Success factors in economic incentives for RES penetration in EU

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Overview

- Introduction
- Policy Instruments for the Promotion of RES
  - Main Instruments in the Sectors
    - Electricity, Heat and Transport
  - Combining Several Support Schemes
  - Success Stories and Key Barriers
- Recent Policy Developments

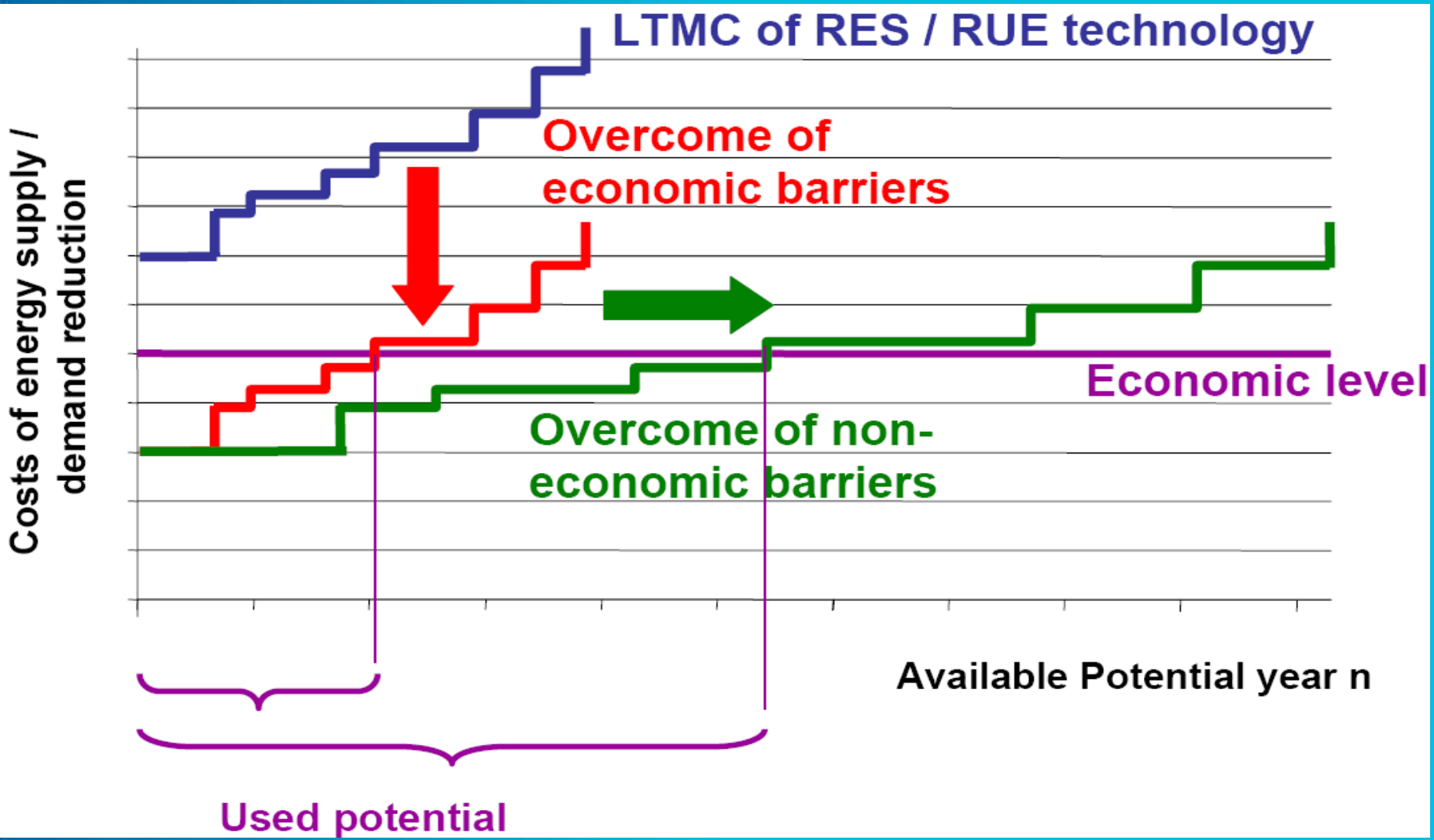
EU Policy Goals in RES

- Reach Environmental goals of EU – Kyoto Protocol
- Increase of security of supply
  - Decreasing the dependence on imported fuels and
  - Diversification of electricity generation sources
- Increase of social welfare
  - Creating new employment opportunities
  - Supporting social cohesion
- Contribution to the goal of the Lisbon process:
  - Sustainable economic growth
  - Improvement of the global competitiveness of the EU

Barriers to RES Growth

- Removal of economic barriers: introducing
  - Financial support mechanisms and
  - Promotion schemes,
- Mitigation of non-economic barriers:
  - Administrative barriers,
  - Market imperfections,
  - Technical obstacles and
  - Grid restrictions.

Barriers to RES Growth



Policy Papers for RES Deployment

- 1997: White Paper “Energy for the future”
  - Target of share of RE in primary energy consumption: 6% in 1997 to 12% in 2010.
- 2000: Green paper on security of energy supply in Europe
- 2001/77/EC: RES-E Directive
  - EU-25 target of 21% share of RES-E in demand by 2010
  - Indicative targets for all 25 member states.
- 2001: Directive on the energy performance of buildings
  - Renewable heating applications support
- 2003/30/EC: Directive on the promotion of biofuels
  - Share of biofuels in total transport: 0,6% (2003) $\rightarrow$ 2% (2005), 5.75% (2010)
- 2003/96/EC: Energy taxation Directive
  - Several mid-term indicative targets and other requirements.

Indicative Targets for RES-E Consumption in 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		

Interaction of Policies

- Policies must adapt to the changing market environment.
- Issues to impact main Directives (White Paper, RES-E Directive and Directive on Biofuels) :
  - EU Enlargement: new RES exploitation prospects.
  - Interaction with other policies, e.g. environmental policies,
  - Completion of internal EU energy market,
    - Free consumer choice -> enhanced competition
    - Possibility to distinguish green products from conventional power.
    - Enhanced by required disclosure of fuel mix and environmental impact
  - Interaction with the Common Agricultural Policy (CAP reform)
  - The establishment of a carbon market – EU ETS,
  - Affects the economic valuation of investment opportunities.

Overview

- Introduction
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  - Main Instruments in the Sectors
  - Success Stories and Key Barriers
- Recent Policy Developments

Main Instruments in the Sectors

- The main RES policies and measures in Europe are focusing on RES-E.
  - Choice of instruments has not been prescribed or harmonized in Europe
  - Each country adopted own unique set of promotion instruments.
- National RES goals:
  - Environment,
  - Security of supply,
  - Employment support for national (emerging) renewable industries.

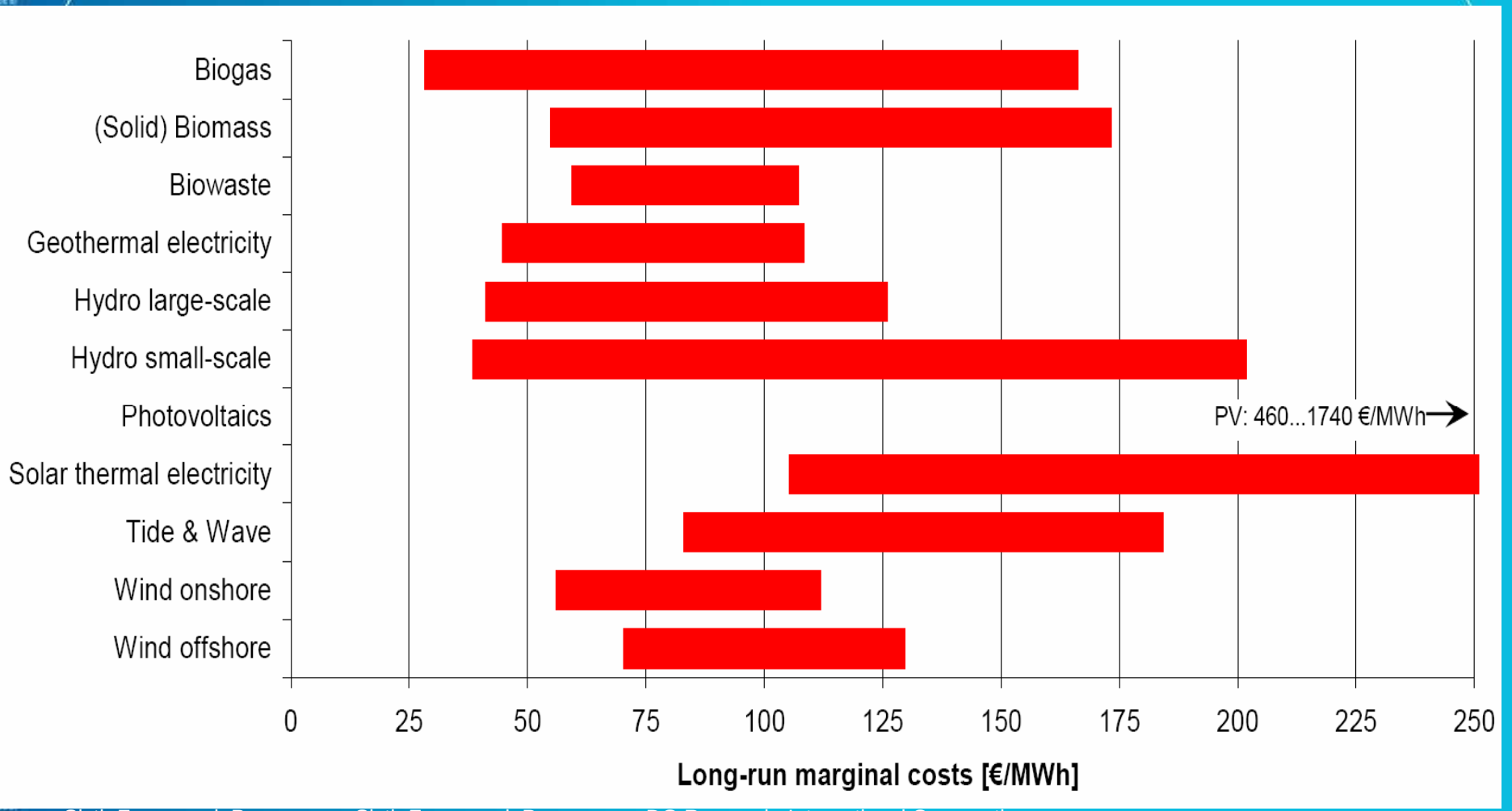
RES-E: Supporting Instruments

- Main instruments to support generation of RES-Electricity are:
  - Fixed feed-in tariffs,
  - Quota obligations,
  - Green certificate system,
  - Fiscal incentives,
  - Tender scheme.

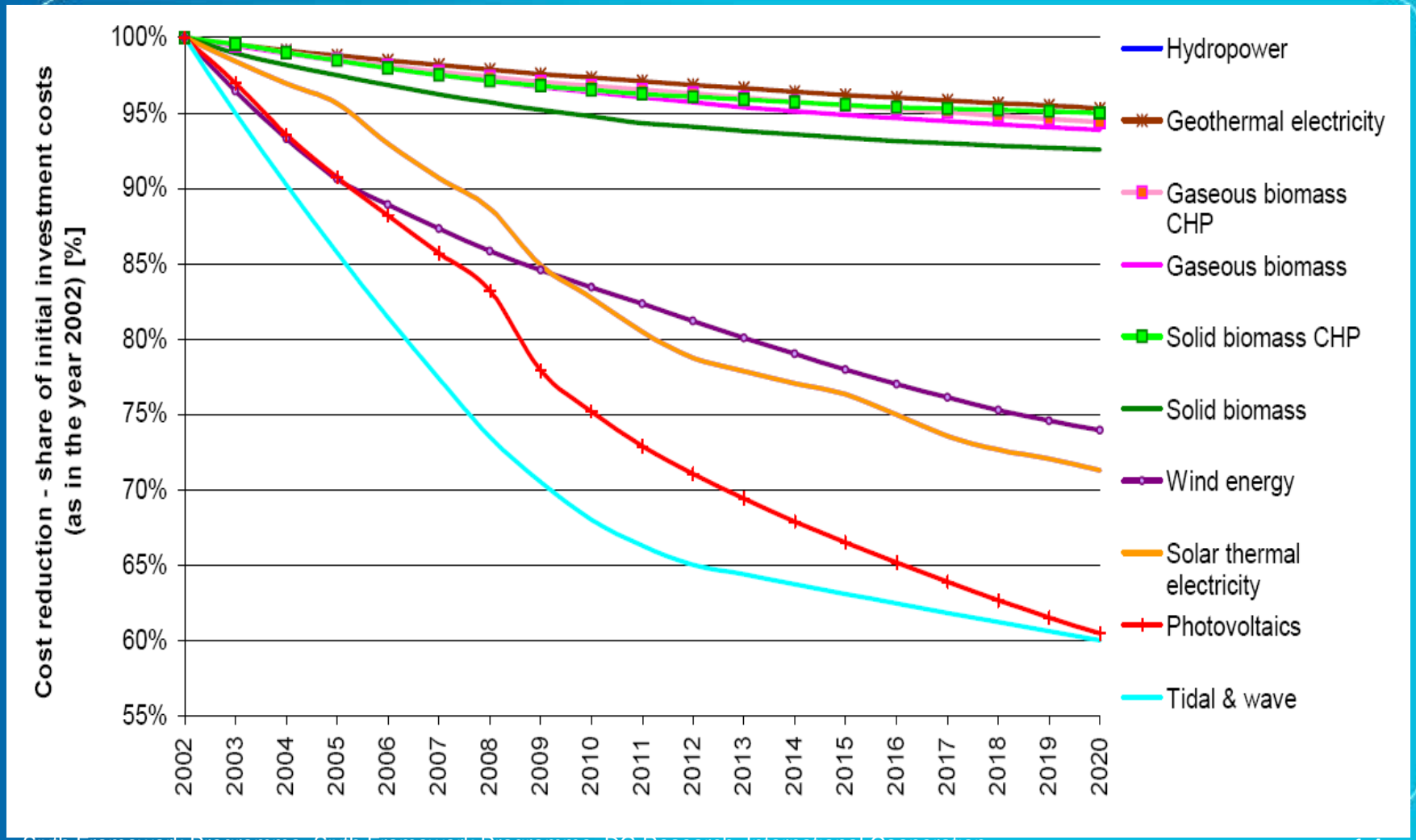
Evaluation Criteria of Policy Instruments

- How do you choose the right instrument?
  - Effectiveness: quantitative goals, capacity or production
  - Market efficiency: price competition, min. of costs
  - Certainty for RES-E industry: system stable in the short/long term?
  - Cost effectiveness: costs per kWh of RES-E
  - Stakeholder support for the system
  - Equity: long-term sustainability os the system
    - fair distribution of costs and benefits of RES-E implementation over various stakeholders.

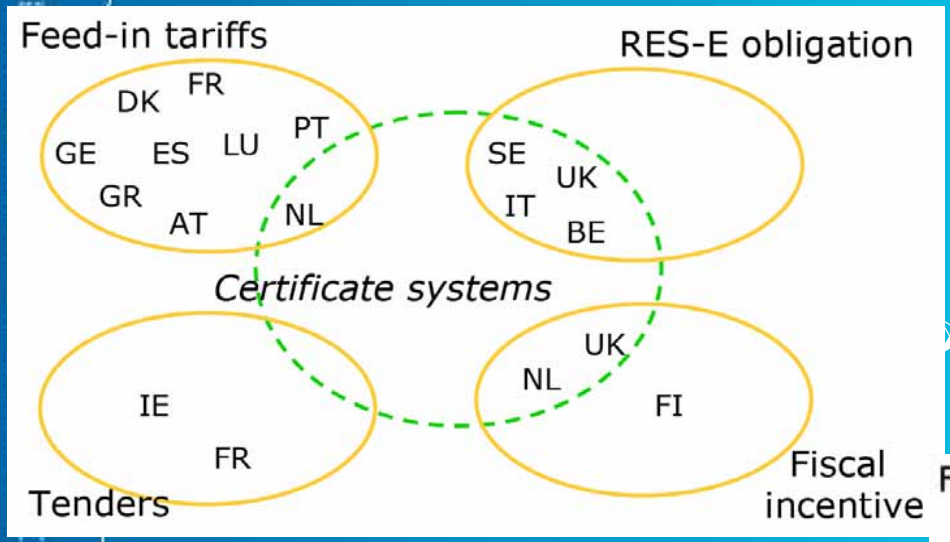
Long-term marginal gen. costs (2002) of RES-E technologies



Development of Investment Costs

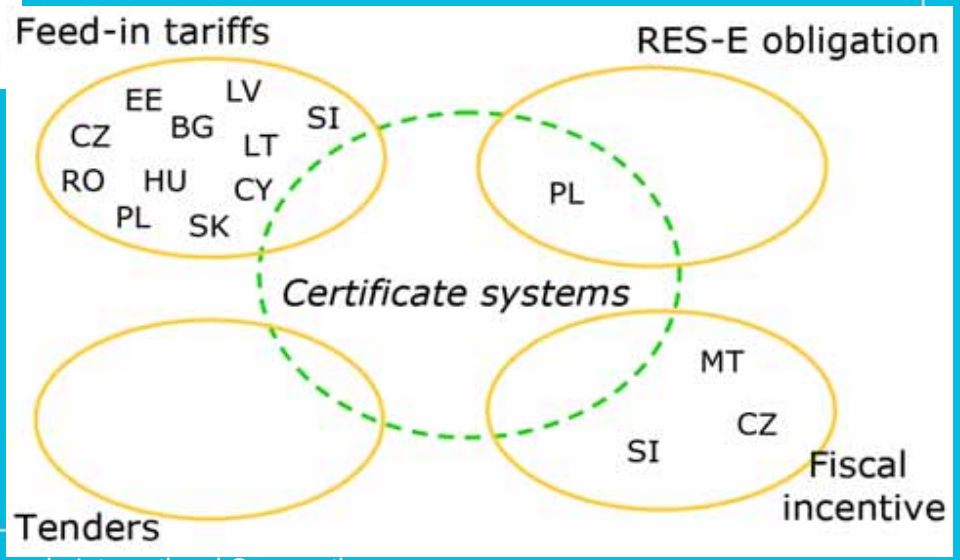


RES-E: Support Systems



➢ EU-15

➢ EU-10

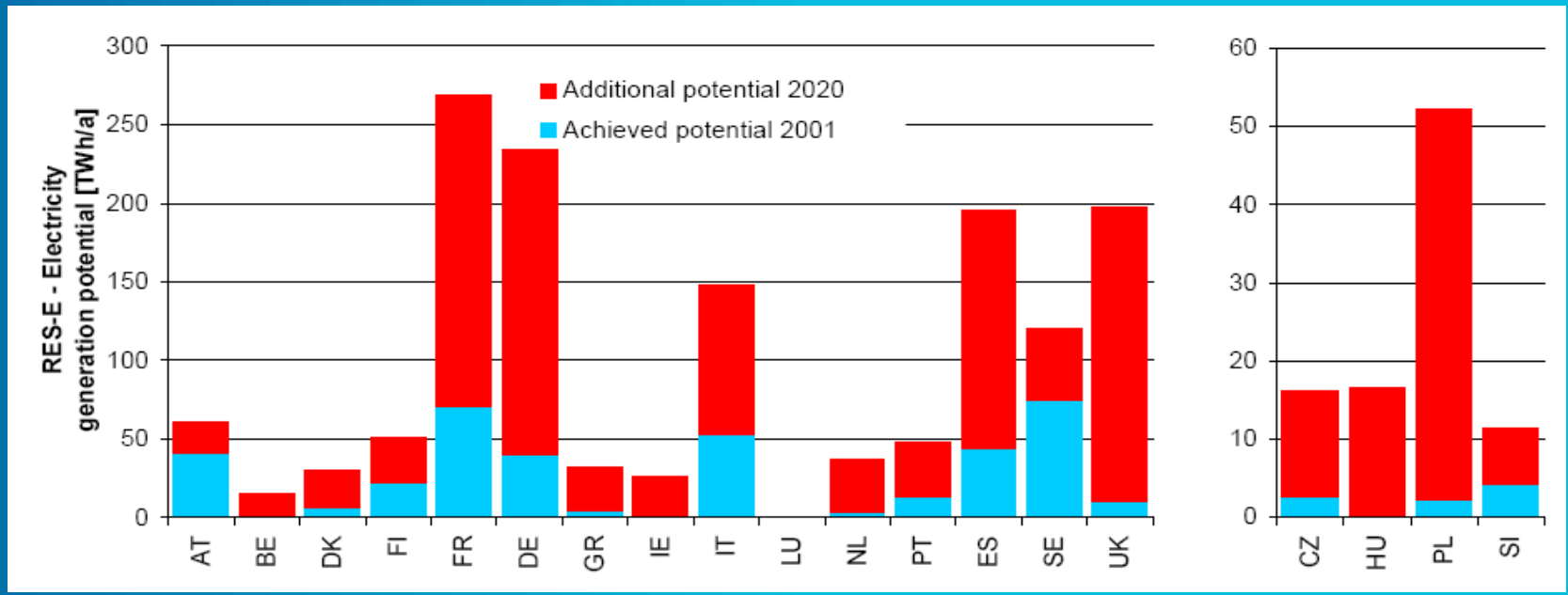


Status of the RES-E market

- RES-E continued to grow significantly in recent years.
  - Most countries are still behind targets.
- Wind: high growth rates are to continue offshore.
- Biomass: starts growing, but slowly in most countries.
  - large unexploited potentials in new member states
- PV: growing, constant high rates
  - DE: new FIT → accelerated growth!
- Active solar thermal el.: to grow by 15-20% annually
- Wave, Tidal: Significant growth in the medium term
- Geothermal: small growth.
- Hydro: small growth.
  - some remaining potential for refurbishments.
  - Large hydro: Most env. sustainable potential exploited

2001 vs. Potential in 2020

- Where can the RES-E generation potential evolve?



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Overview

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Success stories and key barriers

- Specific instrument design or implementation
  - Not instrument type
- Alleviation of market barriers:
  - Political uncertainty:
    - Uncertain or unclear long-term institutional setting
  - Complex administrative systems
  - Grid connection rules and planning issues
  - Transparency of grid connection costs
  - Tender schemes: stop-start nature; uncertainty of winning a bid
- Social acceptance: biomass, large-scale wind.

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RES-E Support 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.

Conclusion: Success factors

- DE: Combination of FIT + investment support
- UK: redistribution of ROQ buyout revenues,
- BE: high penalties for non-performance
- AT: mandatory disclosure of fuel mix
- Key factor:
  - clear and long-term institutional setting → good investor security.

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

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Contents

- Introduction
- Wind Penetration
- Method for calculation of wind penetration limit
  - Objectives
  - Principles
  - Method
- Case study
- Conclusions

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Introduction

- The cost of electric energy in islands is generally higher than in the mainland
- In many islands there are favorable conditions for wind power production
- The wind power penetration in islands is limited due to 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 needed

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Wind penetration (1)

- *Instantaneous penetration* (or *power penetration*) is mainly a technical measure

$$\text{Instantaneous (power) penetration} = \frac{P_{wind}}{P_{load}}$$

- *Average penetration* (or *energy penetration*) is mainly an economic measure

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

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Wind penetration (2)

- On average wind energy penetration represents only 1-2% of the total power generation in the Central European System
- The wind penetration levels in the USA are even lower

	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

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Methodology for the calculation of wind penetration limits (1)

Objectives

1. Estimation of wind energy that can be absorbed annually by an autonomous power system that is composed of diesel generators and wind parks
2. 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

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Methodology for the calculation of wind penetration limits (2)

Principles

1. Securing the right operation of the system and the supply of satisfactory power quality, aiming at maximizing the wind energy penetration in the energy balance of the island
2. The technical part of the problem is studied
3. The characteristics of the conventional power station and the annual load curve are taken into account
4. It is considered that the total produced wind power can be controlled
5. The wind conditions of the island are taken into account through the Weibull curve

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Methodology for the calculation of wind penetration limits (3)

Principles (2)

6. The conventional units of the stations must not be loaded under their technical minimum load limits
7. 100% running reserve of conventional power is considered, which completely secures the load supply even in case that the total wind power is lost
8. 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

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Methodology for the calculation of wind penetration limits (4)

Principles (3)

9. A limit is set for the *instantaneous wind power penetration*. This limit, also called *dynamic operational limit* (C_D), depends on:
   i. The conventional station characteristics, e.g. response rate of the speed governor of each unit
   ii. The wind power parameters, e.g. total wind power installed, the characteristics of the wind generators (e.g. tenacity in under/over-frequency, and under/over-voltage control, power smoothing capability)
   iii. The dispersion of the wind parks on the island
   iv. Many other factors related with the dispatching philosophy, the operators capabilities, the existence of control systems (e.g. CARE and MORE CARE) in the dispatching center

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Methodology for the calculation of wind penetration limits (5)

Method

- The total wind energy that can be absorbed by the system annually is:

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

where

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

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

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

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Methodology for the calculation of wind penetration limits (6)

Method (2)

- A discrete frequency distribution of the *capability of wind power absorption* is calculated
- A discrete frequency distribution of the *wind power that can be generated* is calculated
- A discrete frequency distribution of the *absorbed wind power* is calculated

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Methodology for the calculation of wind penetration limits (7)

Method (3)

- The economic viability of the investment is based on the value of the capacity factor (CF):

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

- According to the estimations of the Greek Regulatory Authority for Energy (RAE), a wind park investment in a Greek island is considered as economic viable if the wind park can achieve a CF over 27,5%

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Case study – Crete power system at 2003

- Total nominal power of conventional units: 628 MW
- Wind parks : 70 MW
- Maximum demand : 514 MW
- Total produced energy : 2.467 GWh
- Wind park production : 207 GWh (8,4%)

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Case study – Wind penetration limits at 2003

	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

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Case study – Wind penetration limits at 2003 (2)

1. Existing situation: 70 MW wind parks installed
   i. CF varies for 32,3% (for C_D=20%) to 35,9% (for C_D=40%)
   ii. From the measured data, the real CF was 33,76%, which corresponds to a C_D=23%. This is in accordance to the restrictions applied by the Public Power Corporation (PPC), since a maximum wind penetration of 25% is permitted and exceptionally, during low load conditions, it can be reduced up to 15%
   iii. The spilled (not produced) wind energy is 228-207=21 GWh, i.e. less than 10% of the capable to be produced wind energy
   iv. The method gives approximately credible results
2. The maximum CF is obtained for C_D=100% (no restrictions in the absorption of wind power)

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Case study – Wind penetration limits at 2003 (3)

3. The economic viable wind power (CF>=27,5%) is:
   i. 95 MW (~18% of the peak), for C_D=20%
   ii. 130 MW (~25% of the peak), for C_D=27,5%
   iii. 160 MW (~31% of the peak), for C_D=35%

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Case study – Crete power system at 2010

- Total nominal power of conventional units: 909 MW
- Maximum demand : 817 MW
- Wind parks
  - 130 MW (15,9% of peak)
  - 160 MW (19,6% of peak)
  - 200 MW (24,5% of peak)
  - 260 MW (31,8% of peak)
- Total produced energy : 3.826 GWh

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Case study – Wind penetration limits at 2010

	Installed wind power							
	130 MW		160 MW		200 MW		260 MW	
C_D	Production (GWh)	CF (%)	Production (GWh)	CF (%)	Production (GWh)	CF (%)	Production (GWh)	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

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Case study – Wind penetration limits at 2010 (2)

1. The economic viable production at 2010 will be 160 MW, if PPC will follow the same operating policy as at 2003 (C_D=23%)
2. The economic viable production at 2010 will be 260 MW, if a C_D=35% will be applied

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Conclusions

1. The method, used by RAE for the assessment of economic 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 dynamic operational limit (C_D)
3. A high value of C_D results in a high wind penetration
4. 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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Conclusions (2)

5. In general, the wind power penetration can be considerably increased by two main ways:
   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)

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Regional Aspects of RES Promotion Mechanisms for the Greek Islands

Antonis Tsikalakis Pavlos Georgilakis Nikos Hatziargyriou

ICCS/NTUA

Contents

- Harmonisation with EU
- Present status of RES promotion on Greek islands
- Policies and specific incentives for RES in islands
- Analysis of economic incentives
- Recommendations for future activities

Harmonization with EU

- According to EU Directive 96/92, 20.1% of energy in Greece by 2010 must be produced from RES
- Greek laws 2244/94 and 2773/99 for the promotion of RES
- Center for Renewable Energy Sources (CRES) was founded before EU Directive in September 1987
- Creation of Regional Centres for energy in various regions of Greece

Regional Energy Centers

- Regional Energy Centers make significant efforts in informing the citizens of specific regions about RES and also for promoting RES. There are offices at various Greek Islands.
- Energy Centers in Greek Islands:
  - Regional Energy Centre of Crete
  - Regional Energy Centre of North Aegean Sea
  - Regional Energy Centre of Cyclades Islands
  - Regional Energy Centre of Dodecanesse Islands

Other Authorities that Promote RES

- Additionally to Regional Energy Centers, other local authorities that promote RES are:
  - Organization for the Development of the Sitia Region, Crete Island
    - 0.5 MW installed wind capacity since 1993
    - License for 1.2 MW wind power
  - Municipality of Mitilini, Lesvos Island
    - 800 kW installed wind power, 8 kW PV capacity
  - Municipal Waste Water Treatment Plant with biogas in Heraklion and Chania, Crete Island

Non-Governmental Bodies that Promote RES

- Greenpeace, WWF
- Hellenic Network of Ecological Organizations
  - consisting of 4 local ecological organizations in Crete and 7 organizations on the rest Aegean Islands
- Greek Association of RES Electricity Producers
- The Hellenic Association of Photovoltaics

Policies and specific incentives for RES

- Feed-in tariff model (Greek laws 2244/94, 2773/99)
- RES and CHP installations do not participate in the electricity market, they are priority dispatched and their energy is sold at fixed tariffs
  - Public Public Corporation is obliged to buy the total power produced by RES at specific price
- RES electricity is bought at prices linked to the consumer tariffs. Energy is paid 90% of the respective retail price for island systems, i.e. 0.08458 €/kWh.

Financing incentives for RES

- Measure 2.1 of the 3rd Community Operational Framework Programme "Competitiveness" of the Ministry of Development of Greece
  - Wind Energy : 30% of the budget
  - PV : 50% of the budget
  - Geothermal : 50% of the budget
  - Biomass energy : 50% of the budget
- Companies operating on Greek islands with population under 3100 inhabitants have tax reduction
- New call for installing PVs on public buildings of islands (with population under 3100 inhabitants) with almost 100% subsidy

Analysis of economic incentives (1)

- Comparison of Actual Operation Cost versus Cost of Purely Thermal Operation for the year 2000 – Crete island

	Heavy Oil (tn)	*Diesel Oil (klt)*	*Cost (k€)*
Actual	***263,166.5***	***283,303***	***178,505.6***
Purely thermal	***269,014.3***	***324,499***	***181,099.3***
Difference	***5,847.76***	***41,196***	***2,593.7***
Percentage savings	***2.22%***	***14.54%***	***1.45%***

Analysis of economic incentives (2)

- Annual (2000) Reduction of Pollutants due to Wind Power Production – Crete island

	Tn	%
Pollutant Particles	60.1	7.27
SO_2	368.5	2.41
NO_X	260.7	6.03
CO_2	119.4	7.78

Recommendations for future activities

- Need for speeding up licence procedures
- Simplification of the procedure for granting authorization especially for small investors
- The licence procedure should be differentiated according to the RES type of installation
- Effective co-operation of the local authorities with the investors
- Creation of new regional energy centres and increasing the financing of the existing regional energy centers

SUCCESS FACTORS IN IMPLEMENTATION OF SOLAR ENERGY IN PUBLIC INSTITUTIONS: CASE IN BOSNIA AND HERZEGOVINA

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Presentation overview I

- Introduction
- Technology
- Applications
- The European market
- A new concept of public structure energy supply
- The trend of energy efficiency and renewable energy
- Saving methods
- *Design concept for energy efficient buildings*

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➢ Presentation overview – II

- Power consumption in public places
- Application of solar system for hot water supply
- *Technical solutions*
- *Range of cost for SHC*
- *Estimated energy saving and used size of SHC*
- The calculation of supply of hot water using a solar system
- Conclusion

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INTRODUCTION

- We are a power hungry society,
- We use largely fossil fuels to move cars, trains, airplains, heat bulidings, and to provide electricity for lights, motors and electronic equipment of all kinds,
- We pay the price for burning fuel both directly, in the price-per barrel or tons of coal, and indirectly, in terms of smog and increased greenhouse gasses,
- A number of alternative technologies can also produce electricity, but they haven't been used widely in the days of plentiful cheap oil.

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INTRODUCTION

- The latest political documents issued by the European Solar Thermal Industry Federation emphasize the necessity of struggleing 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.

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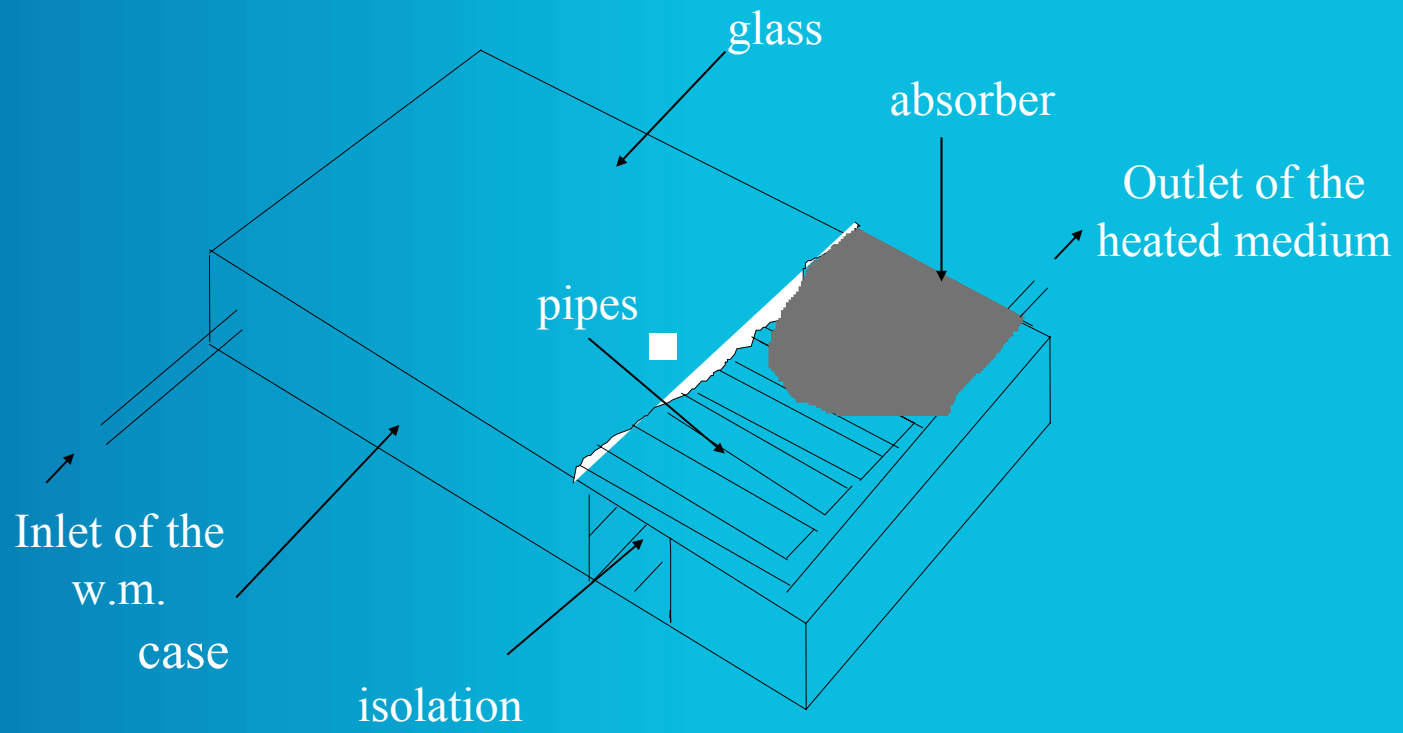
Technology



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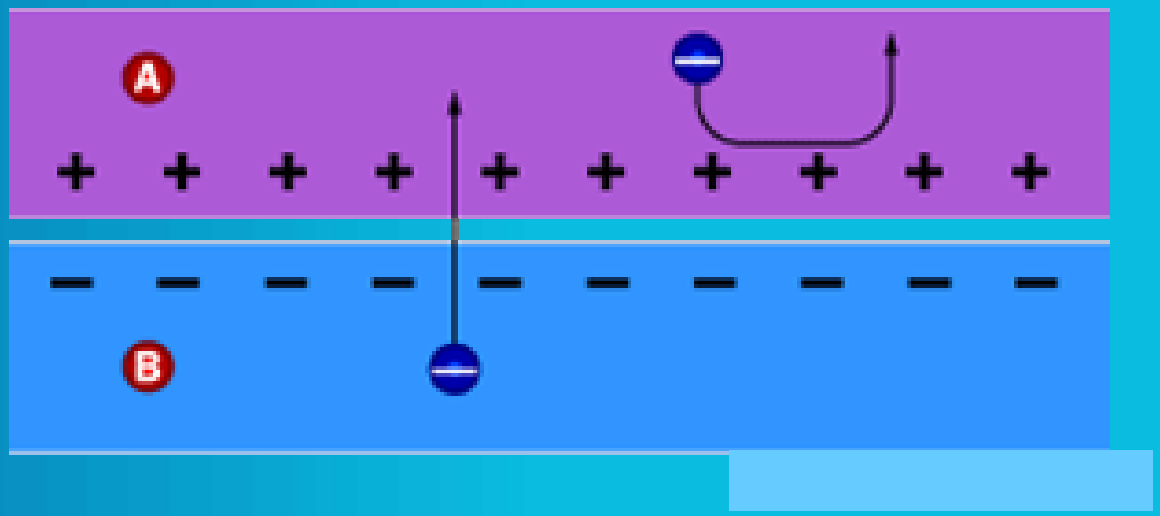
Photovoltaic cell



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Applications

- ***Solar hot water system***

➢ 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.

- ***Combined water and space heating system***
- ***Air conditioning and cooling***
- ***Photovoltaic conversion***

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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.

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A new concept of public structure energy supply

- ***The need for energy efficiency, clean and renewable energy***
- ***The trend of energy efficiency and renewable energy***

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.

- ***Saving methods***

✓*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*

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A new concept of public structure energy supply

- ***Design concept for energy efficient buildings***

- Planning and siting 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.

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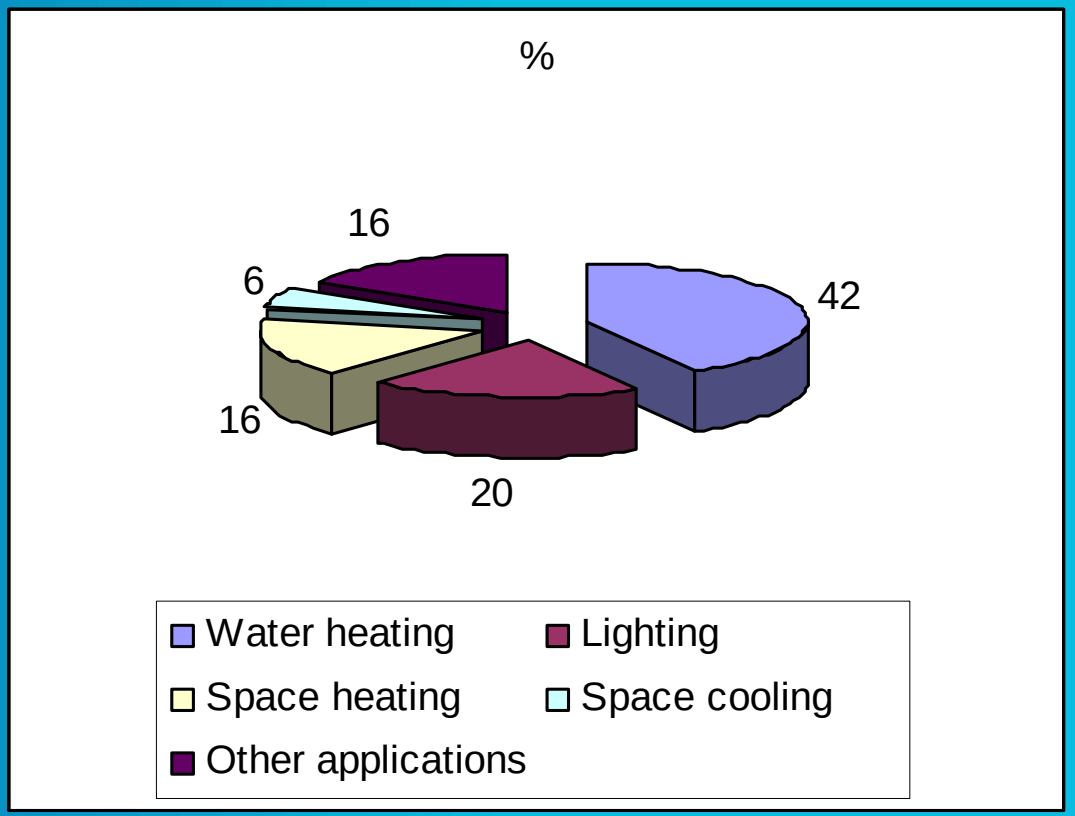
Power consumption in public places (Hotel)



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Application of solar system for hot water supply

- 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

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Application of solar system for hot water supply

Benefits for society:

- Direct contribution to reduction of CO2 and other emissions
  - It provides energy with no emissions
  - It offers CO2 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

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Application of solar system for hot water supply

- 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.

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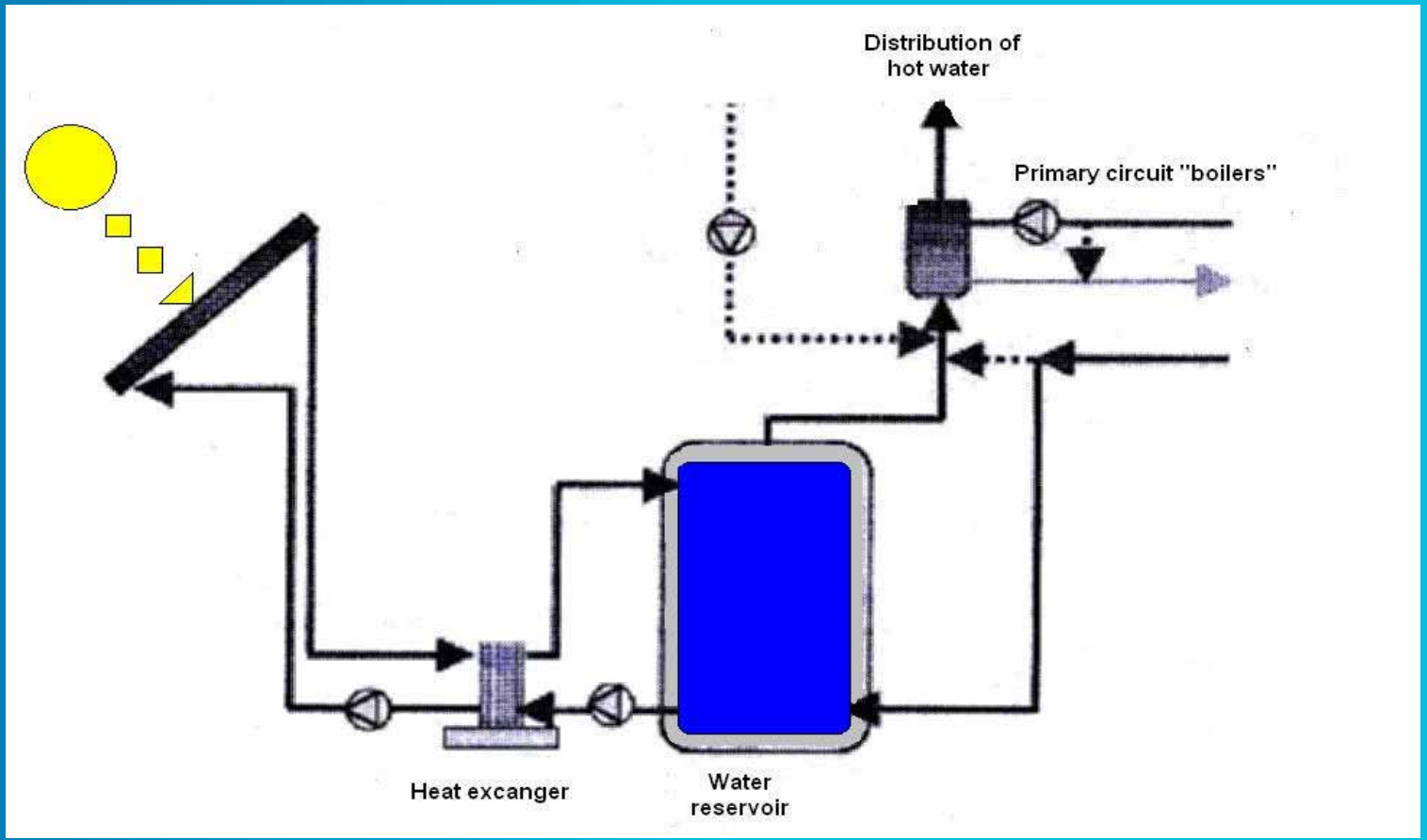
Technical solutions

Standard design of SHC system



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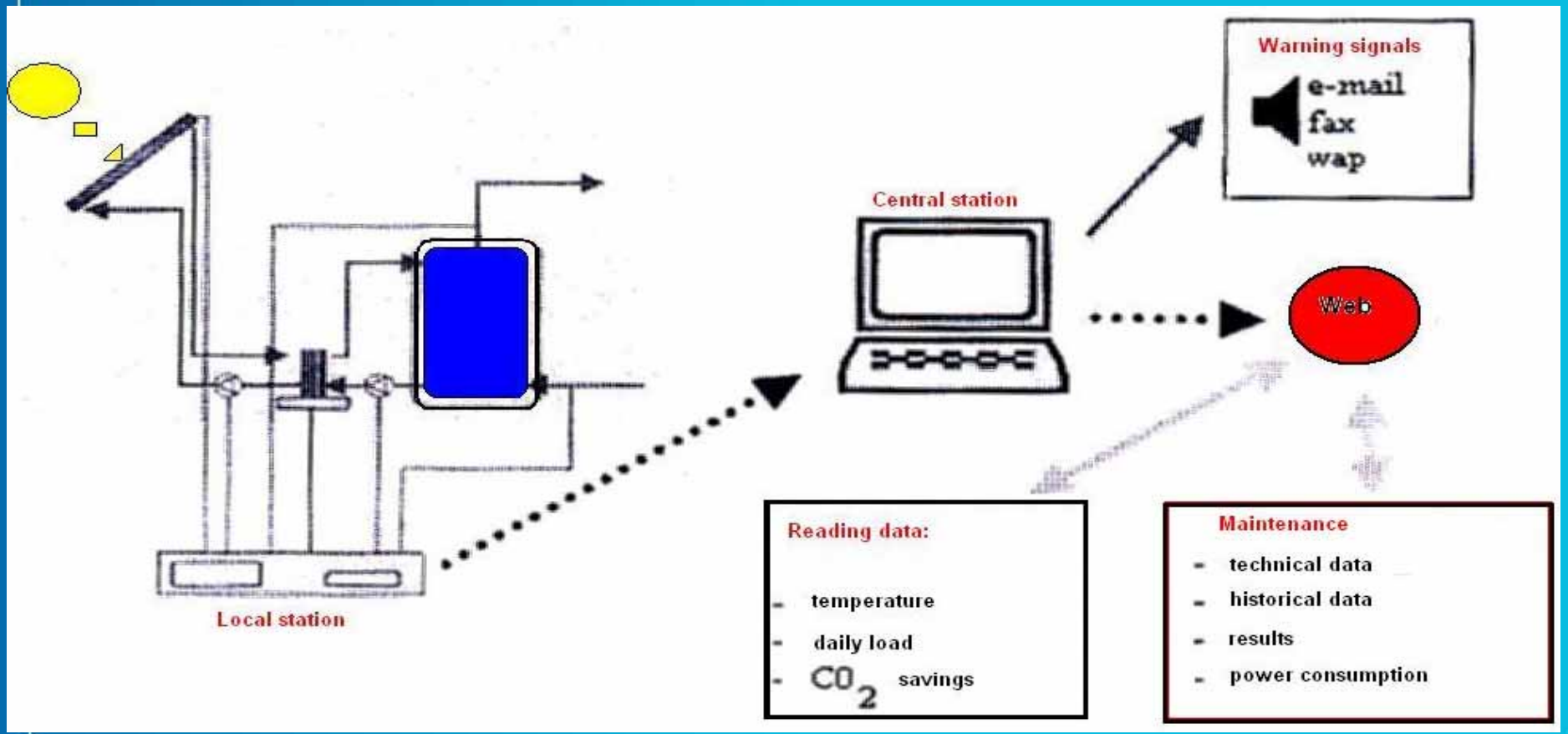
Technical solution

Monitoried and controlled solar heat system



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Costs to instal the SHC

	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 needs	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 kWh/year
Average savings with solar energy	€ 510/year	€ 4900/year
Production average	756 kWh/m^2.year	814 kWh/m^2.year

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Estimated energy saving and used size of SHC

Required area of collectors

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

where:

- Qp – required thermal energy (Wh),
- Qs – 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.

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Estimated energy saving and used size of SHC

Annual energy saving (kWh/year)

$$E_S = (A_C \cdot Q_s \cdot \eta_{solar} \cdot 365) \cdot \eta_{boiler}$$

Where:

η_{boiler} – efficiency of boiler (reservoir)

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Estimated energy saving and used size of SHC

- **The cost of a solar hot water system**

$$C = c_{solar} \cdot A_C$$

Where:

C – the cost of installation of the solar heat system (euro),

C_{solar} – the cost of installation per m^2 (euro/m^2)

300 euro/m^2 for large systems

600 euro/m^2 for medium systems

1000 euro/m^2 for small systems

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Estimated energy saving and used size of SHC

Annual savings

$$S = E_s \cdot C_e$$

Where:

S – annual savings (eura/year),

Ce – the cost of energy from secondary energy supply system

Electric energy - 0,20 eura/kWh

Natural gas - 0,08 eura/kWh

Propane - 0,16 eura/kWh

Oil - 0,10 eura/kWh

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Calculation of a solar system for supplying by hot water the Hotel Tuzla

- 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 inputa 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 ηs = 0.8
- The time of system use, from the beginning of April to the end of September

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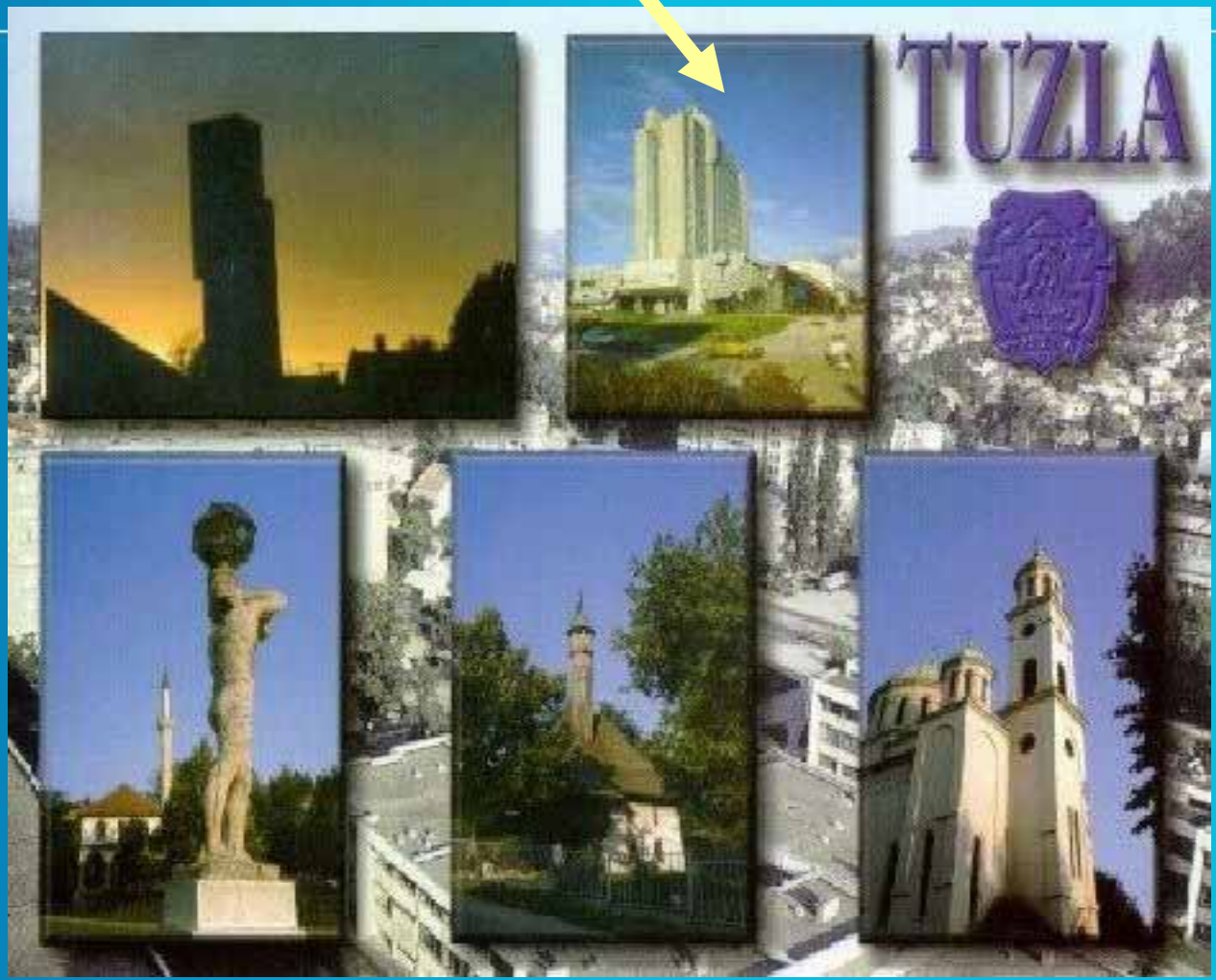

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Calculation

Required thermal energy for this system:

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

$$Q_p = 390775(Wh)$$

Specific heat of water: 1,167 Wh/kg^{0}C

The minimum size of the hot water reservoir is:

$$V_{HT\,\min} = \frac{V_p \cdot n \cdot (t_{cons.water} - t_{cold})}{t_{res.} - t_{cold}} = \frac{70 \cdot 110 \cdot (50-15)}{60-15}$$

$$V_{HT\,\min} = 5988\ (l)$$

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Calculation

The required area of the collectors:

$$A = \frac{Q_p}{Q_s} \cdot \frac{3650}{3370} \cdot k = \frac{390775}{2300} \cdot \frac{3650}{3370} \cdot 1.018$$

$$A = 186.35(m^2)$$

The cost of the system:

$$C = c_{solar} A = 300\ €/m2 \cdot 187\ m2 = 56100\ (€)$$

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Calculation

Annual energy savings:

$$E_s = (A \cdot Q_{se} \cdot \eta_{solar} \cdot 365) \cdot \eta_{reservoir}$$

$$E_s = (187 \cdot 3.37 \cdot 0.8 \cdot 365) \cdot 0.87 = 160.087(kWh)$$

Annual costs saving:

$$S = E_s \cdot C_e = 167.087 \cdot 0.15 = 24013 \ \textbf{€/year}$$

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Calculation

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

$$PBP = C/S = 56100/24013 = 2.3 \text{ years}$$

- 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.

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Conclusion

- In the case of Hotel Tuzla the investment in solar energy would solve the problem of hot water supplies.
- An 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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Economic Incentives for Energy Efficiency and Renewables in R. of Macedonia

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General Provisions of *the Draft Version* of Energy Law

- According to the scope of the draft version, the Energy Law shall govern:
  - …market for thermal or geothermal energy, requirements for realization of energy efficiency and promotion of the utilization of renewable resources.
- One of six objectives of the Energy Law stands for:
  - energy efficiency enhancement and encouragement of the utilization of renewable resources
- Detailed list of energy activities (23 activities) is defined by the Energy Law and some of them are related to EE and RES:
  - generation of geothermal energy;
  - distribution of thermal or geothermal energy;
  - supply of thermal or geothermal energy;
  - generation of energy from renewable energy resources.
- The activities of public interest shall be considered the following:
  - generation of thermal or geothermal energy;
  - distribution of thermal or geothermal energy; and
  - supply of thermal or geothermal energy.

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Energy Strategy

- The policy for renewable energy resources exploitation is established within the Strategy for renewable energy resources exploitation The national policy for the energy sector shall be established based on 7 principles among which:
  - Promotion of energy efficiency and sustainable development of renewable energy sources
  - The National Energy Policy shall be laid down in the Energy Development Strategy and the Implementation Programme of the strategy. The Energy Agency shall provide support to the Government in the implementation of the energy policy.
- The Development Energy Strategy (adopted by Government of the Republic of Macedonia upon proposal of the Ministry) shall address:
  - …
  - incentives for investment in energy facilities that shall utilize renewable energy sources;
  - incentives regarding the enhancement of energy efficiency;
- The Energy Development Strategy shall be adopted for a period of at least ten years.

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The Programme for Realization of the Energy Development Strategy

- The Programme for realization of the energy development strategy, adopted by the Government of the Republic of Macedonia (upon proposal of the Ministry) shall address:
  - …energy efficiency, possible utilization of renewable energy resources...
- The Programme shall be adopted for a period of five years.
- The municipalities and the City of Skopje shall be obligated to ensure the execution of the energy activities of public interest and of local importance. The Local Energy Development Programme, shall be adopted by the Council of the municipality, that is the City of Skopje.
- The Programme shall, in particular, determine:
  - …
  - the measures and activities for enhancing the energy efficiency and generation of energy from renewable sources.
- For safe, reliable and good quality of natural gas, thermal and geothermal energy for citizens and other consumer, the municipalities and the City of Skopje, are competent for this activities:
  - giving the right for use of certain geographical location for the construction of natural gas distribution facilities, distribution of thermal energy and geothermal energy distribution facilities.

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The Regulation of the Energy Activities

- The regulation shall be ensured in accordance with this law, through adoption of:
  - …
  - 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;
  - Construction of new and reconstruction of existing buildings from the aspect of energy efficiency;
  - Certificate for energy characteristics of a building;
  - Technical specifications and standards for efficient utilization of fossil fuels;
  - Energy efficiency labeling of home appliances;
  - Utilization of renewable energy resources;
  - Green certificates;
  - …

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Construction of New Energy Facilities

- By exception, if, based on the Strategy for energy development in the Republic of Macedonia, the prognosis for the demand of electricity and the possibilities for satisfying those needs, it is estimated that the long - term security of supply has been disturbed, the Ministry may launch a public announcement concerning the construction of new electricity generation facilities.
- Before the adoption of the decision for starting the public announcement procedure for the construction of new facilities, the Ministry shall determine whether the security of electricity supply may be assured by energy efficiency measures.
- 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, due to the necessity 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.

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Thermal Energy Market

- Production of thermal or geothermal energy may be performed by a domestic or foreign entity licensed for production of thermal energy by the Regulatory commission in accordance with the provisions of the present law.
- The regulated producer shall provide public services and shall conclude, upon the approval of the Regulatory commission, a contract with the supplier of thermal or geothermal energy for the sale of the entire available thermal or geothermal energy intended for the needs of consumers, with regulated prices and tariffs approved and published by the Regulatory commission.
- The distributor of thermal or geothermal energy may construct, own, operate, upgrade and expand a distribution network for thermal or geothermal energy.
- The operator of the thermal or geothermal energy distribution system shall, upon a previous approval by the Regulatory commission, submit and publish in the "Official Gazette of the Republic of Macedonia" a distribution grid code.

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Energy agency

- The Energy agency of the Republic of Macedonia gives its support to the Ministry in the elaboration and implementation of the Strategy for improvement of energy efficiency and the Strategy for renewable energy resources exploitation.
- The Energy agency of the Republic of Macedonia gives its support to the Ministry in the elaboration of the Programme for the implementation of the Strategy for renewable energy resources exploitation.

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The Strategy for Improvement of Energy Efficiency

- The Strategy for improvement of energy efficiency defines the aims for increase of energy efficiency and the modalities according to which those aims should be accomplished, namely:
  - 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; and reducing the harmful effect on the environment provoked by the production, transfer, distribution and exploitation of energy.
- The Strategy for improvement of energy efficiency shall be adopted for a period of at least 10 years.

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Programme for the implementation of the Strategy for improvement of energy efficiency

- The Programme defines the measures for improvement of energy efficiency and contains:
  - 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.
- Programme for the implementation of the Strategy for improvement of energy efficiency shall be adopted for a period of at least 5 years.
- The local energy efficiency policy is established within the local Energy efficiency programme which must be in accordance with the state Strategy for energy efficiency.
- Upon the proposal of the Mayor, the Programme shall be adopted by the Municipal council or the Council of the City of Skopje.

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The Strategy for the exploitation of renewable energy resources

- The Strategy for the exploitation of renewable energy resources defines the aims of renewable energy resources exploitation and the modalities of achieving these aims, namely:
  - 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.
- The Strategy for the exploitation of renewable energy resources shall be adopted for a period of at least 10 years

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Programme for the implementation of the Strategy for renewable energy resources exploitation

- Upon the proposal of the Ministry, the Government of the Republic of Macedonia adopts a Programme for the implementation of the Strategy for renewable energy resources exploitation.
- Programme for the implementation of the Strategy for renewable energy resources exploitation shall be adopted for a period of at least 5 years.

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On local level

- The local policy for renewable energy resources exploitation comprises geothermal energy, biomass and solar energy. The local policy is established within the local programme for renewable energy resources which has to be in accordance with the Strategy for renewable energy resources exploitation.
- Upon the proposal of the Mayor, the Programme shall be adopted by the Municipal council or the Council of the City of Skopje.

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The Rulebook on the exploitation of renewable energy resources

- The Rulebook on the exploitation of renewable energy resources defined by the minister in charge of energy issues closely defines the measures for exploitation of renewable resources, namely:
  - the target percentage and year of including renewable energy resources in the energy balance;
  - the percent of participation and dynamic plan for realisation 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.

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Green certificates

- EARM issues and maintains a registry of issued green certificates.
- All electricity suppliers shall 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 determined in the Rulebook. Only the green certificates entered in the Registry may be used for fulfillment of this obligation.
- The supplier having a lack of green certificates shall make a payment per certificate determined by the Rulebook, to a special account published by the EARM for the purpose of financing new renewable energy resources.

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Tariffs for purchase of electricity from renewable energy sources

- Until the establishment of functional mechanism for trade in green certificates, the Regulatory Commission shall establish relevant tariffs for purchase of electricity from the distributional generation of electricity from renewable energy sources.
- The green certificates produced by the distributed producers of electricity that use special tariffs shall be considered as property of the Government of the Republic of Macedonia.
- A distributed producer of electricity from renewable energy sources must not use special tariffs and green certificates simultaneously.
- In order to support the exploitation of thermal renewable energy resources the Regulatory commission establishes feed–in tariffs for purchase of thermal energy produced by renewable energy resources

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Financial assistance for realization of the Strategy for renewable energy resources

- A mechanism for financial assistance is established for the realization of the Strategy for renewable energy resources exploitation.
- The means for financial assistance shall be provided by:
  - 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.

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DG network integration. Regulatory review and international comparison of EU-15 MS

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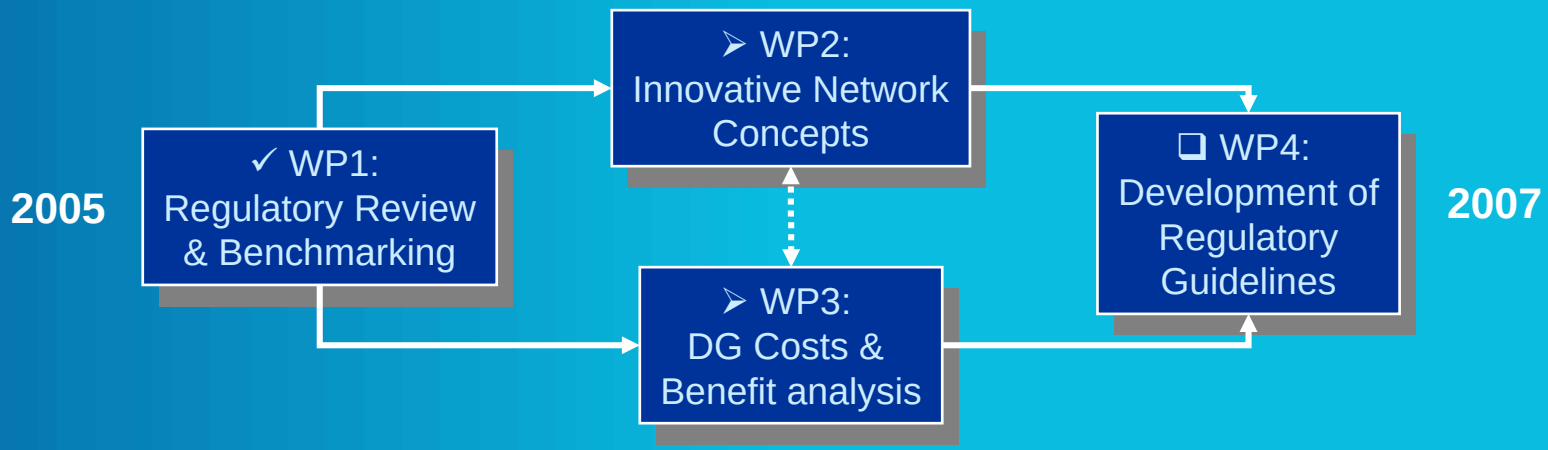
DG-Grid Project

- Enhancement of sustainable electricity supply through improvements of the regulatory framework of distribution networks for DG
- Main objectives:

  review + analysis + assess +develop guidelines
- Structure



- Website www.dg-grid.org

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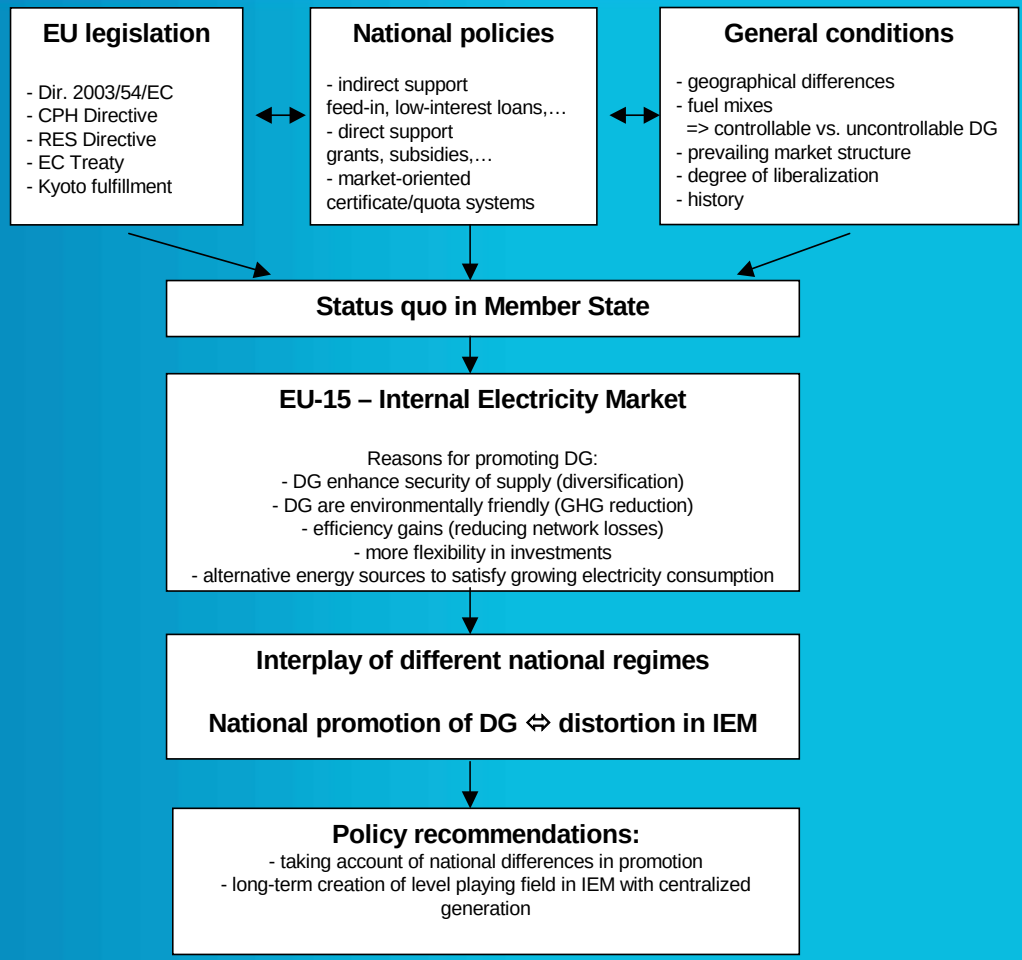
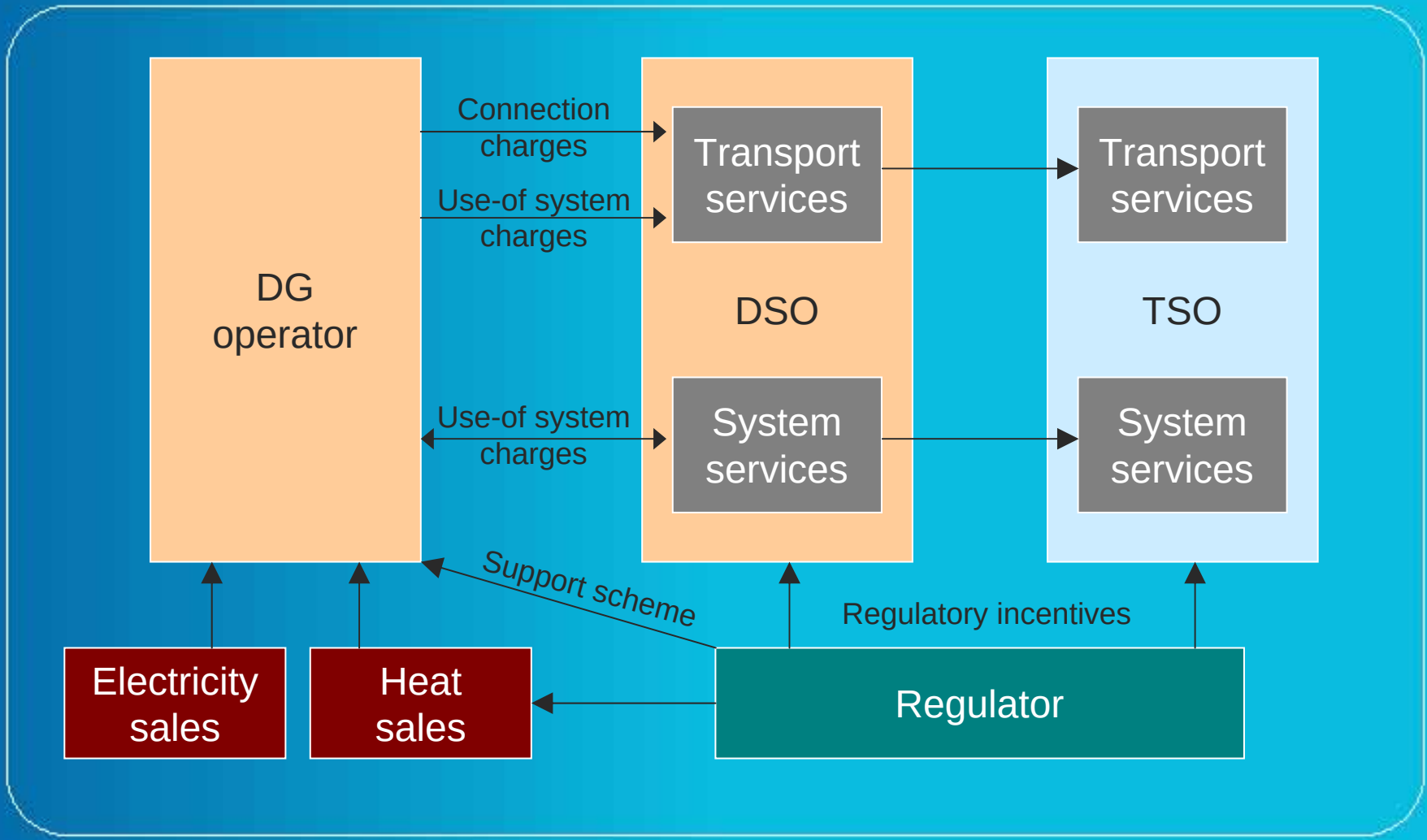
DG legislation in EU



DG economics interplay



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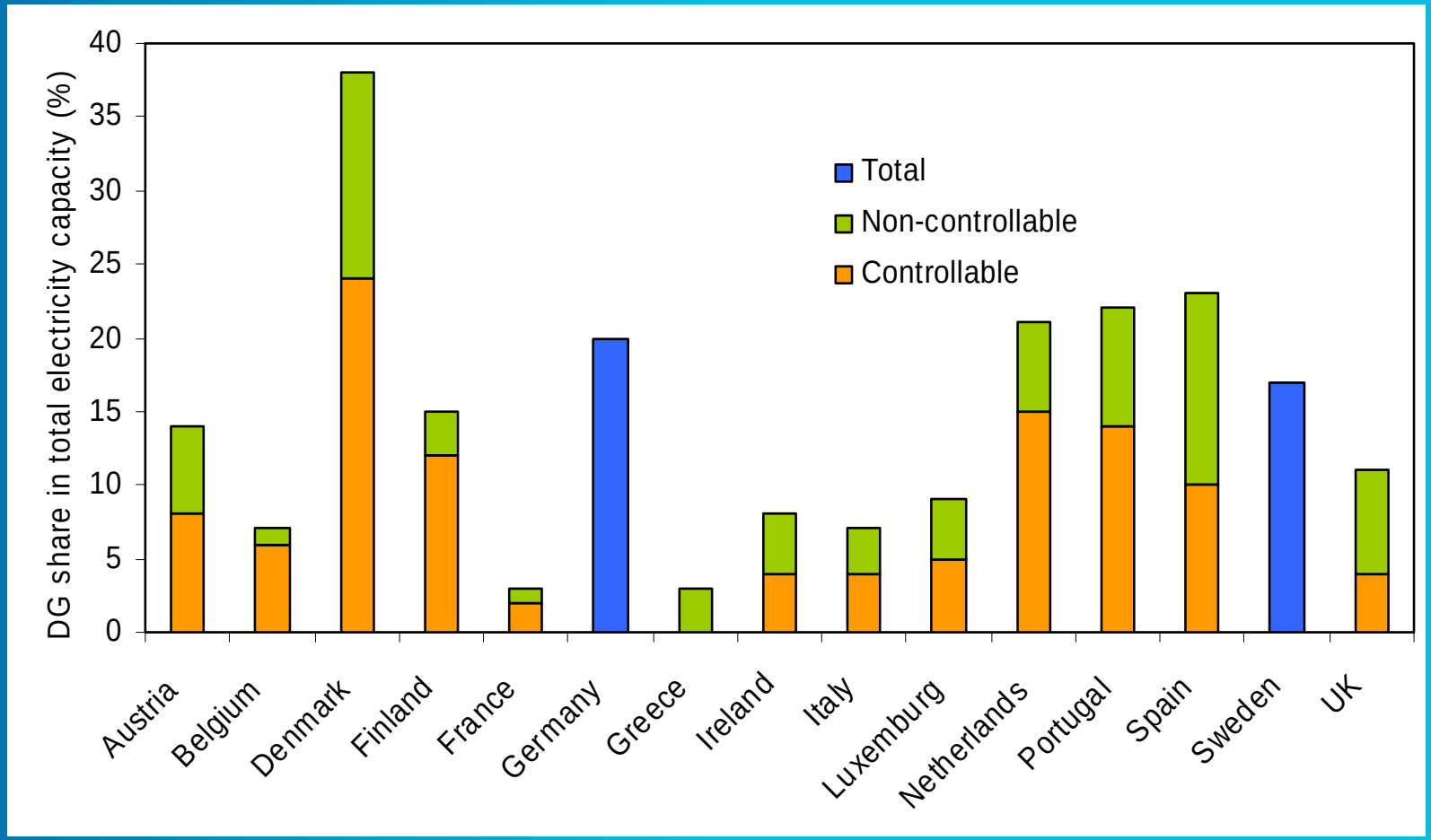
DG presence in EU-15



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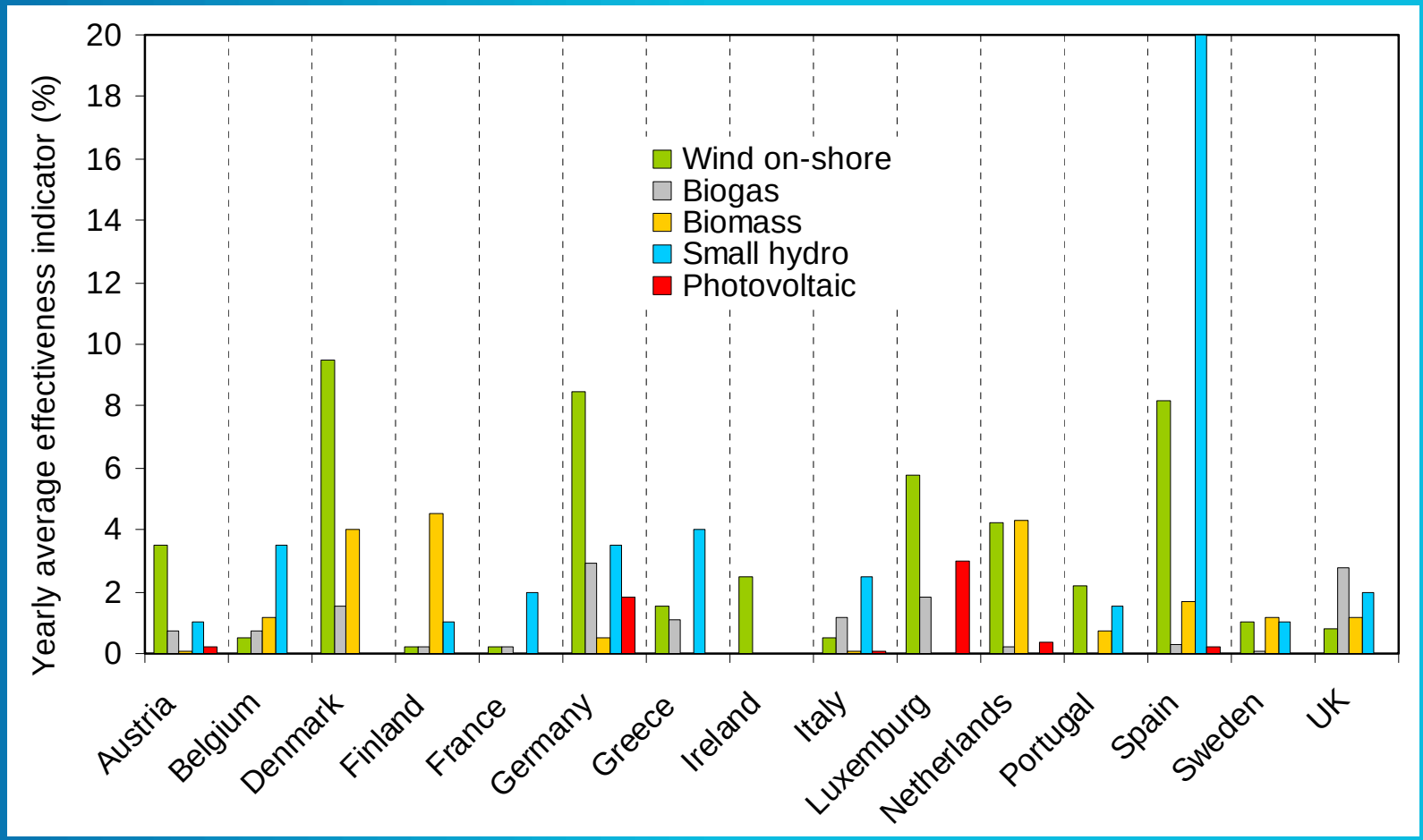
DG effectiveness in EU-15



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Distribution System Operator

- Unbundling
  - Required for DSOs connections > 100.000
  - Most DSOs have legal unbundling
  - The lack of unbundling may become a barrier for new DG
- Incentives to DSOs
  - Consider impact of DG in capital+operating costs for DSOs
  - Currently there is a lack of incentives to DSOs
- Network operation and planning
  - DG may contribute to improving DSO network op.&plan.
  - Currently DSOs do not integer DG into op.&plan.

Market access

- Market concentration
  - DG can contribute to reduce market concentration
- Access to energy markets
  - Most countries have feed-in-tariffs
  - Some include DG into spot-markets
- Balancing markets
  - Used to correct DG energy prediction
  - A barrier for non-controllable technologies
- Ancillary services
  - Benefit for DSOs
  - DG is able to provide most ancillary services, but there is a lack of incentives

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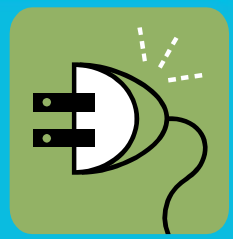
Network access



- Authorization procedures
  - Slow and non-transparent
  - Most countries have guaranteed access for DG
- Technical requirements
  - Measurement (most) + quality (few) + safety (the less)
- Connection charges
  - Deep costs: any cost of network reinforcement
  - Shallow costs: cost to the nearest point of the dis. network
- Use of system charges
  - Objectives: economic efficiency + DSOs recover allowed revenues
  - Half of the EU countries have imposed these DG charges

Index

- DG Legislation in Europe
  - DG legislation
  - Economics interplay
- Regulatory and economic framework for DG
  - Presence of DG
  - Distribution System Operator
  - Market access
  - Network access
- Conclusions and guidelines
  - Main barriers
  - Guidelines

Main barriers

- The lack of incentive for DSO to be proactive in DG integration
- Few countries integer DG into energy markets, with some barriers
- There is a lot of difference between the EU-15 MS in the access to ancillary services and balancing markets.
- Abusive connection charges + network access barriers + network constraints, all delay DG integration.

Guidelines

- DSOs
  - Regulator should include DG network costs into DSOs allowed revenues & design explicit incentives for DG integration
  - DSO should undertake network reinforcements and assume their costs
  - Define new grid codes to integrate DG into the operation and planning of distribution networks
- Market access
  - Move from feed-in-tariffs to energy markets
  - DG must actively participate into ancillary services
  - Improve access to balancing markets
- Network access
  - Transparent and non-discriminatory

Thanks for your attention!

www.dg-grid.org

www.iit.upcomillas.es

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WS 2.3 **"Enhancing implementation in WB Countries"**
2-3 March 2006 in Skopje, R. of Macedonia

ORGANIZATIONAL FRAMEWORK OF RES PROMOTION PROGRAMS IN SERBIA AND MONTENEGRO

Elena Boskov Dragan S. Popovic
DMS Group ltd, Novi Sad, Serbia and Montenegro

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Contents

- Supply and demand aspects for renewable energy sources in the electricity market
- Classification of energy policy instruments

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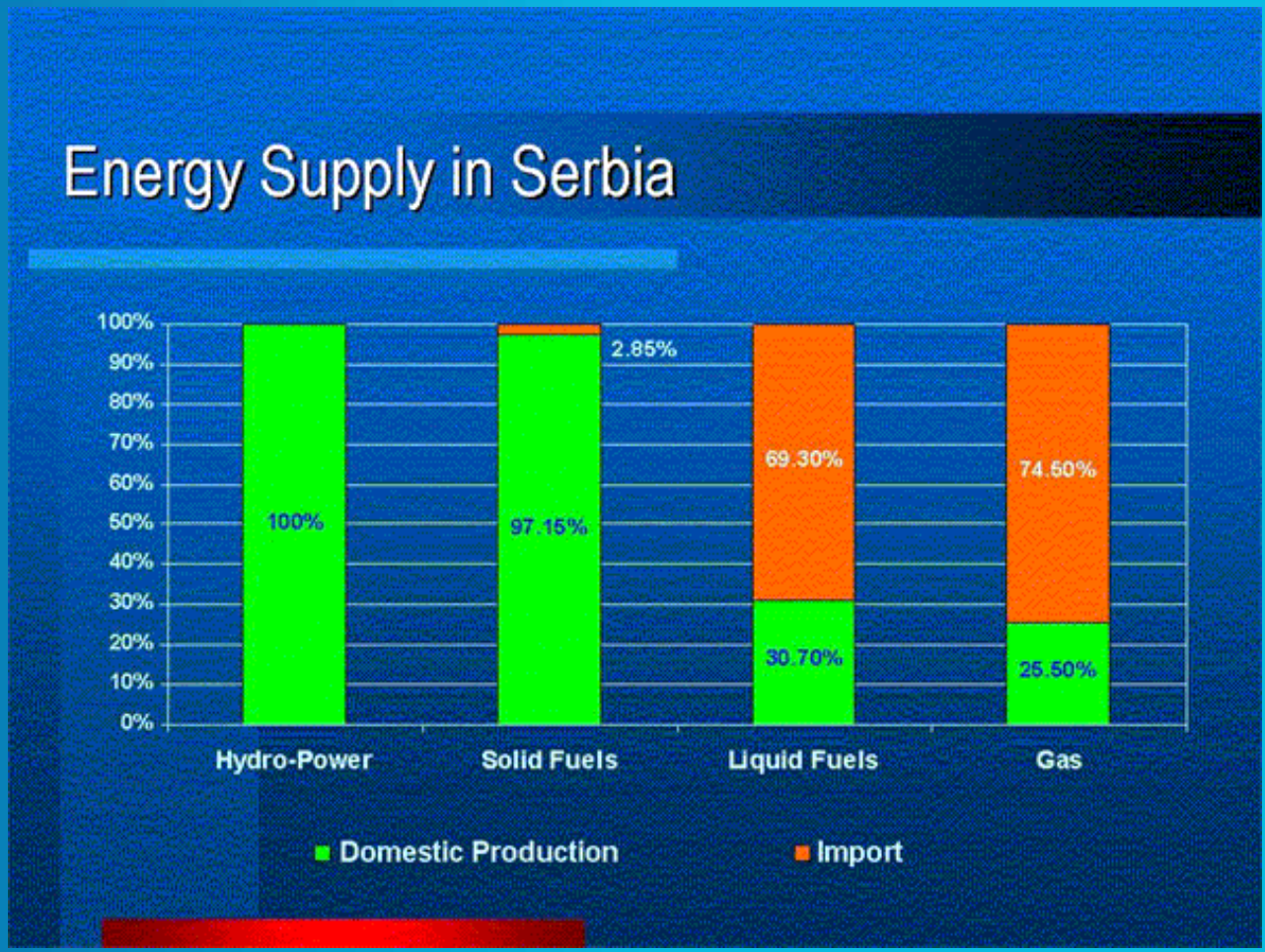
Overview



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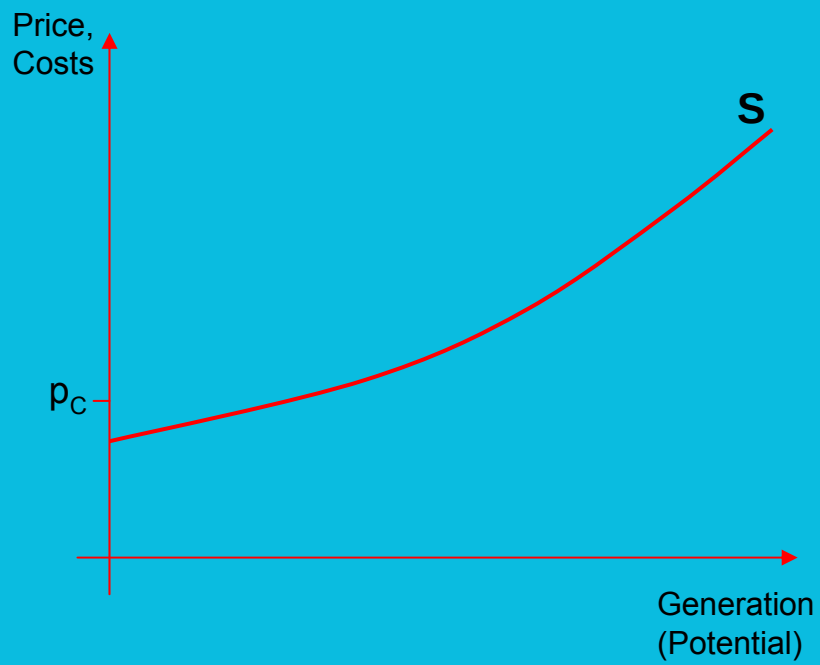
Costs and potentials for RES

- Static ***cost-resource curve (supply 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.



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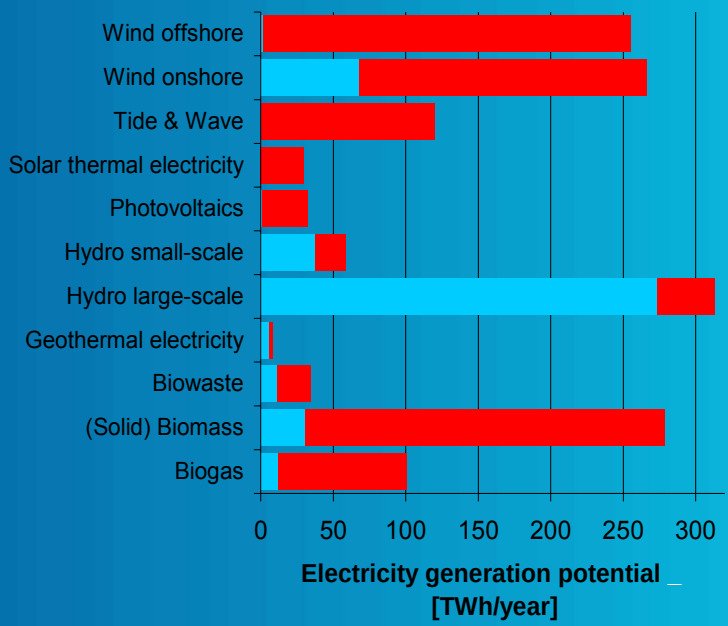
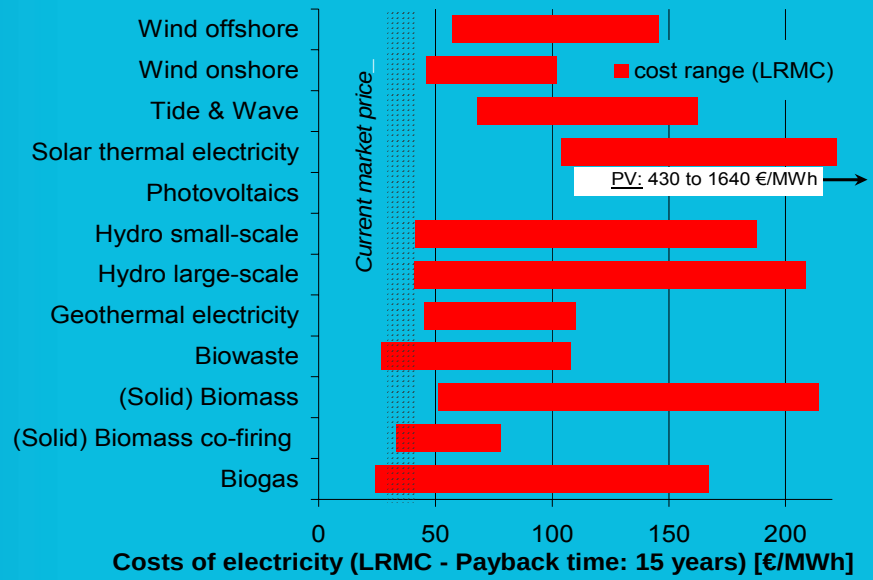
Supply curve

POTENTIALS



COSTS



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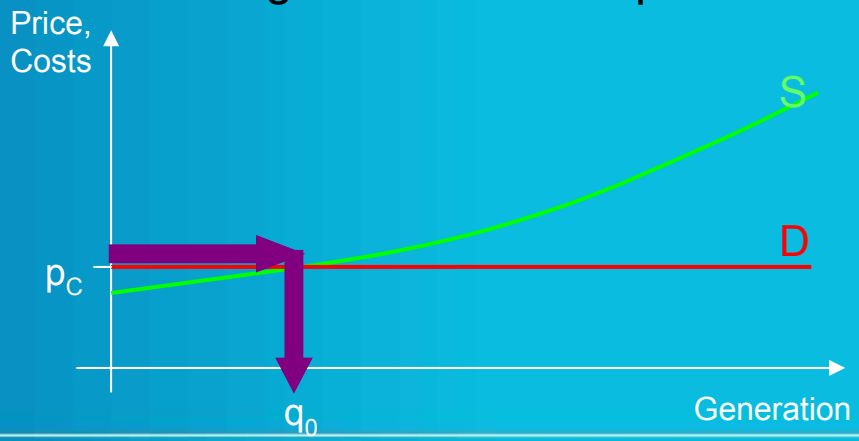
The industrial economic point-of-view

- 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-E**, 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**).



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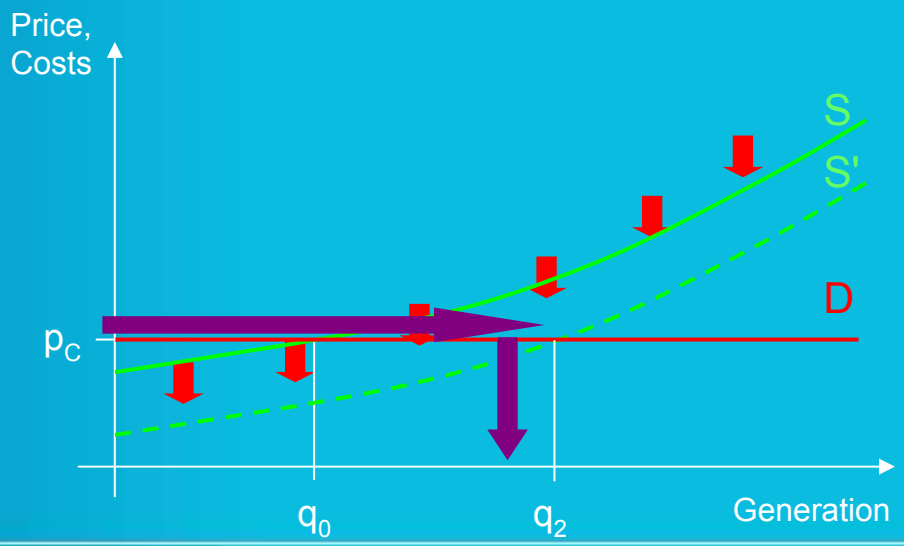
Price-driven strategies

(Promotion instruments for RES on the supply-side)

- **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**.



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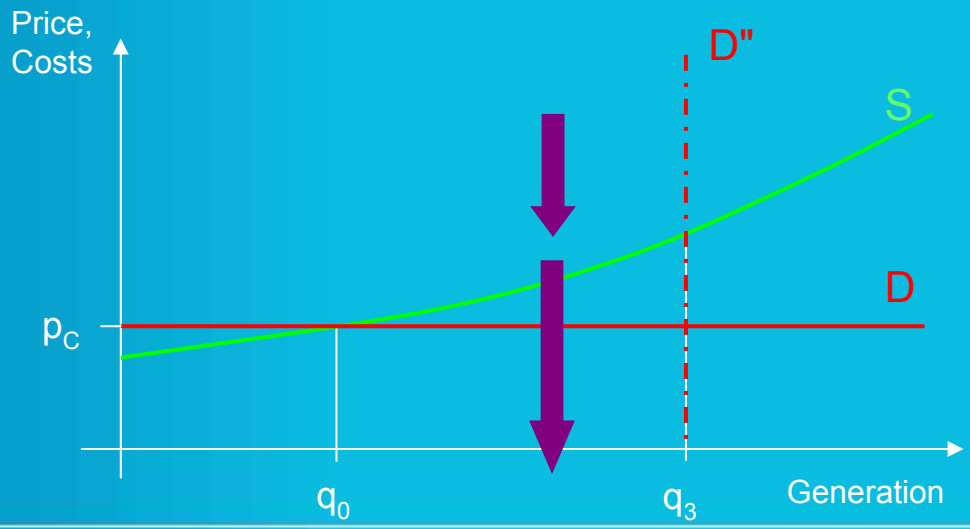
Quantity-driven strategies

(Promotion instruments for RES on the demand-side)

- To promote RES-E, a **mandatory demand** could be **set by the government**. Assuming, a quota for RES-E 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**.



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Classification of energy policy instruments

		Direct		Indirect
		Price-driven	Quantity-driven	
Regulatory	Investment focussed	•**Investment subsidies**	•***Tendering system***	•Environnemental taxes
		•***Tax incentives***		
	Generation based	•**Feed-in tariffs**	•**Tendering system**	
		•**Tax incentives**		
		•Rate-based incentives	•**Quota obligation (RPS) based on TGCs**	
Voluntary	Investment focussed	•Shareholder Programs		•Voluntary agreements
		•Contribution Programs		
	Generation based	•Green tariffs		

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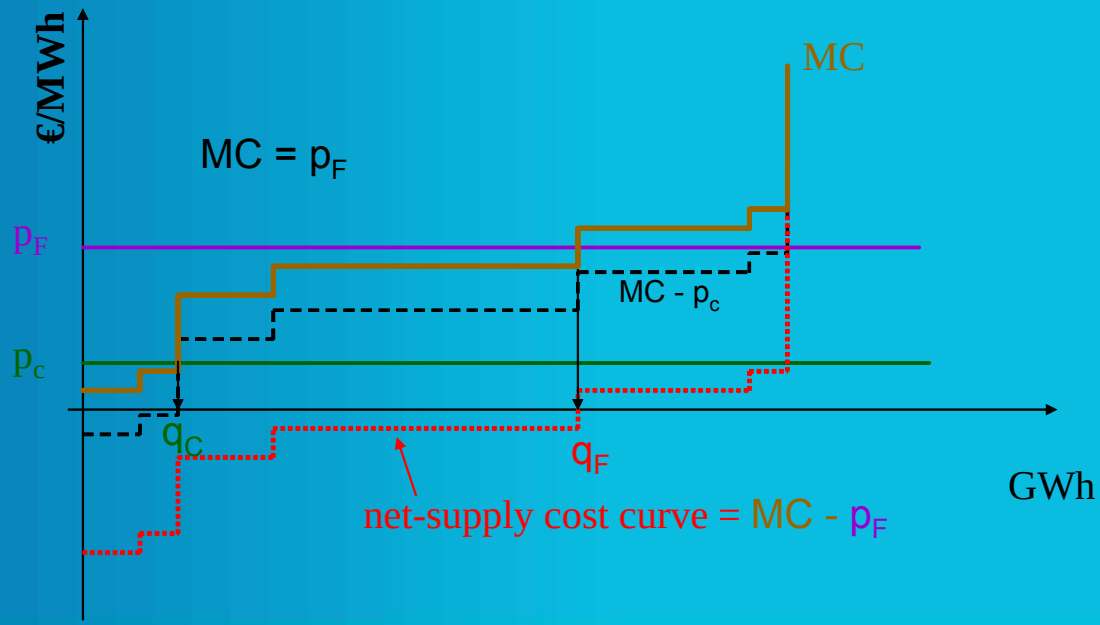
Feed-in tariffs

Suppose the **(marginal) cost-resource curve (MC)** for a RES-E technology is given as in the Figure below. Assuming the price for conventional electricity, e.g. on the spot market, is given by p_C. Without a promotional strategy, the amount q_C will be generated. This quantity is characterised by the intersection of p_C with the MC-curve, p_C = MC.



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- If RES-E producer receive the **feed-in tariff pF** instead of the conventional electricity price pC, they will try to **increase** their generation **from qC to qF**. This amount is shown by the intersection of feed-in tariff with the MC-curve (**pF = MC**).
- *The same result is given by the intersection of (MC – pF) with the x-axis, i.e. MC – pF = 0. (MC – pF) is the net marginal costs of both producing RES-E and of receiving the feed-in tariff (dotted red line).*
- The **amount of electricity generated from RES** depends on …
- the **height of the feed-in tariff**
- and the **guaranteed duration** of this payment.
- *If the tariff as well as guaranteed duration is set high enough, the instrument gives a strong incentive to invest in RES. If it is low, only a moderate expansion can be expected.*

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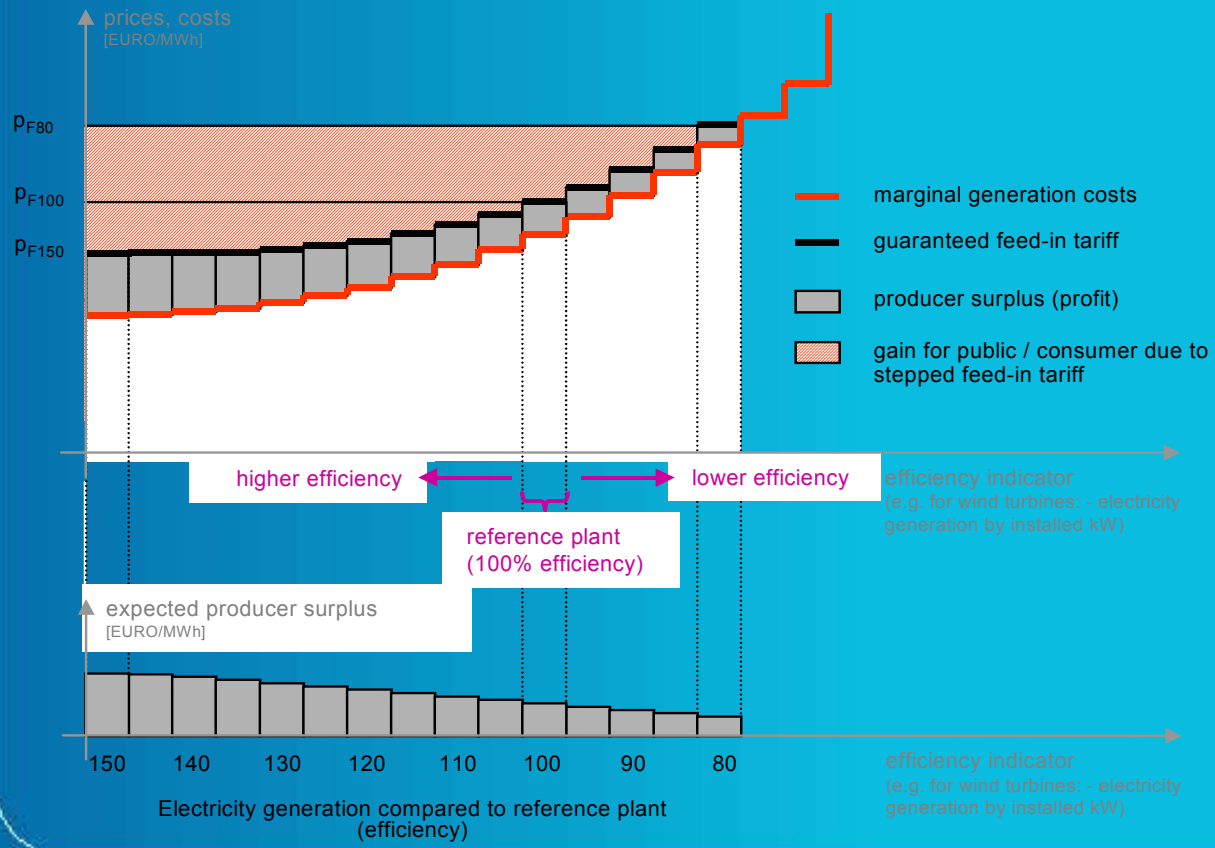
Stepped Feed-in tariffs

In the last years a special design of a feed-in tariff has been developed, the so called 'stepped' feed-in tariff. In practice **this kind of tariff scheme is used for wind energy in Germany, France and Portugal.**



A stepped feed-in tariff is characterized by lower subsides as the 'generation efficiency' increases.

The **decline** in the guaranteed **price**, however, must be **less than the total revenue that can be gained if an efficient plant and location is chosen** - otherwise investors have no incentive to implement the most efficient technologies and locations.
This means that **profits must be higher at cost efficient locations compared to less efficient ones**.
E.g. wind energy: 20% expected profit for locations with 2400 full-load hours and 14% for locations with 1800 expected full-load hours.

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Quota obligation based on TGC's

- A mandatory demand may be set by government via quota obligations (i.e. legally enforceable orders to producers for specified amounts of RES-E to be sold) to promote electricity generation from RES. Quota systems usually operate in a liberalized electricity market The main objective of a legally enforceable quota system is to secure the penetration of a pre-defined amount of renewable energy.
- In general two different approaches exist:
- Non-tradable quotas: Renewable Portfolio Standards and Obligations
- Tradable quotas: Electricity or emissions (e.g. CO2) based certificates

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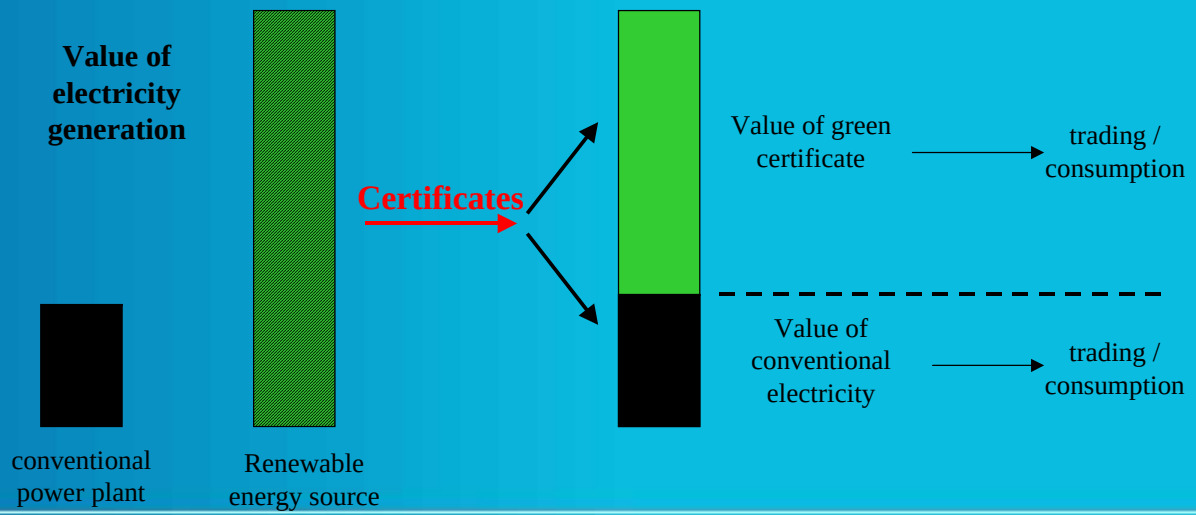
- The advantage of tradable green certificates (TGCs) is to facilitate the fulfillment of the quota obligation, and to increase the economic efficiency of the promotion strategy.
- A **TGC** is used to **represent the 'added value' or 'greenness' of one pre-defined unit of electricity produced from RES.** If only a TGC system operates, each producer of RES-E is producing **two goods**:
- **physical electricity**, which is fed into the grid (exported) and sold at market prices for conventional electricity
- **TGC**, which **represents the added value of the 'greenness'**



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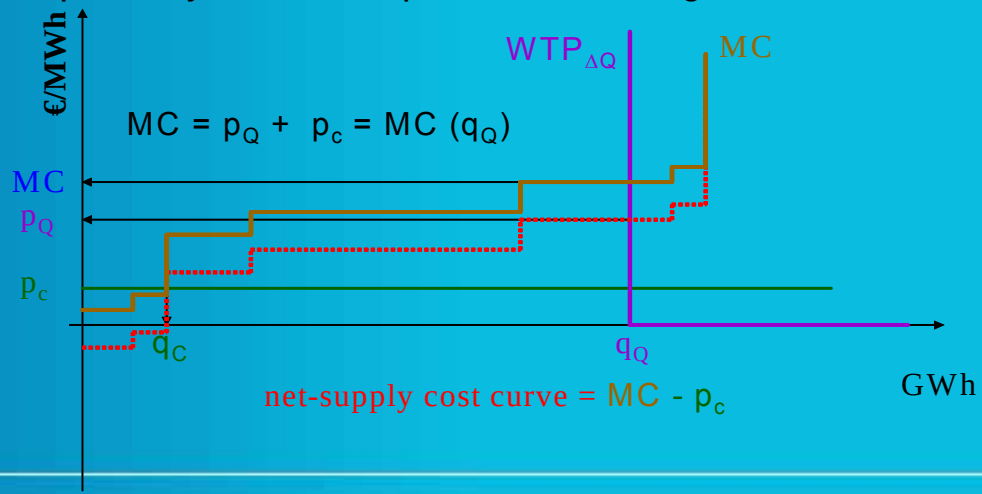
- If the revenue from selling physical electricity into the grid is subtracted from the marginal costs of electricity generation, the marginal cost curve for providing TGC can be determined, i.e. the dashed line *MC – pC*.
- The **total demand for TGCs is given by the quota obligation qQ**. In the Figure below this demand is represented by **WTPΔQ**. The inelastic demand, characterised by the vertical line, can be interpreted as follows: **obliged actors are willing to pay a high amount for each TGC below the quota obligation qQ**, because **they have to fulfill the quota**. (The limit is in fact the 'fine' or 'penalty' paid for non-compliance; such a 'fine' becomes a price cap; see next slide)
- **If**, however, the **obligated actors hold more TGCs than necessary to fulfill the mandatory obligation**, nobody demands additional TGCs, and, thus, the **price for TGC drops to zero**.

The mechanism of a quota system is depicted in the Figure below.



- In the optimum, the price for TGCs, **pQ**, and the offered amount, qQ; are given by the intersection of the net supply curve for TGCs, *MC – pC*, and the demand curve for TGCs, **WTPΔQ**. Due to the inelasticity in demand the offered amount of TGCS is equivalent to the quota obligation. The marginal generation costs for electricity generated from RES are according the supply of two goods equivalent to the price for conventional electricity plus the price for TGCs, *MC = pC + pQ*.

- In practice, at least as long as the market for TGC is not mature, a ceiling price for TGC will be set. This maximum price can be interpreted as penalty per kWh in the case of non fulfillment of the quota obligation. How the optimization looks like under this restriction is shown in the Figure below.

- If the penalty, however, is set too low, obligated actors are not willing to fulfil the quota obligation, because it is cheaper to pay the penalty than the higher price for the TGCs p'Q. Thus, **the upper price for TGCs is restricted by the penalty**, **pQ = penalty**. The **intersection of the penalty** (which can be interpreted as new demand curve in the range $q \in [0, qQ]$) **with the supply curve for TGCs yields the actual level of electricity generated** due to the quota obligation, **qactual**.

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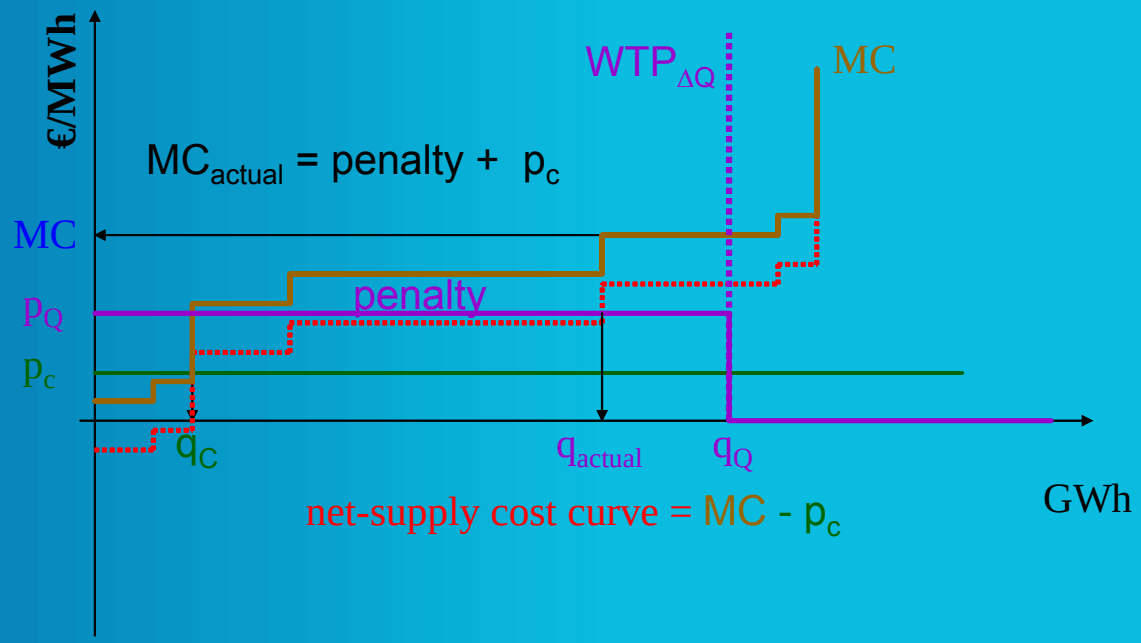
Impact of Penalty …

- Summing up, **the actual price as well as the amount of electricity generated** can be **influenced by setting a price cap for TGCs**.



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Conclusion

Both,

Feed-in tariffs

& **Quota obligations based on TGCs**

create an artifical market!

… either by **setting a price** (*Feed-in tariff*)
with the **uncertainty** with regard to the **resulting demand**

… or by **setting a demand** (*Quota based on TGCs*)
with the **uncertainty** with respect to the **resulting price**

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Economic aspects of RES use in WB countries analysis and recommendations

Borut Del Fabbro

Key issue

- **RES will be used only if this is economically feasible**
- **Basically no investment decision will be made purely on environmental basis**

Competitivness of RES

- **RES are usually not competitive with fossil fuels**
- **The price of fossil fuels does not include the costs of externalities:**
  - **CO2 emissions cause global warming**
  - **Other pollution (SO2, smoke, ashes)**
- **In order for RES to be competitive usually subsidies or other incentivies are needed**

Overview of RES from an economic aspect

- **Active solar**
  - **exclusively dependent on subsidies**
- **Passive solar**
  - **At the limit – in the south sometimes feasible also without subsidies**
- **Wind**
  - **exclusively / mostly dependent on subsidies**

Overview of RES from an economic aspect (2)

- **Small HPP**
  - **mostly dependent on subsidies**
- **Solid Biomass**
  - **generation of electricity exclusively dependent on subsidies**
  - **generation of heat independent of subsidies – feasible also under purely market conditions**
- **Biogas**
  - **exclusively dependent on subsidies**

Overview of RES from an economic aspect - summary

- **Electricity production from RES is largely dependent on subsidies and other financial incentives**
- **Heat production from RES (biomass, solar) is competitive also under market conditions**

Breakeven prices for RES

	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 - today	
	78 €

Advantages & Disadvanatges of WB countries

- **Advantages:**
  - **Lower cost of labour**
  - **Good natural resources (biomass, sun, wind, small HPP)**
  - **Can generate additional revenues using tke Kyoto protocol (CDM – Clean Development Mechanism)**
- **Disadvantages:**
  - **Higher cost of capital (low competition in the financial market; countires deemed riskier)**
  - **Weaker economy – hard to sustain expensive RES => small or unexistent incentives**
  - **Price of electricity artifically kept low**
  - **Electrical grid frequently in bad condition**

Incentives for RES in WB countries

- **In general:**
  - **Usually none**
  - **If existent much lower than in EU => to low to form and adequate basis for economic implementation of RES**

How to deal with this?

- **Capital intensive RES are mostly less suitable:**
  - **For example electricity from solar, wind and small hydro – labour costs near zero – basicly only investment costs present**
- **RES that have a bigger percentage of labour more suitable:**
  - **also indirectly: like biomass**

How to deal with this? (2)

- **Kyoto – Clean Development Mechanism**
  - **CDM projects allow for countries or companies to invest in GHG reduction measures, in other countries. Participating Annex 1 companies are able to obtain CO2 cupons that can be used to fulfill domestic emissions reduction commitments.**
  - **The price of CO2 cupons has been rising steeply (from 6 € per ton at the beginning of 2005 up to 28 € per ton now)**
  - **These are additional funds that are not dependent on local government and represent an opportunity for all countries that have ratified the Kyoto protocol (only Albania did)**

Recommendations for WB countries

- **Take advantage of the situation. Waiting for financial stimulations to be equal to those in western Europe is useless – it will not happen soon.**
- **Take into consideration the resources that WB countries have and take advantage of it – biomass, solar, wind, small HPP**
- **Take advantage of the Kyoto protocol (CDM) – find foreign project implementators**

Thank you very much for your attention!

Financial Incentives for RES Penetration in Croatia: The Role of Environmental Protection and Energy Efficiency Fund

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Zagreb, Croatia

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Contents

- Financial framework for RES penetration in Croatia
- Environmental Protection and Energy Efficiency Fund
  - Establishment
  - Organisation and activities
  - Sources of funding
  - Allocation of financial means
  - Planned investments in RES projects and programmes
- Conclusion

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Financial framework for RES penetration in Croatia

- Urgent need for completion of legislative and regulatory framework
- Minimal renewable energy target – 1100 GWh electricity consumed in 2010, which equals to 5,8% of total electricity consumption in 2010
- Increase of 220 GWh per year in time period 2006-2010 → need for financial incentives

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Financial framework for RES penetration in Croatia, II

- No expenditures from the state budget
- For grid connected facilities → feed-in tariffs financed through an additional surcharge (according to proposal cca. 0,13 €c/kWh to be paid by all electricity consumers)
- For off-grid facilities: support from the *Environmental Protection and Energy Efficiency Fund*

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The Fund - establishment

- Similar funds are very efficient in Central and Eastern European countries (Poland, Czech, Slovakia, Hungary, Bulgaria)
- Primary goal: financing environmental protection projects → experience in energy projects also
- Based on *Energy Sector Development Strategy* and *Environmental Protection Strategy* and appropriate laws, the Fund was established and started to operate in the beginning of 2004

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The Fund - organisation

- Two bodies: director + steering committee
- Steering committee: Ministry of Environmental Protection, Ministry of Economy, Croatian Chamber of Economy, Ministry of Finance, Croatian Parliament and environmental protection experts
- Strong collaboration with expert and scientific institutions and companies

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The Fund - activities

- Gathering, managing and allocating financial means
- Intermediary activities when projects are financed from international sources
- Promoting, establishing and actualising cooperation with domestic and international financing institutions
- Managing the database on actual programmes, projects and assigned financial help

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The Fund – activities, II

- Two basic areas:
  - Environmental protection
    - environment quality, clean production, waste management , biodiversity, sustainable use of natural resources, etc.
  - Energy efficiency → also includes RES
    - national energy programmes, RES use, sustainable building, clean transportation
- Education, technology R&D and demonstration projects

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The Fund – sources of funding

- **Non budget** institution
- "Polluter pays" principle
- The most important sources are environmental charges!
- Bilateral and multilateral cooperation
- International agreements and donations

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The Fund – sources of funding, II

- The charge for emissions into the environment
  - 26,3 €/tone SO_2/NO_2 in 2005
  - 42,5 €/tone SO_2/NO_2 in 2006
  - CO_2 charge has not yet been applied (1,6 €/tone)
- The charge for the environment use
  - For buildings or constructions that require environmental impact assessment
- The charges for burdening the environment with waste
  - for communal and/or no hazardous industrial waste (1,6 €/ metric tone)
  - For hazardous waste (6,8 €/metric tone in 2005, 13,7€/metric tone in 2006)
- Special environmental charges for motor vehicles
  - The most important source of funding
  - Dependant on vehicle, engine and fuel type, engine volume and power, and vehicle age

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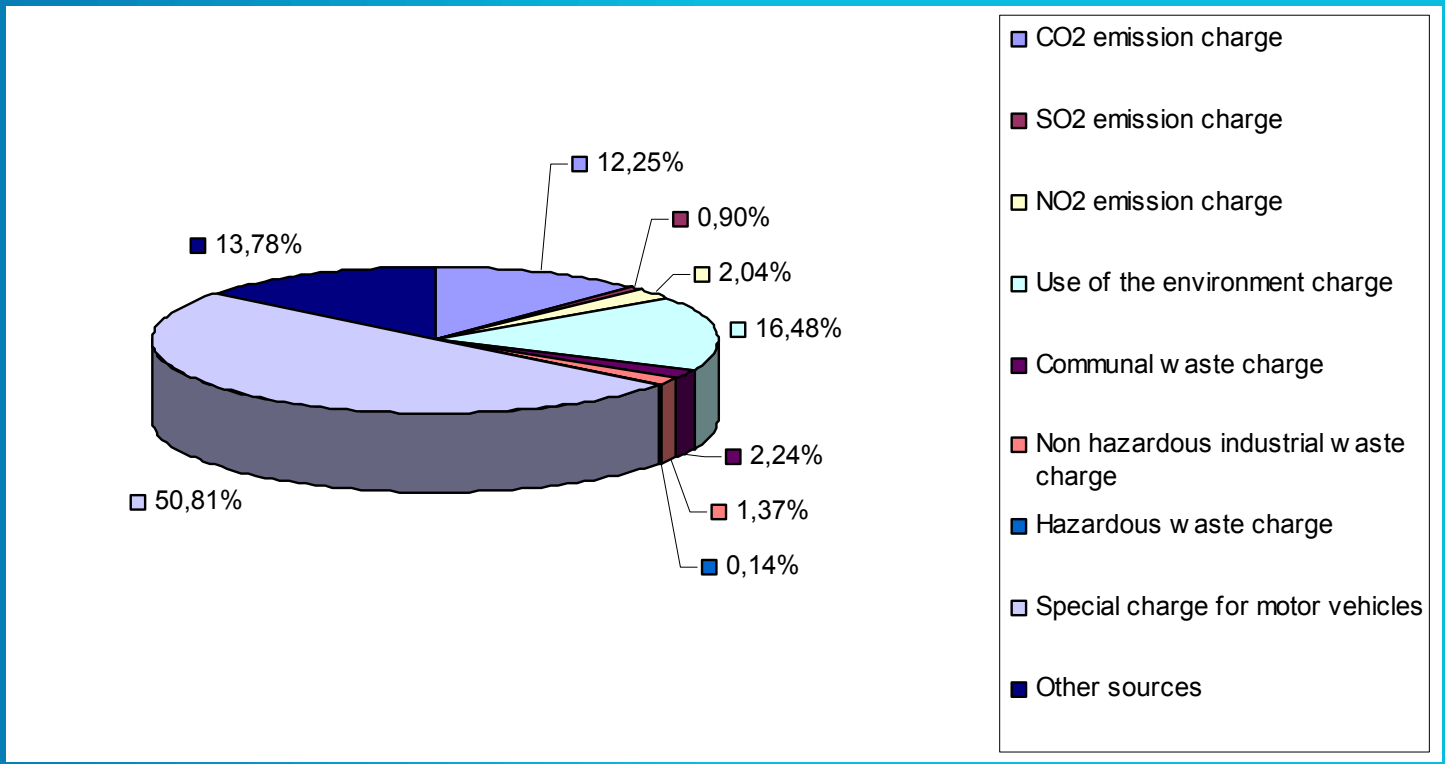
The Fund – sources of funding, III

- 208,8 millions € in time period 2005-2008 expected



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The Fund – allocation of financial means

- Interest-free loans (grants)
  - Repayment period 5 years, with possible 2 years delay
  - Maximal amount 227.000 €
- Subventions
  - on loan interests → 2% subventions according to agreement with Croatian Bank for Reconstruction and Development (final interest up to 4%)
- Financial help
  - Only for local governments
  - Maximal amount determined by contracting
- Donations
  - Usually provided from international financing institutions

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The Fund – allocation of financial means, II

- Users of the Fund's financial support are obliged to invest their own financial means in the proposed project
- The Fund can finance up to 40% of the total required investment, with exemptions
  - Areas under the State's special care up to 80%
  - Undeveloped areas up to 60%
- 71,72% of planned incomes will be allocated for environmental protection projects
- 90% of that amount goes for waste management projects → very interesting fact since waste charges contribute with less then 4% in total Fund's incomes
- For energy efficiency and RES projects 57,23 millions € are predicted

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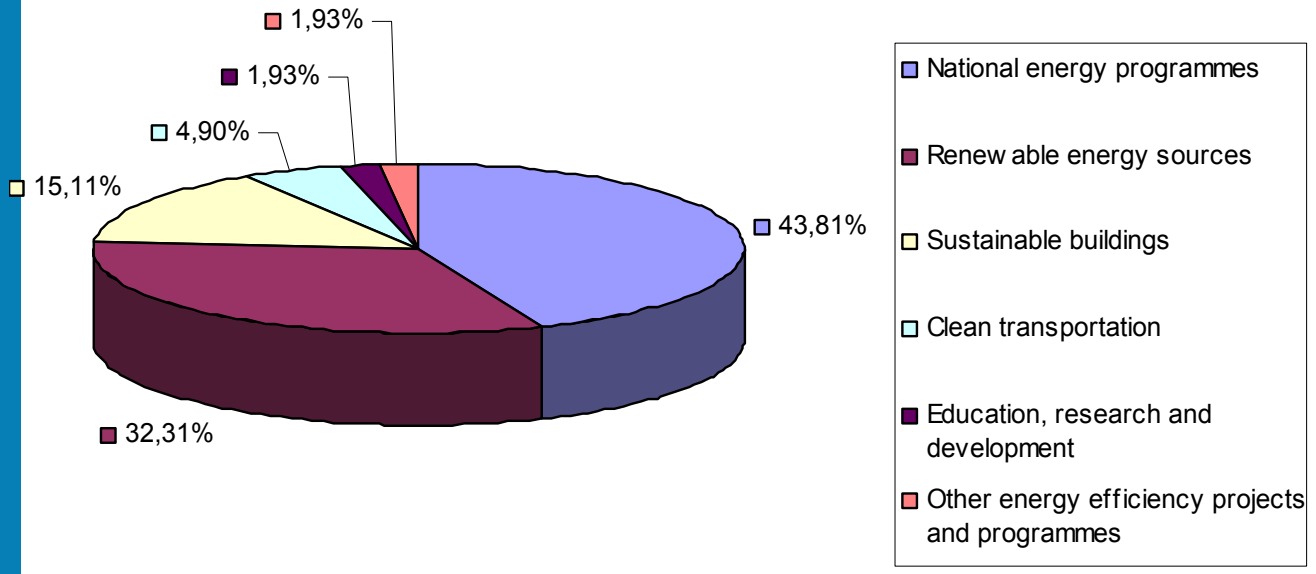
The Fund – allocation of financial means, III



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Planned investments in RES

- Solar energy
  - Solar irradiation measuring
  - Solar thermal systems in households and objects for tourism, especially in coastal areas (the goal 80% of total heat requirements from solar energy until 2020)
  - Solar thermal systems in agriculture (greenhouses, livestock farming, watering)
  - PV systems only for isolated regions (rural and mountain areas, national parks and other protected areas, islands)
  - Extremely important quality control and quality assurance for both equipment and installers
- Wind energy
  - No financing support for large wind power plants
  - Possible financing support for wind turbines in water supply systems (desalinisation and irrigation)
  - Supports for measuring and mapping the wind potential

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Planned investments in RES, II

- Small hydro power plants
  - Support for small HPP not connected to the grid
- Geothermal energy
  - Research of existing and new locations
  - Geothermal projects (documentation preparation, investment study)
- Biomass
  - Up to 15 % of total energy consumption in 2020 could originate from biomass and waste use (BIOEN national energy programme)
  - Individual users: wood pellets furnaces, biogas production equipment, small engines on liquid and gas biomass
  - Local communities: small biomass heating networks, use of waste deposition gases for electricity production, system for collecting eatable oil for bio diesel production
  - Production of all forms of bio fuels
  - Big cogeneration facilities and biomass power plants will not be financed, if they are in the feed-in tariff system

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Conclusion

- Most of the current Fund's activities related to waste management
- In energy efficiency area the most important activity is financing energy audits
- 20 viable projects in the field of energy efficiency, renewable energy sources and sustainable building → 2,3 millions €
- It still remains to be seen if the Fund will act according to its Action Plan and will it trigger more investments in RES
- Very important role of the Fund → providing financial but also institutional support for environmental protection, energy efficiency and renewable energy sources projects

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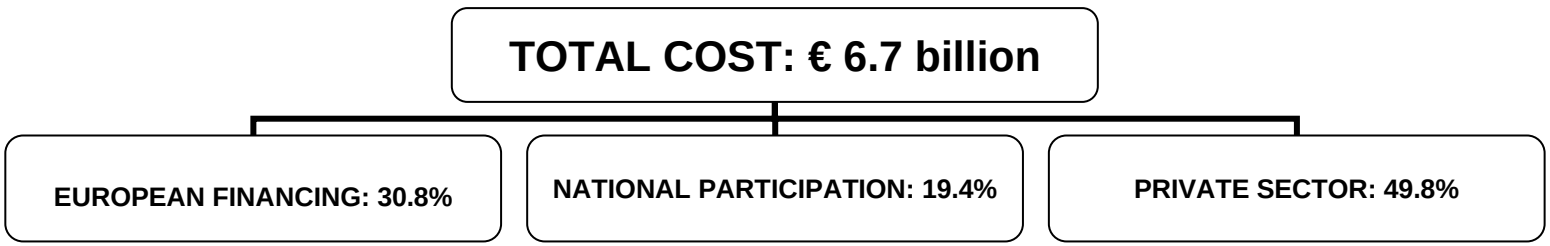
The Framework of the Operational Competitiveness Program for the development of private Renewable Energy Sources (RES) and Energy Saving (ES) investments in Greece (Measures 2.1 and 6.5)

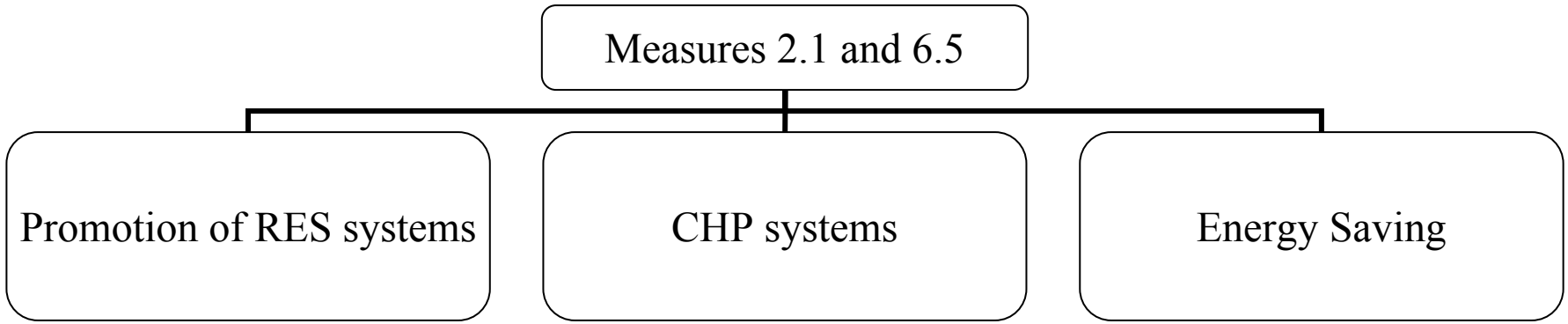
Dr. C. Karytsas, K. Karras
Centre for Renewable Energy Sources

March 2006

Competitiveness program costs



Measures 2.1 and 6.5



Through

- Financial incentives approved by the EC
- Incentives for investments on the electricity grid

Targets of measures 2.1 and 6.5

- Increase of RES and CHP participation in Power production system of the country;
- Secure energy supply with parallel reduction of dependence on imported primary energy through differentiation of energy resources;
- Environmental protection.

TOTAL COST OF MEASURES 2.1 and 6.5: € 1.15 billion

NATIONAL PARTICIPATION: € 360 million with 50% EU contribution

Intermediate Agencies

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	210 660 3302, 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

Intermediate Agencies (continued)

5	SUPPORT PROJECTS MANAGEMENT MME – FINANCIAL CONSULTING AM-S	DESMOS	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. Veniselou & 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.

General investments categories

General investments categories are:

- Energy Saving (Energy Conservation) (ES)
- Combined Heat and Power (CHP)
- Conventional Fuel Substitution with gaseous fuels (FS)
- Renewable Energy Sources (RES)

Final date of investments implementation: 31/12/2007

Technology categories of investments

Code	Technological category/ RES subcategory
ECE	ENERGY CONSERVATION IN EXISTING ENTERPRISES
CHP	COGENERATION of HEAT (heating/cooling) 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

Participation conditions

Before the proposal submission it is needed

a) For investments in existing units an energy audit,

b) For investments in sites with no-operating units Assessment of exploitable energy potential through a scientifically accepted method.

Pre-condition for an investment proposal submission is the ownership of a valid installation license unless such a license is not required

Eligible costs

The costs of works after the date of proposal submission with the exception of

- The energy audit or
- The energy potential assessment

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 included.

Eligible costs upper limits of RES, CHP technologies

TECHNOLOGY	UPPER ELIGIBLE COSTS LIMIT (€)
Combined Heat and Power (CHP)	1.050 / installed kW_e, for installatons < $1MW_e$ 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

Eligible costs upper limits of RES, CHP technologies (continued)

TECHNOLOGY	UPPER ELIGIBLE COSTS LIMIT (€)
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
Autonomous Photovoltaic systems (PV panel, storage system)	10.000 / kWp

Proposals evaluation stages

STAGE I	**Formal Completeness Control**
STAGE II	**Financial Evaluation**
STAGE III	**Techno-economic Evaluation**

Techno-economic evaluation criteria of proposals

		WEIGHTING FACTOR (%)	
No	**CRITERION**	**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**

Regulatory review for RES projects implementation in Bosnia and Herzegovina

Almir Ajanović

Intrade energija

Sarajevo

Sixth Framework Programme, DG Research, International Cooperation
Contract: INCO-CT-2004-509205

Regulatory review for RES projects implementation in Bosnia and Herzegovina

- Since 1998 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.

- Since 2000 in BiH were created all legal conditions on which basis were constructed first BiH electricity Generation capacities based on utilization of renewable resources.

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Regulatory review for RES projects implementation in Bosnia and Herzegovina

- 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.

* 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.

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Regulatory review for RES projects implementation in Bosnia and Herzegovina

- 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.

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- The 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.

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- 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.

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Regulatory review for RES projects implementation in Bosnia and Herzegovina

- 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.

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- 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.

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Regulatory review for RES projects implementation in Bosnia and Herzegovina

- 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 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.

- 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.

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- 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

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