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Priority logo:

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5th BALKAN POWER CONFERENCE

SOFIA, BULGARIA, SEPTEMBER 14 - 16, 2005

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Proceedings

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International RES Seminar

Panel Sessions:

RES: Technology Impact on Economics and Regulatory Framework

Pre-Conference Workshop:

Regional Aspects and potentials of RES in Bulgari

Paper Sessions:

Renewable energy

International RES Seminar is partially sponsored by EU
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Renewable Energy

Chairman: Angelina Galiteva

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RES: Technology Impact on Economics and Regulatory Framework

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Regional Aspects and Potentials of Renewable Energy Sources in Bulgaria

Moderator: Tasko Ermenkov

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Venue

Sofia, Bulgaria

Founded seven thousand years ago, Sofia is the second oldest city in Europe. It has been given several names in the course of history and the remnants of the old cities can still be seen today. After liberation of Bulgaria from Byzantine rule the city was again included in the confines of the country. The city took its name after the “St. Sophia” church which stands to this day next to the “St. Aleksander Nevski” memorial cathedral. In recent years Sofia has expanded quickly to become a major center of handicrafts and trade. New building and numerous churches were built in the city and neighboring villages. As an Associated State to the European Community, Bulgaria and its capital Sofia serve as a dynamic meeting place for business world.

Hotel

Sofia Princess Hotel features one of the largest casinos on the Balkan Peninsula. Located close to the city center, the Central Railway station and being only 12 kilometers from the Sofia International Airport, Sofia Princess Hotel is a convenient place for both business trips and entertainment. It is of the year-round type of city hotels, offering both individual and organized, congress and business tourism.

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ENERGY EFFICIENCY AGENCY

UTILIZATION OF GEOTHERMAL ENERGY IN BULGARIA

5th Balkan Power Conference
14. – 16. September 2005, Sofia

Conditions of energy production

- The cost of energy increases over time.
- Fossil Fuels are in limited quantity.
- Geothermal resources have undeniably potential to meet the increasing share of expanding energy needs.
- Geothermal energy can make a significant contribution toward s reducing the emission of greenhouse gases.
- The average lifetime costs of produced geothermal energy are modest sum and competitive amongst all kind of RES and conventional energy sources.

DEMAND

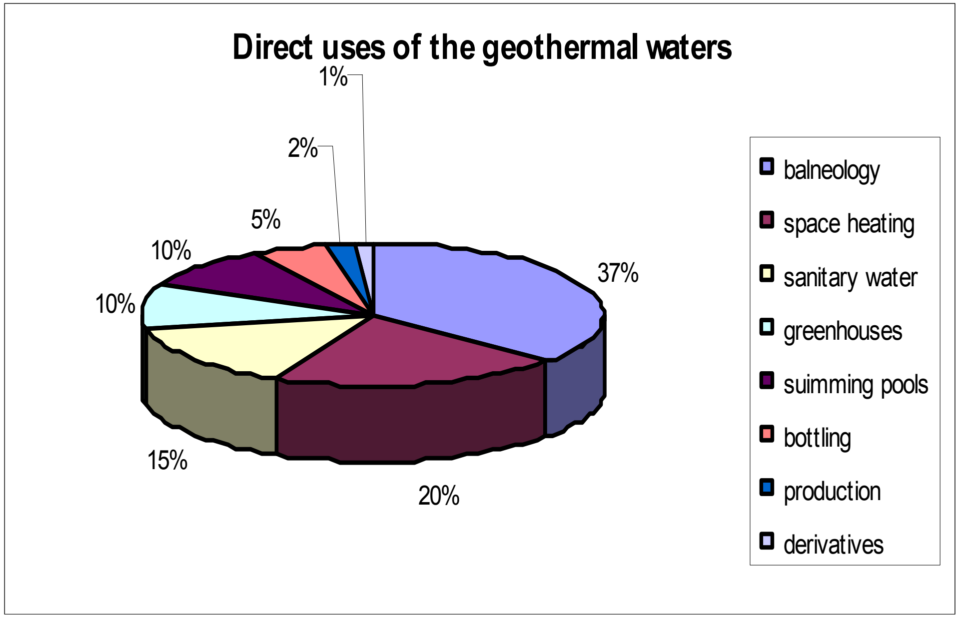
The governments should invest and support the geothermal development.

There are three primary ways for usage geothermal energy

- **for electricity production;**
- **for direct-use applications;**
- **for heating and cooling buildings with geothermal heat pumps.**

UTILIZATION of the GEOTHERMAL ENERGY IN BULGARIA

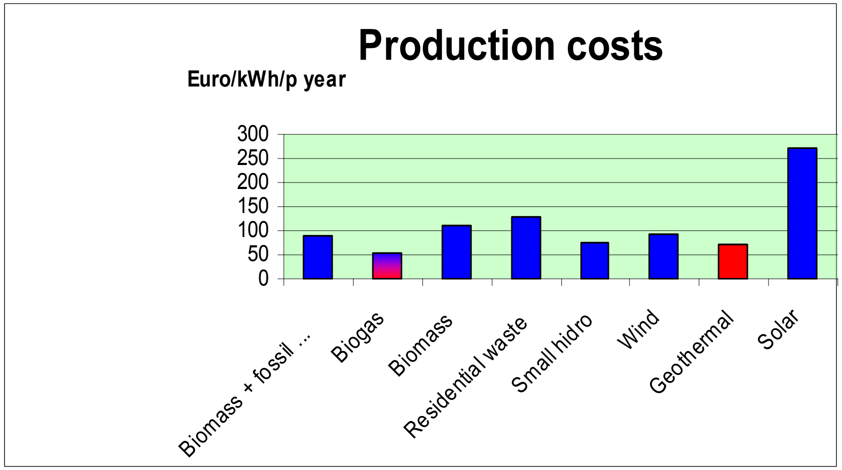
- Electricity production – there is no installed capacity.
- Direct use applications – production of thermal energy about 1400 TJ/year from installed capacity 95÷107 MWt.
- Ground Heat Pumps – about 170 TJ/year, mainly for heating and cooling.



Primary costs of produced energy from RES

For electricity production

- **Geothermal and** hydroenergy– **0,03÷0,15 lv/kWh**
- Wind energy– 0,10 ÷ 0,30 lv/kWh
- Biomass – 0,10 ÷ 0,30 lv/kWh
- Solar PV – 0,40 ÷ 2,00 lv/kWh
- Solar thermal electricity – 0,20 ÷ 0,35 lv/kWh



Direct thermal uses

- **Geothermal - 0,01 ÷ 0,05 lv/kWh**
- Biomass – 0,02 ÷ 0,05 lv/kWh
- Solar heating –- 0,05 ÷ 0,30 lv/kWh

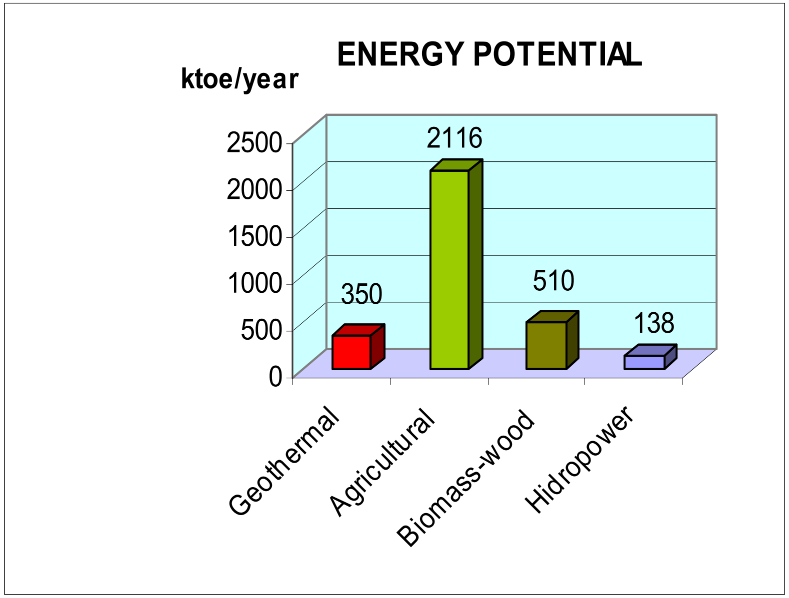
<u>Sources:</u>
Proceedings World Geothermal Congress 2005
Antalya, Turkey, 24-29 April 2005
Geothermal Energy amongst the World's Energy Sources
Ingvar B. Fridleifsson
United Nations University Geothermal Training Programme

Geothermal energy potential of Bulgaria

The research and assessments of geothermal energy potential of R Bulgaria are not completed yet, but on the grounds of present investigations are developed several models of geothermal potential.

Theoretical potential of RES is considerable. The available potentials for utilization are:

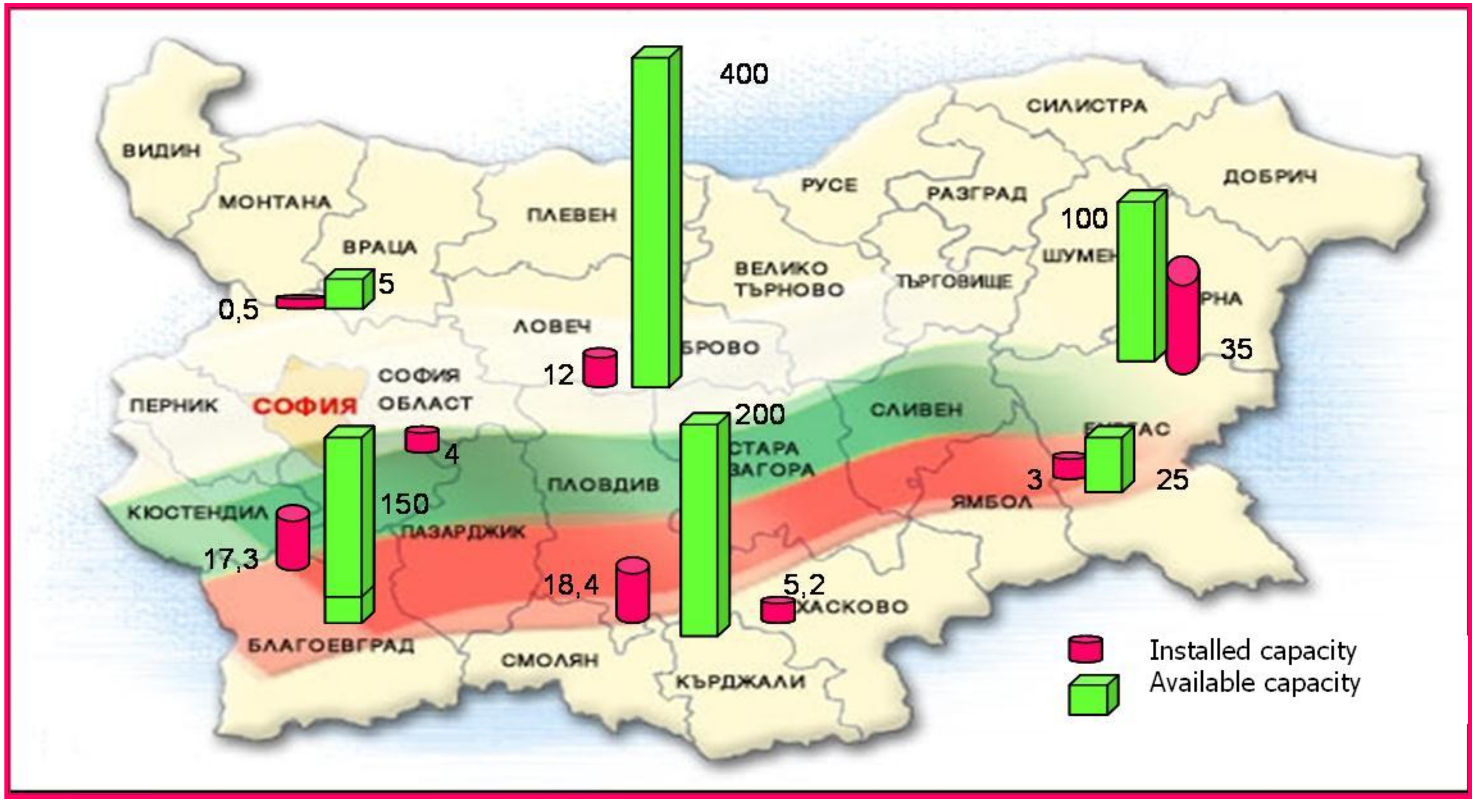
- **14667 TJ/year (350ktoe)-geothermal energy**;
- 88538,4TJ/year (2116ktoe)-from agricultural wastes;
- 21420TJ/year (510ktoe) – biomass of woods;
- 25766 GWh/year (138ktoe) – large and small hydro power stations.



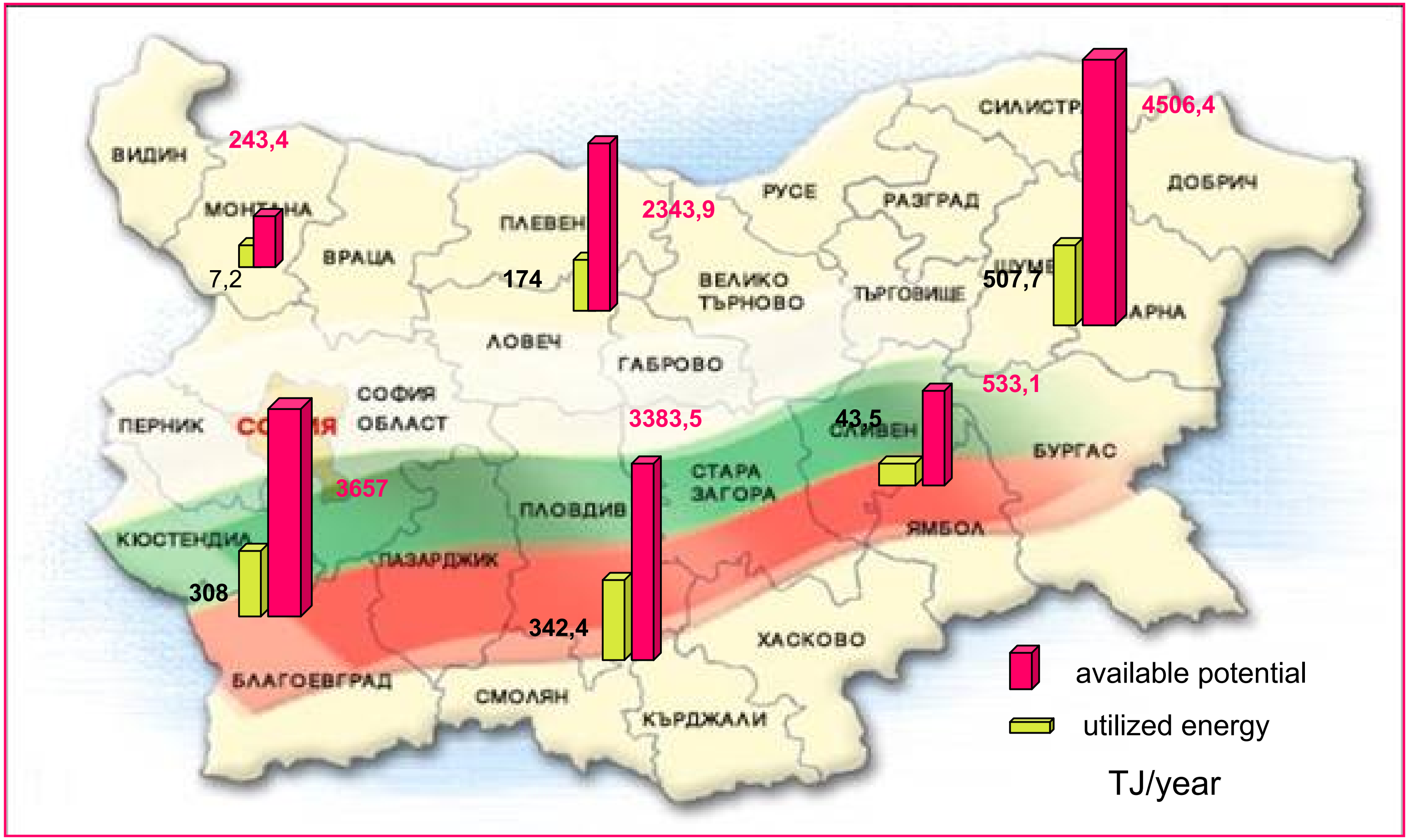
The potential of geothermal energy is comparable with those of the biggest local energy sources.

Bulgaria is characterized by moderate-to-high heat flow values, up to 140mW/m2

Available potential and installed capacity in MWt

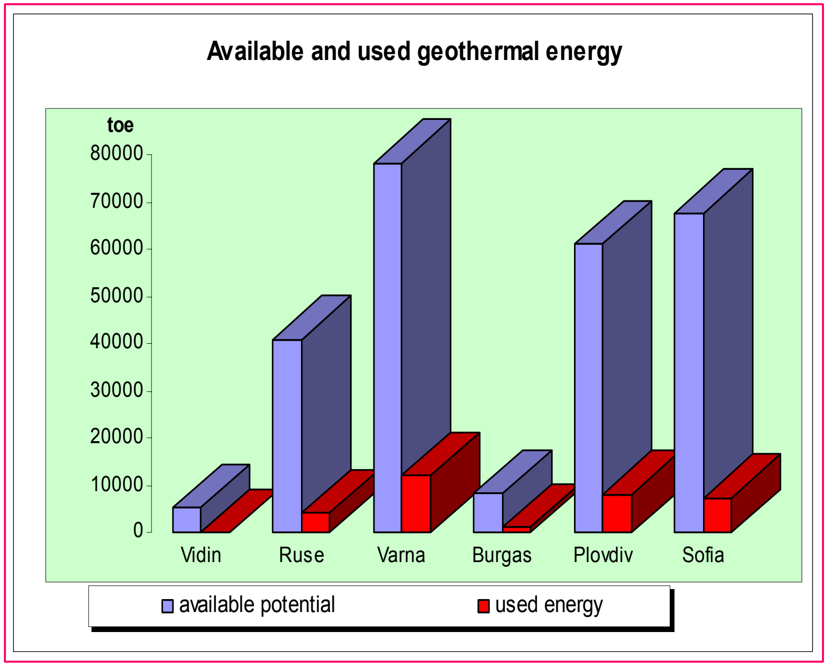


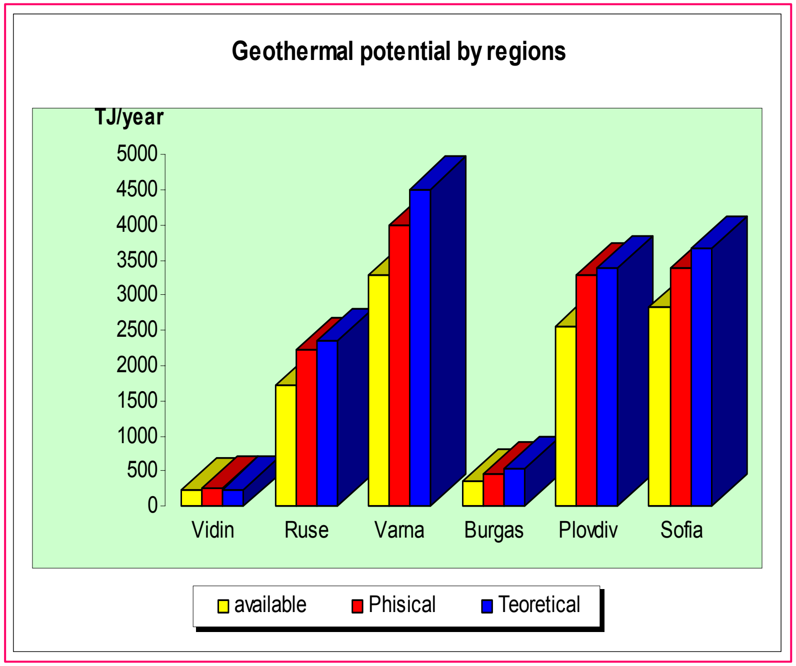
Utilized and available potential



We utilize only a small quantity of the geothermal energy.

ENERGY COMPARISON AND POTENTIALS





- Geothermal energy has great potential.
- Geothermal energy can ensure considerable part of energy independence of the country.

ANALYSIS

GEOTHERMAL INSTALLATIONS

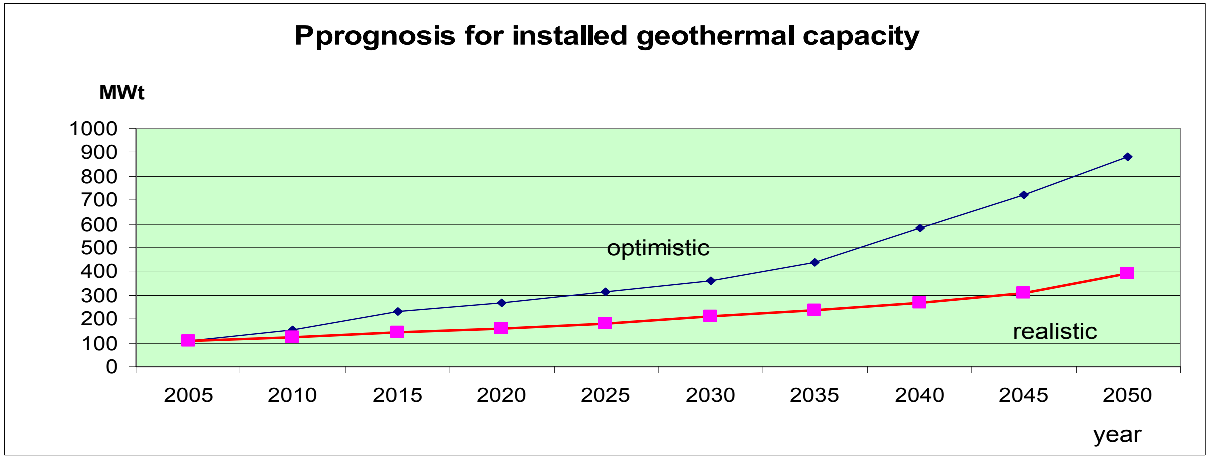
- Primary investment costs are between 300 и 2000 lv/MWt.
- Lower costs refer to the constructed ones in the past, because research and drilling have been financed by state budget.
- In the indicated scope inner networks of heated sites and their control systems are not included.
- Average utilization factor 0,46 ÷ 0,48.
- Heat energy production price is 5,5 ÷ 15 lv/GJ.
- Effect from geothermal energy may reach values over 90000 toe up to 2020 year.

THERMAL PUMPS

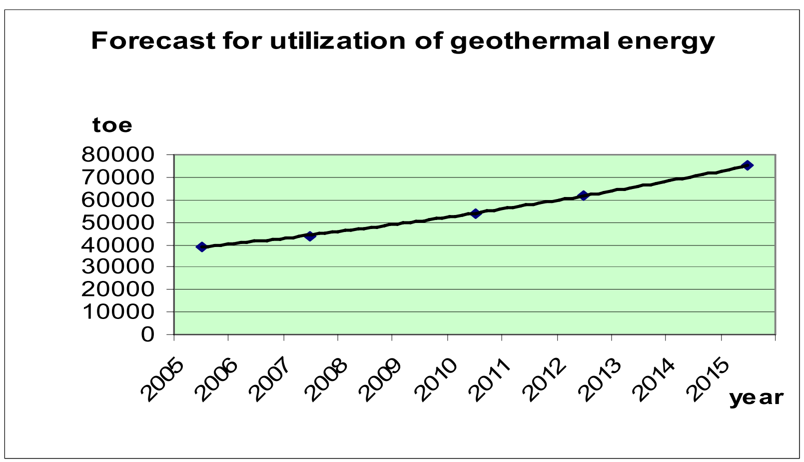
- The high utilization efficiency of earth- or water-connected thermal pumps shall define the growing annualy usage of 4 -5% at present, but after 2009 over 11%
- In case of sustainable development, after 2015 the annualy heat production can reach ~400 TJ/год.

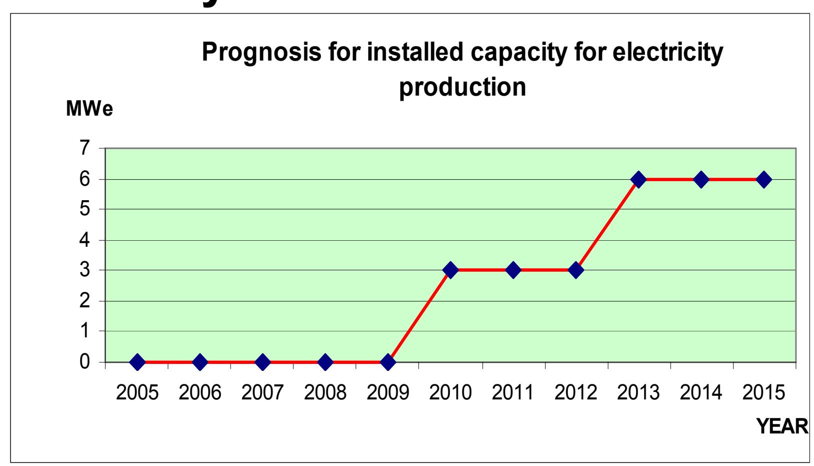
FORECASTS

In long term period



For the next 10 years





DEMAND for AMENDMENT in REGULATORY FRAMEWORK

- Development of socially acceptable strategy for changes in the regulatory framework, concerning the utilization of thermal mineral water (Water Management Act, Concession Act, Energy Act etc.).

- Implementation of antimonopoly mechanism in concession indulgence of geothermal sources.

- Application of unified principle for determination of concession price (quantity assessment, energy assessment, price modification and usage of other parameters).

- Provision of balance between state and individual municipalities interest.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Yordanov@SEEA.government.bg

5th Balkan Power Conference

14 – 16 September 2005

ENERGY EFFICIENCY AGENCY

International RES Seminar: Panel Session 2

"Regional Aspects and Potentials of RES in Bulgaria"

14 September 2005

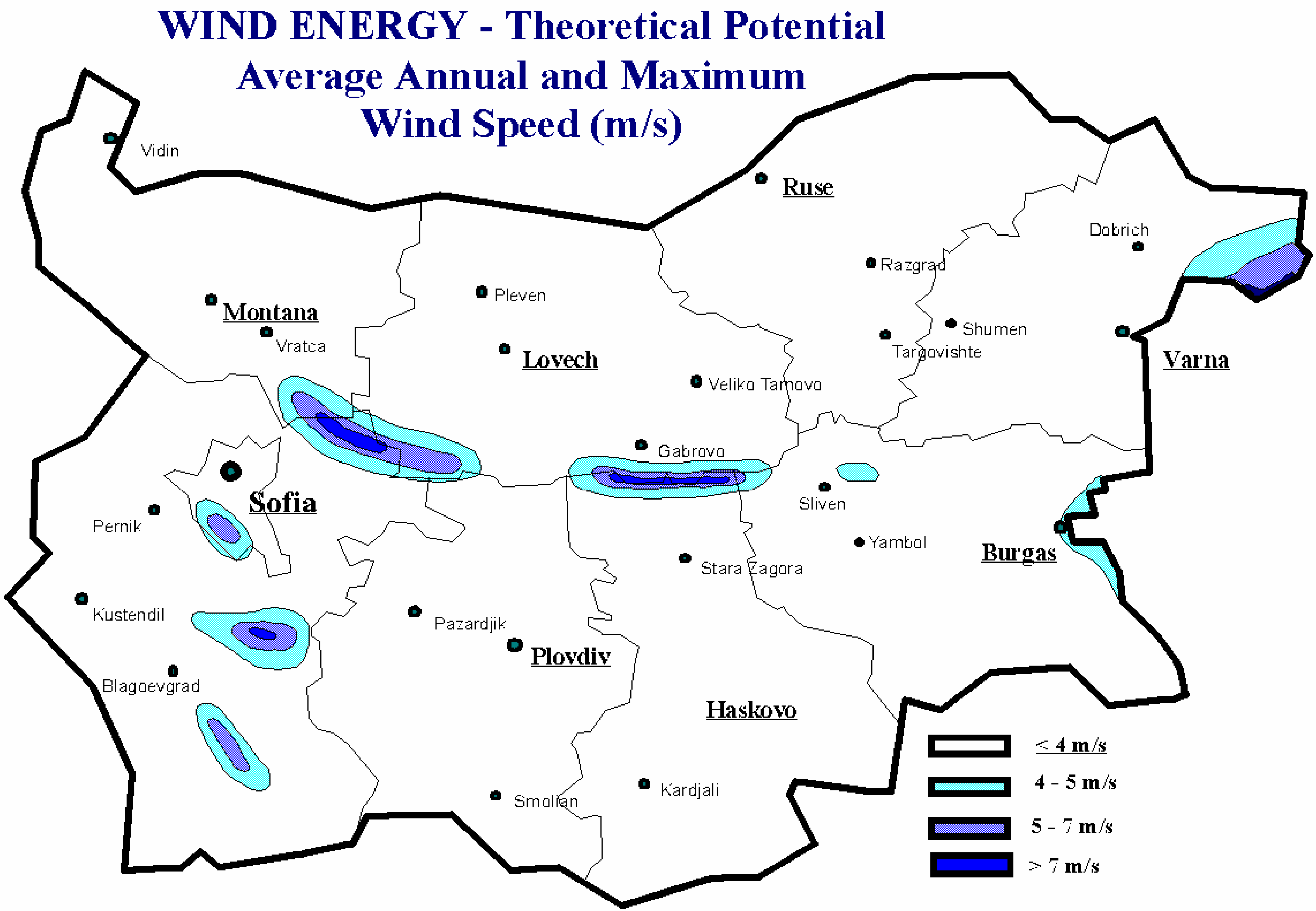
Sofia – Hotel Princess

ENERGY POTENTIAL OF THE WIND IN BULGARIA

The research about the wind energy potential shows, that there are objective possibilities in the country for the wind energy development.

A potential exists for construction of wind farms at the sea cost and at sites above 1000 meters. The future development in suitable mountain areas and such at lower wind speed depends on the implementation of new technical decisions.

There are 119 meteorological stations in Bulgaria, which record the wind speed and direction. The existing data are for e period more than 30 years. On the basis of those data, published in 1982 is prepared a map of the wind potential.



Map about the theoretical wind power potential in Bulgaria

The country is divided on four zones. Two of them are of interest for the power generation:

The zone with the wind speed 5-7 m/s and zone with >7 m/s

The territory of those two zones is 1430 km ^{2}.

The abovementioned wind resources have significant energy potential. For example the energy flow for areas with speed above 6 m/s is as average 500 W/ m ^{2}. Those numbers however mean nothing if that energy is not transformed and utilized into electric power.

Having in mind the total area with sufficiently high wind speed and that 10% of that area would be used for placing of wind turbines, it could be estimated a common potential of installed capacities of 484 MW. That is equal to 75 million t.o.e. for a year.

On altitude higher than 50 m above the earth surface the wind potential is two times higher than on altitude of 10 m.

The dispensation of maximum wind potential is connected with the wind regime at the given place. It varies during the different seasons.

As general, Bulgaria wind potential is not great. The estimation shows that for about 1430 km^2 space there is an average annual wind speed above 6,5 m/s, which actually is a limit for economical advisability of wind power project. Therefore the zones, where it is most relevant the working out of such project are only some regions in the mountain areas and the northern shore.

The wind potential in the country is determined on the basis of measurements on altitude of 10 m from the earth surface.

In the last years the manufacturing of wind generators in the world is with heights of the mast above 40 m., which impose the determination of windpower potential on higher altitudes from the space surface.

In order to be determined the wind speed at higher altitude , in accordance with the tower altitude, it is prepared a model test by the national institute of hydrology and meteorology at BAS, which uses the average multi-annual wind speed, at altitude of wind meter 10 meters on the site, for determination of the possible wind speed on higher altitude. Wind density is reduced according the sea level.

That model test uses mathematical idealization for the possible wind speed. It is advisable the average day or average hours data not to be used for that purpose.

It is very possible the real results to differ from the model ones.

All that preliminary research is serious and on a large scale, but a necessary condition is the determination of the concrete sites, where the wind generators would be installed and in order to work successfully and efficiently and generate wind energy.

For the study of the wind regime at given concrete site are needed long-term and reliable data for the wind speed and direction, possibility for dimensional and temporal interpolation of those data with the help of special software for number modeling of the climate of the ground wind and factors, which determine it.

PRICE FRAMEWORK

The State energy and water regulatory committee has taken decision № Ц-015 from 17/07/2003, with which is determined a preferential price of electric power, generated by wind power plants with capacity up to 10 MW –120 levs/MWh. Within the price is not included VAT.

Fixed price of electric power, generated by wind power plants is with exactly determined aim and mechanism and includes subsidies for the producers of power from RES.

PRICE FRAMEWORK

For promotion of the power generation from RES, having in mind the principles of the market of power and accounting the technologies and characteristics of the different RES with the Energy law it is intended the introduction of system for trade with green certificates.

Tradable green certificates (TGC) are market mechanism, supporting the financing of projects for RES, they are compatible with the liberalized markets of electricity and will lead to economically viable production of power by RES.

PRICE FRAMEWORK

Green certificate is official document issued in electronic format, certifying the generation of 1 MWh electric energy by renewables or by combined way, showing the producer, period and the generation plant. Green certificate is independent asset, which could be a subject of trade. It is traded separately by the electric power and certifies its generation.

eng. Nikolay Nikolov
Chief expert on ecology

Energy Efficiency Agency

Thank you for your attention

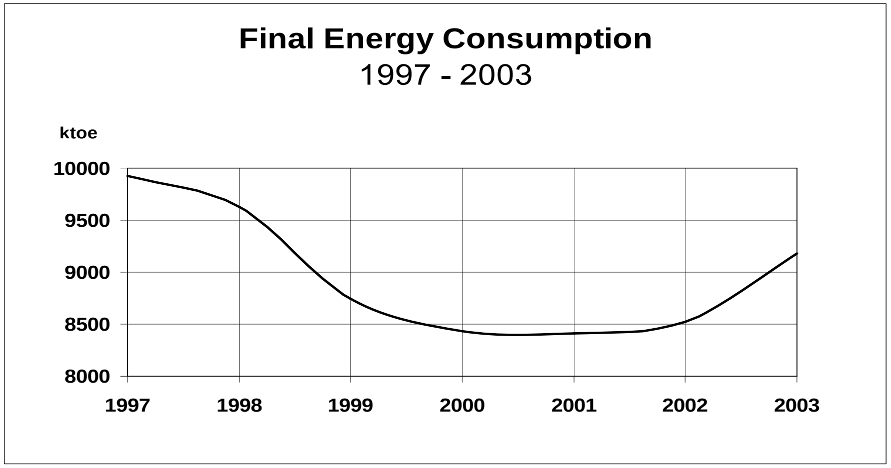
Tel. 02/ 915 40 46
Fax: 02/ 981 58 02
E-mail: NNikolov@seea.government.bg

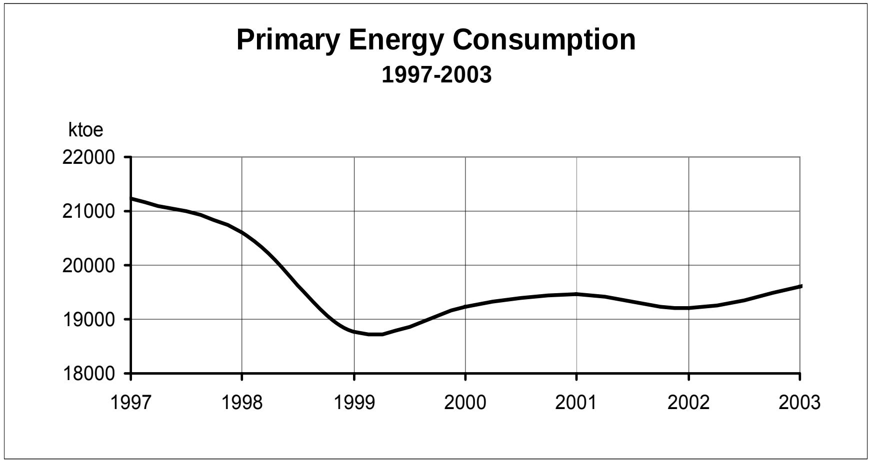
Energy from Wood in Bulgaria - Today and in the Near Future.

Krasimir Naydenov
Ludmil Kostadinov
Energy Efficiency Agency
Bulgaria

General Information on the Economic and Energy Sectors of Bulgaria

During the period of 1997-2004 the **GDP is increased by 5.0-5,25%.** It is expected **this trend to be kept.**





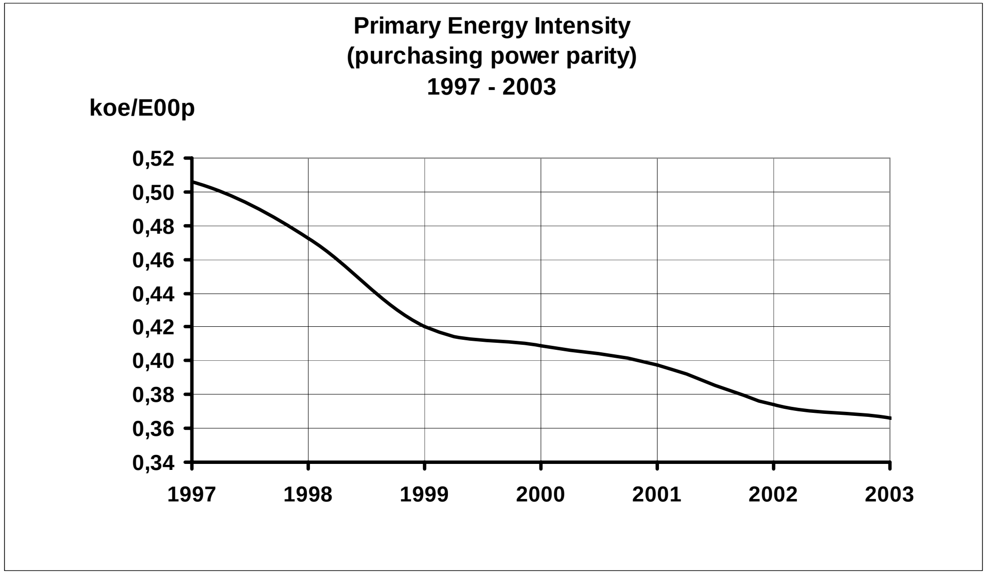
- After a period of reduction by 2002, the Final Energy Consumption starts to increase faster than the Gross Domestic Product ;
- The biomass (prim. firewood) has a share of 8% in the Final Energy Consumption with a trend towards growth ;
- The expectation is the shares of wood and natural gas to increase, and the shares of electricity and heat energy to decrease.

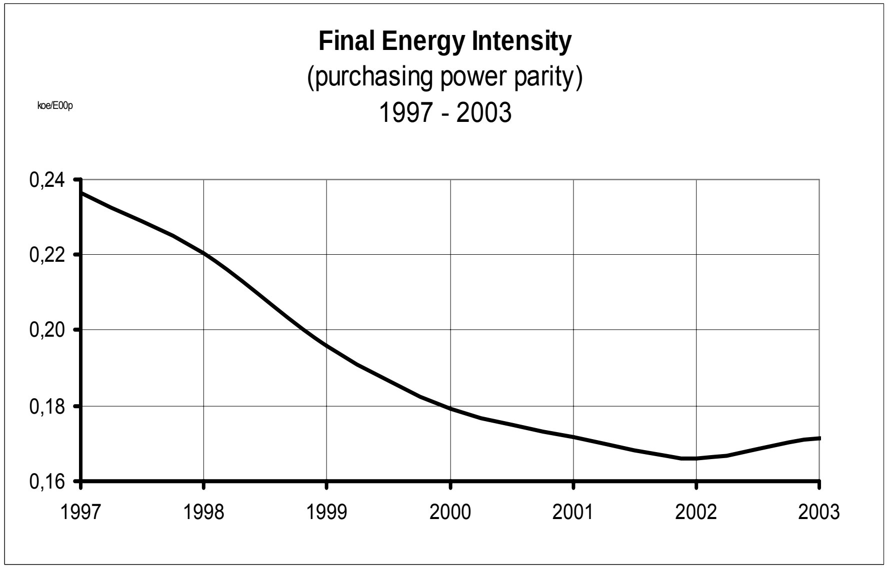
- Almost 53% of the energy resources included in the Primary Energy Consumption are lost in the transformation processes.

After 1999 the PEC starts to increase.

- The biomass (prim. firewood) has a share of about 4 % from the Primary Energy Consumption. The world share of biomass is about 10 % - primarily for heating and cooking

Energy Efficiency Indicators





- After 2002 the Final Energy Intensity starts to increase, i.e. the Final Energy Consumption is increasing faster than the GDP. Indicators for Final Energy Intensity (~0.16 koe/€00p) and Primary Energy Intensity (~0.37 koe/€00p) for 2004 will remain considerably higher than the given average European levels.
- The conclusions given above undoubtedly show:

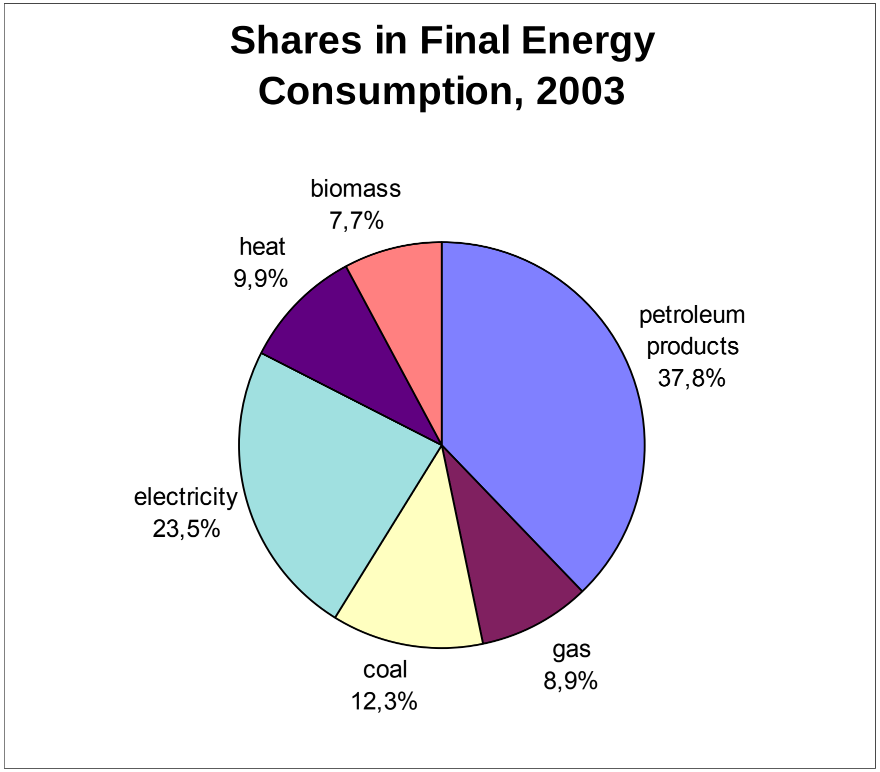
  a/. Necessity of implementation of strong measures for EE ;

  b/. Necessity of introduction of environmentally clean energy sources ;

  c/. The increasing role of the wood (prim. firewood) in the country energy balance.

Wood – With Major Share from All RES in the Energy Balance of the Country

Wood share in Primary Energy Consumption in 2003 is 3.6% or 2.8 times more than the share of hydropower.

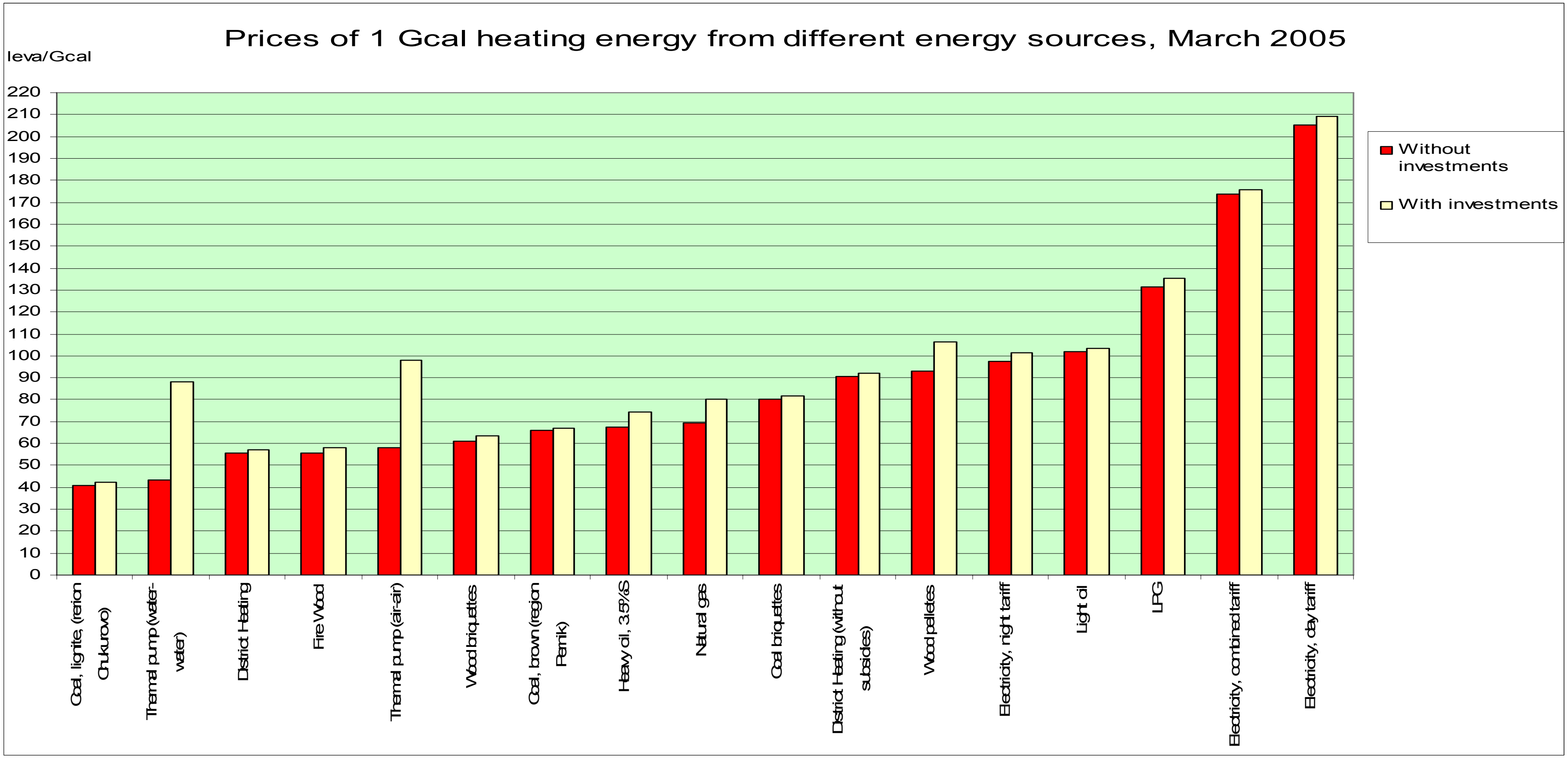


- Wood share in Final Energy Consumption in 2003 (7.7%) is comparable with shares of natural gas and heat energy and its influence on the energy balance(respectively on the energy market) is considerable ;

- Power produced from other kinds of Renewable Energy Sources(excl. hydropower) is insignificantly small and without a real share in the country energy balance ;

- Energy potential of wood in Primary Energy Consumption is supplied more than 85% as firewood to the households.

Economic Preconditions for the Present and Future Use of Wood in Bulgaria



- The price of 1Gcal heat energy, from firewood is:
  - а/. 4 times cheaper, of the heat energy from electricity;
  - б/. 2 times cheaper of the heat energy from liquid fuels.

  The cost of heat energy from firewood is close and compete with the cost of heat energy from natural gas. There are economic conditions for increased use of wood for heating at the expense of electricity and liquid fuels. The cost of heat energy from biofuels produced with drying and compression of wood (pelletes and briquettes) is higher and can not compete with natural gas.
- A special interest for investments in the future will be production, processing and firing of wood and its derivatives. Economically efficient will be projects aiming substitution of liquid fuels and electric power for wood.

Households – Basic Consumer of Wood in Bulgaria

- The relative share of the wood in Final Energy Consumption comes up to 8%, as the main part of it, more than 85% is used in the households as firewood, i.e**. the main driving force of the increasing usage of wood are the households.** Therefore the growth of wood consumption will depend on two factors:
  - Keeping/increasing the share of households in Final Energy Consumption ;
  - Keeping/increasing the share of wood in the energy consumption of households.

- Within the period of 1997-2003 **the share of households in Final Energy Consumption shows a stable trend towards increasing**: from 22.5% in 1997 to 25.1% in 2003. The energy consumption of Bulgarian households is about 70% less than of an EU member-state.

- Within the period of 1997-2003 the usage of wood (firewood) in the household sector has increased 3.4 times, while the usage of other types of fuels and energy has decreased.

Therefore the use of wood in the households rapidly increases in a situation of constant (or increasing) share of power consumed by the households (~25% by the Final Energy Consumption).

Assessment of Future Possibilities

- **Overall potential.** The energy potential of firewood is 15% from the total potential of biomass in the country. (The energy potential of world annual biomass growth is evaluated at 70 billions ktoe, 7 times more than the 2003 total world energy consumption (9,6 billions ktoe)

- **Status of wood production.** The total annual growth of forests in Bulgaria is 12.3 million m3 or 8.1 million tones with total energy equivalent of about 2 200 ktoe. At the end of 2003 the State (State Forestry Fund) owned about 80% of the forests in the country. According to the data of the National Forestry Administration only 70% of the planned quantities of wood are produced in practice, of which 31% are supplied to the population as firewood.

- **Additional production of wood.** For production of firewood are used broad-leaved low-stemmed and sprout forests, as well as part of the broad-leaved high-stemmed (total of 28% of the country forests). The overall annual growth of broad-leaved low-stemmed and sprout forests is 3.5 million m3. If we take into account the necessity of rejuvenation of these forests, related to a considerable increase of their production during the next 10 years and together with the other possibilities, the total production could reach 8.7 million m3. This means that the present production can be doubled without particular problems. Moreover the status of will not only improve but also some positive social and economic effects will be achieved.

- **PROJECTS FOR BURNING OF WASTE/SMALL SCALE WOOD.**

A) Heating

In 2003 the consumption of liquid fuels used in local central heating installations was about 100 ktoe. This quantity of liquid fuels is not enough for heating of all planned volumes. The introduction of wood as a cheaper fuel will lead to savings of means which can be used to pay back the investments made in the relevant facilities, and after that (in some cases simultaneously) for recovering of the heat comfort in these buildings.

B) Cogeneration of heat and power

The possibility for utilization of wood for cogeneration of heat and power should not be underestimated. In many cases, especially when there are consumers with constant heat consumption, such kind of production is extremely profitable.

A medium size biomass cogeneration plant is 10 MW. The amount of biomass fired in such plant is 86 000 m3 solid volume wood/year. A 250 $км^2$ (16x16 км) forest area is needed to supply this quantity of wood! With the increase of the plant size the efficiency is better but for our country the fuel supply of such plants will be difficult.

(The total world electricity from biomass installed capacity is 20GWe.)

Conclusions

- **Bulgarian does not use in full the annual growth of wood.** The increase of production, as well as the improvement of the efficiency of utilization of wood will have at the same time great economic, social, environmental and political effect both inside the country and from the point of view of the EU requirements for increasing of RES share for achievement of the indicative targets ;

- The growth of utilization of wood for energy purposes will lead to saving of power and liquid fuels and will increase the possibility for their export, which is traditional for Bulgaria, as well as to **reduction of the energy dependency of the country**;

- Increase of wood consumption for energy purposes is **the only possibility our country to get closer to the indicative targets of EU for power generation from RES**.

THANK YOU !

Krasimir Naydenov
KNaydenov@seea.government.bg
Ludmil Kostadinov
LKostadinov@seea.government.bg

Ministry of Economy and Energy

Energy Efficiency Agency

5th Balkan Power Conference

co-organized by:

- University of Ljubljana, Slovenia,
- Technical University of Sofia and
- Bulgarian branch of Electrical Engineering Students' European Association – EESTEC LC Sofia

Sofia Princess Hotel, 14-16 Sept. 2005

Ministry of Economy and Energy

Energy Efficiency Agency

Financing of Renewable Energy Projects in Bulgaria

5th Balkan Power Conference

Ognian Markovski
Chief Expert

tel. (+359 2) 915 40 43
fax (+359 2) 981 58 02
omarkovski@seea.government.bg
www.seea.government.bg

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Main barriers to the implementation of RE projects in Bulgaria

- Difficult access to finance
- Perception of high risk
- Weak capacity to develop bankable projects
- Lack of innovative RE financing
- Weak financial incentives for the end-users

Energy prices for the electricity generated by renewables
(incentives for the power producers)

The transport or distribution companies must purchase the power produced by some renewable sources at preferential prices.

The actual purchase **price for electricity**:

- **from HPPs** is 70,24 or 80 leva/MWh depending on the type of the plant;
- **from wind generators** with capacities of up to 10 MW, it is 120 leva/MWh.

The purchase prices from conventional power stations range between 38 and 62 leva/MWh.

(1 euro = 1.95583 leva)

Financial incentives for electricity generation from RES in a competitive electricity market – the introduction of **a system for issuing of and trade with green certificates (TGC system)**, which is to replace the feed-in rates (preferential pricing) for electric power from RES.

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EXPENDITURE : CAPITAL INVESTMENT

Three kinds of finance :

Debt finance	Commercial loans Soft loans
Grant finance	‘Free’ money
Equity finance	A share in the venture

Many projects will require at least two of these !

Sources of RE Projects Finance in Bulgaria

- EBRD's Energy Efficiency and Renewable Energy Credit Line Facility
- EBRD's Residential Energy Efficiency Credit Line (Bulgaria)
- Kozloduy International Decommissioning Support Fund

- National Trust Fund (EcoFund)
- Enterprise for Management of Environment Protection Activities

- Emission Reduction Units Sales by JI projects or offset agreements (green-house gas emissions trading schemes)

Financing Approach –
Industrial Energy Efficiency & Renewable Energy Credit Line Facility

= EBRD's Credit Line + KIDSF's Grant

Total credit line up to 50 million euro for the EE and RE projects blended with 10 million euro KIDSF's grant

- ✓ ***Smaller projects, typically from €20k to €1.5m (difficult to appraise and finance, with major barriers to investment)***
- ✓ ***All in private sector***
- ✓ ***Incentive grant = 20% of the loan principal***
- ✓ ***Provision of Consulting Services***

Eligible Projects: > Energy Efficiency

> **Small Renewable Energy**: **- Run-of the river hydro**

- Solar
- Wind
- Biomass
- Geothermal
- Biogas

www.beerecl.com

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A new and innovative scheme – Residential Energy Efficiency Credit Line (Bulgaria)

= EBRD's Credit Line + KIDSF's Grant

Total credit line up to 50 million euro for the EE and RE projects blended with 10 million euro KIDSF's grant

- ✓ ***Acquisition and installation of equipment, appliances and materials***
- ✓ ***All in residential sector*** *(one or several grouped individuals)*
- ✓ ***Sub-loan maturity <= 5 years***
- ✓ ***Incentive grant = 20% of the loan principal <= EUR 850***
- ✓ ***Provision of Technical Assistance***

Eligible Projects (equipment) in particular: **- efficient biomass stoves/boilers**
- solar water heaters

www.reecl.org

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National Trust Fund (EcoFund)

Provides co-funding for energy efficiency and **renewable energy projects**

Priority area: Reduction of air pollution, in particular –reduction of green-house gas emissions

The EcoFund provides **financing in the form of:**

- ✓ **donation** <= 30% of the total project cost *or*
- ✓ **loan** <= 50% of the total project cost

Average % of the EcoFund's financing/contribution = 19%

Eligible candidates: companies, budget organizations, municipalities, non-profit organizations, etc.

AEE EEA

ENTERPRISE FOR MANAGEMENT OF ENVIRONMENTAL PROTECTION ACTIVITIES (EMEPA)

***The main operational purpose* of EMEPA is to implement environmental projects and activities pursuant of national and municipal strategies and programmes in the environmental area.**

EMEPA provides **funding in the form of:**

- ***grants*** (only to the municipalities) and
- ***interest-free* or *low interest* loans** <= 70% of the total project cost

EMEPA spending focuses, in particular, on the implementation of environmental investment projects, incl. **micro hydro-power plants** & **other RE projects** aiming at reducing the air pollution, in particular, green-house gas emissions

Eligible candidates: companies & municipalities

AEE EEA

Energy Efficiency Agency

Financing of Renewable Energy Projects in Bulgaria

5th Balkan Power Conference

Thank you for your attention

LEGISLATION ON ENERGY EFFICIENCY AND RES IN BULGARIA

Energy Efficiency Agency

www.seea.government.bg

tel./fax 02/981 5802

5 th Balkan Power Conference , Sofia , 14-16.09.2005

The main accents of the Energy efficiency and RES policy :

- high efficiency of all processes during generation, trasnsmission, distribution and consumption of energy
- Development of RES
- Promotion of investments in energy efficiency at the end consumers and RES

LAWS

- ENERGY EFFICIENCY LAW
- ENERGY LAW

Energy Efficiency Law

Adopted by the 39th National Parliament on 19 February 2004, and promulgated in SG, issue 18 dated 05/03/2004

Energy Efficiency Law regulates the public relations, connected with the carrying out of the state policy on improvement of Energy Efficiency.

It is based on the Energy strategy of Bulgaria from 2002.

Energy Efficiency Law

AIMS OF THE LAW

- To determine the EE as a national priority at the carrying out of the state policy.
- To define the engagements and the state support for its development
- To establish institutional, normative and financial conditions for realization of the national policy as precondition for the successful integration into the EU.

Energy Efficiency Law

LEGAL SOURCES

- European energy charter ;
- Kyoto protocol to the UN Framework convention on climate changes;
- Normative regulations of the EU countries;
- The laws for the efficient energy utilization of a number of countries from Central and East Europe - Romania, Czech Republic, Russia, Ukraine, as well as The Law for the rational use of energy of Japan;
- EU directives for EE and rational use of energy.

State administration

State policy on EE is carried out by **the minister of economy and energy**

The measures and activities on improvement on the EE is carried out by **the Executive director** of the Energy efficiency agency, together with the central and territorial bodies of the executive power and the other state bodies, which:

- **Prepares, controls, coordinates and presents to the minister of economy and energy national long-term and short-term programs on energy efficiency, as well as annual report for their implementation.**

ENERGY EFFICIENCY MEASURES

- EE management
- EE services
  - By natural or juridical persons, registered by the Trade law, according to Chapter 3 , Section 2 by EEL ,
- Assessment for EE of the objects
- Certification
- EE auditing

Energy Efficiency Law - REGULATIONS

To the Energy efficiency law are worked out 4 regulations:

1. **Regulation for the energy characteristics of the objects;**
2. **Regulation for building certification;**
3. **Regulation for EE auditing;**
4. **Regulation for the circumstances and order for entering into the registry of the persons, implementing building certification and EE auditing, and receiving of information (Regulation for the registry according to art. 16 and art. 18 by EEL).**

1. Regulation for the energy characteristics of the objects

The Regulation is adopted and is promulgated in SG, issue 108 dated 10/12/2004

The Regulation determines:

- 2.methodology for formation of indicators for energy consumption and energy characteristics of objects;
- 1.conditions and order for specifying of the indicators for energy consumption and energy characteristics of objects;
- 3.technical rules and methods for comparison of energy characteristics of objects;
- 4.norms for annual consumption of energy in buildings.

1. Regulation for the energy characteristics of the objects

Within the regulation are shown:

INDICATORS AND CHARACTERISTICS OF ENERGY CONSUMPTION IN BUILDINGS

➢Building components as integrated system:

- surrounding constructions and elements;
- systems for keeping the microclimate parameters;
- internal heat sources;
- residents;
- Climate conditions.

➢Buildings classification:

- **residential:** one-family houses; residential buildings with low, middle and high construction (buildings); mixed.

- **Non residential:** for administrative service; in education; healthcare; hotels and services; trade; sport; others for public usage.

1. Regulation for the energy characteristics of the objects

➢ Indicators for energy consumption:

- **First group –** characteristics of surrounding construction elements and of the systems, providing the microclimate
  Coefficient of heat passage (W/m2K);
  Efficient coefficient (%).

- **Second group –** defines energy consumption of technological processes for heating, ventilation and biofuels
  Heat losses (kWh/m2 ; W/m3);
  Energy consumption (kWh);
  Power capacities (kW).

- **Third group –** defines building energy consumption as a whole
  General and specific consumptions (kWh/year.; kW/m2 ; Wh/m3.DD).
  General and specific power (kW; kW/m2)

1. Regulation for the energy characteristics of the objects

- **Energy characteristics (EC):**

- **EC as used and as primary energy**
  - **Used energy**: energy, which is supplied in the building in order to be kept given microclimate.
    EC is defined as used energy in order the buildings to be compared at one and the same conditions of living.
  - **Primary energy**: energy resources, which are put on the entrance of transformation into secondary energy.

- **EC as HARMFUL EMISSIONS (ecological equivalent)**
  - EC as harmful emission is the amount of CO2 emissions for all kinds of used fuels and energies (in tones).
  - They are defined as the consumed fuels and energies (in kWh) are multiplied with individual emission coefficients (g/kWh).

1. Regulation for the energy characteristics of the objects

- **Determining of accordance with the requirements for EE:**

1.EP(standard indicator) ≤ EPmax (EC is smaller or equal to its standart value)

2. If it is not possible to be united all factors in one formula or when for some of the indicators can not be defined standard values, EC is determined on the basis of limited number of indicators.

3. Bulgaria is divided on 9 climate zones for EC .

1. Regulation for the energy characteristics of the objects

ENERGY CHARACTERISTICS OF INDUSTRIAL SYSTEMS

1.THE INDUSTRIAL SYSTEMS ARE REGARDED AS INTEGRATED SYSTEMS: technological system, fuel-energy system, electric power system, heat energy system, other systems (water supply, compressed air, cold generation etc.)

They are CLASSIFIED by INDUSTRIAL SECTORS in accordance with the national classification.

2.THE INDICATORS ENERGY CONSUMPTION of industrial systems:

- **are classified into two groups**
  - **- energy transformation (efficient, %) and**
  - **- energy consumption (kWh, kWh/unit production);**
- **are defined by kinds of energy resources; by different technological consumers; by structural units of industrial system; overall for the industrial system.**

2. Regulation for buildings certification

The Regulation is adopted and promulgated in SG, issue 108 dated 10/12/2004

With Regulation for buildings certification are defined conditions and order for buildings certification.

- **The certification certifies the accordance of the buildings with the normative requirements for EE and aims realization of energy saving measures for improvement of energy behavior of buildings.**
- **The Regulation defines rules and order for certification, contents and categories of certificate and the control on the activity (Art. 1);**
- **Certification is carried out by natural or juridical persons, corresponding to the requirements of Art. 16 (4,5) from EEL;**

2. Regulation for buildings certification

On mandatory certification is each building
State or municipal ownership with general useful space above 1000 m2.

According the Regulation two categories of certificates are issued :

Certificate – A with tax incentives up to 10 years and

Certificate B with tax incentives up to 5 years

THE CERTIFICATE is issued with a term of validity of 10 years

3. Regulation for energy efficiency auditing

The Regulation is adopted and issued in SG, issue 112 from 23/12/2004

The Regulation defines conditions and order for implementation of EE auditing of energy consumers. In the Regulation is defined the aim of the auditing and are defined the energy consumers, subject to mandatory auditing, and namely:

- **Producers of cgoods/services, whose objects have annual energy consumption, equal or more than 3000 MWh/year ;**
- **Energy consumers with overall useful space above 1000 m2.**

3. Regulation for energy efficiency auditing

AIM AND KINDS OF AUDITS FOR EE

- AIM OF THE AUDITING:

To determine the potential possibilities for decreasing of energy expenses, to propose measures for increasing of EE and achievement of high level of environment protection.

- KINDS OF AUDITS **(according the contents of the kinds of activities):**

> **simplified;**
> **detailed;**
> **control.**

3. Regulation for energy efficiency auditing

RESULTS FROM EE AUDITING

- RESULTS FROM EE AUDITING ARE COVERED IN PAPER AND SUMMARY, WHICH ARE SUBMIT TO THE ENERGY CONSUMER.
- ENERGY CONSUMER SUBMITS A COPY FROM THE SUMMARY TO EEA.
- THE PAPER FROM AUDITING IS DISCUSSED AND ADOPTED BY THE ENERGY CONSUMER NOT LATER THAN ONE MONTH AFTER ITS DEPOSING BY THE PERSON, THAT MADE THE AUDIT.
- THE TERM FOR PERFORMING OF NEXT AUDIT FOR EE RUNS FROM THE DATE OF APPROVAL OF THE FINAL PAPER.

3. Regulation for energy efficiency auditing

CONTROL

Art. 24 (1) Control on keeping the orders of that regulation is carried out by the EEA Executive director.

(2) When implementing his control rights the executive director of EEA:

1. performs check-up by authorized persons-in-charge;
2. impose administrative punishments, intended in EEL.

- Received by EEA information (from declaration and summaries) is summarized and included into THE INFORMATION SYSTEM.
- EEA submits that information to the state bodies for office use and on request by their side for implementation of their engagements on EEL, connected with working out of EE programs.

4. Regulation for the order of registering of persons, making building certification and EE auditing, and information receiving.

The regulation is adopted and promulgated in SG, issue 5 from 14/01/2005

The regulation for the registry, settles the conditions and order for registration into the 2 public registries of persons, implementing:

- **Buildings certification;**
- **EE auditing.**

4. Regulation for the order of registering of persons, making building certification and EE auditing, and information receiving.

The Regulation settles:

- the order for entering into the public registries of the persons, implementing building certification and EE auditing
- the circumstances, which are subject to entering into the registry
- the order for issuing of certificates of persons, implementing buildings certification and EE auditing
- the order for information receiving from the registries

4. Regulation for the order of registering of persons, making building certification and EE auditing , and information receiving.

EEA keeps:

- register of persons, which implement buildings certification
- register of persons, which implement EE auditing

The registers are public

- **only the circumstances and changes, intended into EEL are registered in them**
- **buildings certification and EE auditing is carried out <u>only from the persons, registered in these registries</u>**

4. Regulation for the order of registering of persons, making building certification and EE auditing , and information receiving.

Entering into the registers of persons

Persons are entered into the registers

- by their *written request*
- *In conditions, that* they are in compliance with the given requirements

For each registered person is created AN ACCOUNT .

To each account is created and kept A FILE .

4. Regulation for the order of registering of persons, making building certification and EE auditing , and information receiving.

Order for issuing of certificates for entering into the registers

To the persons, entered into the registries are issued CERTIFICATES on model.

- ✓ Certificate is issued in 14-day term from the date of the order of executive director for registering;
- ✓ Term of validity of the certificate – 3 years.;
- ✓ Certificate can be updated on the basis of application for update and entered tax.
- ✓ Kept by the Energy efficiency agency REGISTERS are public .

ENERGY LAW
RES – LEGISLATIVE FRAMEWORK - *from art. 157 to art. 161*

CHAPTER 11 - «Promotion of power generationfrom RES and combined generation»

Section I - "Power generation by RES" - incentives

- **Art.159 <u>mandatory purchasing of power, generated by RES</u> .**

  The public supplier and/or public suppliers are obliged to purchase on regulated by SEWRC preferential prices the whole amount of power, generated by plants, using RES, registered with certificate for origin, including from HPP with installed capacity up to 10 MW, excluding the quantities, which are freely negotiated by the producers, or with which the producers take part on the market for balancing electric power.

ENERGY LAW
RES – LEGISLATIVE FRAMEWORK -

- **Art. 160(1) The transmission company and the distribution companies shall be obliged to connect by priority all power plants generating electricity from RES, including HPPs, with total installed capacity up to 10 MW to the transmission network and the distribution network respectively.**

  (2) The costs of connecting the power plant to the respective network up to the property boundary of the electrical equipments shall be covered by the producer.

  (3) The expansion and reconstruction of the transmission and/or distribution networks involved in connecting the power plant pursuant to Paragraph 1, shall be the responsibility of the transmission and respective distributor company.

ENERGY LAW

RES – LEGISLATIVE FRAMEWORK

- **Art.161 The mechanism for mandatory buying of power from RES, registered with certificate of origin is implied until introduction of the system for trade with Green certificates (01/07/2006) , in accordance with «Regulation for issuing of certificates for origin of electric power, generated by RES and/or by CHP way, for issuing of green certificates and the trade with them» .**

ENERGY LAW
RES – LEGISLATIVE FRAMEWORK

ELaw intends determination of the national indicative aims for promotion of consumption of electric power, generated by RES, as a % from the annual gross consumption of electric power for next ten years in the country.

The minister of economy and energy determines minimal mandatory quotas for generation of electric power from RES as a % from the total annual generation of power of each producer by years for a term of 10 years, reckoning from the date of introduction of green certificates system .

The obligation of each producer is considered as performed when presented from SERWC of issued to it or purchased from another power producer green certificate(s) for the quantity of power from RES, consisting its obligation, which are:

- issued to the producer, and/or bought from another producer of power from RES, as the deal for purchase and

- sale is considered for valid in compliance with condition that it is written into the registry according to Art. 25 , p. 1 , i. 4 .

It can be stated with certainty, that there is already created adequate and motivated legal environment, determining the principles and means of Energy Efficiency and RES policy , which leads to change of the culture of energy consumption .

THANK YOU FOR THE ATTENTION!

KOLIO KOLEV – Director in EEA

Tel: 915 40 14

Tel./fax: 915 40 29

E-mail : KKolev@SEEA.government.bg

www.seea.government.bg

Effective Legislation and Strategies for the Successful Implementation of Renewable Energy Programs

Angelina Galiteva, Chairperson World Council for Renewable Energy

Abstract -- **This paper focuses on the practical implementation of renewable energy legislation in a context of recent developments surrounding SB1 -- California's Solar Energy Legislation. SB1 as the most recent solar initiative is an example to present the need for a more comprehensive energy conservation and renewable energy initiative in the State of California as well as serves as the basis for a comparison with some of Europe's most comprehensive Renewable Energy Initiatives.**

The document outlines some of the opportunities and challenges for the development of successful renewable energy legislation and along with outlining the most utilized forms of legislative schemes provides a basic rationale for the superiority of the feed in tariff or minimum price system as opposed to a straight incentive or buy-down scenario.

Index Terms: **Buy-down programs for renewable energy; energy efficiency; green certificate trading mechanisms; Green house gas reduction; legislation for incentivising alternative energy sources; minimum price systems for renewable energy; portfolio standards for green power; tax incentive schemes for renewable energy; rooftop solar incentive program.**

I. Introduction

It is an undisputed fact that California, with its abundance of sunlight, vast quantities of available rooftop and parking lot spaces, bad air quality, an ample, qualified work force, congested transmission lines and an electrical system that is in dire need of distributed energy sources which bypass the grid, can only benefit from harnessing the power of the sun.

The debate at this stage of the game should not revolve around "to be, or not to be (solar)" versus large central power solar or other clean energy sources (wind, geothermal, biomass, etc.) and conservation, but instead – the strategy should be focused on how to pool all available clean generation resources and energy conservation into a comprehensive portfolio that benefits utility customers, the grid, the environment and the economy.

California's Solar Legislation Senate Bill (SB1) deals only with rooftop electrical power and as such has drawn sharp criticism.

The dilemma centers around whether the support of one form of renewable energy technology comes at the expense of all other green sources[1].

Germany figured out how to do it – they have the most aggressive Renewable Energy Act[2], which has resulted in establishing Germany as the global leader in wind and solar generation over the last five years. The economic benefit payoff is tremendous, resulting in over 300,000 new jobs, thousands of MWs of clean generation and the overwhelming support of the German public, labor unions, agricultural and steel industries, just to name a few, united with the renewable energy producers.

The astounding price tag of this major initiative is one Euro per household per month, the equivalent of $1.25 USD (detractors predicted it would be a lot higher). Spain and Italy have recently adopted similar programs and will soon compete with Germany for leadership; while California's leaders continue to debate the benefits and costs of going solar others are reaping the economic and environmental profits!

In Californians people are used to being leaders and innovators. This State is the sixth largest economy in the world and we can and should expect to be the global leader in an industry that relies on a free fuel with which we have been blessed by nature in infinite quantities. It is mind boggling that instead of embracing a much needed and far overdue major statewide solar initiative along the lines of California's new Solar Bill SB1, renewable energy proponents are squabbling over meaningless number crunching and petty turf wars that can be overcome simply by having a will to do so.

As it stands right now, however, Californians will be gazing at the dust of other nations (with considerably less sunshine) such as Germany, Spain, Italy and Japan, who will reap the benefits of having had the foresight to tap into the power of the sun.

It is surprising that at this juncture, clean technology supporters and energy consumers, are doing battle with each other over which technology is cheaper or why chose one clean technological solution over another one – instead of recognizing that often "**perfection is the enemy of the good**" and that by uniting and supporting progressive initiatives all renewable energy technologies stand to gain.

[1] See. Los Angeles Times, Business Section, June 27, 2005 for details.

[2] Act Revising the Legislation on Renewable Energy Sources in the Electricity Sector. Adopted by the German *Bundestag* July 21, 2004.

Yes, California's political leadership should introduce a clear, long-term comprehensive renewable energy and conservation initiative for the State and there are good structures that can be used as examples on how it can be done (Germany for Instance).

In the meantime there should be a California solar rooftop Bill that can take us one step closer to a more encompassing energy portfolio.

II. Why Solar

Here is why a rooftop solar Bill is so important: First and foremost SB1 establishes a foothold that allows for expansion and inclusion of other technologies into the legislation. Solar technology itself is perfect to demonstrate the benefits of renewable energy on a multitude of levels. Solar power is in a league all of its own when it comes to futuristic, versatile, functional and multipurpose power supply: Solar electric power is the technology that can best illustrate the benefits of renewable energy and distributed generation simultaneously. It is perhaps the most singularly versatile energy source of all. Solar electric systems are scalable and modular, and are able to power a pocket calculator, a phone, a computer, a home, space shuttles, commercial buildings, schools or even an airplane.

A. Cost Reductions and Job Development

The cost for rooftop solar has steadily declined over time, and will continue to do so with mass production and implementation – just take the computer or solar calculator scenarios as an example. In addition the development of a robust solar system manufacturing industry enables manufacturers to meet local demand as well as positions the State to supply the global markets for distributed generation systems.

B. On-grid Applications for Peak Load Reduction

Solar power can be connected to the grid in developed urban areas, thus decreasing transmission congestion and at the same time, generating electricity during the highest electrical peak demand, thereby improving overall system reliability and the ambient air quality, while lowering customers' bills.

C. Off-grid Applications

Solar can also power off-grid applications ranging from traffic signals, water pumping stations, homes, communication centers and schools without the need for sophisticated supply chains such as overhead wires, fuel pipelines, rail-ways or utilization of fresh water reserves. Over 38% of our fresh groundwater is used for fossil power plant cooling, barely squeaking in behind agricultural use at 39%.

D. Building Integrated

Solar electricity can offset building materials if it is integrated into the construction of new facilities, it can be a part of a building or a completely stand alone system. Solar systems can be turned into building facades, roof membranes, windows, awnings, canopies, they can also easily be designed to shade parking structures, thus improving the overall efficiency of a building envelope, reducing heat gain and the building's peak energy demand.

E. Architectural Versatility

Solar systems can be translucent, flexible, multicolored, and impregnated into various building materials. It is the only energy source that can be architecturally functional and pleasing, while generating electricity.

F. Economic Development

In addition to the energy benefits, solar systems as well as other renewable energy technologies and distributed generation bring about local economic development through clean manufacturing processes and numerous installation jobs.

G. Inflation-proof Power

The systems are quiet, virtually maintenance free, and utilize an inflation proof fuel, (the price of sunlight or wind will not increase) and extremely safe.

H. Easy and Fast Installation – "Wireless Energy" for Rural Locations and Emergency Power

A solar system can be installed and operational in a matter of hours, without the need for complex power lines and fuel pipeline infrastructures. Thus, very much like wireless telecommunication, through a solar "wireless energy" system, a remote village in Africa, Asia or South America can have lights, refrigeration for medicines and supplies, access to education and medical help via TV and the Internet almost overnight. Last year's tsunami victims in Asia would have been served well by solar powered emergency generators for water purification, telecommunication and medical supplies. Thousands of post tsunami victims were stranded with diesel generators waiting for helicopters to airlift fuel to remote locations because there is no reliable road access.

I. Electrical Power Price Protection

While in California homeowners can almost immediately insulate themselves from fluctuating electricity prices by installing a solar system on their home. The additional benefits of having power when the grid is down due to storms, earthquakes or other disasters are simply the icing on the cake.

Therefore, having a robust solar industry will only result in more high quality jobs, a new silicon industry (solar elements are also made out of sand – the most abundant resource in the world).

III. COMPREHENSIVE APPROACH

That is not to say that renewables such as centralized solar, wind, biomass and geothermal should not be championed under the banner of green power portfolio standards, various feed in tariffs and green credit trading schemes that support "home grown energy".

Indeed large-scale renewable energy plants will be the solution that becomes the cornerstone of our future electricity generation growth that not only powers our everyday lifestyle, but also propels our vehicles in the form of hydrogen as fuel derived from clean power.

Yet renewable energy protagonists are so busy fighting each other over crumbs instead of presenting a comprehensive vision, that the nuclear industry is successfully resurrecting itself and pitching its new image as the logical solution to global warming and cheap hydrogen for the future! And who can blame them; after all, "power abhors a vacuum".

The idea to create an International Renewable Energy Agency structured in the same fashion as the International Atomic Agency or the International Energy Agency with a mission focused on the widespread proliferation of renewable energy is somehow an elusive fantasy?

There is a void of leadership and lack of overall strategy for a comprehensive renewable energy solution that has yet to be presented on any level. This is not solely the fault of elected politicians. This is a symptom of the lack of leadership, strategy and initiative on behalf of the renewable energy manufacturers, supporters and advocates.

Instead of acting like the poor orphaned cousins begging for a few measly crumbs, the renewable energy industry as a whole should be establishing itself as the best energy option for the future and take its rightful seat at the head of the energy mix debate. Renewables have received less than $50 Billion over the last 20 years compared to $300 Billion (and growing) for traditional sources **every single year**! All that is necessary is equal treatment not special favors, so why are we allowing the debate to be sidetracked while the energy source mix of the future is being defined with renewable resources missing in action and green power certainly not a part of the equation?

IV. LEGISLATIVE SCHEMES FOR RENEWABLES

For technologies to succeed we need the right market conditions. Traditional energy structures have historically benefited from heavy subsidies for decades. In order for renewable technologies to have a chance of development there need to be favorable governmental policies that allow the technologies to develop and ensure that there are adequate long-term incentives supporting that development.

As the global population becomes increasingly aware of the intricate connections between climate change; the need for CO_2 emission reductions; our fossil fuel based electricity and transportation sectors; escalating energy and fuel prices; oil dependence, terrorism and war in the middle East -- new, clean energy technology solutions and clean fuel development begin to emerge as a necessary energy source. Therefore, more and more people as well as their political leaders are starting to demand an option to "choose and indeed the mandate to legislate" cleaner energy alternatives. National policies and programs are beginning to respond to that desire and an increasing number of countries have started to adopt rules and regulations that promote the development and deployment of renewable energy technologies, conservation measures and cleaner transportation fuels.

The mechanisms adopted to promote renewables and energy efficiency measures through-out the world vary from financial support programs (i.e. buy-down programs), to specific obligations for electric utilities (i.e. portfolio standards), to feed in tariffs, green certificates, administrative assistance in planning and permitting to widespread education and information campaigns. Certainly countries and indeed geographic regions with clear mandates for the introduction and support of new clean technologies are the most influential in ensuring the successful implementation of renewable energy. In order to thrive, renewable energy programs need to be flexible, easy to understand and access by customers, especially if they allow for the combination of several programs (i.e. distributed generation, recycling, renewable energy, energy efficiency, building construction, fuel economy, etc) to best fit the specific needs and demands of a given customer segment. Programs that operate on a multi level basis, along with allowing flexibility to blend incentives in the deployment of new products and technologies have the greatest chance for long-term success.

Effective renewable energy program parameters are universal and with little adjustment the same principles can apply anywhere. Indeed incentive programs that work in developed nations can be structured to apply to countries in transition and the developing world. A well-designed program will promote a whole new industry, local jobs, economic development, reduce harmful emissions, improve public health and provide environmental benefits in a developing country just as well as in the developed world.

Overall, clear set government policy and legislatively mandated programs and standards are always more effective than voluntary goals (i.e. car manufacturers did not install seat belts until they were mandated, efficiency standards in appliances were increased as a result of mandates, drastic power plant emission reductions and improved safety procedures have only resulted from government intervention, etc).

Manufacturers and industry do not always focus on self-policing, they are typically focused on the bottom line and unless environmental initiatives improve the bottom line, they will not be incorporated without legislative directives. Voluntary programs should not replace legislative initiative and the obligation of governments to work for the public good. Clear standards and rules are the best facilitator for the deployment of renewable energy and energy efficiency programs.

With respect to renewable energy there is a heated debate about the effectiveness of market-based programs – i.e. emission trading programs based on portfolio or quota goals vs. a minimum price or a tariff-based programs. There are certainly advantages in both scenarios, however a detailed review and comparison of both versions has revealed the clear superiority of the minimum priced brand over the quota systems.[3]

A. Feed in tariff and quota systems:

Government policy plays the most important role in advancing the goal for widespread implementation of new technologies; the financial mechanisms adopted to achieve the goals are the most important component in the equation. Currently there are two major mechanisms that have taken the lead i.e. minimum price (feed in tariffs) and the quota (portfolio standard) systems. A minimum price system is characterized by a minimum price for the commodity and an obligation on a party (typically the utility) to purchase the green electricity at a fixed price. The quota system is based on a minimum goal (i.e. 20% of all electricity sold in a certain time-frame or a minimum quantity of capacity to be purchased or sold). The government then creates a specific trading mechanism, usually consisting of certificates and a third party "watchdog" entity tracks the trades to eliminate fraud and double counting.

The minimum price programs are straightforward and easy to administer, while the quota systems are complex and hard to understand, track and account for. In addition the goal of quota systems automatically becomes a ceiling with little incentive to be exceeded, while experience shows that tariffs encourage long-term investment and financial security for all participants, especially if the programs are long term—i.e. 20 years as in Germany. These are only some of the reasons why the recommendation of the EREF/Worldwatch study with respect to a uniform renewable energy sources (RES) support scheme for Europe is as follows:

"EREF is opposed to a harmonised RES support scheme in Europe that is not "feed-in" based. It is crucial that the unified Europe avoid enacting a harmonised RES support scheme that is not minimum-price based, for as long as the market share of RES-based electricity is still far from the critical mass that is necessary to overcome market barriers. Market distortions associated with the traditional energy sector remain high and must be eliminated before a support scheme based on tradable certificates can be introduced in an open electricity market."

The superiority of the feed-in tariff mechanism is evident in several key areas, such as: allowing governments to rapidly reach established renewable energy goals and increase RES capacity at significantly lower prices of RES-generated electricity than in tariff based structures; In addition, long term financial security guaranteed by tariff programs (typically 20 years) enables investors to fund RES projects with a guaranteed a rate of return, thus improving investor and customer confidence and resulting in rapid technology development, manufacturing and technology implementation; This technological development usually leads to technology innovation, economic development and local jobs, resulting in technological diversity and a blend of solutions that best fit the specific region and community needs for the lowest cost. Based on the above, the overall conclusion is that the flexibility and ease of implementation afforded by the minimum price system best serves the overall goal of bringing renewable energy into the mainstream as well as facilitating the introduction of energy efficiency measures and other sustainable development programs to the consumers.

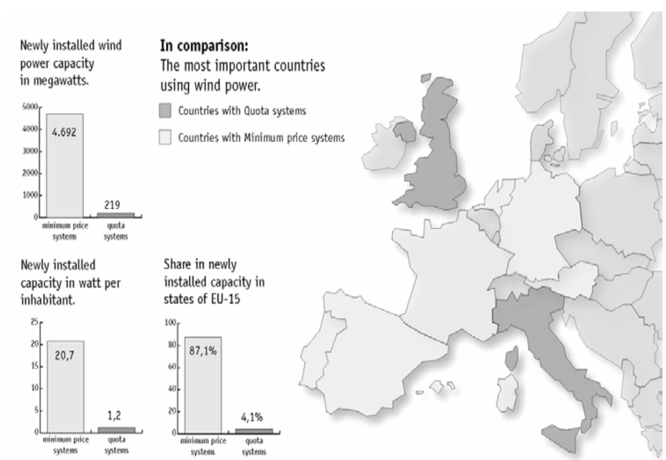

Fig. 1. A comparison of the most important countries using wind power.[4]

Public policy also affects the advance of other key areas related to RES such as energy efficiency, distributed generation and storage. Energy Efficiency programs benefit from policy initiatives and financial mechanisms in a similar fashion as renewable energy programs. For instance a well-balanced economic incentive will affect the rate of technology implementation directly. There are several components that interplay to create the right environment for the growth of

[3] See *A Comparison of Minimum-Price and Quota Systems and an Analysis of Market Conditions,* Joint Report by the Worldwatch Institute and European Renewable Energies Federation (EREF), Brussels, 2005.

[4] Source: *A Comparison of Minimum-Price and Quota Systems and an Analysis of Market Conditions,* Joint Report by the Worldwatch Institute and European Renewable Energies Federation (EREF), Brussels, 2005.

renewable energy programs as well as the successful introduction of distributed generation and transportation solutions, which also become a part of the overall sustainable development composition of a given region. The programs supporting renewable energy wind development in Europe are outlined in the table below.

Country	Price (€ cents/kWh)	Explanation and Remarks
Germany	6.6-8.8	Depends on site; 20 year time span
France	8.38 5.95/3.05	8.38 cent for the first 5 years; thereafter the price drops depending on the number of full load hours (0-2000 = 8.38 cent, 2000-2600 = 5.95 cent, 2600-3600 = 3.05 cent). Compensation period totals 15 years.
Portugal	8.3 8.1	Tariff depends on the number of full load hours; 8.1 cent refers to plants with up to 2,300 annual full load hours. The tariff up to 2,000 annual full load hours was 8.3 cents/kWh.
Austria	7.8	Note that in 2003 and 2004 there was a fiscal investment cost premium of 10% on all **new** investments.
Spain	6 ~6.38	Two tariff options include: a fixed feed-in tariff (approx. 6 cent) or variable compensation rate. Variable compensation rate consists of a fixed premium of 2.66 cent (2003) and market price for electricity—on average, 6.38 cent/kWh.
Netherlands	9.2-9.8	Consists of (1) 4.9 cent fixed government surcharge (MEP) plus 2.9 cent tax exemption, plus (2) a surcharge (MEP). The MEP is granted for a total of 10 years or 18,000 full load hours.
Italy	12.0-14.1 (2003)	Includes certificate trading price (8.4 cents) plus average electricity price. Certificates are allocated for the first 8 years of operation.
United Kingdom	NA	Consists of (1) certificate trading price (7.0 cent/kWh in 2003); (2) tax exemption (climate change levy); and (3) price of electricity.

Fig. 2. Comparison of countries supporting wind power development through feed-in tariffs and buy-down programs.

In the USA renewable energy incentive programs are categorized as follows:

1. *Financial Incentives: Categorized as grants 43 programs, favorable loans 42, production incentives 71, as well as personal 29, corporate 41, property 32 and sales tax benefits, which are applicable to all States.*

2. *Rules, Regulations and Policies: Ranging from net metering 51 programs, interconnection 32 programs nationwide and grid access laws 44, to equipment certification 8 programs, green power purchase programs 24 nationwide, portfolio standards 19, construction and design standards 25, power label disclosure, 24 etc.*

3. *Outreach and Voluntary Programs: mostly centered around green pricing a total of 128 programs, installer certification about 9 in the nation, and a variety of outreach, education and advertising programs a total of 77.*

All of the above elements are important in creating an energy efficiency or renewable energy program that works. It is key to be creative in employing all effective mechanisms and applying them to specific local conditions to achieve maximum benefit.

V. Conclusion

Thus the Green industry should demonstrate that it is capable not only of vision, but action and demand the same treatment and monetary incentives that have and continue to be granted to the "more traditional" energy players. Stop apologizing and over-justifying the need for incentives to implement the necessary solutions and demand equal treatment.

It is leaders with a can-do and why not attitude and vision who will ensure that renewable energy becomes a part of the future energy mix, while making our lives a little more secure and allowing each customer to have a say and control over their own power supply. The fact that this will result in economic progress, jobs, better environment and a more secure and diversified local energy supply is an added bonus. Renewable energy advocates and protagonists should put side their differences, get rid of the smoke and mirrors game, take a step away from the petty squabbles and unite behind a grand vision and good initiatives that will ultimately enable all sources of alternative energy to become a part of the future energy mainstream. All of us, as well as our children and grandchildren are the ones who will ultimately reap the economic and environmental benefits of a little more sunshine in our light switches.

VI. Acknowledgments

The Author gratefully acknowledges the technical assistance, of Teodor Galitev, Solar Energy Expert; the editorial feedback from Judge Sheldon Sloan, President of the California Bar Association; as well as the professional inspiration from Hermann Scheer, Member of the German Bundestag, President of EuroSolar and S. David Freeman, "California Energy Tsar."

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www.SolarAccess.com
US Department Of Energy Home Page - **www.energy.gov/**
DSIRE: Incentives by State: Federal Incentives for Renewable Energy - **www.desireusa.org/**
The above list offers an indication of key sources accessed but it is not an exhaustible list of sources.

VIII. Biography

Angelina M. Galiteva was born in Plovdiv, Bulgaria. She is the Chairperson of the World Council for Renewable Energy (WCRE), she also works as a Consultant specializing in strategic issues related to renewable energy, environmental, efficiency and overall sustainable policy programs for public and private entities. Ms. Galiteva currently serves as President of the Board for New Energy Options, Inc. and is Board Member and Vice President for American Distributed Generation, Inc.
Prior to July 2003, Ms Galiteva was the Executive Director-Strategic Planning, for the City of Los Angeles Department of Water and Power (LADWP). In that capacity she was responsible for managing the Departments' Corporate Environmental Services Business Unit as well as all LADWP's Green LA Programs. The Green LA Programs consist of Efficiency Solutions, Electric Transportation, New Technology and Initiatives, and the Solar Energy Programs. Ms. Galiteva also led the Department wide effort for the Integrated Resource Plan which serves as the basis for LADWP's overall power operations.

Before to joining the Los Angeles Department of Water and Power in 1997, Ms. Galiteva worked for the California Independent System Operator and Power Exchange Trusts and Corporations. Prior to that, Ms. Galiteva worked for the New York Power Authority on conservation, renewable energy and air quality initiatives.

Ms. Galiteva, is an attorney with a JD and Masters' of Law Degrees in International, Environmental and Energy Law from Pace University School of Law, New York.

Wind Power Development in Europe

Nikos Hatziargyriou,
Department of Electrical and Computer Engineering,
NTUA, Greece,
Tel: 301-772 3 661, e-mail: nh@power.ece.ntua.gr

5th Balkan Power Conference, 14-16 September 2005, Sofia

Sustainable Energy Systems
DRIVING FORCES

- Energy Policy:

security and efficiency

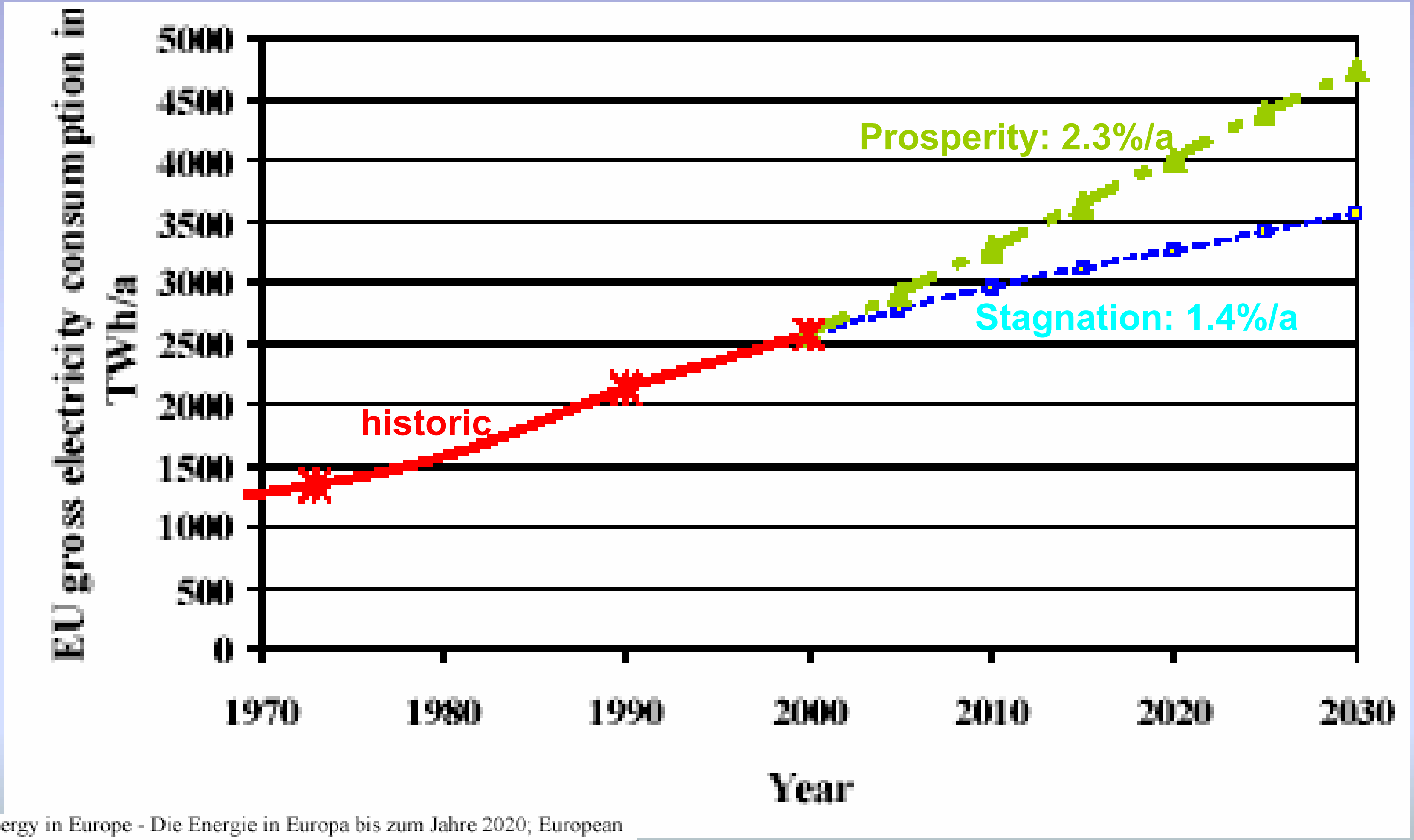
- Environment Policy:

minimising environmental impacts

- R&D&T and innovation Policy:

boosting competitiveness: long term approach

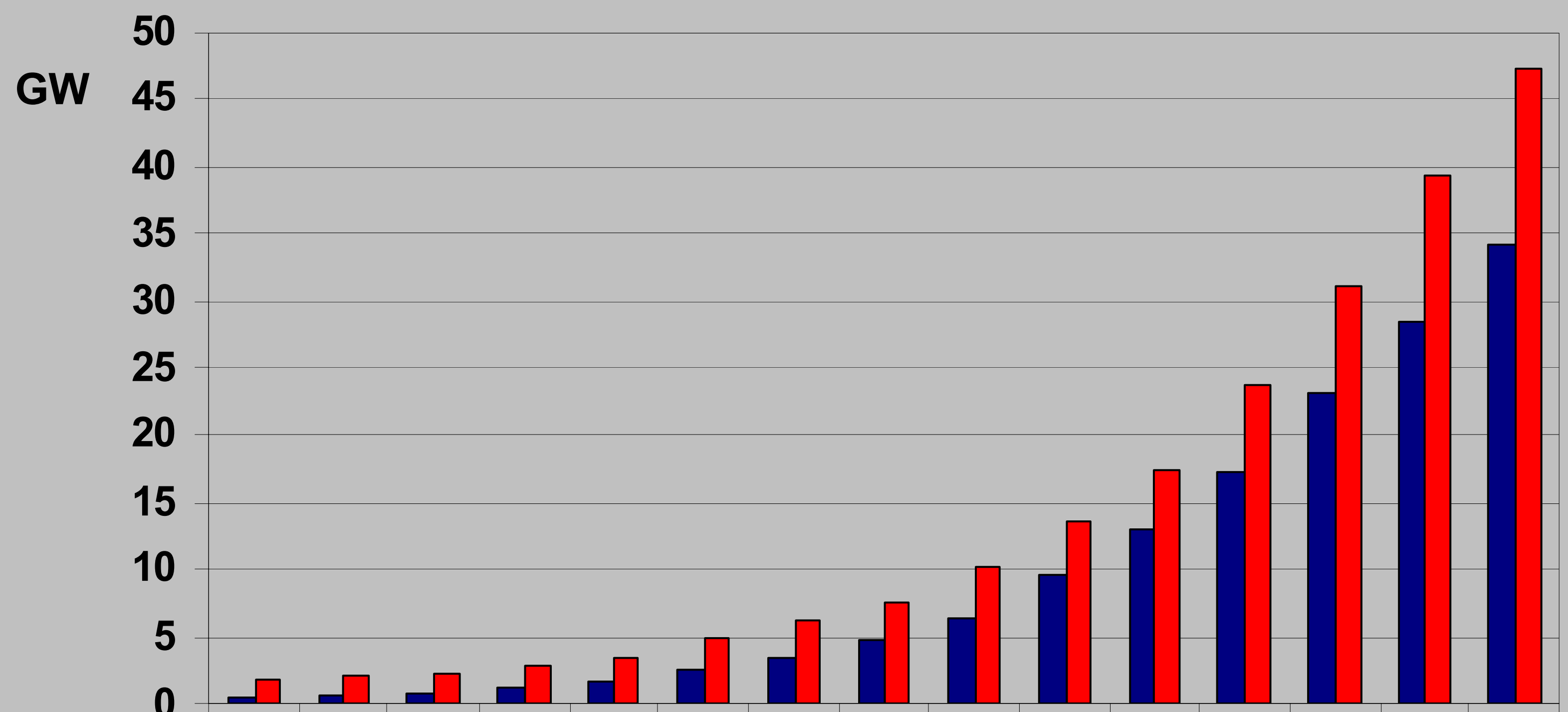
Electricity demand scenarios for the EU-25



DG Energy; Energy in Europe - Die Energie in Europa bis zum Jahre 2020; European Commission, Bruxelles 1996 (Conventional Wisdom Scenario)

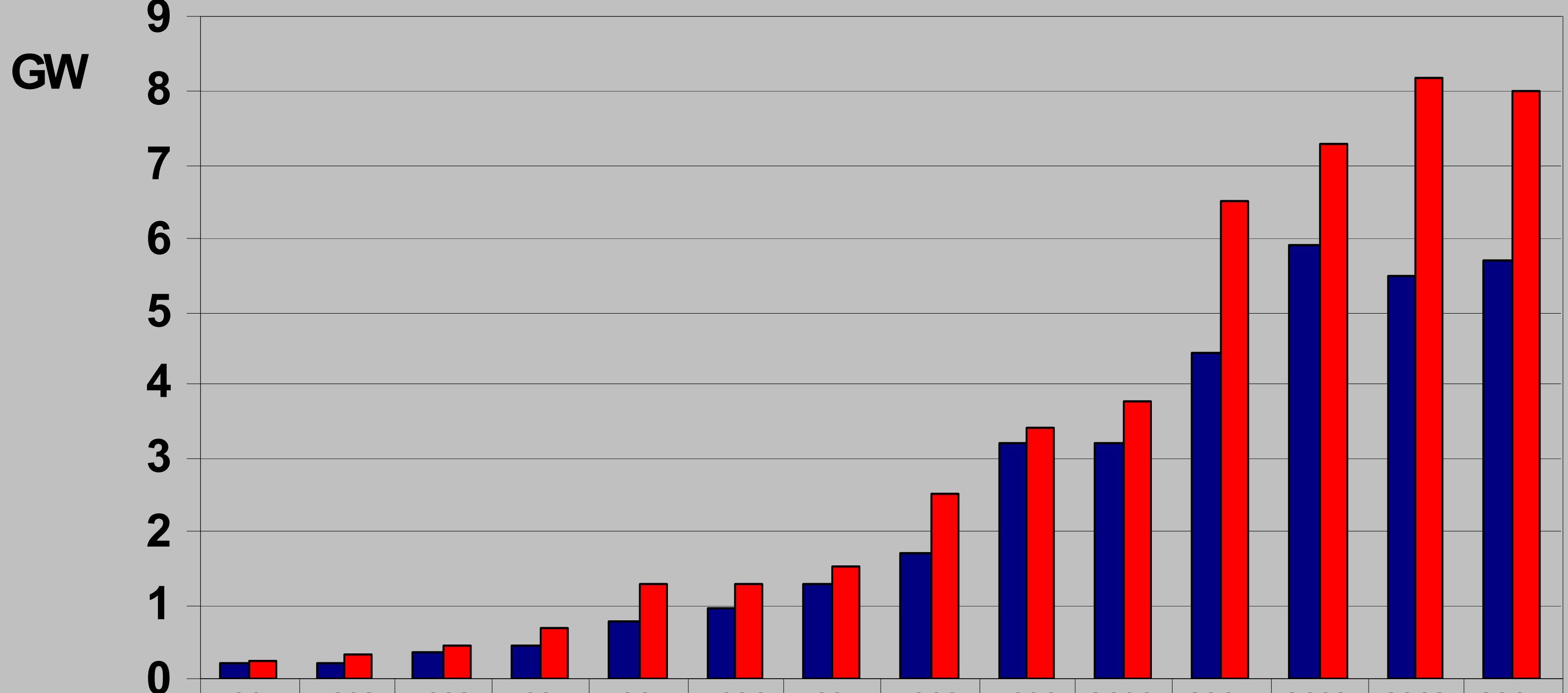
Wind Power Status in Europe by the End of 2004

Cumulative Wind Energy Installed Capacity



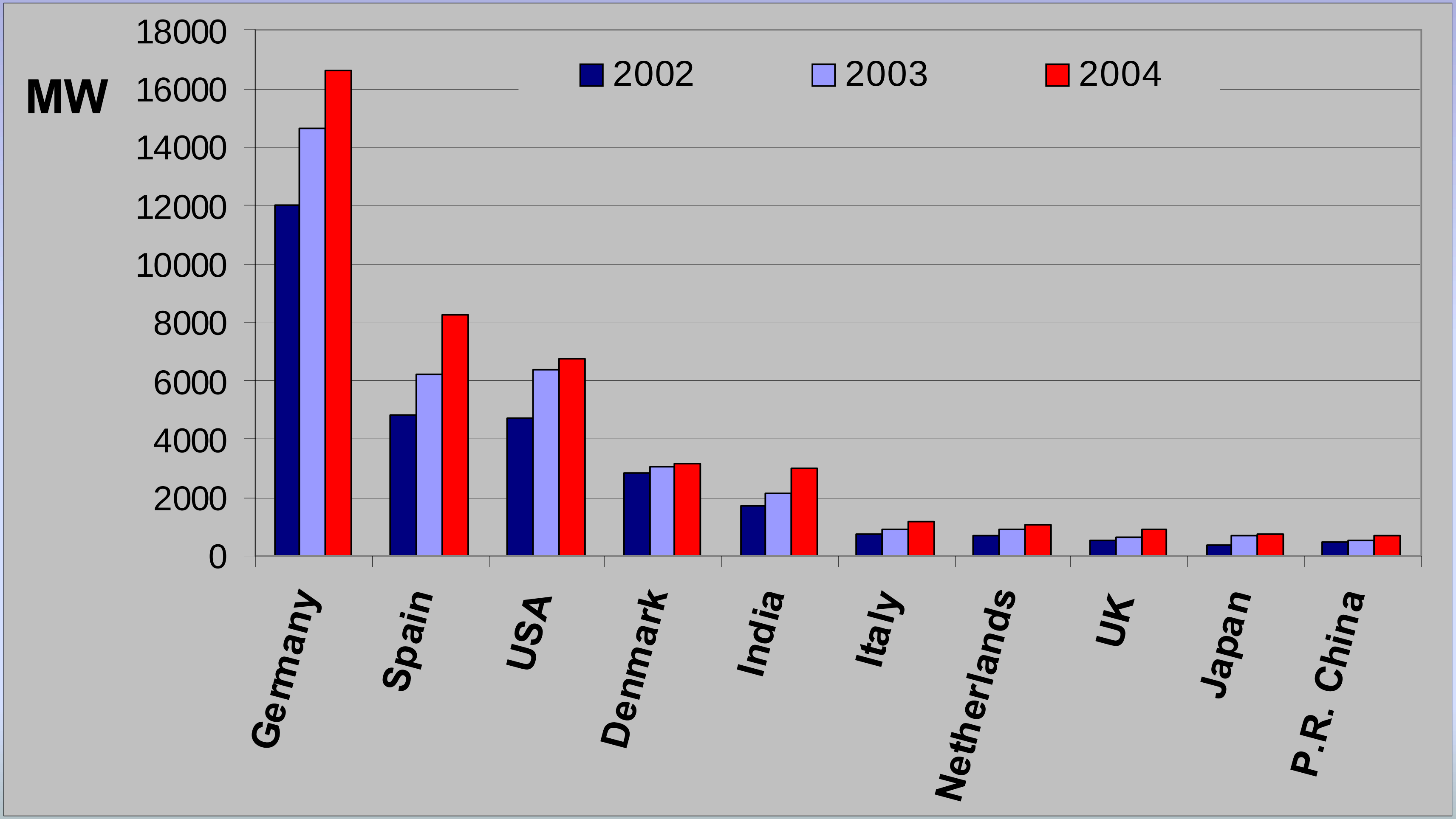
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
EUROPE	0.4	0.6	0.8	1.2	1.7	2.5	3.5	4.8	6.5	9.7	12.9	17.3	23.2	28.6	34.2
WORLD	1.7	2.0	2.3	2.8	3.5	4.8	6.1	7.6	10.2	13.6	17.4	23.9	31.1	39.3	47.3

Annual Wind Energy Installed Capacity

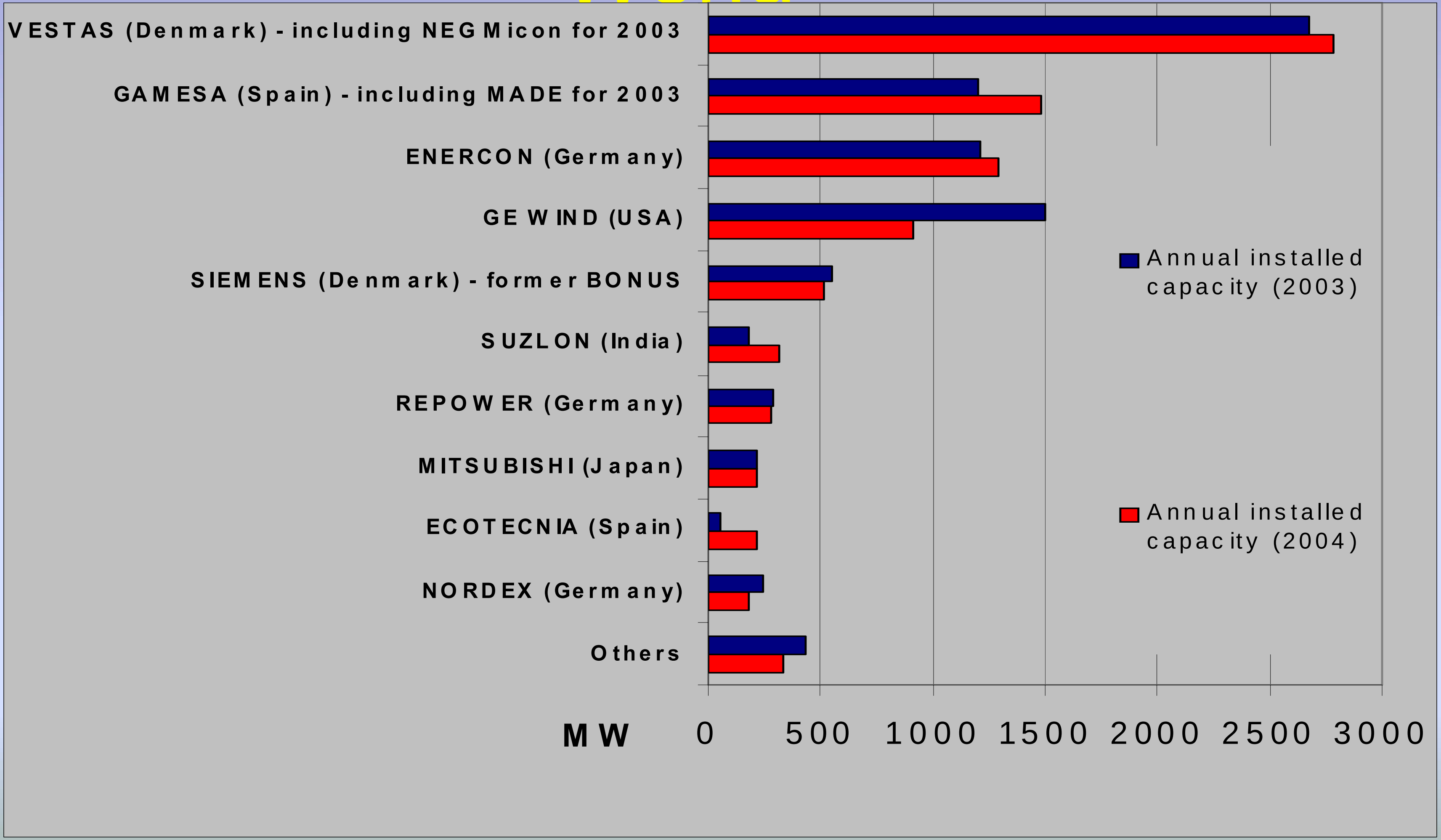


	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
EUROPE	0,19	0,22	0,37	0,47	0,81	0,98	1,28	1,70	3,23	3,21	4,43	5,91	5,48	5,70
WORLD	0,24	0,34	0,48	0,73	1,29	1,28	1,53	2,52	3,44	3,76	6,50	7,27	8,17	8,01

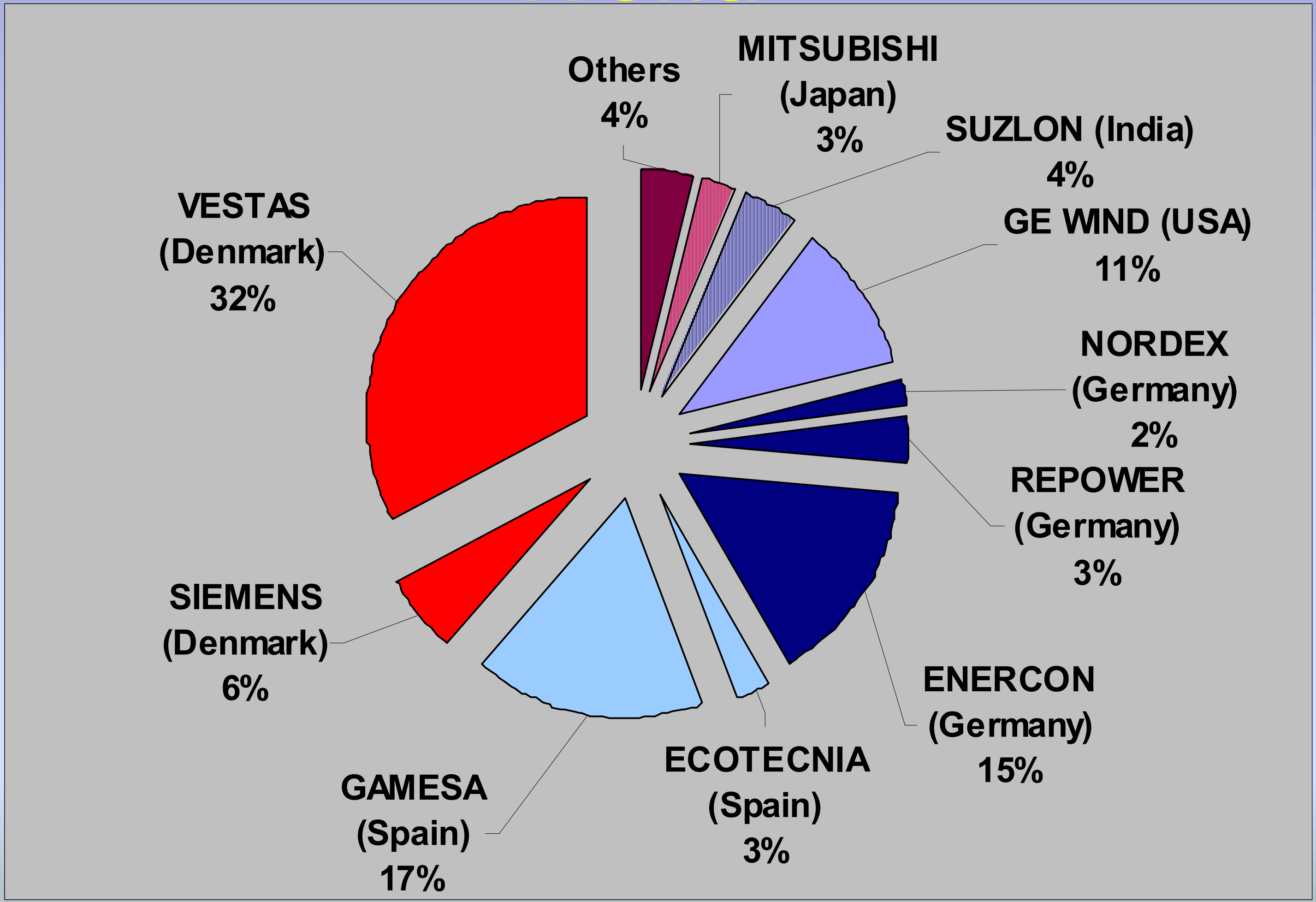
The Top-10 Markets in the World



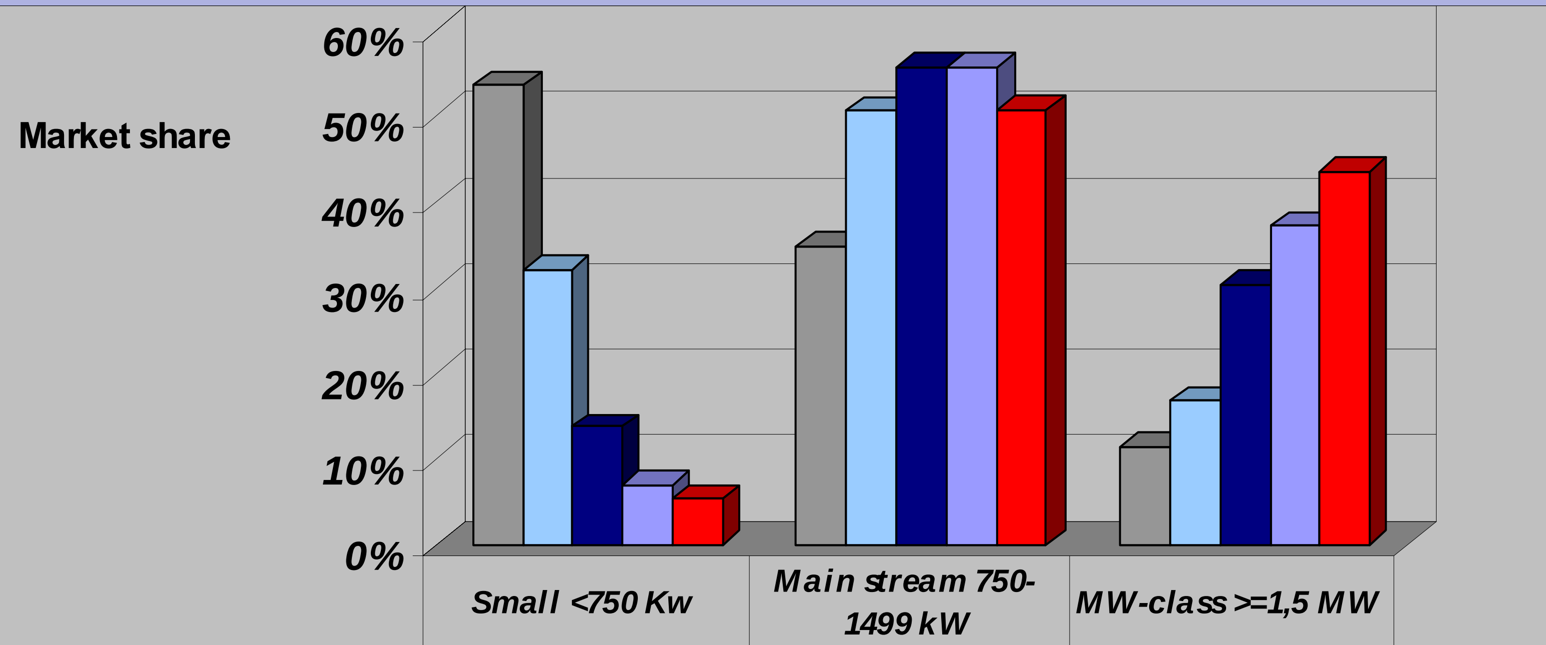
The Top 10 Suppliers in the World



The Top 10 Suppliers in the World

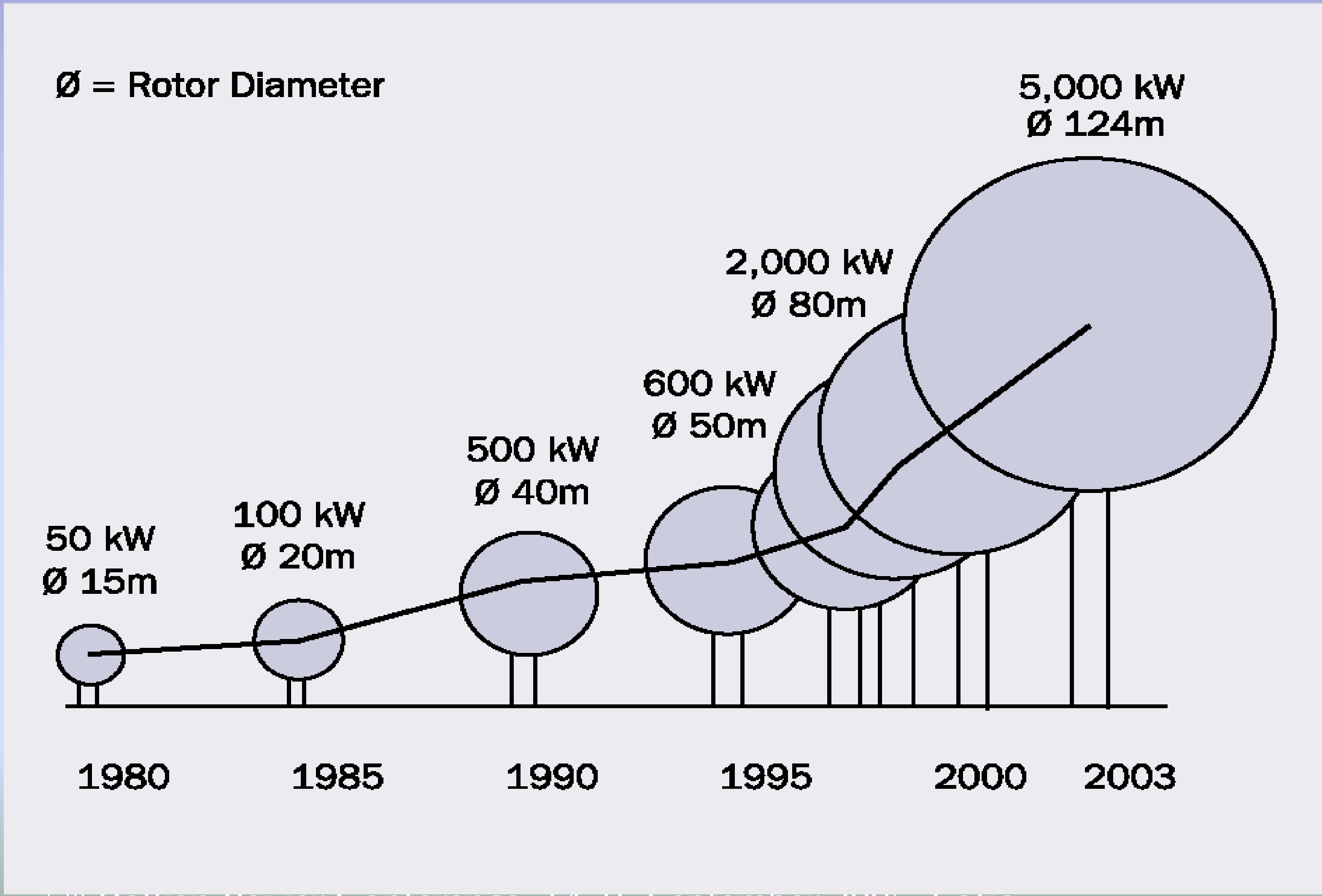


Segmentation of Product Sizes in the 2001 - 2003 Market

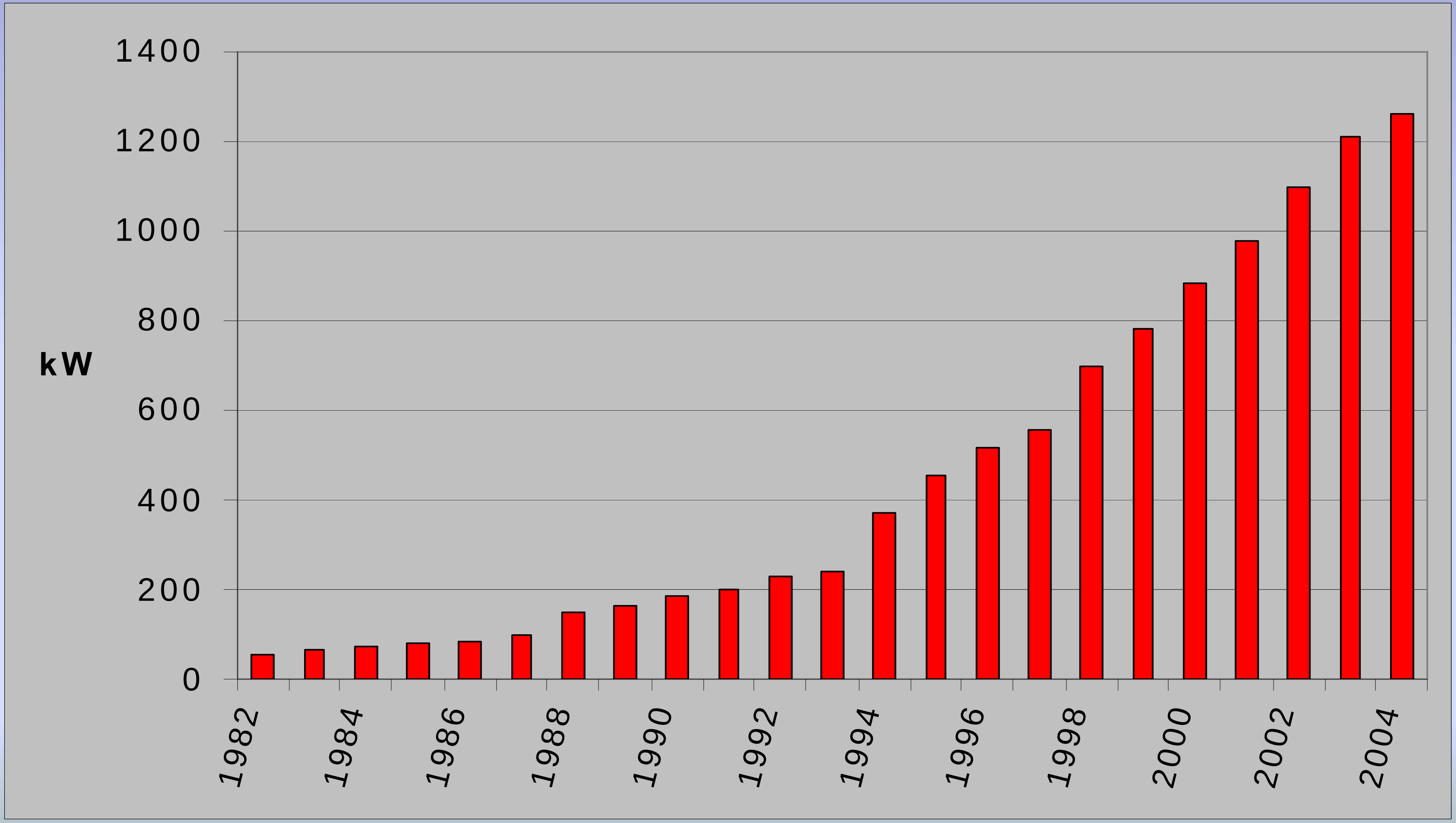


	Small <750 Kw	Main stream 750-1499 kW	MW-class >=1,5 MW
Market share in 2000 (%)	54%	35%	11%
Market share in 2001 - (%)	32%	51%	17%
Market share in 2002 (%)	14%	56%	31%
Market share in 2003 (%)	7%	56%	37%
'Market share in 2004 (%)	5%	51%	44%

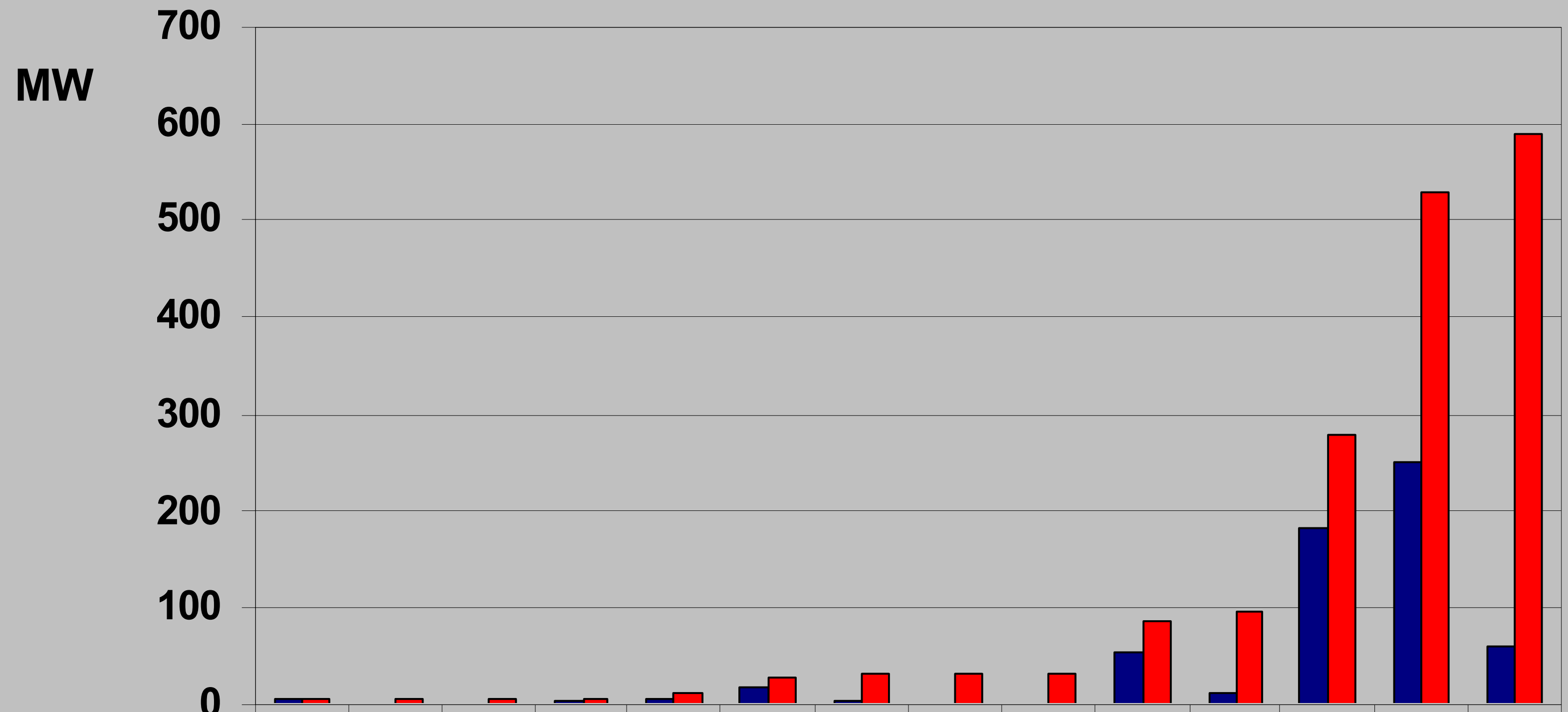
Growth in Size of Commercial Wind Turbine Designs



Average Wind Turbine Size Installed Each Year

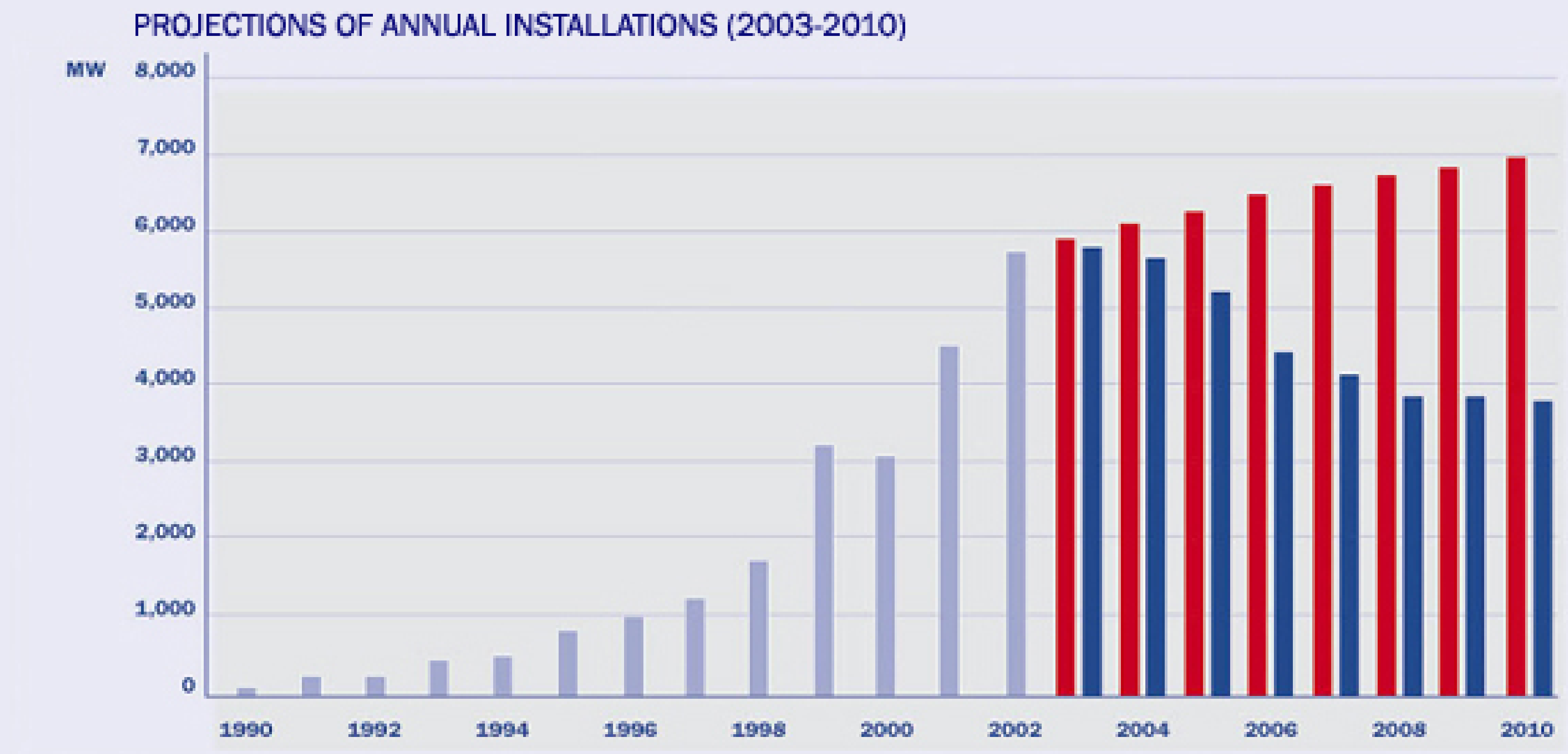


Annual and Cumulative Offshore Capacity (1991 – 2003)



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Annual	5	0	0	2	5	16,8	2,75	0	0	54,5	10	183	250,8	60
Cumulative	5	5	5	7	12	28,8	31,55	31,55	31,55	86,05	96,05	279,1	529,9	589,9

Wind Energy Targets

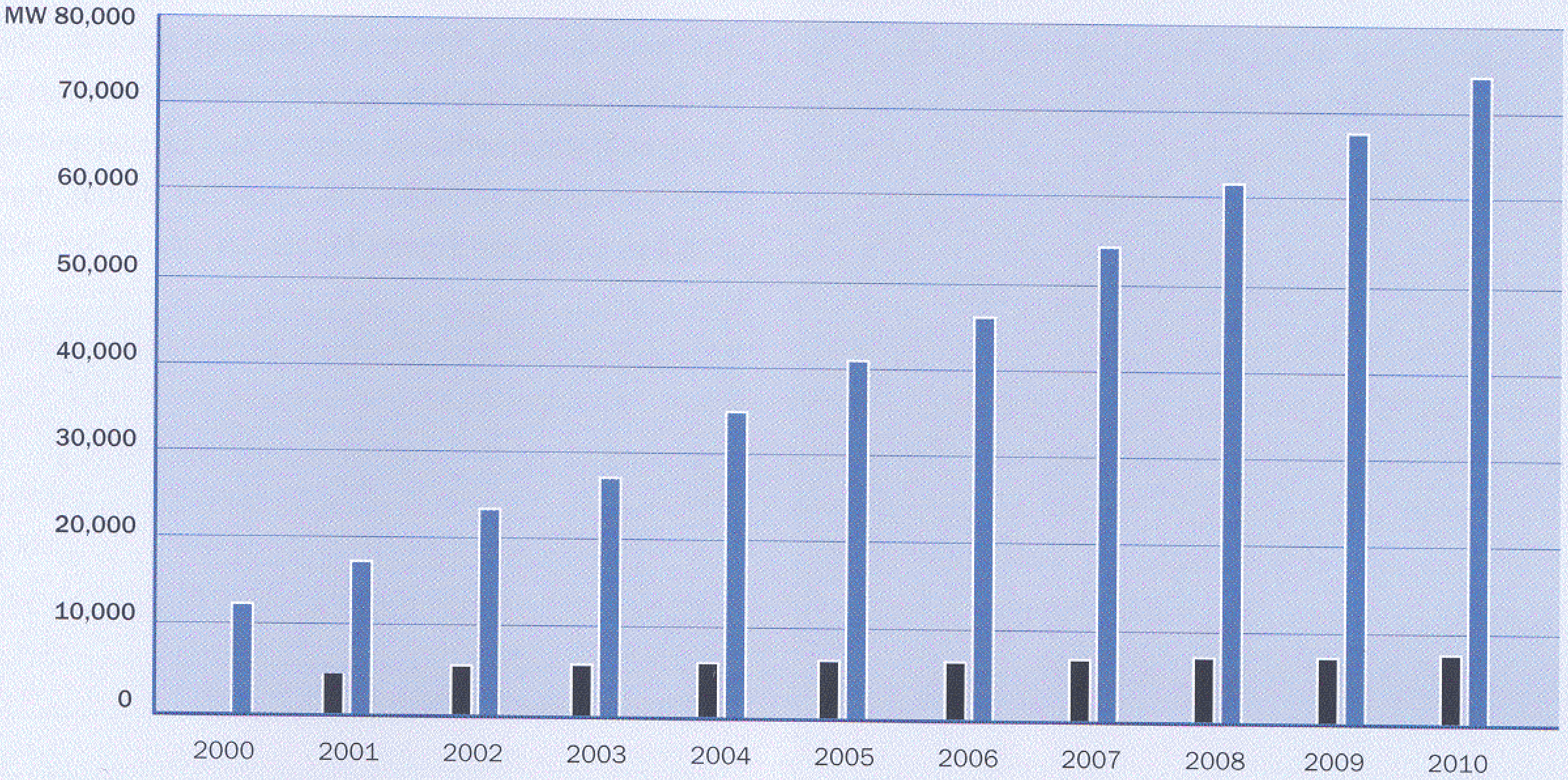


New capacity - target 75 GW														5,900	6,100	6,300	6,450	6,600	6,750	6,900	7,000
New capacity - target 60 GW														5,744	5,650	5,200	4,550	4,150	3,900	3,900	3,850
Actual Market		190	215	367	472	814	979	1,277	1,700	3,225	3,209	4,428	5,871								

Source: EWEA. http://www.ewea.org/

EWEA Wind Energy-The Facts

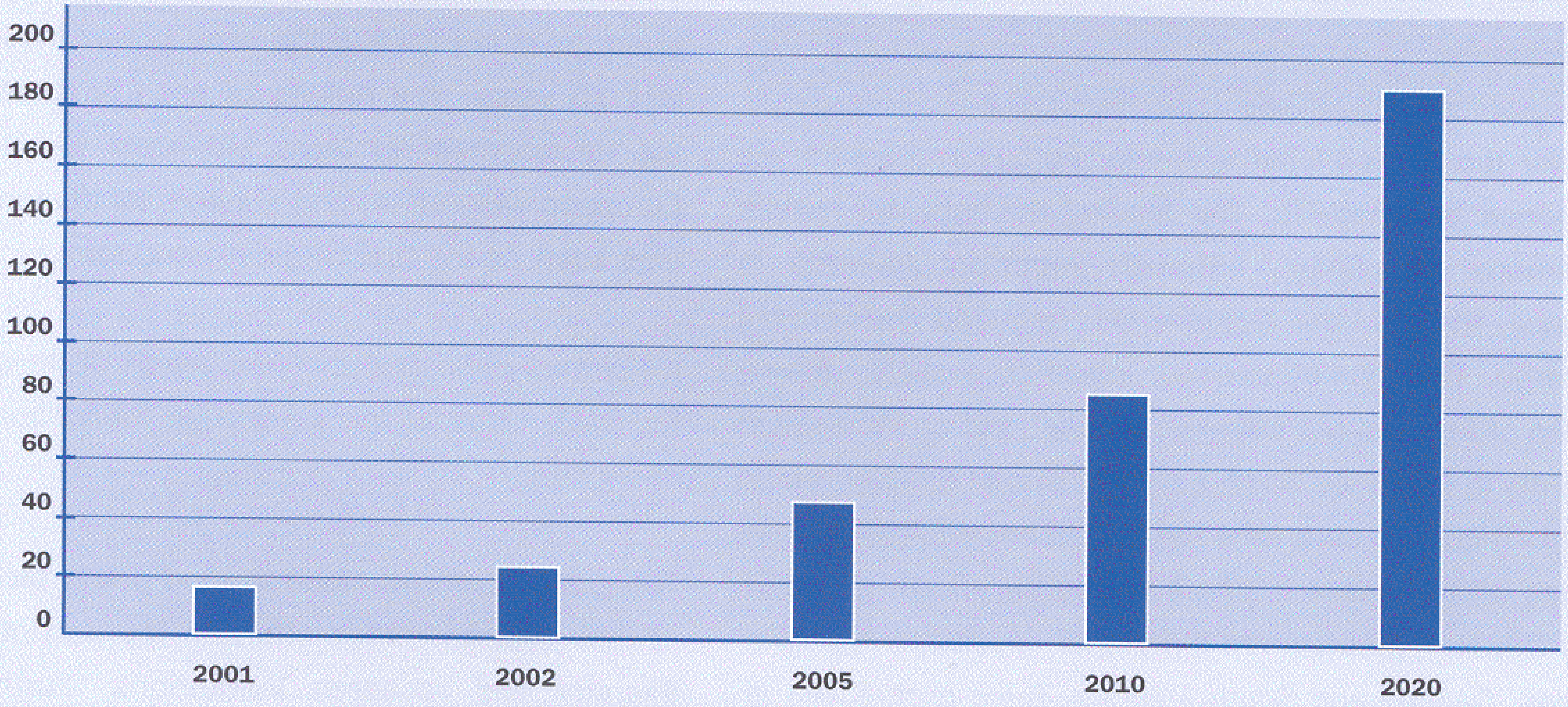
Figure 5: Wind Power Targets in the EU-15 (MW) EWEA Wind Energy-The Facts



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
New Capacity (MW)		4,500	5,700	5,900	6,100	6,300	6,450	6,600	6,750	6,900	7,000
Cumultative Capacity (MW)	12,800	17,300	23,000	28,900	35,000	41,300	47,750	54,350	61,100	68,000	75,000
Annual Growth of New Capacity			26.7%	3.5%	3.4%	3.3%	2.4%	2.3%	2.3%	2.2%	1.4%
Annual Growth of Cumulative Capacity		35.2%	32.9%	25.7%	21.1%	18%	15.6%	13.8%	12.4%	11.3%	10.3%

Equivalent Household Electricity Needs by WP

Figure 6: EWEA Targets to 2020 Equivalent Household Electricity Needs Met by Wind Power (per person)



	2001	2002	2005	2010	2020
European People (millions)	18.91	25.72	47.44	85.66	194.86
Wind Power Production (TWh)	32.4	44.8	86.5	167.4	425

EWEA – The Facts

- Over the past five years, global wind power capacity has expanded at an average cumulative rate of 32%, a figure only matched by the computer industry and the telecommunications sector.
- In 2003 8,133 MW of new capacity was added to the electricity grid worldwide, worth €8 billion.
- By the end of 2003, the capacity of wind turbines installed globally has reached 39,294 MW.
- This is enough power to satisfy the equivalent needs of 19 million average European households or close to 47 million people.
- 67% of the wind power installed worldwide in 2003 was in Europe.
- 72% of the total wind power installed worldwide is in Europe

EWEA – The Facts

- Wind Energy has grown most consistently in Europe, with capacity multiplied by 27 times over the decade 1992-2002.
- The total installed capacity in Europe at the end of 2003 had reached 28,706 MW.
- This provides enough power to meet 2.4% of the EU-15's electricity demand and is the equivalent power needs of 14 million average households or 35 million citizens.
- European Wind Turbine Industry booming. The four largest European manufacturers supply two-thirds of the world market. In 2003 80% of the WTs sold worldwide are by European companies.

EWEA – The Facts

- Germany, Denmark and Spain are the leading countries for wind power in Europe, accounting for 84% of the total European wind capacity.
- Adoption of clear political commitment for wind energy and of support systems in the form of kWh feed-in tariffs.
- Penetration levels in the electricity sector have reached 20% in Denmark and about 5% in Germany and Spain.
- In Schleswig-Holstein 1800 MW of installed wind capacity, enough to meet 30% of the region’s total electricity demand. In Navarra, Spain 50% of consumption is met by wind power.
- Emerging markets include Austria, Italy, the Netherlands, Sweden and the UK.

EWEA – The Facts

- By the end of 2003 a total of 600 MW of off-shore wind farms had been constructed around Europe in the coastal waters of Denmark, Sweden, the Netherlands and UK.
- Over the past two years individual projects have increased in size to more than 50 MW.
- The largest development so far, the 166 MW Nysted wind farm off the southern cost of Denmark started producing electricity in December 2003. This project alone can generate enough electricity for 145,000 homes.
- EWEA's expectation is that by 2010 up to 10,000 MW of offshore wind capacity could be operating around European costs.
- In the longer term, a sea area of 150,000 square kilometres with water depth less than 35 metres could be available to provide enough power for all Europe's electricity demand.

Evaluation of renewable electricity policy in Slovenia

Stane Merše, Mihael G. Tomšič

***Abstract*—Article presents the evaluation of current renewable electricity generation policy in Slovenia. A system of feed-in tariffs is in operation for small and medium sized plants, whereas large hydro plants are developed by state-dominated enterprises with the aid of budget appropriations for reconstruction of public infrastructure. New types of renewable power plants have been built recently (bio-gas, landfill gas, PV), but few more traditional projects (small hydro, wood-biomass) have started operation. Critical points of the current renewables policy in Slovenia are discussed and further developments suggested.**

***Index Terms*-- Electricity generation, renewable energy sources, energy policy.**

I. Introduction

SEVERAL reasons exist for supporting of electricity generation from renewable energy sources (RES electricity, RES-E) in Slovenia:

- use of domestic energy sources
- increase of security of supply
- decrease of import dependence
- decrease of GHG and other emissions
- EU – community and national target
- regional economy and spatial development.

Renewable electricity technologies are also important for industrial development and research. For Slovenia, hydro power plants and biomass are of direct industrial importance, whereas development of wind and photovoltaic sources is more related to research interests.

Slovenia is placed on the high fifth place among EU-25 countries by its share of more than 30% electricity production from renewable sources (RES) in the electricity consumption in the year 2000. More than 98% of RES electricity (RES_E) production is contributed by hydro power plants (HPP, 3.5 TWh, of that 3.4 TWh large scale HPP). The large share of HPP is the cause of annual variability of RES-E production (Fig. 1).

When joining the EU in 2004, Slovenia has set an indicative target of 33.6% of renewable electricity in 2010, in response to the Directive 2001/77/EC. This seemed an easily achievable goal when compared to the average achieved around the year 2000 (See Fig. 1). However, due to fast growth of the electricity consumption in the last three years and very dry recent years, the share of RES electricity production in electricity consumption was lower than 30% in 2002 and 2003. Future consumption growth will have a deciding influence on reaching the target. In this respect the National Energy Programme envisages slower growth of consumption than was observed in the recent years.

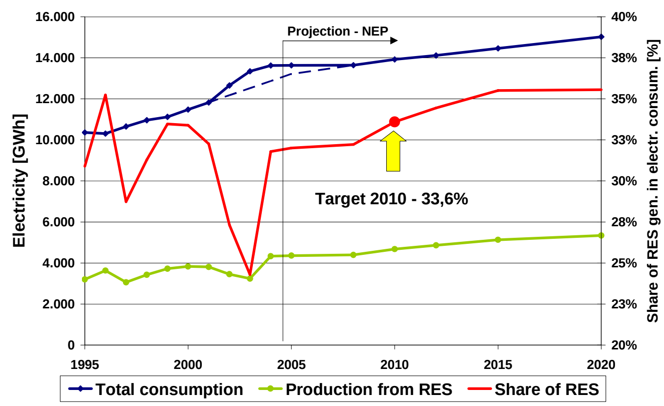


Fig.1. Past data and future projections on electricity consumption and production from RES and its shares in total electricity consumption.

II. Legal framework

Legal framework for promotion of RES-E is based on the special status of Qualified electricity Producer (QP), which has been introduced by the Energy Act[1] (EA, Article 29). Status of QP can be awarded to electricity producers that generate electricity from RES in a manner consistent with the protection of the environment or produce electricity and heat with above-average efficiency during the co-generation of electricity and heat (CHP, total yearly efficiency > 78%).

By EA the network system operators shall be responsible:

• for the purchase of all electricity offered by QP at the price determined by the Government,

• QP may sell all or part of the produced electricity independently and shall be entitled to the payment of a premium from the system operator for such energy,

All costs incurred by the system operator arising from purchase (net of sale) of RES-E, shall be covered by a

S. Merše is with the "Jožef Stefan" Institute, SI-1000 Ljubljana, Slovenia (e-mail: stane.merse@ijs.si).

M.G.Tomšič is with the "Jožef Stefan" Institute, SI-1000 Ljubljana, Slovenia (e-mail: miha.tomsic@ijs.si).

[1] Energy act (Energetski zakon), Off. Gaz. of. RS, No. 79/99, 51/04.

component in the the price for the use of networks.

Ministry for the Economy is responsible for preparation of policy instruments and measures, such as:

• Decree on the requirements to be met for obtaining the status of QP[2],

• Setting and updating of feed in tariffs and premiums for QP[3]

Supporting of RES electricity and CHP has a long tradition in Slovenia. All small power plants (up to 10 MW) have been supported by feed-in tariffs (FIT) since the mid-80's. The new system of FIT is in operation since early 2002 is current the main supporting instrument. State-owned power companies have also been constructing hydro power plants (small and medium sized, e.g. HE Mavčiče, 30 MW) by cross-subsidies from other operations.

A. Dissimilar Support for Private and Public Power Plants

Different conditions for construction of power plants in the private and the public sector arise from the situation in the power industry and its institutional framework in Slovenia. In principle, there is no legal difference. Special laws (lex specialis), e.g. on the support for of the Lower Sava project, point to the difference between the perception by the legislator of public and private power plants. There is a practical preference for large, public power plants over small private or municipal ones.

The Lower Sava project is claimed to be the largest current new hydro power scheme in Europe. It is a chain of six power plants with a total planned capacity of 180 MW and an expected average annual production of 800 GWh. Hydro power plants exceeding 10 MW are not eligible for the feed-in tariff. The Lower Sava project is supported by providing funds from the national budget for all infrastructure changes in the area related to the construction of the power plant series. This includes moving roads flooded by the artificial lakes, up to providing for water treatment plants for municipal effluents. It is estimated that the national budget will assume one third of the money that may otherwise have to be spent by the investors.

Another example of preferential position of large power plants is upgrading of an existing power plant HE Moste, near the lake Bled. The plans of the Savske Elektrarne company include fitting of more powerful turbines and a new downstream equalisation lake. Outside observers estimate that such extension is not economically warranted if real, profit earning capital is employed. The project is feasible only by provision of "own funds" earmarked for the intervention within the corporate system of the state-dominated Holding Slovenske Elektrarne. In any case, the project is stopped due to environmental opposition.

A further example of supplementary support for RES power plants planned by public enterprises is development of wind power by one of the five distribution companies, Elektro Primorska. Full separation between public services and market activities does not yet exist in Slovenia. Under separate accounts, distribution companies now perform both types of activities: the public service of operation of the distribution network and supply to household customers, and market activities of supply to eligible customers and production of electric power. The advantage of distribution companies over other developers is mulitple: firstly, as they are owned by the state, they have better access to the administrative offices, and second, they are still more or less under the regime of soft financial constraints within the broader family of power sector companies. An implicit cash-flow equalisation scheme is in operation among the distribution companies. The scheme is supervised by the responsible ministry.

Two wind power schemes under active consideration seem equally remote from realisation. The erection of up to 148 wind turbines on the Volovja reber ridge, developed by Elektro Primorska, is strongly opposed by environmentalists, while another development by an Austrian-Slovenian private capital company at Dolenje (Divača) is stalled, partly for lack of approval of the connection to the 110 kV grid by Elektro Primorska.

As discussed more in detail later, some small-scale RES power plants have been realised during the validity of the new support scheme. A strict and slow process of water use concession is in most cases stopping new developments. Other project seem to rely on special, individual additional support. Such was the case of the photovoltaic plants, and a biogas – agricultural digester plant. The only type of RES-E production that seems to be sufficiently supported by the existing FIT is that based on landfill or sewage gas.

B. Feed-in tariffs for QP

Feed-in tariffs for QP are defined by government decree and are defined as a sum of average electricity market price and a premium for QP as shown on Figure 1.

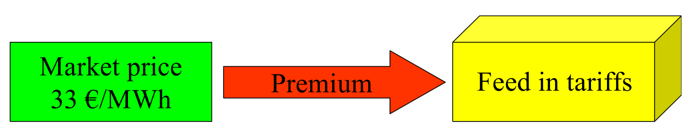


Fig.2. Structure of Slovenian Feed-in tariffs model.

Premiums were initially proposed to be based on the principle of levelling the playing field with conventional plants, by taking into account externalities of large-scale fossil power production and network issues [2]. Premiums now mostly reflects apparent needs for support of different renewable sources and technologies and unit size, as shown in Table 1. The difference between the market price and the

[2] Uredba o pogojih za pridobitev statusa kvalificiranega proizvajalca električne energije (Ur.l. RS, št. 29/2001, 99/2001

[3] Uredba o pravilih za določitev cen in za odkup električne energije od kvalificiranih proizvajalcev električne energije (Ur.l. RS, št. 25/2002) and Sklep o cenah in premijah za odkup električne energije od kvalificiranih proizvajalcev električne energije (Ur.l. RS, št. 8/2004)

feed-in tariff is covered by network charges (a "preferential dispatching" supplement fee defined by the Ministry). The charge is paid by all electricity customers. Network operators are obliged to conclude long-term (10 years) feed-in contracts with QP's. Price level or escalation is though not included in the contracts, as it is set by the government practically at its discretion.

The following main stipulations modify the feed-in prices:

- if a power plant is connected to the transmission network, the price or premium is reduced by 5%,
- for plants in operation for 5 or more years the price or premium is reduced by 5%, for plants in operation for 10 or more years the price or premium is reduced by 10%,
- if the QP has received a non-refundable subsidy from the state, the price is reduced by 5% for each 10% of investment cost, for which the plant has been subsidised.

For own sales of produced electricity, the QP is entitled to the premium, whereas for own consumption of electricity (without use of public network), the QP is entitled to only 30% of premium.

TABLE I
FEED-in TARIFFS FOR QP

Technology	**Unit size**	**Uniform price**	**Premium**
		EURc/kWh	*EURc/kWh*
Wind	<1 MWe	6,1	2,7
	>1MWe	5,9	2,5
Small hydro	<1 MWe	6,1	2,8
	<10 MWe	5,9	2,6
Biomass	<1 MWe	7,0	3,6
	>1 MWe	6,7	3,4
Geothermal		5,9	2,5
Land fill & sewage gas	<1 MWe	5,3	2,0
	<10 MWe	4,9	1,6
Bio gas (animal waste)		12,1	8,7
PV	<36 kWe	37,4	34,0
	>36 kWe	6,4	3,1

Note: Levels set by the government decision of March 2004.

A qualified producer can choose a uniform price, which is applied to all deliveries of electric power to the grid, or he can chose a time-of-day and seasonally variable price, the details of which are provided in the relevant Regulation [3].

For micro-power-plants (below 36 kW), the producer may opt to use the low-voltage supply tariff for households. Two-way counters are used and the subtraction principle applied.

The various feed-in-tariffs are being renewed, in principle, once per year. The government is obliged to consider the consumer prices index increase, and the expected prices of electricity on the market. Actually, prices were set for the first time in February 2002, and reviewed only once, in March 2004. For most types of plants, the economic position was not maintained, considering the inflation and other changes.

QP are not obliged to prepare schedules for network operator and are not paying balancing costs. All cost of network operator caused by QP operation are to be included in costs of the "preferential dispatch".

C. Minimum costs of network prices for use of electricity from QP

To stimulate the development of small QP (up to 1 MWe) and direct sales of electricity to small consumers, article 27 of EA among goals for methodology for calculating and defining the network charge, prescribed that only minimum costs for use of network should be charged to customers buying electricity from QP up to 1 MWe. By provision of article 87 even households consumers, which buy electricity from QP up to 1 MW are treated as eligible customers even before 1.7.2007. This stipulation is realised by a Decision on setting prices for the use of electric power network by the Agency for Energy (AGEN-RS). For power received from QP below 1 MW, the network charges are relieved of the following components:

- network charge for the use of transmission network (if customer and QP are connected on the same distribution network), and
- supplement for preferential dispatch

The relief represents around 14% of current average final price for households or around 9% for commercial customers and is an additional stimulations for development of green electricity market in Slovenia.

For lack of a good-will approach by distribution companies, this legal option for establishing local power sales is not in use.

D. Other Subsidies

Presently, investment subsidies are restricted and available only for biomass, biogas, heat pumps and off-grid PV installation offered on yearly tenders by Agency for Energy Efficiency and RES (AURE)[4].

AURE is also financing (up to 50%) feasibility studies and preparation of project documentation. Environmental Fund of the Republic of Slovenia (a public fund) is offering soft loans for RES and other energy efficiency and ecological projects.

E. Standards and Rules

Conditions and procedures for connection of QP to the distribution network are defined by:

- Decree on general conditions for the supply and

[4] By 1st May 2005 AURE has been cancelled, activities are now carried on by the Sector for the efficient and renewable energy use in frame of the Directorate for the EU affairs and investment of the Ministry for the environment and spatial planning.

consumption of electricity,

- Regulation on system rules for operation of electricity distribution network.

Network operators have also internal technical rules, which should be considered (sometimes with some individual interpretations and requests), which could make problems for QP.

F. Licensing Procedures

Beside ordinary spatial and administrative procedures necessary for acquisition of building permit, QP needs to carry out also procedures for acquisition:

- Status of QP (role to the Ministry of Economics)
- License for the generation of electricity for units above 1 MWe, issued by Regulatory Authority (Energy Agency of the Republic of Slovenia).

III. Green electricity market and green certificates

Producers and/or suppliers attempt to obtain additional support for renewable power directly from final customers on a voluntary basis. An alternative is obligatory share of RES-E. No obligation for a share of RES-E exists in Slovenia, as the decision was to use the feed-in-tariff as the main support instrument and not any quota system, though legal basis for the later also exists in the Energy Act.

Three brands of green electricity are promoted: "Modra energija" ("Blue energy", Holding Slovenske Elektrarne, HSE), and two brands of "Zelena energija" (Green energy), one promoted by Elektro Ljubljana, and another by EkoWatt, a supply company created by owners of small hydro power plants. HSE is targeting primarily corporate customers, Elektro Ljubljana "Green energy" is focused only on household customers. EkoWatt is also targeting small eligible customers and is offering a competitive price[5].

EkoWatt had some problems in negotiating a balancing regime. Up to 2005 only one balancing group existed in Slovenia, that of HSE under which umbrella also the distribution companies are supplying power. The argument between distribution companies and EkoWatt revolved around the terms of supply for the un-balanced power provided by small hydro power plants. Partial resolution of the conflict allowed EkoWatt to conclude some supply contracts.

Largest volumes of certified RES-E power are sold by HSE. They have enlisted some 860 customers.

A. Certification

Dependable certification of origin is essential for functioning of any market for green electricity. The RECS certification system is in operation, with Agency for Energy as the designated certifier.

According to the actual EU electricity market directive (2003/54/EC), a more general "guarantee of origin" scheme will have to be established. It is expected that the two approaches will be harmonised in the near future.

IV. "Best" practicies

Although there was no big "boom" of new RES capacities after the reform of feed-in tariffs, in general it appears that the existing supporting scheme is adequate and offers reasonable investment condition for most RES technologies. Indeed, an adequate rate of return for new investment for different RES technologies was the main criteria for the calculation of the feed-in tariffs. Substantially higher FITs is likely to exceed the country's limited financial resources and may be a too high price paid for the beneficial effects expected from RES-E. Industrial interest is in some cases the driving force behind favourable conditions for RES-E. In the case of Slovenia, excessive benefits for e.g. wind power or PV actually mean that industry in other countires is supported.

The FIT should though be adjusted so that the rate of return for RES technologies reflects relatively high project risks, administrative costs, and general uncertainty. Improving the administrative and planning procedures will also contribute to more expedient development of RES-E.

Recent developments and outlooks in Slovenia are outlined in next subchapters.

A. Landfill gas – realistic market potential

Landfill gas utilisation in internal combustion motors is the technology with the biggest development in recent years: Five new units (internal combustion engines, total capacity 3.6 MWe) have been installed at landfills in Ljubljana, Maribor and Celje. Large economical potential still exist on these and thers landfills with possible profits even without stimulative FIT.

B. Bio gas (digestor) CHP plants - need additional investment subsidies

Three projects (internal combustion engines, total capacity 0.5 MWe) have been recently finished, two on bigger pig farms, one on a smaller private cattle farm Letuš.

Letuš farm installation of 2 gas engines (each 60 kWe capacity) is fuelled by biogas from two manure fermenters[6]. An important side effect of these installations is significant reduction of local pollution by bad odours, decrease of water and soil pollution and reduction of methane (GHG) emissions. Quality fertilizer is a secondary product of fermentation.

With substantial financial subsidy of AURE (32% of total 340.000 EUR investment costs) implemented bio gas plant on Farm Letuš had big demonstration effect. Several new projects are announced.

[5] As small eligible customers are paying the highest electricity market prices, the green electricity from small hydro power plants is getting competitive and cheaper for the consumers but switching to small suppliers is rear and not yet wide accepted by the consumers (risk).

[6] Bigger share of produced electricity is sold to the grid at set FIT One third of the produced heat is used for fomenters heating whereas residual heat is used for heating of near houses in winter and for hay drying in summer.

V. Challenge for the Future

A. Wood biomass

Substantial quantities of wood biomass in Slovenia should make it a promising source for RES-E. In reality, the trend is stagnating or even decreasing, due to decommissioning of some industrial CHP plants.

Except one new biomass CHP plant (600 kWe steam engine) for the district heating system in Železniki, no new projects has been realised. Several old industrial CHP plants operate in the paper & pulp and wood industries. Lack of new projects was due primarily to business problems of the wood-working industries, and also due to relatively low price of electricity from the grid.

Nevertheless, small wood biomass CHP should be considered as a major potential for RES-E. Attention is required both to technology development (including major innovations such as efficient small Stirling engines), and to institutional and project economics issues.

Co-firing in large thermal power plants is proposed as one of the methods for decreasing emissions of normative GHG content and increase of the RES-E share. This option is considered by the management of Termoelektrarna-Toplarna Ljubljana (TE-TOL) and may well be pursued in the near future. An opposing consideration is low overall efficiency of the old, pre-1970 vintage equipment of that CHP plant. Total efficiency of the plant (electricity + heat) is around 75%. Alternatively, any available biomass can be burned in modern specialised heat-only boilers with efficiency around 90%. The challenge of co-firing is one of achieving efficiency of RES use at par with the much simpler, decentralised devices, such as log, chip or pellet boilers.[7]

It is not yet proved weather large scale biomass utilisation could be a threat for the biomass market in Slovenia that is still not well established. High demand from a few large plants, themselves enjoying various subsidies, can be detrimental to the development of small scale applications and wood manufacturing industry (e.g. wood-chip panel production)..

B. Solar PV plants:

In spite of still high investment cost (also compared to some other EU countries) and FIT not offering fast return of investment (>10 years), several PV plants have been installed recently[8].

Obviously, PV plants capture a niche of small off-grid systems and installations with demonstration value. Increase of FIT will not contribute much to the expected steady flow of similar projects.

C. Other RES technologies

Development of other RES technologies was rather limited:

- Small hydro power plants: limited number of new units have been installed with some refurbishment of existing plants. In view of the still remaining substantial technical and even economic potential, the situation warrants analysis of mechanisms for overcoming of these barriers.
- Wind plants: except 5 very small private installation with total capacity 14 kWe (alpine huts) no major investment has been realised although strong interest exists. Developers have encountered hurdles either from environmental interests or from competing commercial interests of the distribution companies.

VI. Lessons Learned

Experience of Slovenia in regulatory framework to support RES penetration could be summarised:

- Recent development of new RES-E capacity was small and slow, far from ambitious plans and targets.
- As RES-E can have unacceptable environmental effects, its support could not be automatic. Only well prepared, equally feasible environmental and economical project should be supported.
- Environmental impacts of RES utilisation are an important aspect that should take more important place in phase of planning and implementation to avoid conflicts and project opposition (case of large wind farms in Slovenia).
- Besides consistent and quality project preparations by investors, prompt and consistent project proceedings by the government, further attention should be paid also to increase of public awareness and communication.
- FIT are rather efficient and adequate, but for faster RES-E development, it is necessary to recalculate the tariffs for ppropriate inclusion of transaction costs, costs of financing or risk-premium. In the case of biomass development a premium on heat generated from RES should be considered[9].
- To stimulate the green electricity market some additional regulation for energy balancing should be issued to avoid current conflicts between QP, network system operators and independent electricity suppliers.
- As RES projects have multidimensional effects on the energy sector, environment, agriculture, etc., supporting schemes should be combined and included not only in the energy policy (bio gas, biomass, etc.) but also in other policies.

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[7] Considering the national energy system, any light fuel oil saved by efficient wood-biomass boilers can be used in CHP plants with efficiency also at a the 90% level.

[8] 1,1 kW PV plant in Ljubljana as a first plant with on-grid connection (1000h/year)

- Several PV installations in mountains huts without el. network connection (52 kW)
- Nanos farm demonstration 4,5 kW PV plant (not connected to the grid)
- Holiday houses PV installations (~25 kW)
- 5 kW PV plant on Technical university of Maribor (educational and demonstration effects)
- Most recent and the biggest: 16,5 kW PV installation on aircraft hangar in Bled airport

[9] This premium should be considered in view of reduced import dependence, and reduction of GHG emissions.

• There is a need for improving and simplifying administrative and spatial planning procedures.

VII. Main barriers to the development of RES

The main barriers to the development of RES in Slovenia are not different from those in other countries:

• Insufficient FIT for some technologies (biomass, PV, micro installations, etc) and lack of timely review of FIT tariffs as economic conditions change.

• Consistent and transparent spatial planning, with clear definition of potential investment area (exclusion of national parks, intact areas) to avoid conflicts of interests and speed up procedures.

• Low electricity prices: especially households prices are under-rated at the moment, uncertain market conditions in other sector not stimulating investments in electricity production. Even the minimal energy tax agreed on in the EU has been derogated until 2007.

• Complex and time consuming procedures.

• Not enough flexible financing instruments.

• Bad project preparation, big environmental effects and low whole economy effects of RES projects that could result in big damage for other RES projects...

VIII. Conclusions

The share of RES-E in Slovenia, now at the favourable 30% level, will be difficult to maintain with the instruments presently in operation. The feed-in-tariff is in principle an adequate instrument, but should be maintained as a reliable, risk-reducing stimulation for the investors in RES-E. Considering the expected exit of the state from power market activities, such as electricity production, the state-owned power companies should not be considered as the preferential, less the only developers of RES-E. This is particularly true when small- and medium scale projects are at stake.

Experience gained to date offers good guidance for the future. Among diverse RES-E options, wind power offers limited potential in Slovenia. In the long run, the largest resources, that of wood biomass and even hydro power, will most probably still play the dominant role. The development of these traditional energy resources presents a real challenge in the modern world of high environmental standards, profitability requirements and energy markets. The challenge can be met by dedicated efforts for research and development, and continuous and balanced institutional and legal improvements.

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X. Biographies

Stane Merše was born in Ljubljana, Slovenia in 1971. He received his Diploma Engineer and MSc degree in electrical engineering at the University of Ljubljana. At present he is associate at Institut Jozef Stefan, Energy Efficiency Centre. His main research interest is in position of qualified producers and consumers in deregulated power systems, integrated resource planning and greenhouse gases mitigation activities. Recently he has contributed to the professional support for preparation of the National programme for reduction of greenhouse gas emissions, and involved in other projects supporting national decisions, such as the support for renewable energy sources, and managed the integrated resource planning research for the development the National energy programme.

Mihael Gabrijel Tomšič born in 1941 was trained as a mechanical engineer at the University of Ljubljana, Slovenia. He also holds a Master of Science degree in nuclear engineering from the Kansas State University, and a Doctor of Science degree from University of Ljubljana. In the first part of his professional career he was mostly engaged with safety aspects of nuclear power plants. Later, Dr. Tomšič and his team at Jozef Stefan Institute pioneered energy management systems in industry with numerous applications in Slovenia and Yugoslavia. Dr. Tomšič has been teaching at the Faculty of Mechanical Engineering energy systems, automatic control of energy systems and system modelling. Second part of the professional career of Dr. Tomšič is centred at energy systems modelling, system planning ("Integrated Resource Planning") with extensions to economic evaluation, utility pricing and tariffs. In the first government of independent Slovenia (1990-92) he has served as the Minister of Energy. Recently he has led the preparation of the National programme for reduction of greenhouse gas emissions, and was involved in other projects supporting national decisions, such as the support for renewable energy sources, and the National energy programme. Dr. Tomšič is the founding president of the Slovenian E-forum, a professional society for energy economics and environment. He is also a member of the parliamentary Council for the Protection of Environment of the Republic of Slovenia, and a member of the Council for Energy of the Slovenian Academy of Sciences.

E-CONTROL

Current Experience with Renewable Support Schemes in Europe

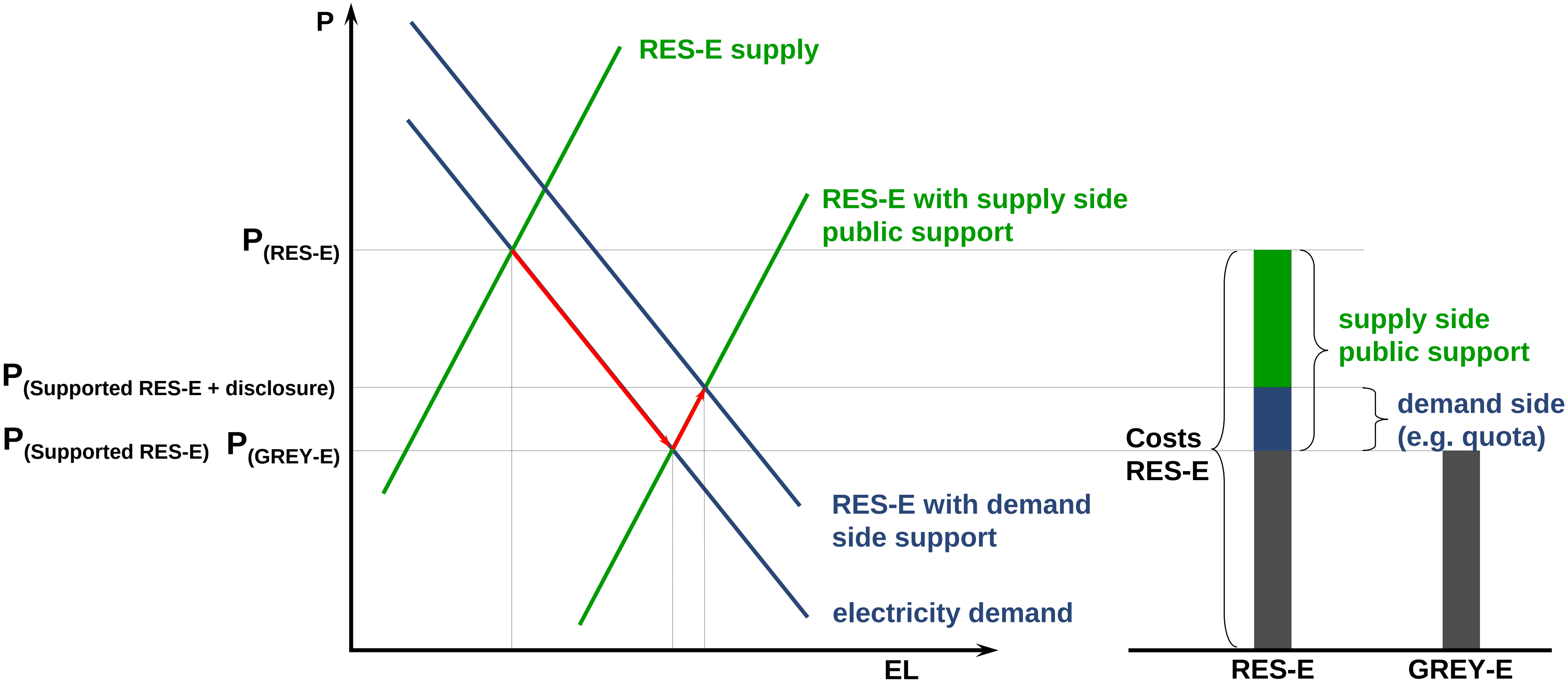
Dietmar PREINSTORFER, E-Control, Austria

Balkan Power Conference – Sofia, 16 September 2005

Advantages of RES_E

- The EU set down indicative targets for the production of electricity from renewable energy sources for all Member States, assuming the following advantages
  - environmental protection,
  - sustainable development,
  - increase in local employment,
  - positive impact on social cohesion,
  - contribution to security of supply and
  - meeting the Kyoto targets more quickly.

RES-E market needs to be supported



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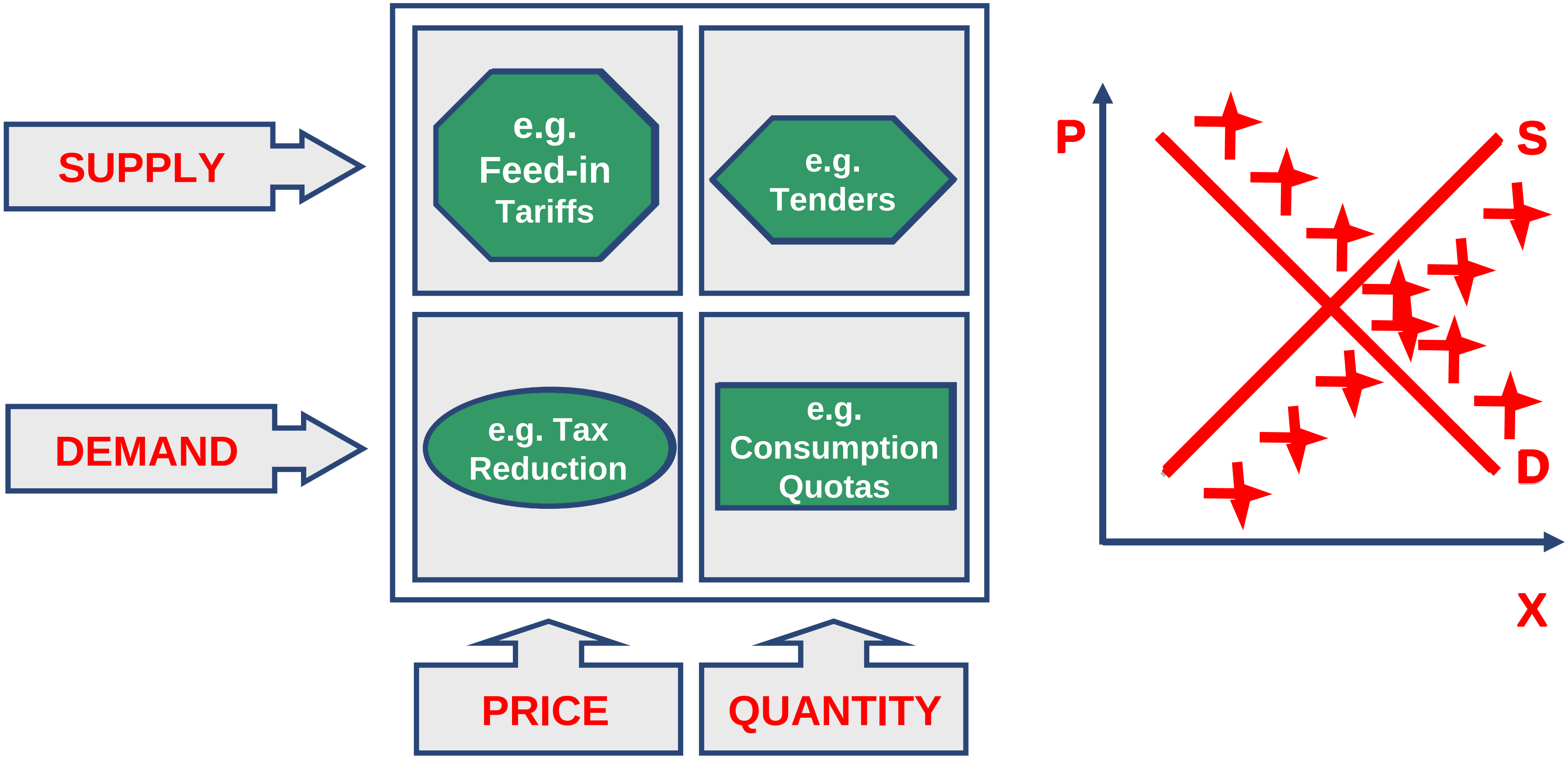
RES-E Support Systems



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The two major support systems

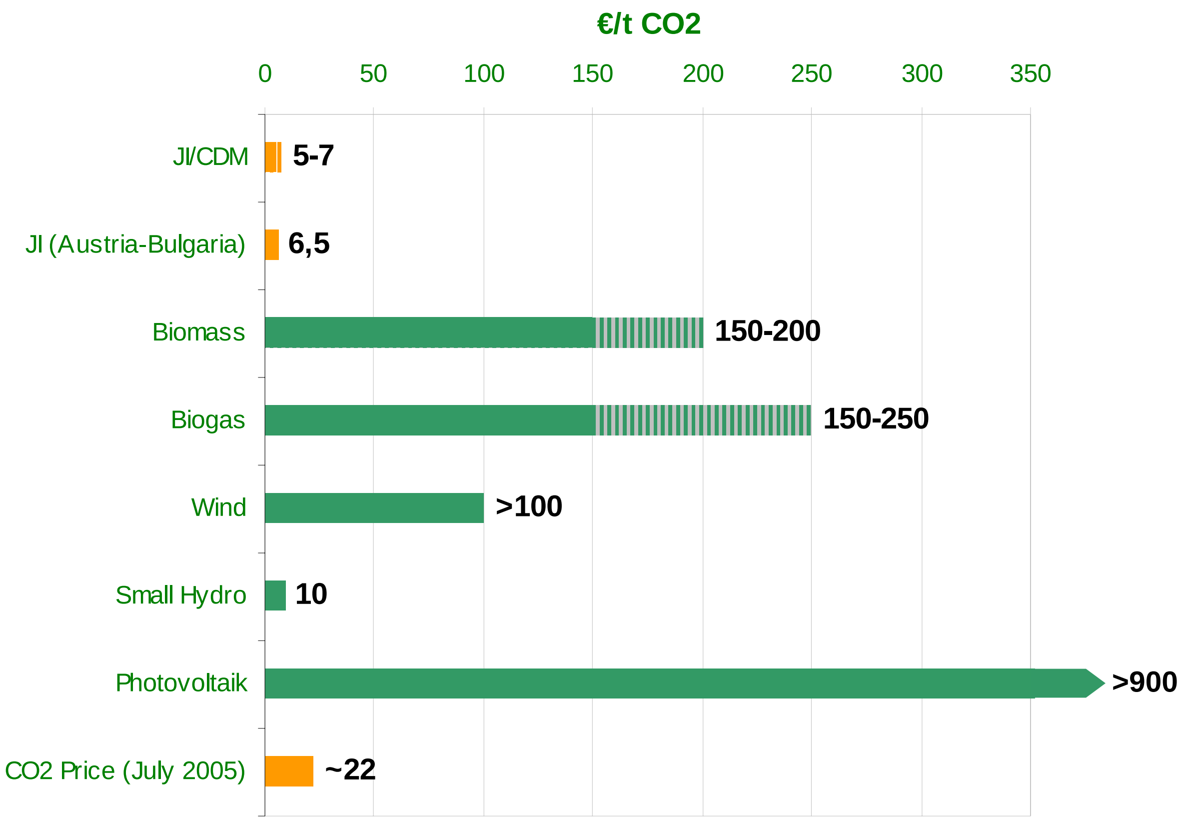
- Certificate system makes national and international trading possible, supports renewable energy production at the best and most productive sites

For mature markets

- Feed in tariffs, if fixed for a minimum period of at least the first 10-15 years of operation period, give interested investors a high economic security.

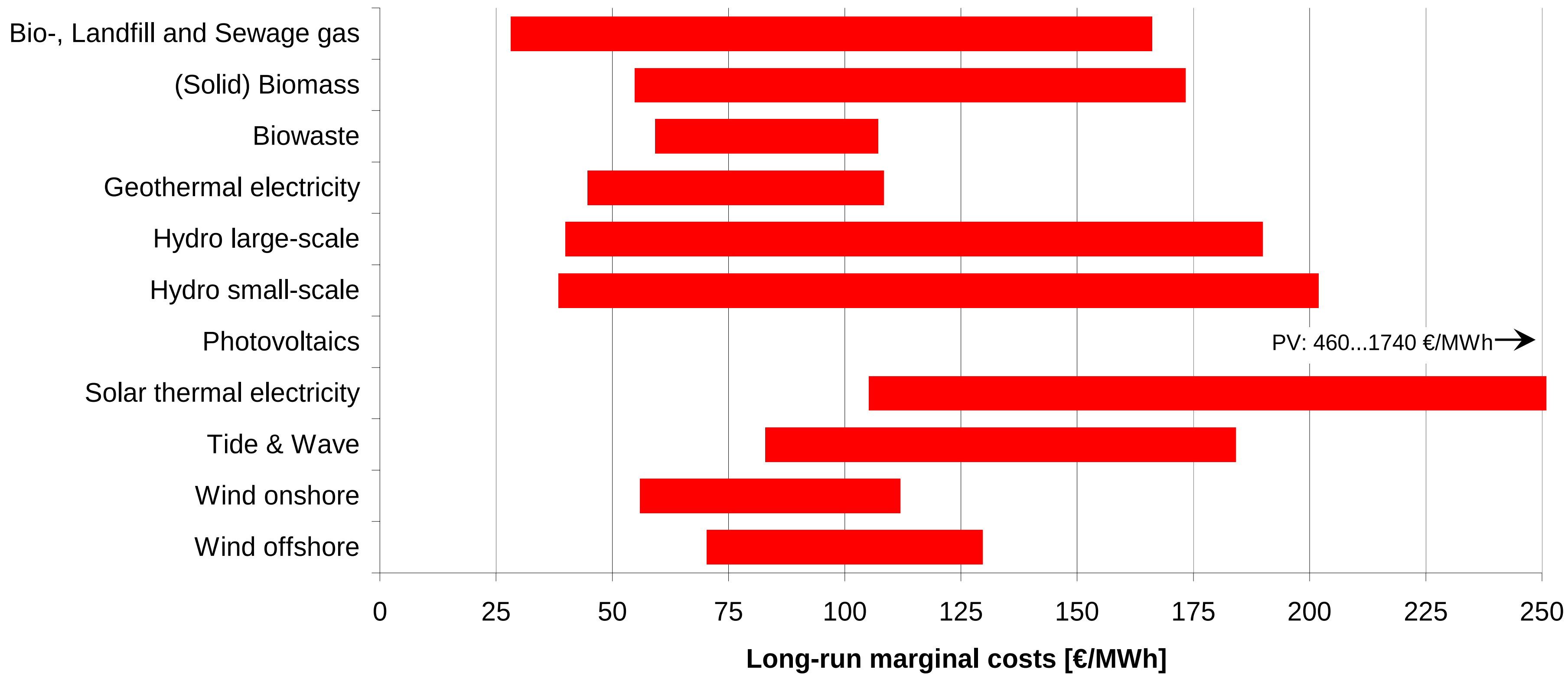
For emerging markets

CO_2 Reduction Costs – Flexible Mechanisms vs. RES_E in Austria



Source: E-Control

Different Costs of RES-E in EU-15 (2003)



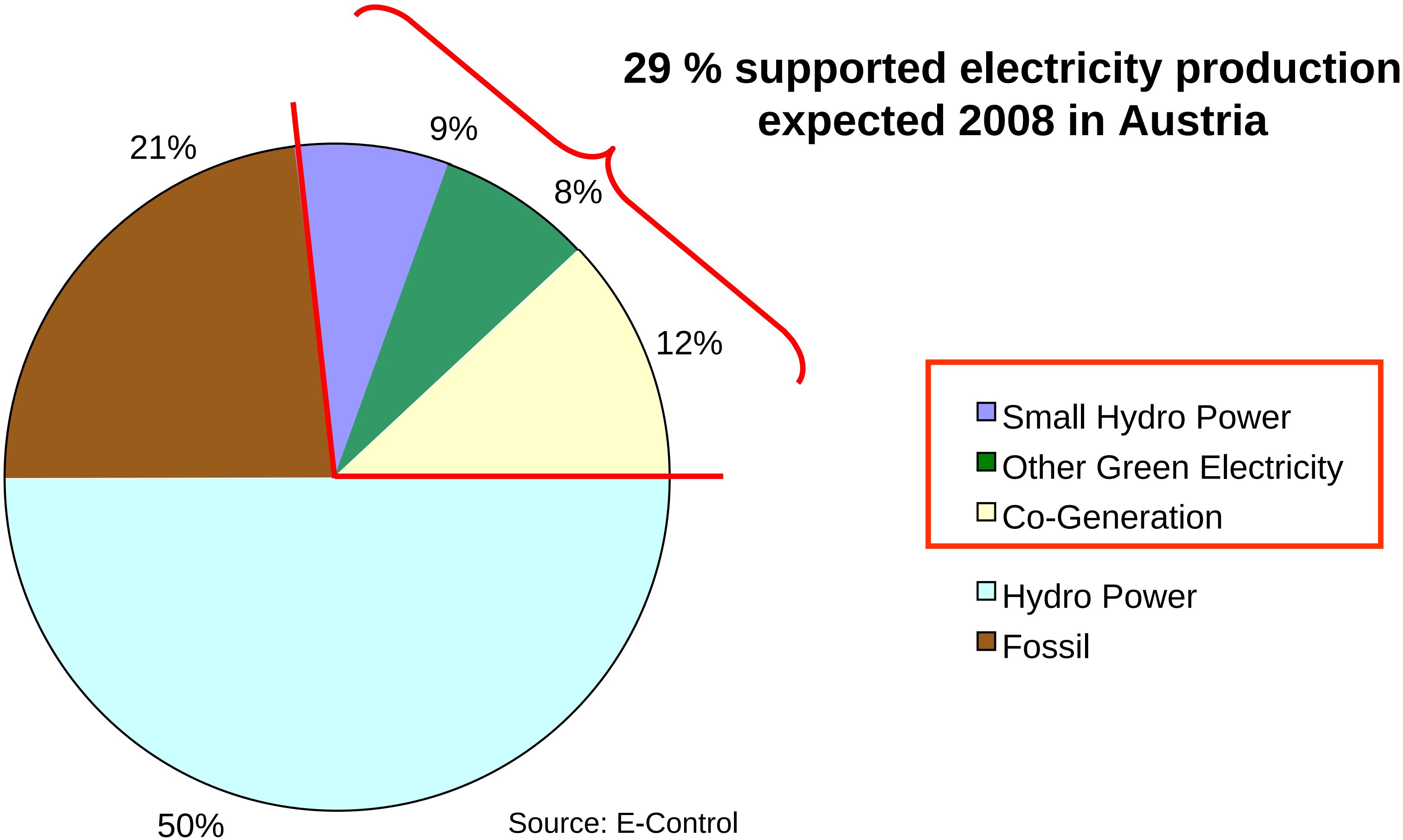
Source: CEER – Current Experience with Renewable Energy Support Schemes in Europe

Subsidies create potential market distortions

- Economic theory states that subsidies in general have the potential to distort the market.

1. Additional costs are allocated differently to end consumers from one country to the other.
2. Different support levels create undue competitive advantages for some market participants.
3. Guaranteed support levels often lead to artificially high production costs, because power equipment producers align their prices to the support level.

Supported Electricity in Austria



Source: E-Control

Support systems need to be harmonized!!!

- Green electricity support in Europe effects market distortions and cost-ineffectiveness
- Main problem: **no harmonised support system**
- A harmonised support system should fulfil the following standards:
  - reflecting the existing potentials of different energy sources within Europe,
  - enhancing competition between generators,
  - encouraging renewable electricity suppliers to improve operation performance and technological efficiency,
  - offering objective information to end consumers,
  - including additional costs and making them transparent and
  - introducing market based mechanisms.

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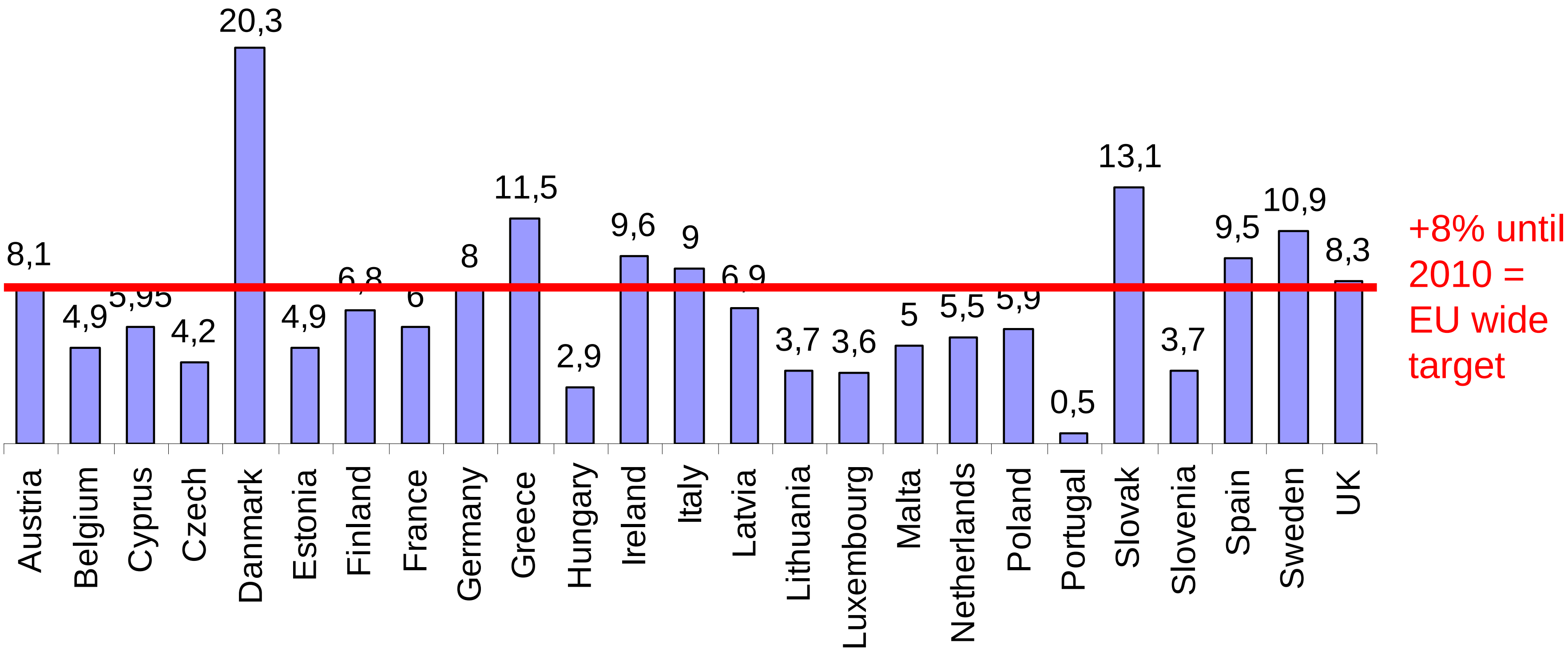
Indicative targets of the RES_E Directive

Different indicative targets lead to an unbalanced burden sharing within the different Member States and the targets are designed as a production target but meant as a consumption target = **distortion + confusion**.



Increase of RES-E production from 1997 to 2010 in %

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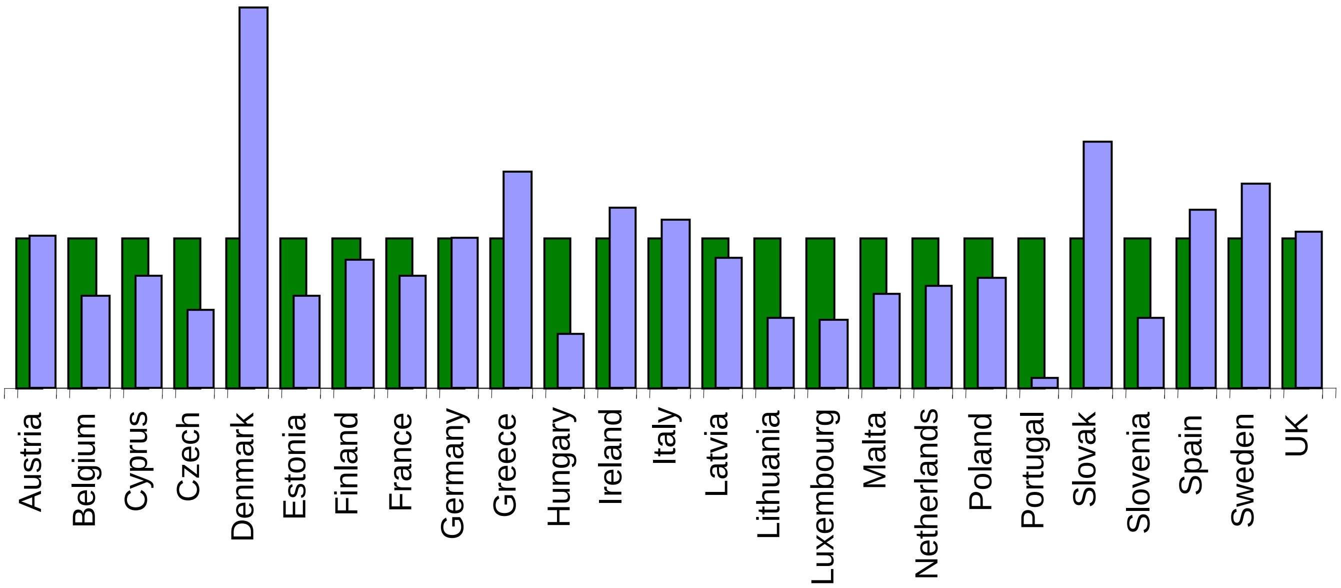
Possible solution: Pan-European certificate system

Change from different national to an overall target

Every end consumer within the geographical scope of the Internal Electricity Market has the same additional obligatory target

Penalties need to be equal

Penalties have to be paid into one single fund



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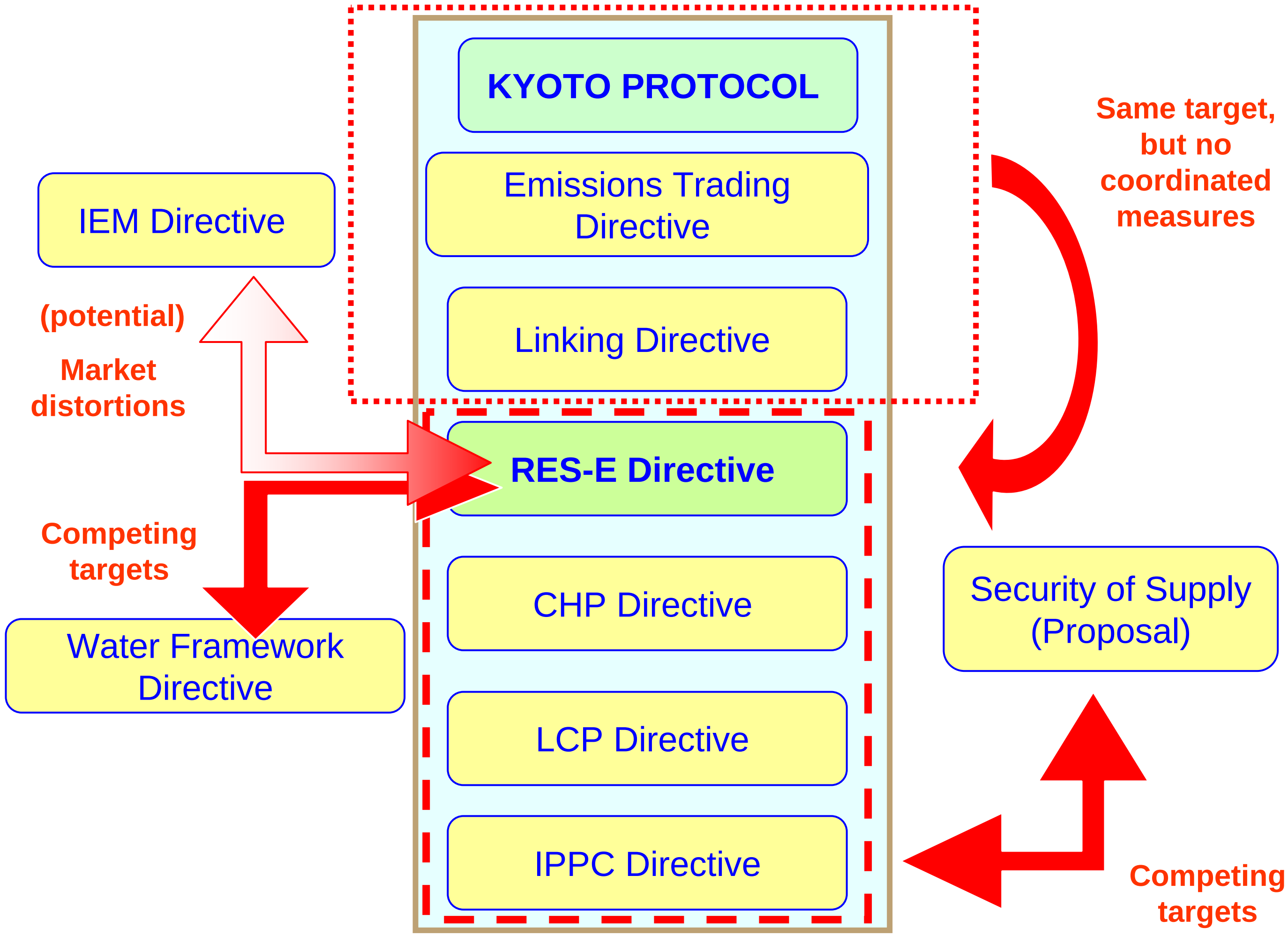
Conflicts between targets of different EU Directives



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Thank you for attention

Dietmar Preinstorfer
Energie-Control GmbH

Rudolfsplatz 13a, 1010 Vienna
dietmar.preinstorfer@e-control.at

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Strategy and Regulation for Renewable Energy Sources (RES) in the Republic of Croatia

Željko Tomšić, Ph. D., Igor Raguzin
Ministry of Economy, Labour and Entrepreneurship
Directorate for Energy and Mining
zeljko.tomsic@mingorp.hr, igor.raguzin@mingorp.hr

***Abstract* - The energy sector reform in the Republic of Croatia, which comprises restructuring, privatisation and changes in the overall energy sector, has a significant effect on the possibilities of introducing and increasing the share of renewable energy sources (RES).**

The paper describes the energy strategy, legal and institutional system and the role of economic instruments for the segmented RES market within the energy market as a whole. The Electricity Market Act sets out the legal obligation to purchase electricity produced from RES in the manner that a quota or a minimum obligatory share of RES in electricity production is determined by a special Government ordinance.

Consequently, on the one hand, incentive funds as strong economic instrument needed to cover increased costs of production from individual RESs will be collected from customers through the supplier and distributed to privileged producers (feed-in tariffs, purchase is guaranteed to RES producers on known terms) through the Market Operator (MO). On the other hand, RES investment projects will be encouraged by other economic instruments: purpose-specific government subsidy (state aid) and by the Environmental Protection and Energy Efficiency Fund (EPEEF - out of public budget).

RES for thermal use will be governed by regulations on district heating/combined heat and power systems. Besides the above-mentioned Fund, certain incentives are placed under the authority of local or regional government pursuant to the RES and cogeneration Use Rules and Tariff system for electricity generation from RES and cogeneration.

By applying new energy legislation and associated by-laws (coming into force in 2006), RES projects in Croatia will be provided with a complete and stable legal framework as well as support through incentive measures which will equitably value environmental, social and other benefits of RES use.

I. INTRODUCTION

ALL European Union countries have committed themselves to changing the relations in the energy sector based on the common rules prescribed in the EU directives relating to the liberalisation of the electricity and gas markets. As part of its European integration process, Croatia has, through its legal and institutional framework, harmonised the overall concept of the energy sector reform with the EU requirements, within its specific national circumstances. The Directive on the promotion of electricity produced from RES in the internal electricity market (2001/77/EC) lays down the national indicative targets are consistent with the global indicative target of 12 % of gross national energy consumption by 2010 and in particular with the 22,1 % indicative share of electricity produced from RES in total Community electricity consumption by 2010.

A precondition for the achievement of energy policy objectives, which are set in the Program of the Government of the Republic of Croatia, is the restructuring of state-owned energy companies and an expedited creation of organisational, economic and legislative conditions for the privatisation which is to take place in the coming years. The Croatian Parliament, at its session held on 19 July 2001, adopted a new legislative framework which governs the relations in the energy sector (Official Gazette 68/01): Energy Act, Electricity Market Act, Oil and Oil Products Market Act, Gas Market Act and Energy Activities Regulation Act. The Energy Act was passed in 2001 and is currently being amended; this amended act was passed Parliament end of 2004. In addition, the Law on Regulation of Energy Activities and Electricity Market Act are being substantially amended. A principal reason for amending the laws is to incorporate EU directives and instructions.

The role of the energy market is growing increasingly bigger since the energy industry is a key segment of an economy. Privatisation is a process that should enable market and competition to be formed, and the market should be both a measure and a mechanism of balance between the market relations and government intervention taking into account all relevant economic, technological and social factors of energy use.

It is precisely the strengthening of the private sector in Croatia in as far as it relates to the strengthening of the energy market that will have an important role in the implementation of energy efficiency and RES use programs. The energy sector reform will enable businesses and/or private initiative in the specific RES area to compete for construction of power production facilities (wind power plants, industrial power plants using biomass, biological waste treatment plants, small hydro power plants, solar power and heating plants, geothermal plants, etc.), fitting of installations, procurement of equipment and materials, manufacture of equipment and devices for the use of RES, and the like.

Energy policy and environmental policy decision-makers in Croatia have recognised the importance of economic instruments, primarily as means to prevent and reduce environmental pollution and use natural resources on a sustainable basis. Starting from their multiple advantages, these instruments are given an important place within the priority economic measures in the strategic and development documents (Energy Sector Development Strategy of the Republic of Croatia, National Environmental Action Plan, etc.). The emphasis is placed on systematic development and gradual introduction of new economic instruments (pollution charge, deposit and refund system, etc.) while at the same time changing the existing system of public revenues and expenses (taxes, customs duties, subsidies).

II.OBJECTIVES OF CROATIAN ENERGY POLICY AND RENEWABLE ENERGY POLICY

The Ministry of Economy, Labour and Entrepreneurship (MoELE) is in charge of the energy sector and as such responsible for formulating energy policy and strategy and drafting energy sector legislation.

The main objectives of the overall energy policy of Croatia are stated in the Energy Sector Development Strategy, which was adopted by the Sabor (Croatian Parliament) in March 2002 for the period of 10 years. These objectives are:

- increased energy efficiency,
- security of energy supply,
- diversification of energy and sources,
- utilization of renewable energy sources,
- realistic and market-related energy prices and development of energy market and entrepreneurship
- environmental protection.

Thus, the use of RES is recognized by the Croatian Energy Strategy as a constituent part of the energy policy. In view of Croatia's accession to the European Union and the gradual integration of Croatian energy systems into European energy markets, the importance of ensuring the implementation of the renewable energy acquis into Croatian legislation is recognized. Nevertheless, the necessary secondary legislation which should enable the development of this sector is still pending.

The newly established EPEEF has become operational in a relatively short time period.

Concerning the legal terms, the Electricity Market Act (Article 8 of the Act updated in December 2004) defines the status of eligible producers and the obligation to buy electricity produced from RES, while the quota or a minimum obligatory share of RES in electricity production will be determined by a special Government decision. This decision's draft proposes the minimum share amounting to 900 GWh of the total consumption (4,5 %) by 2010, excluding hydroelectric plants exceeding 10 MWe.

III.OVERVIEW ON THE POWER SECTOR

From the aspect of providing a long-term security of energy supply it will be necessary to utilize limited energy resources in the manner that ensures the highest value for Croatia's economy, which makes it absolutely imperative to implement efficiently the policy of a more intensive utilization of RES.

The Croatian electricity sector is dominated by the national utility, Hrvatska Elektropriveda (HEP). HEP is the only electricity generating company in the country, despite the allowance of independent or private power. HEP is also the transmission and distribution company, operating approximately 22 local distribution areas. In 2002, HEP's generation was comprised primarily of hydroelectric (46%) and thermal power plants (33%), with imported electricity covering the remainder. Total capacity installed in the country is approximately 3,800 MW.

The installed electricity generation capacity is mainly hydro (2 076 MW) and thermal (1 729 MW), with almost 58% of the electricity produced from hydro and 42% from thermal power plants (2003). The Croatian energy company HEP owns also 50% of the 632 MW Krško nuclear power plant which is located in Slovenia, and owns, respectively has special supply arrangements to receive electricity from coal-fired thermal power plants on the territories of Bosnia and Herzegovina and Serbia, with a total capacity of 650 MW. There are plans to add new power plants (mainly natural gas and coal-fired and hydroelectric) during the coming years, which will probably be independent or joint-venture generation projects. The thermal power plant Plomin 2 is a joint venture between HEP and RWE. While the Croatian electricity system is still a winter peak system, increased use of air-conditioning e.g. in the tourist sector could result in an additional peak in summer.

In general, the Croatian energy networks fulfil an important role in the transit of oil, gas and electricity.

IV. ENERGY SECTOR DEVELOPMENT STRATEGY AND THE ROLE OF RES IN CROATIA

The strategic objectives of the Government of Croatia relating to the energy sector are to achieve post-war reconstruction and to ensure security of energy supply through:

1. Efficient energy supply in the environmentally sustainable manner at realistic and socially acceptable prices;
2. Demonopolisation and liberalisation of energy markets;
3. Enabling competition in energy markets through privatisation where possible;
4. Establishment of a legal framework; and
5. Existence of measures in case the market is not functioning, and existence of institutions for the promotion of energy efficiency and RES and for the environmental protection.

About a half of Croatia's energy needs are satisfied from domestic production (mainly oil and gas). However, production has been falling and energy imports will have to be significantly increased if the economic recovery is to be supported. Croatia will have to pay a full price in the international market for these imports, which may, coupled with significant investments in the reconstruction and expansion of energy infrastructure, present a considerable financial burden on the Government. This burden may be reduced if institutional and legal framework is created which will attract private finance in the sector. In addition, it will be necessary to use the scarce resources in a manner which ensures the greatest value for the Croatian economy.

The restructuring of the energy sector, including the electricity sector, has been carried out. Hrvatska Elektroprivreda (HEP, the national electricity company) has been unbundled into separate generation, transmission and distribution companies.

Resolving of the problem of the financial support and/or compensation for RES incremental costs will enable the system and market operator (through the tariff system generally) to have distribution companies compensated for the difference between RES costs and other incremental costs (avoided costs of production, environmental externalities, etc.) and to pass this difference on to customers, or to compensate it by applying certain economic instruments.

In Croatia, an organised and systematic care for RES began on the basis of National Energy Programs, initiated in 1997 by the Government. The programs that are especially important for RES are:

BIOEN - program for the use of energy from biomass and waste,
SUNEN - program for the use of solar energy,
ENWIND - program for the use of wind energy,
GEOEN - program for the use of geothermal energy,
MAHE - program for construction of small hydropower plants.

The objectives and implementation strategy for any renewable source depend on the specific characteristics of a particular renewable source and/or on the use program. However, what is common for all of them is a significant increase in the share of renewable sources by 2030, which is in line with the general trend in EU countries.

TABLE 1: CROATIA - ENERGY PRODUCTION AND FORECASTS (IN THOUSANDS OF TONS OF OIL EQUIVALENT)

	Statistics			Forecasts		
Year	1990	1995	2000	2005	2010	2020
Primary energy production	5482.4	4364.4	3834.3	3483.3	3494.1	3244.5
Solid fuels	100.6	46.8	0.0	0.0	0.0	0.0
Crude oil	2718.7	1757.3	1448.9	961.7	638.4	500.0
Natural gas	1799.2	1784.7	1505.3	1593.7	1687.3	902.3
Nuclear energy	0.0	0.0	0.0	0.0	0.0	0.0
Hydro power and wind energy	322.3	452.7	506.6	549.3	597.2	709.3
Geotherma l energy	0.0	0.0	0.0	0.0	41.6	114.2
Other renewable sources	541.7	322.9	373.5	378.5	529.7	1018.7

Source: Energy in Croatia, MoELE

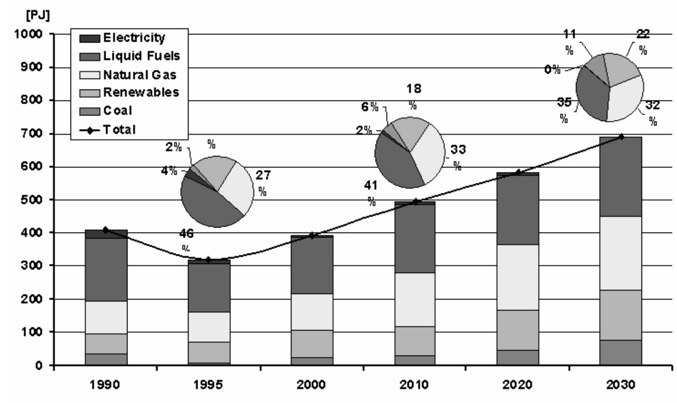


Fig. 1. Total primary energy supply 1990 – 2030.

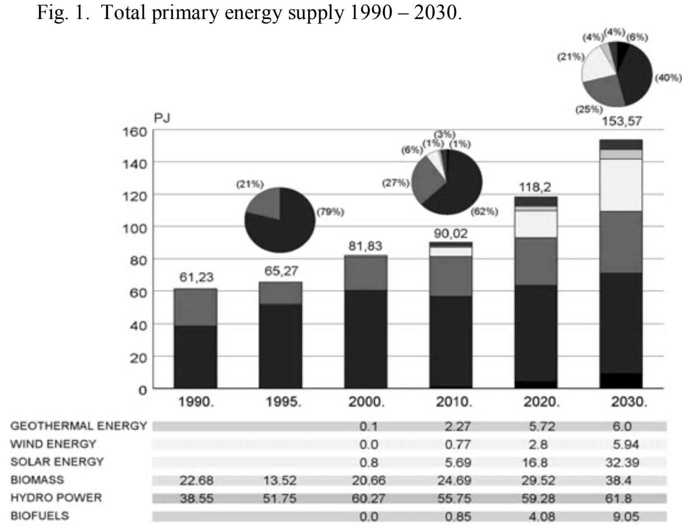


Fig. 2. Structure of renewable energy resources.

V. RENEWABLE ENERGY SOURCES IN THE ENERGY SECTOR REFORM AND NEW LEGISLATION

The adoption of the new legal framework within the Croatian energy sector reform is of vital importance for the further development and future of RES use. Energy Act, as the fundamental law, defines a number of laws and by-laws which regulate the use, rights and obligations, incentive measures, and the organisation and institutions involved in the implementation of RES.

There is a wide range of potential objectives for increasing the share of renewable sources of electricity in the overall generation mix in Croatia. These include the desire to:

- limit global warming caused by the emissions of carbon dioxide;
- reduce the negative impact on the health of the population living near conventional sources of electricity generation caused by local air pollution;
- increase in rural incomes through new employment and new infrastructure that accompanies renewable projects which are often located in rural areas;

- increase in security of supply by diversifying sources of electricity and reducing dependence on imports; and
- meet international legal obligations that will result in other desirable outcomes (e.g. accession to the European Union).

Depending on a particular objective, or relative importance of different objectives, both the efficient minimum share and the mechanism used to implement the policy are likely to be different.

The Electricity Market Act represents a crucial change in the legal treatment of RES, since it sets out the legal obligation to purchase electricity produced from RES. The quota itself, or the obligatory minimum share of RES, is specified only for the energy entity that performs electricity supply as a public service. This means that the minim share obligation will disappear as the market opens, so functioning of the intended incentive mechanism, according to which all customers would bear the costs of the minimum share, asks that the minimum share obligation be extended to include all energy suppliers, or all rather than only tariff customers. It is also necessary to ensure financial guarantees for Market operator (MO) to enable it to ensure the purchase of total electricity produced by privileged producers.

The issue of RES use for production of heat energy will be resolved through regulations on district heating/combined heat and power systems. In addition to the Environmental Protection and Energy Efficiency Fund, which will promote projects on the investment side, certain incentives will be ensured by the application of the RES Use Rules. Further, The Rules on the Granting of the Status of Privileged Producer define the types of privileged electricity producers, minimum requirements to be met by the energy entity, and the procedure for the granting of the status of a privileged producer. The Ordinance on the RES Minimum Share, in respect of a RES share used by an energy entity that performs electricity supply activity as a public service, defines the incentive for the use of RES for the prescribed minimum share of RES as an addition to the fees payable for the use of transmission and distribution network. It is anticipated that the incentive collection and distribution mechanism will be managed by MO pursuant to the provisions of the RES Use Rules.

At the beginning of 2005, the Market Operator (MO) and the Transmission System Operator (TSO) were established as successor institutions of the Croatian Independent System and Market Operator. The MO was fully separated from HEP, while the TSO stays under HEP's umbrella.

The Electricity Market Act (2004) defines the MO as the "energy undertaking performing the activity of electricity market organization". It will have the central role in managing the mechanism for collecting and distributing incentives. The funds for achieving minimum share of RES will be collected through additional costs in electricity bills of all consumers (buyers of electricity) and used for promoting production of electricity from RES. The funds will be collected by the MO from the suppliers of both, tariff and eligible customers, through the so-called charge for incentivizing RES and cogeneration.

The MO is – among other duties - responsible for the following: recording all contract obligations among energy undertakings active in the energy market, keeping records of eligible customers on the market until full electricity market opening, keeping a register of eligible producers, entering into contracts with all suppliers to comply with the decree on the minimum share of electricity produced from renewable energy sources and cogeneration, collecting funds from the charge for incentivizing renewable energy sources and cogeneration from the suppliers, entering into contract with eligible producers entitled to incentive price, to ensure they are able to exercise that right, settlement, collection and allocation of funds from the charge for incentivizing renewable energy sources and cogeneration onto producers of electricity from RES and cogeneration based on the contracts entered into, analyzing market operation and proposing measures for its improvement, etc.

The TSO is defined as the "energy undertaking performing the activity of electricity transmission". Its responsibilities include the following: operation and maintenance, development and construction of the transmission system, connecting system users to the transmission system as provided for in the Energy Act, continuity and reliability of the electricity supply system and proper coordination of the generation, transmission and distribution system, power system control and management, securing access to the network according to the regulated, transparent and non-discriminatory principles, defining and separating costs resulting from electricity transmission in cooperation with the Distribution System Operator (DSO), taking over from eligible customers total electricity produced when engaging generation facilities, securing long term capacity of the transmission system to meet reasonable requests for electricity transmission, managing the electricity flows in the transmission network,passing objective, transparent and non-discriminatory rules on balancing the electric power system, etc.

VI.INTRODUCTION AND APPLICATION OF ECONOMIC INSTRUMENTS FOR RES

1 Environmental Protection and Energy Efficiency Fund (EPEEF)

Regarding the financing in the field of energy efficiency and RES, the Environmental Protection and Energy Efficiency Fund Act provides that financial resources of the Fund will be used for financing of the environmental protection and energy efficiency projects and for promotion of RES use.

Given the common grounds of the environmental protection sector and the energy sector, and Environmental Protection Strategy and Energy Sector Development Strategy, a special law was adopted establishing the Environmental Protection and Energy Efficiency Fund. The financial resources of the Fund will be used in different ways to encourage preparation and implementation of those programs and projects which are in line with the National Environmental Protection Strategy and National Environmental Action Plan, Energy Sector Development Strategy and the implementation program for the Energy Sector Development Strategy and international agreements to which the Republic of Croatia is a party. The financial resources of the Fund, collected from polluter charges (carbon dioxide - CO2 emissions, sulphur oxides - SO2 emissions, and nitrogen oxides - NO2 emissions) and the environment users, charge on environmental loading and special environmental charge on motor-driven vehicles, inter alia, will be used to mitigate climate changes, promote the use of RES, promote sustainable construction and promote cleaner transportation.

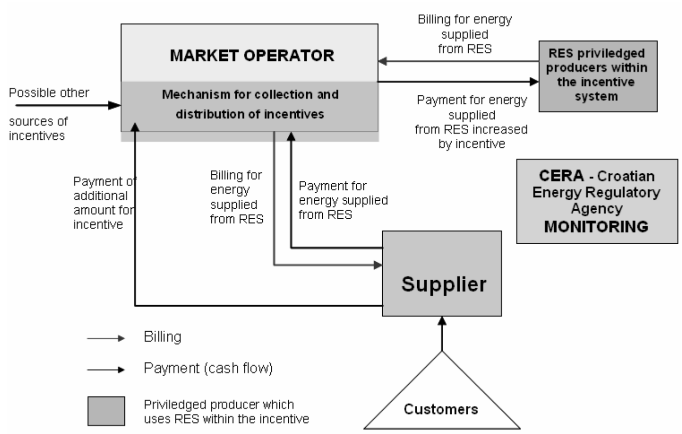
The starting platform for the financing is that the user should reap an economic benefit from the project. This is one of the preconditions, others including the overall economic growth, experience, interest and strategies, imposed by specialised foreign investment funds which invest capital in projects in emerging energy markets and energy sector reforms, including the energy efficiency and RES project. Projected revenue of EPEEF in 2005 is 311 million HRK.

2 The Rules on the use of RES, Tariff system for electricity generation from RES and cogeneration and Ordinance on Minimum Share of RES

The activities relating to the energy sector reform include careful observations of European experiences in the field of promotion of electricity production from RES and in the field of promotion of production and use of liquid biofuel. In preparing the Rules on the Use of RES and for the associated Decision on Minimum Share of Renewable Sources in the generation mix used by the supplier to meet the customer demand, the Directive on the promotion of electricity produced from renewable sources (2001/77/EC) was used as well as numerous regulations of EU member states (Austria, Germany, Portugal, Spain, etc). Currently in preparation is legislation relating to the introduction of biodiesel fuel and for this purpose Directive on the promotion of the use of biofuel and other renewable fuels in transportation is used.

In view of the existing market relations and legal institutional framework within which the system must be implemented, a model for the support of interconnected electricity producers that may be appropriate and efficient is the system which uses feed-in-tariffs, or the one which guarantees purchase to RES producers on known terms (purchase price and duration). In European practice, this system has proved very efficient and easy to apply. The system will be introduced in Croatia within secondary legislation which is currently in the adoption procedure (The Rules on the use of RES, Tariff system for electricity generation from RES and cogeneration and Ordinance on Minimum Share of RES) and will come into force in 2006. An important measure which ensures data for the evaluation and updating of RES policy as well as for the preparation of national reports on the development and share of RES use is use of the statistics and monitoring which is to be continually performed by the Croatian Energy Regulatory Agency (CERA) and Market operator (MO) within the scope of their authority.

The above mentioned implementing acts introduce an institutional organisation which should enable planning and construction of RES projects based on entrepreneurial initiatives. The organisation to be implemented anticipates the establishment of an economic instrument - incentive funds for the coverage of increased costs of production from individual RESs which will be collected from customers through the supplier and distributed to privileged producers through MO, as shown in the below graph:



The establishment of new business relations as required by regulations will unfold continually, depending on the Ordinance on the Minimum Share of RES, available financial resources for the promotion on the investment and production side, entrepreneurial interest in RES projects, development of domestic technology, etc.

3 Other economic instruments

RES use by direct customers will depend on whether the interest chain in which the end user participates is completely closed. RES projects in electricity and heat production will be financed on an entrepreneurial basis, assuming of course the above mentioned incentive measures for RES use are in place. For these projects, it is important that the financing of preparatory and promotional activities comes from the state and local community. This means that it is necessary to achieve market prices of other sources of energy, reduce prices of equipment and devices by incentive measures and offer loans on more favourable terms.

It is known that some measures relating to increase in energy efficiency and to the use of different RES forms (use of solar energy for the domestic hot water, use of biomass and wind for electricity production, etc.) pay back fast and create positive effects on creating of new jobs (resolving the unemployment problem), increasing revenues in agriculture and forestry, and developing rural areas as well as the overall economy in Croatia. But these measures also require incentive funds, so that it will be necessary to apply the above mentioned policy instruments and incentive measures, primarily financial resources of a special fund.

VII.OPPORTUNITIES FOR JOB CREATION

The RES market development will lead to a positive impact of Croatia's energy related industry and will save and create additional jobs in the fields of:

- forestal industry (production of fuel),
- heavy industry (boiler manufacturer, component deliverer for wind and steam turbines)
- power industry (generators, transformers, power transmission)

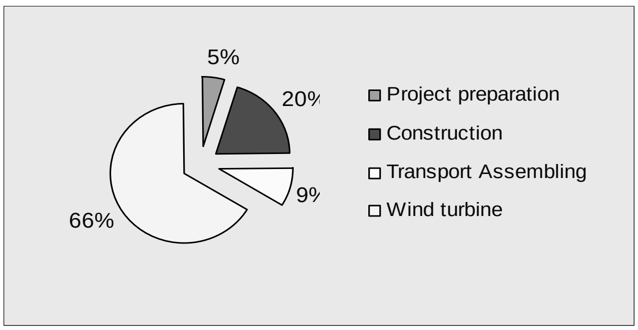


Fig. 3. Potential share of Croatian domestic industry in building of wind power plants (Source: Croatian Chamber of Economy).

With respect to bioenergy there is a long tradition of biomass use in Croatia, in particularly of fuel wood and residues from the wood-processing industry. The Croatian scientists and experts have developed some technologies for energy generation from biomass (Uljanik, Đuro Đaković, Plamen), and a number of scientific researches have been performed.

The conditions are favorable for energy generation from biomass and the means of exploitation and technology are known and proved. Since the subject plants are mostly small plants the required time for their building and putting in operation is short. Recently the growing interest in this type of energy was recorded, new plants are being built and old renewed, as well as new projects launched.

Apart of the benefits of the biomass use, which are the same as for the other resources (environment, greenhouse gases, independence of energy, reduced import etc.) a number of social economic effects should be mentioned with respect to the biomass. According to accomplished researches the biomass use in Croatia could result in creating of almost 5000 direct jobs by 2015, i.e. 60000 of total number of jobs (direct, not direct and induced employment). The collateral benefits should additionally be emphasized, such as money circulation in the local community, development of regional economy and similar.

TABLE 2: STRUCTURE OF CREATING NEW JOBS ESTIMATED AT 1 MW = 20 NEW JOBS

New job per MW	year 1998.	year 2010.	year 2020.
Production component	17	12	9,5
Installment	5	3,5	2,8
TOTAL	22	15,5	12,3

VIII.CONCLUDING CONSIDERATIONS

The changes planned to be made in the markets for interconnected energy systems in Croatia, which include restructuring, privatisation and changes in the overall energy sector, will have a significant effect on the possibilities of introducing and increasing the use of RES.

When new energy legislation and by-laws come into force in the begining 2006 and are fully applied, the RES projects in Croatia will be provided with a complete and stable legal framework and support through incentive measures which will equitably value environmental and other benefits of the renewables. Following the trends in other European countries, Croatia will thus set a transparent platform for the expected growth of the RES sector.

It has been proved beyond doubt that Croatia has good potentials for RES, and significant basic sources, including relatively good resources in all technologies, and excellent resources in some of them. For some years now numerous companies have been working on the development of projects anticipating considerable investments in utilization of RES. Applying the experience of successfully completed projects and facilities constructed in Europe and the world, potential investors and various companies and institutions are making every effort and investing considerable funds in an area which is indeed new for Croatia, but will certainly represent an important segment of the energy sector in the near future. Also, foreign consultants have assessed that Croatia has highly skilled human resources. This is important for the implementation of projects and for the expected future growth and a wider social role of RES.

The introduction of adequate economic instruments aimed at increasing the RES share in the energy system and in the environmental improvement system in Croatia will produce effects at the macroeconomic level too. The number and volume of investments will gradually increase and these will not only help the growth of investments into RES and the environmental protection but in sustainable development as well.

The application of legal and institutional mechanism and economic instruments for the segmented RES market within the energy market as a whole, primarily the RES Use Rules and the associated Ordinance on the Minimum Share of Renewable Sources in the electricity generation mix used by the energy supply entity, and the EPEEF, as well as other incentive and fiscal measures (government support), will surely improve the quality of the overall development of Croatia, accelerate the creation of preconditions for the sustainable economic development, and directly contribute to the use of RES as a condition of sustainable development and healthy living, in a preserved environment. RES is an integral part of the sustainable development concept on a global scale. One of possible contributions to the resolution of current and accumulated economic and social problems with which Croatia is faced on a daily basis, one of the development challenges for Croatia is to use the liberalisation process in the energy market and the creation of new economic, financial, legal, organisational and overall economic environment, to give RES the opportunity to compete with other sources of energy.

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X.BIOGRAPHY

Željko Tomšić, Ph. D. was born in Vrbovec, Croatia, on July 27th 1957, where he attended primary school and high school. He graduated Electroenergetics on the Faculty of Electical Engineering in Zagreb in 1981.

He graduated on postgraduate study with Master of science thesis: "Energy management in industrial plants" in 1990 and Doctor of science thesis: "Method for Analysis of Different Posibilities for Electroenergy System Sustainable Development" in 2001. Since 2003. he has been chosen for assistant professor on the Faculty of Electrical Engineering and Computing in Zagreb.

Since 2004. assistant minister of economy, labour and entrepreneurship for energy and mining.

Since 1991 till 2004 employed at Faculty of Electrical Engineering and Computing in Zagreb, High Voltage and Energy Department. Since 1987 till 1991 employed as manager of research and development department of electrical inatalations systems in the factory of electrotechnical devices TEP in Zagreb. Since 1981. employed at TEP- Tvornica elektrotehničkih proizvoda Zagreb, OOUR Istraživanje i razvoj as development and construction engineer in research and development department for electrical dividing devices.

In the name of Government of Republic of Croatia leader of negotiation team for negotiations with European Commission about Energy Community Treaty for electrical energy and gas.

Scientifical and expert activities in the area of energetics, ecology and economy in energetics, especially planing of electroenergy systems, environment protection, rational energy management in industrial plants and economics in energy management.

Lecturer on undergraduate study subjects: "Energetics and environment", "Energy efficiency and impact on environmen in energy market conditions", "Introduction in electrical energy market theory" and "Energy management" and on postgraduate study subjects: "Impact of electroenergy system on environment" and "Planing of electrical energy production plants in uncertainty conditions. "

Coauthor of "Powerplants and environment" textbook published in 2000.

Awards: Croatian Academy of Sciences and Arts "J. J. Strossmayer" award for the best science work in area of technical sciences; Energy Institute "Hrvoje Požar" award, Energy magazine award for authors with highest number of articles in Energy since 1991 untill 2000; Diploma with golden plaquettes on 14th Yugoslavian exhibition of innovations, technical improvement and novelty RAST YU 86 for system "Medikal"; Bronze plaquettes on exhibition INOVA 86.

Cooperation memeber of Croatian Academy of Tehnical Sciences, Croatian Energy Association, HK CIGRE, Croatian Nuclear Association, Europen Nuclear Society, EDZ.

Member of "Council for technical questions, rules and norms" at Croatian Energy Regulatory Council. Member of commissions at Ministry of Environmental Protection, Physical Planning and Construction of Republic of Croatia for graduation of environment impact studdies for small hydroelectric powerplants, wind powerplants and small combined gas powerplants.

Explorer on international and domestic scientific projects.

Lecturer on international workshops and leader of expert missions in organisation of international institutions (Argonne National labaratory USA, International Center for Theoretical Physics Trieste Italy, Kairo Egypt, Taedong Korea, Abuja Nigeria, Adis Abeba Ethiopy, Kampala Uganda, Rio de Janero Brazil, Ljubljana Slovenija).

Author or leader of study making processes for: HEP, EKONERG; ENCONET International, IAEA Vienna; European Union (EU) TACIS project, Regional Environmental Center for Central and Eastern Europe; World bank, UNIDO (United Nations Development Organization, Vienna).

Published more than 90 articles in international and domestic magazines and workshops at international conferences.

Married and has two children.

Igor Raguzin (28 October, 1963) has a B.Sc. degree in mechanical engineering, and presently works as a Head of Division for Renewable Energy and Energy Efficiency at the Ministry of Economy, Labour and Entrepreneurship, Directorate for Energy and Mining. He is in charge of renewable energy and energy efficiency and coordinating national energy programs, as well as for interactions between environment protection and energy sector; energy sector reform to develop the legislative/secondary legislation and institutional framework; developing economical instruments in the field of renewable energy sources and so on.

1998 – present: manages, coordinates, and cooperates in, numerous national and international programs of utilization of renewable energy sources, energy efficiency programs and programs of environment protection, such as: a bilateral project PSO – Energy Efficiency and Renewable Energy Sources on the island of Hvar within the scope of international cooperation between Croatia and Netherlands; development of ESCO concepts with a back-up provided by the World Bank, the SECI initiative, Stability Pact, UN/ECE Mediterranean initiative, Community of Podunavlje region, the Alpe-Adriatic Project – Energy Efficiency and Renewable Energy Sources; GEF/UNDP project "Removing Barriers to Implementation of Energy Efficiency Measures in Croatia"; GEF/WB project " Renewable Energy Sources - Croatia"; GEF/UNDP Project of drafting a national report on climate changes for the Republic of Croatia; IAEA project "Assessments of External Costs"; OECD Annex I Expert Group on the UNFCCC; Energy Efficiency 2000 and Global Energy 21 (UN/ECE); Working Group for Strategy of Environment Protection of the Republic of Croatia and National Working Plan for the Environment; BIODIESEL Working Group etc.

1989 – 1998: Experience as an energy and environment protection manager gained in the field of tourism: preparation and implementation of energy projects and environment protection programs for tourist facilities; impact assessment for environment protection; reduction of costs and expenses for power, water and environment; energy efficiency improvement; renewable energy sources; collection, processing (assessment) and disposal of waste; international cooperation; elaboration of strategic documents aimed at environment management and new tourist markets.

Igor Raguzin, as an employee of "Jadranka" joint-stock company, was a winner of an Annual Award for Environment Protection (in category of tourist companies) given by the Ministry of Construction and Environment Protection in 1993, for an environment protection program developed by "Jadranka" company. He is also a winner of the Annual Award for Environment Protection Chart Rabuziani, given by the Society for Life Quality Improvement, in 1994, and an individual winner of an award given by the "Hrvoje Pozar" Croatian Energy Society for a Project of rational energy management in 1996.

He published over thirty papers for various scientific and expert gatherings.

Romanian Green Certificates Market

Luminiţa Lupului , Gherghina Vlădescu

Abstract **– The Paper present briefly the legislative framework dedicated to develop renewable energy sources in Romania and review the potential of these sources in Romania.**

Are presented more detailed the system chosen by Romanian Government to promote electricity from renewable energy sources on the internal electricity market, the green certificates market, the role of each entity involved in the development and functioning of this system as well as the motivation to choose them.

The authors point out the OPCOM's role as administrator of the green certificates market and as operator for centralized green certificates market as well as the potential role that OPCOM could have as transaction place for greenhouse gas emission if Romania will join EU ETS scheme.

Keywords **– energy, mechanisms for renewables support, renewable energy sources, support schemes, green certificate, green certificates market.**

I. INTRODUCTION

THERE are many reasons to promote the use of electricity from renewable energy sources (E-RES) but the most important are: economic, environmental and social.

Economic reasons refer to security of energy supply and to development of specific industry which uses RES.

Environmental reasons consider RES as clean energy sources – exemption for biomass which is considered neutral from the point of view of pollutant emissions – and take into account the contribution of RES to mitigate climate changes.

And finally, the social reasons consider employment, economic and social cohesion.

Because of relative high prices for electricity produced from RES, to increase the use of E-SRE presumes the existence of two fundamental elements: financial support mechanisms and an adequate and stable framework for regulation.

To avoid market distortion as much as possible, the support system for RES development must be based on the market mechanisms. Such system based on market forces, transparent, cost efficient which limit price increases and avoid the duplication of support received and, most important, can be international harmonized, is that of tradable certificate system.

II. POTENTIAL TO DEVELOP RENEWABLE ENERGY SOURCES IN ROMANIA AND THE LEGISLATIVE FRAMEWORK DEDICATE TO

Romanian potential for electricity production from renewable energy sources, provided in the National Strategy for renewable energy sources capitalization approved by GD 1535/2003, is 19.65 TWh by 2010, from which 18.2 represents electricity produces from hydropower plants, including large hydro.

Electricity produced in hydropower plants with a capacity less than 10 MW will be only 1.1 TWh.

The Road Map for energy approved by GD 890/2003 indicates little different figures: the national gross consumption forecasted is 64.9 TWh, when electricity produced from renewable energy sources will be 19,47 TWh and those in hydropower plants, about 17.2 TWh. The difference of 2.27 TWh represents electricity from other RES than hydro.

The National Strategy for renewable energy capitalization approved by GD 1535/2003, present the potential existent in Romania for renewable energy sources exploitation.

Thus, the electricity that can produced from hydro sources in power plants less than 10 MW capacity installed, can be 6000 GWh/year, in about 780 units.

The energy potential from wind represent the equivalent of 23000 GWh/year with a very good location in the Black Sea area of about 2000 MW with an average amount of electricity of about 4500 GWh/year including off-shore locations.

At present, there are two wind turbines; one located next Ploieşti, not connected at the network, which supply electricity directly to a local industrial park and another, connected to the distribution network, located in the Tihuţa pass in the Carpathian Mountains.

The biomass can be used in new combined heat and power units which can produce 1134 GWh/year.

Concerning the solar energy used in photovoltaic systems, the potential is of 1200 GWh/year.

Table I presents the energetic potential of renewable energy sources in Romania

TABLE I
POTENTIAL FOR RENEWABLE ENERGY SOURCES APPLICATION IN ROMANIA

Renewable energy source	Energetic potential / year	Application
Solar energy		
➢ thermal	60 x 10^6 Gj	Thermal energy
➢ electrical	1200 GWh	Electricity
Wind energy	23 000 GWh	Electricity
Hydro energy total	40 000 GWh	Electricity
< 10 MW	6 000 GWh	
Biomass	Aprox. 300 x 10^6 GJ	Thermal energy
Geothermal energy	Aprox. 7 x 10^6 GJ	Thermal energy

Sources: ICEMENERG, ICPE, INL, ISPH, ENERO

Whereas the share of electricity produces from hydro power plants is about 28% of Romanian electricity production, the speed-up of the exploitation rhythm of renewable energy sources in Romania is justified by the increase of energy supply security, regional development promotion, environment protection and greenhouse gas emissions reduction.

Luminiţa Lupului – Director - Romanian Electricity Market Operator OPCOM SA, Market Operations manager
Gherghina Vlădescu – Senior Engineer – Romanian Electricity Market Operator OPCOM SA, Green Certificates Market, Priority Production and SEN Operation Synthesis Department

Considering the commitments assumed by Kyoto Protocol ratification and having in view the RES potential for electricity production and the reasons for E-SRE development, Romanian Government have established by GD 443/2003 the share of 30% electricity produced from SRE in Romania gross consumption by 2010.

GD 443/2003 represents the transposition in Romanian legislation of the EU Directive 2001/77.

Same as the UE Directive, the GD 443/2003:

- Indicates targets for renewable energy sources development in Romania
- Stipulate for issuing of Guarantee of Origin for electricity produced from renewable energy sources based on transparent, objective and non discriminative criteria
- Asks for reducing the barriers for development of the electricity produced from renewable energy sources and for authorization procedures simplification and acceleration
- Guarantees the access to the transport and distribution networks at the extent that the reliability and the security of the networks are not jeopardize.

The target of 30% in the Romanian gross consumption it is gone to be changed to 33% and the corresponding quantity of electricity from renewable energy sources is 21.42 TWh. Assuming that large hydro will be 17.2 TWh, the change will affect the electricity from other renewable energy sources (4.22 TWh).

According to the GD1429/2004, the electricity produced from renewable energy sources will receive a certification of its origin. This Guarantee of Origin allow to generators to prove that the energy that they sell is produced from renewable sources. The Guarantees of Origin can be used in case of the import or export of electricity produced from renewable sources based on the reciprocal recognition of these guarantees between the states involved in transaction.

III. ROMANIAN GREEN CERTIFICATES MARKET

The system chosen by Romanian Government to support the electricity from renewable sources is that of Tradable Green Certificates, promoted by GD 1892/2004 for the establishment of the system to promote the production of electricity from renewable energy sources, considering the possibility gives by such system to harmonize the support systems in European Union and not lastly, considering the possibility to reduce the prices which are to be beard by consumers.

This system awards the producer for each MWh produced in installations which use renewable energy sources with a Green Certificate which confirm that this electricity is „green”. This green certificate is tradable which means that the producer can sell them to earn a supplementary amount of money, apart of the income from the electricity sold on the electricity market.

The eligible renewable energy sources to participate in this system are: wind, solar, biomass and hydro in power plants with a capacity less than 10 MW commissioned or refurbished as from 2004.

This system has two main characteristics: the quantity is fixed and the price is determined by the market forces.

In any market, there are demand for a product and supply of that product. For green certificates market, the merchandise is represented by green certificates which are sold by generators that possess them and thereafter, the supply is assured by the generators. The demand can come from electricity suppliers or from those consumers which can prove their “green” orientation. In such cases one says that the system is voluntary. Besides the voluntary systems there are those in which the demand is obtained by means of an obligatory quota.

Romanian system is one with quota obligations imposed on electricity suppliers. According to the national target, the annual share of electricity from renewable sources in the annual national gross consumption of electricity set up by GD1892/2004 are the following :

0.7% in 2005, 1.4% in 2006, 2.2% in 2007, 2.9% in 2008 3.6% in 2009 and 4.3% in 2010.

The electricity suppliers are obliged to purchase a number of green certificates equal with the obligatory quota multiplied with the amount of the electricity supplied yearly to their final consumers.

While the annual green certificates offer is less than annual demand, the annual obligatory quota is diminished proportional with the ratio offer/demand in order to protect the consumers. If the number of generators participants in the system are too small and all suppliers are obliged to buy green certificates, and accordingly, the offer being too small, the suppliers can be penalized for nonconformity with their obligation even they are not responsible for a such situation. The costs resulted from penalties obviously will be transferred by suppliers to the consumers and consequently the consumer be confronted with an unfair increasing of the prices.

The generators and the suppliers will activate on two markets: on the electricity market, where they trade the electricity and on the green certificates market, where are traded the environmental benefits of the electricity production from renewable sources, having in view the fact that the conventional production of electricity not reflect in price all the environmental externalities.

The green certificates price in determined my means of market mechanisms. Are allowed two types of markets for green certificates in Romania:

- A bilateral market, in which producers and suppliers conclude bilateral contracts and where the price of transaction is established by an agreement between the two contractors, and
- A centralized market organized and administrated by the Romanian Market Operator, OPCOM, which is the Romanian Green Certificate Market Operator, too.

The actors involved in the organization and the functioning of the Green Certificate Market, the bilateral market as well as the centralized market, are

- The Regulatory Authority, ANRE
- Electricity generators from renewable sources
- Electricity suppliers
- The Distribution Operators

- The Transport and System Operator (TSO), Transelectrica
- The Electricity Market Operator and Green Certificates Market Operator, OPCOM

A. The role of Regulatory Authority

The Regulatory Authority has three main tasks:

- Qualifies the generators which use those renewable energy sources that are eligible to participate on the Green Certificates Market
- Each year establishes the minimum and the maximum price for the green certificate
- Monitor the quota fulfillment by the suppliers
- Apply penalties to those suppliers which do not fulfill their obligations

The market has an inferior limitation for the price as well a superior limitation. The minimum price intends to protect the generator against the severe falling for the market price and the superior limit has the scope to protect the consumers. Hereby, the market price of green certificates will oscillate between the two values imposed by ANRE.

The minimum and maximum prices set up by ANRE are 125 RON respective 150 RON.

The penalty is set as twice the maximum price for green certificate.

B. The role of TSO

The Transport and System Operator, Transelectrica, receives each month both from the E-RES generators and from the Distribution Operators into whose networks are delivered the electricity produces from RES, data about the amount of electricity produced by the respective generators. Based on this data, verified and validated, TSO issues to each producer a corresponding number of green certificates. A green certificate is issued for 1 MWh of electricity from RES delivered into the network.

Certificates has unlimited availability and exist only in electronic format. A certificate is considered “consumed” if the suppliers use them to prove the quota fulfillment. The certificates “consumed” are retired and cannot more be used.

The amount from the penalties is collected by TSO and has two destinations: to finance the research and development of technologies that use renewable energy sources and to pay those certificates which was offered on the market by the generators but was not bought until the end of the period of conformation, namely until at the end of the year. Hereby, the producers have guaranteed at least the minimum price for their certificates.

C. The role of the Green Certificate Market Operator

OPCOM, as Green Certificate Market Operator, organizes the Centralized Green Certificates Market and administrates the whole market for green certificates – the centralized market and the bilateral market.

Between the main attributions of OPCOM we can specify:

- Records the participants to the Green Certificate Market
- Forecasts and publishes the demand and the offer of green certificates at national level
- Records the bilateral contracts between E-RES producers and suppliers
- Set up and manage the Green Certificates Register
- Assures the trading framework for Green Certificates on the Central Green Certificate Market
- Receives the Green Certificate sell/buy offers from the producers/suppliers (consumers)
- Determines and publishes the Centralized Green Certificates Market Clearing Price (CGCMCP) and the number of green certificates traded monthly on the Central Green Certificate Market
- Monthly publishes cumulate offer and cumulate demand of green certificates for the current year
- Determines the payment rights and obligation of the Central Green Certificate Market participants

Transactions on the Centralized Green Certificate Market are organized monthly.

The offers for this market represent couples price-number of green certificates. Each offer can contain maximum three such couples.

The Centralized Green Certificates Market Clearing Price and the number of green certificates traded are determined at the intersection point of the two curves supply of green certificates and demand of green certificates.

The sell offers are aggregated into a single curve, the supply curve, the sell offers being ordered ascending with the price and the buy offers are aggregated into the a curve named the demand curve, ordered descending with the price. An example of the modality in which are determined the market price and the number of green certificates traded are represented in fig. 1. below.

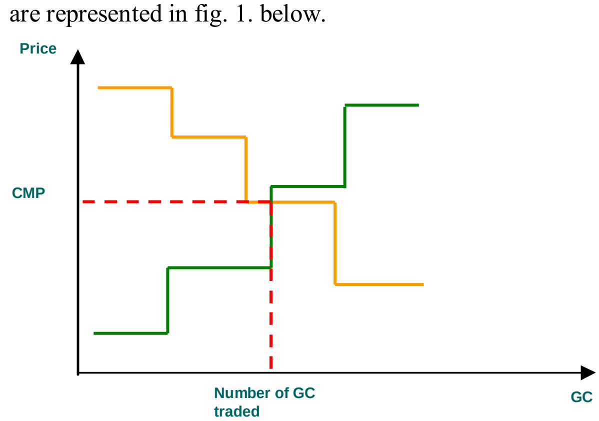

Fig. 1. The modality in which are determined the number of green certificates traded and the Centralized Green Certificates Market Clearing Price

To avoid the double selling of certificates, OPCOM set up and update the register for green certificates and transfer the certificates sold from the seller account into the buyer account, both for the centralized and the bilateral market. All transactions are registered in the green certificates register.

The Romanian generators are now confronted with the electricity market liberalization and with the new rules that govern the Romanian market for electricity. In parallel, emerges a new market in which are traded the environmental benefits of the electricity production from renewable energy sources.

At the international level, appeared and activate new markets for environment protection purposes. Among the most important are the carbon markets whose targets are greenhouse gas emissions reduction. Thereby, the actors of electricity markets are to be involved in three parallel markets: for electricity, for green certificates and for emissions trading according to the national policies. Using the market forces to reach the targets to assure the energy security of supply, to develop new energy sources and to conform to UNFCCC and Kyoto Protocol commitments, the expected benefits will be achieved with the least costs. However, the consumers will confront with a rise of prices for electricity which will reflect also the green certificates prices from the "green" electricity production and the emission permits prices from the "grey" electricity production. The development of the fuel mix will change according to those three markets and their interactions. Consequently, it is important that all targets imposed by governments do not cumber the consumers and to use those systems which result in the least costs.

Green certificates and emission permits represent two produces that can be standardized at the international level. OPCOM as a market operator and in the future as a power exchange, trades two different produces, independently each other and has in view the possibility to trade a third produce, the emission permits according to the evolution of Romanian policy in climate change mitigation. According to the National strategy on climate change of Romania for the period 2005-2007, Romania will use for greenhouse gas reduction two of the flexible mechanisms of Kyoto Protocol: Joint Implementation and International Emission Trading (JI and IET). Besides, as accession country to EU, the Ministry of Environment and Water Management is gone to prepare the joining with EU ETS scheme in 2007.

IV. Conclusions

The main reasons to promote the use of electricity from renewable energy sources (E-RES) are: economic, environmental and social.

Because of relative high prices for electricity produced from RES, to increase the use of E-SRE presumes the existence of two fundamental elements: financial support mechanisms and an adequate and stable framework for regulation.

To avoid market distortion as much as possible, the support system for RES development must be based on the market mechanisms. Such system based on market forces, transparent, cost efficient which limit price increases and avoid the duplication of support received and, most important, can be international harmonized, is that of tradable certificate system.

Romanian Government choose the support for electricity produced from renewable sources the Tradable Green Certificates, considering the possibility gives by such system to harmonize the support systems in European Union and not lastly, considering the possibility to reduce the prices which are to be beard by consumers.

OPCOM has an important role in this system as administrator of the green certificates market – both bilateral and centralized market – and as market operator for the centralized green certificate market.

To avoid the double selling of certificates, OPCOM set up and update the register for green certificates and transfer the certificates sold from the seller account into the buyer account, both for the centralized and the bilateral market. All transactions are registered in the green certificates register.

Romanian market for green certificates will commence to function soon

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VI. BIOGRAPHIES

Luminița Lupului was born in Bucharest, Romania, on November 25, 1954. He graduated from the Polytechnic Institute of Bucharest, and studied at the Energy Faculty.

His employment experience included the Ministry of Electric Energy RENEL, CONEL and starting with 2001, the Romanian Electricity Market Operator. His special fields of interest included electricity trading and electricity trading settlement.

Gherghina Dida Vlădescu was born in Slobozia Mîndra, Romania, on March 13, 1957. He graduated from the University of Bucharest, and studied at the Physics Faculty of Bucharest University.

His employment experience included the Energy Research and Modernization Institute (ICEMENERG), The National Institute for Meteorology and starting with 2001, the Romanian Electricity Market Operator. His special fields of interest included environmental protection and climate change as well as renewable energy sources.

She participate as international expert for GHG Inventory in the UNDP Project "Enabling Moldova to prepare its first National Communication" – Chişinău, Moldova Republic and as expert in the UNDP Project "Romanian National Self-Assessment Capacity for Global Environment Management (NCSA)"

Romanian Power Market Operator
OPCOM

Romanian Green Certificates Market

Presented by:

Gherghina Vlădescu
Green Certificates Market, Priority Production and SEN Functioning Synthesis

Seminar on: International Renewable Energy Sources

Building the Awareness of RES: Technologies and Regulation

Sofia, 16 September 2005

Support system for E-RES

- Fixed Quantities – quota obligation
- Variable price – established on the market

Quota obligation system

- Regulatory Authority establishes a fixed quota for electricity produced from renewable sources, which suppliers are obliged to by it
- Producers receive for each MWh of electricity delivered in the network, a Green Certificate, which can be sold separately from electricity, on the Green Certificate Market
- Suppliers must own a number of Green Certificates equal with the imposed quota
- Green Certificates Value represent a supplementary income
- The price for electricity is determined on the electricity market
- The supplementary price for the Green Certificate sold is determined on a parallel market, where are traded the environmental benefits

Green Certificates Trading

Green Certificates Value is established by market mechanisms:

- **On a bilateral market between producer and supplier**
- **On a centralized market organized by OPCOM**

Electricity are traded separately from Green Certificates

Green Certificate 1MWh

Green Certificate Market

Electricity 1 MWh

Electricity Market

Actors

- Regulatory Authority – ANRE
- Electricity producers from RES
- Suppliers
- Transport and System Operator – TSO
- OPCOM

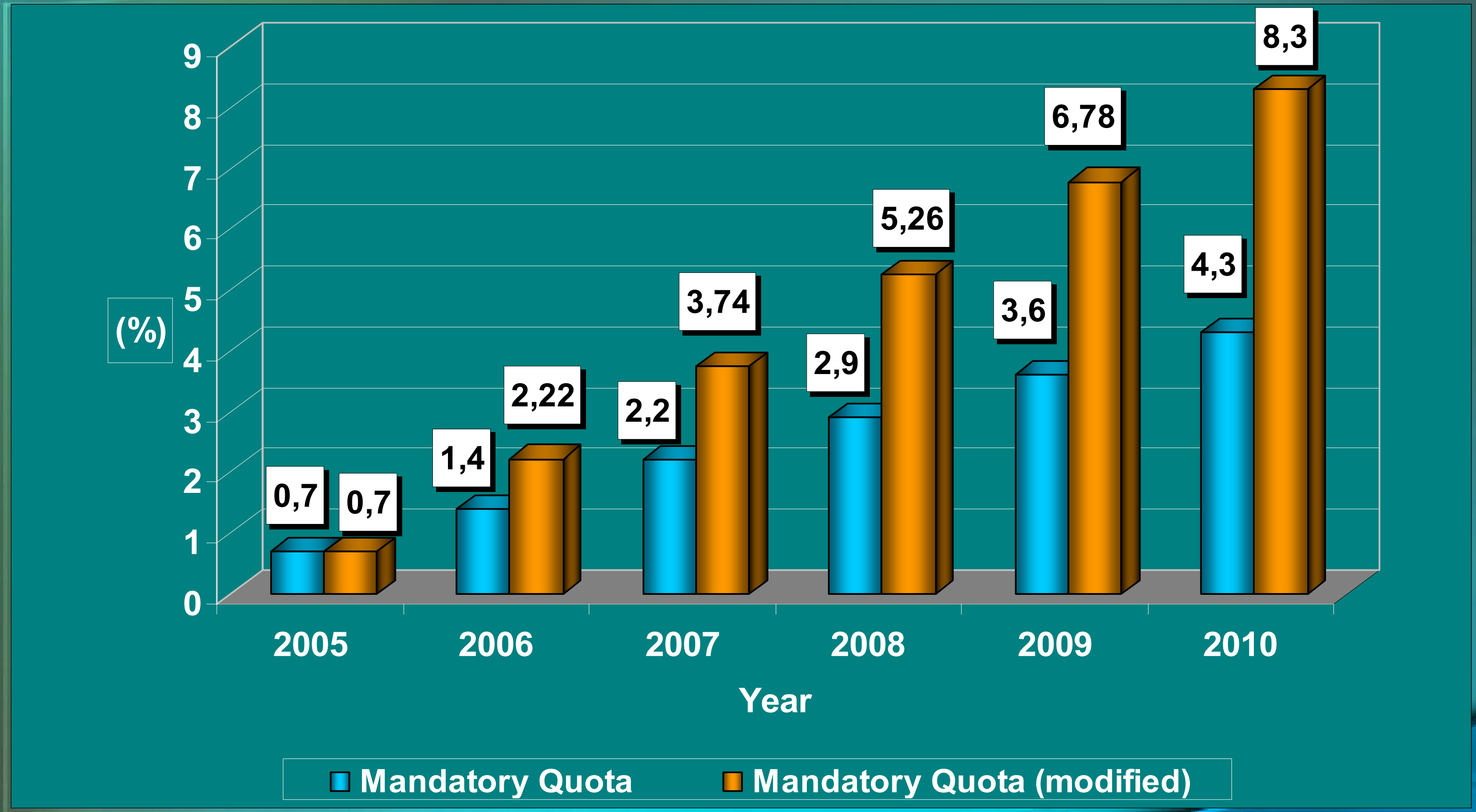
Renewable Energy Sources eligible to receive GC

- Wind
- Photovoltaic
- Biomass
- Hydro Power Plant with a capacity equal or less than 10 MW new or modernized starting with 2004

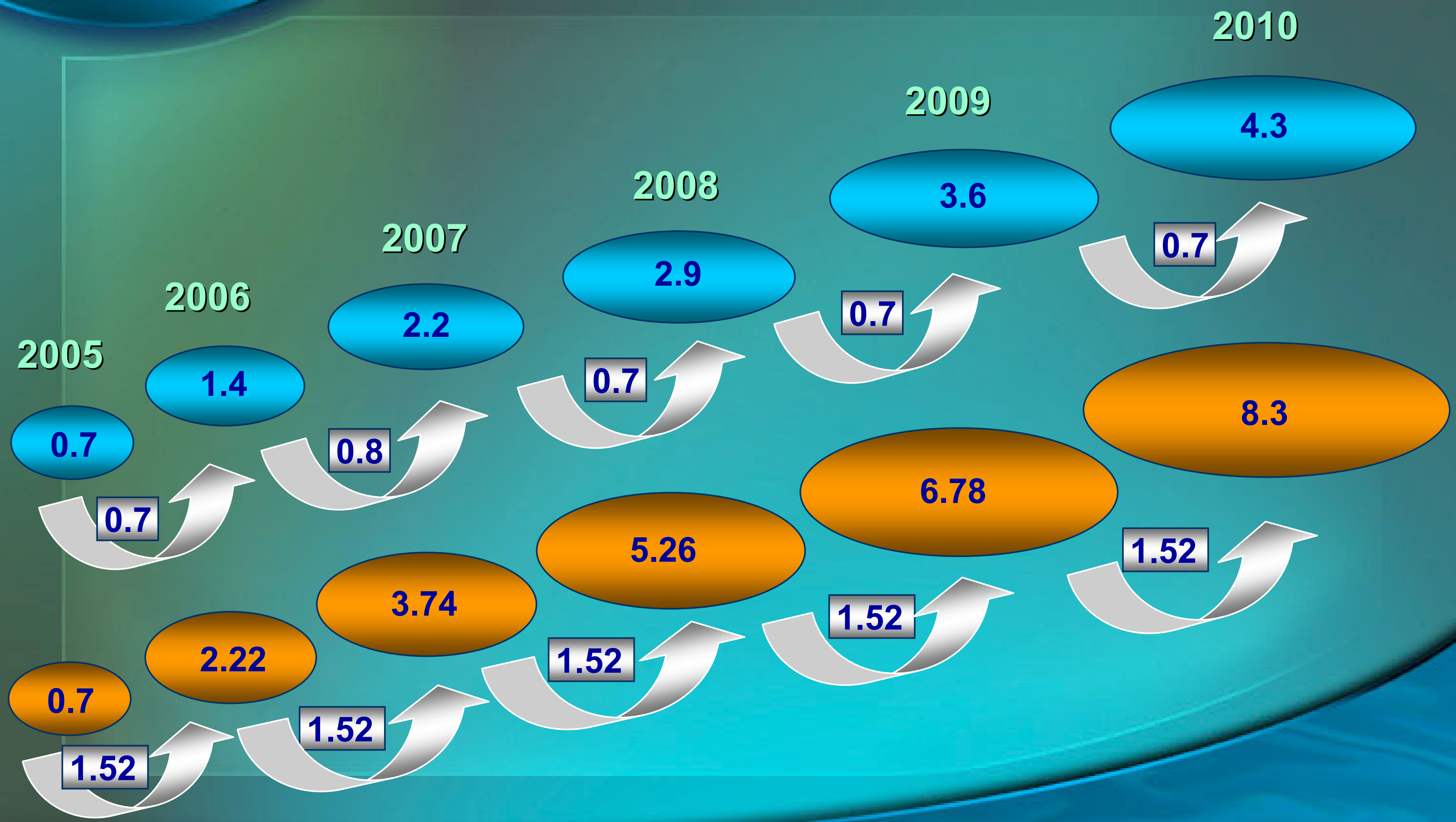
Quota for E-RES until 2010

Mandatory Quota for suppliers (%)		E-SRE (TWh)		Year
GD 443/2004 and GD 1892/2004	Proposal for GD 443/2004 and GD 1892/2004 modifying	GD 443/2004 and GD 1892/2004	Proposal for GD 443/2004 and GD 1892/2004 modifying	
0.7	0.7			2005
1.4	2.22			2006
2.2	3.74			2007
2.9	5.26			2008
3.6	6.78			2009
4.3	8.3	19.47	21.417	2010-2012

Quota for E-RES until 2010



Quota for E-RES until 2010



ANRE's role

- Qualifies the electricity producers which use eligible SRE, to participate on the Green Certificates Market
- Yearly establishes the minimum and the maximum price for Green Certificate (24 € respective 42 €)
- Follows up the fulfillment of the obligatory quota by the suppliers
- Applies penalties for non fulfillment of the quota

Suppliers

Are obliged to buy yearly a number of Green Certificates according to Obligatory Quota value multiplied with the amount of electricity supplied yearly to the final consumers

TSO

- **Monthly** receives data relating the amount of E-SRE delivered into the network
- **Monthly** issues Green Certificates to the producers
- Collects the money corresponding to the penalties

OPCOM (1)

- Set up and manage the Green Certificates Register
- Records the participants to the Green Certificates Market
- Records the bilateral contracts between E-RES producers and suppliers
- Assures the trading framework on the Centralized Green Certificate Market

OPCOM (2)

- Determines and publishes the MCP and the number of GC traded monthly on the Centralized Green Certificate Market
- Monthly publishes cumulate offer and cumulate demand of GC for the current year
- Establishes the payment rights and obligation of the Centralized Green Certificates Market participants

Centralized Green Certificates Market

Assures:

- Competition, transparency, non-discrimination
- Lowering the trading prices for GC
- Establishing the reference price for other transactions with GC

Centralized Green Certificate Market functioning (1)

- Signing the Convention for Centralized Green Certificates Market participation
- Payment of the Market Accession Tariff
- Participant recording in the GC Register

Centralized Green Certificate Market functioning (2)

- Participants monthly send sell or buy offers during the Offer Interval

OPCOM:

- Undertakes the offers and transmits Confirmations for offers receiving
- Validates the offers and communicates Notifications about offers accepting or rejection

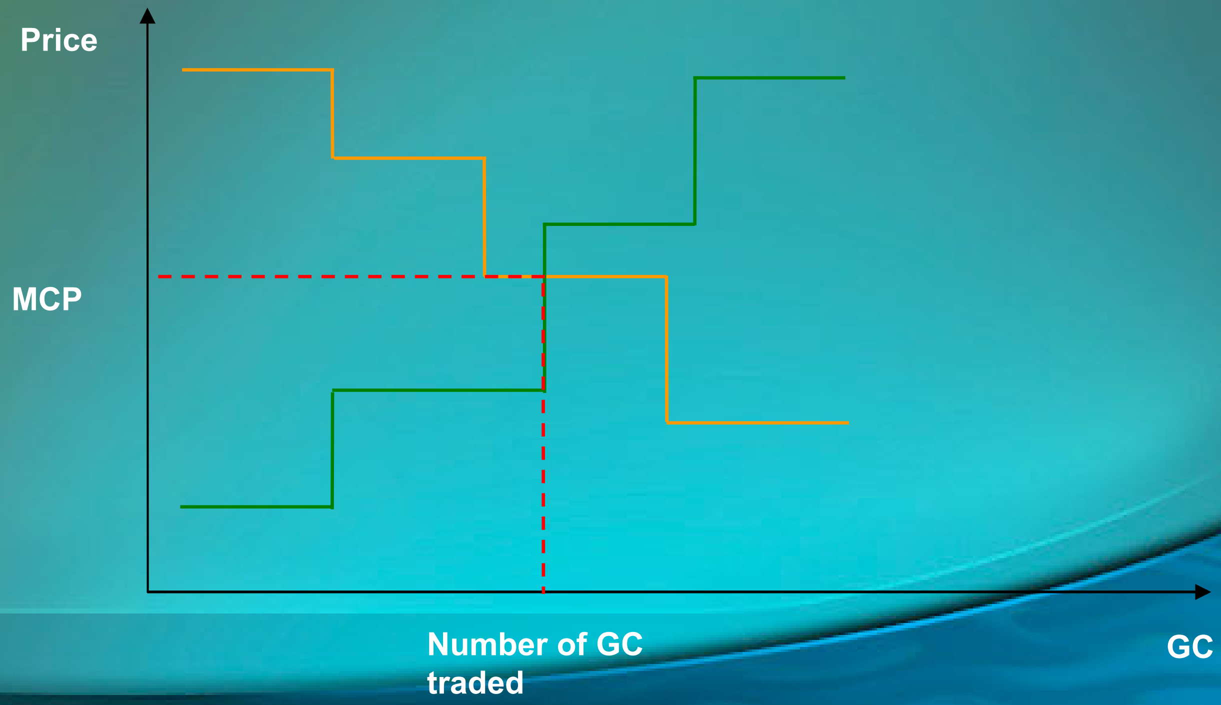
Centralized Green Certificate Market functioning (3)

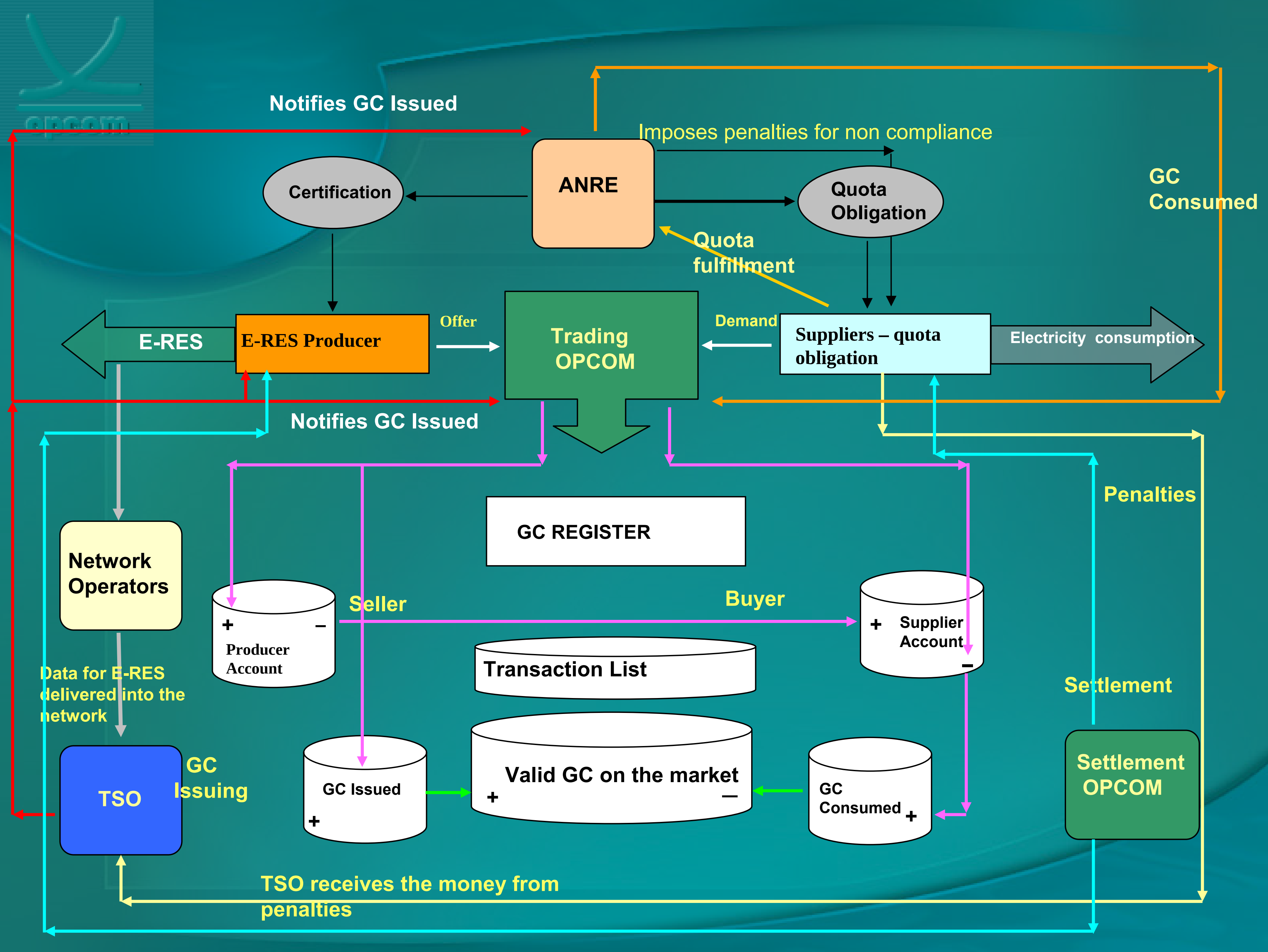
OPCOM:

- **During the Transaction Day, determines the number of GC traded and the market clearing price**
- **Elaborates and transmits to each market participant the Settlement Notes**

MCP and the number of GC traded on the Centralized Green Certificates Market

- The offers represent couples price-number of GC
- MCP and the number of GC traded are determined at the intersection point of the two curves GC supply-demand




Notifies GC Issued
ANRE
Imposes penalties for non compliance
Certification
Quota Obligation
GC Consumed
Quota fulfillment
E-RES
E-RES Producer
Offer
Trading OPCOM
Demand
Suppliers – quota obligation
Electricity consumption
Notifies GC Issued
Penalties
GC REGISTER
Network Operators
Seller
Buyer
+ – Producer Account
+ Supplier Account –
Transaction List
Data for E-RES delivered into the network
Settlement
TSO
GC Issuing
GC Issued +
Valid GC on the market + –
GC Consumed +
Settlement OPCOM
TSO receives the money from penalties

Producers are involved in three parallel markets :

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Green Certificate and CO2 Emission Permit represent two produces that can be standardized at international level:

	Green Certificate	CO2 Emission Permit
Aims	E-RES promotion	The right to emit CO_2
Target	A certain quantity of E-RES production	CO_2 emissions reduction
Buyers	Electricity suppliers (consumers)	Companies that emit CO_2
Price	Established on Green Certificates Market	Established on CO_2 emission permits market
Issuing Body	TSO (TRANSELECTRICA)	National Environment Protection Agency (or MEWM)

Green Certificate and CO2 Emission Permit represent two produces that can be standardized at international level:

	Green Certificate	CO2 Emission Permit
Trading	On Green Certificates Market	On Co2 Emission Permits Market
Market place	OPCOM	Possible OPCOM
Entity that is in charge of conformity monitoring	ANRE	MEWM
Register	Green Certificates Register	CO2 emission and CO2 emission permits Register
Register' administrator	OPCOM	ICIM

Conclusions (1)

Main reasons to promote the use of electricity from renewable energy sources (E-RES) are:

- economic
- environmental
- social

Increasing the use of E-SRE presumes the existence of two fundamental elements:

- financial support mechanisms
- an adequate and stable framework for regulation

Romanian Government chosen as support system, the Tradable Green Certificates:

- to avoid market distortion
- considering the possibility to harmonize the support systems in European Union
- to reduce prices which are to be beard by consumers

Conclusions (2)

- OPCOM is the administrator of the green certificates market – both bilateral and centralized market – and the market operator for the centralized green certificate market
- OPCOM set up and update the register for green certificates and transfer the certificates sold from the seller account into the buyer account, both for the centralized and the bilateral market
- Romanian market for green certificates will commence to function soon
- The actors of electricity markets are to be involved in three parallel markets: for electricity, for green certificates and for emissions trading according to the national policies

Conclusions (3)

- The consumers will confront with a rise of prices for electricity which will reflect also the green certificates prices from the “green” electricity production and the emission permits prices from the “grey” electricity production
- It is important that all targets imposed by governments do not cumber the consumers and to use those systems which result in the least costs
- Green certificates and emission permits represent two produces that can be standardized at the international level
- OPCOM as a market operator, trades two different produces, independently each other and has in view the possibility to trade a third produce, the emission permits according to the evolution of Romanian policy in climate change mitigation

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Back to Proceedings

THE INFLUENCE OF THE ORGANIZED INVESTMENT IN SMALL HYDRO POWER PLANT BUILDING ON THE DEVELOPMENT OF DEREGULATING ELECTRIC ENERGY MARKET IN SERBIA WITH THE ANALYSIS OF POSSIBLE ENERGETIC-ECONOMIC-ECOLOGICAL BENEFITS

M. Babić[1], N.Pavlović[2], D. Milovanović[3], N. Jovičić[4], D. Gordić[5], M Despotović[6], V Šušterčič[7]

***Abstract*--The influence of organized investment in small hydro power plant building on the development of deregulating electric market in Serbia is presented in this paper. The results of analysis of energetic, economic and ecological benefits that can be derived from the process are also presented. In the process of initiation, preparation and forming of such approach participants were Ministry of Mining and Energy of Republic of Serbia, Electric Power Industry of Serbia, Energy Efficiency Agency of Republic of Serbia and Energy Regional Euro Efficiency Center Kragujevac. They prepared comprehensive pre-study entitled "The Master Plan for Small Hydro Power Plants Building in Serbia". The aims of that pre-study were to:**

- **preliminary investigate the influence of organized investment in small hydro power plants building on the development of deregulating electric market in Serbia;**
- **simulate energetic, economic and ecological possibilities of different variants of such approach for the next fifteen years;**
- **establish the optimal scenario for organized building of small power plants.**

All necessary political and administrative decisions related to the future development of Serbian national energetic sector are made and Electric Industry of Serbia had been already restructured. In this work, it has been attempted to identify methods for optimal management of the small power plants building in this new and for Serbian surrounding yet unsatisfactory clear economic conditions.

Besides the results of simulation of potential energetic, economic and ecological benefits from the Master plan realization, basic characteristics of original simulated mathematical model and developed software for determination of these characteristics are shown in this work.

[1] Milun Babić, professor of Faculty of Mechanical Engineering Kragujevac, University of Kragujevac, Regional Euro Energy Efficiency Center Kragujevac, Serbia and Montenegro, nastasija@ptt.yu

[2] Nenad Pavlović, Head of Serbian Energy Efficiency Agency, Belgrade, Serbia and Montenegro, npavlov@yubc.net

[3] Dobrica Milovanović, professor of Faculty of Mechanical Engineering Kragujevac, University of Kragujevac, Regional Euro Energy Efficiency Center Kragujevac, Serbia and Montenegro

[4] Nebojša Jovičić, assist. professor of Faculty of Mechanical Engineering Kragujevac, University of Kragujevac, Regional Euro Energy Efficiency Center Kragujevac, Serbia and Montenegro

[5] Dušan Gordić, assist. professor of Faculty of Mechanical Engineering Kragujevac, University of Kragujevac, Regional Euro Energy Efficiency Center Kragujevac, Serbia and Montenegro

[6] Milan Despotović, assist. professor of Faculty of Mechanical Engineering Kragujevac, University of Kragujevac, Regional Euro Energy Efficiency Center Kragujevac, Serbia and Montenegro

[7] Vanja Šušterčič, assist. professor of Faculty of Mechanical Engineering Kragujevac, University of Kragujevac, Regional Euro Energy Efficiency Center Kragujevac, Serbia and Montenegro

***Index Terms*--Costs, CO_x, electric power, ecological advantages, master plan, economic advantages, small hydro power plant, mathematical modeling, NO_x, optimization, ash, income, profit, reduction of the emission, scenario, simulation, power, SO_x, tempo of the building, expense, water flow**

I. Introduction

Since the first big oil crises during the 1970-s, there were few campaigns related to the problem of utilization of small water flows in Serbia. The campaigns were initiated by the government and they were ended as media events. The only exception is one such campaign in the 1980-s, when the Cadastral with about 800 location for the building of small hydro power plants (SHPP). Today, this result serves to all persons that try to admonish that at the Serbian territory unused energy resources with 500 – 600 MW of power exists so the views of state planners must be direct toward it.

For the first time the Energy Law instituted SHPP as future reality in Serbian Electric Energy System (EES) and stated true energy significance of small water flows. Benefits of SHPP use in the Law present challenge to business people and capital but in order to achieve organized exploitation of this renewable energy potential the relevant state agencies must support a series of directed steps.

Therewith, it should be mentioned that present and future investors in energy of small water flows are interested in:

- precise locations for SHPP building;
- the amount of energy that can be produced at every location;
- building costs of every concrete SHPP;
- payback time of the investment;
- estimation of the profit that can be earned during the time of SHPP exploitation.

This does not complete the list of potential equations that interested investors and businessmen can ask. They will be interested in:

- geo-morphological characteristics of the site;
- hydrological characteristics of water flows;
- the ownership of the land where small hydraulic accumulation and SHPP can be built;
- methodology, terms and conditions for obtaining the concessions from the competent state agencies;
- the position of the nods of distributive electro-energetic network where SHPP can be connected;

- technical and other conditions and terms for connection of SHPP to the network;
- possibilities of physical approach to the locations for the building of SHPP, etc.

In order to stimulate the building of SHPP investors must have prepared catalogues of potential constructional organizations, SHPP manufactures and services for their maintenance.

All mentioned data that should be at disposal to potential investors of SHPP building showed that in process of their collection and systematisation relevant state agencies should be engaged. If the state did not involve timely and pertinently in these activities the building of SHPP will be elemental which can lead to the creation of destabilizing subsystem of EES. In this case, the subsystem will be a disturbance on deregulated market of electric power.

Evaluating existing Cadastral of potential SHPP locations it can be concluded that the data from the Cadastral do not satisfy investor needs so there is a necessity for its reinvestigation, complement and modernization.

Regional Euro Energy Efficiency Center Kragujevac (REEECK) in cooperation with Serbian Energy Efficiency Agency (SEEA), created pre-study “The Main Plan for the Building of Small Hydro Power Plants in Serbia” (MP) evaluating current situation in field of so called “small energetic” “Ref. [1]”.

It was foreseen by the pre-study that SEEA coordinate the complete task. With the strategic support of Ministry of Mining and Energy, EES and partner organizations and experts from Serbia and abroad, SEEA should help that MP will be realized in the next 15 years.

The first phase comprises updating and evaluation of existing data from more then 800 locations for SHPP building investigated twenty years ago. The result of the phase will be:

- The limited number of deeper studied current locations and prospective building of SHPP at these locations in the future;
- The database visualized at geodetic electronic map of Serbia and set as a portal on web site of SEEA. The database will be accessible to potential investors through the internet with adequate reimbursement.

The second phase will be dedicated to questions of investing and building of SHPP at specific number of locations that have higher priority according to their investable characteristics. Those locations are abstracted from the total number of locations from the first phase.

The third phase comprises follow up of research of new locations for SHPP building out of already 800 detected. According to up to date research, water flows in the Serbia have significant potential for building of SHPP in the range of power literary classified as mini and micro power plants. Naturally, the phase comprises updating the web database created during the first phase.

The fourth phase is continuation of the second and third phase. It is related to building of SHPP according to priority list established during the first and third phase. The complete system with 1900 SHPP installed will be created at the end of the phase.

Different scenarios of MP realization were studied in the pre-study “Ref. [1]”. Using the appropriate software created for the purpose, series of interesting facts that enable creating the scenario with optimal relation between the tempo of SHPP building and the most significant ecological, energetic and economic consequences of MP realization were obtained.

II. Relationship between MP and started process of deregulation of electric energy market in Serbia

Following two facts were concerned during the work on the pre-study “Ref. [1]”:

- adequate political and administrative decisions were made in Serbia and preparations for market deregulation are undergoing;
- Electric Power Industry of Serbia (EPS) mastered relevant methods and tools and it started to reconstruct.

In the pre-study “Ref. [1]” it was considered that the range of current and future activities is not completely and/or adequately presented to public. It was also considered that Serbian electro energetic system would be soon confronted with following necessities to:

- complete and reconstitute its new corporative structure;
- improve its business performances in competitive conditions at the market;
- establish the optimal concept of control of Serbian electro energetic assets in the fields of maintenance of equipment and energy objects and reinvestment of assets in new plants with bigger number of investors due to conditions imposed by deregulated market of electric energy.

It should be emphasized that relevant government agencies and private investors will strongly insist on development of new assets in a form of SHPP for the exploitation of national hydro energy resources, as important way for achieving better economic results, for strengthening the market balance and especially for reducing the emissive of fuel gasses because the biggest part of actual environmental pollution is related to electric energy production in thermal power plants.

By initiation of GP modeling, activities on promotion of using all others renewable sources of energy will be launched, and Serbia will be directed toward EU targets, defining within demand for significantly increasing of participation of green energy sources in total energy to be produced until 2010.

With conducting the main targets of MP, within establishing of integral information system related to available locations for SHPP as well as with stakeholders (citizens, media, political and economic factors) awareness arising, in relatively short period, positively effects (economic, energy and environmental) will be viewed by all factors from production to consumption of electricity. The main benefit of MP on community and economy is in making preconditions for:

- efficiently and environmentally sound using of hydro energy from Serbian small water resources;

- environmental and resources protection as well as increasing of participation of renewable sources of energy;
- decreasing the consumption of domestic and imported non-renewable energy resources;
- increasing of domestic economy level, opening new production lines and new employments.

When one emphasizes the social benefit of the GP realization, it should be point to one of Serbian most priority targets defining with demand to follow and to harmonize standards and legislation in area of environmental protection and energy efficiency with EU adopted practice. The key instrument of EU environmental protection and energy efficiency politics is free access to information concerning environmental issues. With this directive, all national administrations in EU are obliged to provide information to each person or organization, with no interest about reason for that request. Having previous in mind, analysis, data management and information about natural resources and environment, as well as establishment, development and maintenance appropriate data base about available location for building small hydropower plants is in compliance with EU demand. Development of Internet portal devoted to available locations for building SHPP may be observed, not only from energy stand point, but as a contribution to development of national environmental information system, that is precondition for accessing to European Environment Information and Observation Network (EIONET) as a collaborative network of the European Environment Agency. Therefore, realization of GP will be one of initial step in process of accessing of Serbia in one such complex system like EIONET, that is sophisticated way to perform European integration in area of environmental protection and energy efficiency.

III. Basic schemes of simulation model

REEECK developed and tested contemporary and original software in order to estimate adequacy and profitability of MP conduct. The software enables easy variation of all input data. As output result, it gives a big number of important data that can be very useful for analyzing and establishing the optimal scenario of MP realization.

Due to limiting space and purpose of the paper, the number of output quantities is reduced in a way that enables simple way of understanding possibilities of MP realization. The possibilities are related to ecological (due to reduced lignite consumption) and financial benefits. For obtaining the more objective picture of benefits that comes with MP realization, performances of its realization that can be achieved in every possible scenario, even in the case the ecological benefits of reduced lignite consumption are excluded from the calculation as well as incomes from side activities (tourism, agriculture, etc), are calculated but not presented in the paper.

III.1. Input data

Analysis of energetic, economic and ecological justification of MB was based on following presumptions:

- number of locations for SHPP buildings in the first and the second phase is 800;
- average installed electric power of SHPP that will be built on the locations in the first and the second phase is 610 kW;
- number of locations for SHPP buildings in the third phase is 1100;
- average installed electric power of SHPP that will be built on the locations in the third phase is 70 kW;
- average prices for SHPP building are: 1700, 1900, 2100 [EUR/kW of installed electric power];
- prices of electric energy produced at SHPP are 0.04, 0.05 and 0.06 [EUR/kWh] in 2004; it was presumed that the price of electricity will rise by 2 % in every two years;
- economic lifetime of SHPP is 20 years;
- real interest rate is 4.5 %;
- loan repayment periods were: 4, 6, 8, 10 and 12 years;
- electricity produced in SHPP reduce the consumption of "Kolubara" lignite with following characteristics: C=23.28%, H=2.28%, O=9.82%, N=0.62%, S=0.26%, A=10.96%, W=52.80% and H_d=7,771[kJ/kg];
- during combustion in boiler with air factor λ=1.3 combustion products have following composition and characteristics: $(CO_2)_s$=14.48%, $(CO_2)_w$=11.14%, $(H_2O)_w$=23.5%, $(O_2)_w$=3.79%, V_{RS}=3.006[m^3/kg]; V_{RV} =3.918[m^3/kg]; V_L=3.065[m^3/kg];
- average efficiency of domestic thermal power plants is $\eta_{TE} = 0{,}28$;
- this equivalence is valid:

$$1\,[MWh\ \ produced\ \ electricity] \equiv$$
$$\equiv 1.654\,[tons\ \ of\ \ equivalent\ \ domestic\ \ lignite]$$

- in order to provide adequate environmental protection, during electricity production with domestic lignite in thermal power plant following quantities must be isolated from combustion products:
  - 0.385 [kgCO_x/kWh of produced electricity];
  - 0.0102 [kgNO_x/kWh of produced electricity];
  - 0.0043 [kgSO_x/kWh of produced electricity] and
  - 0.1813 [kg ashes/kWh of produced electricity].

  Following data are also adopted:
- price of CO_x reduction from exhaust gasses is 8.5 [EUR/tons CO_x];
- price of NO_x reduction from exhaust gasses is 19.3 [EUR/tons NO_x];
- price of SO_x reduction from exhaust gasses is 13.5 [EUR/tons SO_x];
- price of ashes reduction from exhaust gasses is 12.3 [EUR/tons ashes].

III.2. Standard "simulation" scenarios

Using the developed software, the realization of MP could be simulated as:

Simulation scenario {(a-b-c-d)-e-f-k-i-j} , (1)

where the marks are explained in the Table I.

III.3. BASIC MATHEMATICAL EXPRESSIONS USED IN SIMULATION SOFTWARE

For creating the mathematical model of possible MP scenarios, certain presumptions were used. They can be described with mathematical formulae presented in this subchapter.

The growth of produced electric energy in newly built SHPP will be realized according the next mathematical relation:

$$P_{eg} = c + a \cdot (T_g - 2004)^b \quad , \tag{2}$$

where:

P_{eg} $[kW]$ - total power of SHPP that will be built in current year of fifteen years of realization of the fourth MP phase. With alternative scenarios it is foreseen that by the end of the year 2012. SHPP with total power of 10% or 20% or 30% or 40% or 50% or 60% or 70% or 80% or 90% or 95% of total preliminary estimated power 565,000 kW will be set and started on locations with highest priority;

T_g $[year]$ - current year of MP realization;

a, *b*, *c* - coefficients mathematically determined in every simulation process.

Economic benefits of produced electricity were obtained according to:

$$\begin{aligned} D_{elek} &= D_{elekP} + C_{T_g} \cdot A_{elek} \quad , \\ A_{elek} &= 24 \cdot [(\eta_{T_p} \cdot P_{eP} + \eta_{T_g} \cdot P_{eg}) \cdot \\ &\quad \cdot (T_g - T_{(g-2)})] \cdot n_{rdg} \end{aligned} \tag{3}$$

where:

D_{elek} $[EUR]$ - income from the produced electric energy at the end of current two-year period of the fourth phase;

D_{elekP} $[EUR]$ - income from the produced electric energy before the beginning of current two-year period of the fourth phase

A_{elek} $[kWh]$ - amount of electric energy produced by all SHPP during the current two-year period of the fourth phase;

C_{T_g} $[EUR/kWh]$ - average price of electric energy during the current two-year period of the fourth phase (for the based year 2004 the price is 0.05 [EUR/kWh]);

η_{Tp} $[-]$ - degree of SHPP operative readiness during the current two-year period of the fourth phase (they were built before the phase) (adopted value is 0.98);

P_{eP} $[kW]$ - electric power of SHPP that were built before the beginning of the current two-year period of the fourth phase;

η_{T_g} $[-]$ - degree of SHPP construction and operative readiness during the current two-year period of the fourth phase (they were built during the phase) (adopted value is 0.5);

TABLE I.

(a-b-c-d)	*e*	*f*	*k*	*i*	*j*
MP phases which realization is simulated. Next combinations can be realized: 1-2-3-4; 1-2-4 i 3-4	SHPP building costs [EUR/kWh].	Loan repayment time [year]. Every even number from the group (4,…12) could be chosen as a loan repayment time.	Percentage of total available power determined in phases *a*, *b* and *c* that can be used in phase *d* up to set based year. As a base year, any number from the group (2006,..,2016) could be chosen.	Amount in [%] of total produced electric energy in SHPP that defines the incomes from side activities.	Price of electric energy produced in SHPP established for the base year 2004.

T_g $[year]$ - end of the current two-year period of the fourth phase;

$T_{(g-2)}$ $[year]$ - beginning of the current two-year period of the fourth phase;

n_{rdg} $[-]$ - number of annually working days of SHPP during the current two-year period of the fourth phase (adopted value is 295);

$24\,[h]$ - number of daily working hours of SHPP during the current two-year period of the fourth phase;

Income from environmental savings can be calculated as:

$$\begin{aligned} D_{ekolos} &= D_{CO_x} + D_{SO_x} + D_{NO_x} + D_{pepeo} = \\ &= (k_{CO_x} + k_{SO_x} + k_{NO_x} + k_{pepeo}) \cdot A_{eleku} \ , \end{aligned} \tag{4}$$

where:

$D_{ekolos}[EUR]$ - *costs of elimination of all adverse products* that could be generated by combustion of equivalent domestic lignite when producing the same amount of electric energy as SHPP, during the current two-year period of the fourth phase and from the initiation of MP till the beginning of the current two-year period;

$D_{CO_x}[EUR]$ - *costs of elimination of CO_x* (CO_2 and CO) from fuel gasses that could be generated by combustion of equivalent domestic lignite when producing the same amount of electric energy as SHPP, during the current two-year period of the fourth phase and from the initiation of MP till the beginning of the current two-year period;

$D_{SO_x}\left[EUR\right]$ - *costs of elimination of* SO_x (SO_2 and SO) from fuel gasses that could be generated by combustion of equivalent domestic lignite when producing the same amount of electric energy as SHPP, during the current two-year period of the fourth phase and from the initiation of MP till the beginning of the current two-year period;

$D_{NO_x}\left[EUR\right]$ - *costs of elimination of* NO_x from fuel gasses that could be generated by combustion of equivalent domestic lignite when producing the same amount of electric energy as SHPP, during the current two-year period of the fourth phase and from the initiation of MP till the beginning of the current two-year period;

$D_{pepeo}\left[EUR\right]$ - *costs of elimination of ashes* from fuel gasses that could be generated by combustion of equivalent domestic lignite when producing the same amount of electric energy as SHPP, during the current two-year period of the fourth phase and from the initiation of MP till the beginning of the current two-year period;

$A_{eleku}\left[kWh\right]$ - produced electric energy from the initiation of MP till the end of the current two-year period of the fourth phase;

$k_{CO_x} = 3{,}273 \cdot 10^{-3}[EUR/kWh\ prod.\ el.en.]$- unit price of CO_x removal from fuel gases generated by combustion of equivalent domestic lignite;

$k_{SO_x} = 5{,}805 \cdot 10^{-4}[EUR/kWh\ prod.\ el.en.]$- unit price of SO_x removal from fuel gases generated by combustion of equivalent domestic lignite.

$k_{NO_x} = 1{,}969 \cdot 10^{-4}[EUR/kWh\ prod.\ el.en.]$- unit price of NO_x removal from fuel gases generated by combustion of equivalent domestic lignite;

$k_{ash} = 2{,}230 \cdot 10^{-3}[EUR/kWh\ prod.\ el.en.]$- unit price of ashes removal from fuel gases generated by combustion of equivalent domestic lignite;

$k_{PD}\ [-]$- income coefficient from side activities.

Crediting of SHPP construction was simulated in accordance with domestic bank policies. It is possible to select loan period and analyze it effects on profit.

IV. Lay out of energetic and economic results of MP mathematic simulation

At fig. 1. to 14. the results of MP simulation are shown. They were obtained according the following simulation scenario:

Simulation scenario {(1-2-3-4)-1900[EUR]-4[years]-(10%-95%)-20%-0,05[EUR]}, (5)

where arguments ***{(1-2-3-4)-1900[EUR]-4[years]-(10%-95%)-20%-0,05[EUR]}*** in equation (5) corresponds to arguments ***{(a-b-c-d), e, f, k, i, j}*** from equation (1).

V. Conclusion

Firstly, from the structural point of view, MP is demanding challenge considering activities that should be done and consequences it will have on future development of Serbian electro energetic system. MP is significant because it engages experts with different education and enables international cooperation. Secondly, the part of MP preparation costs could be covered with international donations. Thirdly, MP will enable the estimation of problem that EES will face during the continuing process of transition and electric energy market deregulation. So, it can serve as a range for preparation of relevant state agencies, EPS and EES to adequately and qualitatively react on transitional challenges. Fourthly, successful MP realization will open the door for domestic and foreign private investors in EES through the SHPP building and concessions for the building.

It should be emphasized that MP will help in:

- bringing adequate laws in this activities that should simplify and short procedures for obtaining licences for building and use of SHPP;
- preventing unsystematic SHPP building and "polluting" electro distributive network (distortion of electric parameters in the network) that can be created with massive, dilettante building and plugging of SHPP to electro distributive system as well as their inadequate maintenance during exploitation;
- securing that SHPP be a reliable source of electric energy at the whole territory of Serbia in case of eventual climate and other emergencies;
- efficient and ecological use of energy potential of so called small water flows in Serbia;
- environmental and conventional energy recourses protection;
- increasing the concurrency of Serbian economy, opening new production lines and increasing employment;
- directing Serbia toward projected EU targets, defined within demand for significantly increasing of participation of green energy sources in total energy to be produced until 2010.

VI. Literature

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[2] M. Babić, N. Pavlović, D. Milovanović, N. Jovičić, D. Gordić, M.Despotović, V. Šušterčič: **Ecological benefits of implementation of Master plan for SHPP building in Serbia**, „Energija“, No.1, pp. 008 - 012, Belgrad, May 2005.

[3] M. Babić, N. Pavlović, D. Milovanović, N. Jovičić, D. Gordić, M. Despotović, V. Šušterčič: **Analysis of potential energy-economic-ecological contributions of realization of Master plan for SHPP building in Serbia**, accepted for presentation at „Energetika 2005“, Zlatibor, 19 – 22. June 2005.

VII. BIOGRAPHIES

Milun Babić was born on September 16, 1950 in Sjenica, Serbia. Lives in Kragujevac and Belgrade and works as a full professor at Energy and Process Engineering Department, Faculty of Mechanical Engineering, University of Kragujevac.

Fields of interest: turbomachines, applied fluid mechanic, process engeneering, hydraulics and pneumatics, energy efficiency, renewable energy sources, eco-technologies, computer simulations.

Vanja Šušteršič was born in Kragujevac, Yugoslavia, on 15.05.1967. He graduated at the Faculty of Mechanical Engineering, University of Kragujevac in 1985. At the same university, he got M.Sc. degree in Mechanical Engineering in 1995, and Ph.D. degree in Mechanical Engineering in 2004.

Fields of interest: applied hydraulics and pneumatics, energy efficiency in industry, renewable energy sources, eco-technologies, computer simulations.

Milan Despotović was born in Kragujevac, Yugoslavia, on August 11, 1968. He graduated at the Faculty of Mechanical Engineering, University of Kragujevac in 1990. At the same university, he got M.Sc. degree in Mechanical Engineering in June 1994, and Ph.D. degree in Mechanical Engineering in June 2002.

Fields of interest: Computer Simulations, Applied Fluid Mechanics, Computational Fluid Dynamics, CFD Applications, Energy & Computer Aided Energy Engineering.

Dušan Gordić was born in Prijepolje, Serbia on October 26, 1970. PhD in Mechanical Engineering from the University of Kragujevac in 2002. Assistant professor in areas of fluid power & control and energy and environment at the Faculty of Mechanical Engineering in Kragujevac.

Fields of interest: applied hydraulics and pneumatics, energy efficiency in industry, renewable energy sources, eco-technologies, computer simulations.

Nebojša Jovičić was born on March 2, 1963 in Kragujevac, Serbia. Lives in Kragujevac and works as an assistant professor at Energy and Process Engineering Department, Faculty of Mechanical Engineering, University of Kragujevac.

Fields of interest: Applied hydraulics and pneumatics, process engineering, energy management, renewable and alternative energy sources, eco-technologies

Scenario of SHPP building based on different percentage (k = 10%, 20%,…,95%) of total power that can be generated by SHPP at Serbian territory until the year 2012.

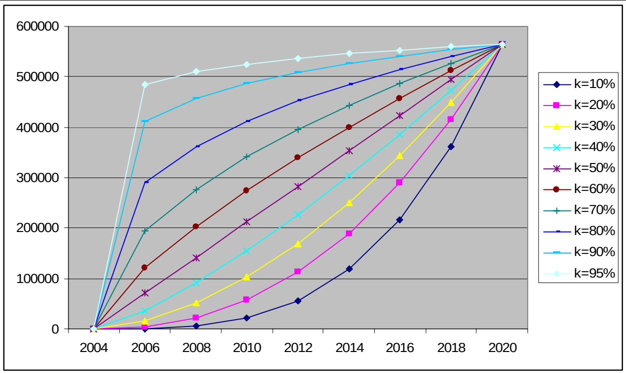


Fig. 1. Tempo of SHPP building during MP (Power P_{eg} [kW] of built SHPP during current period])

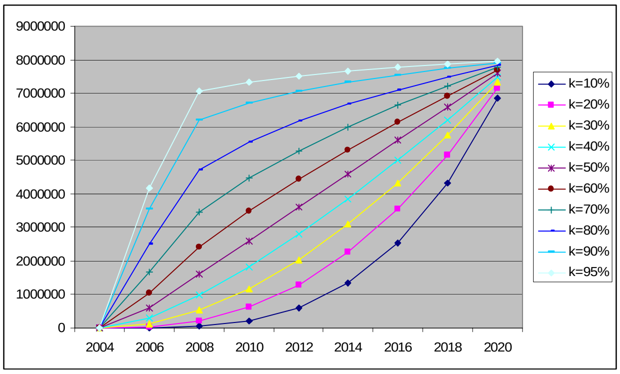


Fig. 2. Electric energy A_{eleku} [MWh] produced by SHPP during MP

Scenario of SHPP building based on different percentage (k = 10%, 20%,…,95%) of total power that can be generated by SHPP at Serbian territory until the year 2012.

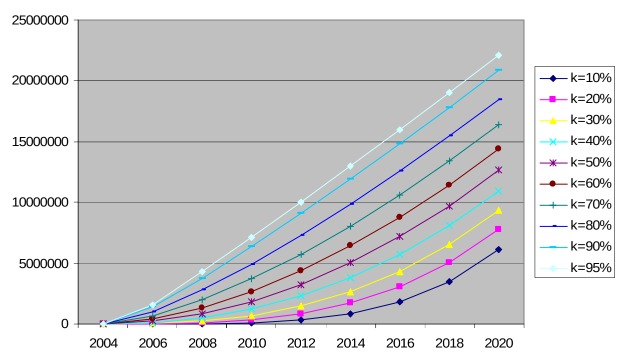


Fig. 3. Reduced CO_x from the begging of MP in [tons]

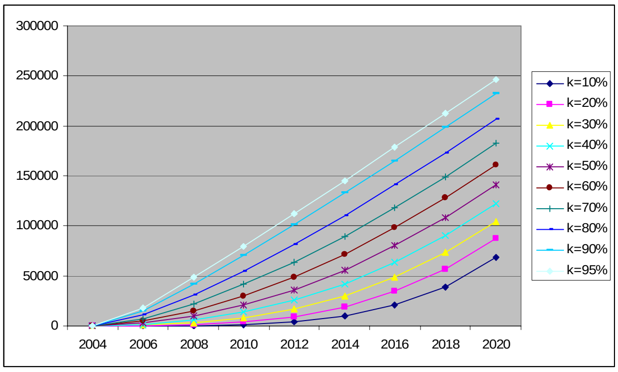


Fig. 4. Reduced SO_x from the begging of MP in [tons]

Scenario of SHPP building based on different percentage (k = 10%, 20%,…,95%) of total power that can be generated by SHPP at Serbian territory until the year 2012.

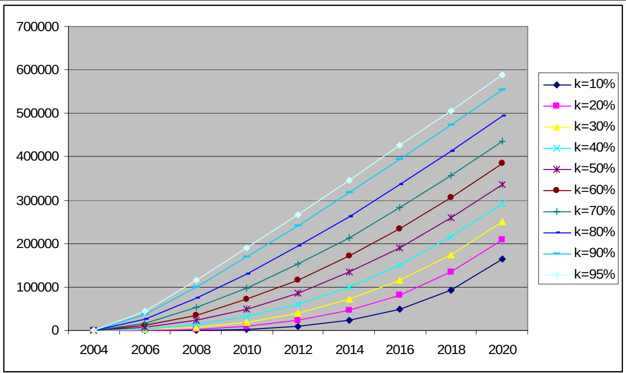


Fig. 5. Reduced NO_x from the begging of MP in [tons]

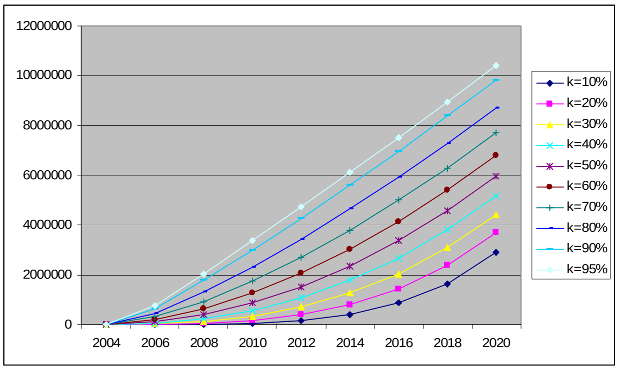


Fig. 6. Reduced ashes from the begging of MP in [tons]]

Scenario of SHPP building based on different percentage (k = 10%, 20%,…,95%) of total power that can be generated by SHPP at Serbian territory until the year 2012.

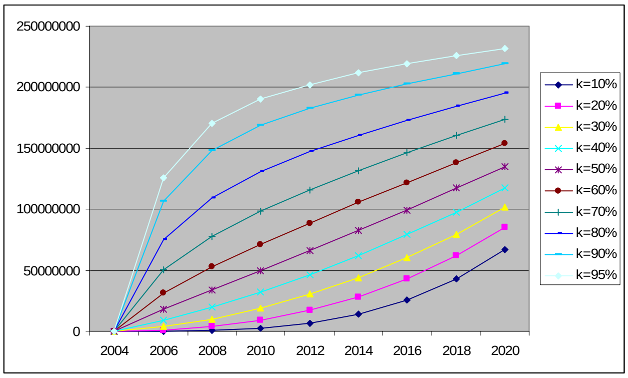


Fig. 7. The average annual income from produced electric energy D_{elek} [EUR/god] during MP

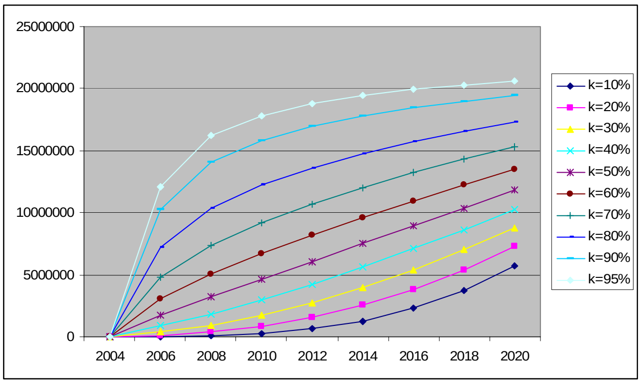


Fig. 8. The average annual cost reduction due to lignite substitution D_{ekolos} [EUR/god] during MP

Scenario of SHPP building based on different percentage (k = 10%, 20%,…,95%) of total power that can be generated by SHPP at Serbian territory until the year 2012.

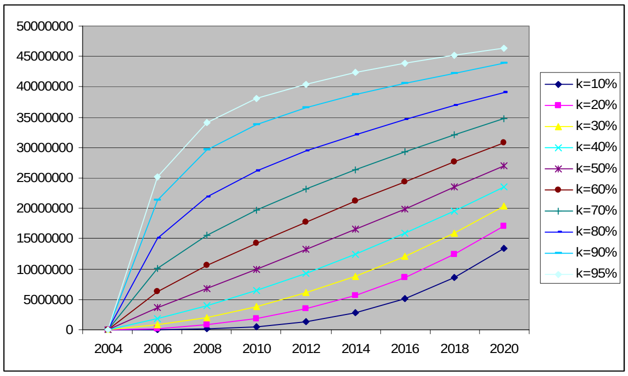


Fig. 9. The average annual incomes from side activities that will be developed simultaneously during MP D_{PD} [EUR/god]

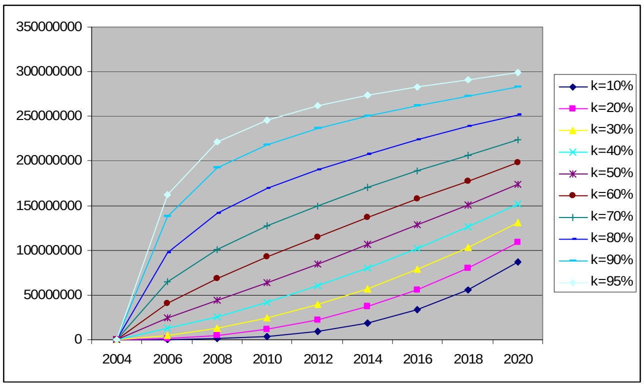


Fig. 10. Total average annual earnings during MP [EUR/year]

Scenario of SHPP building based on different percentage (k = 10%, 20%,…,95%) of total power that can be generated by SHPP at Serbian territory until the year 2012.

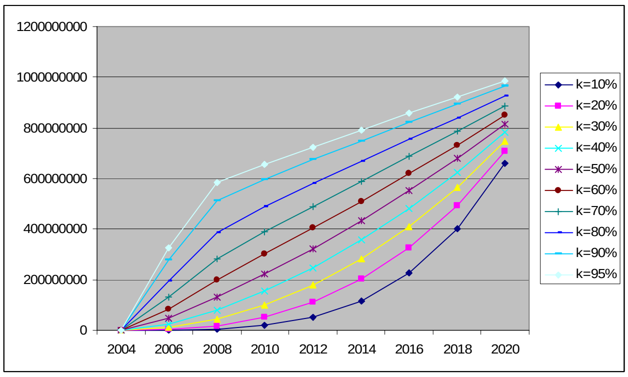


Fig. 11. Incomes during MP (produced electricity + ecological benefits + side activities) in [EUR]

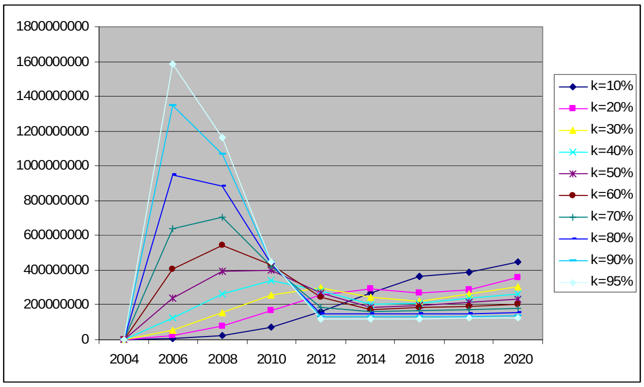


Fig. 12. Costs during MP (SHPP building costs +SHPP maintenance costs + SHPP maintenance worker salaries) [EUR]

Scenario of SHPP building based on different percentage (k = 10%, 20%,…,95%) of total power that can be generated by SHPP at Serbian territory until the year 2012.

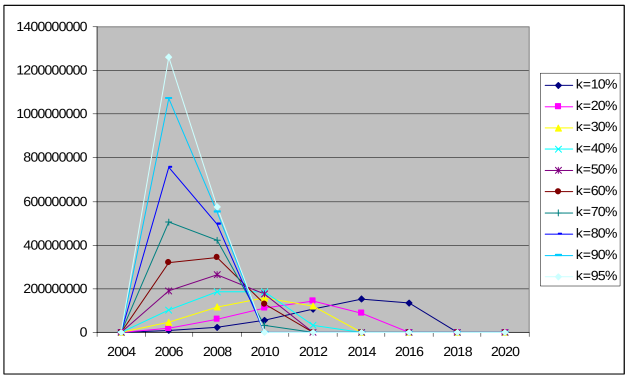


Fig. 13. Loans for MP realization [EUR]

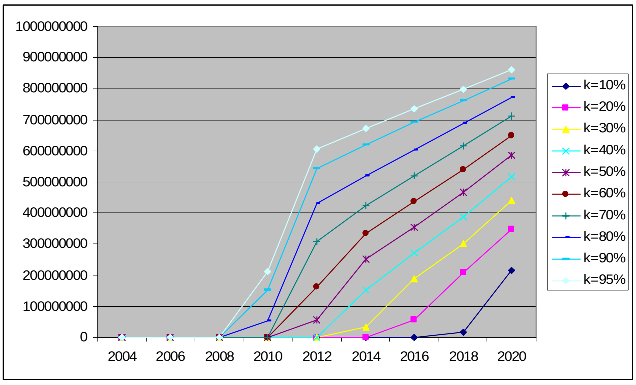


Fig. 14. Profit (difference between incomes and costs plus loan disbursement) during MP [EUR]

"Strategy to Promote RES in Mountain Regions, incl. Eastern European Countries"

Mrs. Violetta Groseva
Manager of Sofia Energy Centre

***Abstract*—A strategy for promotion of RES in Mountain regions is elaborated within the framework of the SHERPA project within "ALTENER" program of EC. SHERPA is an acronym, standing for "Strategy to Promote Mountain Huts Renewable Energy Sources and Their Rational Use World Wide from Alps to Alps". The project is devoted to the establishment of guidelines to help widespread use of Renewable Energy Sources (RES) and to promote the Rational Use of Energy (RUE) in the mountain huts all around the world. As a preliminary work to elaborate the European strategy according to technical, social and economic means, an inquiry took place among the huts managed by the Alpine Clubs in Germany/Austria, France, Italy and Bulgaria. The data were analyzed so as to give an extensive description of the state of the art of the energy supply and RUE. This analysis allows to highlight what kind of systems are suited to different kind of mountain huts and therefore facilitates the elaboration of a list of recommendations and good practices. After this first work phase, two international workshops were organized in order to disseminate the knowledge and the experience to Eastern European countries and the rest of the world.**

I. Main objective

THE main objective of the project SHERPA is to elaborate an appropriate strategy for utilization of renewable energy sources (RES) and rational use of energy (RUE) in mountain regions and especially in mountain huts.

The tourist development of mountain areas contain a specific challenge. On one hand environmental protection and conservation are important, and on the other hand, certain conditions are required in order to satisfy the tourist needs. The tourists look forward to a warm meal and a cool drink. In addition, the tourist infrastructure has to provide a certain degree of security in case of emergency (e.g. communication, assistance and medical care).

The SHERPA challenge is the energy supply in mountain regions for satisfaction of energy needs and at the same time environmental protection.

The aim of sustainable tourism is to conserve the beauty of the mountains and at the same time to guarantee the attractiveness for recreational activities.

The European Alpine Clubs have, for the recent years, installed many systems for utilization of RES, especially photovoltaic elements. The experience from the introduction of RES offers an opportunity to establish the most efficient and appropriate technologies for energy supply, from technical and economical point of view, which are adopted and supported by the end users and protect the environment.

The mountain huts and the isolated settlements represent a remote place for living. Being such, they need all types of energy (electrical, heat, mechanical). Of great importance is electrical energy which is necessary for informational connections and communication (radio, television, mobile phones, etc.).

The connection of the mountain huts and the remote sites to the electrical grid is very expensive and hard. The utilization of diesel gen-sets requires supply of liquid fuels. There are Small HPPs at many places in the mountain regions, but not everywhere there are conditions for their construction. That is why PV systems found great application in the Alpine huts.

II. Methodology

At the beginning of the project, a survey was conducted in order to analyze the actual state of art of the mountain huts and their energy supply.

An elaborated in details questionnaire was sent to 500 huts in Italy, 200 in Germany and Austria, 150 in France and 60 in Bulgaria. From the received answers, for the data base were considered huts situated at 1000 meters above the sea level.

The main topics were:

- General characteristics of the Huts (size, amount of guests per season, period of business, situation, supply with goods);
- Equipment (which household appliances are in use, which kind of service is offered to the guests);
- Energy supply (which energy sources are used for covering the energy demand?);
- Energy efficiency (which measures are taken in order to save energy?);
- Investment costs (what was the price for the energy supply system?);
- Experiences (are the landlords content with the energy supply?)

From this survey we wanted to infer which kind of technology is used at the moment. Moreover, this could provide information about the different nations: Are they implementing a sustainable energy policy in this area and how advanced is it?

III. Hut characteristics

From the analysis of the general data for the different countries, the size of the huts according the average number of beds is:

Country	Bulgaria	France	Germany / Austria	Italy
Beds	67	58	80	40

In conclusion, we could mention that the huts in Germany/Austria are big ones, as well as in Bulgaria, while in Italy the number of small huts prevails.

Below, as an illustration are presented the characteristics of the huts in Bulgaria:

- There are 267 sites to the Bulgarian Tourist Union - BTU (mountain hostels and huts);
- The huts are managed by BTU with the help of 130 tourist companies, on territorial principle, which are legal entities with non commercial purpose;
- Before 1989 the mountain huts in Bulgaria were 100% subsidized by the state budget through the respective municipality. At the present moment this percentage is only 17%;
- Most of the huts and shelters are state-owned and there are some, rented by private companies;
- The huts are comparatively large;
- The huts are guarded and operate all the year around, but they are visited mainly from June-till September;
- Most of them are accessible with vehicles, and where not, with horses and donkeys;
- The huts dispose of cookers and heaters mainly on biomass, and at some places on gas or electricity, where the utilization of biomass is limited;
- The huts dispose of electrical appliances like refrigerators, freezers, washing machines;
- With small exceptions, the huts are grid-connected, mainly on low voltage;
- The huts are equipped with running water, but not everywhere there is hot water;
- The huts are situated as follows: up tp 1000 m – 17%; from 1000 to 1500 m – 33%; from 1500 to 2000 m – 42%; from 2000 to 2500 m – 8%;

IV. Electrical energy supply

In general, due to the commitment of the Alpine clubs, renewable energies are relatively widespread in the Alps. The following figure will give an overview about the technology which is used for electricity production at the present time. In general, Photovoltaic systems are rather numerous. This is also due to the fact that the production ratio of PV cells might be even more efficient than in the lowlands because of reflection and higher sun radiation.

The utilization of hydropower is rather common as well – but hydropower is not available everywhere or may not be used due to legal circumstances (e.g. in France).

Figure 1 shows the number of systems found in each country according to the type of system. A high variety of combinations have been found, many of them use several generators and the very big majority includes batteries and an inverter:

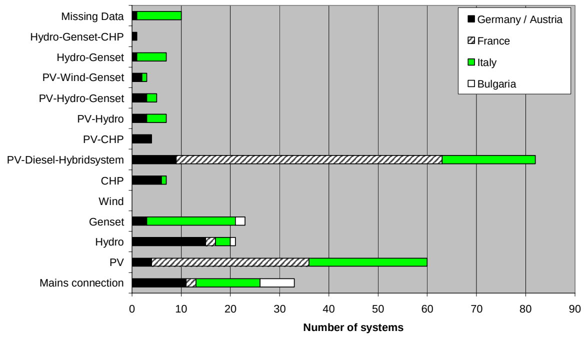


Fig. 1. Different power supply systems.

The main features of the systems are very much linked to the country. In France, mainly PV and hybrid PV-diesel standardized systems have been found.

Contrary to this standardized aspect of French huts, in Germany the systems are very various and are very often a mix of several devices. The German systems have a big power (because the huts are the biggest ones and the most equipped) and use CHP units.

In Italy, the small power systems (small huts) are mainly based on PV or water turbines.

With regard to **Bulgaria** the electricity supply could be summarized as follows:

- The main part (more than 80%) of the huts are grid-connected, mainly on low voltage, which in many cases is unstable;
- In most of the huts (58%) there is a reserve diesel gen-set;
- Some of the huts dispose of Small HPPs;
- The PV systems are not very common. There are PV systems for meteorological stations on the peaks Mussala, Cherni Vruh and Murgash and on hut "Murgash".

V. Heat energy and transport

For the production of warm water and the heating of rooms most huts use boilers and stove with various fuels. Solar Thermal collectors are used in Germany. The commitment of the German Alpine Club to the promotion of CHP units which can be run with vegetable oil can be seen as positive tendency.

In Bulgaria, 80% of the huts are supplied with hot water and heating with the help of boilers. From them, 16 % are wood-fired, and the rest operate with liquid fuel or electricity.

On figure 2 are given different ways for heat production.

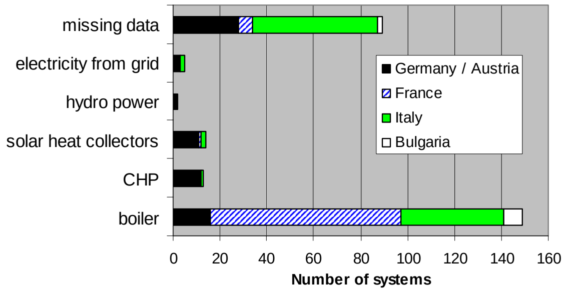


Fig. 2. Different ways to produce heat.

Cooking requires particular kinds of primary energy. Not all kinds of fuels can be used, contrary to the fuels used in a boiler.

In Bulgaria a mix of electricity and wood is used, while in France almost all cookers use gas.

On the contrary, in Italy and Germany and Austria, the fuels used are often a mix of gas, electricity and wood. It has to be noticed that the biomass wood is present in.

Regarding transport, the differences between the nations are quite clear. The huts in France are supplied with helicopters predominantly (about 80%). The construction of a cable railway is prohibited in the French nature protection areas. In Germany, the goods are delivered with cable railways (46%) or by car. In many cases the cars transport the delivery to the cable railway in the valley next to the hut. Helicopters are rarely used. In Italy, cars, helicopters and cable railways are used. In Bulgaria, there is a road to the greatest part of the huts. Where there are no roads, the goods are transported with horses, donkeys or on the shoulders of the mountaineers. There are no special cable railways and no helicopters are used.

The different ways of transportation are presented on figure 3.

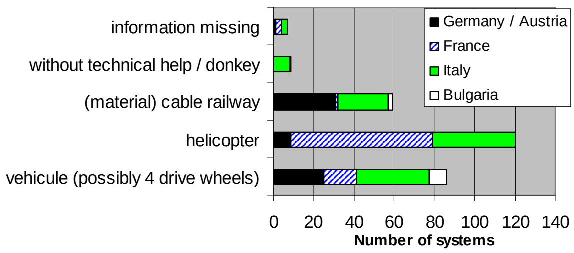


Fig. 3. Different ways of transportation

Strictly speaking, the use of helicopters and of cable railways which are run by a Diesel motor does not fit into the paradigm of an ecological supply concept. But helicopters with bio fuels are still no realistic option, and even the construction of cable railways is not possible due to the legal background in many cases. Additional, they are the more expensive option in most cases.

VI. UTILIZATION OF RES

RES are a good solution for the energy supply in mountain areas due to the following reasons:

- They are using the power of the sun, water ,bio mass and wind in order to produce clean energy. Thus they are ecologically compatible and low-emission.
- They are suited for local and independent energy production.
- They are promoting environmental-friendly energy supply towards tourists and visitors and are contributing to positive attitude toward rational use of energy and innovative technologies

The utilization of the different RES in Bulgaria is as follows:

- **Water energy:** Small HPPs have relatively good application;
- **Biomass:** Wood secure around 16% of the needs from hot water and heating;
- **Solar energy:**
  - There are no solar thermal systems installed;
  - There are few applications of photovoltaic elements.
- **Wind energy:** There are no wind generators.

From the received answers to the question “Which RES do you consider perspective?”, on the first place is solar energy, followed by SHPPs and biomass.

VII. ENERGY EFFICIENCY – RATIONAL USE OF ENERGY (RUE)

The cheapest energy is the one which is not consumed. So measures for energy efficiency are a crucial step towards the implementation of a sustainable energy concept. Many mountain huts can serve as a good example for minimizing the energy demand while offering a good service to the guests. There are huts in France in Germany which are only supplied by a PV system.

Examples for measures of energy efficiency in a mountain hut are:

- Building measures (thermal insulation, well-isolating windows);
- More efficient and better adjustable energy systems (e.g. the heating);
- The use of CHPs;
- Usage of energy efficient household appliances;
- Energy saving lamps and time switches for lighting;
- Restriction of the amount of hot water in the bathroom;
- Additional warm water connection for dishwasher and washing machine

The energy system in a mountain hut has to keep the balance between satisfying people’s needs and the efficient and economical use of available resources. It can be important to convey to the tourists why certain restrictions are necessary. Visiting a mountain hut, the emphasis should lie on the enjoyment of nature.

The SHERPA survey has shown that lots of measures for energy efficiency are already taken, like the usage of energy saving lamps in most huts. Other energy efficient household appliances are used partly, but not systematically.

Regarding energy efficiency in Bulgarian huts could be concluded that there are no energy efficient measures, there are no energy efficient appliances and lamps. The landlords are not aware of the energy efficiency symbols. As energy efficiency measures could be mentioned only the additional payment for hot water or limited quantity of hot water per shower.

VIII. Conclusions for Bulgaria

From the investigation on utilization of RES in Bulgarian mountain regions could be derived the following conclusions:

- **Main factors influencing the implementation of RES:**
  - **Investments.** The high price of the installations for RES and the additional costs, as a result of the remoteness of the mountain huts and hostels;
  - **Motivation.** Mainly the lack of financial stimuli;
  - **Development of the commercial and servicing network.** Consultations, installation, maintenance;
  - **Price of the energy resources;**
  - **Sufficient information** which has to reach to the end user. Necessity from regional and national campaigns, defining the advantages of RES utilization;
  - **Necessity from training courses** on utilization of RES installations.
- **Factors, supporting the utilization of RES:**
  - Strengthening the measures for environmental protection;
  - Implementation of RES with different eco programs, for example, Development of the Bulgarian Eco-tourism;
  - The decentralization of the state regulation and management, and the greater independence of the local and regional authorities will lead to development of RES, while through their utilization is achieved:
    - Improvement of the environment;
    - Economic development and,
    - Increase of employment.
  - The prices of the conventional energy sources have increased manifold and will continue to increase in the future. The price of the equipment for utilization or RES is going down, especially the one of PV systems.
  - One of the priorities for development of Bulgaria is tourism, and especially eco-tourism. The utilization of equipment for RES in mountain regions and huts will contribute to raising the quality of the Bulgarian eco-tourism and preservation of our mountains;
  - The utilization of RES is something new for Bulgaria and requires a new way of thinking and a new approach to development of RES. Joint efforts are necessary, on the part of the state with its regulatory functions, as well as on the part of the entrepreneurs and the financial institutions. Necessary are regional and national campaigns, underlining the advantages of utilization of RES for energy savings and environmental protection.

IX. General conclusions

The SHERPA project objective is sustainable energy supply of mountain huts with rational use of energy, satisfaction of the needs of customers and environmental protection. From the study could be concluded that:

- A political promotion of RES and RUE is necessary, on national as well as on regional level, for wider utilization of renewable energies and energy efficient technologies.
- In this process should actively participate the regional authorities, the different Alpine clubs and Tourist organizations, as well as the personnel in the huts.
- A wider campaign is needed among the visitors of the mountains (tourist, skiers, mountaineers, etc) for rational use of energy and environmental protection and conservation.

X. Acknowledgment

This work was partially funded by the European Commission under the Altener 3 Programme Sherpa AL 2002-098. The project is being implemented with the joint efforts of the partners Sofia Energy Centre - Bulgaria, Transénergie in partnership with the CAF (French Alpine Club) - France, ISET and DAV (German Alpine Club) – Germany and Austria, Sasso in partnership with the CAI (Italian Alpine Club) – Italy and the University Magdeburg - Germany.

XI. Biographies

Violetta Groseva, Manager of Sofia Energy Centre

37, Galichitsa Str., Entr. 2, 1164 Sofia Bulgaria

Tel.: (+359 2) 962 84 43; Fax: (+359 2) 962 84 47

E-mail: vgroseva@sec.bg

Mrs. Violetta Groseva graduated from the Technical University of Sofia as an Electrical Engineer, she also had a post graduate specialization in Energy Management. Mrs. Violetta Groseva has an extensive experience in coordination, elaboration and implementation of studies, assessments and promotional activities under different EU programmes in Bulgaria being: Deputy Director of EC Energy Centre Sofia, Manager of Sofia Energy Centre and Manager of FEMOPET Bulgaria and Balkan OPET. Long record of professional experience in the field of energy efficiency and RES.

Electricity Production in Isolated Regions with Biomass Stirling Engine

E. Podesser, P. Enzinger, H. Dermouz

Abstract-**The goals of the R&D work were the design, construction and operation of a biomass Stirling engine, which is heated by the untreated flue gas of a biomass furnace. All kinds of burnable biomass, e.g. forestry and agriculture residues, log or chip wood, shells of fruits like coffee shells, generally may be used as bio fuel. The major problem of this development is given by the particle content of the flue gas. To avoid obstacles and fouling at the outside of the hot heat exchanger, smooth heat resistant tubes are used. This design assures a self cleaning effect if the flue gas temperature changes. The α-type Stirling engine was selected for cost reasons, because many parts from industrial mass production can be used for this Stirling engine type. A biomass Stirling engine with a shaft power of 3 kW for lab tests was designed and constructed. The engine was integrated in a biomass furnace. No combustion gas treatment was made. Nitrogen was used as working gas. With a working gas pressure of 33 bar, 600 rpm, a shaft power of 3,2 kW at a coefficient of performance of 0,24 (shaft power/heat) was verified. A larger biomass Stirling engine with a shaft power of 50 kW was designed and constructed.**

Index Terms – **Biomass fuel, electricity production, flue gas powered, rural areas, biomass Stirling engine**

This work was supported in part by the Government of Styria, the European Union, Styrian Hydropower and Electricity Company, Leobersdorfer Engine Factory and the Austrian National Bank.

E. Podesser, P. Enzinger, H. Dermouz are with Joanneum Research-Forschungsgeselschaft mbH, A-8010 Graz, Elisabethstrasse 5. (e-mail: erich.podesser@joanneum.at)

I. INTRODUCTION

DECENTRALIZED small scale electricity production in isolated regions without well developed electric grids is of high interest. If biomass or agricultural waste is available as fuel, many applications can be expected at small companies and communities without electrical grid connection. Applications in the following areas may be expected:

- Wood and agriculture residues in the Western Balkan Countries
- Rice industry residues in China, India, Thailand, Bangladesh, Burma, Nepal, Sri Lanka
- Residues from the palm oil industry in Indonesia
- Citriculture residues in Belize
- Sugar industry residues in India, China, Mexico
- Residues from the coffee industry in Brazil and Columbia
- Forestry residues from the wood industry in Brazil and Honduras

Large quantities of rice straw, rice shells, forest residues and of several agricultural residues were discovered [1].

II. THE BEST TECHNICAL OPTION

After basic considerations and evaluation of several technical processes it was found that a biomass fired Stirling engine should be the best technical and economical solution for a small scale grid independent power production in the power range of 5 to 100 kW [2]. Based on these considerations the decision was taken in favour of an α-type Stirling engine whose heater is equipped with smooth heat exchanger tubes for which no hot flue gas treatment is necessary. The decision to use nitrogen as working gas was based on the following considerations:

- Nitrogen, or air without oxygen too, can be supplied even in rural areas.
- Nitrogen is a cheaper working gas than helium.
- Seals of the engine against nitrogen losses can be obtained at lower costs than those against helium losses; in many cases standard products can be used [3].
- The higher weight of the Stirling engines which operates with nitrogen as working gas is of little significance in stationary applications.
- The COP of the engine does not generally depend on the kind of the working gas.

The crank mechanism used in the Stirling engine was that of an in serially produced engine for a motor cycle. Fig. 1 shows this biomass test Stirling engine. The black parts of the engine are the crank mechanism of a DUCATI motor cycle which consists of the crank case, the crank shaft, the original bearings, the oil pump the piston rods and the DUCATI piston as cross heads for the Stirling mechanism. The red parts of the Stirling engine are specially manufactured to meet the requirements of the Stirling principle. The hot heat exchanger can be seen in the heater chamber.

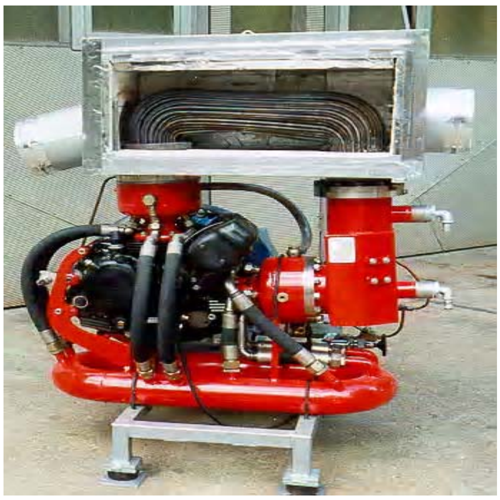


Fig. 1. Biomass Stirling engine at JOANNEUM RESEARCH, Graz, shaft power of 3 kW

The heat exchanger is manufactured from heat resistant smooth tubes with the DIN number 1.4841 and can be used up to 1.150 °C. Due to this measure the dead space of the engine is relatively large. This requires therefore, that the active working space of the Stirling engine may be adapted accordingly. The cylinder diameter and the swept volume are designed with respect to the enlarged dead space in order to avoid a shaft power drop.

The tests with the experimental Stirling engine were performed on a test bed configuration with a wood chip furnace. Engine data and results were found as shown in Table I.

TABLE I
TECHNICAL DATA OF THE 3 KW BIOMASS STIRLING ENGINE [2]

HEATER		
flue gas temperature	800 ... 1.000	°C
particle content of the flue gas	70 ... 700	mg/m^3N
thermal input (hot heat exchanger)	12,5	kW
COOLERS		
engine cooler water temperature (inlet/outlet)	30/40 ... 60/70	°C
cylinder cooler water temperature (inlet/outlet)	30/35	°C
rod seal cooler water temperature (inlet/outlet)	30/33	°C
engine cooler (heat rejected)	6,54	kW
cylinder and rod seal cooler (heat rejected)	2,98	kW
mean pressure of nitrogen	33 (40)	bar
BASIC DIMENSIONS		
bore/stroke diameter	140/51	mm
swept piston volume	840	cm^3
compensator vessel	17	litre
SPEEDS		
working speed	600	rpm
idling speed	950	rpm
EFFICIENCY		
shaft power	3,1	kW
over all efficiency (shaft power/received heat)	0,24	-
CRANK MECHANISM		
non pressurized crank mechanism, 90° shift of cylinder axes,		DUCATI
flywheel and starter		truck

III SYSTEM CONFIGURATION

Fig. 2 shows the configuration of the biomass Stirling engine unit in principle for an application in an isolated region which includes also a heat exchanger to preheat the combustion air by heat recovery from the flue gas. This measure – preheating the flue gas – reduces the quantity of bio fuel. This makes sense if the relationship between electricity produced and the biomass fed should be enlarged. The Sankey diagram in Fig. 3 indicates further that this relationship can reach to about 0,2. The COP for this application with a higher flue gas temperature as it is indicated in TABLE I, will be around 0,33.

The Sankey diagram shows also the relationship between the electricity produced and the thermal capacity of the furnace needed. It is easy to see that the furnace has to have about 50 kW if an electric power of 10 kW should be generated. The heat rejected by the engine cooler at temperatures of 60/40 °C will reach about 25 kW at full load.

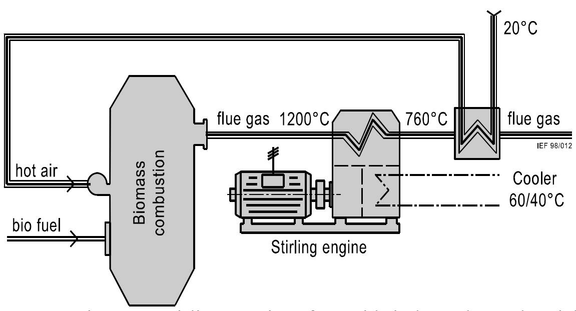
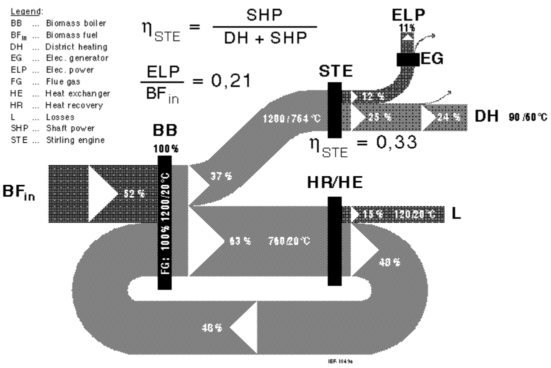


Fig. 2. Biomass Stirling engine for grid independent electricity production



.Fig 3. Sankey diagram of a biomass Stirling engine for grid independent electricity production.
BB ... biomass boiler, BFin ... bio fuel input, DH ... engine cooler (40/60 °C), STE ... Stirling engine, ELP ... electric power, HR/HE ... heat recovery -heat exchanger, L ... thermal losses , SHP ... shaft power, η_{STE} ... COP of the Stirling engine,

IV. ELECTRICITY PRODUCTION PLANT WITH A BIOMASS STIRLING ENGINE

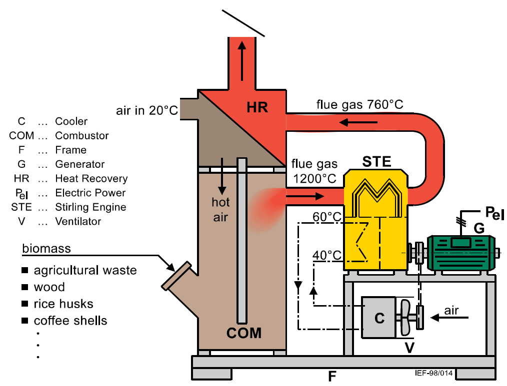


Fig. 4. Electricity production from biomass by a Stirling engine (principle)

The primary goal of the small scale plant showed in Fig. 4 is the grid independent production of electricity from biomass in the capacity range of 5 to 100 kW . The principle arrangement of the components is indicated in Fig. 4. The important parts of the small scale power production unit are the biomass furnace, the Stirling engine as showed in Fig. 1, the electric generator, the engine cooler circuit with pump, fan and the water/air heat exchanger. Biomass residues like coffee shells, rice husks, agricultural residues or any kind of wood may be used as a fuel.

Adaptations of the biomass furnace to several bio fuels with different ashes will be necessary for improvements of the combustion process. The heater of the Stirling engine is directly heated by the hot flue gas of the furnace. A heat exchanger with smooth tubes at the flue gas side for heat recovery is used to preheat the combustion air to some hundred degree centigrade before entering the furnace. The belt driven blower and the cooling water pump which is not visible in Fig. 4, of the engine cooler are important components for rejecting the heat out of the process.

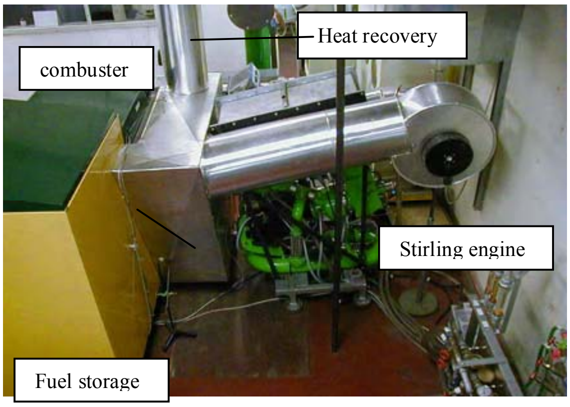


Fig. 5: Electricity from biomass by Stirling engine test facility at JR

Fig. 6. 30 kW biomass Stirling engine under test at JR.

A test plant similar to the principle in Fig. 4 has been realized at JR for testing the grid off electricity production under lab conditions. The system installed is shown in Fig. 5. Wood pellets are used as bio fuel. The flue gas of the furnace is guided in a thermal isolated duct to the hot heat exchanger of the Stirling engine and furthermore to the heat recovery heat exchanger, to preheat the combustion air to about 600 °C. The Stirling engine, as shown in Fig. 5, is an improved type in relation to the engine shown in Fig. 1.

For having larger shaft power capacities a new type of a Stirling engine, shown in Fig. 6 was designed and constructed at JR. The design has been done in the same manner as for the 3 kW biomass Stirling engine. The engine design was carried out on the basis of an available industrial crank mechanism of the Austrian company Leobersdorfer Engine Factory. The crank mechanism used is the basis of an industrial gas compressor and can easily be used also for an α- type Stirling engine. The heat exchangers, cylinders and pistons are designed in accordance to the application described.

V. ECONOMIC CONSIDERATIONS

The part load operation of the Stirling engine plant have been analysed by a simulation with measured data under real conditions of a biomass district heating plant. This results in different annual electrical outputs for different rated capacities of the power production unit (Stirling engine/generator). If the rated capacity of the Stirling engine is too high, electricity production can be maximised, but on the other hand operating costs, and in particular annual repayments, will also increase. If the rated capacity of the power production unit is too low, the possible annual electrical output cannot be achieved, quite apart from the fact that the specific investment costs of a smaller engine are also higher. The mathematical formulation and evaluation of these functions yield the actual annual electrical output, from which the costs as a function of engine size can be determined. Fig.7 shows this calculation of electricity production costs on the basis of real plant data measured at part load [5].

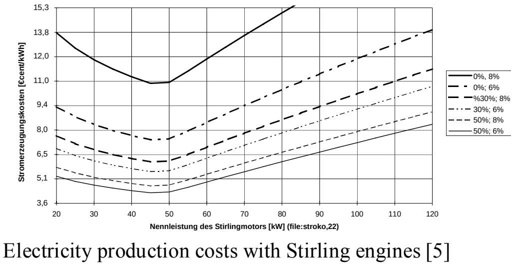


Fig 7. Electricity production costs with Stirling engines [5]
Vertical axis: costs from 3,6 to 15,3 €cent/kWh, horizontal axis: rated engine capacities from 20 to 120 kW
Specific investment costs: 1600 €/kW for a 100 kW Stirling engine, subsidies; 0, 30 and 50 %, interest ratio: 6 and 8 %, furnace thermal capacity: 1000 kW, rate of heat recovery: 0%

The results of this investigations indicates that the optimum capacity of a Stirling engine is about 5% of the heating capacity of a biomass furnace, if no heat recovery from the flue gas to the combustion air is realized. The minimum costs of the electric energy can be discovered with about 4 €cent at a rated engine capacity of 45 kW at the mentioned conditions in the caption of Fig. 7.

For economic reasons, the payback time of a technical plant should not exceed half the plant life, or else the investment becomes too risky. Fluctuations in electricity prices may result in changes in the annual revenue and thus may negatively affect the payback time, extending it beyond the assumed plant life. Fig. 8 shows one example of the many calculation results in [5], which clearly shows the effects of changes in the parameters of 'financing' and 'electrical output' on payback times.
An important measure of plant design is the adaptation of the rated Stirling engine capacity to the combustion capacity. As the optimum Stirling engine capacity for this case of a district heating plant with a thermal capacity of 1.000 kW an engine with 45 kW without a heat recovery was found. An enlargement or a reduction of engine capacity leads in every case to an increase of the pay-back period. For the optimum case the calculated pay-back period covers 5 years, this is 25% of the calculated plant living time. It is worth to mention, that the pay-back period without governmental incentives lies above the plant live time.

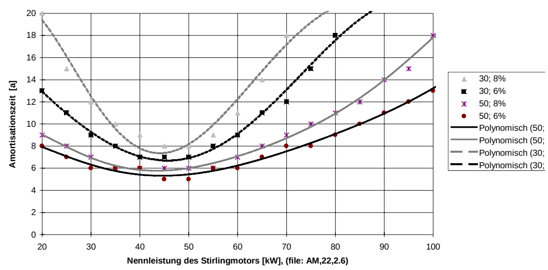


Fig. 8. Pay-back period as a function of the rated engine capacity [5]
Vertical axis: pay-back period from 0 to 20 a, horizontal axis: rated engine capacity from 20 to 120 kW
Specific investment costs: 1600 €/kW for a 100 kW Stirling engine, subsidies; 0, 30 and 50 %, interest ratio: 6 and 8 %, furnace thermal capacity: 1000 kW, rate of heat recovery: 0%

VI. CONCLUSION

The current contribution is a short summarizing description of the R&D work on Stirling engine development at JR over a period of about 10 years. One of the first important decisions was the selection of technology. Results of basic considerations show that the directly with biomass flue gas powered Stirling engine is the most appropriate technique for the electricity production below 200 kW. The assessment of the expected pieces of Stirling engines produced in the future leads to the decision, that serially produced parts from the industry should be integrated in the engine design for cost reasons as much as possible. Therefore the Stirling engines presented use serially produced crank mechanisms which are the most expensive and important components in design and construction of the engine. Further important decisions deals with the design of the hot heat exchanger with smooth tubes and without any fins to avoid obstructions, and further the limitation of the flue gas temperature at 1000 °C which enables the combination of the Stirling engine with conventional biomass furnaces. In the application of the electricity production in isolated regions the furnace/Stirling engine unit is equipped with an additional heat exchanger for heat recovery from the flue gas after the Stirling engine. This measure is important for the operation in isolated regions and enables to enlarge the relation between the electricity produced and the bio fuel fed up to 0.2. Extensive work was also made in economic investigations. The results encouraged the partners to invest their money in a larger Stirling engine of about 50 kW.

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VIII. BIOGRAPHIES

Erich Podesser received his Ph.D. in 1983 at the Technical University Graz, Institute of Heat Engineering. At the beginning of his activity he was research assistant at the Institute of "Grundlagen und Theoretische Elektrotechnik" Technical University, Graz. From 1973 to 1974 he was at Siemens in Erlangen, Germany. Since 1974 he is with Joanneum Research, the former Forschungszentrum Graz. His main fields of interest are: Solar/biomass/waste cooling technologies (absorption refrigeration technology and desiccant air conditioning). Control strategies and techniques. Small scale electricity and heat production with bio fuel. Improvements of industrial drying processes. International cooperation in the frame of IEA Agreements (f. i. Bioenergy).

Peter Enzinger is with Joanneum Research since 1972 and got his education as an electrical engineer. He could gain his special experience over a lot of years in the field of technical developments and operation of new developed technical systems. Special knowledge he could collect in the field of automatically working measurement facilities.

Hans Dermouz is with Joanneum Research since 1985 and could gain lots of experience in the field of construction of technical facilities. Special knowledge he could collect in the field of vacuum technique as well as by construction and test of superconducting components.

Renewable Energy Market and Green Certificates

Andrej Gubina
Faculty of Electrical Engineering
Tržaška 25, Ljubljana
andrej.gubina@fe.uni-lj.si

Blanka Povh, Tomaž Štokelj
HSE d.o.o.
Koprska ulica 92, Ljubljana
blanka.povh@hse.si, tomaz.stokelj@hse.si

***Abstract* – With liberalization of electricity market, electrical energy has become trading commodity and can have different price and quality, also with regards to its energy source. Electricity from renewable energy sources (RES-E) has becoming an important factor in European Union (EU) efforts for sustainable development as well as in trading. EU and Slovenian legislation already prescribes the way for tracking and marking the source of energy. One step further are the voluntary systems for green certificates, which in addition to tracking of the energy source also trace the information reliability, consistency and its transparency.**

In this paper we present briefly the Renewable Energy Certificate System (RECS), which was established in Slovenia in cooperation with RECS International and Energy Agency of Republic of Slovenia (AGEN-RS). RECS system is the cornerstone for setting up of the RES-E market in Slovenia. We present the RES-E product "Modra energija" (Engl. *Blue* or *Smart energy*) that enables the customers to choose the electricity from the environmental friendly source. The "Modra energija" Project and the mechanisms for quality assurance are presented in the paper.

I. Introduction

We can define the Renewable energy sources (RES) as the sources of energy are in part or entirely preserved in nature, particularly the energy of water flows, wind, biomass, and sun energy [1]. In the light of Kyoto protocol and higher environmental demands in EU, the field of Renewable Energy Sources is becoming more and more important. Support of the use of electrical energy from renewable energy sources (RES-E) is very important for emissions reduction of CO_2 and other greenhouse gases. At the same time this means reduction of dependence from electricity imports and assures the development of new technologies and industry.

European Union has ambitious plans on development of RES-E. In the long term a lack of RES-E can be perceived from the average structure of production sources in UCTE (UCTE Mix), as the quantity of Hydro Power in it is between 15,7 % (2000) and 12,8 % (2004). Target of RES-E in EU-15 until the year 2010 is 22,1 % [2], but research shows that the current measures taken allow for only 17,5 % of consumption to be covered by RES-E in 2010 [3]. Slovenia needs to implement new, timely measures for RES-E incentives, in particular market-based incentives for consumers and producers of RES-E. As a EU member Slovenia must increase its share of RES-E in consumption from 29,9 % in year 1999 to 33,6 % until the year 2010 [2],[4].

There is an obvious need to harmonize the legislation in EU to encourage consumption of RES-E, thus also giving a clear market signal to increase RES-E production. Projections of Berlin Forum show that the optimal measures could allow the largest share of RES-E in EU to reach 34 % in year 2020 [5]. There is also a considerable shortage of RES-E in the new EU member states. The RES-E target in new member states is 11,6 % in year 2010, but the share of RES-E in year 2000 was only 5,6 % [2],[6].

II. RES-E Market

In the power system that connects power plants and consumers, electricity is produced in RES-based- as well as fossil- or nuclear-based power plants at the same time. RES-E is therefore available in the system; the challenge is to enable the consumer to purchase it.

A. *RES-E purchase contracts*

The flow of electricity is governed by physical laws. A consumer can only be supplied from a particular power plant if there is a direct power line between the power plant and the consumer to which no other power plant is connected. Slovenian transmission system is of meshed design to which all consumers and producers (regardless the production source) are connected. To enable trading with electricity, transactions are treated on two separate levels: the physical flow of electricity and the supply contracts that define path, quantity, time and price of electricity transmission. Contract signature and electricity production are completely decoupled in time and in space.

Electricity supply contract that defines electricity production source, especially from RES, is therefore in many ways an abstract notion, as it is physically impossible to guarantee the origin of electricity that the buyer will receive from transmission grid. A system is therefore needed that will allow for separation of information about production attributes of electricity from electricity itself, provide for the transfer of this information between the buyer and seller and enable a merger of the information and electricity. The system must include an instrument for transfer of this information which should be tradable separately from energy and should be at the same time transparent, reliable and trustworthy.

B. *Green certificates*

The proper instrument for transfer of the information on production attributes of RES-E is a renewable or green certificate. It comprises a record on production unit characteristics, energy source and the date of production. The quantity of energy which they relate to is usually standardized. Collection of data and the issuing of certificates should be electronically supervised and independently verified. It is essential that the certificates are traded separately from electricity due to the inherently different timescale of their origination, as we will see later on.

The price of a green certificate reflects the value of RES-E production attributes – its environmental benefit – that are embodied in the certificate. The price can be calculated as the difference between the price of the »grey« electricity and RES-E on the market. The consumer purchases a certificate on the market and can use it either in the frame of a RES-E support scheme, for own promotion or some other purpose. In any case, the merger of production attribute information embedded in the certificate with the electricity purchased on the market is should be assured. This way, the consumer decides whether to purchase the green certificate and consequently support RES-E.

The first successful international initiative for green certificates in Europe began in the year 2001 with setting up of RECS International (RECS-I). The EC research project on Renewable Energy Certificate System (RECS) within the 5. Framework Program, in which European countries developed the RECS certificate successfully concluded the test period in 2003. RECS certificate designates production of 1 MWh of RES-E. It contains detailed information about place, time and the production technology of the pertaining RES-E, as well as an earmark whether this energy has already been subsidized at production or at the construction of production capacities. Certificates can be issued for all types of RES. Along with the disclosure of the energy source they provide for reliability and transparency of the pertaining information.

C. *Guaranties of Origin*

A similar instrument to green certificates (e.g. RECS), Guaranties of origin (GoOs) are gaining on importance as the foundation for RES-E market in EU. Issuing of GoO for each MWh RES-E is foreseen in the fifth article of EU Directive 2001/77/EC [6], while since October 2004 the trading with them is possible. Tracking of GoOs is independent of electricity trading. The Directive obliges the members of EU to recognize each others' GoOs. The suppliers can use them also for the public disclosure of the supplied energy source origin, as stated in the Directive 2003/54/EC [7].

It their design, GoOs are very similar to RECS certificates. Among other things, RECS standards are a little more rigorous in disclosure and supervision of data on energy production, and the procedure for issuing of the RECS certificates is internationally harmonized, while the GoOs can be issued by the authorized national agency. EU introduced GoO instrument because the RECS system is a private initiative and as such could not be used as an obligatory European regulatory instrument.

Many countries in Europe have already passed national bylaws on GoOs that provide for their transfer and trading independently from energy (among them are Austria, Belgium, Germany, Denmark, Finland, Italy, the Netherlands, Norway, Portugal, Sweden and Great Britain and Switzerland).

Following the development of certificate systems and potentially prevalent influence of GoO on the market in the future, there are activities in the RECS International and AIB to adapt the RECS system for trading with different types of certificates. Harmonized procedures and databases would enable RECS system to accommodate RECS certificates as well as GoOs. An EECS (European Energy Certificate System) Working Group at RECS International has set up an electronic system for harmonized trading with GoOs in EU. EECS Basic Commitment, [8], represents a harmonized complex of rules for introduction of GoOs in Europe and their trading.

In Slovenia, several bylaws are in preparation, among them the Act on Issuing of Guarantees of Origin, which will prescribe details of the GoO issue and is based on Slovenian Energy law [1] and EU Directives [7], [9]. These instruments and the accompanying measures will without doubt stimulate Slovenian consumers' awareness of RES-E and increase the RES-E penetration.

III. RECS SYSTEM

System RECS is the first international system that enables separation of environmental benefit of RES-E from the electricity itself and its representation in RECS certificates. Trading with certificates is performed separately and independently from electricity and in the same way as trading with other goods. In an open and transparent system none of the participants has a dominating position. The organization behind it, RECS International, is the largest international association of more than 115 energy companies from 18 different countries. Among the RECS-I members are all the most important European energy companies, among others also Verbund AG / APT, RWE Trading GmbH, E.On Energie AG, Vattenfall Europe Trading GmbH, Endesa, Iberdrola Generacion S.A.U., EDF, Enel Trade S.p.A. and Shell Trading International Ltd.. The association promotes international trading with energy certificates from RES-E and promotes the use of renewable energy by making its environmental benefits tradable separately from the physical energy flow and under internationally harmonized rules.

In a new RECS-I member country, first a National Board of RECS is formed that oversees the operation of RECS in the country. Through their national representative they participate in RECS-I. Each member country must also appoint an Issuing Body, choose electronic database for certificate issue, transfer and redemption, and appoint an Auditing Body to inspect and verify the plant certification. Each power plant in the RECS system must have a Renewable Energy Declaration that lists all production-relevant information on the plant, such as technology, energy source, date of commissioning, financial support received and many others, and has to be renewed every five years.

The RECS-I sister organization, the Association of Issuing Bodies (AIB), is on the other hand in charge of development and uninterrupted operation of RECS system and cooperates closely with RECS-I. AIB and RECS-I collaborate also with other international trade associations, e.g. Eurelectric, as well as with European Commission and the national governments.

In Slovenia, RECS system has been set up in 2002. Although the system is fairly new, the Slovenian RECS certificates are already traded internationally. In Slovenia, they serve as a cornerstone for RES-E retail market where a product was introduced under the brand name of »Modra energija«. The Energy Agency of Slovenia (AGEN-RS) was appointed the Issuing Body in Slovenia. It is responsible for issuing, transfer and redemption of RECS certificates, supervises harmonization of Slovenian system with the International RECS standards and is taking care of system reliability by approving Renewable Energy Declarations of the individual power plants. Their verification as RECS Auditing Body in Slovenia is performed by TÜV Sava Bayern G.m.b.H. from Germany.

IV. Trading with Green Certificates

First of all, trade with green certificates is in many ways similar to the wholesale market with electricity and needs to be distinguished from sales of RES-E retail products usually marketed under different brand names (OK Power, TÜV, Eugene, Modra energija, [10],[11],[12],[13]), similar to retail electricity market. When there is no obligatory market for RES-E in a country the certificates are purchased from sellers or producers mostly by suppliers of electricity. They use green certificates to form different RES-E products and market them to end consumers.

By purchasing a green certificate, a buyer ensures that RES-E is produced somewhere in Europe and is willing to pay for this. With the certificate the sellers of RES-E assure their buyers of internationally supervised origin of RES-E and prevent double-selling of renewable energy. National Issuing Body is keeping a record of quantity of RES-E produced in each certified power plant and of the respective numbers of issued, transferred and redeemed certificates.

Trading with the environmental benefit that green certificates embody is performed completely independently from energy trading, mostly through bilateral agreements. The certificates are traded for the past time periods because to issue the certificate, the RES-E has to be already produced. In contrast, electricity is always traded for the future time period, usually from one day until a few years in advance, since it needs to be produced and consumed at the same time, while green certificates can be valid up to several years.

A life cycle of a green certificate consists of the following phases: issuing, trading and redemption. Certificates are issued in electronic form, so the transfer of the certificate means merely their transfer from one trading account in the digital certificate data base to another. When the certificate is redeemed it is transferred to a separate, so-called End Account. With this transfer, the environmental benefit which the certificate is related to is used up and can not be sold again. That is why the certificates are effective and transparent way for energy suppliers to enhance the "greenness" of their portfolio. The certificate is usually redeemed or used up when the buyer claims financial support for RES-E in his country or forms one of the products RES-E and delivers it to the consumer.

Fig. 1 shows separate trading paths of green certificates (e.g. RECS) and of electricity. For every single MWh of RES-E, the environmental benefit is captured in a certificate and separated with the issue of the certificate. Electricity and certificates are the traded on separate markets. A supplier can purchase the certificate and electricity from different sellers, and combine them to form the RES-E product – "dye" the energy green.

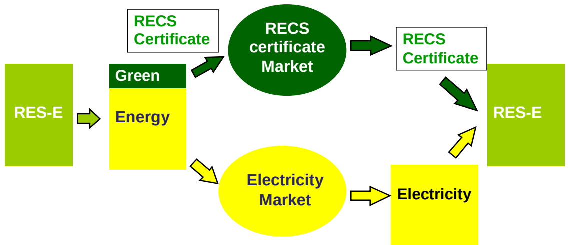

Fig. 1: The RES-E trading path

V. Retail Market with RES-E

In the retail market, green certificates can be used as the assurance of the RES-E end-products' quality, either directly or through energy labels. Since there is no organized international retail market, the sales usually entail bilateral contract between a supplier of RES-E and an end buyer or consumer. The sales procedures differ in different countries and companies, so the retail market with RES-E is quite fragmented. Energy labels which the companies use to as quality assurance for their RES-E products are not harmonized, and often not even comparable. The standardization of European energy labels is the aim of the international association Eugene [12].

For a potential buyer of RES-E retail product, the benefits of its use are of primary consideration. Namely, the RES-E is more expensive than usual »grey« electricity, as it has higher quality and a verified origin. The reasons for purchasing RES-E at the retail market differ among companies and countries according to their national legislation. While individual buyers mostly decide for RES-E out of their environmental consciousness, commercial buyers often see this as a chance to improve their public reputation and as a positive promotion of their activities.

Proper and innovative design of RES-E products structure can also influence the demand on the retail market. The most important property of a RES-E product, aside from its price, is its composition of RES-E share. Two of the basic methods of RES-E products formation are shown in Fig. 2:

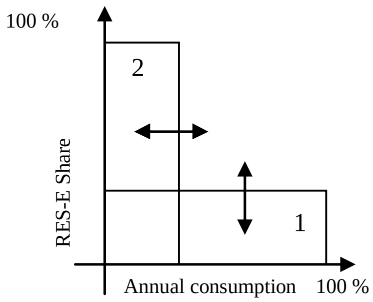

Fig. 2: Two ways to form retail RES-E products

- **Method 1:** The supplier offers a limited number of products, each comprising a different share of RES-E to limit the extent of market fragmentation. The shares of RES-E are usually discrete (example: 10 %, 25 %, 50 %, or 100 %). The product can also differ in the type of RES used and its share in the product's composition. The buyer then purchases one of the products in the amount of his entire yearly electricity consumption. The downside of this method is that while the palette of products is necessarily limited, it contributes to fragmentation of the market and can appear confusing to the buyer.
- **Method 2:** In a simpler approach, the supplier offers only one product with 100 % of RES-E. The buyer than chooses the share in his yearly electricity consumption to be covered by this product. Since in a nascent market, a simpler palette of products is usually preferred, this method was chosen for its simplicity and effectiveness in Slovenian RES-E market.

The retail market with RES-E emerges when the suppliers begin to advertise their RES-E products and offer them on the market. The significance of forming a RES-E retail market on the national level is in raising the individual and public awareness of the importance of RES-E and to stimulate the use of RES-E, since the consumer can finally choose among different »colors« of electricity. The sellers focus on the chosen target groups of buyers to which they tailor the approach and try to present the product according to their needs. Contrary to the wholesale market with green certificates, a comprehensive marketing communication with the buyers is necessary instead of a simple supply contract.

VI. »MODRA ENERGIJA« - BLUE ENERGY

The RES-E retail market emerged in Slovenia in 2005. Following the example of some EU countries, the partners of the »Modra energija« project, namely HSE in cooperation with several distribution companies, have been the first ones to offer a RES-E product nation-wide and in larger quantities. The name of the product, »Modra energija« (ME) (Engl. Blue or Wise Energy) evokes the color of water as the primary energy source of ME, as hydro energy that is also the most important RES in Slovenia. At the same time, the double meaning in the name implies that the purchase of RES-E is wise decision. The brand name was registered for the purposes of trading and sales of ME. The purpose of this project is to stimulate the development of RES-E, to form the RES-E market and to sell RES-E in Slovenia.

At the start, the target consumers for ME were mostly non-household users – companies – but due to the market demand the offer was extended also to household users. Market research show that, the behavior patterns in the field of environmental protection began to emerge in Slovenia, too, although much effort will still be necessary to achieve the European levels of environmental awareness.

The hydro power plants of the HSE Group that produce ME are members of the system RECS International. According to the rigorous international provisions for RES-E production each power plant has a so-called Renewable Energy Declaration, comprising detailed data on produced electricity. The compliance with the RECS measures and European environmental standards is supervised by the Issuing Body and Auditing Body of the RECS Slovenia.

The price for ME was determined based on the results of market research. It is defined as a fixed supplement to the end-consumer electricity price of 1 SIT/kWh (about 0,417 Euro cents/kWh), before VAT. Modra energija is offered to everybody, the suppliers and end users alike. For each MWh of ME sold, HSE guarantees issuing and redemption of one RECS certificate. At the beginning of the year the buyers' suppliers receive from HSE a statement on the number of RECS certificates redeemed for ME of the past year, certified by the Slovenian Issuing Body.

The share of ME in the yearly electricity consumption that each individual buyer can purchase can range between 10 and 100 %. Part of the ME income is used to cover marketing and other costs, in particular the cost of issuing RECS certificates. Most of the ME income – fixed to 60 % – is collected in a special fund called »Modri sklad«, dedicated specifically to financing of the projects that stimulate RES-E production, development and reconstruction of RES-E production units and research of RES. This will contribute to protection of environment and health, increased reliability of electricity supply and reduced import dependence of Slovenia.

By development and strengthening of the ME trademark the partners of the ME project are striving to attract high-profile companies as ME buyers. The buyers can use ME to label their products and services. Through purchase of ME, they attest their high environmental awareness and their willingness to contribute to protection of environment. Users of ME are listed on a dedicated web site of Modra energija, [13], that for each buyer also lists the share of ME purchased in their annual energy demand. In addition to the official certificate/diploma certifying the use of a chosen quantity of RES-E in the calendar year, users of ME can also use a special consumer label (»Napaja nas Modra energija«, Engl. We are powered by ME), which indicates the use of ME in products and services of the company, as well as to mark their business premises to assure their immediate recognition as environmentally aware company or individual.

Sales of ME began in January 2005. In the first five months, more than 650 companies and individuals decided to buy ME, bringing the quantity of ME to more than 22.5 GWh in a year. This shows that the retail market with RES-E in

Slovenia is growing and that it will continue to develop also in the future.

VII. Conclusion

International markets with RES-E are continually developing in new ways. The established green certificate market is expanding, featuring new organized market platforms to increase price transparency. In addition to RECS certificates, which have proven to be a good mechanism for selling RES-E, GoOs are gaining on visibility. On the other hand, retail markets for RES-E products based on green certificates differ in many ways, mainly due to differences in national legislations and other characteristics of national electricity markets. The drive to harmonize European energy labels for RES-E (e.g. Eugene) is positive as it leads to transparency of the retail market and facilitates comparison of different RES-E-based energy labels across Europe. This is the first step to expand the RES-E retail market to international level.

As we have seen, the RES-E market in Europe is quickly developing as this area hold many promises for the future. Judging by current results, we can expect quick and efficient development of the RES-E market in Slovenia, helped in part also by the participants in the project of RES-E from Slovenian hydro power plants - Modra energija.

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IX. Biographies

Andrej F. Gubina received his Dr.Sc. in 2002 from University of Ljubljana, Faculty of Electrical Engineering. Between 1993 and 1997 he was a member of Electroinstitute "Milan Vidmar" in Ljubljana, and between 1997 and 2002 a member of the Laboratory for Power Systems at the University of Ljubljana. In 2000, he has spent a year as a Fulbright Visiting Researcher at the Massachussetts Institute of Technology. Between 2002 and 2005 he headed the Risk Management Dept. at HSE d.o.o., Ljubljana. Since February 2005 he is a senior researcher at the Laboratory for Energy Policy at the University of Ljubljana. His main interests are in the field of power system analysis and control, renewable energy sources, power economics and risk management.

Blanka Povh was born in Slovenj Gradec, Slovenia, in 1975. She received the Diploma in Economics from the Faculty of Economics and Business, University of Maribor, in 1999. She is currently preparing M.Sc thesis. In 2001 she has joined TEŠ d.o.o. and in 2002 HSE d.o.o. where she is dealing with electrical energy trading and with renewable energy. She is the coordinator of Modra energija project, Secretary of RECS Slovenia and Slovenian representative to Board of RECS International.

Tomaž Štokelj, Ph.D., was born in Šempeter pri Gorici, Slovenia, in 1968. He received the Diploma Engineer in Electrical Engineering degree, M.Sc. and Ph.D. from the University of Ljubljana in 1995, 1998 and 2001, respectively. In 1997 he has joined the Laboratory for the Energy Policy at the Faculty of Electrical Engineering, University of Ljubljana, where his main research are was power systems operation and economics, especially production planning in deregulated power systems. Since 2001, Dr. Tomaž Štokelj is heading the Sales & Trading Division of HSE d.o.o. as the Executive Manager of the Division.

The Biomass Exchange in Slovenia in the context of RES support mechanisms

Borut Rajer, Peter Nemček

***Abstract*—Renewable energy sources are coming to the forefront of energy policy priorities in the EU as well as in Slovenia. Since close to 60% of Slovenia is covered by forests, the utilization of biomass has a clear potential. In recent years a number of support mechanisms were put in place in order to encourage the development of this energy source. Since April 2004 an interned-based biomass exchange operates at the address http://res.borzen.si. The goal of the exchange is to connect demand and supply in an otherwise fragmented but promising market. Use of the exchange is free of charge and membership is open to all companies and individuals from Slovenia as well as other countries.**

***Index Terms*—biomass, exchange, market, renewable energy sources, support mechanisms, trading.**

I. Support for Renewable Energy Sources in Slovenia

SLOVENIA became a member of the European Union in May 2004. Joining the EU did not bring about a major shift in support mechanisms for renewable energy sources (RES) since they were more or less already in place, following the goals and recommendations set forth in the EU Green (1996) and White paper on RES (1998).

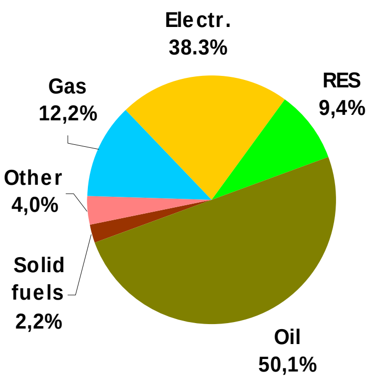

Fig. 1. Final energy consumption by type in Slovenia (2002)

As shown in Fig. 1, about one tenth of energy consumed in Slovenia comes from renewable energy sources, mainly wood. Additionally, we have to consider that about one quarter of electricity is also produced from RES, mainly large hydro. There are also more than 350 small hydro power plants in Slovenia, with installed capacity up to 1MW.

TABLE I
2010 TARGETS AND 2002 SHARES FOR ELECTRICITY FROM RES IN GROSS CONSUMPTION FOR EU-15, EU-25 AND SLOVENIA (IN %)

	2010 TARGET	2002 SHARE	of which:			
			HYDRO	WIND	BIOMASS	GEOTHERMAL
EU25	21,0	12,9	9,9	1,2	1,6	0,2
EU15	22,0	13,7	10,4	1,3	1,8	0,2
Slovenia	**33,6**	**25,9**	**25,1**	**-**	**0,8**	**-**

Beside hydro power there is also a smaller amount of electricity produced from biomass – mainly cogeneration based on wood or landfill gas.

Slovenia's goals regarding RES, stated in the National Energy programme (NEP; adopted in 2004), could be summarized as:

- Increasing the share of RES in the primary energy balance to 12% by 2010,
- Increasing the share of RES in the production of heat from 22% in 2002 to 25% in 2010,
- Increasing the share of RES in electricity to 33.6% by 2010,
- Doubling the share of electricity produced by cogeneration by 2010 and
- 2% of biofuels in transport by the end of 2005.

If we compare Slovenia to other EU countries (see Fig. 2), we can note that its target share is above the EU-25 level, but so is its current share.

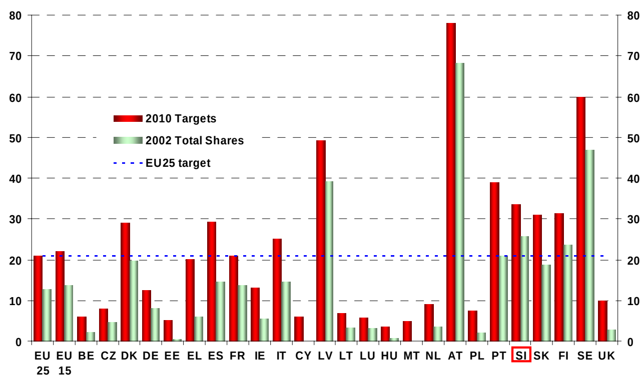

Fig. 2. 2002 shares in total consumption and 2010 targets for electricity produced from RES for EU countries

It is encouraging that according to Eurostat data, RES had the second largest growth (31.8%) among energy sources (immediately after natural gas with 31.9%) in the period 1995 – 2003 for EU-25. On the other hand, Eurelectric estimates that given the current targets and support levels, RES payments in EU-15 in 2010 would amount to 22 billion EUR, up from 6.2 billion EUR in 2001. Who will foot the bill?

As far as support mechanisms in Slovenia are concerned, we have to distinguish the production of electricity from other types of RES support. A system of feed-in tariffs is in place for electricity produced from RES. These tariffs apply only for so called "qualified producers" (a status defined by the Energy Act, adopted in 1999). These are basically all RES plants, excluding large hydro. As an alternative, the producer can choose to sell the electricity directly on the market (e.g. via a broker) and to collect a premium instead of the fixed tariff. The implicit[1] market price is set at 33.3 EUR/MWh (= 8 SIT / kWh). The feed-in tariffs range from 37.3 EUR cents / kWh for solar PV to 4.9 EUR cents / kWh for electricity produced from waste. Electricity from biomass is valued at 6.17 EUR cents / kWh for plants above 1 MW and 6.69 EUR cents / kWh for smaller ones. This is less than comparable producers get for example in Italy or Austria, but still well above the market price. With the requirement of disclosing the production source of electricity already in place and a system of guarantees of origin being planned, new possibilities for marketing "green" electricity directly to the end consumer are opening up.

Other forms of RES utilisation receive other types of subsidies and support, for example tax exemptions for biodiesel or investment subsidies for district heating or individual wood-fired boilers.

If we limit ourselves to the field of wood biomass, the following support and facilitation mechanisms are in place:

- Subsidies for evaluation studies regarding the current use of energy in companies and local communities,
- Subsidies for investment feasibility studies,
- Financing up to 40% of costs for investments in RES technology (e.g. biomass boilers) by individual households,
- Subsidies, capital investment and feasibility studies for e.g. biomass-fired district heating systems,
- Free energy-use consulting for individuals (the "Ensvet" network),
- Loans at convenient interest rates for investments in RES and efficient use of energy,
- Education, dissemination of information,
- Subsidies for forest thinning (since 1999 in the amount of approx. 160.000 – 170.000 EUR in total per year, resulting in approx. 44.000 cubic meters of wood biomass),
- Subsidies for energy crops (e.g. in 2005 subsidy of 325 EUR / ha for rape).

The majority of these mechanisms are carried out through the Ministry for spatial planning and the environment, the Ministry of agriculture, forestry and food or special devoted agencies and funds, such as the (former) Agency of the Republic of Slovenia for energy efficiency and renewable energy sources (www.aure.si) or the Environmental fund of the Republic of Slovenia (www.ekosklad.si). The funds are drawn from the national budget as well as EU and international projects (e.g. GEF).

II. THE BIOMASS MARKET IN SLOVENIA

Close to 60% of Slovenia is covered by forests, so wood biomass is considered to be one of the most important RES in Slovenia. Currently the annual felling of wood is about 2.6 million cubic meters of which 1.2 million cubic meters are used for fuel. Different studies estimated the wood biomass potential up to several hundred thousands tons per year. The sources of this wooden biomass would mostly be low quality wood from birch logging and forest thinning, forest residues, industrial wood residues, which are obtained in wood processing (e.g. sawdust), waste wood from housekeeping, industry etc.

The wood biomass potential in Slovenia is large, but in practice much of it remains unexploited. The reason is that wood biomass is distributed over large areas which make exploitation difficult. There is a big disproportion between quantities of wood raw material, volume of processed wooden biomass into pellets or briquettes, and the volume of wooden biomass actually used as fuel.

Other main characteristics of the market are:

- Small average size of privately owned forests that hinder the exploitation of forest resources,
- Though the amount of wood used as fuel is large, one has to consider that the majority stems from production for own use from own forests and just a fraction is traded,
- Lack of information, lack of connection between supply and demand,
- High initial financial investments in technology (up to six times higher than with fossil fuels, e.g. natural gas),
- Non-existence of common quality standards and poor application of existing standards in practice,
- Different types of biomass (e.g. pellets or firewood) are in some ways separate markets with separate characteristics,
- Conflict between the use of biomass for energy or manufacturing purposes (wood panels) and
- "Public relation" difficulties in regard to some mistakes made in initial district heating systems.

1 The difference between the feed-in tariff and the premium.

A. Potentials

It is estimated that a sustainable supply of biomass in Slovenia would amount to between 1.3 and 1.5 million cubic meters from forests and around 300.000 cubic meters from non-forest areas. Additionally, around 850.000 tons of industrial wood waste from around 2400 companies could be used. The problem lies in the costs of retrieving this biomass that is frequently located in less accessible areas. Moreover, small forest owners do not have the economic incentive to exploit their forests – the average size is only 2.3 hectares (70% of Slovenian forests are privately owned and there are around 314.000 owners).

B. Market Actors

On the supply size, we have around 30 companies that "produce" some form of wood biomass, ranging from larger state-owned forestry companies to farmers. The annual production is estimated at 13.500 cubic meters of firewood, 80.456 loose cubic meters of wood chips, 35.000 tons of pellets and 2.373 tons of briquettes. For example, in the last couple of years two new pellet plants were build – one in Nazarje and one in Pivka. Production for own use is not included in these figures.

As far as the demand is concerned, around a quarter of households still use wood for heating (mainly firewood from own forests or acquired on the "grey" market) and there are 8 small to medium district heating plant already in operation. Two of them, in Vransko and Kočevje, started operating in 2005. There are also some cogeneration plants, with a total installed capacity of 4 MWe. While in 2001 only around 100 units of machinery and equipment relating to the energy use of wood biomass were sold in Slovenia, this figure has risen to above 500 in 2004. There is an upward trend regarding industrial and household boilers as well. Around 120 were installed just in 2003, counting only those that received some form of support. The trend is positive but clearly below the goals of installing 1500 individual and 50 industrial boilers per year.

The export and import have risen constantly since 1999. Contrary to expectations, the import (mainly from Croatia, Bosnia and Herzegovina, Romania and Bulgaria) is larger than the export (mainly to Italy and Austria). On the other hand, after joining the EU export to Italy seems to be on the rise.

C. Prices

It is very difficult to state current market prices since biomass is clearly not a homogeneous good. Each 10% of additional water content decreases the energy value by 12%, which naturally affects the price. Trades with wood chips, that can vary considerably regarding water content, were concluded on the Biomass Exchange in the range from 1.000 SIT to 4.000 SIT per loose cubic meter (4 – 16 EUR). For other products it is very difficult to state "exchange" prices since the number of deals was smaller. Other sources estimate the price of firewood at around 9000 SIT per stacked cubic meter (40 EUR), while pellets sell in the range from 28.000 SIT to 43.000 SIT per tonne (115 – 180 EUR), depending on the packaging and quantity ordered. If we consider the price regarding useful energy delivered, this means that biomass fuel is still cheaper than oil, natural gas or coal.

III. The Biomass Exchange in Slovenia

In the previous two sections we discussed RES support mechanisms and the state of the biomass market in Slovenia. Since April 2004 there is another mechanism at the disposal of market players, albeit one aimed more at facilitating trade than at supporting in the narrower sense of the word.

The Biomass Exchange in Slovenia (http://res.borzen.si) was established as a pilot project and is for the moment entirely free of charge. It was financed by the Agency of the Republic of Slovenia for Energy Efficiency and Renewable Sources in the frame of the GEF project "Removing barriers for the increased use of biomass as an energy source". The exchange was implemented by Borzen, which is also the power market operator in Slovenia. Any foreign or domestic company as well as individual can become a member of the Biomass Exchange free of charge. They may enter the trading from any part of the world since the exchange operates entirely over the internet.

The main goals of the Biomass Exchange are:

- First and foremost, to connect market actors that have (wood) biomass (e.g. carpenters) with those who need it (e.g. operators of biomass-fired heating devices) and vice versa. In other words, the Biomass Exchange project aims to counter the fragmented state of the market by creating a common point of contact between supply and demand.
- Secondly, to offer information about related fields (e.g. machinery or services regarding biomass).

The second goal is accomplished via a web site or "Borzen OVE portal" that offers the following information and services:

- Free advertising for companies involved in the peripheral segments of the biomass market (equipment, machinery, services),
- Free advertising for equipment rental (a place where individuals or companies can post their offer of or demand for biomass equipment),
- Information regarding renewable energy sources with an emphasis on biomass (containing basic information, answers to frequently asked questions and useful links).

The actual trading takes place in a trading application, also web-based, that is accessible through a link on the portal. The trading application is a form of bulletin board which offers the possibility of entering bids to buy or sell various biomass products.

At the moment it is possible to trade with the following biomass product groups: pellets, briquettes, wood chips, firewood, split logs/billets, rolls one meter long, low quality round wood, sawdust, side trimmings/off cuts, wood waste, bark and charcoal. The user has to determine the type of offer (buy or sell), type of product, price (per unit), quantity, validity of offer, type of offer (can the offer be accepted only in whole or also partially, quantity wise), terms of delivery (date and location). All offers are shown anonymously.

The Biomass Exchange acts as a mediator, meaning it does not sell nor purchase itself. When a deal is concluded, the Exchange provides both parties via e-mail with all relevant contact information that allow for the actual conclusion of the deal.

The web page (portal) is freely accessible, and is aimed at companies and individuals (from Slovenia and other countries) working in this market, as well as the general public. Access is controlled only to the trading section, for which users need to register.

The use of the portal and trading application does not require any additional hardware or software – just an ordinary web browser.

In the first year of operation 145 members have registered, 7 of them from outside Slovenia. Twenty-four ads were published, 18 on the Slovenian-language web site and 6 on the English-language web site. Fifty-one offers were submitted and 18 deals concluded.

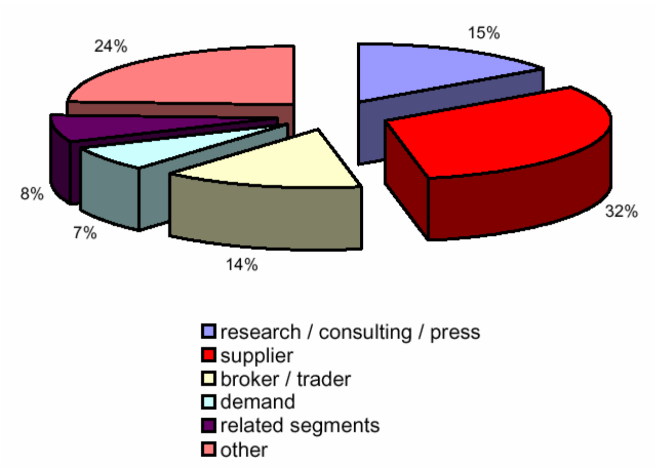

Fig. 3. Structure of members on the Biomass Exchange

About two thirds of members are companies. Suppliers seem to outnumber the demand side, although this classification is based only on the primary activity listed in the registration form by the member and is thus just an approximation.

TABLE II
BIDS ON THE BIOMASS EXCHANGE IN THE PERIOD 15TH APRIL 2004 – 15TH APRIL 2005

Product	Buy	Sell	Total
Briquettes	3	6	9
Wood waste		7	7
Side trimmings	4		4
Wood chips	6	12	18
Sawdust	1	1	2
Split billets		1	1
Pellets		3	3
Bark	1	1	2
Round wood one meter long		3	3
Low quality round wood		2	2
Total	15	36	51

In the first year offers to sell were more frequent than offers to buy. Wood chips were clearly the dominating product with 18 offers, followed by briquettes with 9 and wood waste with 7 offers.

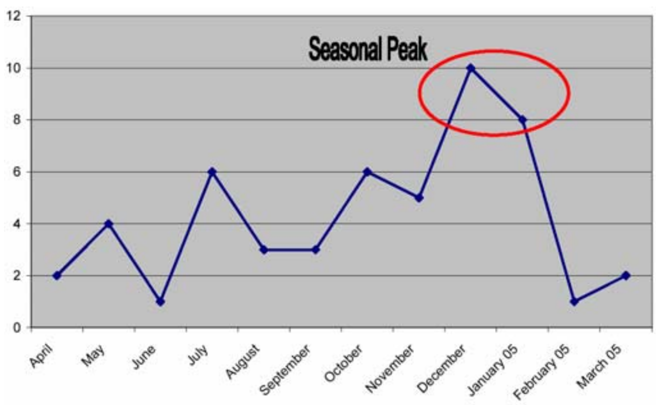

Fig. 4. Number of offers entered by month

As can be seen in Fig. 4, offers were more frequent in the fall-winter period, when heating is needed.

Due to the relatively large number of offers for wood chips it is not a surprise that the largest number of deals concluded was for this product group. Out of 18 deals, 9 were for wood chips, followed by briquettes with 3, sawdust and wood waste with 2 and bark and pellets with 1.

The results of the first year are very encouraging, even though some difficulties still require attention. The most common problem was how to clearly define the product. Although existing (Austrian) standards were taken into account when developing the product codes and definitions, these do not suffice. In order to address this problem, a modification will be implemented to allow the user to briefly describe the product in his own words, rather than just rely on the product code and thus the description in the catalogue of products. Existing standards are perhaps even too complex for small to medium users, since they do not have the equipment necessary to measure for example the water content or the wood chip standard size (G30, G50, G100). It was also found that different market segments tend to use different units of measurement for the same product, for example kilograms and loose cubic meters. During the course of last year some new product codes were added to allow the user to enter the offer in the unit of measurement he or she is most accustomed to.

In conclusion, we can state that wood biomass as an energy source clearly has potential in Slovenia. Developments in recent years, like the construction of two pellet plants and several biomass-fired district heating systems suggest we are on the right track, even though falling behind maybe too ambitious plans.

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V. Biographies

Borut Rajer, born in 1975, holds a B.Sc. degree in Economics from the University of Ljubljana, Slovenia, and works as a researcher in the Research and Development Department of Borzen, the Slovenian Electricity Market Operator. His work primarily encompasses analysis of electricity markets, renewable energy sources and climate change.

Peter Nemček, born in 1973, holds a M.Sc. degree in electrical engineering from the University of Ljubljana, Slovenia. He heads the Research and Development Department. His tasks involve management and coordination of work both within the department as well as in the execution of various projects, for example to carry out studies, introduce new products and services or to expand the market. In addition, he also actively cooperates with foreign exchanges, electricity companies in foreign markets and with international organizations.