<td>0.29</td>
</tr>
<tr>
<td>Solar energy</td>
<td>0.28</td>
<td>0.72</td>
</tr>
<tr>
<td>Wind energy</td>
<td>0.80</td>
<td>0.46</td>
</tr>
<tr>
<td>Biofuel</td>
<td>0.50</td>
<td>0.46</td>
</tr>
<tr>
<td>Total:</td>
<td>9.2024</td>
<td>11.72</td>
</tr>
</tbody>
</table>

**Source:** [www.avei.lt](http://www.avei.lt)

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### Newly installed small hydro power plants

**Source:** [www.avei.lt](http://www.avei.lt)

- **Installed capacity 0-200 kW**
- **Installed capacity 200-500 kW**
- **Installed capacity 500-1000 kW**
- **Installed capacity 1000-10000 kW**
Wood boiler-houses & power plants

Source: www.avei.lt

Other plants using RES

Source: www.avei.lt
Development of electricity production from RES

Lithuanian electricity balance after closure of Ignalina NPP
## Barriers and opportunities

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relatively cheap, clean and abundant electricity from nuclear power plant</td>
<td>Closure of Ignalina NPP in 2010</td>
</tr>
<tr>
<td>Lack of economic motivation for RES electricity producers</td>
<td>Growth of fossil fuel prices increases attractiveness of RES</td>
</tr>
<tr>
<td>Lack of proven technologies for some potential sources</td>
<td>ES and local Policy support, technology development</td>
</tr>
<tr>
<td>Grid reinforcement issues for large scale wind farms</td>
<td>Benefits from ETS</td>
</tr>
</tbody>
</table>

---

THANK YOU FOR YOUR ATTENTION!

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Specific economic details of the RES regulation

Tamás Tóth
Hungarian Energy Office

Budapest, 21th May 2008

EU expectations regarding the support scheme

- Effective
  - Ensure the RES utilization
  - Enough support for RES >> countable
    >> low risk

- Efficient
  - RES utilization at the least cost
  - Low consumer expenditure

Increase the security of investment
Create acceptance
Effectiveness

Experiences of the Hungarian support scheme (1)

Experiences of the Hungarian support scheme (2)

Roundtable on: "Integration of more Renewable electricity in the CEE region: network or support problem?", Budapest, Hungary, 20-21 May 2008
Main features of the Feed-in-tariff system

1. obligatory taking over and feed-in-tariff for RES-E (only for the licensed period and amount)
2. Hungarian Energy Office (HEO) sets the amount of RES-E and the period of the obligatory taking over in the license
   - Individually project inquiry
   - Period and amount depend on the submitted business plan (depend on the return period of the investment)
3. Feed-in-tariff is set by the Act (VET): average tariff 9 EURcent/kWh*k (k= last year inflation rate)
   - By wind, PV at all day periods the same tariff
   - By the others depend on the electricity demand at day periods the tariffs are different, but the average tariff is the same

Price is fixed        Length of supported period is variable
Experiences of the Hungarian support scheme (5)

Efficiency

2003 2004 2005 2006 2007
RES-E: 0,8 5,6 13,9 14 13,8 (in billion HUF)

New draft (uniformized payback period calculation)

• Based on:
  – net present value calculation of a benchmark power plant
  – Datas of domestic RES power plants, international experiences

• Result
  – Biomass (firewood, agricultural waste, liquid biomass) 10-12 years (depend on the size)
  – Biomass (energy plantation) 12-14 years
  – Biogas (with gasstation) 11-12 years (without gasstation) 7 years
  – Waste 8 years
  – Geothermal 15 years
Thank You for your Attention!

Tamás TÓTH

Hungarian Energy Office
WIND PROJECTS INTEGRATION IN LITHUANIAN ELECTRICITY NETWORK

Vaida Tamašauskaitė
Energy Development Department
Lietuvos energija AB

Budapest
2008-05-21

THE STRUCTURE OF ENERGY SECTOR IN LITHUANIA

PRODUCTION
• 3 production companies
• 3 CHP of district heating companies
• Few private mini HPP
• Few industrial power plants

DISTRIBUTION
• Two distribution companies (one private)

TRANSMISSION
• One Transmission System Operator company – Lietuvos Energija AB
LIETUVOS ENERGIJA AB

- Owns:
  - 110-330 kV transmission grid;
  - Kaunas HPP and Kruonis HPSSP;
  - The dispatch centre;
  - The telecommunications and information system;
  - Kauno energetikos remontas UAB (civil works);
  - Energetikos pajégos UAB (design).

- Main functions:
  - Maintenance and Development of Transmission System
  - System Operation
  - Market Administration
  - Security of Supply in Lithuania

---

<table>
<thead>
<tr>
<th>Power plants</th>
<th>Installed/available capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignalina Nuclear PP</td>
<td>1300 / 1183</td>
</tr>
<tr>
<td>Lithuanian PP</td>
<td>1800 / 1732</td>
</tr>
<tr>
<td>Mazeikiai CHP</td>
<td>160 / 148</td>
</tr>
<tr>
<td>Vilnius CHP</td>
<td>372 / 355</td>
</tr>
<tr>
<td>Kaunas TPP</td>
<td>170 / 161</td>
</tr>
<tr>
<td>Petraičių TPP</td>
<td>8 / 7</td>
</tr>
<tr>
<td>Klaipėda CHP</td>
<td>11 / 9</td>
</tr>
<tr>
<td>Panevėžys CHP</td>
<td>35 / 33</td>
</tr>
<tr>
<td>Auto producers</td>
<td>75 / 7</td>
</tr>
<tr>
<td><strong>Total thermal PP:</strong></td>
<td><strong>2632 / 2519</strong></td>
</tr>
<tr>
<td>Kaunas HPP</td>
<td>101 / 51</td>
</tr>
<tr>
<td>Kruonis PSPP</td>
<td>900 / 760</td>
</tr>
<tr>
<td>Small hydro PP</td>
<td>26 / 26</td>
</tr>
<tr>
<td><strong>Total hydro PP:</strong></td>
<td><strong>1027 / 837</strong></td>
</tr>
<tr>
<td>Biofuel PP</td>
<td>19 / 18</td>
</tr>
<tr>
<td>Wind PP</td>
<td>52 / 52</td>
</tr>
<tr>
<td><strong>Total renewable PP:</strong></td>
<td><strong>71 / 70</strong></td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>5030 / 4609</strong></td>
</tr>
</tbody>
</table>
TRANSMISSION GRID

<table>
<thead>
<tr>
<th>Voltage Level</th>
<th>Length of Overhead Lines, km</th>
<th>Length of Underground Lines, km</th>
<th>Substations</th>
<th>Switchgears</th>
<th>Total Capacity of Transformer, MVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>110 kV</td>
<td>4970</td>
<td>21</td>
<td>12</td>
<td>213</td>
<td>143</td>
</tr>
<tr>
<td>330 kV</td>
<td>1670</td>
<td>12</td>
<td>12</td>
<td>213</td>
<td>3325</td>
</tr>
<tr>
<td>Total</td>
<td>6640</td>
<td></td>
<td></td>
<td></td>
<td>3468</td>
</tr>
</tbody>
</table>

LATVIA

BELARUS

RUSSIA

POLAND

TRANSMISSION GRID DEVELOPMENT 2006 – 2016 M.

Roundtable on: "Integration of more Renewable electricity in the CEE region: network or support problem?", Budapest, Hungary, 20-21 May 2008
MAIN LEGISLATION ACTS REGULATING RES DEVELOPMENT

- National energy strategy.
- Law on energy.
- Law on electricity.
- Decree for approval of technical requirements for wind power plants for connection to the Lithuanian power system.
- Rules for connection of new consumers to the existing networks.
- Law on promotion electricity production from renewable energy sources.

WIND RESOURCES IN THE BALTIC STATES

[Map of wind resources in the Baltic States]
WIND POWER DEVELOPMENT ZONES IN LITHUANIA

Wind connection zones:
Zone 1 – 30 MW any place in 10 kV network
Zone 2 – 40 MW
Zone 3 – 45 MW
Zone 4 – 30 MW
Zone 5 – 35 MW
Zone 6 – 20 MW, any place in 110 kV, except 110 kV lines in Zones 2-5

TENDERS FOR WIND FARMS CONNECTION TO THE GRID

- Tender goal - choose producers, who can get permissions to build wind farms.
- Separate tenders for different zones.
- Tender participants can be any of physical or legal persons.
- Tender participants get preliminary technical conditions according to data they provide to grid operator about wind farm location and geographical place.
- Tender participant formulate the proposal according to given technical conditions.
- Tender commission choose the best proposal.
- Criterion for best proposal – the highest connection fee for one MW.
- Tender winner will get permission from Ministry of Economy, following procedures the same like for usual producers.
GRID CONNECTION PROCEDURES

1. Preliminary technical conditions from grid operator.
2. Permission from Ministry of Economy.
3. Technical conditions from grid operator.
4. Technical project.
5. Connection agreement.
6. Public tender for choosing contractor for project implementation.
7. Construction works.
8. Technical evaluation commission.
9. Commission for object acceptance as suitable for use.
10. Agreement for buying/selling electricity.
## EXISTING WIND POWER PRODUCERS

<table>
<thead>
<tr>
<th>Producer</th>
<th>Location</th>
<th>Type and capacity of units</th>
<th>Total installed capacity, MW</th>
<th>Output, GWh</th>
<th>Capacity utilization factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAB „Vojų spektros“</td>
<td>Kiauleikiai village, Kretinga municipality</td>
<td>ENERCON 2.0 MW</td>
<td>30</td>
<td>45.9</td>
<td>2038</td>
</tr>
<tr>
<td>„Achema“ Hidrostotys UAB</td>
<td>Benaičiai village, Kretinga municipality</td>
<td>VESTAS 2.75 MW</td>
<td>16</td>
<td>19.4</td>
<td>2085</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>46</strong></td>
<td><strong>65.3</strong></td>
<td><strong>2060</strong></td>
</tr>
</tbody>
</table>

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## THANK YOU

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Energy Development Department  

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Lithuania  

vaida.tamasauskaite@lpc.lt  
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Integration of more Renewable electricity in the CEE region: network or support problem?

- Within the Renewable Energies Unit in the last two years a project has been carried out to evaluate the effects of the different financial conditions.
- In these two years more than half of the investment for energy generation investment to new facilities was directed to RES-E (Dexia Bank).
- With higher market security (obligatory price, feed-in tariff system) from financial point of view the RES projects became more similar to bonds – so banks became more active in this sector.
- However they invest where they find the most attractive conditions: Europe competes with North America, Australia, Japan.

The rational behind the study was the significant difference between the financial conditions of the EU and other OECD countries.

<table>
<thead>
<tr>
<th>Year</th>
<th>Spain</th>
<th>Germany</th>
<th>Italy</th>
<th>UK</th>
<th>USA</th>
<th>Japan</th>
<th>Australia</th>
<th>Average Europe 4</th>
<th>Average other OECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
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<td></td>
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<tr>
<td>1996</td>
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<td></td>
<td></td>
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<tr>
<td>1998</td>
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<td></td>
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<tr>
<td>2000</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>2002</td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>
The study took into account the dynamic technological environment

The dominance of gas would only be reduced with the above mentioned gradual capital cost reduction the new energy sources can unlock from the niche market.
With the gradual reduction of the difference, the lower capital costs would result in the following changes

AND THIS IS NOT ONLY OUR PROJECTION...

Figure 24: Changes of electrical power transmission in UCTE Scenario North


20-21 May 2008 Budapest
The obligatory (accepted) targets for the Member States in RES-E in 2020

Share of renewable electricity (%)

Large hydro Other renewables Indicative targets 2010

Source: Eurostat

Institute for Energy

20-21 May 2008 Budapest
THANK YOU FOR YOUR ATTENTION

http://www.jrc.cec.eu.int
Abstract

The proceeding aims at classifying and ranking the most important factors in CEE countries impeding a more rapid deployment of renewable energy sources for electricity production (RES-E). Another objective is to identify efficient ways to overcome these barriers from demonstrations of successful examples from Member States with longer RES-E integration experience. Some of the best available techniques and country experience with the different policies were presented at the roundtable. The invited experts shared their experiences gained at various institutions: energy regulation offices, grid operating entities, energy production units and quite a few in energy related research organisations. The more rapid development of RES can offer advantages for all stakeholder groups; this win-win situation can be realised if all stakeholders of the market and regulation would be informed better how to benefit from the increased diversification offered by RES. The major benefits can be identified as the following for the stakeholders:

- Regulators can get a better understanding how the problems of larger scale integration the RES sources were overcome in different countries. More sophisticated regulatory mechanisms and better information systems can strengthen the position of regulatory bodies. Improving market conditions, bidding procedures, (ie. day and hour ahead market instead of the monthly schedule), embedding forecasting systems will lead to enhanced regulatory regimes.

- Grid operators are interested in the RES integration challenges, system loss reduction, access conditions, integrating output forecast from intermittent generators that can contribute to improved grid operation methods.

- Power production investors seek low volatility, secure cash flow (feed in tariff), diversification, immunity from oil price changes and carbon prices.

- Researchers quest for innovation and cost reduction by technological learning.

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