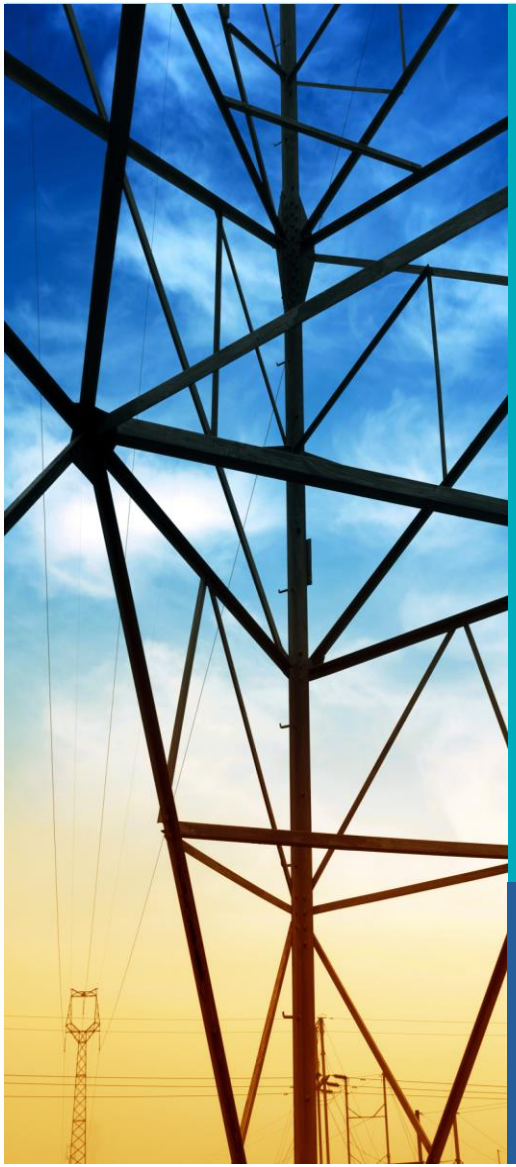

Strengthening the EU CO2 Cap in Exchange for a Free Allocation of Quotas: A Pragmatic Way towards a Sustainable Low-Carbon Electricity Supply

Jan Horst KEPPLER

Scientific Director, Chaire European Electricity Markets
Professor of Economics, Université Paris-Dauphine

CEEM and CEC

PRIX PLANCHER DU CO2 ET RÉFORME DE L'EU ETS : LES IMPACTS SUR LE SECTEUR ELECTRIQUE

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DAUPHINE UNIVERSITÉ PARIS

CHAIRE EUROPEAN ELECTRICITY MARKETS
Fondation Paris-Dauphine

The State of Electricity I

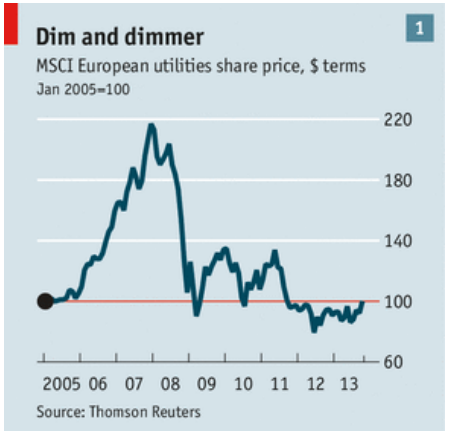
Much Pain for little Gain

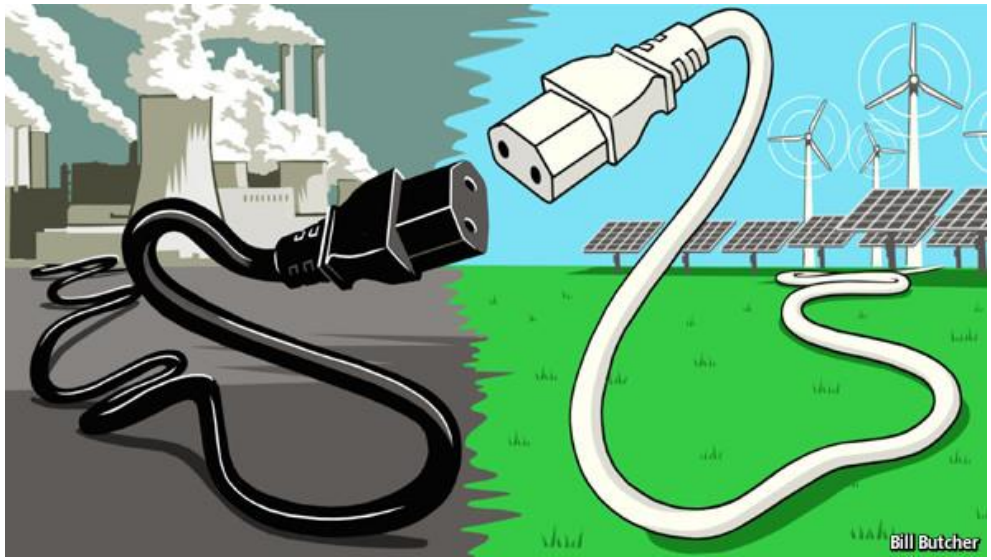
The Economist

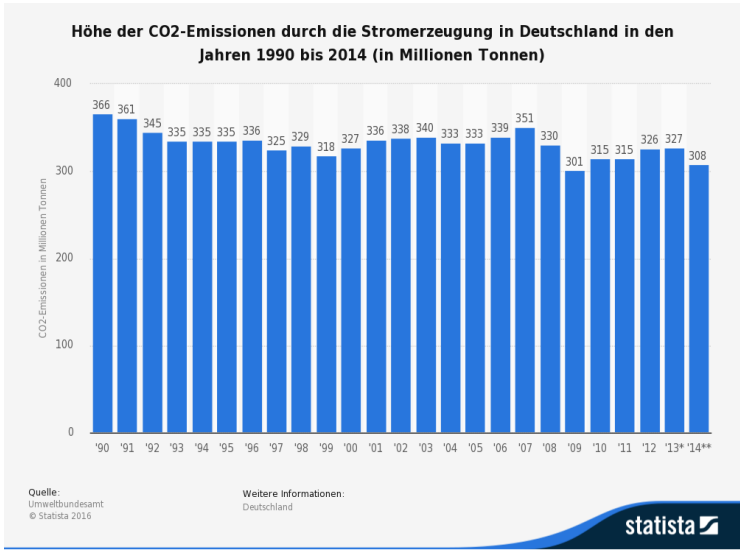
European utilities:

How to lose half a trillion euros

Europe's electricity providers face an existential threat

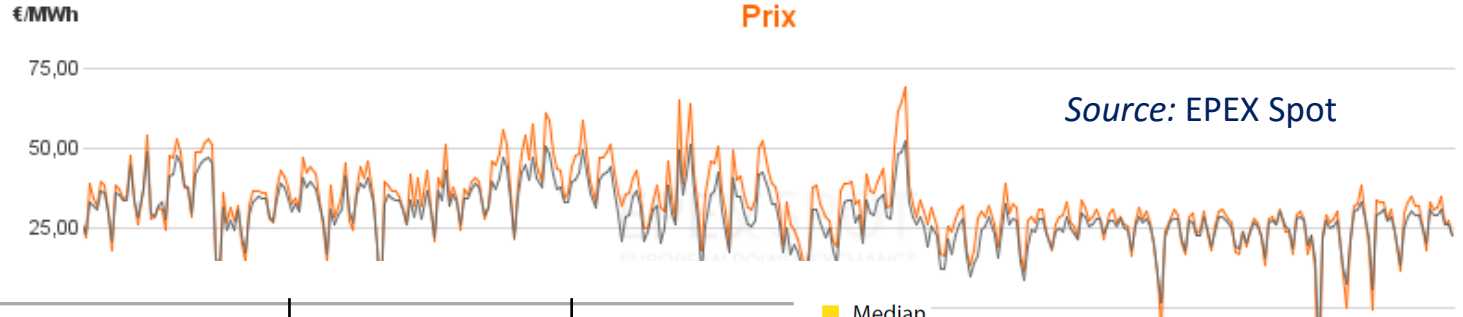




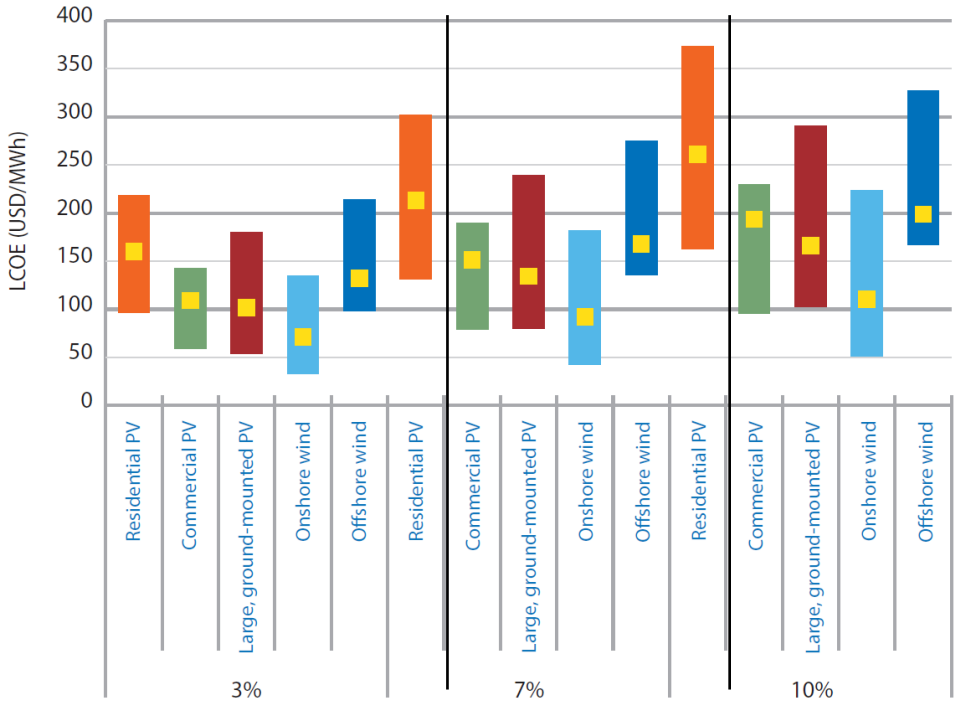


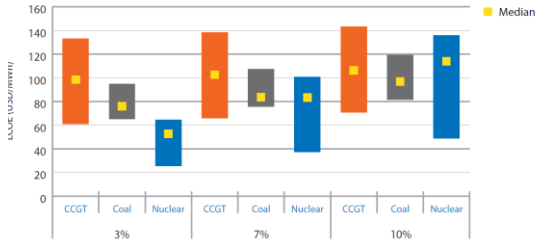
The State of Electricity II

A Wide Gap between Prices and Costs



Source: EPEX Spot

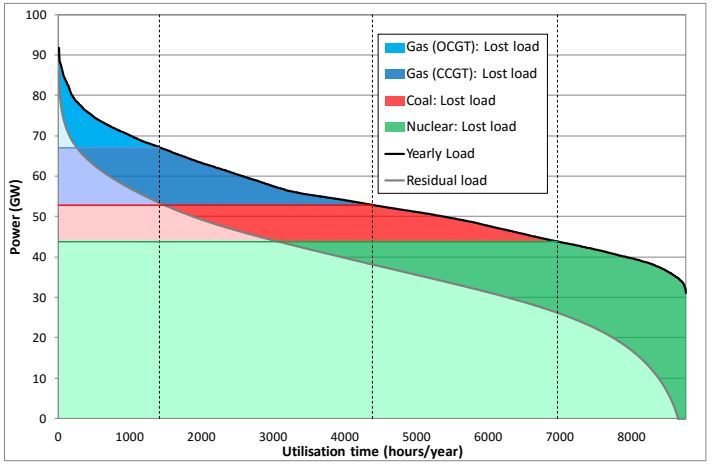




Source: NEA/IEA (2016)

The State of Electricity III – The Reasons

1. Variable renewables (wind, solar) with zero marginal costs and out-of-market finance displace dispatchable thermal generation (nuclear, lignite, coal, gas). Hence:
   - Reduced generation by dispatchable power plants (*compression effect*).
   - Reduced wholesale electricity prices (by 13-14% for 10% and 23-33% for 30%).



		10% Penetration level		*30% Penetration level*	
		Wind	***Solar***	***Wind***	***Solar***
Load losses	***Gas Turbine (OCGT)***	-54%	-40%	-87%	-51%
	Gas Turbine (CCGT)	-34%	-26%	-71%	-43%
	Coal	-27%	-28%	-62%	-44%
	Nuclear	-4%	-5%	-20%	-23%
Profitability losses	***Gas Turbine (OCGT)***	-54%	-40%	-87%	-51%
	Gas Turbine (CCGT)	-42%	-31%	-79%	-46%
	Coal	-35%	-30%	-69%	-46%
	Nuclear	-24%	-23%	-55%	-39%
Electricity price variation		-14%	-13%	-33%	-23%

2. Stagnating demand due to (a) low growth and (b) improving energy efficiency.
3. **Low CO2 prices in EU ETS due to (a) supply of quotas (2 billions) exceeds industrial demand (1.8 billion) and (b) overhang of "banked" quotas of 2.5 billion.**

Current low prices are mostly set by variable cost of lignite !

4

The State of Electricity IV – The Principal Strategies for Re-establishing a Safe Low Carbon Electricity Supply in Europe

1. **Flexibilisation**

   Intraday markets, demand response, curtailment, storage, interconnections etc.

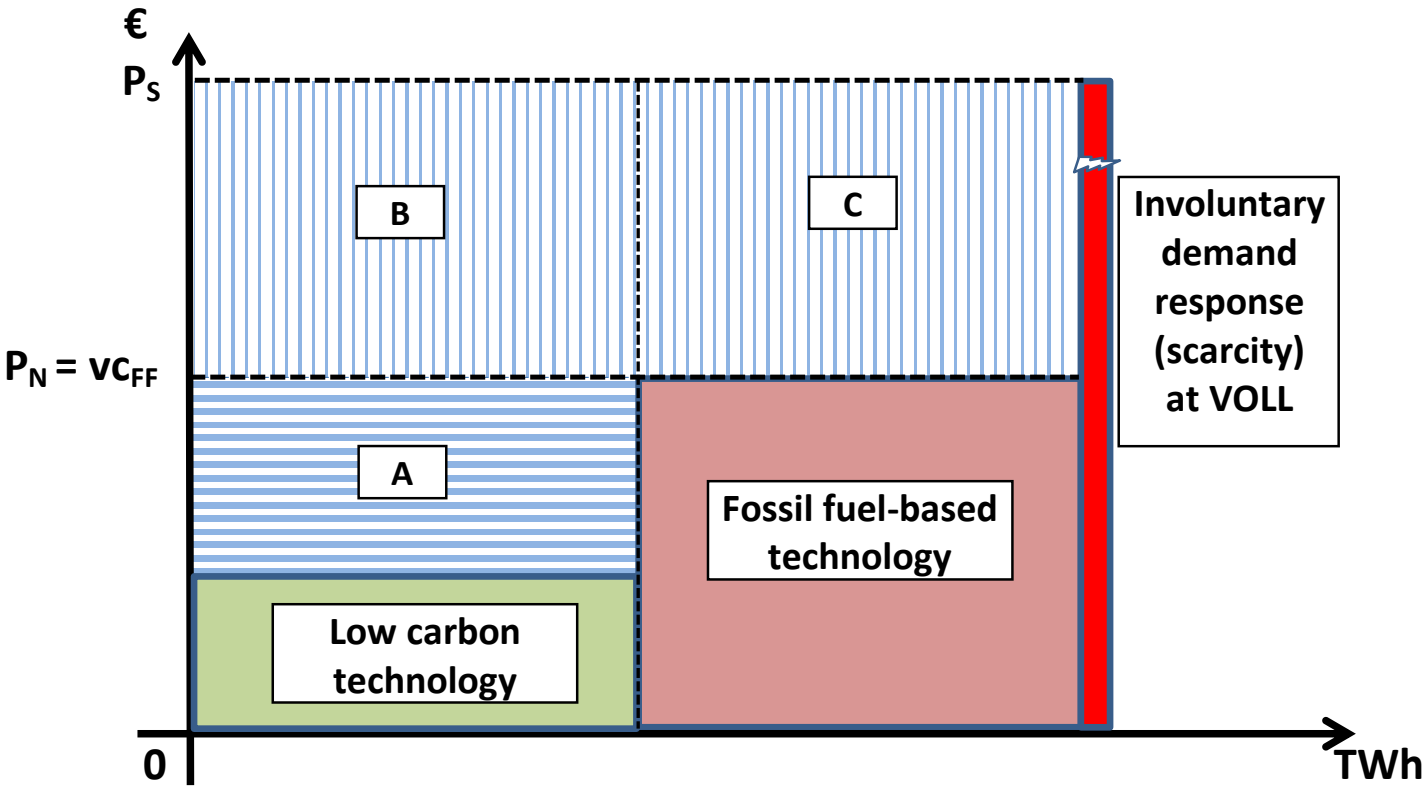
2. **Long-run power purchase agreements (PPAs) for dispatchable technologies**

   PPAs, FITs, CFDs, long-term contracts, capacity auctions etc.

3. **Significant but pragmatic reform of EU ETS**
   a) **Reduction of annual supply from 2 million to 1.8 million quotas.**
   b) **Rapid phase-out of unused quotas; new "use it or lose it" rule.**
   c) **In exchange: return to free allocation for at least 50% of quotas (50%<Q<100%); already the case I**
   d) **Meaningful *carbon price floor* w/o free allocation is unacceptable for German (and French) fossil fuel-based power producers.**

Alternative is progressive renationalization of electricity markets with selective *ad hoc* subsidization!

The Stylized Long Term Situation in an Electricity Market without Carbon Pricing

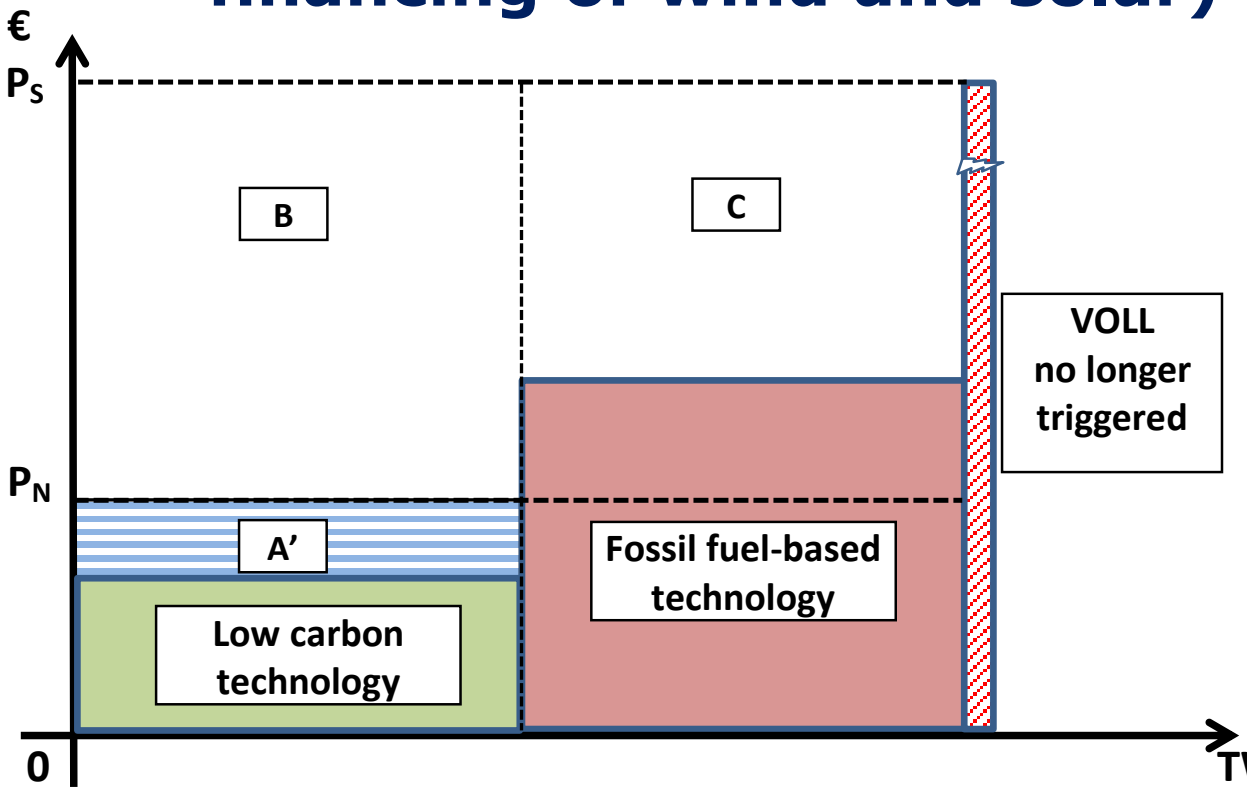


Profit of low carbon technology: $\Pi_{LC} = A + B - vc_{LC}*q_{LC} - INV_{LC} = 0$

Profit of fossil fuel technology: $\Pi_{FF} = (P_N - vc_{FF})*q_{FF} + C - INV_{FF} = 0.$

With $A = P_N*q_{LC}*(8760 - h_{VOLL})$, $B = q_{LC}*VOLL*h_{VOLL}$, and $C = q_{FF}*VOLL*h_{VOLL}$.

The Current Situation (low carbon pricing and out-of-market financing of wind and solar)



Profit of low carbon technology (no support): $\Pi_{LC} = A' - vc_{LC}*q_{LC} - INV_{LC} < 0$

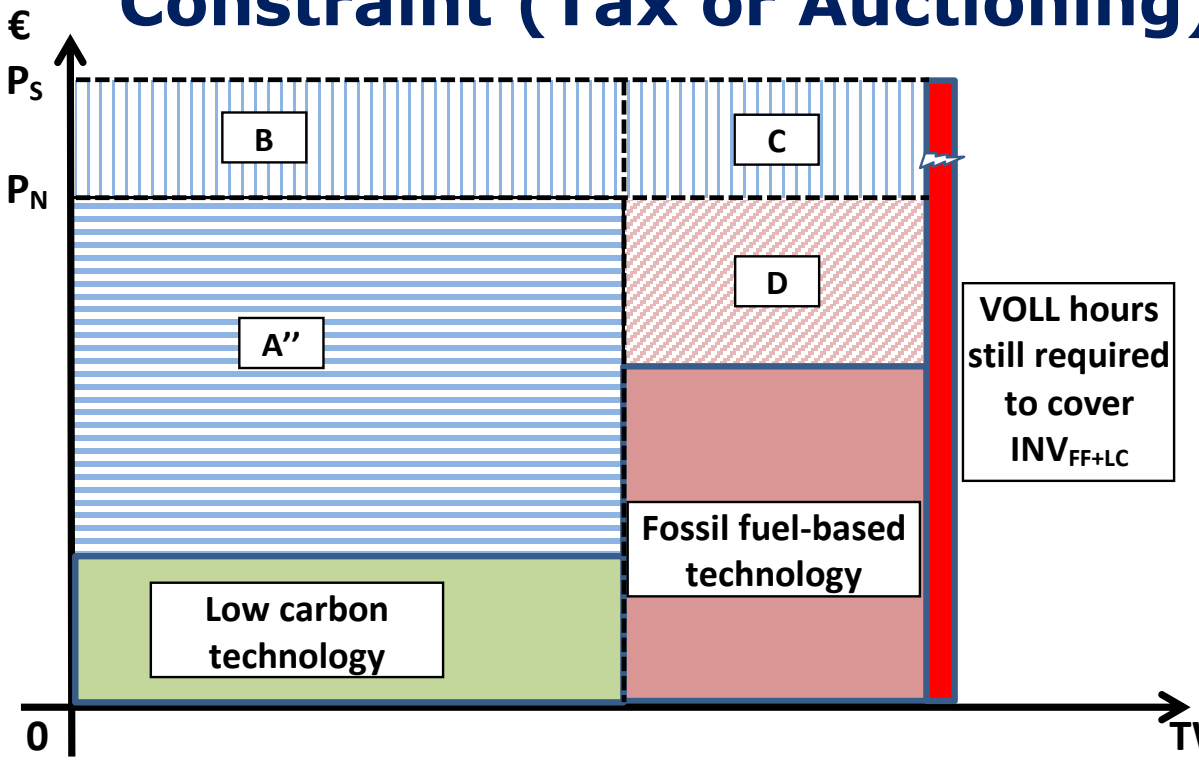
Profit of fossil fuel technology: $\Pi_{FF} = (P_N - vc_{FF})*q_{FF} - INV_{FF} << 0$

With $P_N = \alpha*vc_{LC} + (1 - \alpha)*(vc_{FF} + p_{CO2}*CO2_{FF})$

If low carbon technology receives out-of-market support (e.g., CSPE or EEG) profit becomes:

$\Pi_{LCS} = A' - vc_{LC}*q_{LC} - INV_{LC} + (INV_{LC} - (A' - vc_{LC}*q_{LC})) = 0.$

The Long Run Situation with a Carbon Constraint (Tax or Auctioning)



Situation similar to Case 1 as carbon tax is analytically identical to an increase in the variable costs of the fossil-fuel based technology.

Electricity consumers transfer part of CS as monetised resource rent to taxpayers (govmt.).

Share of LC technology increases. Scarcity pricing still required for covering fixed costs.

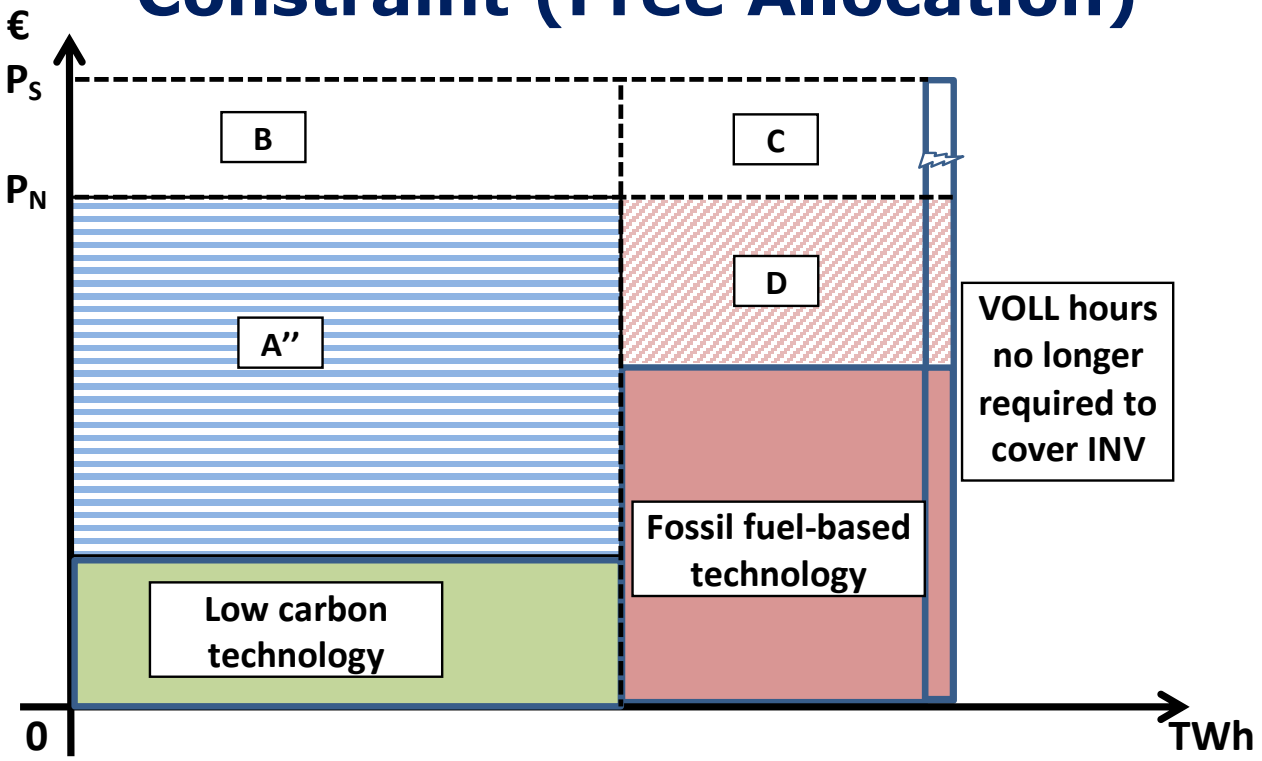
At European level, politically difficult to realise.

Profit of low carbon technology: $\Pi_{LC} = A'' + B - vc_{LC}*q_{LC} - INV_{LC} = 0$

Profit of fossil fuel technology: $\Pi_{FF} = (P_N - (vc_{FF} + p_{CO2}*CO2_{FF}))*q_{FF} + C - INV_{FF} = 0$.

With $P_N = vc_{FF} + p_{CO2}*CO2_{FF}$ and $D = p_{CO2}*CO2_{FF}*q_{FF}*(8760 - h_{VOLL})$.

The Long Run Situation with a Carbon Constraint (Free Allocation)



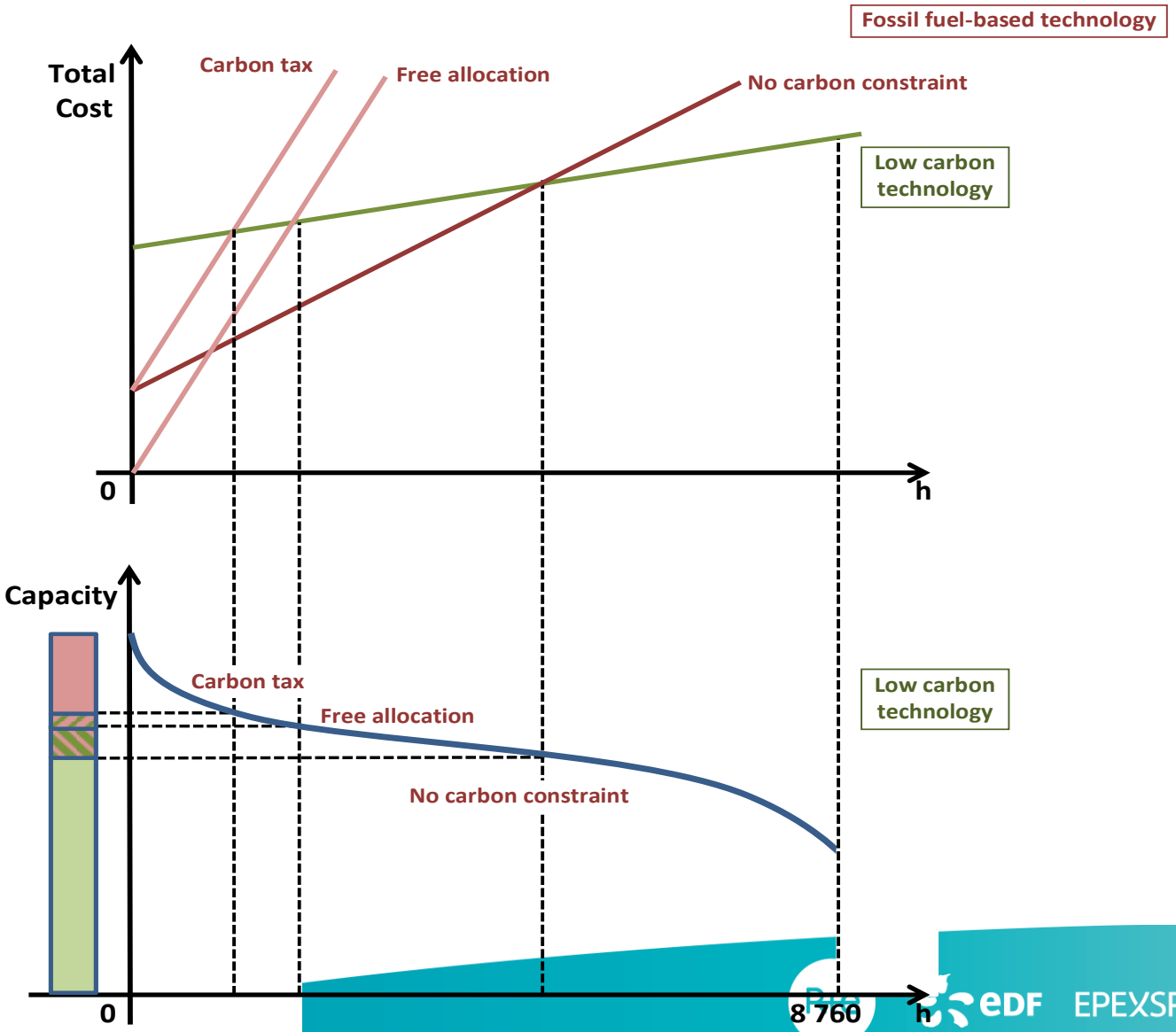
- Opportunity cost principle will ensure that marginal values are *not* affected.
- Marginal FF technology now earns rent (equivalent to *capital-cost subsidy*). Same effect as capacity payment covering "missing money". Scarcity pricing no longer required.
- Share of LC technology slightly lower than in Case 3, but higher than in Case 1.
- Environmentally, Cases 3 and 4 are identical (same CO2 target). EU political acceptability.

Profit of low carbon technology: $\Pi_{LC} = A'' - vc_{LC} * q_{LC} - INV_{LC} = 0$

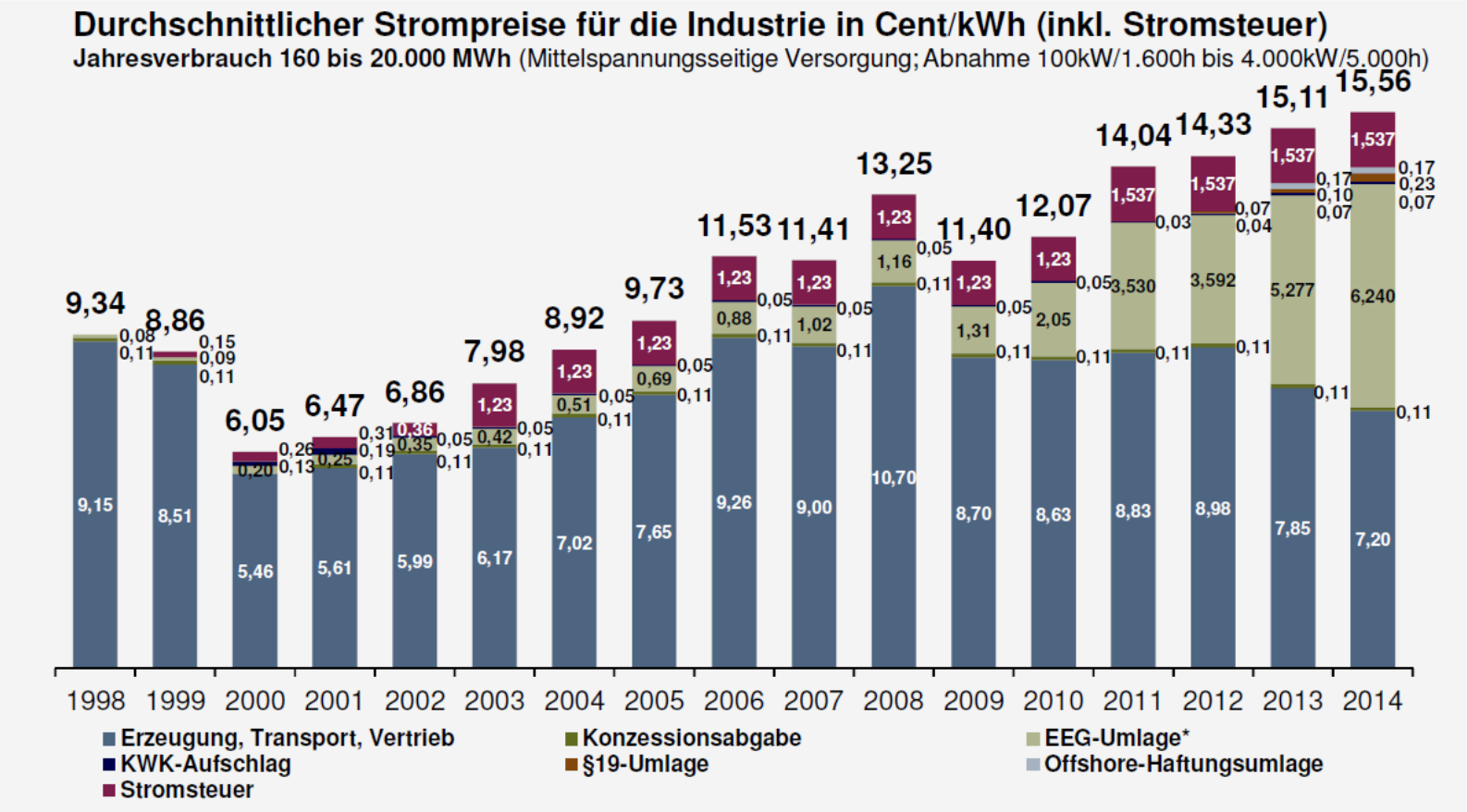
Profit of fossil fuel technology: $\Pi_{FF} = (P_N - vc_{FF}) * q_{FF} - INV_{FF} = 0$.

With $P_N = vc_{FF} + p_{CO2} * CO2_{FF}$ (same as Case 3) and $D = p_{CO2} * CO2_{FF} * q_{FF} * 8760$.

The Same in Terms of Screening Curves



Impact of Higher CO2 Price on Consumers Limited as "Wedge" Would Disappear



Instead governments would return historic carbon rent confiscated from electricity sector in 2012.

Welfare Considerations

A carbon constraint with free allocation of allowances in a competitive electricity market with free entry will yield a long-term equilibrium with

- Full remuneration of all factors including investment costs for both low carbon and fossil-fuel based producers.
- A CO2 emission target identical to that under auctioning or an equivalent tax.
- No need for involuntary demand response during scarcity hours at VOLL.

How is this possible? The monetised resource rent embodied in the allowances works like a capacity payment for the fossil-fuel based producers.

NB: Not theoretical first best solution. With perfect information, absence of lumpy investment or security of supply externalities, scarcity pricing remains least-cost solution.

In broader framework that includes security of supply externalities resulting from scarcity pricing, free allocation might well be the welfare optimising solution.

Conclusions

Return to free allocation of CO2 allowances as practiced during 2005-12, when EU ETS was widely seen as functioning, would have a number of significant advantages:

- Respect of historically established CO2 rights (resource rent remains in electricity sector);
- Identical to tax or auctioning in terms of environmental integrity. EU consensus for stricter targets and higher prices with countries relying on fossil fuels becomes possible.
- Resolution of “missing money”, capacity investment and security of supply by leaving monetized resource rent to producers.
- Share of LC electricity lower than with CO2 tax but higher than in absence of carbon pricing.
- Limited impact on electricity consumers as price increases are off-set by decreases in CSPE/EEG;
- Inclusion of security of supply externalities points towards overall welfare maximization.

Returning to free allocation of quotas in exchange for strengthened CO2 targets by far most straightforward and quickest way to put the European electricity sector back on an economically sustainable low carbon footing!