Part 6: How to provide Policy and Finance

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MBA Energy Management, Abu Dhabi, November 30, 2009

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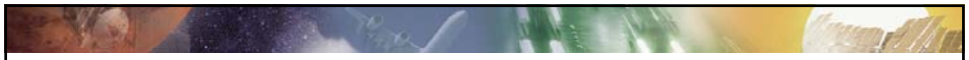

Renewable Energy Investment Challenges

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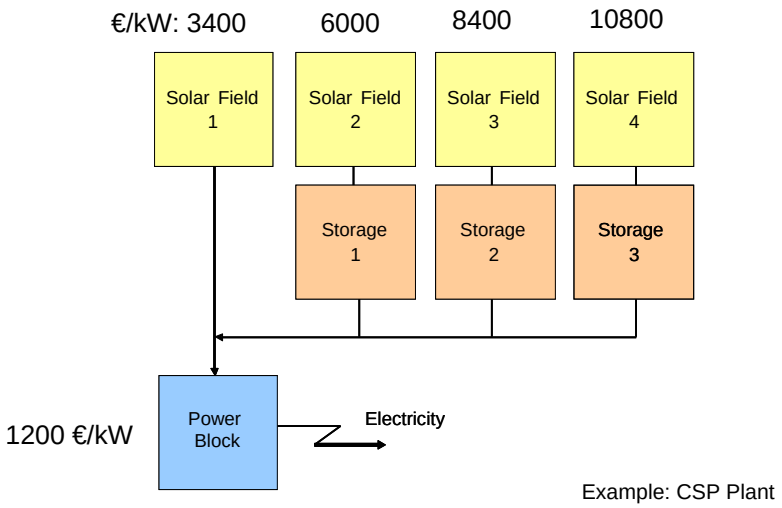
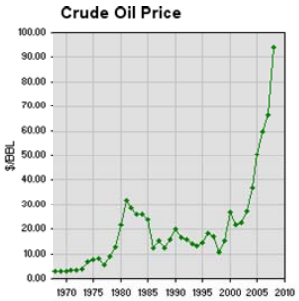
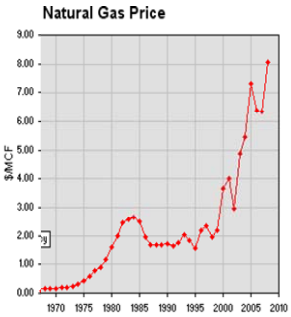
Challenge 1: Investment replaces Fuel

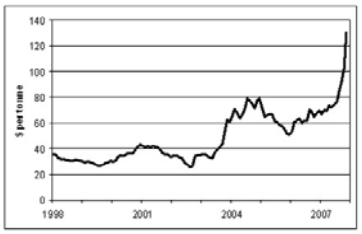


Example: CSP Plant

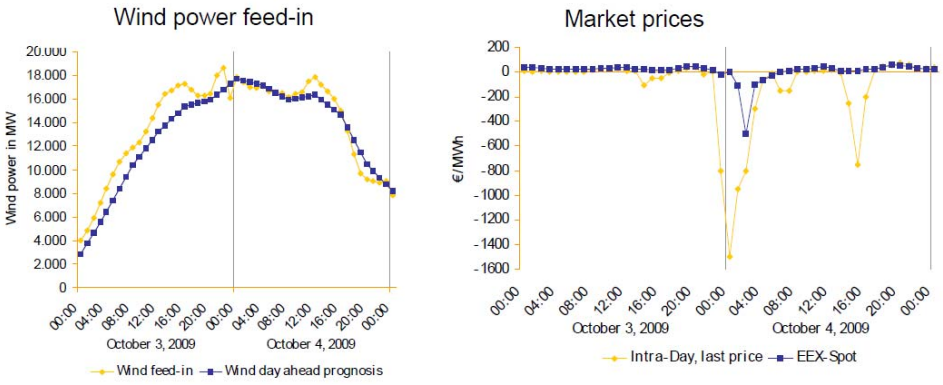
Challenge 2: Known immediate cost but unknown future savings





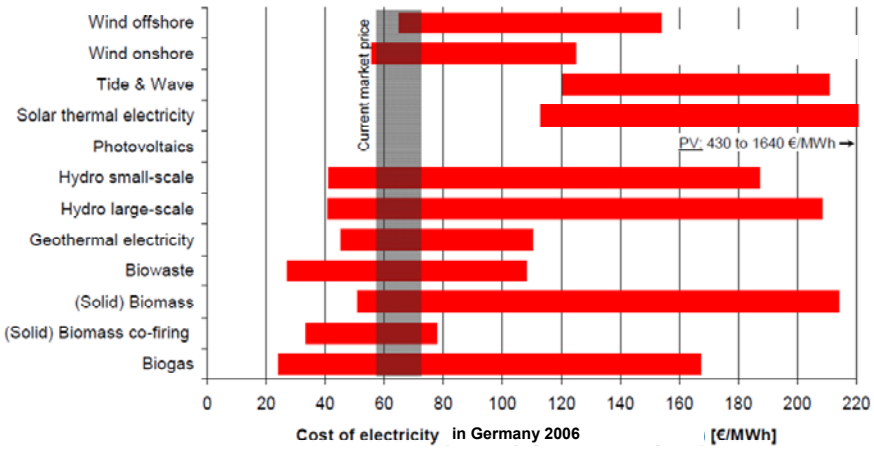


Challenge 3: Fix Cost but Non-Fix Revenue



German power market during the first week-end of October 2009

Challenge 4: Initial Cost Levels above Market Price



Investment Challenges

1. Long-term investment (20-40 years) not only for the power plants but also for their „fuels“.
2. Unknown future savings compared to volatile and unpredictable conventional fuel prices.
3. Known long-term cost but unknown long-term revenues if electricity output is fluctuating and sold at spot markets.
4. Additional cost of early plants cannot be recovered under conventional market conditions and less if competitors are subsidized.

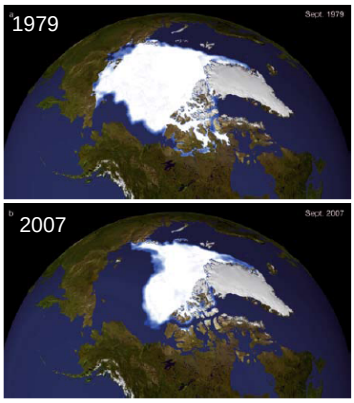
➔ Pioneers are punished by market forces because markets are adapted to conventional power schemes.

Policies

Policy Drivers for Renewable Energy

1. Global Climate Change
2. Fuel Import Dependency and Security of Supply
3. Volatility and Escalation of Fossil Fuel Prices
4. Environmental Impacts of Fossil Fuel Combustion
5. Cost of Nuclear Decommisioning and Disposal
6. Risk of Nuclear Proliferation
7. Exploding Subsidization of Conventional Power Schemes

The Threat of Global Climate Change



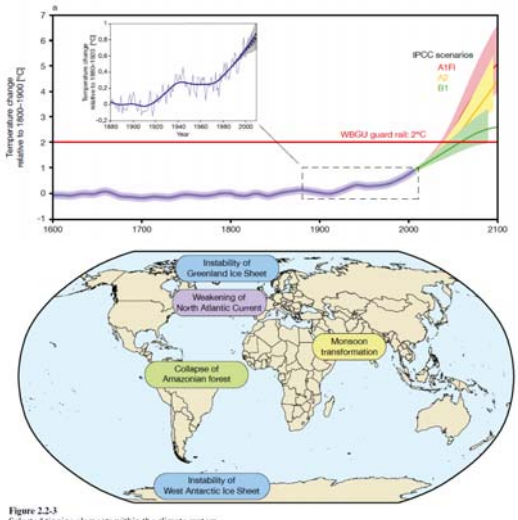
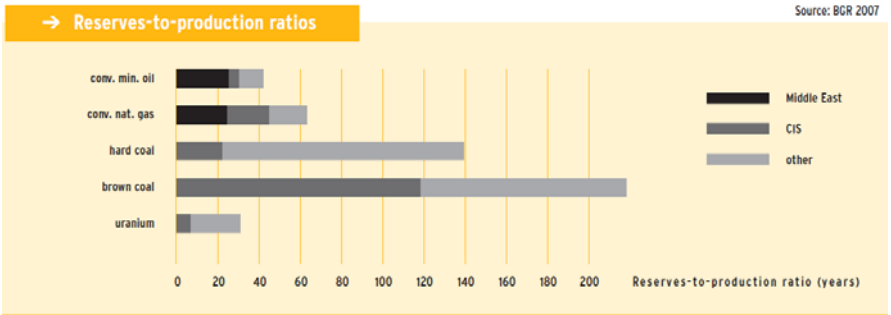


Figure 2.2-3
Selected tipping elements within the climate system.
Source: WBGU, 2008

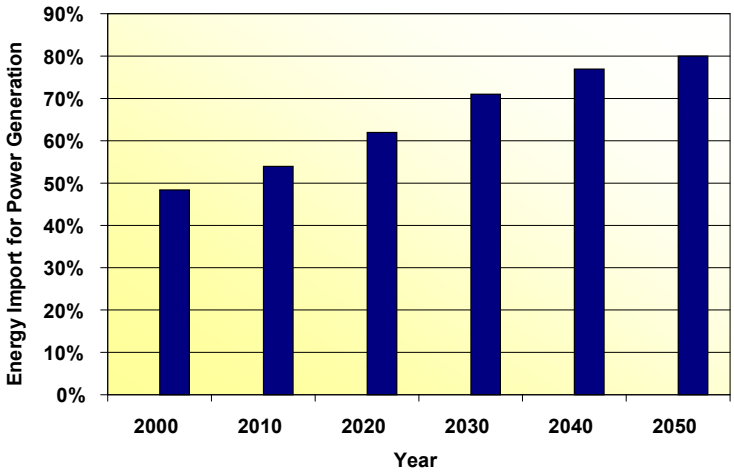
WBGU 2009

Availability of Fossil Fuels



Reserves-to-production ratios for various fuels and regions (at constant rate of consumption).

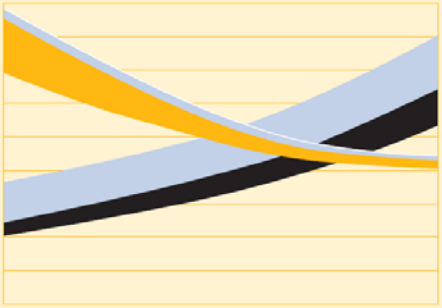
Import Dependency of European Power Generation



→ Development of costs for renewable and conventional energy sources

Source: DLR

Specific energy costs



time →

Renewable energies — Fossil and nuclear energies — External costs

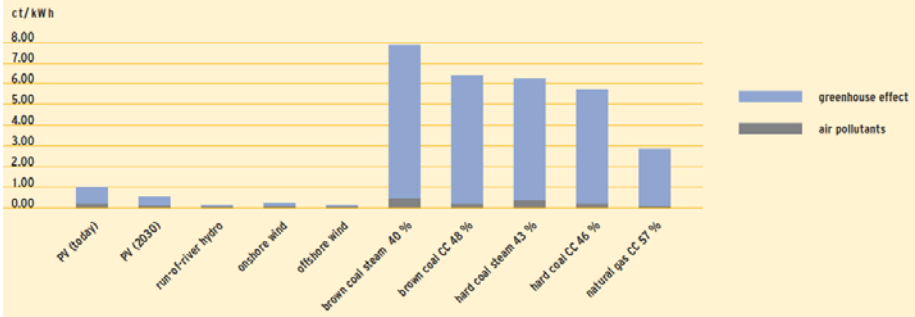
Renewable energies
- Young technologies; large potential for technological progress and cost reduction
- Unlimited, global availability
- Globally applicable, can not be misused, practically no hazards
- Low external costs (system manufacture)

Fossil and nuclear energies
- Limited resources, unequal regional distribution
- Prices increase in the long term
- Expensive and high-risk nuclear technologies (breeders) required to substitute fossil resources
- Nuclear energy is not globally available; high potential for misuse and high-risk
- External costs: prohibitive in the long term for fossil fuels (climate change), probably prohibitive for nuclear

Renewable energy sources provide the cheapest energy in the long run.

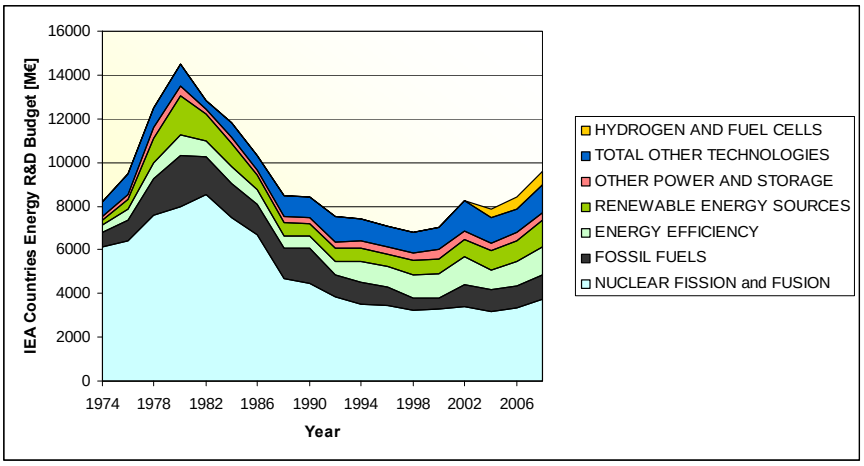
→ External costs for various energy systems

Source: DLR 2006



External costs caused by air pollutants and greenhouse gases

Government Energy R&D Budget in IEA Countries



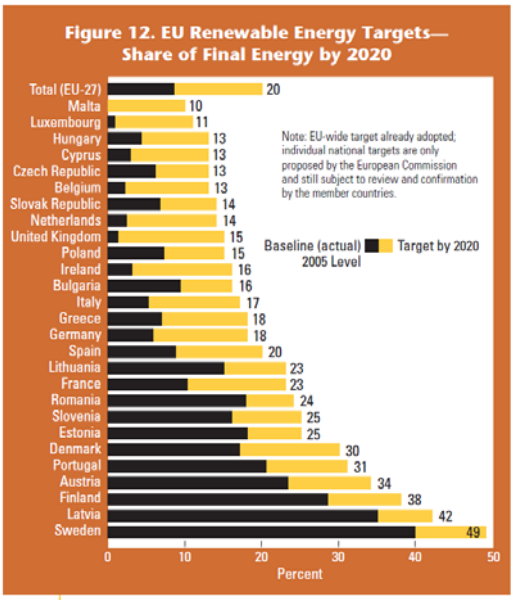
IEA 2009

Energy Subsidies

Government intervention	Examples
Direct financial transfers	Grants to producers Grants to consumers Low-interest or preferential loans to producers
Preferential tax treatments	Rebates or exemption on royalties, duties, producer levies and tariffs Tax credit Accelerated depreciation allowances on energy supply equipment
Trade restrictions	Quota, technical restrictions and trade embargoes
Energy-related services provided by government at less than full cost	Direct investment in energy infrastructure Public research and development
Regulation of the energy sector	Demand guarantees and mandated deployment rates Price controls Market-access restrictions Preferential planning consent and controls over access to resources
Failure to impose external costs	Environmental externality costs Energy security risks and price volatility costs

Subsidies [billion €/y]	Coal/Lignite	Oil/Gas	Nuclear	Renewables	Total
on-budget	6,4	0,2	1,0	0,6	8,2
off-budget	6,6	8,5	1,2	4,7	21,0
external costs *	36,0	16,0	2,7	2,3	57,0
Total EU 15	**49,0**	**24,7**	**4,9**	**7,6**	**86,2**

EEA 2004, ExternE 2003



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REPN 2007

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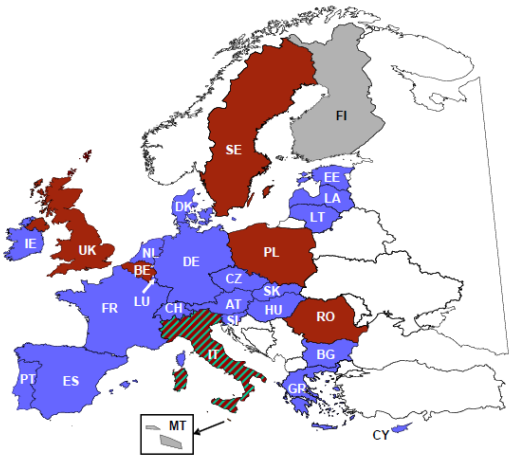
Support Models in European Countries



- Feed-In Tariffs
- Quota + Carb. Certif.
- Quota + Carb. Certif., Feed-In Tariff
- Tax Credits, Grants

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Carbon Trading

Key elements of the budget approach

- The 2°C guard rail is adopted as legally binding in international law.
- For carbon dioxide (CO_2) from fossil sources, a global emission budget that is compatible with the 2°C guard rail is adopted.
- The global CO_2 budget is subdivided into national CO_2 budgets among all countries on an equal per-capita basis.
- Global CO_2 emissions must start to decrease between 2015 and 2020.
- Each country is committed to producing verifiable decarbonization road maps.
- An international emissions trading system is established, with all countries participating.
- The extent and institutional arrangements for financial and technology transfers are agreed.
- A decision is taken to establish a world climate bank.
- For CO_2 emissions resulting from land-use changes, especially deforestation, a separate legally binding regime is agreed.
- Specific agreements are reached on other greenhouse gases and climate-relevant substances.

WBGU 2009

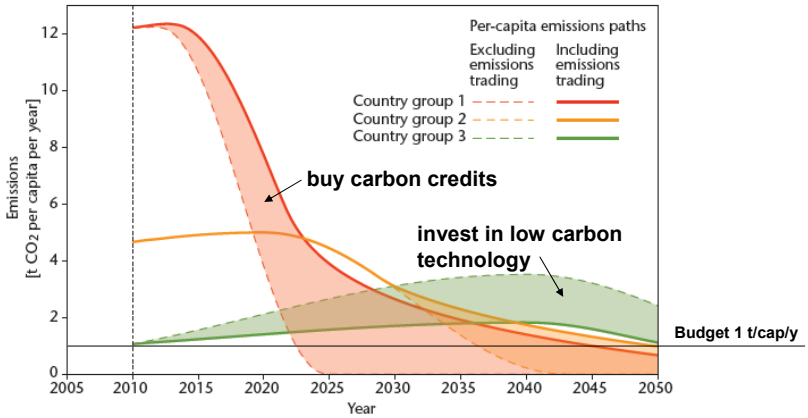
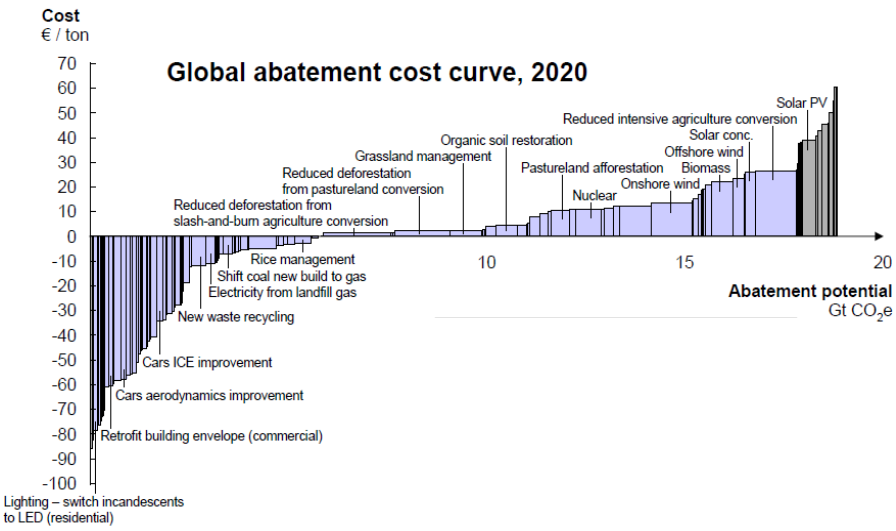


Figure 1: Examples of per-capita CO_2 emissions trajectories without (broken curves) and with (unbroken curves) emissions trading. It is assumed that Group 1 countries increase their budget by purchasing emission allowances for 122 Gt CO_2, at a cost of €10–30 per t CO_2, equivalent to €20–60 per capita per year on average. Total annual costs would amount to €30–90 billion. Group 2 countries purchase emission allowances totalling 41 Gt CO_2. The suppliers of the sum total, i.e. 163 Gt CO_2, are the Group 3 countries.
Source: WBGU, 2009



Carbon Trading:

A global CO_2 per capita budget must be agreed and enforced.

Carbon trading will accellerate avoidence in developing countries and delay avoidence in industrial countries.

Least cost options will be realized first (no learning curve is initiated for other options).

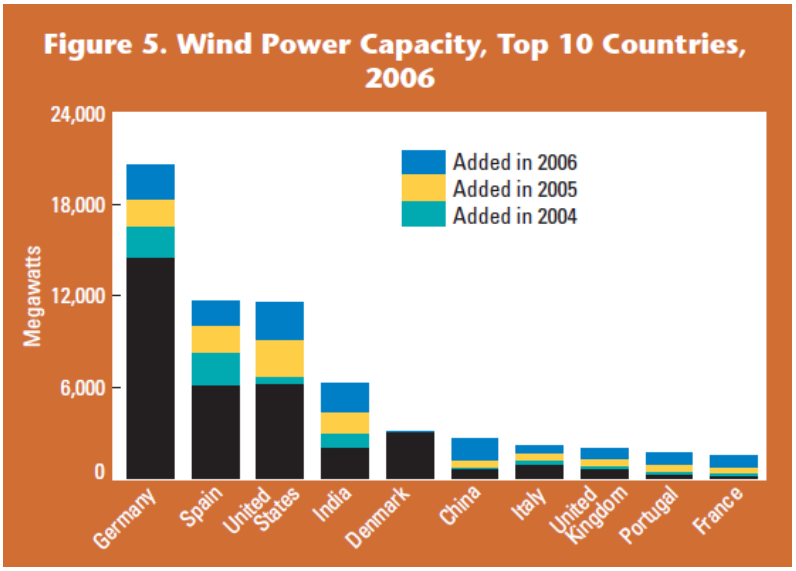
Quota Models

Quota Model:

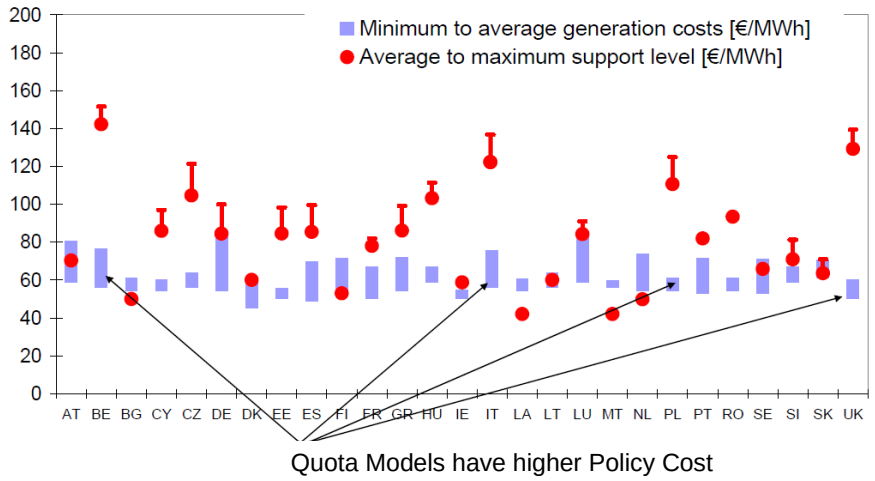
A portfolio standard is set by government and market players are forced to introduce a certain amount of renewable energy.

Market will select most economic solutions.

Is considered the most market-oriented instrument by some groups.



Support Levels in European Countries



Quota Models have higher Policy Cost

Quota Model:

High risk for investors leads to high (capital) cost.

Only least cost options are selected.

Was the favorite instrument of Mao Tse Tung.

Feed-In Law

How does a Renewable Electricity Feed-In Law Work?

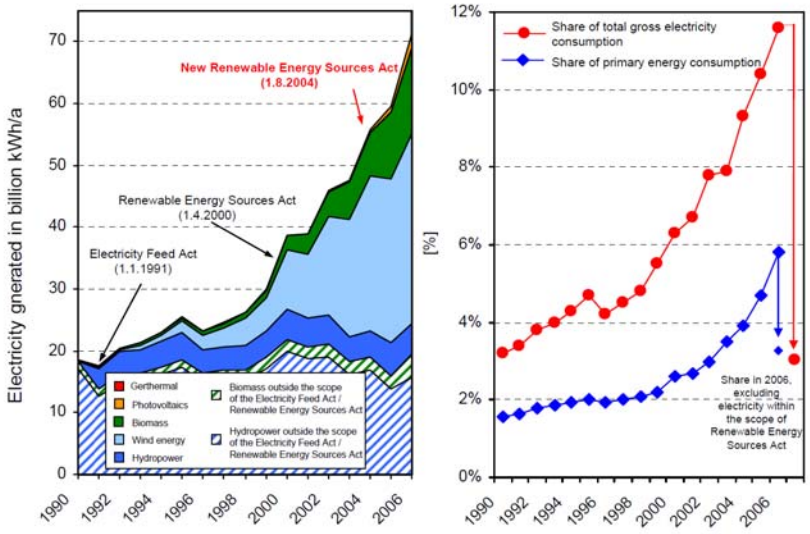
1. A feed-in law is a long-term power purchase agreement enforced and guaranteed by the government.
2. Utilities must take renewable electricity as generated and pay a fix tariff or an additional premium per kWh to producers.
3. Utilities bill additional costs to consumers.
4. Feed-in tariffs must be adjusted to local conditions, e.g.:
   - renewable resource potential
   - technology type, status and learning curve
   - inflation rates
5. Regulation must be reliable, transparent and predictable and should only be fine-tuned after implementation.

German Feed-In Law: Example Tariffs 2008

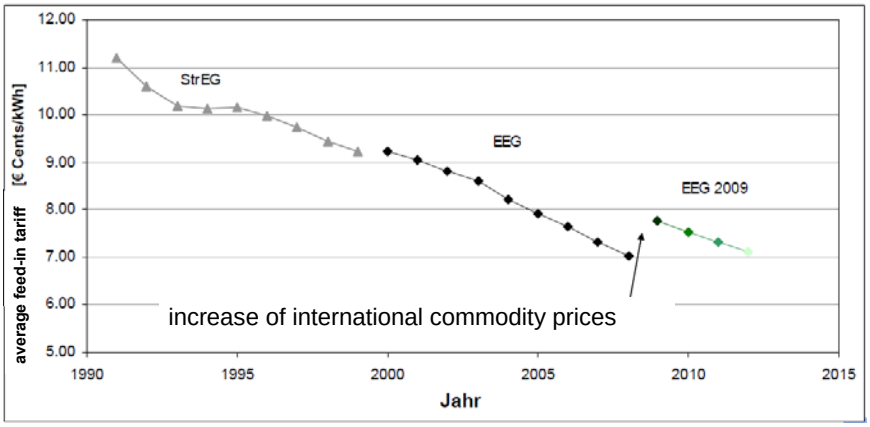
	Feed-In Tariff	Annual Degression	Payment Period
	ct/kWh	%/a	a
large Hydro	3.55 - 7.36	1.0	15
small Hydro	6.65 - 9.67	0.0	30
Biogas	7.92 - 16.65	1.5	20
Geothermal	7.16 - 15.00	1.0	20
Wind onshore	5.07 - 8.03	2.0	20
Wind offshore	6.07 - 8.92	2.0	20
Photovoltaic	35.49 - 51.75	5.0	20

higher values: first 5 years and bonus additions

German Feed-In Law: Impact on RES Utilization



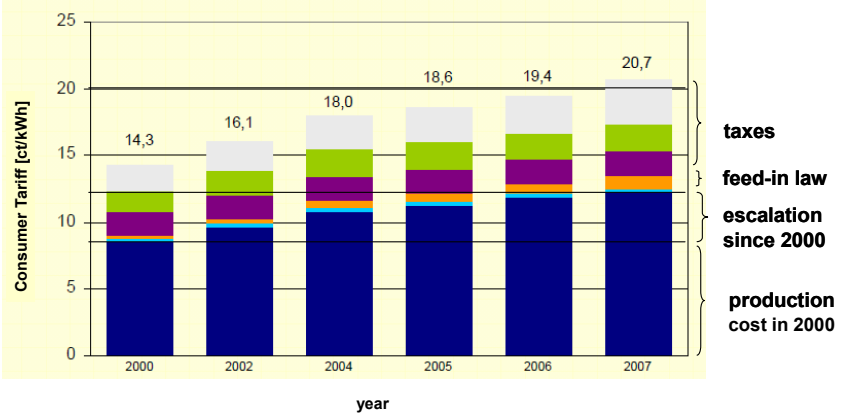
Support Level of the German Feed-in Tariff System



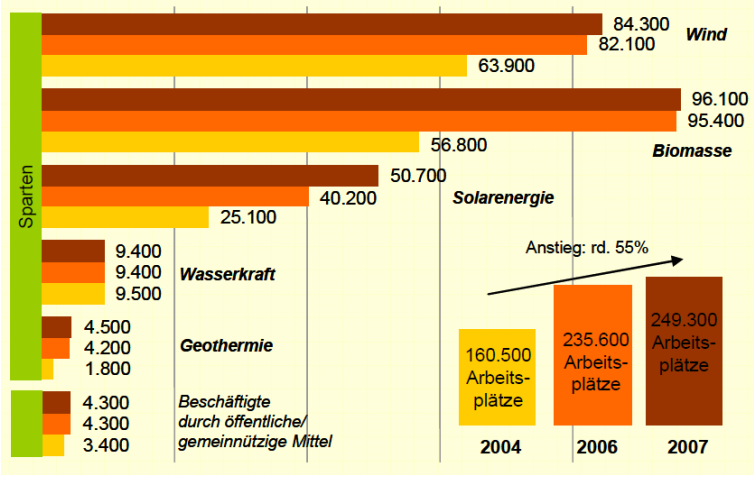
German Feed-In Law: Impact on Consumers

Year	Feed-In Electricity	Feed-In Tariffs Paid	Avoided Fuel Cost	Additional Load to Consumers	Consumer Tariff Addition	Avoided Cost Escalation
	GWh/y	Billion Euro	Billion Euro	Billion Euro	€-cent/kWh	€-cent/kWh
2000	10391	1,00	0,00	1,00	0,200	0,000
2001	18145	1,58	0,38	1,20	0,300	0,073
2002	24970	2,23	0,43	1,80	0,400	0,081
2003	28417	2,61	0,71	1,90	0,400	0,131
2004	38511	3,61	1,11	2,50	0,600	0,202
2005	43967	4,50	1,70	2,80	0,600	0,304
2006	51545	5,81	2,51	3,30	0,800	0,440
2007	67010	7,61	3,31	4,30	1,000	0,571

German Feed-In Law: Impact on Consumers



German Feed-In Law: Impact on Labour



Why does a Renewable Electricity Feed-In Law Work?

1. Long-term investments need long-term power purchase agreements. Renewables guarantee long-term price stability.
2. PPA security leads to lower interest rates expected by investors (6-7%). This reduces dramatically the (capital) cost.
3. Consumers do not feel the temporary additional load but profit from more stable prices and fuel savings.
4. Feed-in tariffs leave room for competition within each technology segment, but assure that new sources are made accessible.
5. Well balanced feed-in tariffs reduced from year to year optimise cost reductions by learning, competition and economies of scale.

➔ its not a subsidy, but a least cost investment in new energy

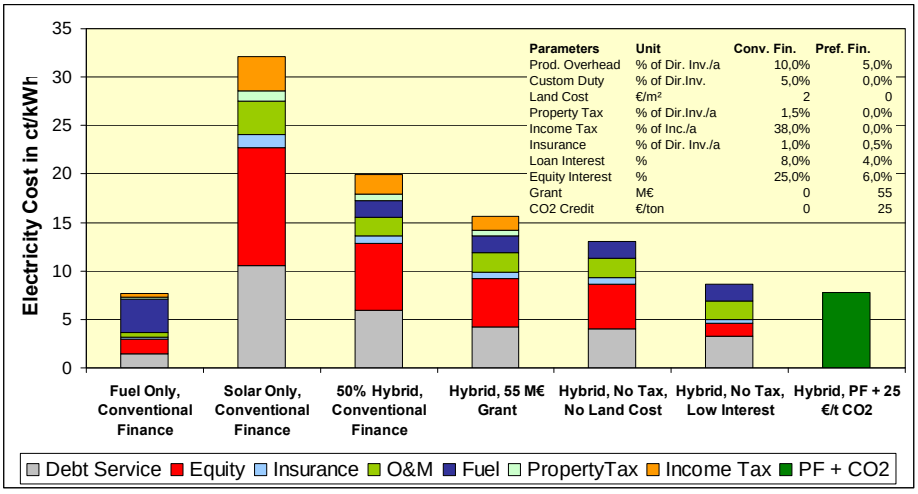
Feed-In Law:

Pioneers are rewarded while consumers are forced to invest in new sources of energy.

Additional cost is only paid for delivered renewable kWh.

Buy Down Subsidies

Effects of Preferential Subsidized Finance on CSP Project



Parameters	Unit	Conv. Fin.	Pref. Fin.
Prod. Overhead	% of Dir. Inv./a	10,0%	5,0%
Custom Duty	% of Dir.Inv.	5,0%	0,0%
Land Cost	€/m²	2	0
Property Tax	% of Dir.Inv./a	1,5%	0,0%
Income Tax	% of Inc./a	38,0%	0,0%
Insurance	% of Dir. Inv./a	1,0%	0,5%
Loan Interest	%	8,0%	4,0%
Equity Interest	%	25,0%	6,0%
Grant	M€	0	55
CO2 Credit	€/ton	0	25

medium load plant with 3600 full load hours per year

Buy Down Subsidy:

Consumers are „protected“

No guarantee that plant will ever produce electricity

Investors ≠ Beneficiaries (consumers)

"**Carbon pricing** alone will not be sufficient to reduce emissions on the scale and pace required … **deployment incentives** for low emission technologies should increase two to five times … **public energy R&D funding** should double" – Stern Review

Sources and Literature

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