Environmental Policy

Renewable Energy:

Wind Energy

Prof. C. San Juan

Annika Karstadt, Martin Galonska

Wind energy - Agenda

1	What is renewable energy
2	Wind energy
3	Wind farms
4	EU policy (White Paper & Action Plan)
5	**Impacts of wind energy**
6	**Comparison of costs**

Wind energy - Agenda

1 What is renewable energy?

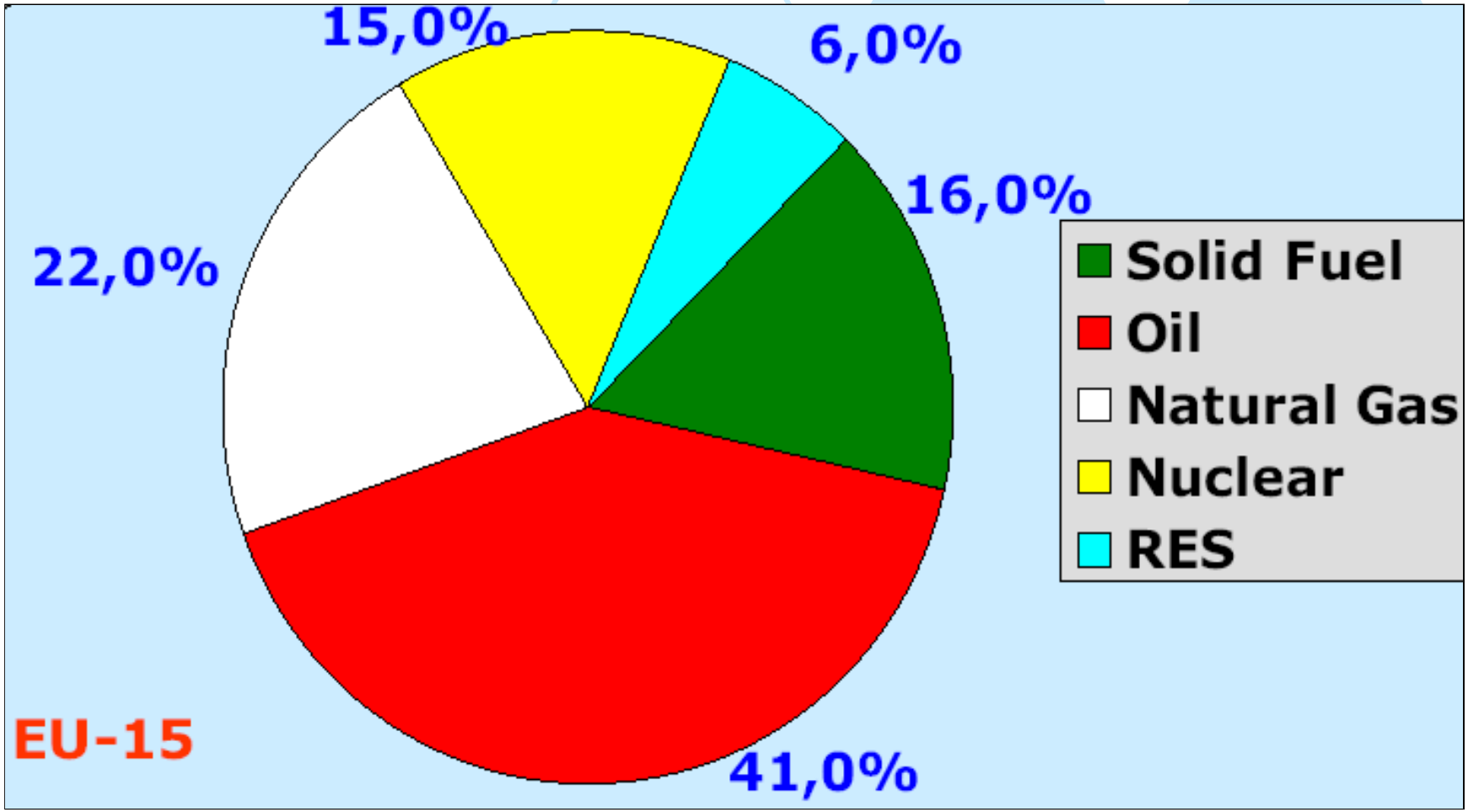
Energy obtained from sources that are essentially inexhausted and of which there is a final supply:

- Photovoltaic
- Fuel energy
- Biomass
- Hydro power
- Geothermal
- Solar-thermal energy
- Wind energy

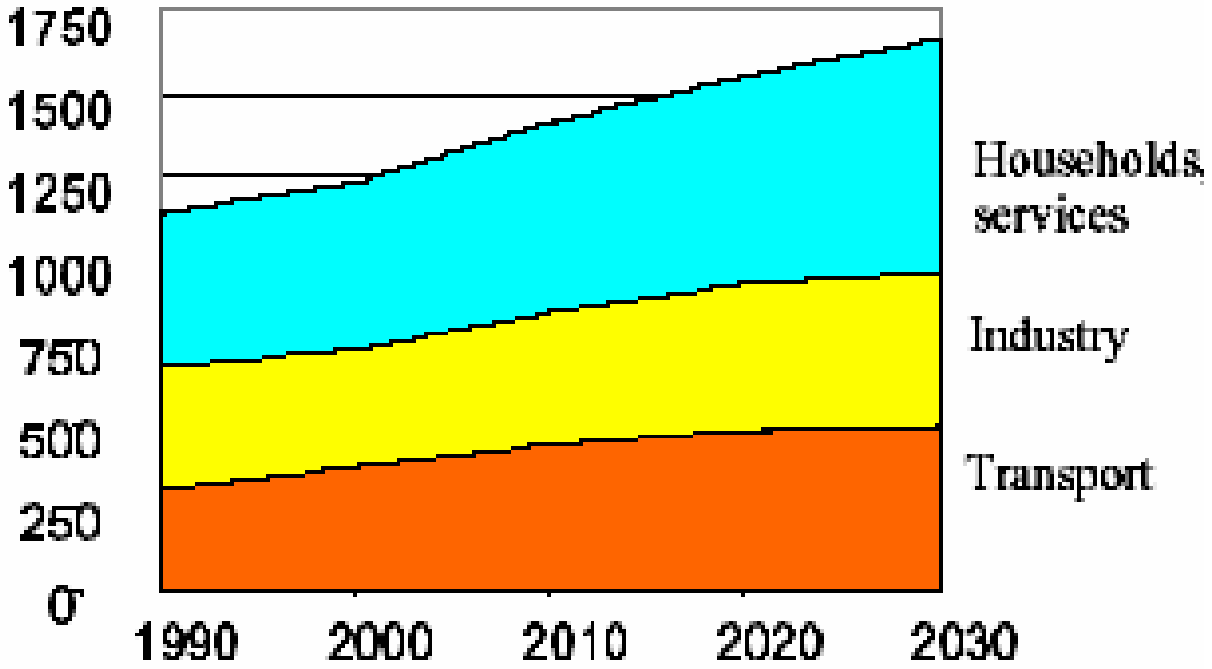
2 Wind energy - Why is wind energy important?

- fossil fuels are running out
- dependency become a threat to economic stability
- Europe relies on imports
- wind energy is an opportunity for the EU
- economic future can be planned

2 Wind energy - Energy Mix 1998



2 Wind energy - Basic facts about energy

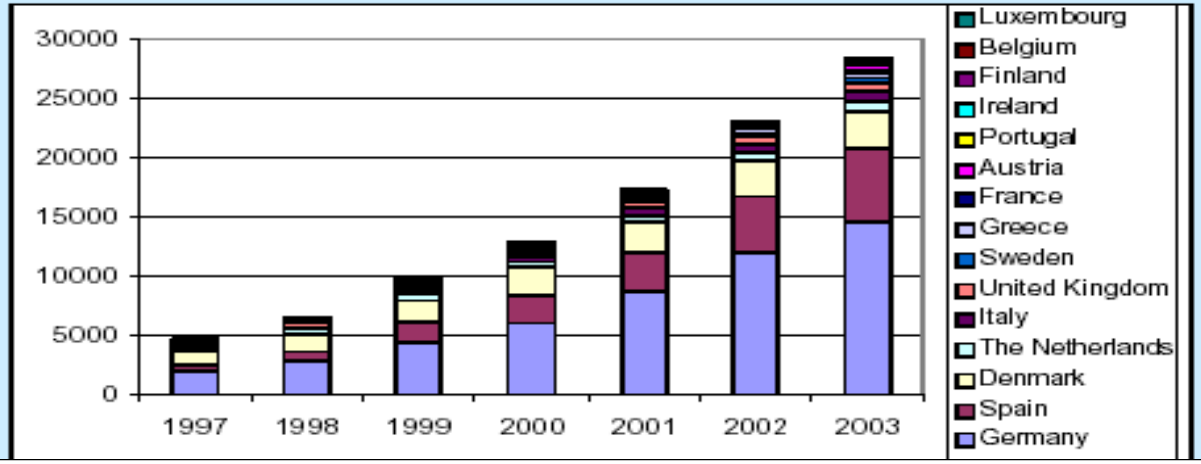


3 Wind farms - Development

- during the last 5 years wind power capacity grew at an average rate of 28%
- increase in annual installation 15.8%
- EU accounts 73% of total installed capacity

3 Wind farms - Development

- **Installed wind energy capacity in EU15 grew by around 600% from 1997 to 2003 - in 2003 alone by 23%**
- **In an average wind year this capacity can produce 60 TWh (= around 2.4% of EU electricity consumption)**
- **Germany, Spain and Denmark contribute 84% of total EU15 wind power capacity:**



3 Wind farms - Spain vs. Germany

Spain

- 2064 MW
- meets 6% of its national electricity from wind power
- FIT´s
- Tax Incentives (10-20% of Corp. Tax)

Germany

- 2054 MW
- meets 5% of its national electricity from wind power
- FIT´s
- Tax Incentives (losses deductible)

3 Wind farms - Statistics...

Wind capacity in:

- India
  3000MW
- USA
  6750MW
- Japan
  991MW
- China
  769MW

4 EU policy - Targets

- Meeting Kyoto Objectives

8% CO2 reduction between 2008 – 2012 compared to 1990

- Doubling the Share of Renewable Energy

From 6% to 12% of gross inland energy production 2010

- Improving Energy Efficiency

Increase by 18% until 2020 compared to 1995

- Maintaining Security of Supply

4 EU policy - How to achieve the targets?

- White Paper on Energy policy
- White Paper on RES & Action Plan
- Green Paper on security of energy supply

4 EU policy - White Paper on Energy Policy (01.1996)

Objectives:

- Environmental protection
- Security of energy supply
- Industrial competitiveness

4 EU policy - White Paper on renewable energies

- Sets out a community strategy and Action Plan to double the share renewable energy from 6 -12% in Gross Inland Production by 2010
- Establishes Sub-Targets in the various sectors
- Preserves flexibility in view of community enlargement
- Instigates a tri-annual review procedure

4 EU policy - White Paper & Action Plan

Campaign Action	Proposed New Installed Capacity	Estimated Total Investment Cost in € billion
1) 1,000,000 PV systems	1,000 MWp	3
2) 10,000 MW Wind Farms	10,000 MW	10
3) 10,000 MWth Biomass	10,000MWth	5
4) Integration in 100 Communities	1,500 MW	2,5

4 EU policy - Green Paper on security of energy supply

On 29 November 2000, the Commission adopted a Green Paper on supply security, in order to launch a debate on the:

- Geopolitical
- Economic
- environmental

5 Impacts of wind energy

Economical & environmental benefits

- Pollution→ reducing air pollution and greenhouse emissions

i. e. 1-MW wind turbine can displace 2,000 tons of carbon dioxide per annum

- Reducing the dependency on non EU member states

- Onshore surface of wind farms can still be used for i. e. agricultural purposes

5 Impacts of wind energy

- Employment

Direct: manufacturing, installation and maintenance
Indirect: inputs needed for manufacturing WT

i. e in Germany 10% increase in the branch of RNS in 2005.

Estimations→ 196,900 in Europe 2020

5 Impacts of wind energy

Economical & environmental costs

- Noise→ at distance of 350 meter = 35dB(A) – 45 dB (A) (noise of a refrigerator)
- Offshore surface of wind farms→ conflicts with fishery, military or shipping routes
- Characteristic landscape→ Wind farms disappear at a distance of 45km (Soeker 2000)
- Birds→ bird strike, bird migration, brood and regeneration areas

6 Comparison of costs

IS WIND ENERGY COMPETITIVE TO OTHER ENERGY SOURCES?

6 Comparison of costs

PRODUCTION COST + EXTERNAL COST = TOTAL COST

Production costs:

Coal → 3.6 Eurocents/kWh
Wind → 6.75 Eurocents/kWh

6 Comparison of costs

External Costs

External costs arise when any cost of production or consumption are passed on to third parties, like future generations or society at large. They are not covered by market prices.

6 Comparison of costs

Examples:

- *Climate change and its resulting damages*
- *Forest damages due to acid rain*
- *Health damages from nuclear reactors accidents*

Aim: internalizing costs and figuring sustainable energy systems out

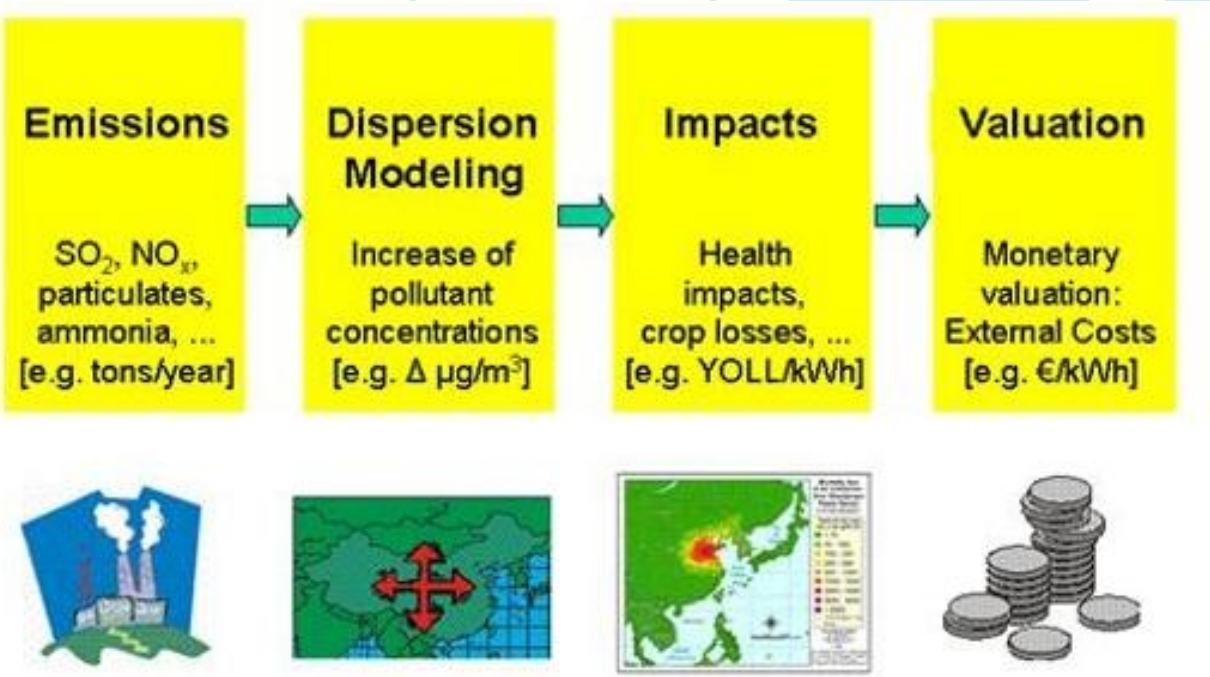
(incorporated in art. 174-2 EU Treaty)

6 Comparison of costs

HOW TO MEASURE EXTERNAL COST?

6 Comparison of energy costs

The impact pass way approach:

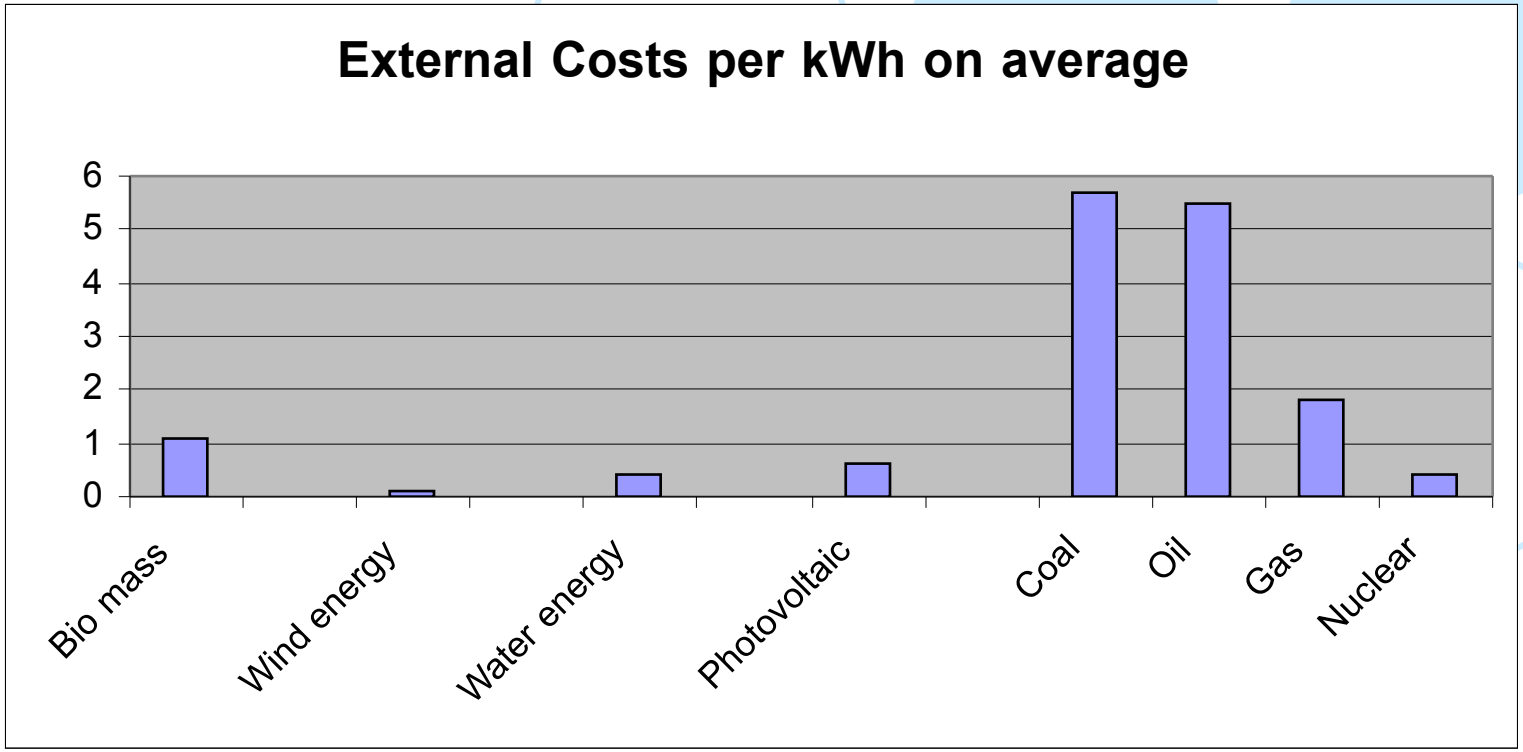


6 Comparison of energy costs – overview external costs

EXTERNAL COST FIGURES FOR ELECTRICITY PRODUCTION IN THE EU FOR EXISTING TECHNOLOGIES[1] (IN € CENT PER KWH*)

Country	Coal & lignite	Peat	Oil	Gas	Nuclear	Biomass	Hydro	PV	Wind
AT				1-3		2-3	0.1		
BE	4-15			1-2	0.5				
DE	3-6		5-8	1-2	0.2	3		0.6	0.05
DK	4-7			2-3		1			0.1
ES	5-8			1-2		3-5**			0.2
FI	2-4	2-5				1			
FR	7-10		8-11	2-4	0.3	1	1		
GR	5-8		3-5	1		0-0.8	1		0.25
IE	6-8	3-4							
IT			3-6	2-3			0.3		
NL	3-4			1-2	0.7	0.5			
NO				1-2		0.2	0.2		0-0.25
PT	4-7			1-2		1-2	0.03		
SE	2-4					0.3	0-0.7		
UK	4-7		3-5	1-2	0.25	1			0.15

6 Comparison of energy costs – overview external costs



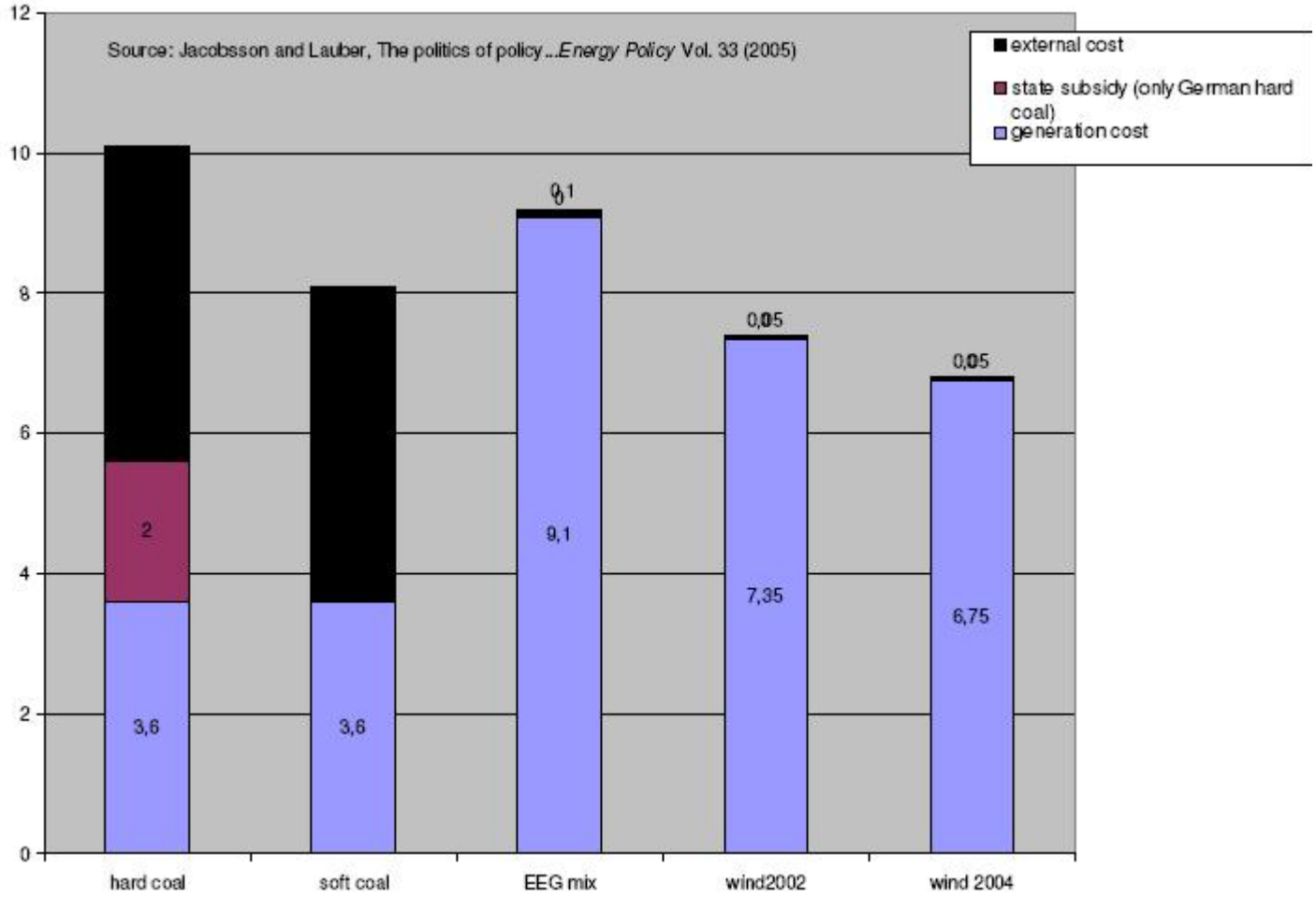
6 Comparison of costs

In general:

- Traditional energy sources
  = economically advantageous
  = ecologically disadvantageous
- Renewable energies = other way around

But due to internalizing external costs wind energy becomes competitive!

6 Comparison of energy costs



6 Comparison of energy costs

HOW ARE EXTERNAL COSTS INTERNALISED IN PRACTISE?

EC guidelines published in February 2001 encourage members states to subsidise "new plants producing renewable energy on the basis of external costs avoided", up to 5 c/kWh.

7 Support mechanisms

3 main approaches:

- Voluntary systems (market determines price & quantity)
- Fixed price systems (government dictates price)
- Renewable quotas (government dictates quantity)

7 Support mechanisms: Voluntary Systems

Depends on the willingness of customers to pay extra for “green” electricity

7 Support mechanisms: Fixed-price systems

- Operators are paid a fixed price for every unit of output.
- Feed-in tariffs
- Fixed-premium system (used in the most Member States)
- Tax incentives

7 Support mechanisms: Renewable quotas

- Fixed Quantity System
- Tendering System
- Tradable Green Certificate

7 Support Mechanisms - Overview

Spain	FITs	2.7 c€/kWh On a regional level: tax incentives investm. subsidies
Germany	FITs	6-8.9 c€/kWh
France	FITs	3.05-8.38 c€/kWh
Denmark	Partial tax exemption & tender	Tax: 4.4 c€/kWh Minimum price: 1.33c€/kWh
Belgium	TGC & guaranteed electricity purchase	Minimum prices for RES

8 Future Markets – Targets of EU

- Target of EU 1997 White Paper → 12% (40,000 MW) in 2010 (level already achieved in 2002)

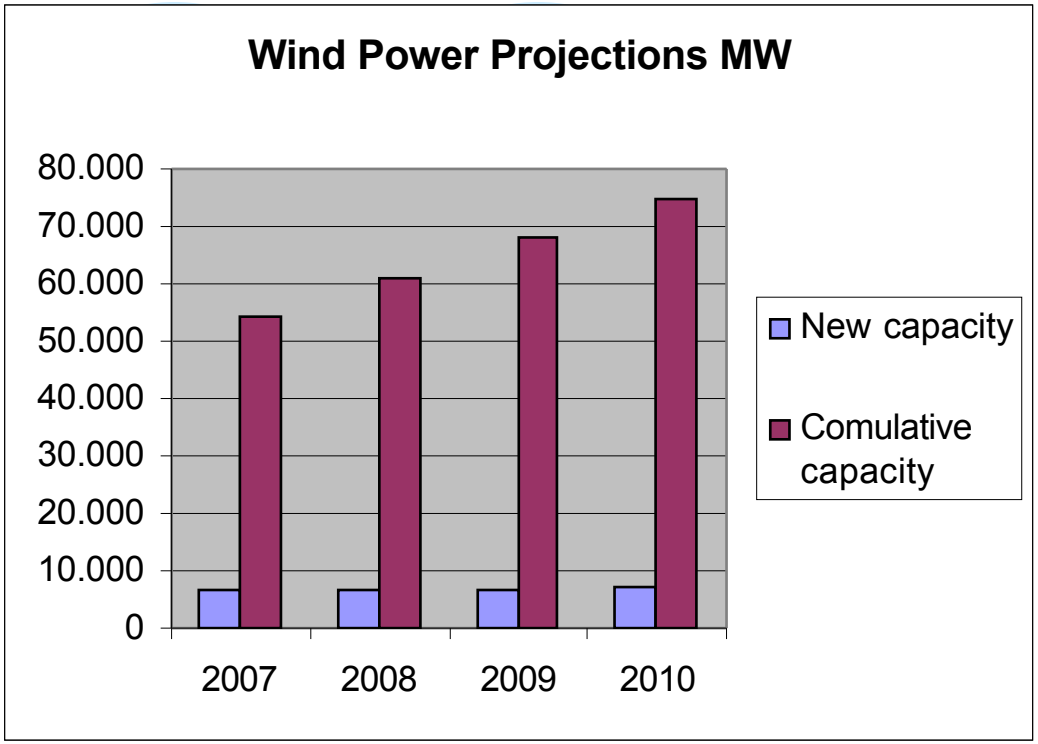
- New target → 22% (69,900 MW) in 2010 (EU Renewables Directive 2001/77/EC)

- Community framework with regard to support mechanism of renewable energy

8 Future Markets - Projections

- Market forecast EU, depending on:

  Cost development, social / environmental benefits & costs, government support, investors, improvement of wind power technology and so on. .



8 Future Markets - Projections

Advanced Scenario:

- In 2020 → 94,800 MW
- In 2030 → 120,200 MW

9 Critical Aspects

- In theory its called inexhaustible but actually the wind energy is just temporarily available.
- Expensive technology (storage capacity) has to be developed to balance supply and demand.
- When considering the whole process from raw material to the disposal of establishment it causes more CO2 output.
- Adjusting costs through subsidies may be not possible in long term

THANK YOU FOR ATTENTION!!

GROUP DISCUSSION

Are objectives of the EU realistic?

Are they economically advantageous in the long term?

Or would it be better to stick to i. e nuclear energy?