

Learning or Lock-in:

Optimal Policy Instruments to Support Clean Technology

Prof. Dr. Ottmar Edenhofer

Our Common Future
Hannover, 4th November 2010

Volkswagen Stiftung



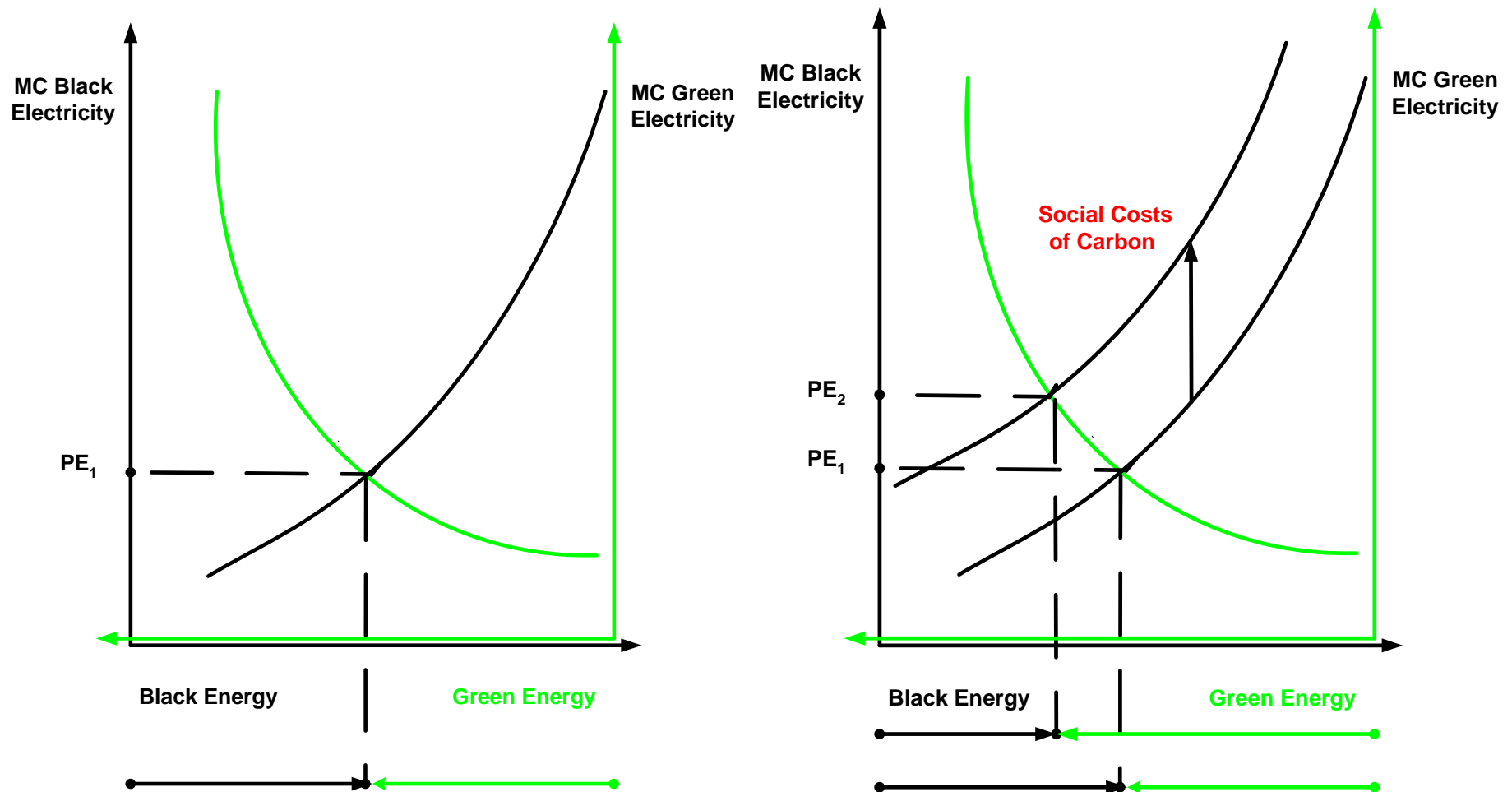
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



Working Group III
Mitigation of Climate Change



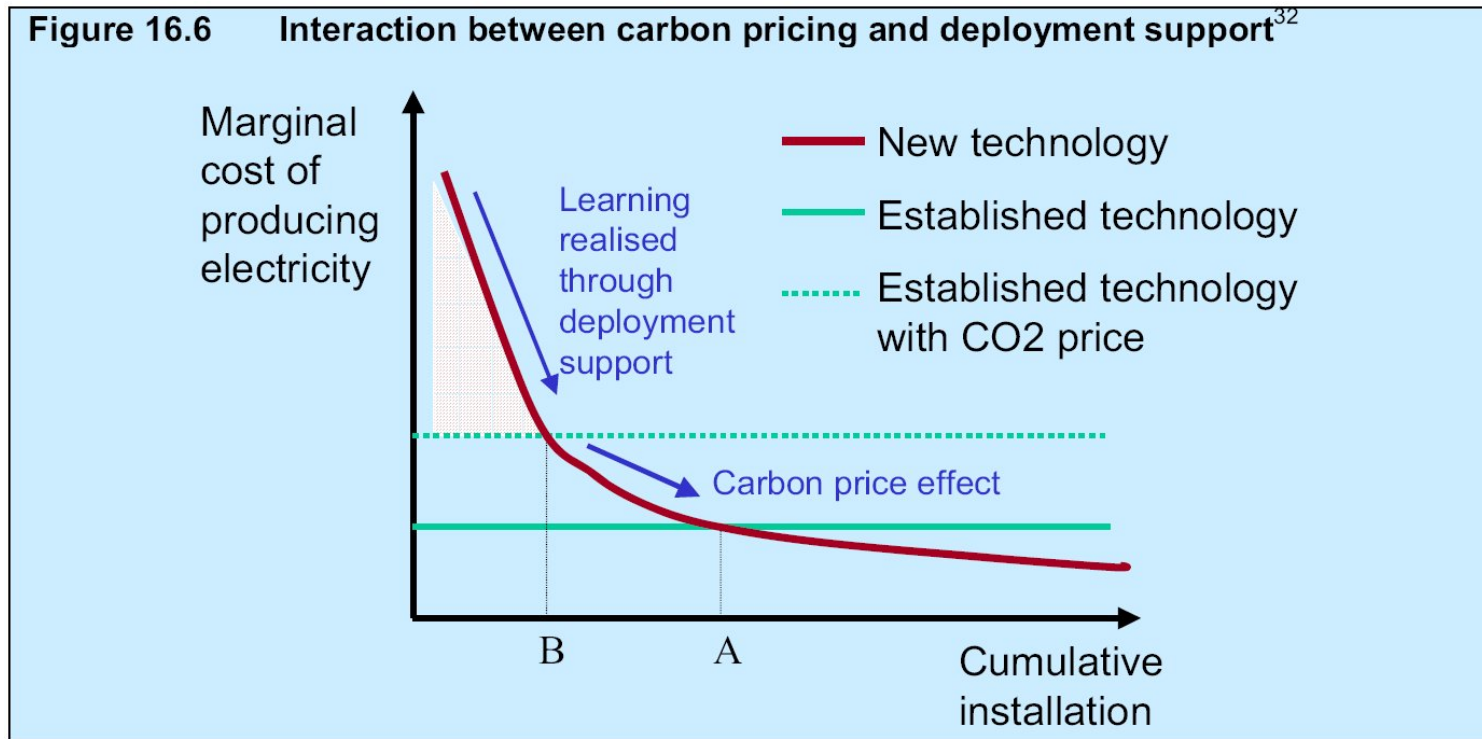
The Carbon Price Only Crowd



Reasons for underinvestment: Learning effects

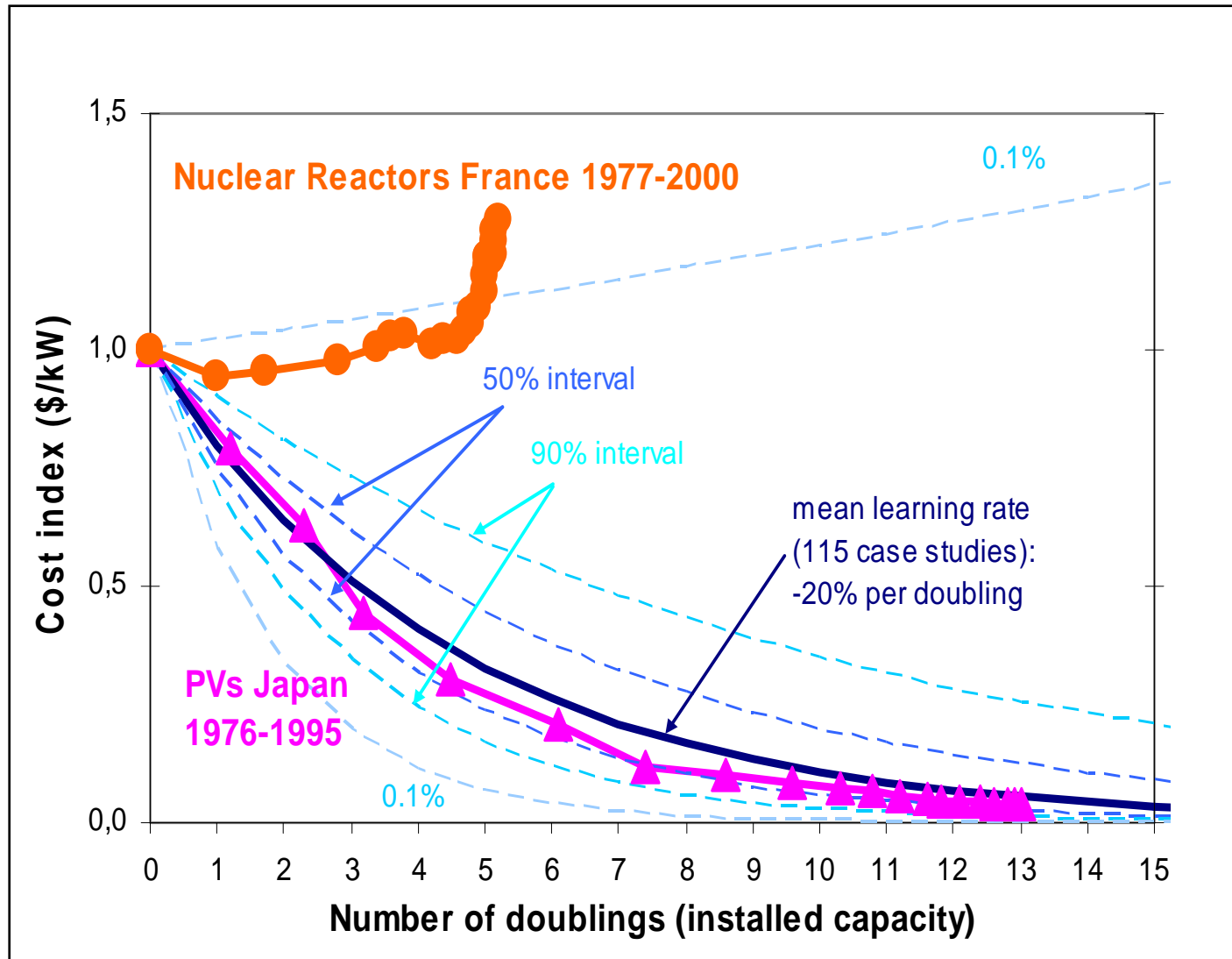


Government support for R&D interacts with Carbon Prices



Source: Stern Review 2006

Learning rates and market growth



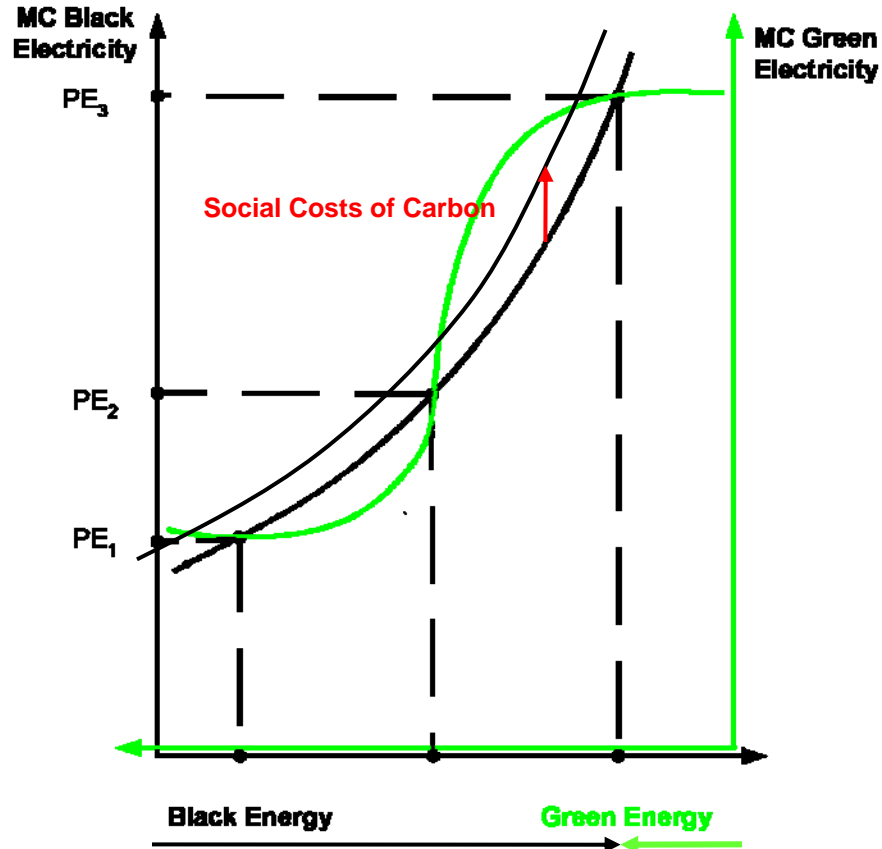
Adopted from Gröbler 2010

The „Technology Policy“ Only Crowd



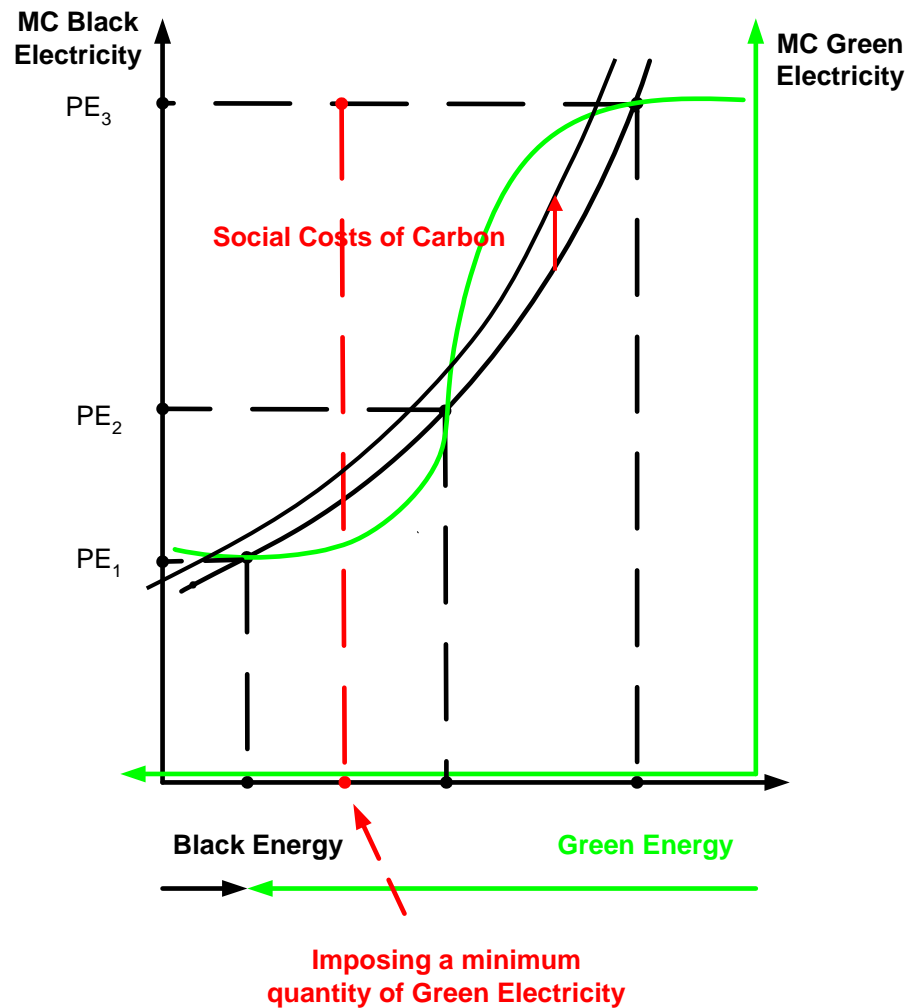
- Subsidizing technologies seems to be institutionally less demanding than carbon pricing
- Innovation policies are perceived as beneficial because of jobs and economic growth
- However: Policies have to be evaluated according to policy goals and to potential market failures

Internalizing Social Costs is Not Sufficient!



- ▶ The internalization of the social costs of energy supply (e.g. via a cap and trade system) improves the competitiveness of renewable energies
- ▶ As long as the cross-over point PE_3 does not vanish, this, however, still results in an inefficient state.

Support for innovative technologies



- ▶ A combination of emission trading and a specific support scheme for innovative technologies (e.g. feed-in tariffs or quota systems) shifts the system towards a state of higher efficiency (state PE_1).

Technology Innovation in a Dynamic Context



What drives innovation?

- High carbon prices → ambitious ETS
- R&D expenditures → publicly financed research programs
- Learning-by-doing → technology-specific deployment policies

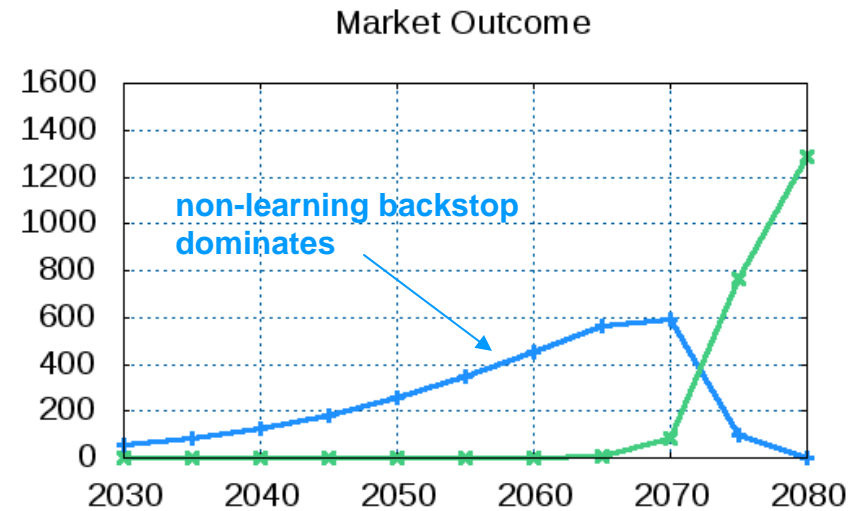
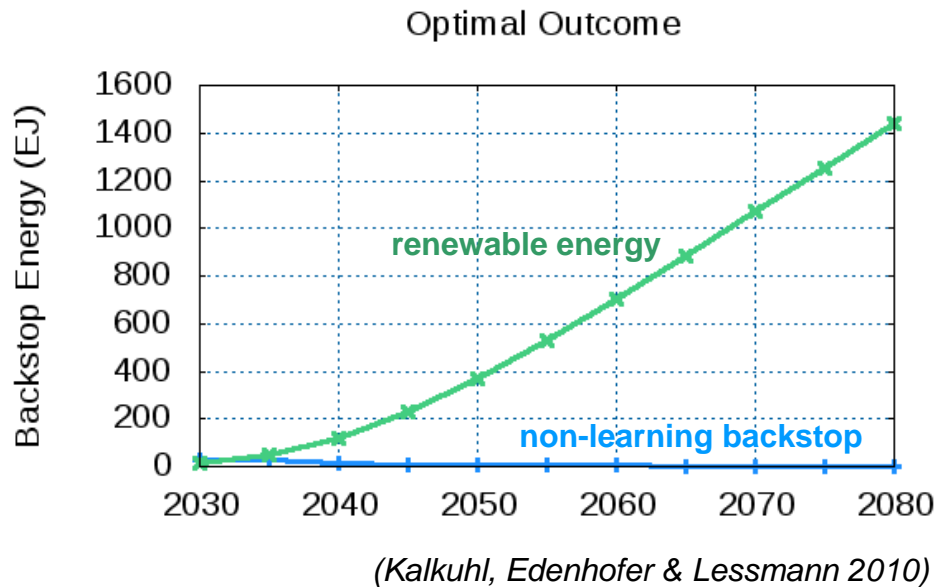
Why markets for innovative technologies fail

- Spillovers between firms
- High discount rates (risk premiums, principal-agent-problems, uncertainty about future climate policy)

→ Analysis within intertemporal general equilibrium model

- fossil energy
- learning backstop energy (wind, solar)
- non-learning (mature) backstop energy (nuclear, gas, coal+CCS)

The Impact of Spillovers: Lock-in Effects



Different scenarios:

- moderate substitutability
- high substitutability
- very high substitutability

“Trio Infernale” creating path dependencies:

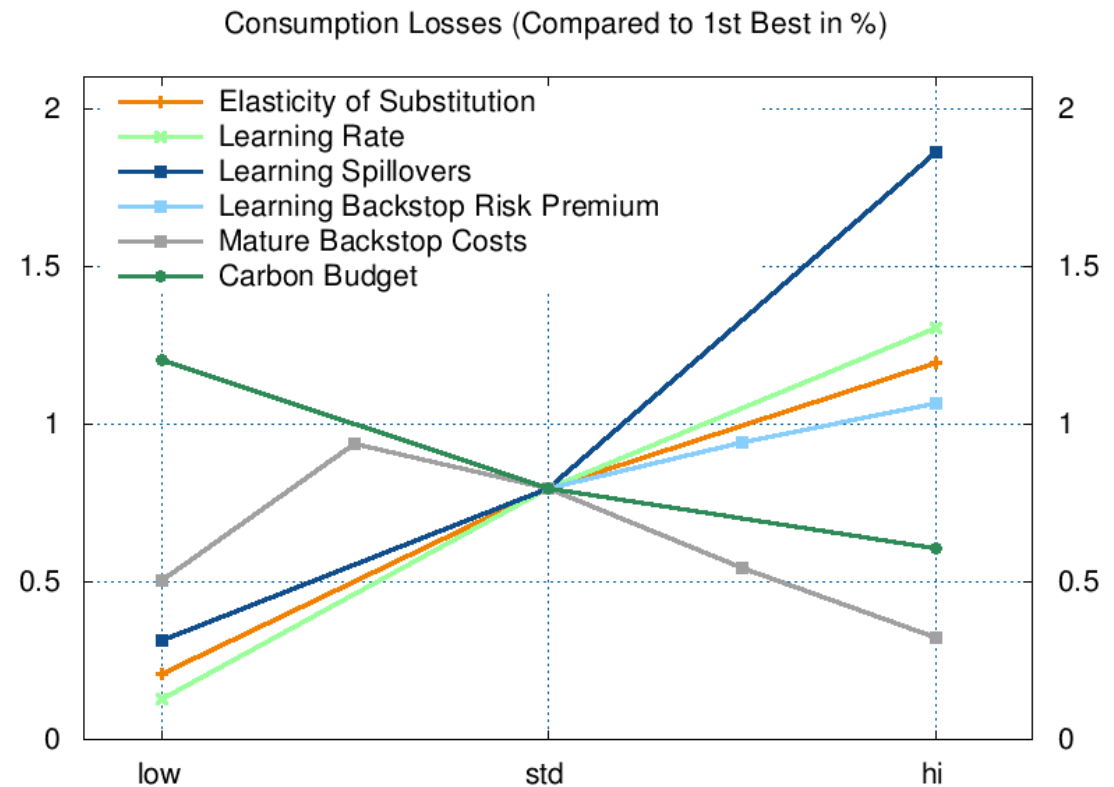
1. Spillovers or risk premiums (→ market failure)
2. Technology with learning rate (→ path dependency)
3. High substitutability between backstop technologies (→ amplifies market failure)

Lock-ins in the Energy System



Impacts:

- Delayed renewable energy deployment
- High consumption losses
- Increased carbon price
- Serious pressure on ambitious mitigation targets

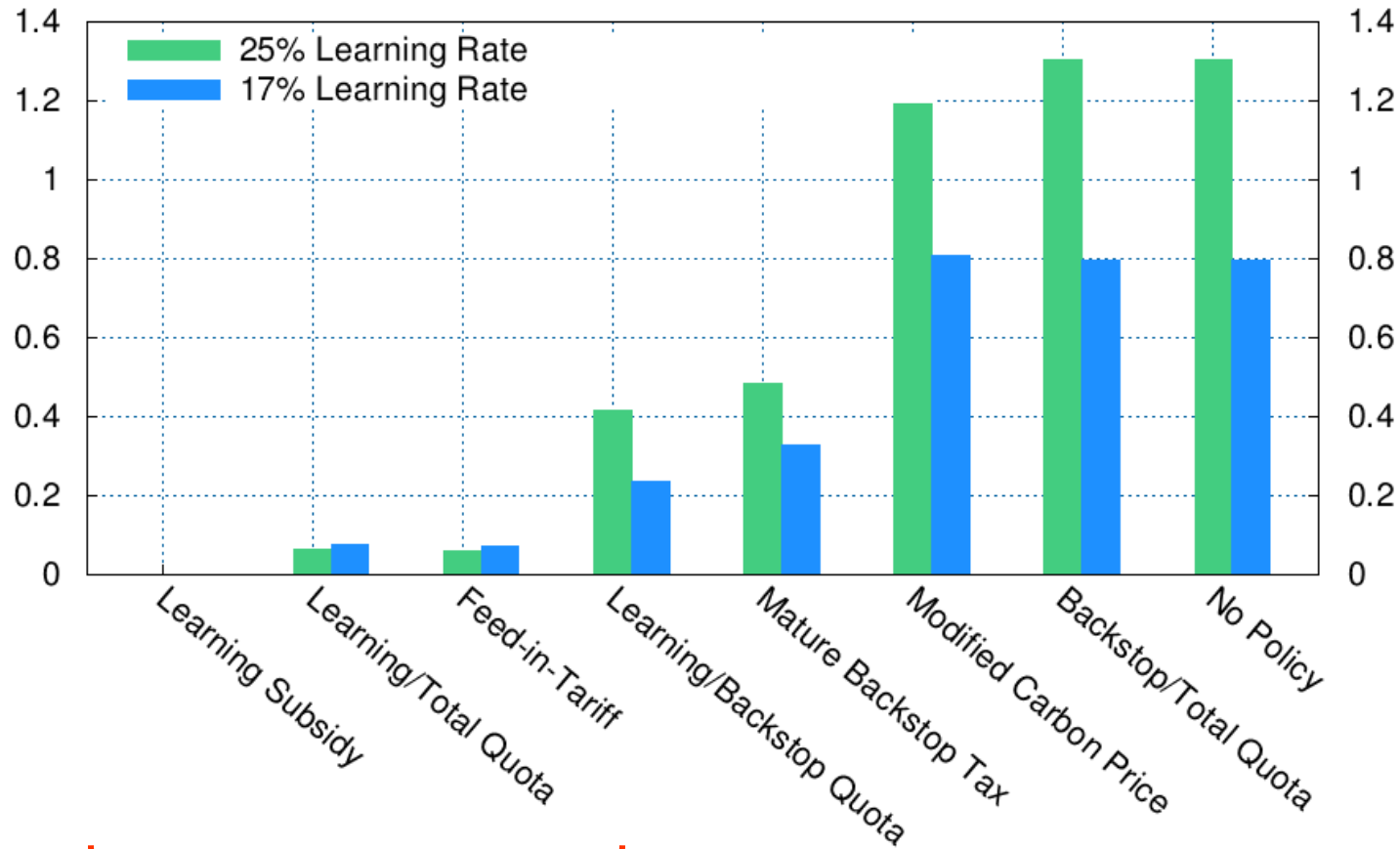


(Kalkuhl, Edenhofer & Lessmann 2010)

Policy Instruments to Prevent Lock-ins



Consumption Losses Compared to 1st-Best (in %) -- Trajectory



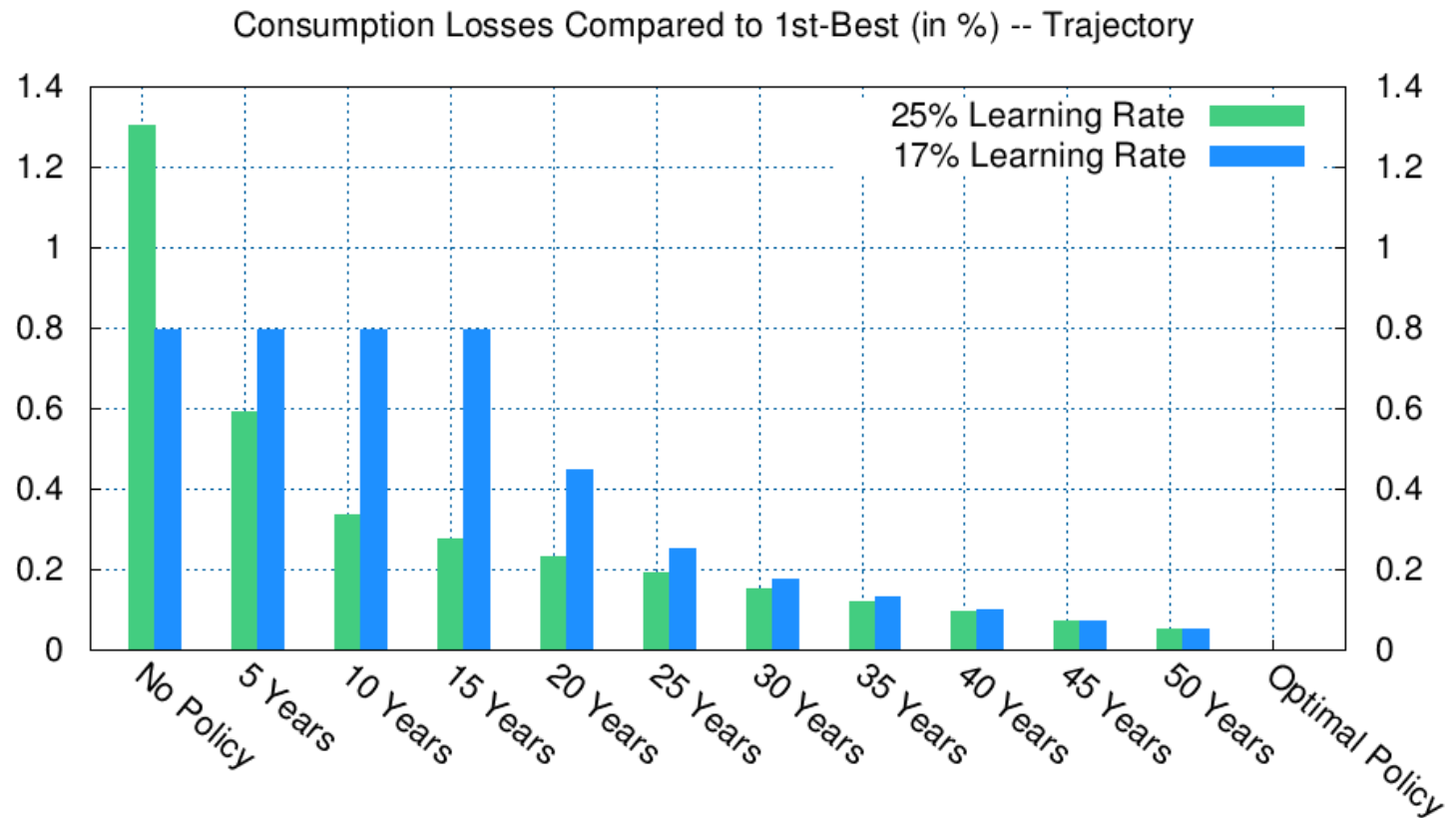
best performance

(Kalkuhl, Edenhofer & Lessmann 2010)

Policy Stimulus



- Push system to dynamically more efficient equilibrium
- Temporary action (some decades) sufficient

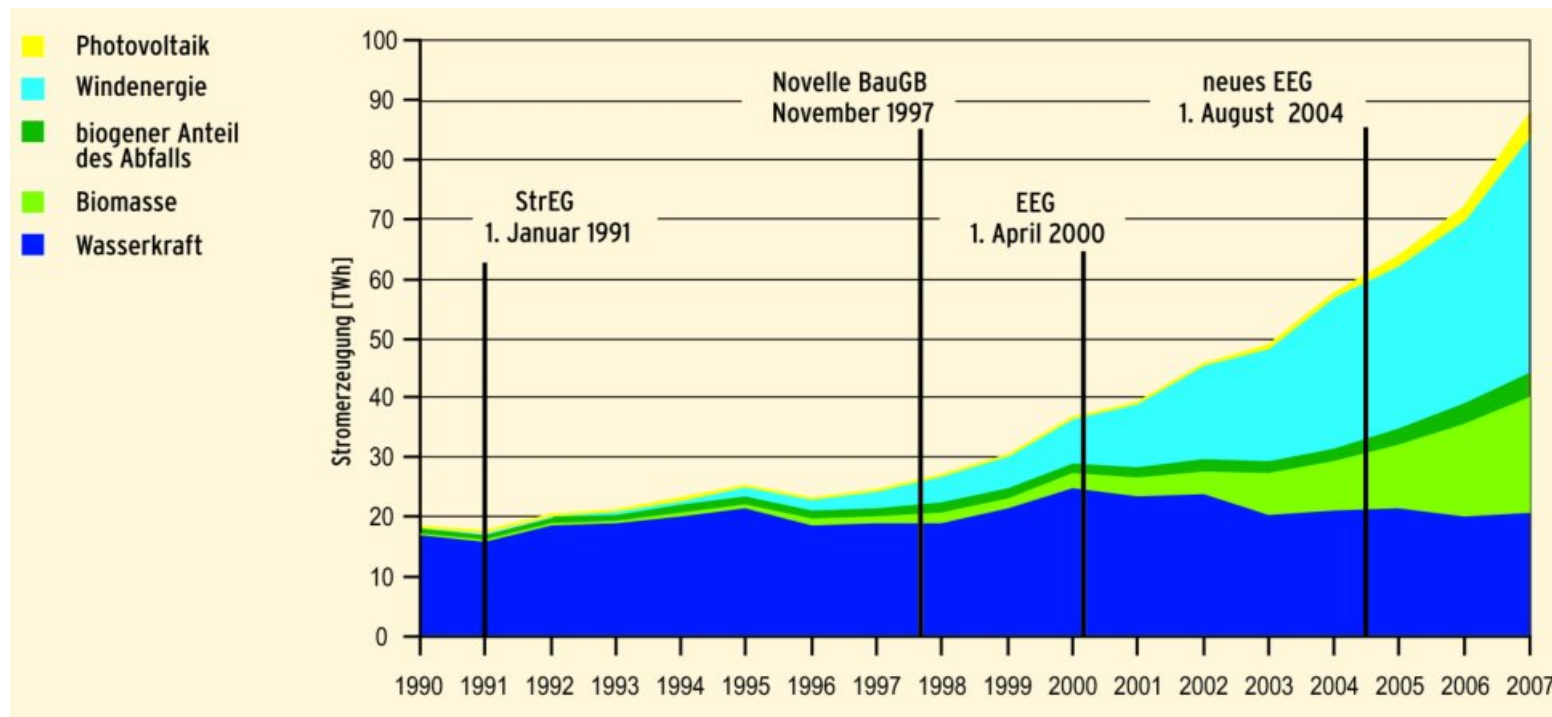


(Kalkuhl, Edenhofer & Lessmann 2010)

Feed-in-Tariffs Increase Renewable Capacities



In recent years experience with **Feed-in-Tariffs** was gained:
In Germany the *Renewable Energy Law* (Erneuerbare-Energien-Gesetz, EEG) greatly increased capacities.

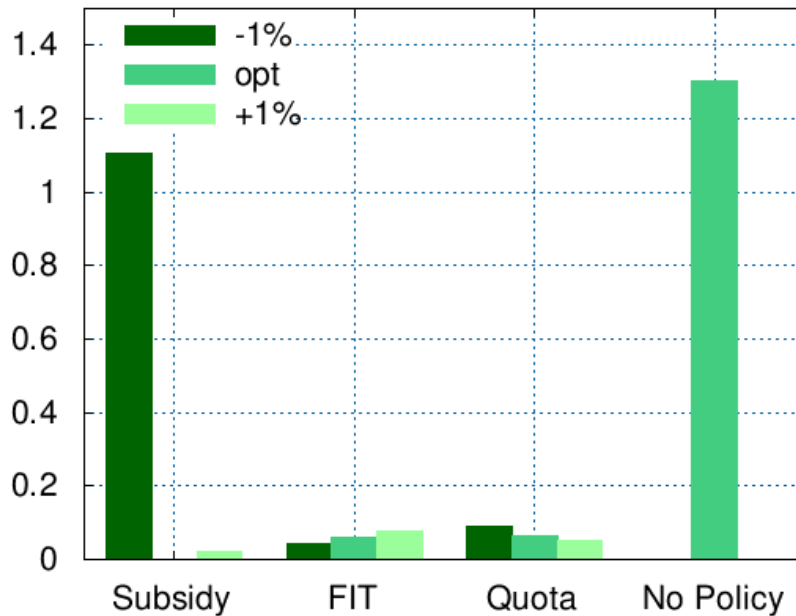


But: It is questionable whether this lead to sufficient cost reduction.

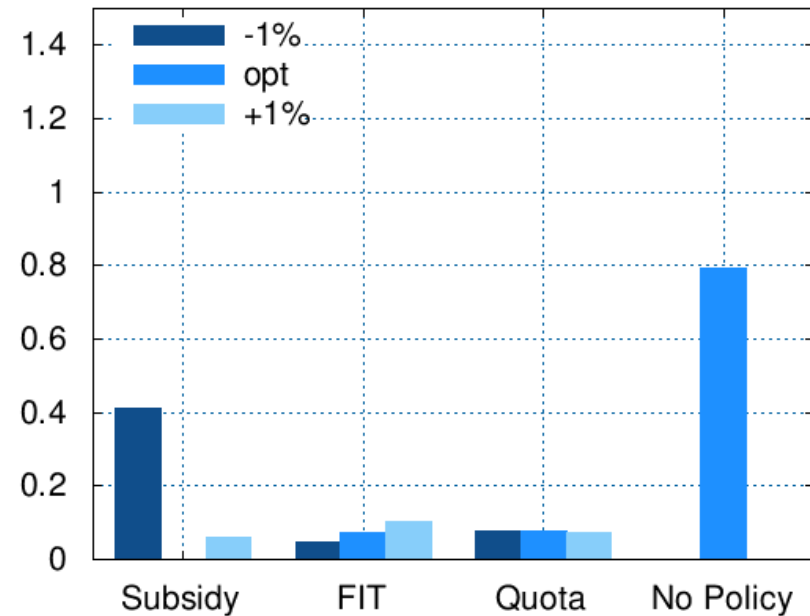
Robustness of Instruments



Consumption Losses compared to 1st-Best (in %)
25% Learning Rate



Consumption Losses compared to 1st-Best (in %)
17% Learning Rate



(Kalkuhl, Edenhofer & Lessmann 2010)

- Significant consumption losses if subsidy was chosen too low
- FIT and quota are more robust against small deviations

Conclusions



Why innovations in the energy sector are a special case

- Electricity is a homogenous good (pure price competition)
- Costly lock-in arises only for good substitutability

→ Technology-specific policy intervention necessary

Optimal policies: Create niche demand for learning technologies

- Subsidies, feed-in-tariffs or technology-specific quotas
- Learn about uncertainties and revise policies

German EEG:

- + High investment security
- European / global solution required (to use most productive locations)