SOLID-DER Workshop
16th May 2008, Vienna

Role of Renewables in the European Energy Mix – Electricity industry view

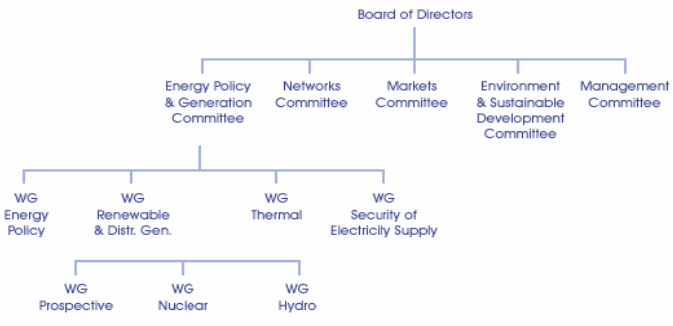
Gerd SCHAUER

EURELECTRIC, WG REN&DG

The Union of the Electricity Industry - EURELECTRIC

is the professional association which represents the common interests of the electricity industry at pan-European level, plus its affiliates and associates on several other continents

- 33 members
- 3200 Customers
- 275 Mio. customers
- 800 GW
- www.eurelectric.org



- Contribute to the development and competitiveness of the electricity industry and to promote the role of electricity in the advancement of society
- Representing common interests of the electricity industry at Pan- European level
- Seeks to contribute to the competitivesness of the electricity industry
- Publish documents on high-quality input with up-to-date information
- Formal opinions, policy positions and reports are formulated in Working Groups, composed of experts from the electricity industry

- **www.eurelectric.org**

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Bringing RES to the market!

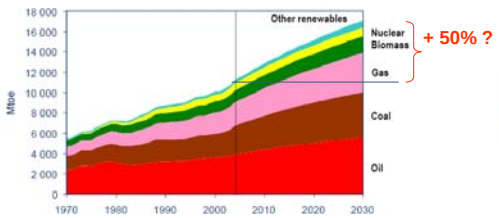
1. Energy Outlook: Why RES?
2. Eurelectric project „Role of Electricity“
   - Demand side, Generation, RES-Technologies & Potentials, Scenarios

   ERMInE project

   Grid Integration of RES
3. RES in the market and support
4. Conclusion

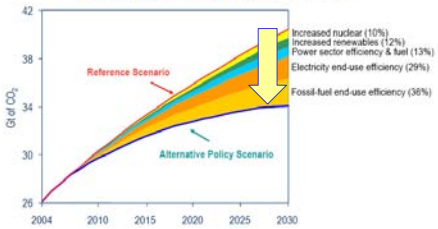
IEA Energy Outlook

Reference Scenario:
World Primary Energy Demand



Global demand grows by more than half over the next quarter of a century, with coal use rising most in absolute terms

Alternative Policy Scenario:
Global Savings in Energy-Related CO_2 Emissions

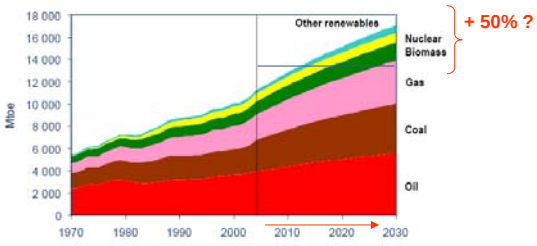


Improved end-use efficiency of electricity & fossil fuels accounts for two-thirds of avoided emissions in 2030

Delaying actions by 10 years would reduce the impact on emission reduction in 2030 by three quarters

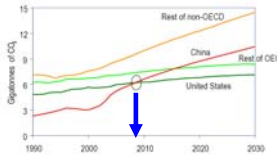
IEA Energy Outlook

Reference Scenario: World Primary Energy Demand



Global demand grows by more than half over the next quarter of a century, with coal use rising most in absolute terms

Reference Scenario: Energy-Related CO_2 emissions by Region



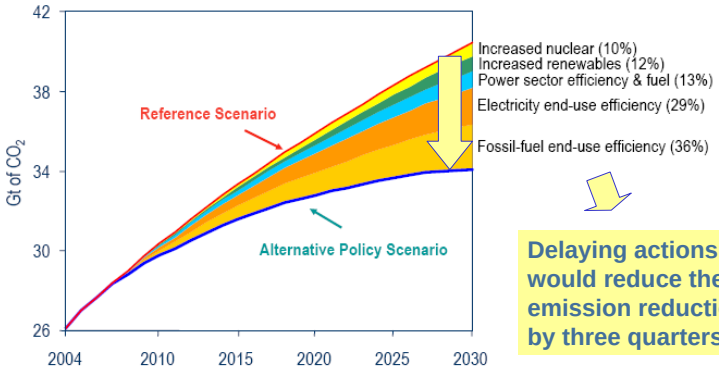
China overtakes the US as the world's biggest emitter before 2010, though its per capita emissions reach just 60% of those of the OECD in 2030

Reference scenario
... does not consider:

CO_2 emissions, peak oil, renewables, efficiency measures

→ Alternative Scenario!

Alternative Policy Scenario: Global Savings in Energy-Related CO_2 Emissions



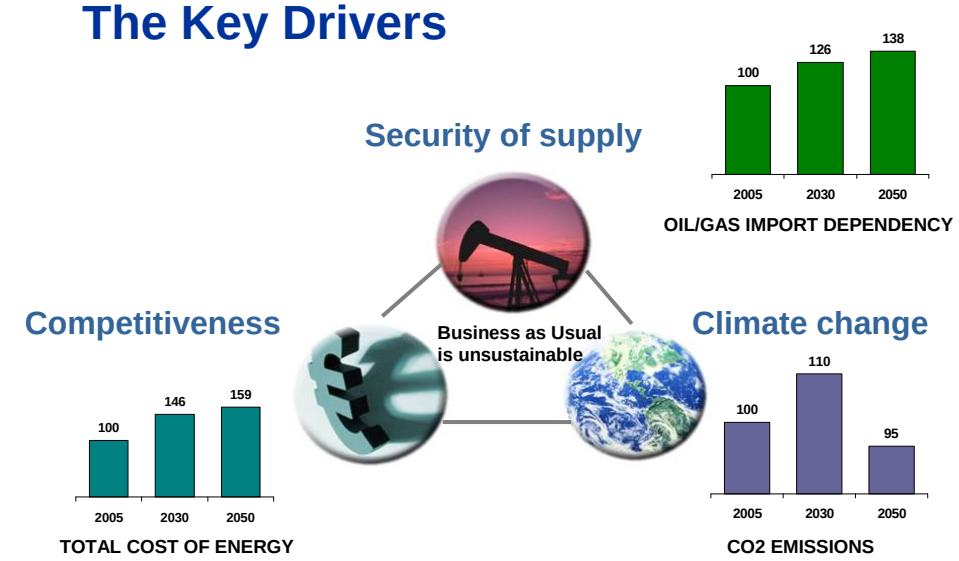
Delaying actions by 10 years would reduce the impact on emission reduction in 2030 by three quarters

Improved end-use efficiency of electricity & fossil fuels accounts for two-thirds of avoided emissions in 2030

EU - Challenge: Balance of objectives

- Energy Package & Roadmap for REN (20-20-20)
  - 20 % emission reduction **by 2020**
  - 20 % share of REN **in EU energy mix until 2020**
    - **10 % biofuels minimum**
    - **Binding overall renewables targets for member states**
  - 20 % **reduction by energy efficiency measures**

The Key Drivers



2. Role of Electricity project: Goals and Means

Three Goals	Means
• Cap on CO_2 emissions (1) • from 1990: -20% in 2020, -30% in 2030, -50% in 2050 • Reduce security of supply vulnerability • Least impact on energy costs and prices	• Accelerated Energy Efficiency • Higher Development of Renewables • Demand-side electro-technologies • Nuclear policy: no phase-out, extension of life time, new technology • Carbon capture and storage technology

(1): The cap on emissions is imposed at the level of the whole of the EU; the model determines the "optimal" burden sharing by assuming as if a perfect ETS was operating over the entire system

2. Eurelectric project „Role of Electricity"

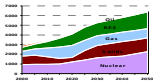
- **Demand side**
- **Supply side**
- **Scenarions**

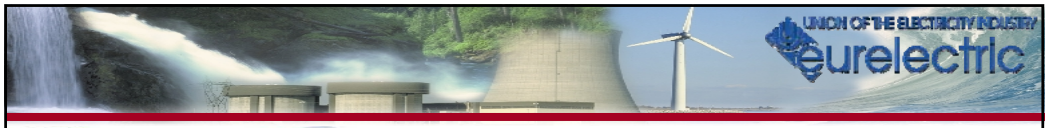
Role of Electricity

1. **Demand side energy efficiency**

2. **Supply side all technologies**

3. **Energy modelling and scenarios**





Demand
Supply
Modeling

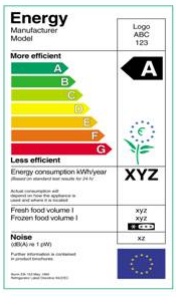
Unleash demand-side efficiency

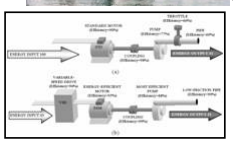
Industry

PHEV

Rail transport

Household Appliances



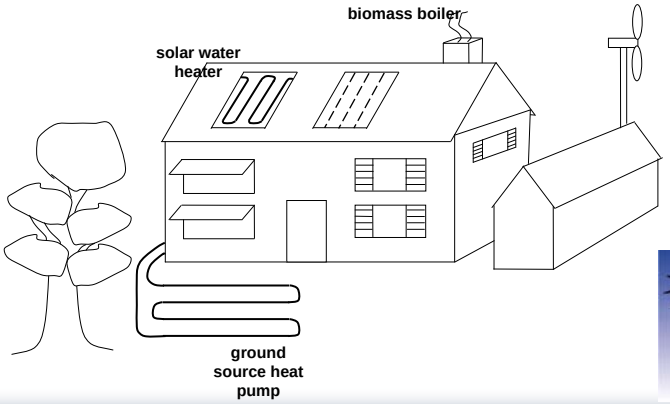


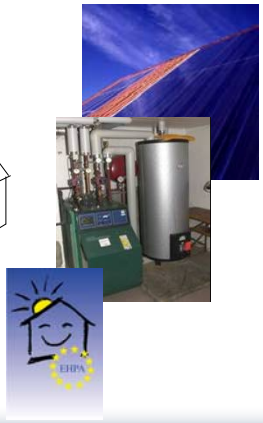
Motor Systems

Heat Pumps

Lighting

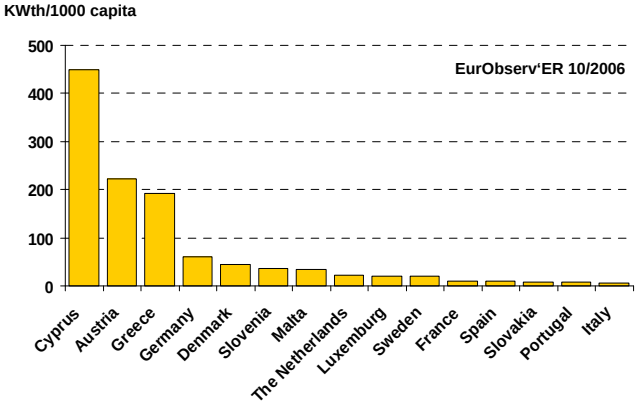
Integrating Demand and Supply solutions: Renewables for sustainable Heating





Leading EU countries: Thermal Solar Energy per capita

Greece, DIMAS Athens

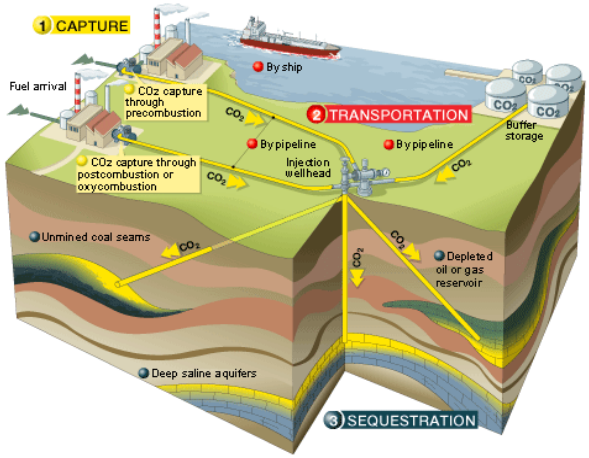


Demand
Supply
Modeling

Supply Side

Towards low-carbon power generation and new technologies in electricity supply

CO2 Capture and Storage



Reduces CO2 emissions in the power generation considerably

At an energy penalty of 5-14% efficiency loss

Enhances oil recovery

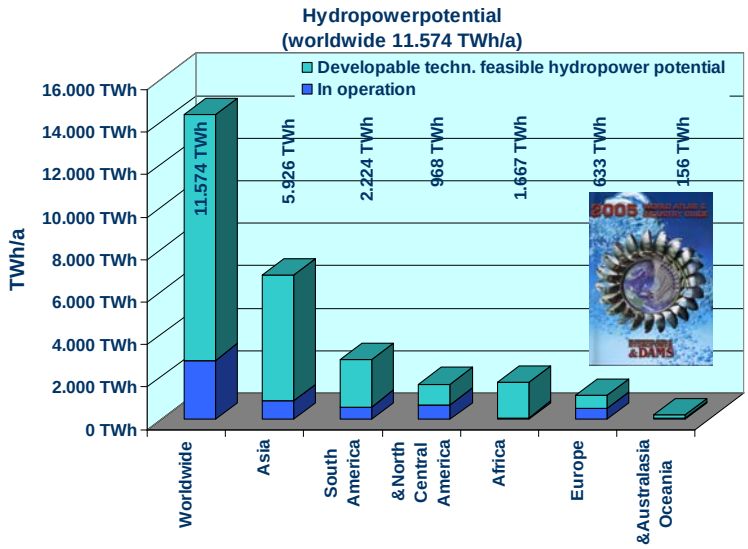
Source: Total

Renewable Power

Key technologies:

Hydro power
Biomass
Wind energy
Solar thermal power
Photovoltaic

Hydro power potential - worldwide

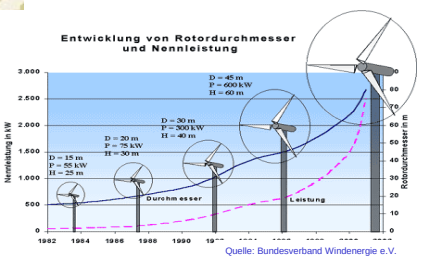


EU Wind Energy

Source: EWEA

„Supergrid“ for off-shore windparcs

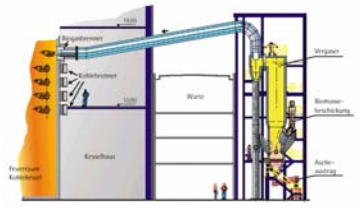
- **EU-goal: 40 GW until 2010 already reached 2005**
- **Outlook 2010: 70-75 GW**
  2020: 180 GW
  2030: 300 GW



Quelle: Bundesverband Windenergie e.V.

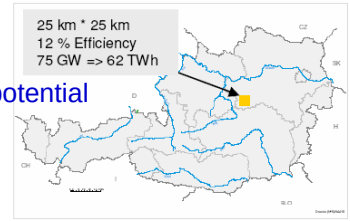
Biomass(es)

- Solid, liquid, biogas: Successful projects!
- Biomass action plan(s)
- **But: Extensive use of biomass causes … … conflict of interests!**

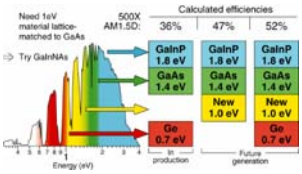


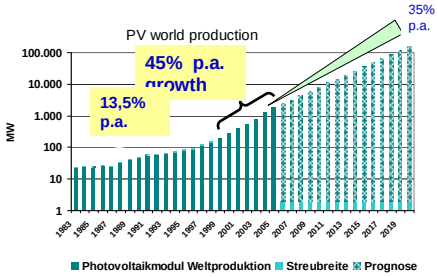
Photovoltaic

High potential



New technologies:



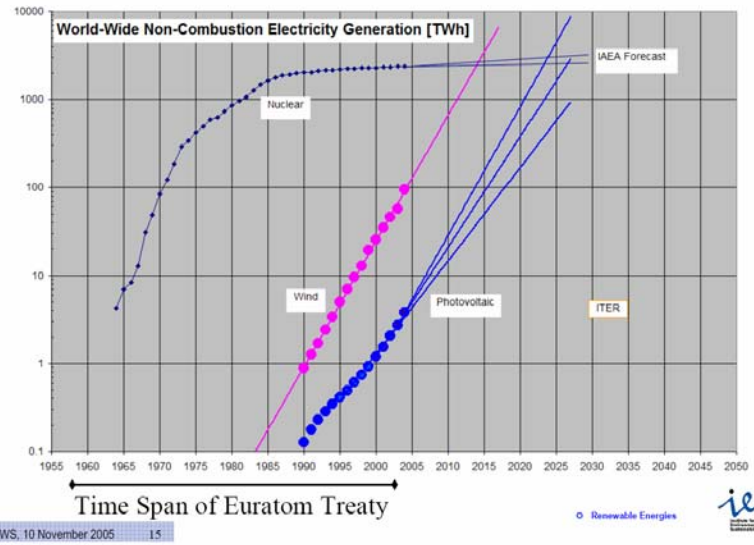


- 3 GW in 2007
- ~6 GW PV production in 2010
- 35 GW in 2015 (?)

→ 100 GW … in 2020 ?
(with 30% growth, is
~400 GW cumulative!)

EUROPEAN COMMISSION
DIRECTORATE GENERAL
Joint Research Centre

Electricity from Wind and Solar: Global Share



Joint Research Centre

Renewable Energies

Nuclear Technology Generations

Generation I

Early Prototype Reactors

- Shippingport
- Dresden, Fermi I
- Magnox

Generation II

Commercial Power Reactors

- LWR-PWR, BWR
- CANDU
- AGR

Generation III

Advanced LWRs

- ABWR
- System 80+

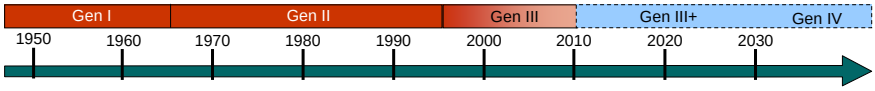
Generation III+

Evolutionary Designs Offering Improved Economics for Near-Term Deployment

Generation IV

- Highly Economical
- Enhanced Safety
- Minimal Waste
- Proliferation Resistant

Source: VGB Powertech



Demand

Supply

Modeling

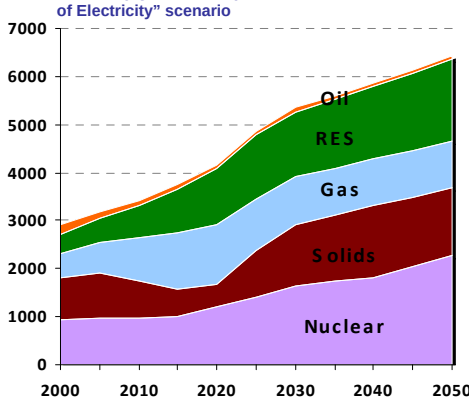
Demand
Supply
Modeling

Alternative scenarios with different policy focus

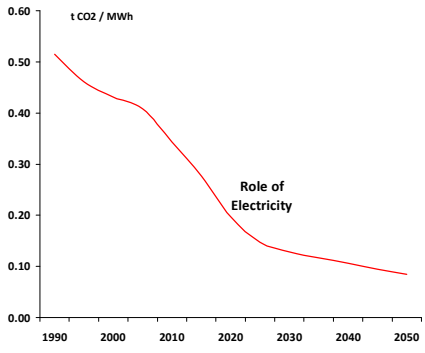
Scenarios	Efficiency & RES	Supply Scenario	Role of Electricity
High Energy Efficiency	✓	×	✓
New electro-technologies	×	×	✓
High Renewables	✓	×	✓
Nuclear Option	×	✓	✓
Carbon Capture and Storage	×	✓	✓

Projections for 2030, EURELECTRIC Role of Electricity Project

Electricity generation by fuel under the "Role of Electricity" scenario



CO2 per MWh under the "Role of Electricity" scenario



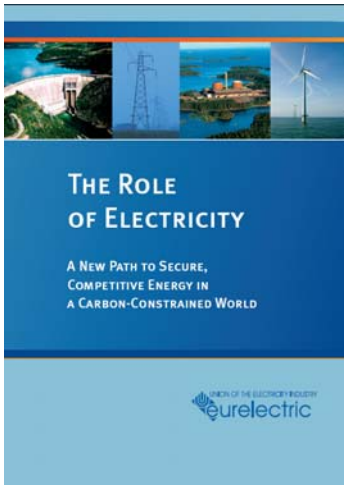
RoE-Project: CONCLUSION

Substantial reduction of GHG emissions without unreasonable costs together with reduced oil-gas dependency

IS POSSIBLE

More Information see:

- www.eurelectric.org



ERMInE: Electricity Research Road Map In Europe

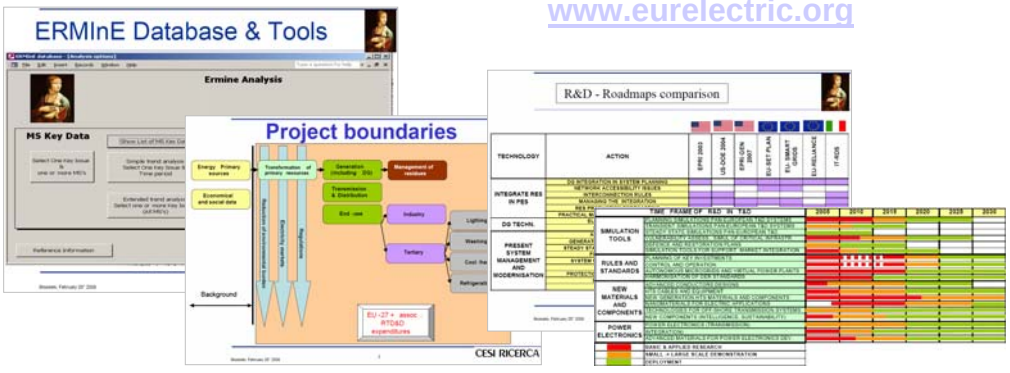
- EU funded project
- Getting an exhaustive idea of **present situation of electricity Research and Technology Development** (RTD) efforts in Europe

- Having indications about **specific RTD needs of the European utilities** and plant/equipment manufacturers in the next 20-25 years

ERMInE: Results

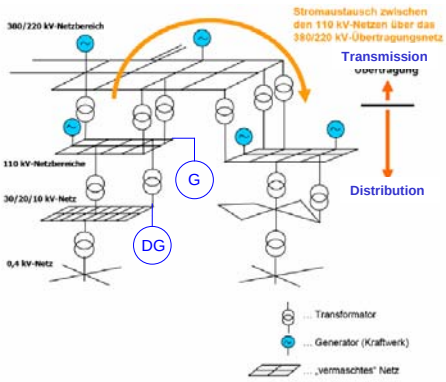
- **Data collection**, RTD data base, EU regional RTD Workshops
- **Road map** for generation, transmission/distribution & end use technologies, comparison of road maps

→ For more information see:
www.eurelectric.org

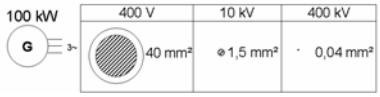


3. Transmission & Distribution, RES Integration

	U	S (Transformer)
HV Transmission	400/230 kV	600 … 1000 MW
MV Distribution	110 kV	300 … 600 MW
	10, 20, 30 kV	10 … 60 MVA
LV Distribution	0,4 kV	50 … 630 … 2000 kVA

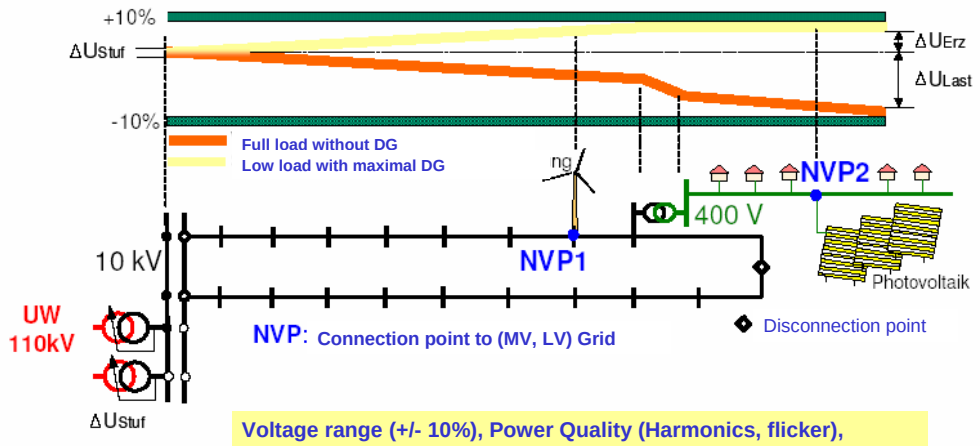


Example 3~ 100 kW :				
Voltage	230/400 V	10 kV	110 kV	400 kV
Line current	144,33 A	5,77 A	0,52 A	0,14 A



Line losses: $P = I^2 * R$
… decrease considerable with higher voltage

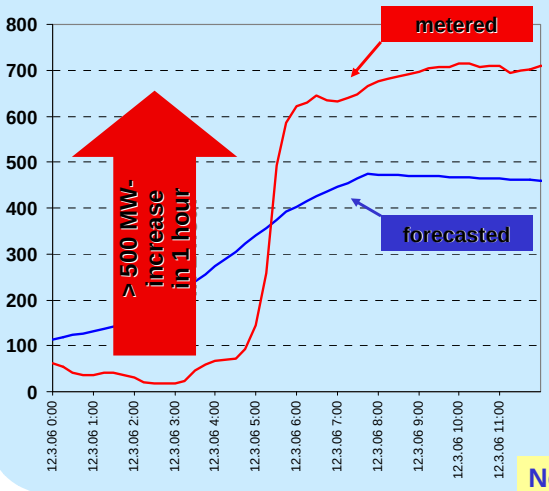
Integration of REN & DG



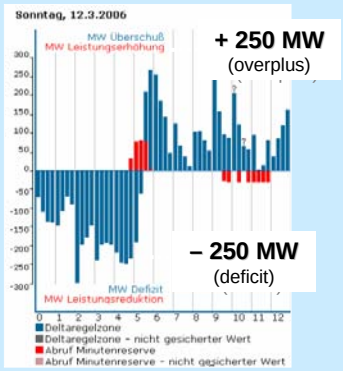
Voltage range (+/- 10%), Power Quality (Harmonics, flicker), Frequency – balancing power (primary, secondary and tertiary control), Control zones, Protection, …

Extreme windpower-fluctuations:

Windpower in MW



Imbalance in control area APG



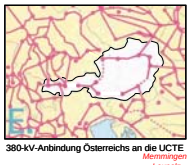
Need of balancing power!

Wind integration: Situation in Austria

about 500 windturbines in a local area → distributed generation?

> 90% of the installed windpower

... bottleneck



Compensation of volatile production with Pump Storage Power Plants!

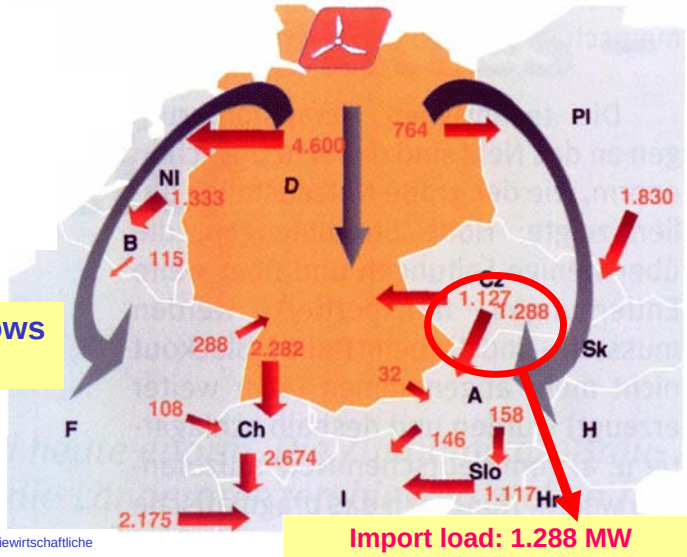
Influence of the German windpower

Middle-Europe
physical load flows

Wind power feed in
Germany:
11.461 MW

Export:
abt. 6.200 MW

European load flows not predictable!



Source: E.ON Netz, Veröffentlicht in et-Energiewirtschaftliche Tagesfragen, Ausgabe Dezember 2005

22. Dez. 2004, 17:30 Uhr,

Import load: 1.288 MW
program value: 490 MW !

Summary

ALL energy options have their pros and cons in terms of:

- AVAILABILITY
- TECHNICAL AND ECONOMIC CHARACTERISTICS
- ACCEPTABILITY
- …

RES are technically and economically complementary to conventional technologies, not opposing them.

Renewable energy: pros

1. RES reduce GHG emissions
2. Supply security: RES contribute to curbing import dependency and improving energy mix diversity
3. RES will provide local or embedded solutions
4. European leadership in RES technologies creating export possibilities

EURELECTRIC fully supports further development of RES

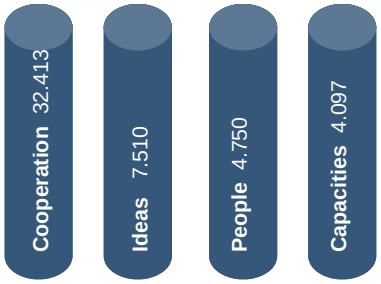
Renewable energy: cons

1. High cost: most RES still not competitive in the market
2. Many RES technologies still immature
3. Supply security: grid impact of intermittent generation to be taken seriously

Cons cannot be ignored, but must be <u>managed</u>

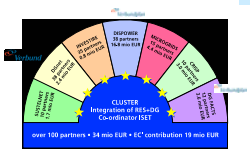
EU Research: 7. Framework Programme (2007-2013)

Total: 54.600 Mio. €



Cooperation: 10 Topics

- Health
- Food, Agriculture and Fisheries, Biotechnology
- Information & communication technologies
- Nanosciences, nanotechnologies, materials & new production technologies
- Energy
- Environment (including Climate Change)
- Transport (including aeronautics)
- Socio-economic Sciences and the Humanities
- Space
- Security

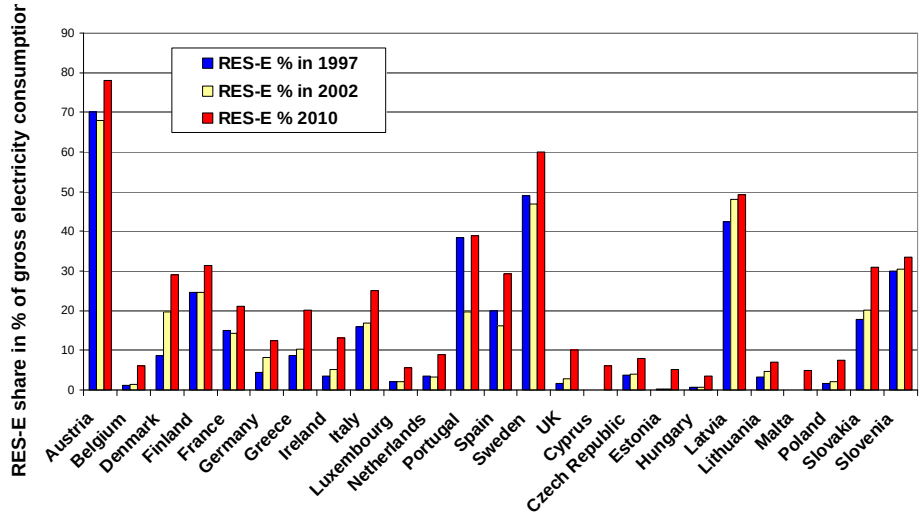


ENERGY: 2.300 Mio. €, 9 Topics

- Hydrogen and fuel cells
- Renewable electricity generation
- Renewable fuel production
- Renewables for heating and cooling
- Energy savings and energy efficiency
- CO2 capture and storage technologies for zero emission power generation
- Clean coal technologies
- Smart energy networks
- Knowledge for energy policy making

3. RES in the market and Support

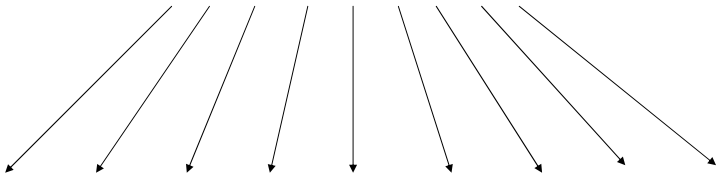
Renewables Electricity share in EU-25



(Source: European Commission, EURELECTRIC)

RES objectives and support schemes

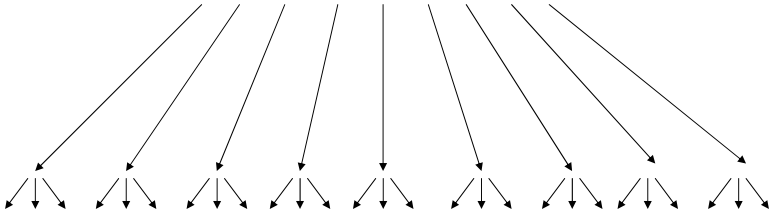
EU target of 20%



27 national targets and support schemes

RES objectives and support schemes

EU target of 20%



27 national targets and support schemes

+ national sub-targets and support schemes:
- biofuels
- heating and cooling
- electricity

RES support in the internal market - risk of current systems

- Separation of RES to a non-market segment in most countries (feed-in tariffs) does not lead to cutting of RES costs
  - RES producer does not have to sell the product → taken automatically into grid
  - Subsidising production, not technological development!
  - Danger of "boom and bust": support levels produce unsustainable levels of cost to consumers

RES support in the internal market - where to go? (1)

Costs must come down:

- No separation to a niche market, but RES to become part of the IEM
- Development of technologies is key to cutting costs
- Move from support of production to support of technological development
- RES support to favour technologies close to market-maturity

RES support in the internal market - where to go? (2)

Allow RES-trade across borders

- Full implementation of standardised Guarantees of Origin
- Certified imports to count to national targets
- As the following step, a move towards harmonised support systems is indispensable in the IEM
  - As called for also by BusinessEurope, IFIEC, ECOSOC, regulators, ETSO, etc
  - Start process in 2007!

Bring RES → Market: Summary

- **Worldwide large potential for REN**
  … is a key component of energy potfolio
- **Steady development necessary**
  … avoid boom and bust!
- **Some Renewables already in and close to the market**
- **Barriers must be overcome (costs, external costs, long term view), force cooperation of all stakeholders**
- **Support must be optimised**

EURELECTIRC position
Conclusion 1/2

- EURELECTRIC supports promotion of renewable energy within a portfolio energy mix
- Renewables Directive shows challenging binding targets for REN. Need for stable investment framework and strong policy commitment → influences higher costs
- Harmonisation of incentive schemes based on RES certificates should be long term aim for Pan-EU Electricity Market
- cost effective way requires efficient trading mechanism, tradeable Guarantees of Origin complement existing national incentive schemes
- EURELECTRIC does not support mandatory priority access rules for renewables - should be transparent and non-discriminatory for all producers. Regulators should recognise the need for an expanded grid and investments in accommodating renewable gerneration

EURELECTIRC position
Conclusion: 2/2

- Lengthly authorisation procedures for renewable generation projects, transmission lines and distribution networks are a major obstacle to the developement of renewable sources. EURELECTRIC fully supports the Comission´s endeavours to simplify authorisation procedures in MS
- Directive recognises the potential of ambient renewable energy utilised by heat pumps. EURELECTRIC fully supports this.
- Existing European and national legislation, e. g. the Water Framework Directive and Habitats Directive, needs to be reviewed to ensure that it is compatible with the developement of renewables
- Support of renewable is best achieved with a market- based approach

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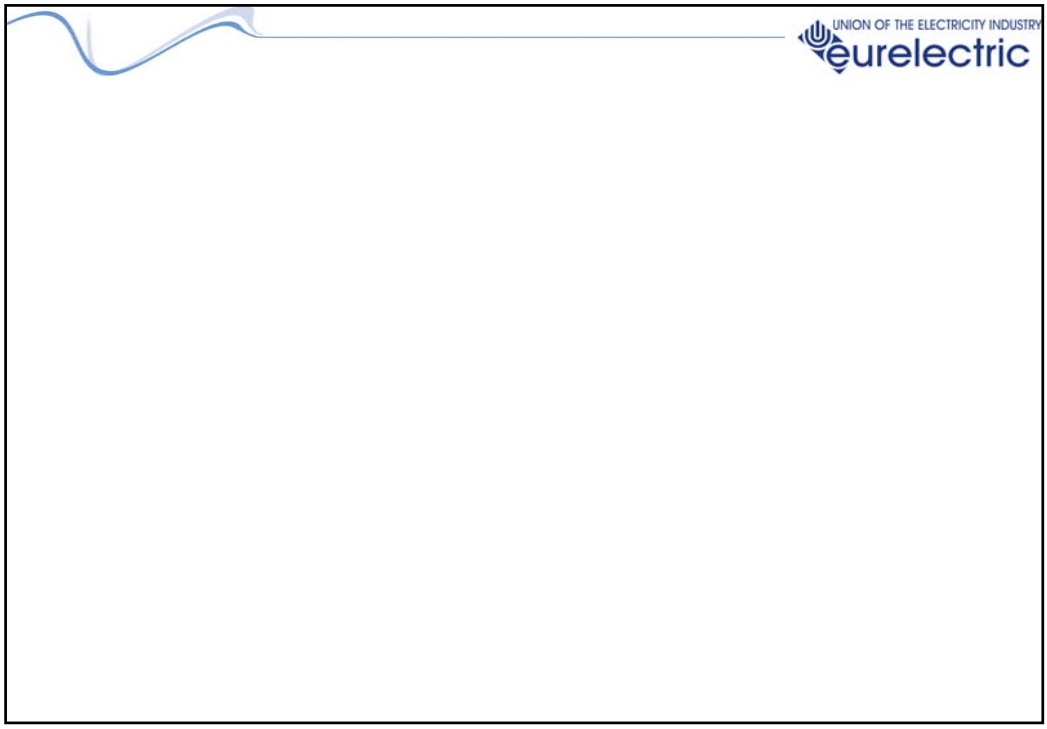
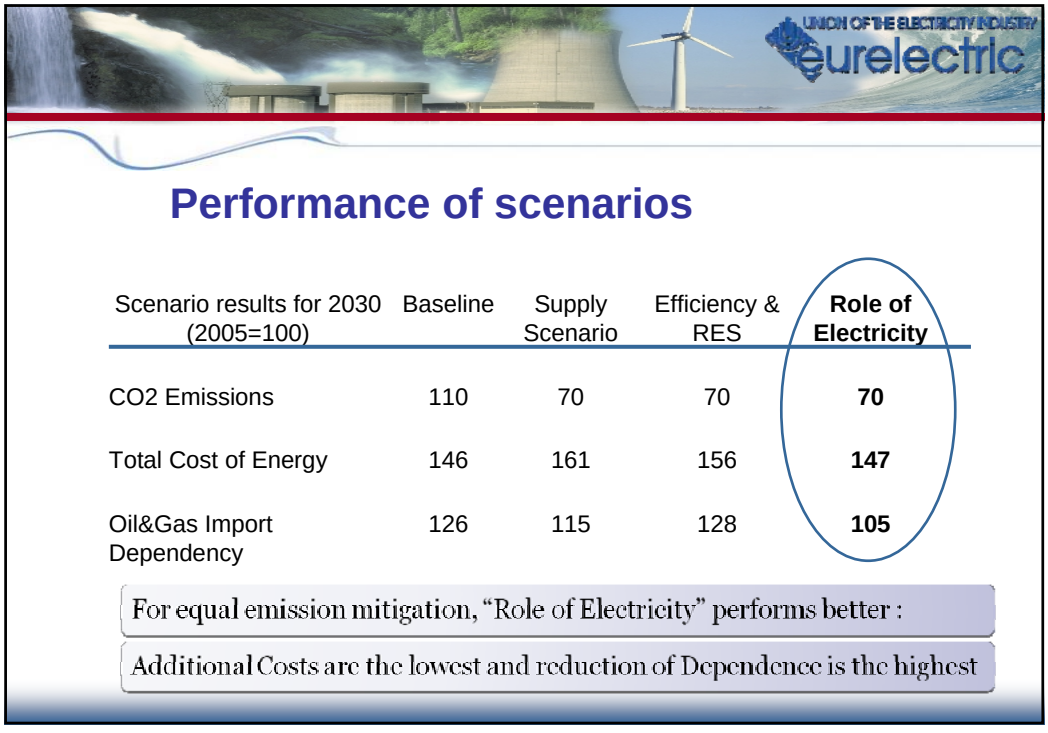




Performance of scenarios

Scenario results for 2030 (2005=100)	Baseline	Supply Scenario	Efficiency & RES	**Role of Electricity**
CO2 Emissions	110	70	70	**70**
Total Cost of Energy	146	161	156	**147**
Oil&Gas Import Dependency	126	115	128	**105**

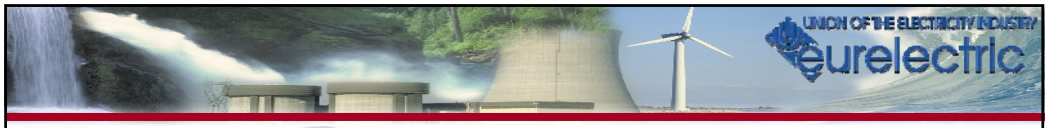
For equal emission mitigation, "Role of Electricity" performs better :

Additional Costs are the lowest and reduction of Dependence is the highest

Link between GHG and renewables policies

	2020		
	Renewables share	Compared to 1990	
		CO2 emissions from energy	Total GHG emissions
Baseline projections	12.9%	4.9%	-1.4%
20% RES achieved	20.0%	-5.6%	-9.0%
20% GHG achieved	14.7%	-14.6%	-20.0%
20% RES and GHG achieved	19.9%	-16.9%	-20.0%

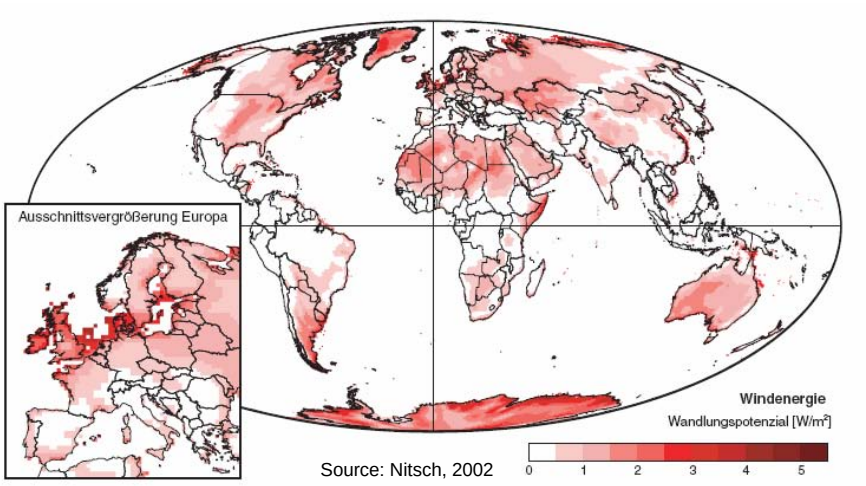
Source : Primes



3. RES & Technologies

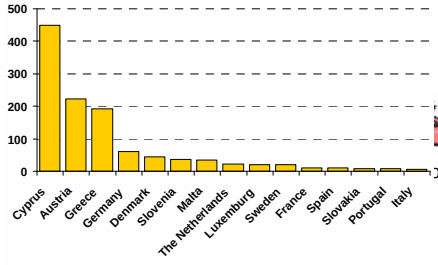
- Hydro
- Wind
- Biomass
- Solar thermal and Photovoltaic
- Heat pump

Wind energy



Source: Nitsch, 2002

Solar thermal energy - Photovoltaic (PV)



ource: Nitsch, 2002

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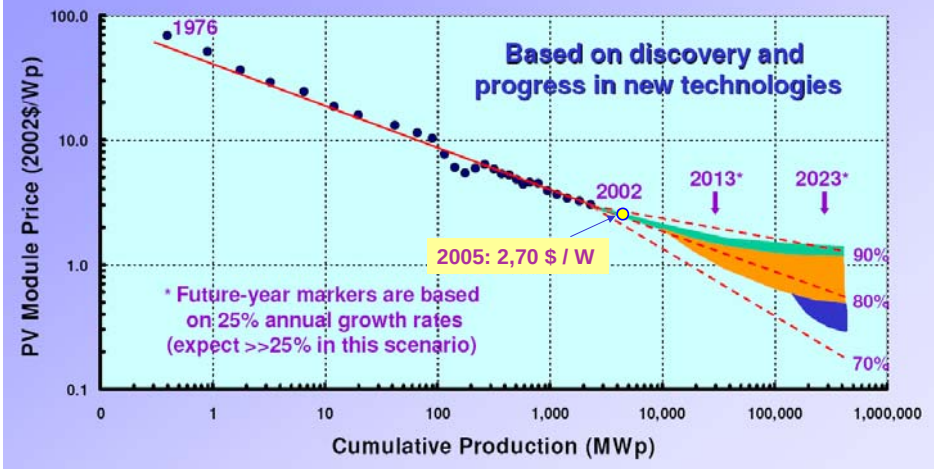
Reduction of Costs

PV Module Production Experience (or "Learning") Curve … The "wishful thinking" scenario



Source: NREL

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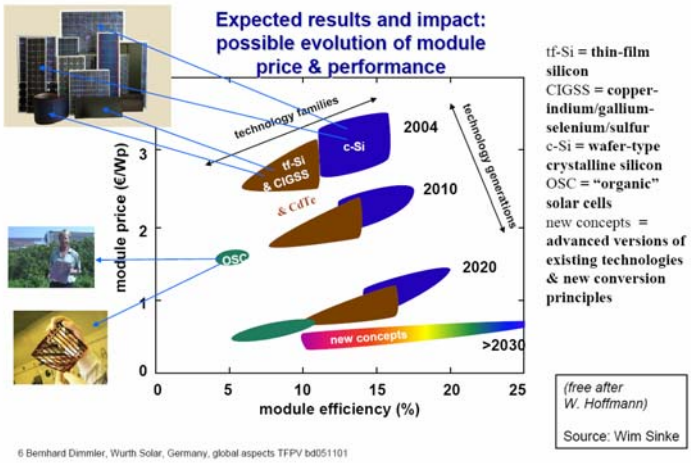
1st international Thin Films in Photovoltaic Industry workshop

10 & 11 November 2005 at JRC/IES, Ispra, Italy



tf-Si = **thin-film silicon**
CIGSS = **copper-indium/gallium-selenium/sulfur**
c-Si = **wafer-type crystalline silicon**
OSC = **"organic" solar cells**
new concepts = **advanced versions of existing technologies & new conversion principles**

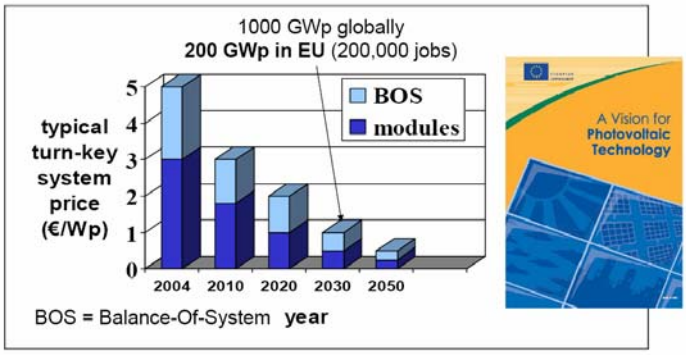
(free after W. Hoffmann)

Source: Wim Sinke

6 Bernhard Dimmler, Wurth Solar, Germany, global aspects TFPV bd051101

http://re.jrc.ec.europa.eu/refsys/html/Workshop%20Thin%20Films%20in%20the%20Photovoltaic%20Industry-November%202005.htm

Expected results and impact: evolution of turn-key system prices



Source: Wim Sinke, http://europa.eu.int/comm/research/energy/pdf/vision-report-final.pdf