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Virtual Balkan Power Centre for Advance of
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Balkan Power Center Report

Enhancing implementation in WB Countries

Workshop T.2.3, WP 2

"Ss. Cyril and Methodius" University, Skopje, R. of Macedonia
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Editorial Office
Balkan Power Center
University of Ljubljana, Faculty of Electrical Engineering
Tržaška 25, SI-1000 Ljubljana, Slovenia
Tel: +386 1 4768 222
Fax: +386 1 4264 651
Email: info@balkanpower.org

Computer Typesetting
Gregor Taljan

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INDEX

1 Summary

The two days workshop “Enhancing Implementation in WB Countries” was held at the Ss. Cyril and Methodius University, Skopje , on March 2nd an 3rd 2006. The Workshop belongs to the project “Virtual Balkan Power Centre for Advance of Renewable Energy Sources in Western Balkans”, project acronym: VBPC-RES, Contract INCO-CT-2004-509205, under the Sixth Framework Program, International Cooperation (INCO). The Workshop WS 2.3 is a part of the Work Package 2 (WP2) of the VBPC-RES project, entitled “Regulatory and organizational framework: barriers and incentives for renewable energy sources penetration”.

At the beginning of the workshop Prof. Glamočanin of Ss. Cyril and Methodius University, as the organizer of this workshop greeted the participants. His presentation comprised a short review of the WP2 goals, and the introduction of the topic of the Workshop WS 2.3. The program of the WS comprised 9 contributions from Project Partners. The main points of their contributions are presented below.

A. Gubina, University of Ljubljana, Slovenia: “Success Factors in EU Support Policies for RES-E Penetration”

To achieve their ambitious target for the use of electricity from renewable energy sources (RES-E), the EU Member States have chosen different policy mechanisms to support RES-E. These mechanisms have met different success in promoting the consumption of RES-E according to the national indicative targets, including cost effectiveness, cost efficiency, compatibility with the internal market, and the ability to develop different technologies.

In the paper, we investigate various support instruments, review the barriers that hinder their success in promotion of RES-E, and highlight their strong and weak points. Based on objective performance criteria, we identify and present the success factors for each instrument that leads to efficient and effective implementation of RES-E. We recommend the measures that the Member States shall enact to optimize and improve the success of their support schemes.

P. Georgilakis, A. Tsikalakis, N. Hatziargyriou , NTUA, Greece: “Success Factors in Maximizing the Wind Energy Penetration in Isolated Power Systems: Case of Greece”

Although the exploitation of the wind potential for electricity production in many island power systems presents a large economic interest, the wind power that can be installed is limited, due to the technical restrictions raised by the operation of wind turbines in parallel with the conventional units. In addition, the rejected (not produced) energy by each wind park operating in an island becomes great, as the total installed wind power in the island increases. Especially for the operation stage, software like CARE and MORE CARE can considerably help the system operators in order to to maximize the wind power penetration and reduce the operation cost of the system, because their proper use reduce the risk and indicate the most economical dispatching. However, it is also of primary interest the possibility to assess the wind penetration limits in an island, in the stage of the development of its electric power system, so that the wind power planned to be installed should be technically acceptable and economically viable.

Due to the fact that it is impossible to increase voluntarily the wind power, as well as that usually it is not possible to reduce the produced wind power in a controllable manner, an upper percentage limit for the parallel operation of conventional and wind power is provided. This limit, named “dynamic operational limit”, depends on: (a) the conventional station characteristics, such as the response rate of the speed governor of each unit, (b) the wind power parameters, such as the total wind power installed, the characteristics of the wind generators (tenacity in under/over-frequency and under/over-voltage control, power smoothing capability, etc), (c) the dispersion of the wind parks on the island, (d) many other factors related with the dispatching philosophy, the operators capabilities, the existence of control systems (e.g. CARE, MORE CARE) in the dispatching center. Considerable increase of the penetration limits can be obtained when variable-speed and controlled wind turbines are installed. From the experience and measured data for the Crete system, the dynamic operational limit is usually kept from 15% (during the night and abrasive weather conditions) to 25% (during the day and smoothed weather conditions).

A coefficient named “capacity factor” (CF) is usually used to indicate the viability of a wind park. The capacity factor presents the ratio of the total annual wind energy produced over the maximum annual wind energy. The maximum annual wind energy is the product of the nominal wind power installed and the hours of the year (8760). According to the estimations of the Regulatory Authority for Energy, based on applied economic conditions in Greece, a wind park investment in an island is considered as economically viable if the wind park can achieve a CF over than 27.5%.

The use of hybrid system with storage facilities can considerably increase the wind power energy penetration limit. For example, a recent study for the medium sized island of Syros has shown than without storage the average annual wind energy penetration is 19.6%, while this penetration limit is 27.5% if a pumped storage system is used.

S. Halilčević, M. Halilović, V. Madžarević, University of Tuzla, Bosnia and Herzegovina:
“Success Factors in Implementation of Solar Energy in Public Institutions: Case in Bosnia and Herzegovina”

The importance of overcoming our dependence on fossil fuels is becoming more and more evident. A large quantity of fuel being imported into Europe comes from unstable areas of the world. The last Gulf crisis affected the price of fuel and its supplies. Another motivation for the use of solar energy is environment oriented. With regards to work places, solar energy can be used for hot water, central heating, air conditioning and electricity production. Taking in account all of the above, it can be said that there is a justified basis for investment in solar powered devices. In the case of Hotel Tuzla the investment in solar energy would solve the problem of hot water supplies.

About 42% of energy consumption in hotels is due to water heating. It is obvious that it is possible to achieve a reduction of energy expenses and a reduction of harmful gas production by using solar systems for hot water supply. The time required to get the return of the original investment (pay-back period) is for considered object 2,3 years (Hotel of the middle size) in the current market conditions.

Therefore, as the lifetime of such a system, with adequate maintenance is longer than 20 years, the investment of a solar system for the supply of Hotel Tuzla with hot water looks a very sound economical idea. It is important to mention that the main condition for the development of solar heat systems is the standardisation of individual devices as well as the system as a whole. We should also bear in mind the importance of implementing the right rules and regulations in this field.

In most European states, the goverment sponsors the installation of medium and large solar heating systems. The French goverment grants for such projects are about 200 €/m^2-collector, while in Germany, following an order from the government in 2003, the grants are increased from 90 to 125 €/m^2-collector.

V. Glamocanin, A. Krkoleva, S. Veleva, S. Velickovic, Ss. Cyril and Methodius University, Macedonia: “Economic Incentives for Energy Efficiency and Renewables in R. of Macedonia”

The new Energy Law is expected to outline the energy policy in the country towards establishment of new markets for electricity, natural gas, oil and oil derivatives, as well as market for thermal or geothermal energy. The new Energy Law introduces, regulates and encourages the implementation of measures for energy efficiency, but also employment of renewable resources. In such a way it is expected that the new law will influence the energy system to become not only sustainable, but also more compatible with the ecosystem. These major technological and regulatory changes will lead to increased competition and enhanced quality, reliability, security and safety. The Strategy for renewable energy resources exploitation it is expected to put in force several mechanisms and incentives for financial assistance. These mechanisms and incentives shall provide business environment for the potential investors to build, produce and maintain renewable energy resources.

P. Frías Marín, T. Gómez San Román, J. Rivier Abbad, Universidad Pontificia Comillas, Spain:
“DG network integration. Regulatory review and international comparison of EU-15 MS”

The analysis of the integration of Distributed Generation (DG) into the Distribution network (DN) can be divided into three major issues, (i) the role of the Distribution System Operator (DSO), (ii) market access and (iii) network access for the DG.

Currently, in EU-15 MS, there is a lack of incentives for the DSOs to integrate DG into their networks. Some guidelines are proposed, such as considering DG costs and benefits - when connecting to DNs- to design DSO incentives. Moving from deep costing to shallow costing mechanisms will also help DG integration. Finally, new grid codes should be designed to integrate DG into the operation and planning of DNs.

On the other hand, only a few countries of EU-15 have fully integrated DG into the energy markets, and sometimes with restrictions. When the capacity share of DG in a country surpasses a certain level, moving from feed-in-tariffs to energy markets increases economic efficiency. The participation of DG into ancillary services and balancing markets should be also improved.

Currently, in EU-15, the structure and amount of the connection charges, procedural barriers for network access, and physical and network constraint are delaying the integration of DG into DNs. New mechanisms should be designed to integrate DG into DNs, using transparent and non-discrimination criteria.

E. Boškov, D. S. Popović, DMS Group ltd, Serbia and Montenegro:
“Organisational Framework of RES Promotion Programs in Serbia and Montenegro”

Energy generation in Serbia and Montenegro is almost entirely dependent on hydro and thermal power facilities. There are no identified renewable energy feed-in tariffs.

Based on the current situation, the government is moderately engaging its efforts in promoting renewable energy. Since Serbia and Montenegro is dependent on hydro resources there may be an opportunity for hydro rehabilitation projects. The solar insulation is relatively high, but the typical cost barriers will limit solar applications. Although there are many sources of low enthalpy geothermal resource, high enthalpy geothermal resources supporting electricity production are absent. Further studies and data collection need to be done before a statement can be made about biomass or wind projects.

In history, most of the new energy technologies which were introduced into the market received support in different ways for the process of market penetration, such as nuclear energy, for example.

Support schemes for market introduction are not exotic features, but common instruments. This paper presents a short overview of the main schemes which currently are under discussion and implementation.

Feed in tariffs: this model guarantees a long term minimum price for electricity obtained from renewable sources and obliges e.g. system operators to purchase it. It has for example been introduced in Denmark, Germany and Austria and has shown to be superior to other methods which have been tried in the EU. Here, the price is dictated and it is left to the market to supply the quantity.

Investment subsidies can support the installation of plants. They are generally not related to production and therefore considered being economically inefficient.

Tender system: this model was developed and tried in the UK. Within this system, calls for tenders for a limited quantity of renewable power produced or tenders with a price limit are carried out. The providers of the lowest asking prices within the announced contingent or underbidding the price limit respectively are given the contract.

Certificates trading model: producers of electricity from renewables receive a total payment consisting of the market price for their electricity supplemented by the market price for the green certificate which is thought to be produced simultaneously with the electricity. Thus, the price of the green certificates should represent the additional costs of producing renewable electricity compared to conventional sources. Green certificates could also be traded on an international market.

Quota system: under this system, governments set quotas per source (for example in percent of electricity from wind of total supply of electricity) and set the requirements to meet this quota. A variety of market actors can be obliged (producers, suppliers, consumers ;..). In other words, the quantity is dictated and it is left to the market to determine the price.

In practice, there can also be models which contain elements of more than one such scheme.

B. Del Fabbro, Istrabenz energetski sistemi, Slovenia: "Economic Aspects of RES use in WB Countries – Analysis and Recommendations"

In the paper the renewable energy sources are analysed strictly from the economic point of view. An overview of renewable energy sources is made according to their economic feasibility in an open market without government subsidy. The specific factors of the western Balkan countries have been taken into account (lower labour costs, high capital costs, scarce or absent subsidy schemes) and according to this economic acceptance of different RES have been analysed.

It is proposed that in the WB countries market based companies should focus on RES that have in their total costs relatively low share of capital costs and high share of direct or indirect labour cost.

V. Bukarica, M. Božičević Vrhovčak, Ž. Tomšić, University of Zagreb, Croatia: "Financial Incentives for RES Penetration in Croatia: The Role of Environmental Protection and Energy Efficiency Fund"

The most important barrier for stronger RES penetration is in their high up-front costs, which are still quite above those of conventional energy sources. Apart from favourable legislative framework, there is a strong need for financing mechanisms that will trigger more investments in renewable energy sources. Until recently only commercial loans were at disposal for RES projects in Croatia. The situation has changed by establishing the Environmental Protection and Energy Efficiency Fund, which can offer incentives for RES instalments not covered by tariff system for electricity produced from RES and cogeneration facilities.

In this paper the main characteristics of the Environmental Protection and Energy Efficiency Fund will be presented. The Fund's organisation, activities, sources of funding and allocation of financial means will be described. Special attention will be given to the possibilities for financial support of renewable energy sources projects and planned investments in these projects.

It still remains to be seen whether the Fund will act according to its work plan and enable more RES project implementations.

C. Karytsas, K. Karras, CRES, Greece: "The Framework of the Operational Competitiveness Program for the development of private Renewable Energy Sources (RES) and Energy Saving (ES) investments in Greece (Measures 2.1 and 6.5)"

The regulations and terms of public subsidies for energy investments from the resources of Measures 2.1 and 6.5 of the Operational Competitiveness Program of Greece are analysed in this study.

Measures 2.1 and 6.5 support investments in Energy Conservation systems, Cogeneration of Heat and Power (CHP), conventional fuels substitution with Liquefied Petroleum Gas (LPG) or Natural Gas (NG), and Renewable Energy Sources (RES). The maximum amount of a specific investment to be subsidised is € 44 million. The total budget of an investment proposal may exceed the aforementioned limits only by its part regarding the interconnection cost to the national power grid.

The total cost of Measures 2.1 and 6.5 is approximately 1.15 billion €. From this amount the total public subsidy (National and European) reaches €360 million. The rest of the cost will be covered by private sector contribution.

A. Ajanović, INTRADE, Bosnia and Herzegovina: "Regulatory review for RES projects implementation in Bosnia and Herzegovina"

The Law on Waters passed in Year 2000 was presenting the first step in creating necessary strategy of energy development in BiH. In year 2002, Government of Federation of BiH had passed the Electricity Law which defines and regulates:

- Electric-power system,
- Electric-power industry activities,

- Development of electricity market and institutions for the market regulation,
- General conditions for electricity supply,
- Planning and development, construction,
- Reconstruction and maintenance of electric-power facilities,
- Supervision of law conduction and other issues considerable for performing of electric-power industry activity in Federation of Bosnia and Herzegovina except electricity transmission, activities related to transmission, international trade, managing and operation of electric-power systems in competence of Bosnia and Herzegovina.

This Law introduces function of the qualified producer and purchaser of electricity. The task of regulatory agency is to establish who satisfies legal obligations for producer and purchaser of electricity.

The Law on Concessions establishes:

- Subject, manner and conditions under the domestic and foreign legal persons could be awarded with concessions for providing the infrastructure and services and exploitation of natural resources,
- Financing, designing, construction, reconstruction and/or managing with such infrastructure and all accompanied buildings and facilities in fields which are exclusively in capacity of Federation of Bosnia and Herzegovina,
- Competencies for concessions awarding,
- Establishing Committee for the Federation's concessions,
- Tender procedure,
- Content of the concession contracts, termination of the concession contracts, rights and duties of the concessionaires, solving of disputes and other issues important for the concession awarding at the territory of BiH Federation.

The aim of this Law is to create transparent, nondiscriminatory and clear legal framework for establishing conditions under the domestic and foreign legal persons could be awarded with concessions in BiH Federation as well as encouraging investment of foreign capital in subject fields. This Law also had foreseen establishing of Committee for concessions of Federation of Bosnia and Herzegovina as independent regulatory body.

In parallel with activities of BiH Federation Government almost all Cantons made similar Laws which define this field. Since the Federal Law on Concessions precise that energy generation capacities with installed power up to 5 MW are in rank of Canton's decision-making, these Laws were with their legal acts additionally arranged this area.

The Government of BiH Federation brings in year 2004 “Decision on Methodology for establishing redemption price levels of electricity generated from renewable resources with the installed power up to 5 MW”.

Conclusion

The workshop has been finished with a Consortium meeting, where the results of the workshop were discussed and future activities identified in details.

2 Success factors in EU support policies for RES-e penetration

Andrej Gubina
University of Ljubljana, Faculty of Electrical Engineering
Trzaska cesta 25, SI-1000 Ljubljana, Slovenia
Phone: +386 41 601 759, FAX: +386 1 426 46 51, e-mail andrej.gubina@fe.uni-lj.si:

2.1 Summary

To achieve their ambitious target for the use of electricity from renewable energy sources (RES-E), the EU Member States have chosen different policy mechanisms to support RES-E. These mechanisms have met different success in promoting the consumption of RES-E according to the national indicative targets, including cost effectiveness, cost efficiency, compatibility with the internal market, and the ability to develop different technologies.

In the paper, we investigate various support instruments, review the barriers that hinder their success in promotion of RES-E, and highlight their strong and weak points. Based on objective performance criteria, we identify and present the success factors for each instrument that leads to efficient and effective implementation of RES-E. We recommend the measures that the Member States shall enact to optimize and improve the success of their support schemes.

2.2 Introduction

The European Union now imports 50 % of its energy needs, while in 25 years, the share is forecast to rise to 70 %. Coupled with the increasing share of fossil fuel, this situation makes EU vulnerable economically, politically and with regard to the environment. To follow-up on its commitment to reduce its dependency on fossil fuel imports, as highlighted in the Commission's Green Paper on Security of Energy Supply [2], and to reduce greenhouse gas emissions, a joint strategy for promotion of renewable energy sources in EU (RES) has been set up.

As an attractive option to diversify the EU's energy supply, RES are available locally, they bring environmental benefits and they contribute to employment and the competitiveness of the European industry. Support for renewable energy is needed as long as technologies are still developing and market prices for non-renewable energy do not reflect their full costs to society due to subsidies and external costs.

By the year 2010, the EU set the goal to double the share of renewable energy in national gross energy consumption to 12 % (White Paper "Energy for the future", [1]) and to provide 21 % of the electricity from RES (RES-E) (Green paper on the security of energy supply in Europe, [3]). In Fig. 2.1, the development of new RES-E penetration is shown.

Indicative targets for the share of renewable electricity (RES-E) consumption for each of the EU-25 countries for 2010 are given in Tab. 2.1. Other targets have only been specified at EU level.

Tab. 2.1 Indicative targets for RES-E consumption for 2010

EU-15	Target (%)	EU-10	Target (%)
Austria	78.1	Cyprus	6
Belgium	6.0	Czech Republic	8
Denmark	29.0	Estonia	5.1
Finland	31.5	Hungary	3.6
France	21.0	Latvia	49.3
Germany	12.5	Lithuania	7
Greece	20.1	Malta	5
Ireland	13.2	Poland	7.5
Italy	25.0	Slovak Republic	31
Luxembourg	5.7	Slovenia	33.6
Netherlands	9.0		
Portugal	39.0	**Total EU-15**	22
Spain	29.4	**Total EU-10**	11
Sweden	60.0	**Total EU-25**	21
United Kingdom	10.0		

The Member States have set up different targets for the consumption of RES-E and they can choose their preferred support mechanism. The different mechanisms used in Member States have met different success in promoting the consumption of RES-E according to the national indicative targets, including cost effectiveness, cost efficiency, compatibility with the internal market, and the ability to develop different technologies.

To increase the share of renewables in each sector of the energy system, a comprehensive regulatory framework has been set up in EU. The main objectives were:

- Removal of economic barriers to the development of RES by introducing financial support mechanisms and promotion schemes, and
- Mitigation of non-economic barriers such as administrative barriers, market imperfections, technical obstacles and grid restrictions.

In deployment of RES-E, two aspects are important: sufficient financial support and the reduction of barriers.

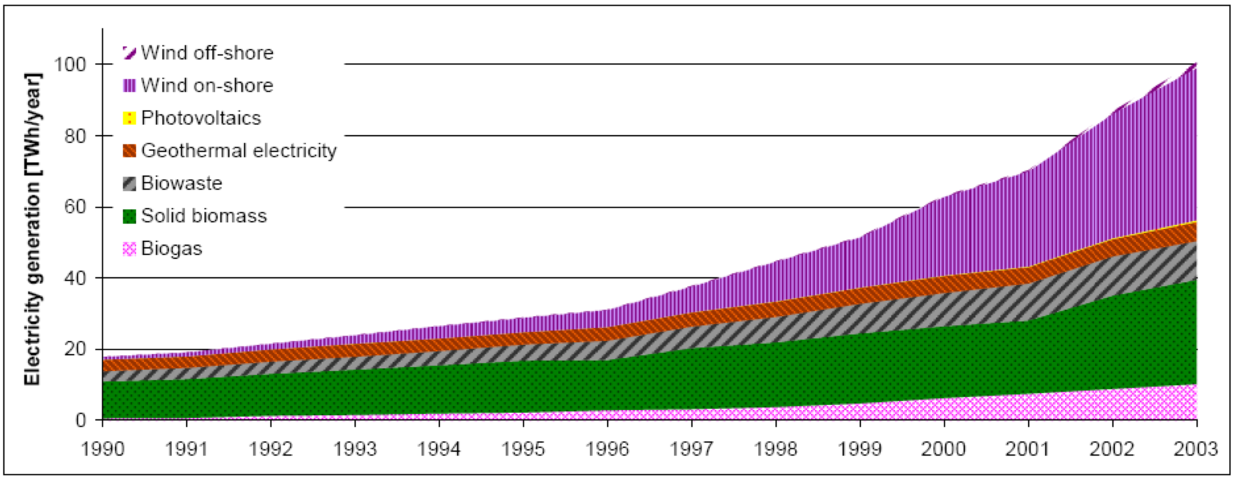

Fig. 2.1 Historical development of new RES-E generation in the EU-25 from 1990 to 2003

2.3 RES-E Policy Instruments in EU

To provide financial support, a range of different systems is in place, with the two most important: RES feed-in tariffs (FIT) and tradable green certificate (TGC) systems.

Feed-in tariffs exist in most of the Member States. A specific price is normally set for several years that must be paid by electricity companies to domestic RES-E producers. The additional costs of these schemes are paid by suppliers in proportion to their sales volume and are usually passed through to the consumers. In some countries, e.g. Denmark, Slovenian and partially in Spain, a variant of the FIT scheme exists. In this fixed-premium mechanism, the government sets a fixed premium or an environmental bonus, paid above the spot electricity price to renewable electricity generators.

Under the **tradable green certificate system**, currently existing in eight Member States, renewable electricity is sold on the market at the market prices. To finance the additional cost of producing green electricity, and to ensure that the desired green electricity is generated, all consumers (or in some countries producers) are obliged to purchase a certain number of TGCs from RES-E producers according to a fixed percentage, or **quota**, of their total electricity consumption/production. Since producers/consumers wish to buy these TGCs as cheaply as possible, a secondary market of certificates develops where renewable electricity producers compete with one another to sell green certificates.

Under a **tendering procedure**, the state places a series of tenders for the supply of renewable electricity, which is then supplied on a contract basis at the price resulting from the tender. The additional costs generated by the purchase of renewable electricity are passed on to the end-consumer of electricity through a specific levy. Pure tendering procedures existed in two Member States (Ireland and France). However, France has recently changed its system to a FIT combined with tendering system, and Ireland has just announced a similar move.

Systems based only on **tax incentives** are applied in Malta and Finland. In most cases (e.g. Cyprus, UK and the Czech Republic), however, this instrument is used as an additional policy tool. In Fig. 2.2, the chosen national policy instruments are shown [11].

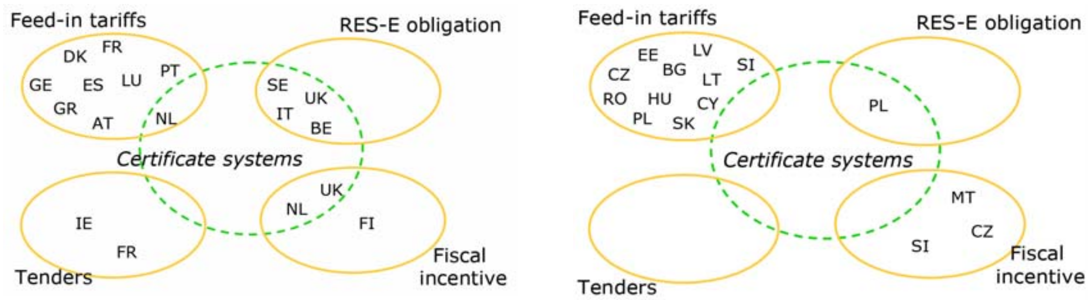

Fig. 2.2 Overview of RES-E support systems in EU-15, and in EU-10 & BG, RO

Policies are interdependent, and need to adapt to the continuously changing market environment. Since the "holy three" Directives took place (White Paper, RES-E Directive and Directive on Biofuels), the following issues impact their success:

- Enlargement of the EU: new opportunities for the exploitation of RES (esp. bioenergy).
- Interaction with other objectives and policies, e.g. environmental policies,
- Completion of internal EU energy market [6], in which free consumer choice fosters enhanced competition. In addition to that, possibilities exist to distinguish green products from conventional power supplies. RES-E impact is enhanced by required disclosure of fuel mix and environmental impact.
- Interaction with the Common Agricultural Policy (CAP reform) [7], which is a highly important element of a consistent RES support strategy.
- The establishment of a carbon market - greenhouse gas Emissions Trading Scheme [8], which affects the economic valuation of investment opportunities in RES-E.

These forces need to be accounted for in evaluation and evolution of RES-E support policies. In Tab. 2.2, strengths and weaknesses of different RES-E support schemes are evaluated.

Tab. 2.2 RES-E Support Schemes Success Factors

	PROs	CONs
REFIT (Feed-in tariffs)	Highly effective. Highly efficient; low risk for investors. Permits strategic support for technology innovation.	More difficult compatibility with the internal market. Needs regular adjustment.
Premium	Highly effective. Efficient; medium risk for investors. Good compatibility with the internal market.	Risk of over-compensation in the case of high electricity prices without appropriate adjustment.
TGCs (Green certificates)	Good compatibility with internal market. Competition between generators. Supports the lowest-cost technologies.	Currently less efficient: higher risks and administrative costs. Not very appropriate for developing medium- to long-term technologies.
Tendering	Fast development with political will.	Stop-and-go nature causing instabilities. If competition is too severe, development is blocked.
Investment subsidy	Good complement for some technologies.	Inefficient as a main instrument.
Fiscal measures	Good secondary instrument.	Good results only in countries with high taxation and for the most competitive technologies.

2.3.1 Criteria for Performance Assessment of RES-E Support Systems

The following criteria are used to assess the performance of RES-E support systems:

Effectiveness describes the capability of a support system to actually deliver renewable electricity. Thereby the amount of RES-E delivered needs to be assessed against the realistic potential of the country. When assessing the effectiveness, the effects of more recent systems are difficult to judge due to lack of experience, e.g. with TGC support schemes.

Efficiency describes the capability of a support system to produce at the lowest possible cost. The generation cost for RES-E varies widely between the different technologies on the one hand and geographic conditions on the other.

Other criteria would also include

- **Certainty** for RES-E industry: Growth of RES-E capacity ultimately depends on the decisions of individual investors. Is the system perceived as stable in the short/long term?

- **Cost effectiveness**: What are the costs per kWh of RES-E, including the 'dead weight' costs such as transaction costs, overcompensation of certain market actors etc.?
- **Stakeholder support** for the system: What is the level of support the system has from various stakeholders? Strong stakeholder support indicates a well-functioning policy.
- **Equity**: government wants a long-term sustainability of the system and fair distribution of costs and benefits of RES-E implementation over various stakeholders.

An interesting criterion would also be to compare the **investors' profits** and the effectiveness within a support system. This gives an indication whether the high effectiveness of a specific support system is primarily based on the high financial incentives, or whether other aspects have a crucial impact on the market diffusion in the considered countries.

2.3.2 Performance of various RES-E Support Systems

As an important part of the EU renewable energy policy efforts, the assessment of policy efficiency is required. The first progress report issued in May 2004 showed member states were off track from meeting this target, estimating only an 18-19 % share would be achieved by 2010. In Fig. 2.3, the performance of the EU Member States in shown, compared to their potential RES-E implementation by 2010. In the second report in December 2005, the efficiency of various systems was analyzed [12], [13]. In a separate study, efficiency and harmonization of RES-E support mechanisms was analyzed by Centre for European Policy Studies [14].

The assessment of the support systems was done separately for the different renewable technologies. As an example, the results for Wind and Biomass are explained.

2.3.2.1 Wind energy support

Currently, the most effective systems in wind energy are currently in Germany, Spain and Denmark with feed-in tariff systems, although the green certificate systems, where they apply, present currently a significantly higher support level than the feed-in tariffs. This could be explained by the higher risk premium requested by investors in case of green certificate systems, the administrative costs as well as a still immature green certificate market. The question is how the price level for green certificates will develop at the medium and long term. The analyses show that for wind energy, in one fourth of the Member States, the support is too low to stimulate investors. Grid and administrative barriers hinder development in another 25 % of member countries, bringing about mediocre results despite adequate support.

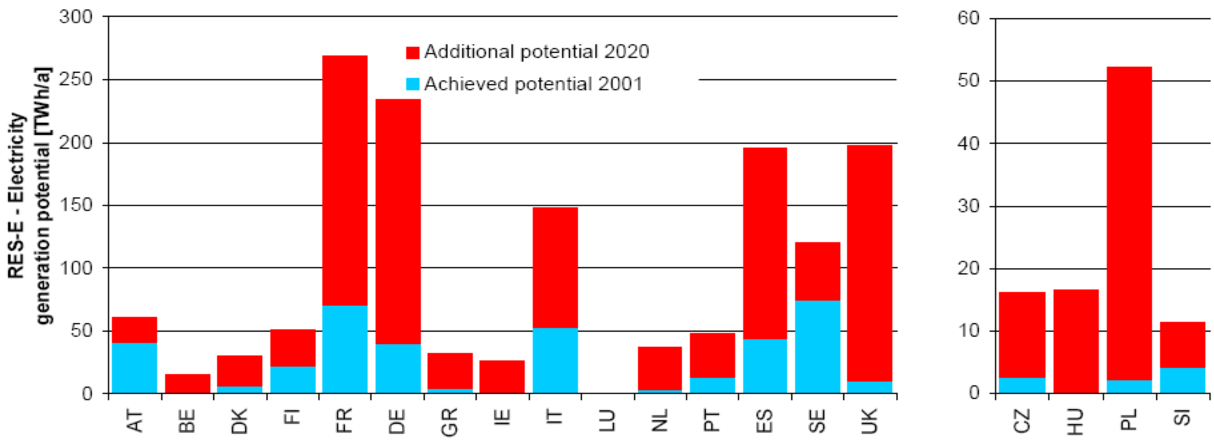

Fig. 2.3 Achieved (2001) and Mid-term (2020) potential in RES-E of EU Members

2.3.2.2 Biomass and Biogas support

Due to different **biomass** sources, processes of transformation and sizes, the generation cost of biomass presents big variations. Denmark with feed-in tariffs and the Finish hybrid support (de-taxation and investment subsidies) clearly show the best performance in the biomass sector, both in terms of effectiveness as well as economic efficiency of support. A long tradition in biomass use for energy purposes, stable planning conditions and a combination with heat generation can be considered as key reasons for this development.

In the **biogas** sector six countries present effectiveness which is higher than the EU average, four of them with feed-in (Denmark, Germany, Greece, Luxemburg), two of them with green certificates (UK, Italy). But in nearly 70 % of the EU countries the support level is too low to develop this high potential technology.

2.3.3 Barriers to greater deployment of RES-E

The barriers can increase the cost of RES-E or can inhibit the deployment completely, so they are crucial in the policy deployment strategy. Barriers that project developers and investors encounter when installing new capacities can be of administrative, grid, social and financial nature.

Administrative barriers can unnecessarily hamper the planning process. This is usually the case when a high number of authorities are involved in the planning process and there is a lack of coordination between them. Long lead times exist to obtain necessary permits, and potential sites for renewable electricity production are insufficiently taken into account in spatial planning.

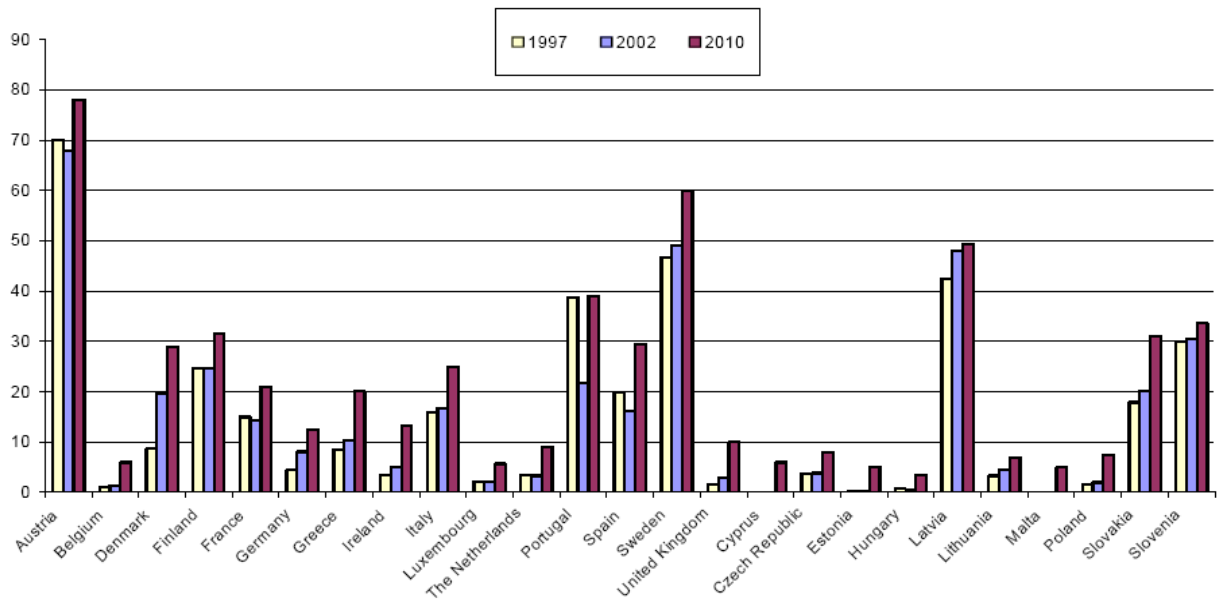

Fig. 2.4 Share (%) of RES-E in the member states consumption compared to 2010 targets

Priority access to the grid at a reasonable and transparent price is essential to the development of renewable electricity generation, but is not provided for in many Member States. Furthermore grid infrastructure was mainly built when the electricity sector was publicly owned and has been designed to allow large power plants being situated near mines and rivers, or near the main centers of consumption. RES-E generation is normally not situated in the same places as conventional electricity production and has, in general, a different scale of generation. Thus RES-E production can be confronted with a lack of sufficient grid capacity. This barrier is worsened by the lack of transparent rules for bearing and sharing of various grid investment costs, as well as the existence of vertical integration and dominant utilities. Transparent rules for bearing and sharing of costs of various grid investments have been put in place in Denmark, Finland, Germany and the Netherlands.

2.4 Recommendations for improved RES-E penetration

The EU member states have each chosen their own policy structure for RES-E support. In the view of gaining significant experience with renewables support schemes, competing national schemes could be seen as healthy at least in a transitional period. Competition among schemes should lead to a greater variety of solutions. The EC therefore considers it too early to directly compare the advantages and disadvantages of well-established support mechanisms with systems with a rather short history, and hence too early to present a harmonized European RES-E support system at this stage.

Based on cooperation between countries and consideration for optimizing the impact of the national schemes, the Commission considers a co-ordinated approach on RES-E support schemes. Examples like the starting cooperation between the feed-in tariff systems in Germany, Spain and France, and the new foreseen common Swedish-Norwegian green certificate system can be examples for others.

The Commission proposes a process of optimizing of national systems, concerning the economic mechanisms but also the removal of administrative and grid barriers. Member States shall optimize and improve the success of their support schemes by enacting the following measures [13], [14]:

- **Increase of legislative stability and reducing investment risk**. Since one of the main concerns with national support schemes is their stop-and-go nature of a system, such instability in the system creates high investment risks, resulting in higher costs for consumers. Thus, the long-run stability and reliability of support system is needed to reduce the perceived risks. Reducing investment risk and increasing liquidity to minimize unnecessary market risk is an important issue, notably in the green certificate market. Increased liquidity could improve the option of long term contracts and will give a clearer market price.
- **Reduction of administrative barriers**, including the streamlining of administrative procedures for access support schemes should minimize the burden on consumers. Clear guidelines, one-stop authorization agencies, the establishment of pre-planning mechanisms and lighter procedures are concrete proposals to Member States in addition to the full implementation of the Renewables Directive.
- Review of **grid issues and the transparency of connection conditions**. Transmission reinforcements need to be planned and developed in advance based on the fully transparent and non-discriminatory principles of cost bearing and sharing. Secondly, the necessary grid infrastructure development should be undertaken to accommodate the further development of renewable electricity generation. Thirdly, the costs associated with grid infrastructure development should normally be covered by grid operators. Fourthly, the pricing for electricity throughout the electricity network should be fair and transparent, taking into account the benefits of embedded generation.
- **Encouraging technology diversity**. Some support schemes tend to support only the strongest of the renewable technologies in terms of cost competitiveness. A good overall support policy for renewable electricity should preferably cover different renewable technologies. For instance, offshore wind energy would usually not be developed if it came under the same financial framework as onshore wind power. Such schemes could therefore be complemented with other support instruments, in order to diversify the technological development.
- Better use of **tax exemptions** and reductions offered to renewable energy sources under the Directive on the taxation on energy products [5].
- Ensuring **compatibility with the internal electricity market**. This criterion assesses the ease with which a support scheme can be integrated into a liberalised power market, and its effectiveness in functioning together with existing and new policy instruments set out in [3], [6].
- **Encouraging employment** and Local and Regional Benefits. A substantial part of the public benefits pursued by policies supporting renewables relate to employment

and social policies, rural development while other national policy goals should be respected and duly take into account [7].

- **Twinning** with actions on **energy efficiency, demand management and Greenhouse Gas Emissions Trading Scheme**. The progress of renewable electricity generation is being offset by excessive growth in electricity consumption and must be avoided. Only a combination of RES-E support measures with electricity end-use efficiency measures [4] will bring Europe further in its energy policy goals [1]. At the same time, the EU Emission Trading Scheme presents a powerful driver to reduce GHG emissions, generating economic incentives for introduction of RES-E generation [8].

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3 Success factors in maximizing the wind energy penetration in isolated power systems: case of Greece

Pavlos S. Georgilakis, Antonis G. Tsikalakis, Nikos D. Hatziargyriou
Institute of Communication and Computer Systems, National Technical University of Athens
9 Iroon Polytechneiou street, 15780, Athens, Greece
Phone: +30 210 7723661, FAX: +30 210 7723968, e-mail: nh@mail.ntua.gr

3.1 Introduction

The cost of electric energy in islands is generally higher than in the mainland, because this energy is produced using exclusively oil products as fuel of generating units. On the other hand, in many islands there are favorable conditions for wind power production, as is the case in the Aegean islands. However, the wind power penetration in islands is limited, due to the operational problems raised from the parallel operation of the wind generators with the conventional power units. In order to maximize the wind penetration a proper planning of the wind power that can be installed and the adequate schedule of the operation are necessary.

In the simulation models that have been developed in order to maximize the permissible wind penetration during the operation of the power system, the conventional power units and their operational characteristics are simulated in detail, e.g. the run-up and run-down procedure of the controlled units, the forecasted load change, the required running reserve etc. Detailed load and wind speed time series, in the base of one or a few minutes, are also used, so that all the actions of the operators, under different operating conditions, are modeled.

These models, usually named “logistic models” [1,2], can also calculate the energy produced by each one of the units, conventional and wind turbines, in one (or a few) minute-by-minute base, and consequently the spilt (rejected or not produced) wind energy, the total fuel consumption, etc. Such models are also incorporated in advanced control systems, specially developed for the optimum operation and dispatching of relatively complex island power systems with high wind power penetration. Such control systems are CARE and MORE CARE [3] that were developed in the frame of projects funded by the European Community and are in operation in Crete, Madeira and Ireland. The main advantage offered by the installation of control systems like CARE and MORE CARE, is the possibility to achieve high wind power penetration by monitoring the power system in such a way that the risk of deterioration of the power quality, due to the uncertainty of the behavior of the wind, is considerably reduced. For this scope, additional software, e.g. for wind and load forecasting and security assessment, are also incorporated.

In this paper, first a definition of wind penetration is given together with an overview of the current status of wind penetration. Next, a methodology for the calculation of the penetration limits of renewable energy sources in non-interconnected islands is presented. The Greek Regulatory Authority for Energy (RAE) applies this methodology for granting generating licenses to wind power plants in islands. The results from the application of the methodology for the island of Crete are presented and discussed. It is marked that in Crete, a considerable wind power penetration already exists.

3.2 Wind penetration

3.2.1 Definition of wind penetration

When incorporating renewable-based technologies into isolated power supply systems, the amount of energy that will be obtained from the renewable sources will strongly influence the technical layout, performance and economics of the system. For this reason, two parameters are used – the instantaneous and average power penetration of wind – as they help define system performance [4].

Instantaneous penetration, often referred to as *power penetration*, is defined as the ratio of instantaneous wind power output, P_{wind} (in kW), to instantaneous primary electrical load, P_{load} (in kW):

$$\text{Ins tan tan eous (power) penetration} = \frac{P_{wind}}{P_{load}} .$$

Thus, the instantaneous penetration is the ratio of how much wind power is being produced at any specific instant. Instantaneous penetration is primarily a technical measure, as it greatly determines the layout, components and control principles to be applied in a system.

Average penetration, often referred to as *energy penetration*, is defined as the ratio of wind energy output, E_{wind} (in kWh), to average primary electrical load, E_{load} (in kWh), measured over days, months or even years:

$$\text{Average (energy) penetration} = \frac{E_{wind}}{E_{load}} .$$

Average penetration is primarily an economic measure as it determines the levelized cost of energy from the system by indicating how much of the total generation will come from the renewable energy device.

3.2.2 Current status of wind penetration

In most parts of the world wind energy supplies only a fraction of the total power demand, if there is any wind power production at all. In other regions, for example in Northern Germany, Denmark or on the Swedish island of Gotland, wind energy supplies a significant amount of the total energy demand. In 2003, wind energy supplied around 4.200 GWh of the total system demand of 13.353 GWh (energy penetration of 31,45%) in the German province of Schleswig-Holstein [5]. Table 1 shows two more examples of wind penetration. On average wind power generation represents only 1-2% of the total power generation in the Scandinavian power system (Nordel) or the Central European System (Union for the Coordination of Transmission of Electricity, UCTE). And the penetration levels in the USA (North American Electricity Reliability Council, NERC) are even lower.

Table 1: Examples of wind penetration levels in 2000

	Area	
	Tamil Nadu (India)	Eltra (Denmark)
Wind capacity (MW)	750	1.900
Conventional capacity (MW)	7.804	4.936
Total capacity (MW)	8.554	6.836
Wind power penetration (%)	8,8	27,8
Wind production (GWh)	1.157	3.398
Consumption (GWh)	37.159	20.604
Wind energy penetration (%)	3,1	16,5

3.3 Methodology for the calculation of the penetration limit of renewable energy sources in non-interconnected islands

This section presents the main points of the methodology [6] applied by RAE. This methodology is used for granting generating licenses to wind power plants in islands, in the frame of the deregulated electricity market.

3.3.1 Objective

The methodology has two main objectives:

- The estimation of the wind energy that can be absorbed annually by an autonomous power system that is composed of diesel generators and wind parks.
- The determination of the maximum permissible wind power that can be connected with the power system (maximum penetration), without reducing the system security or causing inadmissible contingencies during the system operation.

The methodology can be extended for other renewable technologies (not only wind energy) as well as for hybrid systems [7].

3.3.2 Principles

The methodology concerns autonomous power systems that include one or more conventional power stations, which are composed of units with controllable generation rate (usually diesel generators). For the application of the methodology, it is required that the operation of the units with controllable generation rate is centrally dispatched by the System Operator and as a result the dispatch order in the system is determined together with the terms and conditions for their operation.

The main principles of the methodology are the following:

1. The main principle of the methodology is the securing of the right operation of the system and the supply of satisfactory power quality to the consumers, aiming at maximizing the penetration of the renewable energy sources in the energy balance of the island, as defined by the Greek law 2773/1999 and the European Commission Directive 2001/1977.
2. The methodology is limited to the study of the technical part of the problem and it does not take into account the economic operation of the system. This means that no economic impact (negative or positive) is considered that can result from the obligatory operation of the renewable power station (that operates many times not at its optimum operation) because of the obligation (according to the Greek law 2773/1999) for absorption of the renewable power. However, the methodology gives the ability to calculate the above economic impact (fuel cost, etc).
3. The methodology takes into account the characteristics of the conventional power station as well as other units with controllable generation rate, together with the load characteristics through the annual load duration curve.
4. It is considered that the total produced wind power can be controlled, so that it can be reduced if it is required by the system. For this reason, it is considered that the wind power stations are composed of small production units (e.g. in the order of 500-700 kW), or from big generating units with the ability to control their power production. A uniform power curve is used for all the wind turbines of the island.
5. The wind conditions of the island are taken into account through the probability distribution curve of the wind speed (Weibull curve), which corresponds to a particular annual average wind speed of the island, which usually comes from measurements.
6. It is followed the basic principle that the conventional units of the station must not be loaded under their technical minimum load limits. These limits are determined by RAE based on proposals of the System Operator. Today, the technical minimum load limits of the majority of diesel generators with heavy oil are between 40-50% of their nominal power. These limits are significantly lower for diesel generators with light oil.
7. In order to completely secure the service of the system load in case of partial or total lost of the wind power, it is considered that, in any time, the minimum units with controllable generation rate (currently diesel generators) will be dispatched, which units can completely meet the load even with zero wind power production. This means that it is necessary to have continuously a 100% running reserve of conventional power. This consideration is clearly "on the safe side". However, in order to succeed in the maximum exploitation of the renewable energy sources, the System Operator can operate the system with smaller reserve, taking into account the actual conditions of each particular time.
8. A limit is set for the *instantaneous wind power penetration*, since the fluctuations in wind energy production can cause unfavorable consequences to the conservation of the frequency within the permissible limits or even to the system stability. This limit, also named *dynamic operational limit*, depends on: (a) the conventional station

characteristics, such as the response rate of the speed governor of each unit, (b) the wind power parameters, such as the total wind power installed, the characteristics of the wind generators (tenacity in under/over-frequency and under/over-voltage control, power smoothing capability, etc), (c) the dispersion of the wind parks on the island, (d) many other factors related with the dispatching philosophy, the operators capabilities, the existence of control systems (e.g. CARE, MORE CARE) in the dispatching center. The analysis and the experience have shown that the instantaneous wind power penetration cannot exceed 40-50% of the load with the today wind technology and the usual control means of diesel units, without the installation of other means for the compensation of the fast fluctuation of the wind power production. However, for the accurate determination of the instantaneous wind power penetration of each island, it is necessary to realize measurements.

9. The methodology determines the ability to absorb wind energy from the system on an annual basis. This energy will be dispatched to all the wind power stations approximately according to their power. This power can be the maximum power that was measured during the previous year, or the rated power for new wind power stations.
10. The estimation of the wind energy that can be absorbed is done with probabilistic analysis, where the probabilistic variables are the wind speed and the load demand, which are considered as completely independent each other.

3.3.3 Input data

The input data that is required for the application of the proposed methodology is the following:

1. Annual load duration curve of the system for the previous year.
2. The characteristics of the conventional power station (stations). In particular:
   - i. The synthesis of the power station and the dispatch order of the units of the station.
   - ii. The maximum production capability and the technical minimum load limit of each unit.
   - iii. The maximum permissible fast variation of the load of each unit (kW/min) for the satisfactory response of each unit to the conservation of the frequency within the permissible limits (at least three operating points, e.g. 40%, 70% and 100% of load).
   - iv. Fuel consumption for each unit (at least for three different loads, e.g. 40%, 70% and 100%).
   - v. Other particularities and limits (if there exist) for the units.
3. The existing wind power stations, especially their nominal power, their location, and their synthesis.
4. The new wind power stations.
5. The characteristics of the wind at the locations of the wind parks. More specifically, the Weibull curve is used. It is expected that the characteristics of the wind in an island (in particular in a small or medium island) are similar, so only one Weibull curve can be considered for the whole island.

The System Operator provides the above data 1 to 3, while RAE provides the data 4 and 5.

3.3.4 Proposed methodology

Taking into account that the existence of the wind power does not change the applied optimum dispatching order of the conventional units, the permissible wind power, $E_w^{max}(t)$, for each time interval t (usually one hour) can be calculated as the smaller of the two maximum permissible values $P_{w\,max}^{C_T}(t)$ and $P_{w\,max}^{C_D}(t)$:

$$E_w^{max}(t) = \min\left\{P_{w\,max}^{C_T}(t), P_{w\,max}^{C_D}(t)\right\} \tag{1}$$

where

$$P_{w\,max}^{C_T}(t) = P_L(t) - \sum_i C_{Ti} \cdot P_{Di}(t) \tag{2}$$

$$P_{w\,max}^{C_D}(t) = C_D \cdot \sum_i P_{Di}^{nom}(t) \tag{3}$$

where

$P_L(t)$ the load at time interval t

C_{Ti} the technical minimum load coefficient of the unit i

C_D the dynamic operational limit coefficient

$P_{Di}(t)$ the generating power of the unit i at the time interval t

$P_{Di}^{nom}(t)$ the sum of the maximum generating power of the conventional units in operation at the time interval t

The value of C_{Ti} depends on the type of the unit i and is given by its manufacturer.

The total wind energy that can be absorbed by the system annually, E_w^{max}, is calculated as follows:

$$E_w^{max} = \sum_{i=1}^{8760} E_w^{max}(t) \tag{4}$$

Also, if specific wind power is considered and the wind conditions at each site are known, the total produced and rejected wind energy, as well as the energy produced by the conventional units, for the whole year can be calculated.

The procedure for the calculation of the wind penetration is as follows:

1. A discrete frequency distribution of the *capability of wind power absorption* is calculated
2. A discrete frequency distribution of the *wind power that can be generated* is obtained
3. A discrete frequency distribution of the *absorbed wind power* is calculated

3.3.4.1 Capability of wind power absorption

A discrete frequency distribution of the *capability of wind power absorption* is calculated as follows:

1. The cumulative load curves, one for each year, are formed. Each year is divided in N "operational states". If h_i are the hours and P_{Li} the mean power

corresponding to the operational state i, the probability of its occurrence will be $f(P_{Li})=h_i/8760$.

2. For each operational state i:
   i. The minimum required controlled units are estimated that have to be dispatched according to their dispatch order, so that the demand P_{Li} is fully covered (100%).
   ii. Taking into account the technical minimum load limit of each unit, the load that has to be met by the conventional units is estimated.
   iii. The capability of wind power absorption is calculated as the difference between the load and the power that the controlled units must supply.
3. The calculations are repeated for all the states i = 1 to N, so that the cumulative and the frequency distribution of the *capability of wind power absorption* curves can be obtained. However, it is noticed that in the case of planning stage the selection of the proper dynamic coefficient C_D is more difficult than in the operation stage because most of the parameters are unknown or impossible to be quantified. It is clear that this "capability" presents the maximum wind power and energy that could be absorbed from the system if unlimited controllable wind power was available.

3.3.4.2 Wind power that can be generated

A discrete frequency distribution of the *wind power that can be generated* is obtained as follows:

1. Based on the Weibull distribution curve suited to the wind conditions in the island (it can be obtained by measurements), the probability of occurrence $g(V_j)$ of the wind speed V_j during the state j, is obtained considering M states (j = 1 to M) for the wind speed.
2. Based on these M states, the corresponding wind power for each state can be calculated, considering an aggregate wind park of which each wind turbine receives the uniform wind velocity V_j at the state j and produces the power corresponding to a specific power curve. This approximation is on the safe side for the system stability, because in the real world, the wind parks operating in a region rarely produce their nominal power at the same time (in average hour values), even if they are neighboring.
3. The calculations are repeated for all states (j = 1 to M), so that the discrete frequency distribution is obtained of the wind power P_{Wj} that can be generated.

3.3.4.3 Absorbed wind power

The discrete frequency distribution of the *absorbed wind power* is obtained by the convolution of the distributions (a) *capability of wind power absorption* and (b) *wind power that can be generated*, as follows:

1. The total operating states of the system is NxM and the probability of occurrence of each state can be calculated by the simple formula:

$$PR(P_{Li}, V_j) = f(P_{Li}) \cdot g(V_j) \quad (5)$$

   The calculation of the $PR(P_{Li},V_j)$ by the simple relation (5) is justified because the distribution of load and the wind power can be considered approximately uncorrelated.

2. For each operational state (i,j), the load demand, the capability of absorption and the really absorbed wind power are known, so that the total produced and the rejected (non produced) wind energy, as well as the energy produced by the conventional units, for the whole year can be calculated.

Other interesting quantities, e.g. the obtained reduction of the oil consumption, can be easily calculated.

3.3.4.4 Synthesis

By the application of the above method for many years and different wind penetration scenarios, a clear picture of the wind penetration capacity, which can be incorporated in the power system of the island, can be drawn. Extensive analyses concerning the different assumptions and values of the parameters considered, related with the particularities of the island or the installed equipment, can b e easily made.

3.3.4.5 Economic viability of the investment

The economic viability of the investment of a wind park clearly depends on its produced energy during a year. This is mainly related with the wind potential at the wind park site and the capability of the power system to absorb the produced energy by the wind park. In the case of islands, the Distribution Network Operator (DNO) imposes the obligation to each wind park to spill (not produce) a part of the energy that it could produce, in case that the system cannot absorb it. This obligation is realized by the regularly definition for a specific time interval (e.g. for each hour), of the power that can be absorbed from the power system (set point).

A coefficient, defined by the relation (6), named *Capacity Factor* (CF), is usually used to indicate the viability of a wind park:

$$CF = \frac{E_w}{8760 \cdot P_w} \tag{6}$$

where

E_w the total energy produced by the wind park in a year

P_w the nominal power of the wind park

According to the estimations of RAE, based on the applied economic conditions in Greece, a wind park investment in an island is considered as economically viable if the wind park can achieve a CF over than 27,5%. This value corresponds to a wind park operating in the mainland (that means without restrictions of energy absorption) and situated at a site with mean annual wind velocity of 7,2 m/sec. It is remarkable that in many Greek islands, the value of CF, without rejected (not produced) energy, usually lies in a range of 30% -40% and in the extreme cases can rise up to 45%.

3.4 Case study

The previously described method is applied to assess the amount of the wind power that can be installed in Crete and consequently to indicate the wind power licenses that can be granted to the investors.

First, the method is applied for the year 2003 and the results are compared with the real data of that year for verification reasons. Next, different amount of wind power that could be accepted, under specified conditions, for the same year are considered, in order to assess the maximum economically viable wind power that could be installed on the island, under different values of dynamic operational limit C_D. Finally, an investigation for the viable wind power that can be installed at the year 2010 is presented and discussed.

3.4.1 Crete power system at 2003

The total nominal power of the conventional generating units of the power system of Crete for the year 2003 is 628,03 MW. Steam units are used for the base load, diesel units and the combine cycle unit for the medium load and gas turbines for the peak load.

There were also 9 wind parks in operation at that year, with a total installed power of 70 MW. More than 90% of this wind power is installed at a restricted area of Lassithi in the East Crete.

The maximum demand of 2003 was 514 MW and the total produced energy was 2.467 GWh. The wind parks contributed with 207 GWh, corresponding to 8,4% of the total produced energy.

3.4.2 Wind penetration limits for the year 2003

In Table 2, the results of the application of the simplified method for the year 2003 are presented [8]. First, in the 2nd and 3rd columns, the existing situation is considered, with a total installed wind power of 70 MW, which is 13,6% of the maximum demand. Next, several amounts of installed wind power are considered: 95 MW (18,5%), 130 MW (25,3%) and 160 MW (31,1%), as it is indicated in the next columns. The coefficient C_D is taken to vary between 100%, corresponding to the case of no restrictions in the absorbed power, up to 20%, which corresponds to the most conservative operating condition.

The real data of load demand for the year 2003 was taken into account for the calculations. For the wind speed, a Weibull distribution curve, obtained by available measurements of one-hour mean value time series, was considered. This time series has a mean wind speed of 8,5 m/sec, which is a typical value for many areas in Crete.

Table 2: wind penetration limits in 2003 for Crete

	Installed wind power							
	70 MW		95 MW		130 MW		160 MW	
C_D	Production (GWh)	CF (%)	Production (GWh)	CF (%)	Production (GWh)	CF (%)	Production (GWh)	CF (%)
100	228	36,3	302	36,3	414	36,3	509	36,3
40	221	35,9	290	34,9	371	32,6	417	29,8
35	220	35,9	288	34,6	355	31,2	391	27,9
30	218	35,5	278	33,4	330	29,0	357	25,5
25	213	34,7	259	31,2	297	26,0	317	22,6
20	198	32,3	230	27,6	255	22,4	271	19,3

Based on the results of Table 2, the following can be concluded:

1. In the existing situation of 70 MW wind power installed, the CF varies from 32,3% (corresponding to 198 GWh of produced wind energy) in case of system operation with C_D=20%, up to 35,9% (221 GWh) in case that C_D=40%. From the measured data it is found that the real CF was 33,76% (207 GWh) that corresponds to a C_D=23%, approximately. This value is in accordance to the restrictions applied by the Public Power Corporation in Crete, where according to the existing conditions a maximum wind penetration of 25% is permitted and exceptionally, during low load conditions, it can be reduced up to 15%. The main reason for this conservative operating policy is the fact that a sudden disconnection of the majority of the wind power is possible to happen, for example, because of a voltage dip that may follows a short circuit on the feeding 150 kV network.
2. In any case, it can be concluded that the method gives approximately credible results. In case of low wind power penetration, as in the existing of 70 MW (13,6% of peak demand), the spilled (not produced) wind energy is negligible and consequently the CF is not changed considerably. The spilled wind energy is calculated as the difference between the produced energy for the C_D considered and the produced one for C_D=100%. So, the spilled wind energy for the 2003 was 228-207=21 GWh, that is less than 10% of the capable to be produced wind energy.

3. The maximum CF is clearly obtained if there are no restrictions in the absorption of the produced wind energy. In this case, its value depends only on the wind characteristics. In the case studied, it is 36,3% and is

evidently independent on the amount of installed wind power, as it is deduced from the relation (6), if the produced wind energy is proportional to the total wind power installed. However, it is remarkable that the value of the CF, as a function of C_D, is reduced fast when the installed power increases. This means that the spilled wind energy, both as absolute number and as percentage of the energy capable to be produced, is being greater as the installed wind power in the island (at the examined period) increases, as it was expected. In general, it can be concluded that the value of the C_D, which is a part of the operating conditions of the power system, is of primary importance, in terms of achieving high wind penetration.

4. Precisely, if the limiting satisfactory value of CF for the economic viability of the wind power investments be equal to 27,5%, according to the estimations of the RAE under the actually existing conditions in Greece, then, as it is concluded from the Table 2, the economically viable wind power is:

   95 MW (~18% of the peak), for C_D=20%
   130 MW (~25% of the peak), for C_D=27,5%
   160 MW (~31% of the peak), for C_D=35%

3.4.3 Wind penetration limits for the year 2010

The power system of Crete is going to be considerably changed until 2010, compared to that of 2003. New conventional power plants will be installed and many of the old units will be withdrawn. It is not clear yet, which the accurate composition of the generating power will be, so, a few assumptions had to be made.

The load demand is assumed that increases with mean annual rate of 6,5%, reaching a peak of 817 MW at 2010. The total consumption at the same year is estimated to be 3.826 GWh.

Several scenarios for the wind power installed at this year were considered, i.e. 130 MW (15,9% of peak), 160 MW (19,6%), 200 MW (24,5%) and 260 MW (31,8%). The results of the method application are presented in Table 3 [8].

As it is seen from Table 3, the viable wind power at 2010 is 160 MW, if the DNO will follow the same operating policy as 2003 (C_D~23%). This power could be increased to 260 MW, if a value of C_D=35% will be applied. This indicates, once again, the importance of the value of “dynamic operational limit”, which currently takes values only by the experience.

Table 3: wind penetration limits in 2010 for Crete

C_D	Installed wind power 130 MW Production (GWh)	130 MW CF (%)	160 MW Production (GWh)	160 MW CF (%)	200 MW Production (GWh)	200 MW CF (%)	260 MW Production (GWh)	260 MW CF (%)
100	414	36,3	509	36,3	636	36,3	827	36,3
40	414	36,3	499	35,6	589	33,6	680	29,9
35	410	36,0	484	34,6	558	31,8	629	27,6
30	399	35,0	460	32,8	516	29,5	569	25,0
25	377	33,1	422	30,1	461	26,3	502	22,0
20	340	29,9	369	26,3	397	22,7	428	18,8

3.5 Conclusions

A methodology for the calculation of the penetration limits of renewable energy sources in non-interconnected islands was presented in this paper. The method was applied to assess the amount of the wind power that can be installed in Crete and consequently to indicate the wind power licenses that can be granted to the investors.

The main conclusions are the following:

1. The method, used by RAE for the assessment of the economically viable wind power that can be installed on an island, gives credible results.
2. The accuracy of the method strongly depends on the correct choice of the value of the dynamic operational limit (C_D).
3. A high value of C_D results in a high wind penetration.
4. In general, the wind power penetration can be considerably increased by two main ways [7]:
   i. By the installation of more wind power, so that a part of it could be switched off when it is not possible to be absorbed by the system (the disadvantage is that a large part of wind energy that could be produced is spilt, i.e. a part of the installed wind energy is not properly used).
   ii. By the installation of energy storage systems of different types (the advantage is that almost the whole spilt wind energy can be exploited for electrical energy production).
5. Especially for the operation stage, software like CARE and MORE CARE can considerably help the system operators in order to increase the wind energy production and reduce the operation cost of the system.

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4 Success factors in implementation of solar energy in public institutions: case in Bosnia and Herzegovina

[(1)]Suad Halilčević, [(2)]Muamer Halilović, [(1)]Vlado Madžarević
[(1)]University of Tuzla, Faculty of Electrical Engineering, [(2)]High School of Electrical Engineering
Franjevačka 2, 75000 Tuzla, Bosnia and Herzegovina
Phone: -- 387 35 259 600, FAX: -- 387 35 259 608 ; e-mail: suad.halilcevic@untz.ba

4.1 Introduction

Since concerns about air pollution and untenable current energy sources are growing, it is becoming clear that turning to clean and renewable energy sources is necessary. For that reason, different concepts of energy provision, including any type of energy, should be implemented. The first step should be made in public structures such as hotels, administrative buildings, malls, etc. In order to meet these demands, a new generation of SHCs and photovoltaic panels has been developed which already has great future market opportunities and make up an essential part in the European energetic strategy.

The latest political documents issued by the European Solar Thermal Industry Federation emphasize the necessity of struggling with the increased emission of green-house gases. SHCs, photovoltaic panels, and other renewable energy sources will have a major role in solving this problem. By signing the Frame Climate Change convention, more than 160 nations have accepted the responsibility of taking action to decrease the emission of green-house gases. In case of Bosnia and Herzegovina, whose primary goal is joining the EU, it means that this issue will have to be addressed very soon.

4.2 Technology

SHCs are heating devices which use the Sun's energy and are used in homes, hotels and various institutions. Such systems usually consist of solar collectors placed on the roof, an isolated hot water tank and a heat transfer system (heat exchanger) together with control and security devices.

The solar collector takes in the Sun's light and converts it into heat. It usually consists of an absorption board which is in most cases in southern Europe painted mat black, whereas in northern Europe it is covered with a specially selected protection layer. In order to minimize loss of heat, the collector is isolated and covered with a see-through layer made of special glass or plastic. Usually, the pipes of SHC are built under two absorption board where between them the air is evacuated in order to achieve vacuum isolation. The greater efficiency is obtained because in this case the reflection of solar irradiation is decreased and absorption of SHC is increased. The heated working medium is pumped into the storage tank with circulation pumps, or by natural flow. The heat in storage tank is transferred by means of exchanger in to water or air. Today's solar systems are easy to install, reliable, durable and with small maintenance demands.

Solar photovoltaic panels are the most popular sources of alternative energy to get the electricity for either individual or public use. Since the Sun reaches everyone during the year, it means that everyone can benefit from its energy whether it covers the whole system or charges the batteries with free electricity.

Photovoltaic panels directly convert the Sun's energy into electric energy, by which they produce a direct current easily stored in batteries, and by using invertors the direct current is transformed into an alternating one. The price of reliable batteries as well as the price of invertors increases the total price of the system.

Photovoltaic panels do not consist of mobile parts and do not require complicated control mechanisms. The future of this energy source seems brighter because of the simplification of the process of solar cell creation, which is the factor of its high price at the moment.

4.3 Applications

4.3.1 Solar hot water system

This is one of the most often used applications. Such systems can provide more than 50% of hot water necessary per year, where the rest is provided by conventional methods (gas boilers, electrical heaters). A typical family house system can have a collection surface from 2 to 5m^2 and a tank with capacity from 150 to 200 liters. Apart from systems installed in individual objects, larger systems provide hot water in hotels, hospitals, and even housing blocks.

4.3.2 Combined water and space heating system

Solar systems are increasingly used for space heating as well, and can be used for heating individual objects, hotels or whole housing blocks using the present heating schemes. Conventional methods can be used as auxiliary schemes.

4.3.3 Air conditioning and cooling

Highly efficient solar systems can be used to power cooling devices, and their future is certain because of the necessity of space cooling during summer.

4.3.4 Photovoltaic conversion

Careful planning and the integration of photovoltaic panels in public light systems, alarm systems, vertical transportation systems and other similar systems can result in significant energy savings and a decrease of gas emission as well.

4.4 The European market

Current sales of solar collectors and panels are about 1.5 million m2 per year, with the biggest market in Germany, Austria and Greece. Sales increase is about 23% per year up to this year, with the chance of greater increase in future provided by government structure policies.

The surface covered with solar collectors in the EU up to 2003. is about 12.3 million m2, which decreases the yearly emission of CO2 gas by 2.4 million tons which is equivalent to savings of 450 thousand tons of fuel. At the same time, 10.000 new jobs are created. This data corresponds to 20 m2 of installed solar collectors per thousand residents, and since there are already areas with 1000m2 of solar collectors per 1000 residents it is clear that there is a huge potential market in Europe.

4.5 New concept of public structure energy supply

4.5.1 The need for energy efficiency, clean and renewable energy

Generally, public buildings are office buildings for government, departments, ministries, agencies, hospitals, residential space for government officials, schools and higher learning institutions. Most hotels and shopping complexes and large department stores are classified as commercial buildings.

The energy consumption of these buildings varies depending on the size, design, the materials used, the age and the equipment or system used in the building. Electricity is a common form of energy used for lighting, air conditioning and other electrical appliances. The energy sources for water heating are oil, gas, biomass, electricity and solar power.

Electricity is clean energy at the point of use. However, electricity generation in most cases involves the burning of fossil fuels in power plants. The burning of fossil fuels emits combustion products (CO, CO_2, SOx, NOx and particulates) depending on the fuel properties and composition, operating conditions and the plant's efficiency. These emissions contribute to air pollution, acid rain and global warming. These in turn will adversely affect life and vegetation.

Energy efficiency in simple words means the extraction of maximum energy out of fuel or less energy wastage. This can be achieved by the use of efficient equipment, system and plants. An efficient use of energy or energy efficiency will help to reduce energy consumption, hence causing less emission.

Energy efficiency can be applied to energy production, distribution and utilisation in many areas such as power plants, and in industrial, transport, commercial and residential sectors.

The world trend is to use clean fuel, renewable energy and efficient energy use. Solar energy is a clean and renewable energy that has been used since ancient times for drying, heating and light. Technologies are now available to convert solar energy to electricity. Natural gas is in expansion of using because it is the cleanest form of fossil fuel and the world's gas reserves are larger compared to oil.

Where resources are available and accessible the use of more natural gas and renewable energy particularly solar energy, will reduce dependency on high sulphur fossil fuel especially coal and oil.

4.6 The trend of energy efficiency and renewable energy

Energy efficiency and renewable energy should be applied in every possible place such as homes, offices, other working places such as retail outlets, department stores, hotels, hospitals, manufacturing plants or other institutions.

With the concern abut global warming as a result of generating electricity from fossil fuel, the trend is to use alternative clean energy such as natural gas and renewable energy especially solar energy. The approach taken in energy efficiency application to new buildings differs from the existing buildings. For new projects the move is to build energy-efficient and self-powered buildings, and for the old and existing buildings the approach taken is efficiency improvement.

To improve the energy efficiency in existing buildings, measures such as good energy management practices and/or energy auditing is recommended to identify possible areas for improvement. Some of the most important and established energy efficiency improvement trends are to employ good operation and maintenance practices, replacement, retrofit, fuel substitution and co-generation.

To build an energy efficient building, a multi-disciplinary team comprising architects, systems designers and operating engineers must work together starting at the planning stage. Energy efficient buildings are those that provide the specified internal environment for minimum energy cost, normally within the constraint of what is achievable cost effectively. This can be achieved by using innovative materials, technologies and design concepts as climatically optimised architecture is being developed to reduce the unnecessarily high-energy consumption in buildings while retaining the same level of comfort.

4.7 Saving methods

The saving methods can be classified into the following categories:

- Saving lighting expenses by using efficient illumination
- Saving water and energy by using solar systems for hot water supply
- Application of combined heating systems for water and space
- Application of solar cooling systems and solar air conditioning
- Application of photovoltaic panels

We are going to explain some of the above mentioned saving methods but before that it is necessary to point out some of the concepts of passive design that can increase power efficiency of the object.

4.7.1 Design concept for energy efficient buildings

The concepts of building design proposed by professionals are to provide a comfortable living and working environment. These can be achieved by the use of daylighting, a carefully chosen building envelope, proper indoor air quality and a high degree of thermal comfort while at the same time reducing energy consumption in the overall lifetime of the building. The source of energy to be considered begin from the obtaining and manufacturing the appropriate construction materials, building construction and energy use in the equipment and system needed to provide the specified environment for the lifetime of the building.

Fundamental to energy efficiency and conservation strategies is the maximising of passive design principles, thus eliminating unnecessary active systems and therefore energy consumption.

The maximum passive design principle includes:

- Planning and sitting of individual buildings to be climate responsive at both macro and micro-scale,
- Being aware of seasons, climate, temperatures and winds resulting from the geographical latitude of the site,
- Being responsive to the winds, sunshine and shade from adjacent trees, water or buildings,
- Providing buffer walls and shading against solar heat gain in hot climate,
- Orientation to trap solar heat gain in cold climate and to avoid heat gain in hot climate,
- Taking advantage of natural daylight,
- Windows able to be opened for ventilation,
- Detailed design of window positions to enhance ventilation, and
- Appropriate location of stairs to reduce lift demand.

4.8 Power consumption in public places

The price of electric energy in the world market suffers the constantly increasing. Operators and owners of public places have to fill the consumers' needs for comfort, which of course implies intensive power consumption on commodities such as air conditioning, swimming pool heating and a constant supply of hot water. Reducing expenses can be a challenge especially in a hotel industry where a final result is directly linked to the satisfaction of a customer.

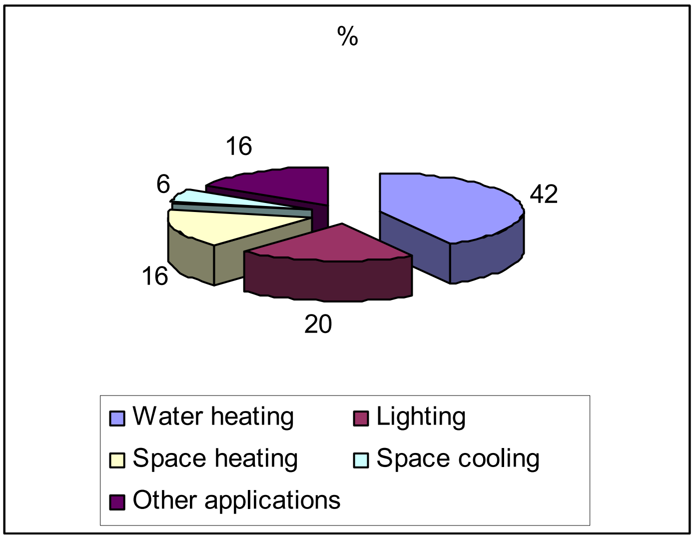

Figure 1: Power consumption in hotels

In Figure 1, the biggest part of power consumption (42%) belongs to water heating. Almost half of the electric energy bills are due to the water and swimming pool heating and especially to laundry service. Regardless of the hotel size, the owner's assignment is to cut the energy expenses but not to reduce the quality of service.

4.9 Application of solar system for hot water supply

About 42% of energy consumption in hotels is due to water heating. It is obvious that it is possible to achieve a reduction of energy expenses and a reduction of harmful gas production by using new technologies, especially solar systems for hot water supply.

Solar systems for hot water supply have become an accepted technology, and more and more are used as one of the most profitable ways of water heating in the domestic sector and of every type of heating in the public sector such as hotels, laundries, restaurants, etc.

When they function as they are designed, solar systems make a significant contribution to the preservation of energy in a region. A well-designed solar system for hot water supply should be able to deliver all of the hot water necessary during the summer. However, solar energy varies from season to season in some regions, which means that there is not enough solar energy for water heating. In this case, conventional ways of heating can be used. Many solar systems for hot water supply function badly or break down too early because of inadequate installation or maintenance. As a consequence of this, energy and economy savings are not fully realized. Solar systems offer many benefits for both the individual and the society overall.

Benefits for the users are as follows:

- Substantial savings on conventional heating bills
- Higher predictability of heating costs
- Autonomous energy production reducing reliance on imported energy
- It provides basic heat in case of disruption of conventional proven and reliable technology
- Immediately available solutions

Benefits for society:

- Direct contribution to reduction of CO_2 and other emissions
- It provides energy with no emissions
- It offers CO_2 savings at very low costs
- Energy payback time for solar heat collectors through the time is lesser and lesser
- It reduces dependency on imported fuels
- It saves environmental costs caused by transport of fossil fuels
- It creates local jobs

The implementation of the solar thermal potential in Europe, especially SHC, will significantly contribute to several political goals of the EU and its member states:

- Security and diversity of energy supply
- Reduction of greenhouse gas emissions
- Reduction of emissions causing urban pollution
- Reduction of other external costs caused by fossil fuels and nuclear power
- Export of know – how and equipment.

4.9.1 Technical solutions

Passive systems for hot water supply are the most efficient in areas with a high percentage of solar radiation. They are useful for heating smaller mediums and circulation happens because of the gravity or the natural flow as a warmer medium (water, anti-freeze) is lighter than a colder one. Public objects are usually big buildings and as such they are big consumers of hot water so closer attention should be paid to active solar systems that can better assist the needs of these objects.

Active solar systems for hot water supplies beside solar collectors and reservoirs for working mediums also need an outside energy source for pumps, ventilators, controllers and other mechanical devices.

Solar systems are usually sold with guaranteed performances. This means that every installation is expected to deliver a minimal quantity of energy for the expected hot water consumption during a year. A guarantee is responsible for every possible problem that can occur. That guarantee can be:

- Solar system designer
- Collector manufacturer
- Person responsible for installation
- System manager

If it is known that one malfunctioning component can cause system failure, that business appears risky. However, if the system anomalies are identified soon enough, all faults can be solved without a break in the hot water supply. In those conditions, the risk is reduced.

To guarantee a satisfactory performance of solar systems located in various climates, the following must be satisfied:

- Simple and correct methods for the calculation of solar system dimensions must be used.
- All components, such as: solar collectors, pumps, heath exchangers, reservoirs, and heat isolation must have a quality certificate.
- The design for the assembly of those components into a system must be standardised and simple (Figure 5.1)
- The system operation must be monitoried and controlled remotely. (Figure 5.2)

In most cases, a solar heating energy system is used together with conventional heating technology such as gas, oil, electricity or biomass based energy. The combination of those two technologies, makes the total system very complex. The supply of hot water is a standard problem with a good integration of solar heat systems.

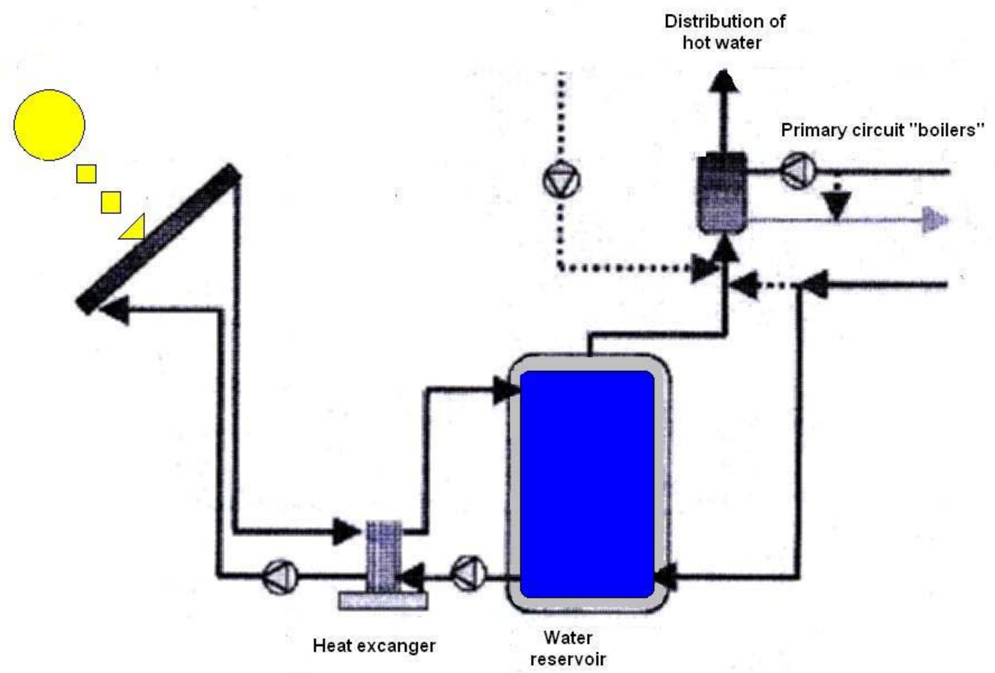

Figure 2: Standard design of SHC system

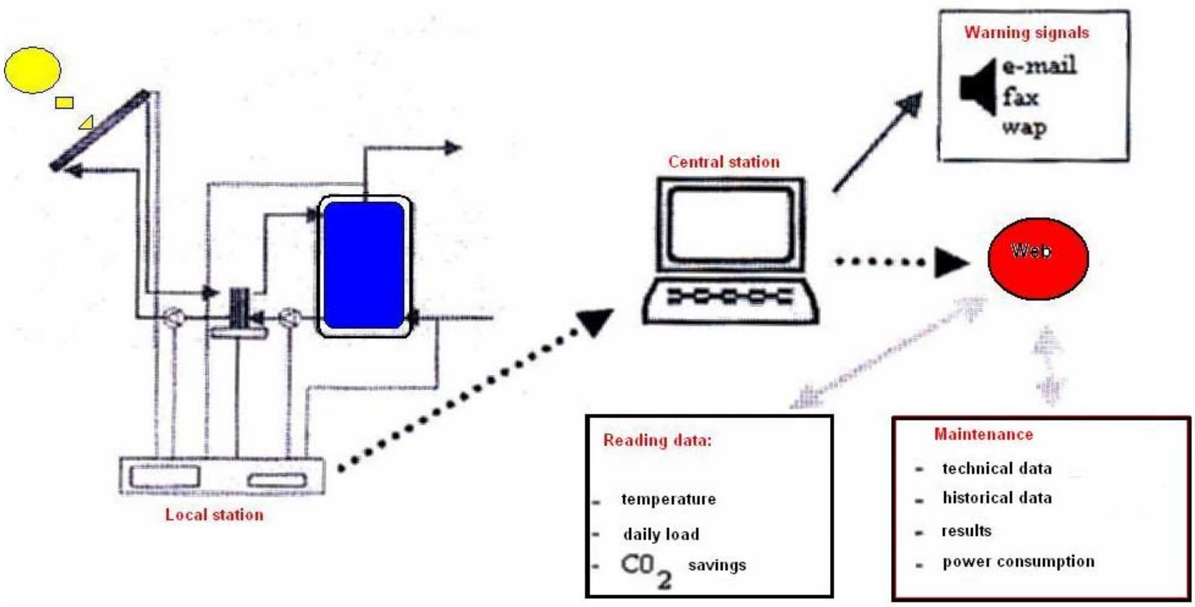

Figure 3: Monitoried and controlled solar heat system

4.10 Range of cost for SHC

The costs of solar thermal energy installations depend on a number of factors including the type of appliances, (open or closed solar heat systems, respectively), size and market conditions. Other less specific factors have to be added: the convenience of selling at a low price in order to find commercial objectives, the introduction of products by companies new to the market, and the elimination of stocks, etc.

In one-family housing, usually occupied by three to four persons, the most commonly installed solar heat system is the open solar heat system. In order to cover more than half of the energy needs of a house of this type two square meters of collecting surface is needed. The average cost for such an installation is around € 1800.

The costs for this type of equipment are estimated to decrease to around € 840 in 2010. The costs of operation and maintenance are low, around €12 depending on type and year of installation, with a useful life of the installation of at least 20 years.

The necessary investment costs per square meter of collecting surface installed for the second system type of a solar heat installation (closed system), corresponding to a large installation, e.g. in a hotel with high hot water consumption, is around € 420/m^2.

This price average is estimated to decrease to € 270/m^2 in 2010, which represents a cost reduction of 35%.

This type of installation will cover the 60% of energy demand to heat the sanitary water of the 240 hotel's guests, with a collecting surface of 173 m^2. The costs of operation and maintenance are very low, around €480 for the type and year of installation, with costs of € 0.0034/kWh.

Table 1: Cost example

	Family house	Hotel
	Open solar heat system	Closed solar heat system
Occupation	4 persons	246 persons
Collecting surface	2 m^2	173 m2
Covered energy	56 %	60%
Cost of maintenance	€ 12/year	€ 480/year
Investment/surface	€ 600/m^2	€420to€270 /m^2
Energy produced	1.500kWh/year	141.000
Average savings with solar energy	€ 510/year	€ 4900/year
Production average	756 kWh/m^2.year	814

4.11 Estimated energy saving and size of SHC

4.11.1 Required area of collectors

$$A_c = \frac{Q_p}{Q_s} \cdot \frac{\varepsilon_{region}}{\varepsilon_{place\ of\ SHC}} \cdot k \qquad (1)$$

where:

Q_p – required thermal energy (Wh),

Q_s – minimal amount of energy which emits the SHC (Wh/m^2),

ε_{region} – average energy transmitted from the solar collector to the working media for the region where belong the considered object (Wh/m^2),

$\varepsilon_{place\ of\ SHC}$ – average energy transmitted from the solar collector to the working media at the place where the SHC will be built in (Wh/m^2),

k – correction factor.

4.11.2 Annual energy saving

$$E_s = (A_c \varepsilon_{place\ of\ SHC} \eta_{solar} 365) \cdot \eta_{reservoir} \tag{2}$$

in (Wh), where $\eta_{reservoir}$ – efficiency of water reservoir

4.11.3 The cost of a solar hot water system

$$C = c_{solar} A_c \tag{3}$$

where:

C – the cost of installation of the solar heat system (€)

c_{solar} – the cost of installation per m^2 (€ / m^2)

300 € / m^2 for large systems

600 € / m^2 for medium systems

1000 € / m^2 for small systems

4.11.4 Annual cost savings

$$S = E_s C_e \tag{4}$$

where:

S – annual savings (€ / year)

C_e – the cost of other energy sources

eletric energy 0.15 € / kWh

natural gas 0.08 € / kWh

propane 0.16 € / kWh

oil 0.10 € / kWh

4.12 Calculation of a solar system for supplying of Hotel by hot water

Thanks to the entrepreneurs and hotel owners, in the last 30 years large numbers of hotels have installed systems for the supply of hot water using solar energy. The main reason for this is a heavy use of hot water in public buildings, especially in hotels, having large energy consumption.

Modern hotels require 80-100 litres of water of temperatures between 45 – 60°C per room per day. The water consumption is increased when you add services such as washing and water consumption in restaurants. The supply of water can be unstable depending on hotel occupancy and capacity. This can vary depending on the day, weekday or weekend, or type of hotel, commercial city hotel or a tourist sea side location.

The following text presents a supply of hot water calculation in Hotel Tuzla, a commercial hotel with a capacity of 220 rooms. This hotel has two separate water reservoirs, the first of capacity 12 m^3, a second of 6 m^3 (for sanitary use). The average monthly use of water is 3100 m^3. The calculation process of hot water providing is based on the input data such as follows:

- The angle of solar collector 30°
- The direction of solar collector from the south 15°
- The number of rooms = 110
- Water consumption V_p = 70 *l* / per room
- The temperature of consumed water $t_{cons.\ water}$ = 50°C
- The temperature of cold water t_{cold} = 15°C
- The efficiency rate of installation η_s = 0.8
- The time of system use, from the beginning of April to the end of September

It is assumed that the solar system is built in such a way to satisfy hotel requirements when 50% of available capacity is in use (110 rooms). When the angle of solar collector from horizontal line is 30°, the average energy transmitted from the solar collector to the working media, is 3650 Wh/m^2-day for the Tuzla region, and 3370 Wh/m^2-day for the considered place of build, i.e. at the place of Hotel Tuzla. The minimal amount of energy which emits the SHC is marked as Q_s and it is amounted to 2300 Wh/m^2 for the start of April to the end of September. The correction factor that takes into account the 15° declension of SHC from direction of south is 1.018.

Therefore, the required thermal energy for this system is:

$$Q_p = \frac{V_p \cdot n \cdot c \cdot (t_{cons.water} - t_{cold})}{\eta_s} = \frac{70 \cdot 110 \cdot 1.16 \cdot (50-15)}{0.8} \qquad (5)$$

$$Q_p = 390775 (Wh)$$

(c – specific heat of water; 0,001167 kWh/kg^{0}C).

The minimum size of the water reservoir is:

$$V_{reservoir} = \frac{V_p \cdot n \cdot (t_{cons.water} - t_{cold})}{t_{res.} - t_{cold}} = \frac{70 \cdot 110 \cdot (50-15)}{60-15} \quad (6)$$
$$V_{reservoir} = 5988 \ (l)$$

where $t_{res.}$ – the temperature of the water in reservoir.

The required area of the collectors:

$$A = \frac{Q_p}{Q_s} \cdot \frac{3650}{3370} \cdot k = \frac{390775}{2300} \cdot \frac{3650}{3370} \cdot 1.018 \quad (7)$$
$$A = 186.35(m^2)$$

The cost of the system:

$$C = c_{solar} A = 300 \text{ €} / \text{m}^2 \cdot 187 \text{ m}^2 = 56100 \text{ (€)} \quad (8)$$

Annual energy saving:

$$E_s = (A \cdot Q_s \cdot \eta_{solar} \cdot 365) \cdot \eta_{reservoir} \quad (9)$$
$$E_s = (187 \cdot 3.37 \cdot 0.8 \cdot 365) \cdot 0.87 = 160.087 (\text{kWh})$$

Annual costs saving:

$$S = E_s \cdot C_e = 160.087 \cdot 0.15 = 24.013 \text{ €/year} \quad (10)$$

The time required to get the return of the original investment (pay-back period):

$$PBP = C / S = 56100 / 24013 = 2{,}3 \text{ years} \quad (11)$$

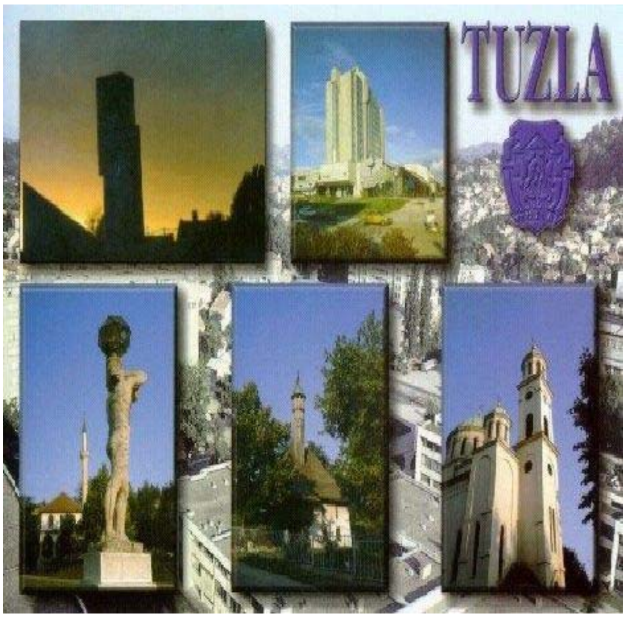

Figure 4: Targeted object – Hotel Tuzla

Therefore, as the lifetime of such a system, with adequate maintenance is longer than 20 years, the investment of a solar system for the supply of Hotel Tuzla with hot water looks a very sound economical idea.

In most European states, the goverment sponsors the installation of medium and large solar heating systems. The French goverment grants for such projects are about 200 €/m2,while in Germany, following an order from the government in 2003, the grants are increased from 90 to 125 €/m2.

4.13 Conclusion

The importance of overcoming our dependence on fossil fuels is becoming more and more evident. A large quantity of fuel being imported into Europe comes from unstable areas of the world. The last Gulf crisis affected the price of fuel and its supplies. Another motivation for the use of solar energy is environment oriented. Every newly installed solar powered device cuts down on threats posed to the environment by the use of conventional energy sources. The use of solar energy does not encourage global climate change, does not involve emission of poisonous gases into the air, nor does it leave radioactive waste as a dangerous inheritance to future generations. Solar power is a clean and self-sustaining source of energy. With regards to work places, solar energy can be used for hot water, central heating, air conditioning and so on. Taking in account all of the above, it can be said that there is a justified basis for investment in solar powered devices. In the case of Hotel Tuzla the investment in solar energy would solve the problem of hot water supplies.

At the end, it is important to mention that the main condition for the development of solar heat systems is the standardisation of individual devices as well as the system as a whole. We should also bear in mind the importance of implementing the right rules and regulations in this field.

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5 ECONOMIC INCENTIVES FOR ENERGY EFFICIENCY AND RENEWABLES IN R. OF MACEDONIA

Vlastimir Glamocanin, A. Krkoleva, S. Veleva, S. Velickovic
DAAD Competence Center
Faculty of Electrical Engineering, Ss. Cyril and Methodius University,
Karpos II, bb., 1000 Skopje, Macedonia
Phone: +389 2 3099177, e-mail: Vlasto@etf.ukim.edu.mk

5.1 Introduction

In the beginning of 2006 a procedure of adoption of a new Energy law has been initiated with a delivery of a draft version in January 2006. The new Energy Law is expected to outline the energy policy in the country towards establishment of new markets for electricity, natural gas, oil and oil derivatives, as well as market for thermal or geothermal energy. Satisfying and responding to customer requirements was one of the key features of this legislative document for liberalized electricity markets. Above all, reliable, safe and good quality supply of energy and energy fuels to the consumers are the major factor, which is intended to boost competitiveness, job creation, social cohesion and environmental sustainability. Besides the legislative issues related to the introduction of new energy markets, the new Energy law should proclaim not only the energy activities and construction of new energy facilities, but also the position and role of the Energy Regulatory Commission. What is also very important, the new Energy Law introduces, regulates and encourages the implementation of measures for energy efficiency, but also employment of renewable resources. In such a way it is expected that the new law will influence the energy system to become not only sustainable, but also more compatible with the ecosystem. These major technological and regulatory changes will lead to increased competition and enhanced quality, reliability, security and safety.

This paper gives the comments and analysis of the draft version of the Energy Law and it is expected to catch the attention of to initiate discussions and comments of the participants of the Workshop 2.3 “Enhancing Implementation in WB Countries”.

5.2 Activities and Competences in the Energy Sector

The draft version of the Energy Law identifies not only the traditional energy activities (generation, transmission and distribution) of electricity, natural gas, oil and oil derivates, but also activities closely related to RES:

- Generation of thermal energy
- Generation of geothermal energy
- Distribution of thermal or geothermal energy
- Supply of thermal or geothermal energy
- Generation of energy from renewable energy resources.

All listed activities related to electricity, natural gas, oil and oil derivates, but also including RES can be carried out by local or foreign legal entity based on gained license for pursuing the adequate energy activity, a concession for provision of public service is to be obtained and in compliance with Law or other regulation. Therefore, introduction of RES and EE measures is not restricted to financial opportunities and strength of local companies, but the opportunity is given also to foreign investors under same conditions, prices and tariffs, approved by the Energy Regulatory Commission, which shall include the costs for provision of the service, as well as for efficient utilization of the energy resources, environmental and climate protection and promotion.

Promotion of energy efficiency and sustainable development of renewable energy sources is expected to be provided with establishment of the national policy for the energy sector. The main goals of the National Energy Policy, design by the Government of the Republic of Macedonia, will be stated in the Energy Development Strategy and the Implementation Program of the Strategy. The implementation of the energy policy should be governed by the Energy Agency. The Development Energy Strategy of the Republic of Macedonia, adopted by he Government of the Republic of Macedonia for a period of at least ten years, shall introduce the incentives for investment in energy facilities that shall utilize renewable energy sources, and the incentives regarding the enhancement of energy efficiency.

In addition to the Development Energy Strategy, the Government of the Republic of Macedonia adopts the Program for a period of five years for realization of the strategy, as:

- Conditions,
- Method and dynamics of realization of the Strategy,
- Construction of requisite energy facilities, having regard to the anticipated energy and energy fuels consumption,
- Energy efficiency,
- Possible utilization of renewable energy resources,
- Efficient technology for generation of energy and energy fuels,
- Promotion of investments in the energy sector.

The realization of the energy activities of public interest is not associated only with the interests and the responsibilities of the Government of the Republic of Macedonia, but it is closely related with the responsibilities of the Local Government and very often it is of local importance. Accordingly, the measures and activities for enhancing the energy efficiency and generation of energy from renewable sources are determined in the Local Energy Development Program which upon proposal of the Mayor, and upon prior obtained opinion by the Ministry, shall be adopted for a period of 5 years by the Council of the municipality that is the City of Skopje. Certainly, the Local Energy Development Program should comply with the Energy Development Strategy of the Republic of Macedonia.

5.3 The Regulation of the Energy Activities

The regulation of the energy activities in Republic of Macedonia shall be ensured with adoption of following documents:

- Methodologies for price setting as to certain types of energy and regulated services,
- Tariff systems with regard to relevant types of energy;
- Prices of specific types of energy in compliance with the price setting methodologies and tariff systems for relevant types of energy and services related to the pursuing of different energy activities;
- Conditions for supply of certain types of energy from the energy systems;
- Granting of licenses for pursuing energy activities, as well as monitoring and control of the operation of the licensees and meeting the requirements provided for in the licenses;
- Construction of new and reconstruction of existing buildings from the aspect of energy efficiency;
- Certificate for energy characteristics of a building;
- Energy efficiency labeling of home appliances;
- Utilization of renewable energy resources;
- Green certificates.

5.4 Construction of new generation facilities

The draft version of the Energy Law introduces the opportunity of involvement of energy efficiency measures to alleviate the need for the construction of new facilities when the long - term security of supply could be disturbed. Namely, before the adoption of the decision by the Ministry for starting the public announcement procedure, the Ministry shall determine whether the security of electricity supply may be assured by energy efficiency measures. Also, it is very important to mention that the draft version raise the awareness of reducing the negative impact on the environment and improvement of the exploitation of renewable energy resources, as well as the introduction of new technologies and combined electricity and thermal energy production. Specifically, the public announcement for the construction of facilities may be published in function of determining a preferred producer of electricity, in accordance with the Strategy for energy development in the Republic of Macedonia.

5.5 The Energy agency

The Energy agency of the Republic of Macedonia gives its support to the Ministry in creation of the policy for improvement of energy efficiency and for the exploitation of renewable energy resources by creating:

- The policy for efficient energy exploitation is established within the Strategy for improvement of energy efficiency.
- The policy for renewable energy resources exploitation is established within the Strategy for renewable energy resources exploitation

Upon the proposal of the Ministry, the Government of the Republic of Macedonia adopts the Strategy for improvement of energy efficiency and the Strategy for the utilization of renewable energy resources for a period of ten years.

5.6 The Strategy for improvement of energy efficiency

The Strategy for improvement of energy efficiency, adopted for a period of at least 10 years, defines the main aims for increase of energy efficiency by:

- Reducing the energy consumption per GDP unit in the Republic of Macedonia;
- Increasing the energy efficiency in all sectors of state policy;
- Promoting new technologies with high degree of energy efficiency;
- Promoting measures for increasing the energy efficiency;
- Raising the public awareness for the aims of the energy efficiency;
- Reducing the harmful effect on the environment provoked by the production, transfer, distribution and exploitation of energy.

5.7 Program for the implementation of the Strategy for improvement of energy efficiency

The Program for the implementation of the Strategy for improvement of energy efficiency, adopted by the Government of the Republic of Macedonia for a period of at least 5 years, regulates and identifies the following measures:

- Measures;
- Financial resources;
- Implementation requirements;
- Indicators for achieved results;
- Technical regulations and national standards for energy efficiency

- Other relevant data, and the entities performing the activities and the delays for realization of envisaged activities.

The improvement of energy efficiency is not associated only with the interests and the responsibilities of the Government of the Republic of Macedonia, but it is closely related with the responsibilities of the Local Government and very often it is of local importance. Accordingly, the measures and activities for enhancing the energy efficiency are specified by the local Energy efficiency program adopted by the Municipal council or the Council of the City of Skopje

5.8 The Strategy for the exploitation of renewable energy resources

The Strategy for the exploitation of renewable energy resources, adopted for a period of at least 10 years, defines the following main aims:

- The potential of renewable energy resources;
- The possibilities for exploitation of the potential of renewable energy resources;
- The volume and dynamics of representation of renewable energy resources in the energy balance;
- Introducing production certificates for renewable resource energy for the purpose of establishing market economy;
- Defining transitional measures for subvention of the renewable energy resources exploitation through special tariffs, financial assistance and other.

5.9 Program for the implementation of the Strategy for renewable energy resources exploitation

Program for the implementation of the Strategy for renewable energy resources exploitation, will be adopted by the Government of the Republic of Macedonia for a period of at least 5 years. The Energy Agency of the Republic of Macedonia has very important responsibility by giving its support to the Ministry in the elaboration of the Program. In accordance with the Strategy for renewable energy resources exploitation, local policy is established within the local program for renewable energy resources exploitation.

5.10 The Rulebook on the exploitation of renewable energy resources

The Rulebook on the exploitation of renewable energy resources approved by the minister in charge of energy issues regulates and identifies the following measures:

- The target percentage and year of including renewable energy resources in the energy balance;
- The percent of participation and dynamic plan for realization of the target percentage of participation of renewable energy resources in the energy balance;
- The procedures for issuing and registration of green certificates for renewable energy for the electricity suppliers;
- Providing financial assistance;
- Implementation requirements;
- Indicators for achieved results;
- Raising the public awareness about the advantages of renewable energy resources exploitation;
- Other relevant data, and the entities performing the activities and the delays for realization of envisaged activities.

5.11 Green Certificates

In order to regulate the exploitation of renewable energy resources it is requested all electricity suppliers to provide or produce a relevant quantity of green certificates in the course of one year. The quantity is defined as a percentage of their annual sale of electricity. The supplier having a lack of green certificates shall make a payment per certificate, to a special account published by the Energy Agency of the Republic of Macedonia for the purpose of financing new renewable energy resources. The Energy Agency of the Republic of Macedonia issues and maintains a registry of issued green certificates for renewable energy for the electricity suppliers. However, until the establishment of functional mechanism for trade in green certificates, the Regulatory Commission shall establish relevant tariffs for purchase of electricity from the distributed generation of electricity from renewable energy sources. The green certificates produced by the distributed producers of electricity that use special tariffs should be considered as property of the Government of the Republic of Macedonia.

5.12 Incentives for Financial Assistance

The Strategy for renewable energy resources exploitation it is expected to put in force the mechanisms and incentives for financial assistance, such as:

- The Budget of the Republic of Macedonia;
- The budgets of municipality or budget of Town Skopje
- Grants, donations, sponsorships by foreign and domestic entities; and
- Foreign and domestic loans;
- State subsidiary in accordance with Law for state subsidiary.

These mechanisms and incentives shall provide business environment for the potential investors to build, produce and maintain renewable energy resources. The Development Energy Strategy of the Republic of Macedonia introduces the incentives for investment in energy facilities that shall utilize renewable energy sources. The Energy Agency shall provide support to the Government in the implementation of the energy policy of development and penetration of renewable energy resources.

6 DG network integration: Regulatory review and international comparison of EU-15 MS[1]

Pablo Frías Marín
Tomás Gómez San Román
Juan Rivier Abbad
Institute of Technological Research (IIT), Universidad Pontificia Comillas, Spain
Alberto Aguilera, 23, 28015 Madrid, Spain
Phone: + 34 91 542 28 00, FAX: + 34 91 542 31 76
e-mail: pablo.frias@iit.upcomillas.es, tomas.gomez@upcomillas.es, juan.rivier@iit.upcomillas.es

6.1 Introduction

Nowadays, distributed generation (DG), which includes renewable energy sources (RES) and combined heat and power (CHP), is actively promoted by the European Commission as it positively contributes to the energy diversification, efficiency and sustainability. A main issue for DG is their integration in electricity networks and energy markets. DG generation costs are higher than other traditional technologies. Additionally they can impose network costs for their connection to electricity networks with limited capacity. On the other hand, benefits associated with DG network integration are also achievable. Therefore, explicit support mechanisms and fair rules to share benefits and costs should be designed and implemented.

This paper is a resume of a survey for DG network integration carried out under the DG-Grid project in the 15 Member States of the European Union (EU-15 MS). The results of this survey are presented in the reports [17] and [18]. This paper is structured in three main sections. First a brief description of the legislation for DG is presented. Then the different regulatory issues, comparing countries, are analyzed. Finally, recommendations and guidelines for future regulation are proposed.

[1] This work is part of the DG-Grid Project, supported by the European Commission, Directorate-General for Energy and Transport, under the Energy Intelligent Europe (EIE) 2003-2006 Programme.

6.2 The DG-GRID Project

The results presented in this paper have been obtained under the DG-GRID project work [21], which is supported by the EU Energy Intelligent Europe 2003-06 Programme under the ALTENER Projects Group [23].

The main objective of the DG-GRID project is to improve the interface between distributed generation and the electricity supply system, to promote the deployment of RES/CHP through the development of regulatory guidelines. This includes both improving coordination between RES/CHP and the network operator within the existing framework, and implementing new network and regulatory structures in the medium-term.

The EU has been funding research projects on the integration of distributed generation in its 4th, 5th and 6th Research Framework Programmes. Within the 5th Framework Programme, research on the integration of DG and RES constituted Key Actions, including the projects SUSTELNET, ENIRDGnet, DISPOWER, MICROGRIDS, CRISP and DGFACTS. The most relevant current projects dealing with DG under the ALTENER programme are ELEP and DG-FER, and under the 6th framework program IRED and EU-DEEP projects.

6.3 DG Legislation in Europe

The current situation of DG development in each country of EU is the result of the conjunction of three different regulatory guidelines: the EU legislation, national policies, and general conditions in each MS, see Fig.1 [17].

First, EU legislation sets broad framework conditions for energy and electricity regulation. For instance, the **White Paper** [1] defines the European energy policy, which is based on three major objectives: overall competitiveness, security of supply, and environmental protection. EU actively promotes DG, as it contributes positively to these three goals and also with the Kyoto Protocol, especially in fuel-mix diversification and emissions reduction.

On the other hand, the **Internal Electricity Market Directive** [5] defines the basic conditions for a liberalized market in EU. This Directive also considers the impact of DG in electric networks, considering the possibility of priority access, unbundling, and the need of network planning.

The EU has also published two specific guides for DG integration in the energy markets, which are the RES and CHP Directives [4, 6]. According to these directives the electricity supplied from DG should be considered in the operation and planning of electric networks, and also the costs and benefits of the distribution network for DG connection should be included in the network regulation.

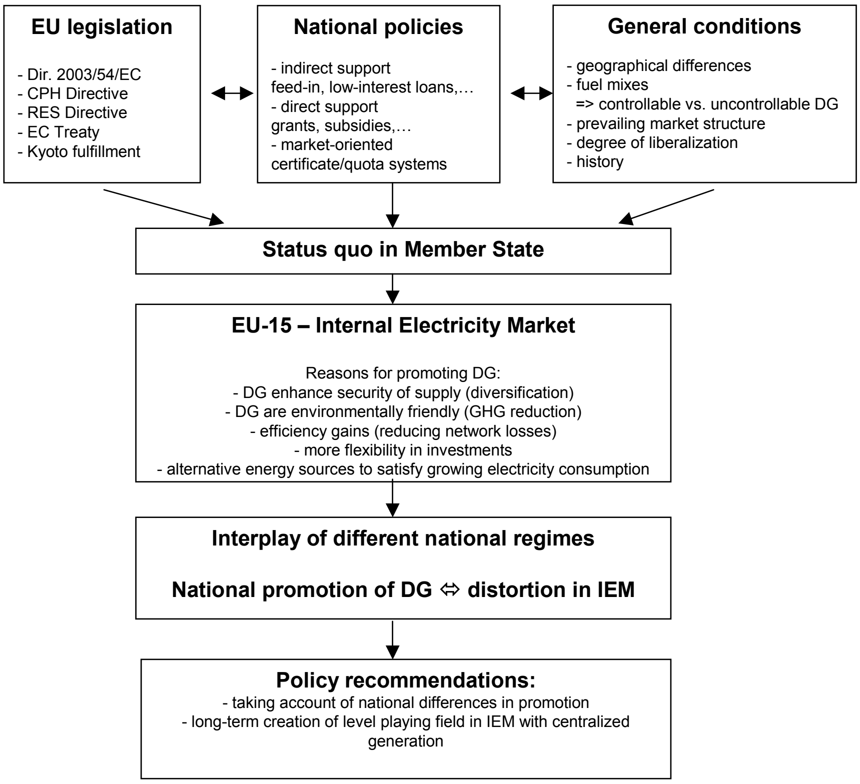

Fig. 1 Interplay of EU legislation, national policies, and general conditions for DG

The interplay of the different regulatory guidelines defines the current situation of DG in each MS. The different national regimes for DG promotion is a distortion for the Internal Electricity Market, so to achieve common rules for DG development in EU-15 all those differences should be analyzed, and settle long-term guidelines.

6.4 Regulatory and economic framework for DG

The basic requirements for the correct development of DG in each MS can be simplified in technical, economic and regulatory issues. Some technical requirements are needed for DG integration in the electricity networks, and DG has to be considered in the operation and planning of the electricity infrastructure. Secondly, costs and benefits to the distribution network induced by the various distributed generation technologies should be taken into account in the electricity network regulation. Finally, a legal framework based on fair and transparent principles has to be developed.

In practice, current electricity regulation often does not consider regulatory mechanisms to ensure effective participation of DG in the internal electricity market. This can become a serious barrier for the deployment of DG and complicate the attainment of European and national sustainability targets.

In this section a deep review of the current regulation for DG is presented, where the above three main issues are analyzed.

6.4.1 Presence of DG

The presence level of DG in each Member State of the EU differs significantly, see Fig.2 [17]. This is due to different cost-resource conditions and to the considerable differences in the support mechanisms. In most of the EU MS, controllable sources (CHP, biomass and some hydro) have more capacity share than non-controllable ones (wind power, photovoltaic, geothermal, and hydro). Denmark, Spain, Germany, Portugal and Netherlands are the countries with the largest DG capacity share.

The analysis of the different technologies for DG, shows that the most dominant renewable sources are wind power (15.3% onshore), small hydro (8.5%), and biomass (7%) [8]. In Denmark a large share of DG is natural gas CHP fired plants, and in Finland or Sweden biomass fired plants are mainly used. Germany, Spain, and Denmark are currently leading wind power installed capacity.

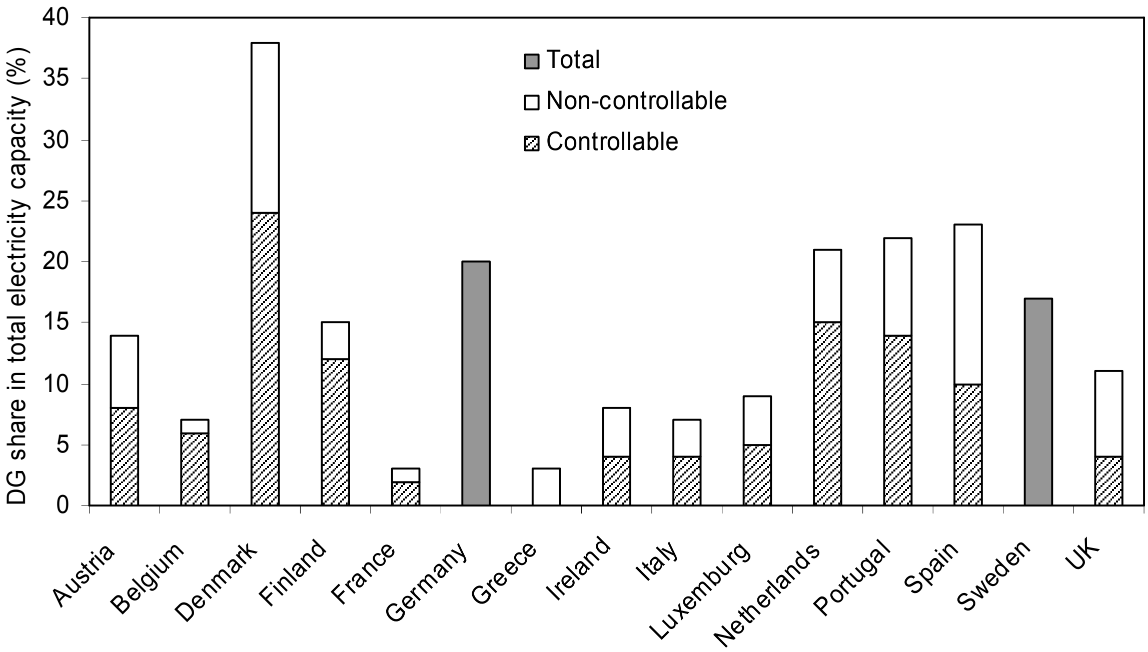

Fig. 2 DG share in total electricity capacity]

An interesting comparison between the available potentials of a specific country for individual DG technologies is presented in [8], see Fig. 3. In this report the concept of effectiveness is defined as the outcome in renewable electricity compared to what's remains of the 2020 potential. For example, a country with 8% yearly average effectiveness indicator over a six-year period will deploy 48% of its 2020 potential.

According to this report on-shore wind power is the technology with the larger effectiveness followed by small-scale hydropower.

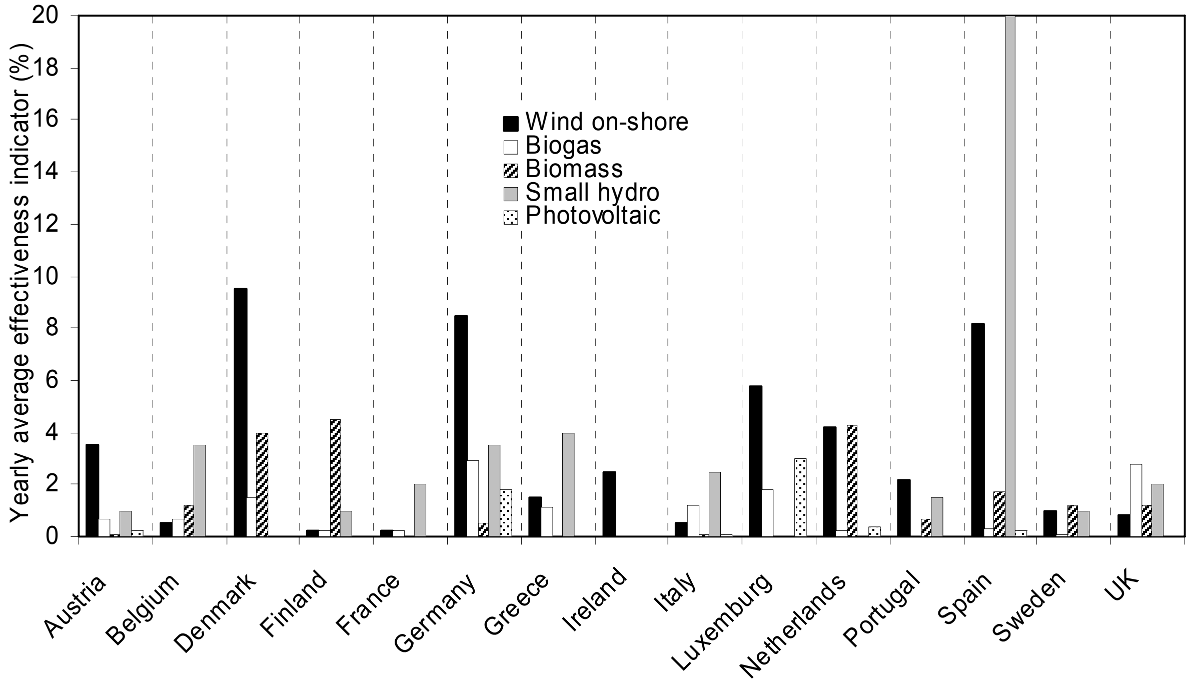

Fig. 3 DG effectiveness

6.4.2 Distribution System Operator

The Distribution System Operator (DSO) is responsible for the operation and planning of the distribution network. DG deeply changes the operation and planning principles, (i) operation is more complex, and (ii) planning drivers are not only demand increase but also DG installed capacity. Three main issues are considered in this section, DSO and DG unbundling, incentives to the DSO to integrate DG, and operation and planning with DG.

6.4.2.1 Unbundling

Before liberalization begun, electricity sector was structured in vertical integrated utilities. To introduce competition the Directive for the Internal Market of Electricity required unbundling between transmission, distribution and generation activities. According to this principle, unbundling between network and generation activities is required for DSOs with a number of connections higher than 100.000.

A review of the current unbundling progress in the EU-15, shows that most of the countries has implemented legal separation in their activities, see Table 1 (Col. 1). Anyway, some MS have only implemented management or account unbundling, which are less transparent than legal separation.

The lack of unbundling is a barrier to DG promotion as the DSO may discriminate other DG and benefit their own DG. This discrimination may exist in different ways, for example: limit the access to the network due to a hypothetical lack of capacity, charge abusive transmission connection fees, or delay access without any justification [14]. Despite unbundling helps the entrance of new DG in the network, that is not enough, transparent operation rules and tariffs are also needed.

6.4.2.2 Incentives to DSOs to integrate DG

Traditionally regulators set the allowed revenues for each DSO according to cost-of-service regulation. These revenues are collected through use-of-system tariffs. Recently, most countries are migrating to incentive regulation schemes, like price cap or revenue cap. Incentive regulation set system tariffs taking into account the expected operational and investment costs.

DG deeply can affect DSO operational costs and investment in networks, such as network reinforcement, measurement and control equipment, staff training, transaction costs, and local increment of energy losses. On the other hand, DG integration can produce some benefits, for example losses reduction, contributions to peak load reduction, and postpone network reinforcement. DG generation can also mean fewer revenues for DSOs because of auto-generation or the supply of energy to small networks operating in an isolated mode from the system [18]. All these modification in costs should be taken into account to design and compute the incentive mechanisms for the DSOs.

Currently in most EU-15 there is lack of incentives for DSOs to integrate DG in their networks, therefore, explicit incentive mechanisms should be designed and implemented.

6.4.2.3 Network operation and planning with DG

Operation of distribution networks deals with different technical and economic aspects, such as to avoid line or transformer overloads, voltage management, losses minimization, and security of supply. DG may actively contribute to all these topics, and especially to distribution network security. DG may improve DSO system security if their protective devices stand network failures, and DG is able to cope with islanding operation.

Currently, most DSOs network developments consider only future consumers demand growth, neglecting power generation support from DG. This conservative solution is based on the assumption that DG may not to be available when peak loads will occur. This situation is due to the lack of an incentive to the DG to be available. Furthermore, most countries do not send economic signals to locate DG, so generation in general is not located where it would be most economically needed, to reduce investments or energy losses.

This is a practice economically inefficient. The definition of new grid codes for distribution networks integrating DG plants, to promote active network control and to mandate least cost planning with DG is required.

Country	Unbundling (1)	Number DSO (2)	Current share (3)	Support mechanism (4)	Balancing market	Generation reserve	Authorisation procedure (5)	Technical requirements (6)	Connection charges (7)	Use of system charges
Austria	L	138 / -	M	F	Y	N	Y	M +Q	S	N
Belgium	L	30 / 20	L	Q	Y	N	Y	M +S+Q	T	Y
Denmark	L	120 / 112	H	P	Y	Y	Y	M	S	Y
Finland	A	94 / 88	M	I / T	Y	Y	Y	M	M	Y
France	M	166 / 160	L	F	N	Y	ST	M +Q	T	N
Germany	L	950 / 900	M	F	Y	N	Y	-	S	N
Greece	L	1 / 0	L	I / F	N	Y	NE	-	-	N
Ireland	M	1 / 0	L	T / B	Y	Y	Y	M +S+Q	D	N
Italy	L	170 / -	L	Q / F	Y	Y	Y	M +S+Q	S	Y
Luxemburg	M	10 / 9	L	F	N	N	NE	-	S	Y
Netherlands	L	20 / 0	H	F	Y	Y	Y	M +S+Q	S	Y
Portugal	A	11 / 10	H	F	-	-	Y	-	S	N
Spain	L	308 / 300	H	F / P	Y	Y	Y	M +S	D	N
Sweden	L	184 / 179	M	Q	Y	Y	Y	M +S+Q	D	Y
UK	L	18 / 3	M	-	N	N	Y	M +S+Q	M	Y

(1) L: legal, M: management, A: account, N: no unbundling.
(2) Number of DSOs / Number of DSOs with more than 100.000 connections.
(3) H: high when the share of DG is larger than 20%, M: 10-20%, L: <10%.
(4) F: feed-in tariffs, Q: quota system, P: price premium, I: investment grant, T: tax reimbursement, B: bidding system, M: mixed.
(5) Authorization procedure guaranteed, Y: yes, N: no, ST: study needed, NE: negotiated.
(6) M: metering, S: safety, and Q: quality.
(7) S: shallow costs, D: deep costs, T: tariff.

Table 1 EU-15 comparison for DG

6.4.3 Market access

The future deployment of DG depends greatly on how DG market access is regulated. To achieve economic efficiency with high levels of DG penetration it is important to fully integrate DG within energy markets. Market access deals with the access to the energy, balancing, and ancillary services markets, and how the different DG support schemes affect them.

Taking into account the small size of some DG units, to facilitate their market access avoiding high market management costs, it is important to allow or even actively promote the aggregation of different DG units to play in the market.

6.4.3.1 Market concentration

One important barrier to competition in energy markets is the concentration in the generation production [7]. In some countries, such as Greece, France, Ireland and Belgium, generation concentration is above 85%. On the other hand, in the UK and in the Nordic markets the largest producer owns less than 20% of the total capacity. DG producers can contribute to decrease the level of horizontal concentration, and to make more competitive the market.

6.4.3.2 Access to the energy markets

Most of the EU-15 countries have established a support mechanism for DG based on feed-in-tariffs, see Table 1 (Col. 4). Under this mechanism DSOs must buy all the energy produced by DG plants, which is paid at a regulated tariff. This tariff is usually specific for each renewable technology, and is updated every year.

Feed-in-tariff remuneration is very efficient when promoting DG, but when the share of DG becomes higher, it is more efficient to integrate DG production into the energy market, receiving all the economic signals as the rest of the market agents. One way to achieve this objective is to remunerate DG production by the energy market price plus a premium.

Currently some countries have included DG into spot markets, both through price premiums (Denmark and Spain) or quota mechanisms (Belgium, Italy and Sweden).

Under the energy market DG has the same obligations and benefits than conventional generators. The energy can be traded in both the spot market and bilateral contracts, and some incentives are provided to increase DG competitiveness. Additional payments can be obtained with balancing markets and ancillary services provision.

6.4.3.3 Balancing markets

DG plants integrated in the energy market, as any other market player, are responsible for its energy balance in an hourly basis. Therefore, DG has to foresee its day-ahead energy production, and report to the DSO or TSO. Energy prediction improves when the hour for energy delivery comes closer, specially for non-controllable DG (solar and wind power), so some countries have intra-day markets to balance power, and correct their prediction.

Deviations between the scheduled and the actual energy production are costly, because reserve capacity must be called to cover this deviation. This extra-cost should be paid by those DG plants whose deviations exceed a determined tolerance (in Spain 20% and 5% for un-controllable and controllable DG respectively).

The access to the balancing markets has been implemented in many countries (10 countries), see Table 1 (Col. 5), except France, Greece, Luxemburg and UK.

Notwithstanding imbalances can be a mayor barrier, especially for non-controllable technologies. To help the access to this market, some improvements must be carried out, such as DG aggregation to compensate and reduce deviations, and by shortening the timeframe for announcing the energy prediction and therefore being able to correct the energy prediction.

6.4.3.4 Ancillary services

The participation of DG in the provision of ancillary services is twofold useful for the DSOs, first it will avoid the DSO to buy these services from the TSO, and second DG can improve the operation of the distribution network and postpone network investments. According to the report [16, 19] DG can provide different ancillary services to the network, that can be classified into TSO and DSO provision. TSO ancillary services provision includes frequency response, regulating and standing reserve capacity, and reactive power management. Security of supply contributions, quality of supply services, and voltage and power flow management services, are the ancillary services that can be provided to the DSO.

Combined Cycle Gas turbine Generators and Double Feed Induction wind generators are the most promising technologies for the provision of frequency response. On the other hand, diesel generators and combined heat plants can provide reserve services.

In the survey [17] nine countries had already included DG into the generation reserve ancillary service, see Table 1 (Col. 6), but only some of them have defined specific standards for reactive power management and voltage control.

6.4.4 Network access

Connecting to the electrical network requires DG to complete certain authorization procedures, and to fulfil some technical requirements. There are also connection charges that can be divided in connection and use-of-network charges.

6.4.4.1 Authorization procedures

Currently, authorization procedures for DG connection in all EU members are slow and not transparent. In many countries, especially Southern Europe, the period since the project is defined until it is carried out takes very long time, with an average time of 1.5 to 4.5 years [10]. The review showed that in most of the countries DG has guaranteed access, while in Greece the access is negotiated with certification procedures, and France demands an additional impact study for the DG plant, see Table 1 (Col. 7).

6.4.4.2 Technical requirements

DG units must fulfill certain technical requirements to be connected to the distribution network, which can be divided into metering, safety and quality requirements.

Metering is required in most countries, and in approximately half of them, the DSO is charged for the cost of installing the meters.

Automatic or manual disconnection are the main safety requirements applied in Austria, Belgium, Ireland, Spain and UK, see Table 1 (Col. 8). Islanding operation is also required in Ireland and UK.

A full design for energy quality is considered in Austria, Ireland, Netherlands and UK. This includes harmonics distortion, voltage fluctuation, frequency band, and power factor. Other countries, such as Spain and Sweden use minimum requirements.

6.4.4.3 Connection charges

Connection charges differ from countries, existing two main criteria: shallow costs and deep costs. Historically deep charges has been used, and comprises any cost of reinforcements of the existing network that have to be carried out due to the new customer. This can be a major barrier for DG when connecting to weak networks. Moreover, as deep charges are calculated by the DSO they may not be sufficiently transparent and fair. In the review only four countries in EU-15 used deep charges, see Table 1 (Col. 9).

The positive impact of DG on network operation and investment costs should be recognized. Shallow connection charges eliminate the barrier of deep costs, because this includes only the cost of connecting the DG to the nearest point of the distribution network. In fact, this is the charging mechanism most used in EU-15. Then the costs for network reinforcement will be charged through use of system charges.

6.4.4.4 Use of system charges

Network pricing has two main objectives, (i) ensure economic efficiency, and (ii) permit DSOs to recover their allowed revenues. Economic efficiency concerns to sending price signals to users of the network for operation and development costs. This signals would influence users take decisions on (i) location in the network, (ii) network use patterns, and (iii) location of new network investments [18]. Since DG has the opposite effect than demand on these three issues, different charges should be applied. For instance, it is very important the influence of DG on energy costs and network investment delay.

Currently half of the EU-15 countries have DG use of network charges (see Table 1, col. 10), and some countries as Finland the system charges can be positive, zero or negative depending on the time period and location.

6.5 Conclusions and guidelines

According to the analysis carried out in the report [17] the main barriers for DG integration in electricity networks are:

- The lack of incentive for DSO to be proactive in DG integration into distribution networks.
- Only a few MS have fully integrated DG into energy markets, and in some of them exist procedural barriers to allow this market access.
- There is a lot of difference between the EU-15 MS in the access to ancillary services and balancing markets.

- The structure and amount of the connection charges, procedural barriers for network access, and physical and network constraints are delaying DG integration.
- A more detailed description of the main barriers in each MS can be found in [17, 18].
- Table 2 schematically represents the country situation. Denmark and Italy are the countries with fewer barriers for DG connection to the network, while Greece fails to be the country with the less developed DG regulation.
- As a conclusion, some guidelines to improve DG integration in distribution networks are proposed:
- The regulator should include the additional cost of DG integration in the networks when designing the incentives and the allowable revenues for DSOs. Explicit incentives for DSOs can be implemented, similar to ones to improve quality of supply, to promote active networks, or economic incentives proportional to the number of new DG connections.
- DSOs should undertake the necessary network reinforcements and plan future investments to accommodate the development of new DG capacity. The costs associated with grid infrastructure development should be covered by DSOs, collected through network tariffs, but not by DG. This represents a movement from deep to shallow charges.
- New grid codes for distribution network operation taking DG plants as active control elements should be designed and implemented. In addition, new planning and network development practices that consider DG contribution to cover system demand should be mandated in order to achieve long term economic efficiency.
- To improve DG market access three major changes are recommended: first moving from feed-in-tariffs mechanisms to participation in energy markets. Second DG must participate more actively in the ancillary services for DSOs and TSO. And third, the access to the balancing markets must be improved, both allowing DG market participation and creating intra-daily markets to adjust DG energy predictions.
- Getting access to the electrical network should be transparent and non-discriminatory for DG. Therefore, regulators should design mechanisms to integrate DG in their networks, and share the new costs and benefits [8].

Country	Lack of unbundling	Lack of incentive to DSO	Power market access	Market procedural barriers	Connection charges	Technical network constraints	Network procedural barriers	Lack of benefit for DG
Austria		X	X		X	X	X	X
Belgium	X	X	X		X			X
Denmark								
Finland		X	X		X			
France		X				X	X	
Germany	X	X			X		X	
Greece	X	X	X	X	X	X	X	X
Ireland		X		X	X	X		
Italy							X	
Luxemburg	X	X						X
Netherlands			X		X		X	
Portugal		X	X				X	
Spain		X		X		X	X	
Sweden			X		X	X		
UK		X	X		X	x		

Table 2. Main barriers for DG promotion in EU-15

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7 Organizational framework of RES promotion programs in Serbia and Montenegro

Elena Boskov
DMS Power Engineering Ltd,
Puškinova 9a, 21000, Novi Sad, Serbia and Montenegro
Phone: +381 21 475 0376 FAX: +381 21 455 865, e-mail: elena.boskov@dmsgroup.co.yu

Abstract: Energy generation in Serbia and Montenegro is almost entirely dependent on hydro and thermal power facilities. There are no identified renewable energy feed-in tariffs. Based on the current situation, the government is moderately engaging its efforts in promoting renewable energy. Since Serbia and Montenegro is dependent on hydro resources there may be an opportunity for hydro rehabilitation projects. The solar insulation is relatively high, but the typical cost barriers will limit solar applications. Although there are many sources of low enthalpy geothermal resource, high enthalpy geothermal resources supporting electricity production are absent. Further studies and data collection need to be done before a statement can be made about biomass or wind projects. In history, most of the new energy technologies which were introduced into the market received support in different ways for the process of market penetration, such as nuclear energy, for example. Support schemes for market introduction are not exotic features, but common instruments. This paper presents a short overview of the main schemes which currently are under discussion and implementation.

7.1 Introduction

The Serbian power sector is now at breaking point. The potential electricity production deficits and the need for modernization of resources have lead to a plan for new power capacities. Energy efficiency, energy savings and the use of currently unexploited renewable sources of energy, which are still marginalized in policy papers, represent a major opportunity for the development of the Serbian energy sector.

Overall, the country is poor in energy resources, and the main indigenous resource is lignite. In general about 50 percent of final energy consumption in Serbia is based on imported fuel – chiefly oil and gas – despite the fact that about 95 percent of electricity is produced from domestic energy resources – lignite 62 percent and hydropower 36 percent. Only about 20 percent of necessary oil and gas is supplied from domestic resources. Proven crude oil reserves are 78 billion barrels or 23 percent of the total reserves in South East Europe, while natural gas reserves are roughly 60 percent, or 48 trillion cubic meters, of total reserves in the region.

7.2 Policies and mechanisms for the promotion of energy efficiency and renewable energy

7.2.1 New Energy Law

The new law, the first comprehensive energy law in Serbia, was adopted in July 2004. It was drafted with the assistance of USAID under its support program for the South East Europe Regional Electricity Market. It introduces several new institutions to the energy sector: 1) Energy Agency of the Republic of Serbia (EA), a new body for the Serbian legal system; 2) it re-establishes the Energy Efficiency Agency (SEEA) which was abolished as a separate entity in May 2004; 3) it establishes the Serbian Energy Regulatory Agency (SERA), and the independent Transmission, System, and Market Operator (TSMO).

For the first time, the energy law recognized small hydropower plants and underlined the importance of small watersheds, as well as of the other renewable energy sources: solar, wind and geothermal energy. The law introduces privileged prices for producers of energy using renewable resources, an important step towards the increased use of renewable resources as the producers will receive privileged access to the electricity market. However, there is still a need for the adoption of secondary legislation that will deal with tariff issues. The implementation of the newly adopted legislation is likely to be the hardest part of the policy process. Serbia still has a lot to do on judicial reform, since even when laws are in place, due to a lack of capacity and sometimes political will, implementation does tend to be poor.

7.2.2 The Energy strategy

After several years of stagnation, there is an increase in electric consumption in Serbia. In 2004, for example, it rose by 3,4 percent in comparison with 2003. This shows that Serbia is heading gradually towards increased deficits in the production of electricity. The official overview of the problem in the draft text of the Serbian Energy Strategy up to year 2015 foresees several scenarios for dealing with possible future deficits. The Strategy was prepared by the Ministry of Mining and Energy and is still in the process of being officially adopted. The main action points for the government, according to the Strategy, will be attracting new consumers to district heating and increasing the use of natural gas for space heating purposes in the residential and public/commercial service sector: 400 000 households should be connected to the natural gas system for heating, and 180 000 should be connected to district heating systems by 2015.

7.2.3 Classification of promotion strategies

		Price-driven	Capacity-driven
Regulatory	Investment focussed	• Rebates • Tax incentives	• Tender systems
	Generation based	• Feed-in tariffs • Production tax incentives	• Quotas (RPS) based on TGC • Tender systems
Voluntary	Investment focussed	• Shareholder Programs • Contribution Programs	
	Generation based	• Green tariffs	

Figure 1. Classification of promotion strategies for RES

These policies can be classified according to different criteria (i.e., whether they affect demand or supply of RES or whether they support capacity or generation). Support schemes can be grouped in several categories:

• Investment incentives establish an incentive for the development of renewable energy projects as a percentage over total costs, or as an amount of Euros per installed kW. The levels of these incentives are usually technology-specific and may vary significantly between regions.

• Feed-in Tariffs (FITs) are generation based fixed price incentives that usually take the form of either a total price for renewable production, or an additional premium on top of the electricity market price paid to RES-E producers. Besides the height of the tariff its guaranteed duration represents an important parameter for an appraisal of the actual financial incentive (compare for example the case of Spain and Germany). Furthermore, feed-in tariffs easily allow technology specific promotion as well as an acknowledgement of future cost-reductions by implementing decreasing tariffs.

• Production tax incentives are generation-based price-driven mechanisms that work through payment exemptions of electricity taxes applied to all producers. This type of instrument differs from feed-in schemes in terms of the cash flow of RES-E producers, since it represents a minus cost instead of an additional income.

• Tendering systems can either be investment focused or generation-based, but in both cases they are capacity-driven mechanisms. In the first case, a fixed amount of capacity to be installed is announced and contracts are given following a predefined bidding process, which offers winners a set of favorable investment conditions, including investment subsidies per installed kW. The generation based tendering systems work in a similar way. However, instead of providing onetime investment incentive, they offer a 'bid price' per kWh given to winner projects that may receive it through out the duration of the contract.

• Quota obligations based on Tradable Green Certificates (TGCs) are generation-based capacity driven instruments. These instrument are usually implemented through government defined targets and obligations on consumers or suppliers of electricity. Once defined, a parallel market for renewable energy certificates is established and their price is set following demand and supply conditions (forced by the obligation).

Besides these regulatory instruments voluntary approaches appear today which are mainly based on the willingness of consumers to pay premium rates for renewable energy. Nevertheless, so far in terms of effectiveness – i.e. actual installations resulting from their appliance – their impact on total RES development is negligible.

In the following section a short overview is given on currently implemented promotion strategies for RES.

7.3 Method of approach

7.3.1 Evaluation criteria

Support instruments have to be effective for increasing the penetration of RES-E and efficient with respect to minimizing the resulting public costs (transfer cost for society) over time. The criteria used for the evaluation of various instruments are based on the following conditions:

. Minimize generation costs

This aim is fulfilled if total RES-E generation costs (GC) are minimized. In other words, the system should provide incentives for investors to choose technologies, sizes and sites so that generation costs are minimized.

. Lower producer profits

If such cost-efficient systems are found, – in a second step – various options should be evaluated with the aim to minimize transfer costs for consumer/society. This means that feed-in tariffs, subsidies or trading systems should be designed in a way that public transfer payments are also minimized. This implies lowering producer surplus.

In some cases both goals – minimize generation costs and producer surplus – may not be reached together so compromise solutions must be found.

7.4 Costs and potentials for RES

Static cost-resource curve (supply curve) is given below:

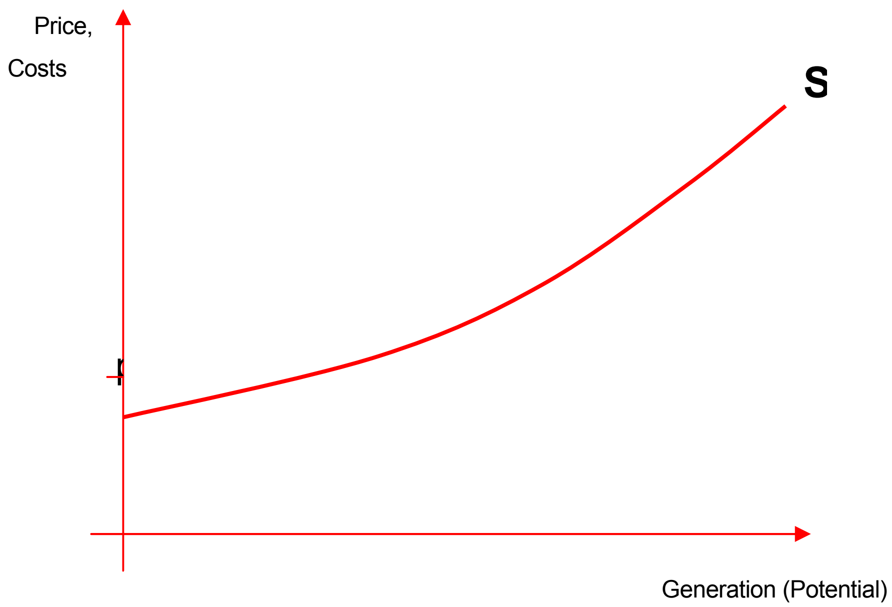
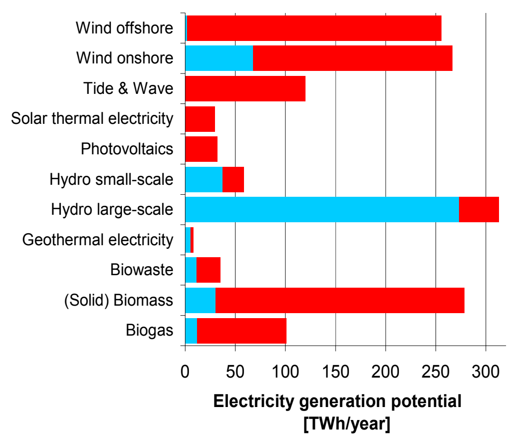


Figure 2. Static cost-resource curve

This cost curve combines information on the **potential** and the according **costs of electricity**. All costs/potentials-bands are sorted in a least cost way. For limited resources (as RES) costs rise with increased utilization



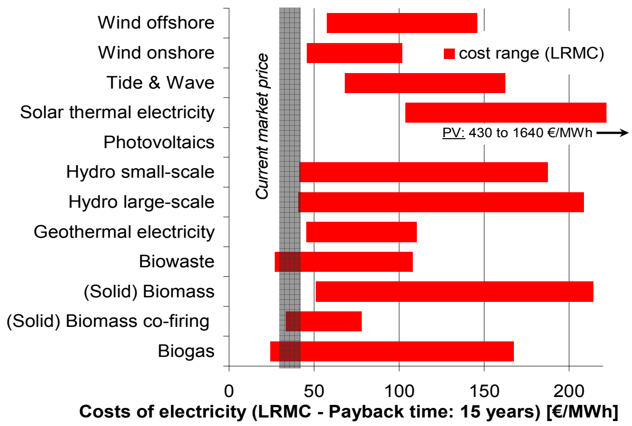


Figure 3. Supply curve: Electricity Generation Potential and Costs of Electricity

The price for conventional electricity is set by supply and demand for electricity in general. According to specific market conditions across Europe, this price differs by country and by region. These differences will continue to change due to the ongoing liberalization process. Under the assumption that no other promotional instrument exists, the price of conventional electricity (pC) would determine the market penetration of RES, see Figure below (demand D). In this case only the quantity of green electricity would be produced that could be generated to lower or equal costs than the according conventional price level (quantity q0).

- **Supply-side policies**, e.g. investment subsidies or feed-in tariffs, **shift the supply curve downwards (S').**
- As a consequence, the total amount of **electricity generation from RES increases from q0 to q2**.

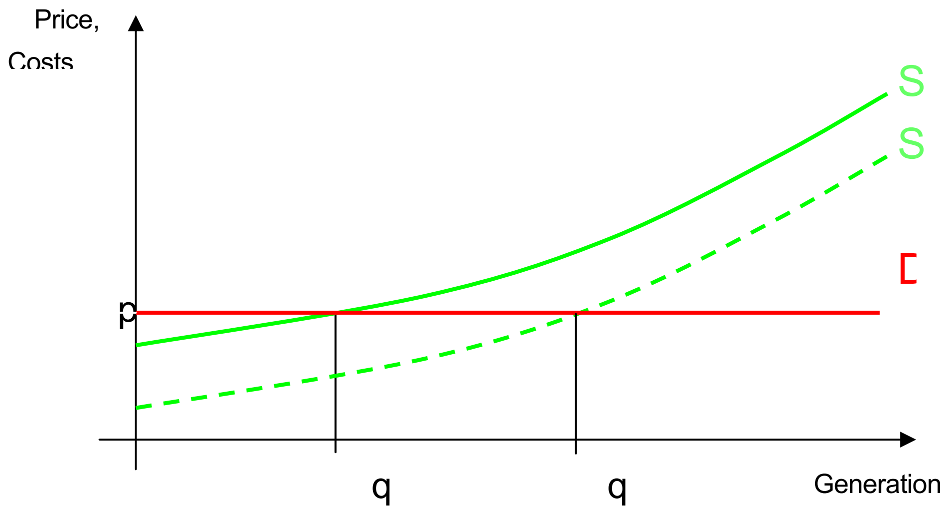


Figure 4: Price-driven strategies – supply side

To promote RES, a mandatory demand could be set by the government. Assuming, a quota for RES is introduced, a mandatory (inelastic) demand for electricity from RES results, for illustration see Figure below (demand D”). This inelastic demand, characterized by the vertical line, occurs because obliged actors are required to pay a high price for electricity from RES in order to fulfill the quota q3.

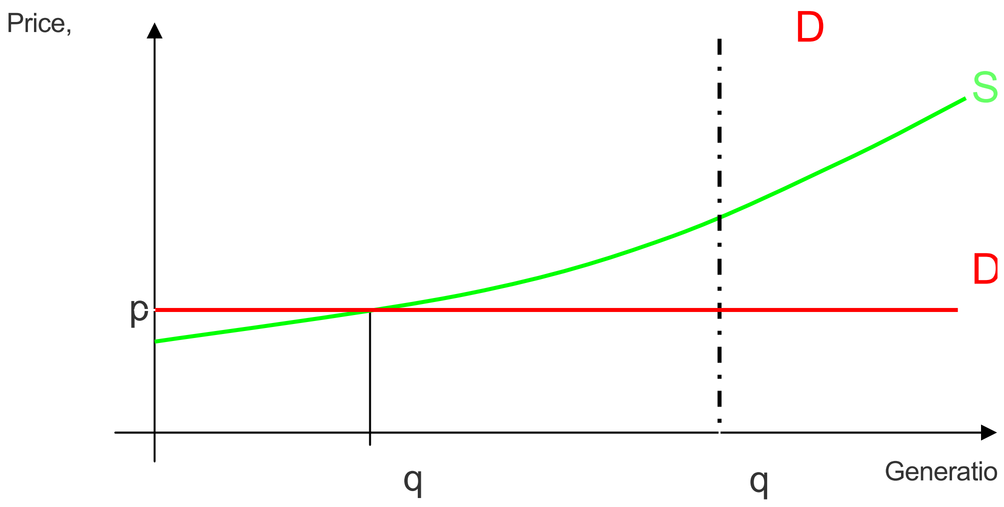


Figure 5. Quantity-driven strategies

7.5 Comparison of support schemes

There is no clear favorite support scheme; each instrument has its pro and cons. Most important differences among the analyzed support schemes are:

• In contrast to a feed-in tariff scheme or a tender procedure, no adjustment is necessary to fulfill targets under a quota obligation if the penalty (penalties) is set right;

• From society’s perspective, the cost effectiveness of the support scheme depends on the target that should be met. The RES-E target greatly influences the cost effectiveness of the applied instrument.

• A tender scheme (based on price bids) represents a mix between a feed-in tariff (the price is guaranteed by a contract, hence, the risk and uncertainty about the economic conditions are low) and a TGC system (competition among the investors exist). A tender scheme (based on price bids) is similar to a stepped feed-in tariff, but with the difference that the granted price for RES will be determined by the market itself and not by a regulatory authority.

Generation costs can be minimized in the early phase of RES-E deployment by avoiding a differentiation among the promotion of the different RES options. In practice, a TGC system fits best due to the competitive character. In the long term higher generation costs may occur as alternative RES potentials can not be used at time.

Feed-in tariffs and tender schemes are useful in promoting a more homogeneous distribution among different technologies by setting technology-specific guaranteed tariffs. The long-term technology development of various RES, which are currently not cost-efficient, can be stimulated by implementing such a policy. This can be essential to decrease future generation costs for these technologies and to increase the available future potential. This means, there will be a higher potential available at lower costs in the future. Of course, this positive effect is compensated by economic distortions among the RES. Governmental planning and control effort increase with the complexity of the feed-in tariff scheme or the diversification of the tender procedure.

The gain for society occurring from a more specific approach must be compared with these premium costs. In addition, the rent seeking and lobbying activities increase under such conditions compared to a simpler implementation or a TGC system.

7.6 Conclusion

In the long-term a substantial penetration of RES technologies can only take place if framework conditions are set such that various barriers in the different areas will be removed. This 'institutional context' issue is of high relevance for setting the framework of RES promotion in Serbia & Montenegro, as well as the rest of Balkans.

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8 Economic aspects of RES use in WB countries – analysis and recommendations

Borut Del Fabbro,
Istrabenz energetski sistemi d.o.o.
Tumova 5, 5000 Nova Gorica, Slovenia,
Phone: +386 1 33 11 974, FAX: +386 1 33 11 979, e-mail: borut.delfabbro@istrabenz.si

8.1 Abstract

In the paper the renewable energy sources are analysed strictly from the economic point of view. An overview of renewable energy sources is made according to their economic feasibility in an open market without government subsidy. The specific factors of the western Balkan countries have been taken into account (lower labour costs, high capital costs, scarce or absent subsidy schemes) and according to this economic acceptance of different RES have been analysed.

It is proposed that in the WB countries market based companies should focus on RES that have in their total costs relatively low share of capital costs and high share of direct or indirect labour cost.

8.2 Introduction

All promotion of renewable energy sources is futile if RES do not prove to be economically feasible. This can be achieved in two ways:

- by increasing revenues:
    - feed in tariffs
    - investment subsides
    - REC certificates
- other financial incentives
    - by reducing costs:
    - technology improvements
    - lowering operation costs
    - lowering investment costs

8.3 Overview of RES – economic aspect

In this chapter we will take a look on RES from an economic point of view, we will consider investment costs, operation costs and other characteristics of RES:

8.3.1 Photovoltaics

Solar cells, also referred to as photovoltaic cells, are devices or banks of devices that use the photovoltaic effect of semiconductors to generate electricity directly from sunlight. Until recently, their use has been limited due to high manufacturing costs. One cost effective use has been in very low-power devices such as calculators with LCDs. Another use has been in remote applications such as roadside emergency telephones, remote sensing, cathodic protection of pipe lines, and limited "off grid" home power applications. A third use has been in powering orbiting satellites and other spacecraft.

However, the continual decline of manufacturing costs (dropping at 3 to 5% a year in recent years) is expanding the range of cost-effective uses. The average lowest retail cost of a large solar panel declined from $7.50 to $4 per watt between 1990 and 2005. With many jurisdictions now giving tax and rebate incentives, solar electric power can now pay for itself in five to ten years in many places. "Grid-connected" systems - that is, systems with no battery that connect to the utility grid through a special inverter - now make up the largest part of the market. In 2004 the worldwide production of solar cells increased by 60%. 2005 is expected to see large growth again, but shortages of refined silicon have been hampering production worldwide since late 2004.

My opinion is that except for special applications, solar energy for producing electricity is for now a resource and not a reserve, to use economic jargon. This means that our civilization would survive if we were dependent on solar energy, e.g. could not use nuclear energy. However, solar energy would be expensive enough to put nations that decided to depend on it alone at a serious economic disadvantage compared to nations that were not constrained to rely on it. Their citizens would be poorer.

The basic cost problems with solar energy are

- High capital cost
- The need to store energy, because of daily, hourly and weekly (from clouds) and seasonal availability.

In some areas solar power is a cost effective energy solution. In many places the initial cost of buying a PV system is higher than the dollars saved over time, making conventional sources of power less expensive.

Places where using photovoltaics is currently cost-effective are:

- remote, off the grid sites
- energy efficient buildings with PV systems as part of the building design

8.3.2Active solar

Active solar systems use solar collectors and additional electricity to power pumps or fans to distribute the sun's energy. The heart of a solar collector is a black absorber which converts the sun's energy into heat. The heat is then transferred to another location for immediate heating or for storage for use later. The heat is transferred by circulating water, antifreeze or sometimes air. Applications for active solar energy include heating swimming pools, domestic hot water use, ventilation and industrial process air and water for commercial facilities such as laundries, car washes and fitness centres.

Another common way to use the sun's heat is with the use of a solar domestic hot water system. Depending on how the system is used, a typical system will provide 50 to 75 per cent of a family's hot water needs. With water heating accounting for about 20 per cent of home energy use, a solar domestic heating water system is an attractive method of reducing a home's fossil fuel consumption.

A solar water heater typically uses glazed collectors mounted on a roof and connected to a storage tank. Fluid is pumped to the collectors where it is warmed by the sun, then returned to a heat exchanger where it heats the water in a storage tank. Year-round residences often will have a additional backup water heater. Modern solar water heaters are relatively easy to maintain and can pay for themselves with energy savings over their lifetime. Large, commercial systems can dramatically cut heating costs, making them ideal for businesses that use a great deal of hot water, such as restaurants, car washes, laundries and fitness centres.

Active solar has relatively low cost compared to active solar. The variable costs are near to zero and thus this way of capturing the sun energy can be reasonably attractive. Inspite of the fact that the energy provided by a passive solar system is only low temperature heat it can be used to substitute other much more expensive sources of heat. Usually the passive solar has a pay back time of 5 to 10 years if it is used to substitute heating of water with heating oil or electricity.

8.3.3Wind

For many centuries, wind power like water power has provided energy to pump water and run mills and other machines.

In recent years, the cost of wind-generated electric power has dropped significantly, and by some accounts is now lower than the cost of fuel-generated electric power, even without taking externalities into account. Since 2004, wind power has been the least expensive form of new power generation. Wind power is growing quickly, and is one of the fastest growing form of electricity generation on a percentage basis. In the late-1990s, the cost of wind power was about five times what it is in 2005, and that downward trend is expected to continue as larger multi-megawatt turbines are mass-produced.

Wind energy is emerging as a centerpiece of the new energy economy because it is abundant, inexpensive, inexhaustible, widely distributed, clean, and mitigates the greenhouse effect. Rural communities welcome wind farms because they provide income to farmers and ranchers, skilled jobs, cheap electricity, and additional tax revenue to upgrade schools and maintain roads.

The cost of electricity from utility-scale wind systems has dropped by more than 80% over the last 20 years.

In the early 1980's, when the first utility-scale wind turbines were installed, wind-generated electricity cost as much as 30 cents per kilowatt-hour. Now, state-of-the-art wind power plants at excellent sites are generating electricity at less than 5 cents/kWh. Costs are continuing to decline as more and larger plants are built and advanced technology is introduced.

However wind energy has also some negative aspects:

- Maintenance of wind turbines can be difficult and expensive. Repairs require a much more complicated and expensive operation than ground based generation.
- Many potential sites for wind farms are far from demand centers, requiring substantially more money to construct new transmission lines and substations.
- Intermittence of wind as the fraction of energy produced by wind ("penetration") increases, different technical and economic factors affect the need for grid energy storage facilities. Large networks, connected to multiple wind plants at widely separated geographic locations, may accept a higher penetration of wind than small networks or those without storage systems or economical methods of compensating for the variability of wind. In systems with significant amounts of existing pumped storage this proportion may be higher. Isolated, relatively small systems with only a few wind plants may only be stable and economic with a lower fraction of wind energy.

Wind energy is becoming more and more competitive and the gap between production price and market price is getting narrower and narrower. However in most cases the production price is still above the market price, especially if we take into account the intermittency of wind energy.

8.3.4 Small HPP

For centuries, water has been used to provide power for various systems. Today hydropower is widely used to produce electrical energy.

Reservoirs constructed for hydroelectric plants have the potential to cause major environmental problems. First, the impounded water frequently covers agriculturally productive, alluvial bottomland. This water cover represents a major loss of productive agricultural land. Dams may fail, resulting in loss of life and destruction of property. Further, dams alter the existing plant and animal species in the ecosystem (Flavin 1985). For example, cold water fishes may be replaced by warm water fishes, frequently blocking fish migration. However, flow schedules can be altered to ameliorate many of these impacts. Within the reservoirs, fluctuations of water levels alter shorelines and cause downstream erosion and changes in physiochemical factors, as well as the changes in aquatic communities. Beyond the reservoirs, discharge patterns may adversely reduce downstream water quality and biota, displace people, and increase water evaporation losses. Because of widespread public environmental concerns, there appears to be little potential for greatly expanding either large or small hydroelectric power plants in the future.

Small scale hydro power systems can be installed in small rivers or streams with little or no discernable environmental effect on things such as fish migration. Most small scale hydro power systems make no use of a dam or major water diversion, but rather use flow turbines with little environmental impact.

In poor areas of the world, many remote communities still do not have access to electricity. Micro hydro power, which has a capacity of 100 kW or less, allows such communities to generate their own electricity. Micro-hydro power can be used directly as "shaft power" for many industrial applications. Alternatively, the preferred option for domestic energy supply is to convert to electricity either through the use of a custom generator or through a reversed electric motor which, while often less efficient is more likely to be available locally and cheaply.

Generally speaking small HPP can hardly survive on a market basis electricity price. It depends a lot on each individual case, however most small HPP require electricity prices that are for now above the current market price.

8.3.5 Solid Biomass

The necessity of a larger-sized boiler and the need for a waste-handling plant involve 1.5 to 4 times the investment cost of oil-fired package boilers. A combustion efficiency of 65% to 75% may be expected when burning wood waste, compared with 80% obtained from gas- or oil-fired units. The difficulty of automatic firing, slow response to peak demand, and the need for ash removal and disposal are other disadvantages that must be carefully weighed when considering the use of what may at first glance appear to be a cheap fuel.

The cost of electricity from wood-fired power plants ranges from $0.06 to more than $0.11 per kWh. These plants have an efficiency of 18% to 24%. They are competitive typically when they receive feedstock at very low prices or are located in areas of high electricity costs.

Although it is technically feasible to use wood waste as fuel for power generation, economics invariably proves to be the limiting factor in most cases. Obvious benefits may be gained by burning wood residues to reduce a manufacturer’s fuel oil and electricity bill. These benefits may be offset by high capital costs, low plant efficiency, and increased maintenance levels. Of course, the economics of wood waste energy generation becomes more attractive as traditional fuel prices increase. Before comparative studies can be made, the real value of wood waste as a fuel source must take into account its available heat content and the investment and operating costs of the plant needed to handle and convert it to usable energy.

Generation of electricity from biomass is in spite of the use of relatively well known and mature technology exclusively dependent on government subsidies. It cannon compete with fossil fuels on a cost basis without additional subsidies.

However the generation of heat form biomass can be completely independent of government subsidies. Due to relatively simple technology and low operation costs it is entirely competitive and does not need any additional financial stimuli from other sources.

8.3.6 Biogas

The number of farm-based biogas plants increased rapidly in the recent past, the interest in this technology is expected to continue. A survey was carried out in 2002 to provide information for farmers and decision makers about motives, plant concepts, investment costs and labour requirement. In most plants slurry and manure is co-digested with energy crops and/or organic waste. The trapped biogas is utilized in CHP-units and the electricity is sold to the grid. The heat is supplied to the farm and farm house; a few operators sell it for district heating. The labour requirement depends on the fermented feedstock. The investment costs per unit decrease. At the substantially subsidized price of electricity at 160 € / MWha the simple payback period is usually between 7 and 11 years. Which is still quite high if not even to high for a private investor, without additional investment help from the public funds.

8.3.7 Quick overview

In the table below we can find the approximate breakeven electricity prices per MWH for electricity production. These prices were calculated on the basis of experience of the company Istrabenz energetski sistemi.

	Approximate breakeven prices per MWh
solar	500 - 550 €
biogas	140 - 170 €
solid biomass	90 - 110 €
wind	60 - 70 €
small HPP	45 - 70 €
market price - base - 1 year ago	
	42 €
market price - base - april 2006	
	78 €

The electricity prices until 2006 were quite stable and ranged well bellow 50 € per MWh. However there was a significant increase at the end of 2005 and in 2006. Electricity prices practically doubled and thus made power production investments much more interesting.

However, we can summarize that in general electricity generation from renewable energy sources has not been economically feasible without some financial stimulations. On the contrary heat generation proves to be economically feasible also under market conditions. With increasing electricity prices the market conditions are changing dramatically and making some types of renewables economically very attractive (e.g. small HPP, wind). However most of renewables still remain too expensive

8.4 Evaluation of economic feasibility of RES in WB countries

8.4.1 Incentives for RES in western Balkan countries

As it was shown in other papers in the VBPC-RES project incentives for renewable energy sources in the western Balkans are very low or inexistent.

8.4.2 Advantages and disadvantages of WB countries in comparison to Western Europe

Western Balkan countries are from the economic point of view less developed than western fro example EU countries. But this is not necessarily always a disadvantage for the use of RES.

WB countries are characterised by the following factors:

- Lower cost of labour
- Higher capital costs
- Bad condition of the electricity grid

High capital costs, due to greater risk perceived, requires higher return on investments, which is quiet difficult to achieve. Moreover, when producing electricity there is always a problem how to deliver the electricity to the gird, since the gird is frequently so weak that it can hardly accept major or even mediocre sources of energy.

However these countries can turn lower labour costs into advantage. If they use renewable sources which are directly or indirectly relatively labour intensive, they can achieve lower costs and thus higher returns. Such a case is with biomass. The cost of biomass is basically the costs of harvesting it that means the cost of labour to cut the wood and process it and the cost of transportation.

8.5 Recommendations

My recommendation to western Balkan countries is to take advantage of the situation. Waiting for financial stimulations to be equal to those in Western Europe is futile. The economy of the western Balkan countries is too weak to support the RES in such an extent as in Western Europe.

Take into consideration the resources that WB countries have and take advantage of it. For example all WB countries have large resources of biomass in the form of wood or agricultural biomass. These sources can be used in the first phase for heating and in the next for electricity generation. The prices of fossil energy are global, the prices of biomass can be locally much lower due to transportation costs and other barriers.

9 Financial incentives for RES penetration in Croatia: the role of environmental protection and energy efficiency fund

Vesna Bukarica, Maja Božičević Vrhovčak, Željko Tomšić
Faculty of Electrical Engineering and Computing, University of Zagreb
Unska 3, HR-10000 Zagreb, Croatia
Phone: +385 1 6129 986, FAX: +385 1 6129 890, e-mail: vesna.bukarica@fer.hr

9.1 Financial framework for RES penetration in Croatia – the current state

The basic precondition for higher RES penetration in Croatian energy system is adequate legislative and regulatory framework. The main problem remains non existence of secondary legislation that will ensure proper implementation of directions given in different legal acts (especially Energy Law and Electricity Market Law). The most important secondary legislation documents, whose adoption will complete the legislative and regulatory framework for RES penetration, are Ordinance on RES and cogeneration, Decision on minimal share of electricity produced from RES and cogeneration and Tariff system for electricity production from RES and cogeneration. These documents will define minimal renewable energy targets (MRET), compensation for encouragement of RES and cogeneration payable as part of both regulated and free energy price for all forms of energy as well as incentive prices for purchasing electricity from RES and cogeneration facilities. According to the proposals, MRET in Croatia will be set to 1100 GWh electricity consumed in 2010. This equals to 5,8% of total electricity consumption in 2010. This actually means that the share of RES should increase by 220 GWh per year in time period 2006-2010.

In order to achieve this goal, financial incentives for RES installations will be necessary. It is expected that tariff system for RES and cogeneration will act as a trigger for investments. According to the proposals, incentive price for purchasing electricity from RES and cogeneration facilities will be financed through surcharge on electricity price payable by all electricity consumers. This amount still has to be determined and adopted by the Government, but due to overall economic situation in the country it should not represent an additional burden for the final users (current proposal is set to 0,0098 HRK/kWh, or 0,13

€c/kWh). Also, feed-in tariffs for different RES and cogeneration facilities should be yet adopted by the Government.

However, for the RES projects that are not covered by the above mentioned tariff system, other forms of financial incentives are needed. This is especially the case for isolated RES installations (without grid connection), solar thermal systems and bio fuels production. For these kinds of RES projects financial incentives can be provided by the Environmental Protection and Energy Efficiency Fund. The aim of this paper is to clarify the significance of the Fund by describing its organisational structure, operation and main goals.

9.2 The Environmental Protection and Energy Efficiency Fund

9.2.1 The basis for establishing the Fund

Environmental protection funds have proven themselves to be very effective in number of Central and Eastern European (CEE) countries, i.e. countries with economies in transition. The main purpose of these funds is to provide financial and institutional support for investments in environmental protection and in that way to more efficiently conduct the environmental policy objectives. First such dedicated fund in CEE was Polish National fund for environmental protection and water management, established in 1989. It was followed by Czech and Slovak state funds for environmental protection established in 1991, while Hungary and Bulgaria established similar funds in 1993. Apart from projects directly connected to environmental protection (waste management, biodiversity, air, water and soil quality, endangered species protection, etc.), environmental protection funds have also valuable experiences in conducting energy projects. It is so due to the fact that improving efficiency of energy use and increasing the RES use are the most important ways to fight negative environmental impacts caused by energy production and use.

Available financing sources in the most of transitional countries were state budget, regional/local communities' budget, commercial loans and international programmes. Environmental protection funds were introduced as an additional source of financing with extremely important characteristic of not being on the state budget. The funding are collected thorough various environmental and energy charges.

Environmental protection funds act as financial and institutional support for realisation of energy and environmental protection policy goals. For that purpose, this kind of fund was also established in Croatia in 2003. The basis for establishing this kind of Fund lies in Croatian environmental protection and energy policy objectives.

Directions for future development and reform of energy sector in Croatia as well as main characteristics of energy policy are given in the Strategy of Energy Sector Development. Environmental protection policy is defined in National Environmental Protection Strategy and Environmental Protection Action Plan. Both energy and environmental policy objectives include priority economic measures that will enable achievement of specified goals. The proposed measures included also an establishment of the Environmental Protection and Energy Efficiency Fund (in further text “the Fund”). So, based on the Energy Law and the Environmental Protection Law, the Law on the Environmental Protection and Energy Efficiency Fund was brought out and adopted in July 2003. The Law entered into legal force on January 1st 2004.

9.2.2 Organization and activities of the fund

The Fund has two bodies: director and steering committee. Steering committee consists of two representatives of the Ministry of Environmental Protection, Physical Planning and Construction, one representative of the Ministry of Economy, Labour and Entrepreneurship, one representative of the Croatian Chamber of Economy, one representative of the Ministry of Finance, one representative of the Croatian Parliament and one environmental protection expert.

In general, activities of the Fund include:

- Gathering, managing and allocating money;
- Intermediary activities when projects are financed from international sources;
- Promotion, establishment and actualisation of cooperation with domestic and international financing institutions;
- Managing the data base on actual programmes, projects and assigned financial support.

These activities are divided into two areas:

- Environmental protection and
- Energy efficiency and renewable energy sources

They specifically include:

- Protection, preservation and improvements of air, soil, water and sea quality;
- Mitigation of climate changes;
- Implementation of national energy programmes;
- Promotion of renewable energy sources;
- Promotion of sustainable building;
- Promotion of clean transportation;
- Waste management (improvement of landfills, decreasing of waste generation, recycling);
- Promotion of clean production;
- Protection and preservation of bio and landscape diversity;
- Sustainable use of natural resources;
- Sustainable development of rural areas;
- Sustainable economy development;
- Enhancing environmental information system and implementation of environment management system ;
- Promotion of educational and research and development programmes and projects, including demonstrational activities.

9.2.3 Sources of funding

The Fund is non budget institution and as such it has become the underlying mechanism for gathering money and investing it in projects and programmes that otherwise could not be performed. The most important sources of funding are various environmental charges. In that way "polluter pays" principle is applied. Apart for environmental charges, the Fund can also provide financing from international bilateral and multilateral collaboration, donations and incomes from managing own free financial assets. However, the most important sources of financing are environmental charges. These are as follows.

- **The charge for emissions into the environment (sulphur dioxide $S0_2$, nitrogen dioxide NO_2 and carbon dioxide CO_2)**

  Charges for SO_2 and NO_2 emissions are prescribed with special regulation [**Error! Reference source not found.**] approved by the Government and applied from June 1st 2004. According to this regulation, the unit charge for SO_2 and NO_2 emissions was equal to 192 HRK/tone (26,3 €/tone) in 2005 and will increase to 310 HRK/tone (42,5 €/ tone) in 2006. Total charge amount is additionally corrected by correction factor that depends on the annual emission amount, emission origin (fuel combustion or technological process) and satisfaction of boundary emission amount.

  For CO_2 emissions the appropriate regulation has not been passed yet. The date of its implementation is up to the Government to decide. However, the unit charge will be equal to 12 HRK/tone (1,6 €/tone).
- **The charge for the environment use (charges for buildings or structures whose construction has to be subjected to the environmental impact assessment)**

  This charge is calculated according to physical, technical and technological characteristics of the structure (area, length, capacity, etc.).
- **The charges for burdening the environment with waste (charge for communal and/or no hazardous technological (industrial) waste and charge for hazardous waste)**

  These charges are determined by the special regulation [**Error! Reference source not found.**] approved by the Government and applied form June 1st 2004. According to this regulation, the unit charge for communal and no hazardous (industrial) waste is equal to 12 HRK/metric tone (1,6 €/metric tone).

  The unit charge for hazardous waste was equal to 50 HRK/metric ton (6,8 €/meric tone) in 2005 and it will increased to 100 HRK/metric ton (13,7 €/metric tone) in 2006. The total charge is additionally corrected by the correction factor dependant on hazardous waste characteristics.
- **Special environmental charges for motor vehicles**

  These charges are paid by all owners of motor vehicles, while performing technical inspection of a vehicle. The charge is determined by the special regulation [**Error! Reference source not found.**] approved by the Government and applied form March 1st 2004. Unit charges are prescribed for different vehicle types and corrected according to engine and fuel type, engine volume and vehicle age. Currently, this is the most important source of financing!

Parties obliged to pay the charges are registered in an inquest register, managed by the Fund. The party is registered according to the Fund's decision. Obligations and payment modes are specified for every charge type.

According to the Fund's action plan for the time period 2005-2008 [**Error! Reference source not found.**], the Fund will gain in total 1,566 billions HRK (208,8 millions €). Special charges for motor vehicles will contribute with 50,81% of that amount. The charge for environment use will bring 16,48% of that amount, CO_2 emission charge 12,25%, SO_2 emission charge 2,04%, NO_2 emission charge 0,89%, communal waste charge 2,24%, non hazardous industrial waste charge 1,37%, hazardous waste charge 0,14% and other sources will bring 11,43% of total four year period incomes.This can also be seen in Fig. 4.

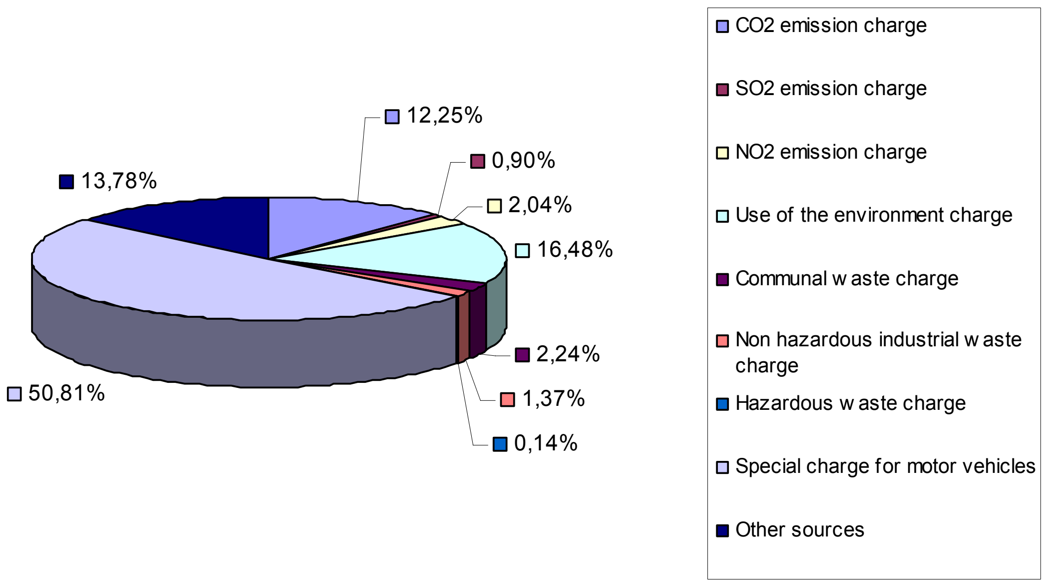

Fig. 4 The Fund's planned incomes in time period 2005-2008

9.2.4 Allocation of financial means

Collected financial means can be allocated to the local (regional) community and to legal and physical entities. The mode of financial support that can be allocated to a specific programme or project is defined by the Fund's ordinance [**Error! Reference source not found.**]. These modes are as follows.

- **Interest-free loans (grants)**

  Loans are usually allocated to companies, craftsmen, legal and physical entities. The Fund performs feasibility study and assesses the financial, economic, technical and personnel solvency of the possible funding user. For these activities the Fund strongly collaborates with Croatian Bank for Reconstruction and Development (HBOR). Loans are interest free, with repayment period of five years, with possibility for two years delay. Maximal amount that can be awarded for the project is 1,7 millions HRK (approx. 227.000 €).

- **Subventions**

  The Fund can provide subventions on loan interests for environmental protection, energy efficiency and RES projects. For this purpose the agreement between the Fund and HBOR was concluded. The subvention user can be legal and physical entity that is eligible for HBOR loans. The subvention can be up to 2% of agreed interest. Interest for the final user can not exceed 4%.

- **Financial help**

  Financial help is allocated only to local self-governments for implementing environmental protection, energy efficiency and RES projects. The maximal amount per project is determined in bidding documentation.

- **Donations**

  Donations are usually provided from agreements with international financing institution.

Important is that user of the Fund's financial support are obliged to invest their own financial means in the proposed project. The Fund can ensure up to 40% of the total investment. For regional and local self-governments in the special care areas (heavily stroked by the war) this amount can be equal up to 80% and for undeveloped areas (islands, mountain and rural areas with the average income per capita less then 65% of Croatian average) up to 60%.

9.2.5Allocation of financial means

The Fund's activities are divided into two areas: environmental protection and energy efficiency, which also includes renewable energy sources. However, the money for investments will not be equally divided between these two areas.

According to the Fund's action plan for the time period 2005-2008 [**Error! Reference source not found.**], 71,72% of total incomes will be allocated for environmental protection projects. This equals to 1,088 billions HRK (145 millions €). 90,06% of this amount is appropriated for refurbishment of existing and construction of new waste disposals and for waste management in general. This is very interesting fact, especially since waste charges contribute to the total incomes with less then 4%.

However, in analysed four year period, energy efficiency and renewable energy sources will be awarded with 429,21 millions HRK (57,23 millions €). The figure 2.2 represents the distribution of planned financial resources for energy efficiency and renewable energy sources projects and programmes.

These projects will include:

- Implementation of national energy programmes;
- Stimulating the use of renewable energy sources;
- Stimulating sustainable building;

- Stimulating clean transportation;
- Stimulating educational, research and development studies;
- Other projects and programmes related to energy efficiency and renewable energy sources.

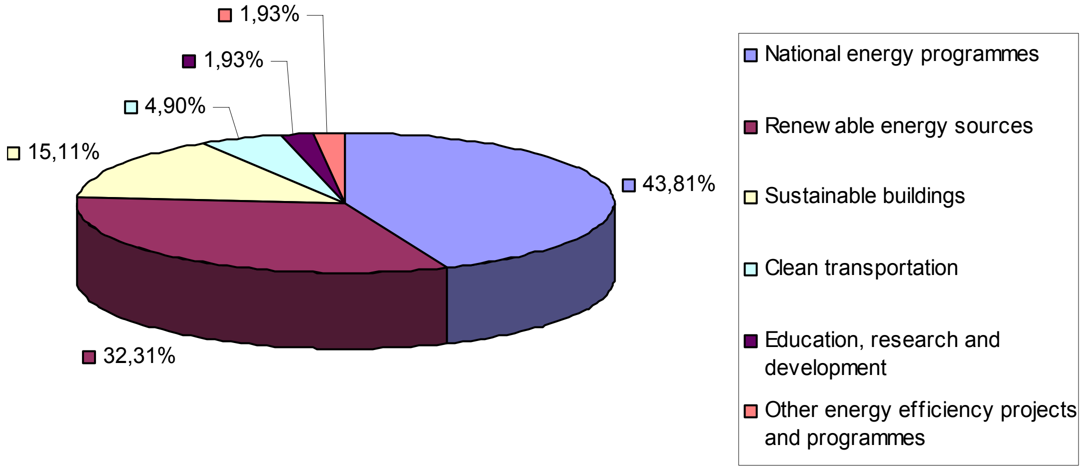

Fig. 5 The distribution of the Fund's financial means for energy efficiency and RES projects

In this paper the interest will be limited only on planned measures for enhancing use of renewable energy sources.

The Fund will provide financial support for solar irradiation measuring (determination of solar energy potential), solar thermal systems and solar photovoltaic systems installations. The greatest potentials exist in the use of low temperature heat (30-80°C) for hot water preparation and space heating. According to the National Solar Energy Programme SUNEN, in coastal area 80% of space heating and hot water preparation requirements can be satisfied by using solar thermal systems until 2020. The Fund will support SUNEN programme in achieving this goal. Apart from households and especially objects for tourism, there are also significant potentials for use of solar energy in agricultural sector. It could be use for technological hot water preparation in livestock farming, for drying facilities and for greenhouses (heating and warm watering water preparation). Photovoltaic systems will be funded only if they were installed in isolated regions without grid connections (islands, mountains and remote rural areas or national parks and other protected areas). However, in order to provide financial support for above stated activities, the Fund requires quality assurance and quality control of both equipment and installers. Solar systems have to have minimal guaranteed performance and efficiency in the equipment lifetime period. Also, installers must be qualified for solar systems installation. These requirements are still to be regulated by the Law on Trade and Commerce. Without these regulations, the Fund will not be able to provide incentives.

The Fund will not finance large wind power plants, since they will be financially supported through feed-in tariffs. However, wind power systems that could apply for Fund's financial support are wind turbines in water supply systems, especially in desalinisation systems for Croatian islands' irrigation systems. Also, the Fund will support measuring and mapping of the wind potentials as a part of the National Wind Energy Programme WINDEN.

In order to support the National Small Hydro Power Plants Programme MAHE, the Fund will participate in financing small hydro power plants demonstration projects, unless they are grid connected and eligible for feed-in tariffs.

Although Croatia has good potentials for geothermal energy use, still there are no greater interests for these kinds of investments. The reason lies in very expensive location research with very uncertain results. However, the Fund can support research of existing and new geothermal sources as a part of the National Geothermal Energy Programme GEOEN. The Fund can also finance documentation preparation, investment studies and specific geothermal projects.

There are very large potentials for biomass use in Croatia. The biomass originates from hewing down and maintaining forests, from wood, agricultural and food industry waste. Technical potential for biomass use is assessed in the National Biomass Energy Programme BIOEN to between 50 and 80 PJ. Energy production from biomass and waste can contribute up to 15% of total primary energy supply on Croatia in 2020. The Fund will strongly encourage and support use of biomass by individual users by providing incentives for wood pellets furnaces, fermentation devices for bio gas production and small engines on liquid and gas biomass. The Fund will provide support for small biomass heat networks and boiler rooms, use of waste deposition gases for electricity production and for the establishment of the system for collecting eatable waste oil. For these purposes financial support will be allocated to the local communities. The Fund will also support production of bio fuels: wood pellets, bio diesel and other liquid bio fuels, wood coal and wood chips from forest biomass. Big cogeneration facilities and biomass power plants will not be financed by the Fund, if they are in the feed-in tariff system.

For the time being, the most of the Fund's activities are directed towards waste disposal, waste minimisation and waste recycling. In the field of energy efficiency, the most important activity is financing energy audits in industrial facilities. In 2005 the Fund has announced the public initiation for submitting requests for financial support to projects in the field of energy efficiency, renewable energy sources and sustainable building. 61 offers have arrived and 20 of them are satisfactory. It is expected to allocate 17 millions HRK (2,3 millions €) for these projects.

9.3 Concluding remarks

Due to international obligations, fulfilment of Kyoto demands and strategic goals of environmental protection and energy policy, the share of renewables in total energy consumption will have to rise. First of all, it is necessary to set minimal renewable energy target. The adoption of MRET is just a matter of time and current proposal is that in 2010 the share of renewables in total electricity consumption should be equal to 1100 GWh, which corresponds to 5,8% of expected total electricity consumption.

The Croatian government's position is that energy sector should be able to finance itself. Therefore, no direct investments in renewables from the state budget are probable. There are two main sources predicted for renewable energy sources funding: feed-in tariffs and the Environmental Protection and Energy Efficiency Fund.

For grid connected RES facilities, incentive electricity purchasing price will be determined in tariff system for electricity produced in RES and cogeneration facilities. Incentive price will be dependant on the RES type. The tariff system still has to be adopted by the Government. Financial resources for this kind of incentives will be collected through additional surcharge per kWh consumed.

Apart from grid connected RES facilities, there are number of RES related activities that require financial support. These activities include education, information dissemination, assessment of potentials, technology research and development and especially involvement of domestic entrepreneurs and industries. For these activities as well as for stand-alone facilities, both thermal and electric, the role of the Fund is extremely important. Not only that the Fund ensures a certain amount of financial help, it also provides necessary institutional support for environmental protection, energy efficiency and renewable energy projects and programmes.

To conclude with, the Environmental Protection and Energy Efficiency Fund has become very important institution that provides guidance as well as financial support for environmental protection, energy efficiency and renewable energy sources projects and programmes, that otherwise would not be implemented. It is well organised institution with developed rules an as such acts as important investment trigger. Although, the most of the current activities are directed towards waste management, the Fund has defined action plan according to which investments in energy efficiency and renewable energy sources are to be increased. Thus, it still remains to be seen weather the Fund will be successful in triggering investments in renewable energy sources.

9.4 References

[1] Law on the Environmental Protection and Energy Efficiency Fund, Official Gazette (Narodne novine) 107/03, Zagreb, 2003

[26] Regulation on unit charges, corrective coefficients and detailed criteria and benchmarks for determination of the charge for emission into the environment of sulphur oxides, in the form of sulphur dioxide, and nitric oxides, in the form of nitric dioxide, Official Gazette (Narodne novine) 71/04, Zagreb 2004

[27] Regulation on unit charges, corrective coefficients and detailed criteria and benchmarks for determination of charges for burdening the environment with waste, official gazette (Narodne novine) 71/04, Zagreb 2004

[28] Regulation on unit charges, corrective coefficients and detailed criteria and benchmarks for determination of the special environmental charge for motor vehicles, Official Gazette (Narodne novine) 02/04, Zagreb 2004

[29] Action plan for the time period 2005-2008, Environmental Protection and Energy Efficiency Fund, Zagreb, 2005, available at Internet, http://www.fzoeu.hr, February 10th 2006
[30] Ordinance on conditions and modes for environmental protection and energy efficiency funding allocation and detailed criteria and benchmarks for requests assessments, Official Gazette (Narodne novine) 183/04, Zagreb 2004

10 The Framework of the Operational Competitiveness Program for the development of private Renewable Energy Sources (RES) and Energy Saving (ES) investments in Greece (Measures 2.1 and 6.5)

Dr. C. Karytsas, K. Karras
Centre for Renewable Energy Sources (CRES)
19th km Marathonos av., 190 09 PIKERMI
Phone: 2106603300 , FAX: 2106603301, e-mail:cres@cres.gr

10.1 Introduction

10.1.1 The Third Community Support Framework 2000-2006

The Third Community Support Framework (C' CSF) has been approved by the Commission with Decision E(2000)3405 of 28-11-2000. The C' CSF includes structural interventions of the European Union in the Greek Regions, with period of application from 1-1-2000 until 31-12-2006.

The C' CSF constitutes an agreement between the Greek Government and the Commission for the targets and priorities referring to the exploitation of € 22.707 million from the resources of Structural Funds for the period 2000-2006.

For more effective achievement of its targets the C' CSF is structured in 11 National Operational Programmes and 13 Regional Operational Programmes. The National Operational Programs include the Operational Program "Competitiveness", which is following described.

10.1.2 The Operational Program “Competitiveness”

The Operational Programme “Competitiveness” was approved by the Commission with Decision C(2001)550 of 14/3/2001. The program is funded by the European Regional Development Fund and the European Social Fund. The total cost of the programme was € 6.7 billion from which the European co-funding is 30.8%. The national public expense is 19.4% of the total costs, while the private sector participates with 49.8% of the total cost.

The Programme “Competitiveness” is structured with 9 priority axes:

1. Optimisation of business environment,
2. Support and encouragement of businesses,
3. Promotion of business excellence,
4. Technology innovation and research,
5. Differentiation of the tourism product – promotion of Greece as a tourist destination,
6. Safety of Energy supply and promotion of energy market liberalization,
7. Energy and sustainable development,
8. Human resources,
9. Technical assistance.

Each priority axis is further analyzed in measures. Each measure includes activities and projects of common orientations and contiguous subjects.

Following Measure 6.5 of priority axis 6 is described which refers to support of private investments for CHP systems, for substitution of conventional fuels with LPG or NG, for Renewable Energy Sources and Energy Conservation applications.

All Measure 2.1 and 6.5 investments will be selected through national call of interest and subsequent proposals submission and evaluation.

10.1.3 The measures 2.1 and 6.5

The measure 2.1 aims at:

- Securing of energy supply and reducing of imported primary energy forms through differentiating energy supply resources,
- Increasing of Greek added value,
- Environmental protection,
- Enforcement of financial activity as well as regional development and employment.

The measure 6.5 is entitled “Promotion of RES and CHP systems in the energy system of the country” and it belongs to the priority axis 6: “Safety in energy supply and promotion of energy market liberalization”. It refers to the promotion of RES and CHP systems and Energy Conservation through

- Supply of financial incentives for isolated private energy investments for cogeneration systems, RES, Energy Conservation. Regulation of public support N323/01 is applied referring to investments for Energy Conservation, CHP and RES, approved by the Commission on 12.12.2001 (c(2001)3968fin).
- Enforcement of investments in the power system / network for the connection of power production projects funded by the “Competitiveness” Program.

In the framework of the measure 6.5 it is possible for works of enforcement/extension of the national electric grid/network necessary for the connection to be subsidized independently. These works are necessary for the connection of RES or CHP projects to the national grid/network.

General targets of the measure are

- Increase of power production from RES and CHP in the total power-production of the country,
- Secure of energy supply and decrease of dependence on imported forms of primary energy through the differentiation of supply energy sources,
- Environmental protection.

The total budget of measure 6.5 for the period 2000-2006 is € 79.2 million. The total public cost (European + National) is € 39.6 million. 50% of the public subsidy is European contribution stemming from the European Fund for Regional Development, which mission is the contribution to widening of inequalities among the regions of the European Union. The authority responsible for the application of measure 6.5 is the ministry of Development.

Interconnection works of power production projects will be eligible for co-financing provided that the following requirements are fulfilled:

- For the interconnection of power production projects from RES additional works for the enforcement of the electrical network and the system is not required. In case that it is required it will have been integrated according to the Transmission system Development Study and the works of system enforcement and/or according to the provisions of Power Network Operator for the works of network enforcement until the date of initialization of the interconnection works of the project, according to its timetable and not later than 31/12/2006.
- The interconnection that will be funded will be realized according to the connection terms that are issued by the network operator for the Non Interconnected Islands or the Network Operator for the system and the grid of the country with the exception of the Non Interconnected Islands and according to the definitions of the System Operation Code.

10.1.4 Intermediate Agencies

Table 1.1 : Intermediate Agencies for Monitoring (IAM) and management of private projects of Measure 6.5 of Programme "Competitiveness"

No	TITLE	TITLE	REGION OF RESPONSIBILITY	ADDRESS	TELEPHONE	FAX	e-mail
1	CENTRE FOR RENEWABLE ENERGY SOURCES	C.R.E.S.	Thematic*	19o km Marathonos av. 190 09 PIKERMI	210 6603000 - 210 6603230	210 66 03 302, 3	isiad@cres.gr
2	HELLENIC COMPANY FOR DEVELOPMENT	HELANET	Attica, North and South Aegean sea	4 Valaoritou 106 71 ATHENS	210 3620242 210 3620977	210 3621950	contact@elanet.gr
3	EUROPEAN PROJECTS MANAGEMENT OF WEST GREECE - PELOPONNESSE - EPIRUS – IONIAN ISLANDS	DIACHIRISTIKI	Western Greece, Peloponnese, Epirus, Ionian islands	58 Michalakopoulou 262 21 PATRAS	2610 622711	2610 277830	efd@patrascc.gr
4	KEPA-ANEM	KEPA-ANEM	Central and Western Macedonia	41 Marinou Antipa P.B. 60068 570 01 Thermi, Salonica (Building INFO-QUEST)	2310 480000	2310 480003	kepa@otenet.gr
5	SUPPORT PRJECTS MANAGEMENT MME – FINANCIAL CONSULTING AM-S	DESM-OS	East Macedonia and Thrace	14 Apostolou Souzou, P.B. 145, 69100 KOMOTINI	25310 35916 25310 72388	25310 72328	desm-123@otenet.gr
6	DEVELOPMENT AND MANAGEMENT OF STEREA HELLAS AND THESSALY	AN. DIA. OF STEREA HELLAS AND THESSALY	Sterea Hellas	15 George Genimatas 351 00 LAMIA	22310 67498 22310 67047	22310 67499	andia@otenet.gr
7	DEVELOPMENT INSTITUTE OF EUROPEAN PROGRAMS OF THESSALY AND STEREA HELLAS	A.E.D.E.P. THESSALY AND STEREA HELLAS	Thessaly	4 El. Venizelou & Iasonos 382 21 VOLOS	24210 76894-8	24210 29320	aedep@aedep.gr
8	SUPPORT AND DEVELOPMENT INSTITUTE OF CRETE ENTERPRISES	ANAPTIXIAKI KRITIS	Crete	50 Giamalaki& Sof. Veniselou 71202 HERAKLION	2810 302400 - 342842	2810 344107	info@ank.gr

* For wind power installations in all country regions in the interconnected system as well as installations of power greater than 5MW at the regions of non-interconnected system.

10.2 Participation conditions

10.2.1 General

Investments concerned can be included in one of the following general technological categories, throughout the Greek territory.

- Category Energy Saving (ES),
- Cogeneration of Heat and Power (CHP),
- Conventional Fuel Substitution with gaseous fuel (FS),
- Renewable Sources of Energy (RES).

The respective investments are included in the Measures 2.1 and 6.5 of the operational Program “Competitiveness”.

The implementation of investments has to be finalized on 31/12/2007 at the latest.

Before the submission of an investment proposal, requirements are:

- For investments realized on existing units influencing their energy condition via conducting of a brief or an extended energy audit is required depending on whether the investment budget is lower or equal to € 440 thousands respectively, according to the requirements of the Decision 1526B/27.7.99.
- For investments not realized in the site of an existing unit the application of a scientifically acceptable method of the exploitable energy potential assessment is required.

Precondition for a valid submission of an investment proposal is the possession of a valid installation license or in the cases that the license is not required, by law, a precondition for the submission of an investment proposal is the possession of Environmental Provisions Approval in the cases that this is required. Specifically in cases of proposals for bio-fuels production to be used in the transport sector precondition is the application for granting Environmental Provisions Approval.

In the sectors of power production and thermal energy distribution a prerequisite for an investment proposal submission for public subsidization is the existence according to laws N. 2773/99 and N. 3175/03 of Power-production and Thermal energy Distribution licenses respectively (when required).

10.2.2 Eligible investment types (Investments categories and subcategories)

Eligible categories and subcategories are presented on Table 2.1. Investments must refer to technologically mature categories, not technologies being at the Research & Development stage[2].

[2] The interested for technologies which are still in an experimental stage can search the Programs of Priority Axis 4 of EPAN on GSRT web-page: www.gsrt.gr .

Table 2.1: Investments eligible to Measures 2.1 and 6.5 of Operational Program "Competitiveness"

Code	Technological category/ RES subcategory
ECE	ENERGY CONSERVATION IN EXISTING ENTERPRISES
CHP	COGENERATION of HEAT (heating[coling) and POWER
SUB	SUBSTITUTION OF ELECTRICITY OR OTHER CONVENTIONIONAL FUELS WITH NATURAL GAS OR LPG IN EXISTING UNITS (ENTERPRISES)
RES/WI	WIND ENERGY SYSTEMS
RES/GE	GEOTHERMAL ENERGY APPLICATIONS
RES/SH	SMALL-HYDRO PROJECTS
RES/SO	CENTRAL ACTIVE SOLAR SYSTEMS
RES/BI	BIOMASS UTILISATION
RES/PV	PHOTOVOLTAIC SYSTEMS

10.2.2.1 ECE. ENERGY CONSERVATION IN EXISTING ENTERPRISES

- Replacement interventions of existing and/or embedment of new materials or equipment for reducing of non working consumption and energy losses
- Replacement interventions of existing or/and embedment of new equipment in functional installations of the unit. This equipment does not include the production equipment of the unit.
- Installation interventions of new equipment for the recovery of energy wasted either directly or indirectly by recovering/recycling of waste material, product or working means. This investments option does not include CHP investments or investments for Biomass utilization.
- Embedment of information systems and/or automations or/and tele-measurements-systems.

Energy conservation interventions on vehicles and moveable machinery are not eligible.

Study of and machinery construction able to operate with fewer natural resources are not eligible activities for financing in the energy conservation investments category for existing enterprises.

10.2.2.2 COMBINED HEAT (Heating/Cooling) and POWER

CHP1: Installation of a new cogeneration system
CHP2: Transformation of a solitary power generation and/or heating/cooling generation system to CHP system

Category CHP also includes district heating/cooling investments in combination with cogeneration investments. CHP investments which exploit exclusively and only RES are not included in this category.

Cogeneration (CHP) is defined according to the following definition as stated in law N. 2773/99:

CHP installations are those which produce electricity through:

- Waste-heat recovery
- Energy exploitation of non-toxic and environmentally non-hazardous industrial by-products (meaning the products-residues of the specific industry, which are released through the production process) of units legally installed within Greek territory
- Combination with heat production and have secured disposal of the produced heat for the direct coverage of the heating and indirectly of the cooling loads. Furthermore, as the cogeneration does not hse exclusively RES, the relation between electric and thermal power must provide an annual total performance of at least 65% and especially in the case of using combined cycle technology 75%. In the specific case of auto-producers of the tertiary sector the value of total annual performance should be 60%.

In CHP-systems production of heat and power uses simultaneously common energy source. CHP-units on vehicles and mobile machines are not eligible.

SUB. SUBSTITUTION OF ELECTRICITY OR CONVENTIONAL FUELS WITH NATURAL GAS OR LPG IN EXISTING UNITS (ENTERPRISES)

SUB.1 Substitution with Natural Gas

SUB.2 Substitution with LPG

Substitution interventions on vehicles and mobile machines are not eligible

RES/WI. WIND ENERGY SYSTEMS

Wind power systems for power production and other uses.

RES/GE. GEOTHERMAL APPLICATIONS

RES/GE.1 Utilization of geothermal fields for a) Power production, b) Cogeneration of power and heating/cooling, c) District heating or/and cooling and d) Production of heating / cooling in a single central unit and distribution to a wider area

RES/GE.2 Space air-conditioning systems via utilization of geothermal formations as well as heat of waters (surface and underground, which are not characterized as geothermal fields

RES/SH. SMALL HYDRO PROJECTS OF POWER UP TO 10 MW_e

RES/SH.1 In rivers and generally water-streams

RES/SH.2 In existing hydraulic networks

RES/SO. CENTRAL ACTIVE SOLAR SYSTEMS

RES/SO.1 Production of hot water for industrial or domestic use via flat water thermal solar collectors. The collector incidental degree of performance, measured by certified laboratories, in accordance with the standards (ISO 9806-1, EN 12975-2), has to greater than 50% for the following conditions:

Average operational collector temperature minus ambient temperature ΔT=30K,

Incident solar radiation G=800W/m^2 with reference surface the window surface of the collector.

RES/SO.2 Heat production by various types of high efficiency thermal solar collectors (parabolic, flat, vacuum etc.) for warm water production for domestic use, space heating–cooling by use of heat pumps-chillers or for thermal processes. High efficiency flat thermal solar collectors are the collectors which incident efficiency degree is greater than 60% in the following conditions ΔT=30K, G=800W/m^2, measured according to standards ISO 9806-1, EN 12975-2.

RES/BI. BIOMASS UTILISATION

RES/BI.1 Bio-fuels production for transport

RES/BI.2 Heat/cooling production in a single central installation and distribution to the wider area for either district-heating or/end district-cooling.

RES/BI.3 Combined Heat and Power (CHP) by use of biomass exclusively.

RES/BI.4 Power production by use of biomass exclusively.

Biomass is defined as the biodegradable fraction of the products, wastes and residues coming from agriculture (animals and plants), forestry and related industry, as well as the biodegradable fraction of industrial wastes and municipal sewage sludge.

RES/PV. PHOTOVOLTAIC SYSTEMS

RES/PV. Photovoltaic systems either autonomous or inter-connected.

10.2.3 Types of Investments (Primary or Environmental)

This distinction is fundamental and causes differentiations to the eligible budgets and to the maximum amount of subsidies. Following, relative examples are presented:

10.2.3.1 Interpretation of definitions of Initial and Environmental Investments

All the investments considered for subsidization are **energy investments**. The energy system of an enterprise is considered for the following definition.

An **Initial energy investment** concerns the creation of new or expansion of an existing energy system.

Environmental energy investment is an investment that refers to **single substitution** of energy equipment elements independently to the magnitude of the energy results it causes.

10.2.3.2 Characteristic examples of distinguished Initial and Environmental investments

Installation of a new management mechanism (not a simple monitoring mechanism), that causes substantial energy results is an expansion of the existing energy system, thus it consists an Initial investment.

Installation of a new heat exchanger or of a new solar thermal system consists an expansion of an existing system, thus it is an Initial Investment.

Substitution of an existing heat-exchanger constitutes an Environmental Investment.

Similarly, installation of new solar collectors substituting existing ones of a solar system constitutes an Environmental Investment.

10.2.4 Total cost of investment

The minimum and maximum budget limits of the investment proposals to be subsidized are €44.000 and €44 million respectively for all technology categories or RES subcategories.

The aforementioned limits refer to the budget of the investment proposal not including the cost of interconnection to the grid of power production projects from RES and CHP. The total power project budget may exceed these limits only by its part that refers to its interconnection to the grid. For each technological category or RES subcategory the budget must be at least €44.000.

Proposals must be integrated and operational with no need of complementary or supportive works.

In the case in which the total budget of the project exceeds €44 million, the final public subsidy corresponds to total budget of €44 million.

In the case of CHP investments public subsidy can not exceed the amount that corresponds to installed capacity of 35 MW_e, except in the case of power auto-production, whereas the limit of installed capacity is 50 MW_e.

10.2.5 Public financing

Public financing has the form of subsidy of a percentage of the eligible cost of the investment. The maximum percentages of public subsidies in all the types of investments and for all the regions of the country are presented on Table 2.2.

Table 2.2: **Maximum Public Subsidy Percentages**

Code	Country region	Subsidy Percentage of Initial Investment	Subsidy of Environmental Investments in		
			Big Enterprise	SME	Maximum Percentage
ECE	Thrace (Xanthi, Rodopi, Evros prefectures)	40 %	60%	75 %	40% of the total budget
	Eastern Macedonia-Thrace, Epirus, Western Hellas, Peloponnese, North Aegean		55%	70%	
	Rest of the country		50%	65%	
	Regions A and B of Central Macedonia and Attica, according to Law N.3299/04		45%	60%	
CHP	Thrace (Xanthi, Rodopi, Evros prefectures)	35 %	60%	75%	35% of the total budget
	Eastern Macedonia-Thrace, Epirus, Western Hellas, Peloponnese, North Aegean		55%	70%	
	Rest of the country		50%	65%	
	Regions A and B of Central Macedonia and Attica, according to Law N.3299/04		45%	60%	
SUB	Thrace (Xanthi, Rodopi, Evros prefectures)	30 %	60%	75%	30% of the total budget
	Eastern Macedonia-Thrace, Epirus, Western Hellas, Peloponnese, North Aegean		55%	70%	
	Rest of the country		50%	65%	
	Regions A and B of Central Macedonia and Attica, according to Law N.3299/04		45%	60%	
RES/WI	All the country	30 %	100%	100%	30% of the total budget
RES/GE	All the country	40 %	100%	100%	40% of the total budget
RES/SH	All the country	40 %	100%	100%	40% of the total budget
RES/EL.1	All the country	30 %	100%	100%	30% of the total budget
RES/EL.2	All the country	40 %	100%	100%	40% of the total budget
RES/BI	All the country	40 %	100%	100%	40% of the total budget

Code	Country region	Subsidy Percentage of Initial Investment	Subsidy of Environmental Investments in		
			Big Enterprise	SME	Maximum Percentage
RES/ PV	Thrace (Xanthi, Rodopi, Evros prefectures)	50 %	100%	100%	50% of the total budget

The cost of interconnection of RES or CHP power production projects to the national grid is not subsidized according to the percentages of Table 2.2 but it is financed independently and ti can be either 45% or 50% depending on the region of the project implementation and on the size of the entity implementing the project. Table 2.3 presents the subsidy percentages of the interconnection for various regions.

Table 2.3: Public subsidy percentages of interconnection works

Country region	Subsidy percentage	
	Big enterprises	SME's
Regions A and B of Central Macedonia and Attica, according to Law N.3299/04	45%	50%
Rest of the country	50%	

Definition of Small Medium Enterprises (SME)

SME are the enterprises which

α. Have less than 250 personnel[3].

b. Annual turnover does not exceed €50 million or their annual balance does not exceed €43 million.

Data used for the calculation of the personnel number and financial amounts are them of the balance of the last year and are calculated on an annual basis.

c. Are independent enterprises.

3 Part-time or seasonal workers can be considered as full time workers, based on their working time. Trainees and students as well as maternity and parental leaves are not included.

10.2.6 Private Contribution

Private Contribution can be constituted by candidate investor's own capital (own contribution) or/and bank loan (bank contribution). In any case own contribution must be at least 15% of the investment budget.

10.3 Eligible costs

10.3.1 Maximum percentages of eligible costs

VAT is not included, normally, in the eligible costs. Investment proposal submission must be done before commencement of the investment works. Consequently, only costs of works realized after the date of proposal commencement can be eligible, except the costs of

- The energy audit or
- The assessment of the exploitable energy potential, provided that the works have been implemented after 1/1/2000 and before the proposal submission.

Table 3.1 presents eligible costs categories and respective maximum limits, as percentages of the investment budgets. The interconnection costs of power production projects to the national grid are not included.

Table 3.1: Maximum percentages of Eligible Costs per Category

No	Eligible Cost Category	UPPER LIMIT
1	Equipment (main equipment supply, software, materials, transport and installation costs, auxiliary equipment and measuring instruments)	88-100 %
2	Energy Audit or Energy Potential Assessment*	2 %
3	Consultants fees	6 %
4	Interventions to building sites, buildings and infrastructure works **	8 %
5	Training in equipment operation and software	3 %
MAXIMUM OF THE SUM OF SUPPORTIVE COSTS (2- 5)		**12 %**

* For investments with budgets less/equal to €440.000 the percentage can become 3%.

** Purchase costs of building sites and buildings required exclusively by the energy investment are as well included.

Interconnection costs of RES and CHP power production projects to the national grid do not come under the limits of Table 3.1, but they are financed if they are less or equal to the Connection Offer of PPC, etc. The Interconnection cost of RES, CHP power generation projects is considered an Initial Investment. These costs are considered eligible costs, provided they are implemented after the energy investment proposal submission date. Equipment costs include the following costs:

- In all district heating and district cooling investments the transport networks costs.
- In heating / cooling production applications in single central installations for distribution to a wider area the networks of heating/cooling transport and distribution networks are included in the eligible costs.
- In all geothermal applications the realization of new drillings provided that the drillings are productive and with re-injection.
- In all small-hydro projects the civil engineering works necessary for the construction, operation and maintenance (e.g. dams, tunnels, the rest of hydraulic works etc.)

Upper limits of eligible costs per RES and CHP technology excluded interconnection costs are presented on Table 3.2.

Table 3.2: Upper limits of eligible costs for RES and CHP Technologies

TECHNOLOGY	**UPPER ELIGIBLE COSTS LIMITS (€)**
Combined Heat and Power (CHP)	1.050 / installed kW_e, for installations < $1MW_e$ 750 /installed kW_e, for installations > $1MW_e$
Wind	900 / installed kW_e
Geothermal applications in Greenhouses	100.000 / 1000 m^2 of glass greenhouse 60.000 / 1000 m^2 of plastic greenhouse
Small-hydro on water streams	1.500 / installed kW_e
Small-hydro on hydraulic networks	1.100 / installed kW_e
Power-production or Combined Heat and Power by biomass	• Agricultural residues: 1.600 / installed kW_e • Sewage wastes: 1.300 / installed kW_e • Industrial and municipal sold wastes: 1.500 / installed kW_e
District-heating / district-cooling by RES or by Natural Gas	750 / installed kW_{th}. 900 / installed kW_{th}, in case of total transformation of the produced thermal energy into cooling
Bio-fuels production (bio-ethanol, bio-diessel)	500 / tonne
Central Solar systems – Conventional collectors	300 / m^2
Central Solar systems – High efficiency	500 / m^2
Photovoltaic systems (interconnected to the grid without storage system)	8.800 / kWp

10.3.2 Differentiation of eligible budget between Initial and Environmental investments

In Initial investments the eligible budget is the total budget proposed provided that it covers the limits and percentages of the eligible costs and has been accepted by the evaluators. Regarding though the Environmental Investments the eligible budget is the proposed budget if it covers the limits and percentages and has been accepted by the evaluators. The eligible cost of environmental investments is this way reduced to the additional cost required for the investment as foreseen by the Commission for state subsidies regarding environmental investments.

More specifically:

➢ In the case of ECE-type environmental investments, the benefits considered are benefits regarding either the production or energy management optimization. These benefits are presented on Tables 3.3, 3.4, 3.5 and on part of Table 3.6 following described:

- Tables 3.3 and 3.4 concern alterations of either the enterprise product quantity or its value,

Table 3.3: Products and services per year before the investment (subdivided in Initial and Environmental parts of the investment)

(preferably averages of the three last years)

PRODUCT OR SERVICE	UNIT	QUANTITY	AMOUNT (thousand €)
		Before the investment	Before the investment
TOTAL			

Table 3.4: Products and services per year after the investment (subdivided in the Initial and the Environmental investment parts)

PRODUCT OR SERVICE	UNIT	QUANTITY	AMOUNT (thousand €)
		After the investment	After the investment
TOTAL			

- Table 3.5, concerning the enterprise operation cost before and after the investment.

Table 3.5: Contribution of Energy cost to the total operational cost of the enterprise (subdivided in the Initial and Environmental parts if applicable)

COSTS	Before the investment	After the investment
AVERAGE ANNUAL COSTS	Thousand €	Thousand €
ENERGY		
RAW MATERIALS		
LABOUR		
SERVICES		
TOTAL		

- The Part of Table 3.6 that concerns the energy revenues caused by the investment is following presented.

Table 3.6: Estimation of annual energy cost and investment revenues (Subdivided in Initial and Environmental parts of the investment if applicable)

(before and after investment)

COSTS	Before the investment	After the investment
	Thousand €	Thousand €
Cost of electricity		
Cost of fuels for energy production		
Cost of thermal energy		
Operation and Maintenance cost excluding fuels		
TOTAL ENERGY COSTS		
Electricity Revenue		
Thermal Energy Revenue		
TOTAL ENERGY REVENUES		

- ➢ In the case of Environmental investments of RES or CHP types he cost that corresponds to a conventional energy production unit is
  - The cost of a binary-cycle power production unit and
  - The cost of installation of a boiler for thermal energy production.
- ➢ In the case of Environmental Investments the eligible budget is coming from the proposed total budget.

10.4 Evaluation and incorporation of proposals

10.4.1 Evaluation process of investment proposals

The Main Evaluation Committee is assisted by special committees, whenever necessary. Moreover, parts of the evaluation may be attached to consulting experts.

Evaluation of a proposal consists of three stages:

- Formal integrity control
- Financial evaluation of the proposal
- Technical evaluation of the investment proposal.

10.4.2 Formal integrity control (i)

At this stage proposals are characterized either as **formally complete or formally incomplete** and the formally complete are forwarded to the next evaluation stages.

10.4.3 Financial Evaluation of the Investment (ii)

In the evaluation stage ii, documents regarding investor's adequacy and investor's ability of covering own participation are checked as well as the nature of investor's enterprise (whether it is a big one or a SME).

10.4.4 Technical evaluation of Investment proposal (iii)

The technical evaluation of proposals includes:

- Examining of eligibility and integrity of the investment proposal,
- Examining of standards keeping and normal completion of the financial study
- Check of investment characterization as Initial or Environmental
- Check of costs eligibility and keeping of the respective maximum per cost category and technology category. Costs that exceed the respective maximum limits have to be adequately documented.

Examination of the grid interconnection offer for the accurate evaluation of the respective works cost.

Table 4.1 Evaluation Criteria of investment proposals

No	CRITERION	WEIGHT FACTOR (%)	
		Investments with budget Greater than €440.000	Investments with budget Lower or equal to €440.000
1	Internal Return Rate (IRR)	20	-
2	Primary Energy Saving	25	40
3	Environmental Impacts	15	20
4	Social Impacts	10	10
5	Technology Reliability and Competence of Investment Proposal	30	30
TOTAL		**100**	**100**

10.4.4.1 Internal Return Rate

This criterion favours proposals with IRR between 5% and 25%. The maximum grade is given to proposals with IRR=15%, whereas proposals with IRR<5% or IRR>25% get grade 0 to this criterion, which as well holds true for proposals with undetermined IRR.

10.4.4.2 Primary Conventional Energy Saving

The grade of an investment is related to the ratio of the annual primary conventional energy savings to the investment budget.

10.4.4.3 Environmental Impacts

The investment grade is a function of the annual pollutants avoidance to the investment budget.

10.4.4.4 Social Impacts

The investment grade is a function of:

- The ratio of the investment magnitude over the relative regional gross domestic product index and
- The product of new working positions and the relative regional unemployment index.

10.4.4.5 Reliability of Technology and Competence of the investment proposal

Over-all correctness and reliability of the investment proposal data are taken into account, documentation of the investment need and know-how of the prposed technologies.

More specifically the following are assessed:

- Reliability and data documentation sufficiency and that of the proposal in general, according to the evaluator's documented assessment,
- Quality of the energy audit and assessment of the exploitable energy potential in combination with the techno-economical study,
- Know-how of the specific technology,
- Existence of certifications for the specific technology according to international standards and
- Existence and competence of implementation plans and exploitation of the investment.
- Investment proposals that are taking grade less than 5 to that criterion are rejected.

10.4.5 Final Pronouncement by the Main Evaluation Committee

The Main Evaluation Committee examines all the proposals and more specifically

- Proposals rejected at stage iii.
- Proposals with physical/financial subject changed during stage iii and in cases with in-compliances among evaluations.
- Proposals with special problems (e.g. obscurities regarding eligibility).

10.5 Conclusions

Measures 1.2 and 6.5 of the Operational Competitiveness Program target to encourage RES and CHP investments for power production in Greece, In the near future enforcement of the networks is expected to fulfill the new network requirements. An estimate of the RES penetration potential by year 2010 can be drawn, based on the RES economic potential and the consequent investors' interest. The estimate results are shown on Table 5.1**.**

Table 5.1: An estimate of RES penetration potential by year 2010

	Installed power In year 2003 (MW)	Installed power Estimate for 2010 (MW)	Power production, by 2010 (TWh)	% per RES-type by 2010
Wind	420	2170	6.08	8.45
S-hydro	66	475	1.66	2.31
Large hydro	3060	3680	5.47	7.59
Biomass	8	125	0.99	1.37
Geothermal	0	8	0.06	0.09
Photovoltaic	0	5	0.01	0.01
Total	**3461**	**6463**	**14.27**	**19.82**

Greece tries very hard on institutional, regulatory, technical and subsidies levels, as for example Measures 1.2 and 6.5 of the Operational Competitiveness Program to achieve the indicative target of 20.1% of Directive 2001/77. In parallel, Greece tries to achieve the subsequent environmental target of a significant CO_2 emissions reduction.

10.6 References

[1] Ministry of Development: Investments Guide for Measure 6.5 of Program "Competitiveness" (2004)

[2] Dr. C. Karytsas, M. Birmpili, K. Karras, Dr. P. Georgilakis: "Impact of the current Greek legislation for RES electricity production on the energy balance and economy", VBPC-RES, WS2.2 (2005)

11 Regulatory review for RES projects implementation in Bosnia and Herzegovina

Almir Ajanović
Intrade energija d.o.o.
Zmaja od Bosne 44
71000 Sarajevo
Phone: 00387 33 657 205
Fax.: 00387 33 657 206
Email : almir.ajanovic@intrade.co.ba

11.1 Introduction

In 1999 when the state owned electric power company announced public tender for construction of over 50 small hydro power plants at the territory of Federation of Bosnia and Herzegovina, i.e. at the territory of the company's work and when over 25 companies from the country and abroad had appeared at the post-tender meeting, the first question was whether in this field exists legal provisions. The answer at that time was that there is no almost any legal provision defining methods and conditions for utilization of natural resources for electricity generation. The above mentioned event was a reason for governmental and entity bodies to be more seriously and more actively included into the growing up discussion within the expert circles regarding need for making legal provisions which would define field of utilization of natural renewable resources in general, but especially for purpose of electricity generation.

Bosnia and Herzegovina has a complex structure consisting of two entities: Federation of Bosnia and Herzegovina and Republic of Srpska. The Federation of BiH is consisted of ten cantons. Each of the above mentioned political units has its laws regulating some living sections. Naturally, general laws start from the state level through the entity laws and then to the cantons in Federation of BiH. All laws have to comply with law from higher instance, but they can have peculiarities. So it is known that responsibility of cantons in Federation of BiH is awarding of concessions for facilities with the installed power up to 5 MW, and above 5 MW it is authority of Federation of BiH entity. Authorities for awarding of concessions in Republic of Srpska are at the entity level. In case of distribution and transmission network, voltage level over 110 kV is at the state level while distribution levels at the entity levels. But, since then and until nowadays in BiH were created all legal conditions on which basis were constructed first BiH electricity generation capacities based on utilization of renewable resources.

11.2 First steps

First were passed Laws on Waters at the entity levels who were used in the beginning as a base for announcing of first tenders during year 2000. During procedure of one of those tenders, the Intrade energija Company was awarded with concession for construction of four small hydro power plants. The above mentioned Laws for the first time in Bosnia and Herzegovina enabled the private capital to be involved into the projects aiming water exploitation particularly for purpose of electricity generation. The above mentioned Law on Waters was presenting the first step in creating necessary strategy of energy development in the country.

In year 2002, Government of Federation of BiH had passed the Electricity Law which defines and regulates:

- electric-power system,
- electric-power industry activities,
- development of electricity market and institutions for the market regulation,
- general conditions for electricity supply,
- planning and development, construction,
- reconstruction and maintenance of electric-power facilities,
- supervision of law conduction and other issues considerable for performing of electric-power industry activity in Federation of Bosnia and Herzegovina except electricity transmission, activities related to transmission, international trade, managing and operation of electric-power systems in competence of Bosnia and Herzegovina.

The above mentioned Law, as the fundamental Law in this field has the following targets:

- encouragement of development in field of electric-power industry,
- encouragement for private domestic and foreign investments,
- more reliable supplying of customers with high quality electricity,
- joining to the international electricity market through the unified electricity market in Bosnia and Herzegovina,
- economic and rational electricity utilization,
- energy efficiency,
- introducing of competition, transparency and preventing of unwanted effects of monopoly,
- environment protection in accordance with regulations and domestic and international standards,
- protection of interests of system users,
- application of electricity renewable resources.

The emphasis was put on the institutions for market regulation as the future holders of activities at the electricity market. Their competencies are:

- supervision and regulation of relation between electricity generation, distribution and electricity purchasers including electricity traders,
- prescribing of methodology and criteria for setting a price for supplying of unqualified electricity purchasers,
- establishing of tariff items for users of distributive systems and tariff items for unqualified purchasers,
- issuing or revocation of licenses for generation, distribution and supplying of electricity and electricity trade,
- issuing of preceding permits for construction and permissions for utilization of electric-power facilities except facilities for electricity transmission,
- establishing General conditions for electricity supply.

It is very important to note that this Law introduces function of the qualified producer and purchaser of electricity. The task of regulatory agency is to establish who satisfies legal obligations for producer and purchaser of electricity. It is worthwhile for the state owned electric-power companies as the existing producers as well as for future private companies which decide to construct new generation or some other electric-power facilities. Generally, this institution from its establishing has the task to regulate electricity market completely.

Almost at the same time where the Law on electricity passed, the Government of Federation of Bosnia and Herzegovina also passed the second, very important Law on Concessions. This law establishes:

- subject, manner and conditions under the domestic and foreign legal persons could be awarded with concessions for providing the infrastructure and services and exploitation of natural resources,
- financing, designing, construction, reconstruction and/or managing with such infrastructure and all accompanied buildings and facilities in fields which are exclusively in capacity of Federation of Bosnia and Herzegovina,
- competencies for concessions awarding,
- establishing Committee for the Federation's concessions,
- tender procedure,
- content of the concession contracts, termination of the concession contracts, rights and duties of the concessionaires, solving of disputes and other issues important for the concession awarding at the territory of BiH Federation.

The aim of this Law is to create transparent, nondiscriminatory and clear legal framework for establishing conditions under the domestic and foreign legal persons could be awarded with concessions in BiH Federation as well as encouraging investment of foreign capital in subject fields.

As in case of the above-mentioned Law, this Law also had foreseen establishing of Committee for concessions of Federation of Bosnia and Herzegovina as independent regulatory body. The exclusive capacities of the Committee are:

- monitoring of the overall work of the concessionaires aiming to ensure supplying customers with services in the adequate manner, where to the concessionaires is paid an appropriate indemnity,
- approving of deadlines and conditions of the standard contract on providing of services for the customers,
- consideration of customer complaints regarding the compensation amount or conditions for supplying of services provided by the concessionaires, and
- making decisions about each submitted request or demand for revision that is submitted according to this Law.

In parallel with activities of BiH Federation Government almost all Cantons made similar Laws which define this field. Since the Federal Law on Concessions precise that energy generation capacities with installed power up to 5 MW are in rank of Canton's decision-making, these Laws were with their legal acts additionally arranged this area.

As additional step toward arranging of this segment, Government of BiH Federation brings in year 2004 Decision on Methodology for establishing redemption price levels of electricity generated from renewable resources with the installed power up to 5 MW. Pursuant to this Decision, establishing of the redemption price levels of electricity generated from renewable resources with the installed power up to 5 MW would be done by application of correction coefficients to the amount of valid tariff system for active energy, namely higher seasonal and higher daily for category at 10(20) kV voltage and in accordance with valid tariff system. Relative amounts of the coefficients are as follows:

- small hydro power plants	0,80
- power plants using bio gas from waste depots and biomass	0,7
- power plants using wind and geothermal sources	1,00
- power plants using solar energy	1,10

On the basis of this Decision as well as on the basis of prepared investment-technical documentation, it can be perceived technical-economic benefit of each project.

In addition, this Decision defines cases when occur:

- decreasing of amount of the valid tariff system, the correction coefficients are increasing for percent of decreasing of the tariff system,
- increasing of the amount of the valid tariff system when correction coefficients are not subject to the changes.

With such attitude are significantly privileged future investors in electric-power facilities.

Besides, at the same Decisions are other encouragement parts such those which had foreseen that:

- price level from this decision could be subject of correction up to +10% in case when construction of power plants with renewable resources with the installed power up to 5 MW contributes to the development and rational needs for extension of the existing electric-power network, especially in non electrified areas, and
- financing of project is done from credit means, and in purpose of paying off the credit in first years, and if Elektroprivreda has an interest it is possible to make additional differentiation of price up to +10% for period mutual agreed by both parties. But after expiration of that period, the price is reduced for the same percent in future period according to the agreement between the contracting parties.

11.3 Activities on State level

11.3.1 Introduction

In the meantime, Government of Bosnia and Herzegovina brought:

- Law on Transmission of Electric Power, Regulator and System Operator of BiH,
- Law Establishing the Company for the Transmission of Electric Power in BiH,
- Law Establishing an Independent System Operator for the Transmission System of BiH.

The above-mentioned Laws define electric-power sector on the level of the entire country, primarily in part that is in country competence: transmission, i.e. voltage level over 110 kV and international trade. For that purpose are established:

- ISO - Independent System Operator,
- SERC - State Regulatory Electricity Commission, and
- State electric power Transmission Company.

SERC is put in charge for regulation of system at the state level, such as two entity obliged to do that at the entity level. For performing of international trade is necessary to have a license, i.e. license issued by SERC.

The State Regulatory Electricity Commission (SERC) carries out regulation of the electricity transmission system in Bosnia and Herzegovina and has responsibilities and jurisdiction over electricity transmission, transmission system operations and international trade in electricity in accordance with the international norms and European Union standards.

11.3.2 SERC's activities

The SERC's jurisdiction includes:

- issuance, modification, suspension, revoking and monitoring, as well as compliance with licenses within its jurisdiction,
- regulating, approving and monitoring tariffs and tariff methodologies for services of transmission, ancillary services and operation of the Independent System Operator (ISO),
- issuance of rules and regulations within the framework of its competencies including revision and approval of market rules and grid codes as well as conditions for connection and access to the networks,
- establishment, monitoring and conduction of rules related to fair and non-discriminatory access of the third parties to the transmission network,
- monitoring and enforcing of conditions related to international trade in electricity, in particular ensuring that international technical requirements are met and adhered to,
- establishing, monitoring and enforcing quality standards for electricity transmission and ancillary services,
- coordinating and approving investment plans of company for transmission of electricity, including the plans related to transmission network and quality of electricity transmission services,

- monitoring of efficiency of mechanisms and methods securing the balance between electricity demand and supply within the system,
- consumers protection ensuring: fair and non-discriminatory treatment, high quality services and prevention of anti-competitive activities,
- resolution of disputes among system users in accordance with regulatory powers and applicable State laws,
- creation and maintenance of competitive markets when practicable and prevention of anti-competitive conduct,
- approving mechanisms for dealing with congestions of the electricity transmission system capacities,
- regulation of standards of services, conduct codes and accounting requirements of license’s owners,
- issuance of annual reports and other public information about the SERC.

11.3.3 Activities of ISO

The Owners of ISO of BiH shall use their rights exclusively through the Managing Board. Owners of ISO of BiH are:

- Federation of Bosnia and Herzegovina and
- Republic of Srpska

Activities of ISO of BiH include managing of transmission system for purpose of securing reliability, management with funds and facilities at the central control system, managing of the balanced market and ensuring of system services, ensuring of auxiliary services, development and application of reliability standards, development and management of rules that regulate usage of the transmission system, development and enforcing of market rules which are managed by provisions related for system and auxiliary services at the transmission system, as well as other activities included in Article 7 of the Law.

It is important to mention that beside all mentioned legal provisions there are problems that are not treated by Law, but they appeared in practice.

Therefore in the future shall be done necessary corrections of some parts of the Law as well as of some provisions so that they could be applicable in practice.

Bosnia and Herzegovina is signatory of the Energy Community Treaty which was signed in Athens on October 25, 2005; and represents the achievement of the largest internal market for electricity and gas in the world, with effective participation of 34 parties: 25 European Union Member States and Croatia, Bosnia and Herzegovina, Serbia, Montenegro, Albania, Macedonia, Romania, Bulgaria and UNMIK Kosovo. Negotiations with Turkey are ongoing. Moldova, Ukraine and Norway have applied to join the Community, but for the moment they have status of observers. Signing of the Treaty is result of the Athens process which started in 2002 when the European Commission brought forward proposals for creation of a regional electricity market in South East Europe.

11.4 Conclusion

Bosnia and Herzegovina has a complex structure consisting of two entities: Federation of Bosnia and Herzegovina and Republic of Srpska. The complexities reflect in the problematic issuing of the energy legislation. The Law on Waters passed in Year 2000 was presenting the first step in creating necessary strategy of energy development in BiH. In year 2002, Government of Federation of BiH had passed the Electricity Law which defines and regulates electric-power system and all the issues connected to power system operation, control, planning, and market activities.

Another important piece of legislation, The Law on Concessions, establishes subject, manner and conditions under the domestic and foreign legal persons could be awarded with concessions for providing the infrastructure and services and exploitation of natural resources. The aim of this Law is to create transparent, nondiscriminatory and clear legal framework for establishing conditions under the domestic and foreign legal persons could be awarded with concessions in BiH Federation as well as encouraging investment of foreign capital in subject fields. This Law also had foreseen establishing of Committee for concessions of Federation of Bosnia and Herzegovina as independent regulatory body.

In parallel with activities of BiH Federation Government almost all Cantons made similar Laws which define this field. Since the Federal Law on Concessions precise that energy generation capacities with installed power up to 5 MW are in rank of Canton’s decision-making, these Laws were with their legal acts additionally arranged this area. Government of BiH Federation brings in year 2004 “Decision on Methodology for establishing redemption price levels of electricity generated from renewable resources with the installed power up to 5 MW”.

11.5 References

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12 Authors

Andrej F. Gubina
University of Ljubljana, Faculty of Electrical Engineering
Trzaska cesta 25, SI-1000 Ljubljana, Slovenia
Phone: +386 41 601 759, FAX: +386 1 426 46 51, e-mail andrej.gubina@fe.uni-lj.si:

Pavlos S. Georgilakis, Antonis G. Tsikalakis, Nikos D. Hatziargyriou
Institute of Communication and Computer Systems, National Technical University of Athens
9 Iroon Polytechneiou street, 15780, Athens, Greece
Phone: +30 210 7723661, FAX: +30 210 7723968, e-mail: nh@mail.ntua.gr

[1]Suad Halilčević, [2]Muamer Halilović, [1]Vlado Madžarević
[1]University of Tuzla, Faculty of Electrical Engineering, [2]High School of Electrical Engineering
Franjevačka 2, 75000 Tuzla, Bosnia and Herzegovina
Phone: -- 387 35 259 600, FAX: -- 387 35 259 608 ; e-mail: suad.halilcevic@untz.ba

Vlastimir Glamočanin, A. Krkoleva, S. Veleva, S. Veličković
DAAD Competence Center
Faculty of Electrical Engineering, Ss. Cyril and Methodius University,
Karpos II, bb., 1000 Skopje, Macedonia
Phone: +389 2 3099177, e-mail: Vlasto@etf.ukim.edu.mk

Pablo Frías Marín
Tomás Gómez San Román
Juan Rivier Abbad
Institute of Technological Research (IIT), Universidad Pontificia Comillas, Spain
Alberto Aguilera, 23, 28015 Madrid, Spain
Phone: + 34 91 542 28 00, FAX: + 34 91 542 31 76
e-mail: pablo.frias@iit.upcomillas.es, tomas.gomez@upcomillas.es, juan.rivier@iit.upcomillas.es

Elena Boškov
DMS Power Engineering Ltd,
Puškinova 9a, 21000, Novi Sad, Serbia
Phone: +381 21 475 0376 FAX: +381 21 455 865, e-mail: elena.boskov@dmsgroup.co.yu

Borut Del Fabbro,
Istrabenz Energetski sistemi d.o.o.
Tumova 5, 5000 Nova Gorica, Slovenia

Phone: +386 1 33 11 974, FAX: +386 1 33 11 979, e-mail: borut.delfabbro@istrabenz.si

Vesna Bukarica, Maja Božičević Vrhovčak, Željko Tomšić
Faculty of Electrical Engineering and Computing, University of Zagreb
Unska 3, HR-10000 Zagreb, Croatia
Phone: +385 1 6129 986, FAX: +385 1 6129 890, e-mail: vesna.bukarica@fer.hr

Dr. C. Karytsas, K. Karras
Centre for Renewable Energy Sources (CRES)
19th km Marathonos av., 190 09 Pikermi, Greece
Phone: 2106603300 , FAX: 2106603301, e-mail:cres@cres.gr

Almir Ajanović
Intrade energija d.o.o.
Zmaja od Bosne 44, 71000 Sarajevo, Bosnia and Herzegovina
Phone: 00387 33 657 205, Fax.: 00387 33 657 206, Email : almir.ajanovic@intrade.co.ba