

Some thoughts on the energy and climate package

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Messages

- **Energy is a crowded policy space**
- **The big decarbonisation challenge: balancing flexibility and long-term commitment**
- **Only targeting RES deployment is under-complex**
- **Need for a neutral and transparent accounting framework to structure the debate**

Agenda

- 1. A crowded policy space**
- 2. The ETS – an efficient tool in troubled water**
- 3. RES-support – deployment is not everything**
- 4. Potential Lessons**

Each technology is faced with a number of externalities

	Externalities			Public goods	Information problems	Behavioral failures	Other MF, BF & barriers	Policy failures
	Env't (-)	Tech (+)	SoS (-)					
Mitigation								
Low-carbon technologies	<i>P</i>	<i>S</i>	<i>S</i>	<i>P</i>	<i>S</i>	<i>N</i>	<i>P</i>	*
Energy savings	<i>S</i>	<i>S</i>	<i>S</i>	<i>N</i>	<i>P</i>	<i>P</i>	<i>N</i>	*
REDD	<i>P</i>	<i>N</i>	<i>N</i>	<i>P</i>	<i>N</i>	<i>N</i>	<i>N</i>	*
Sequestration	<i>P</i>	<i>S</i>	<i>S</i>	<i>P</i>	<i>S</i>	<i>N</i>	<i>P</i>	*

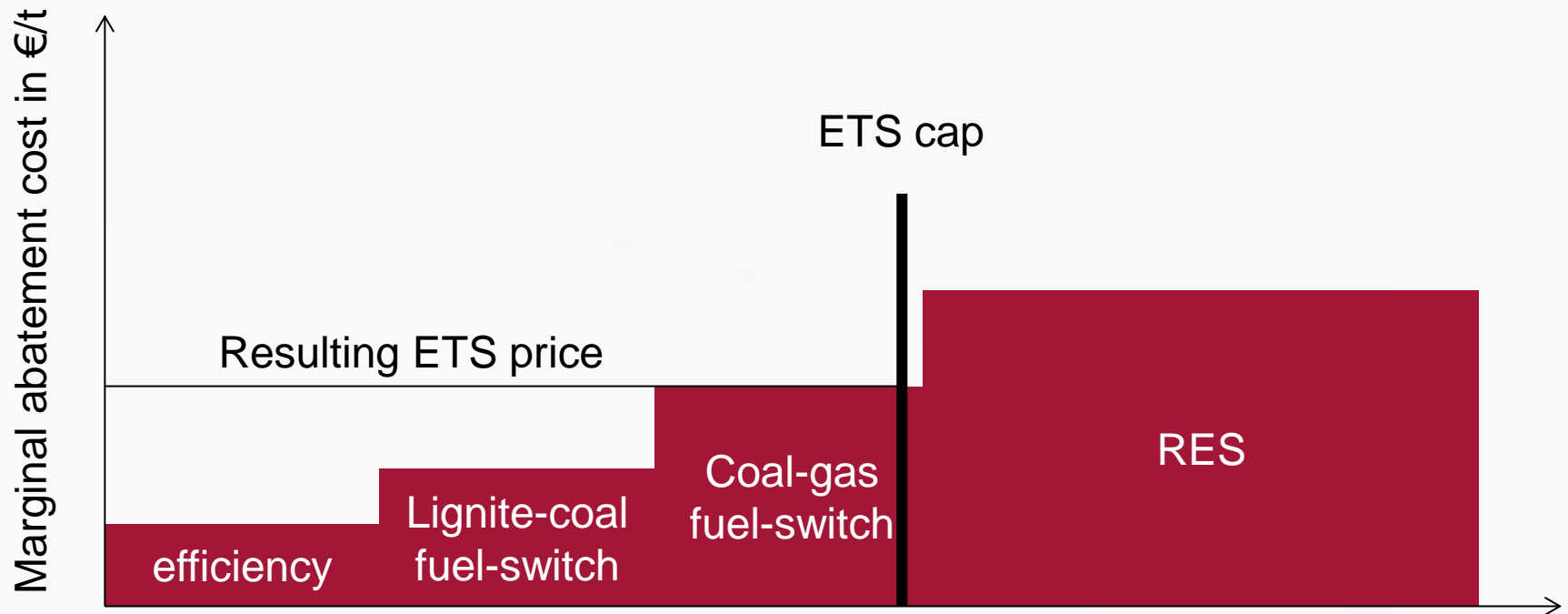
For externalities there are multiple solutions

Solutions	Env't (-)	Tech (+)	SoS (-)	Public goods	Information problems	Behavioral failures	Other MF, BF & barriers
<i>Markets</i>							
Establish property rights	<i>P</i>	<i>P</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>
Create new markets	<i>P</i>	<i>N</i>	<i>P</i>	<i>N</i>	<i>S</i>	<i>S</i>	<i>N</i>
<i>Incentives</i>							
Taxes	<i>P</i>	<i>N</i>	<i>P</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>
Subsidies	<i>S</i>	<i>P</i>	<i>S</i>	<i>S</i>	<i>S</i>	<i>S</i>	<i>S</i>
<i>Rules</i>							
Frameworks	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>
Command & Control	<i>S</i>	<i>N</i>	<i>S</i>	<i>N</i>	<i>P</i>	<i>P</i>	<i>N</i>
Nudge	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>P</i>	<i>P</i>	<i>N</i>
Enhanced appraisal	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>P</i>	<i>N</i>	<i>P*</i>
<i>Insurance</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>P</i>	<i>P</i>	<i>P**</i>
<i>Non-market supply</i>	<i>N</i>	<i>N</i>	<i>S</i>	<i>P</i>	<i>P</i>	<i>N</i>	<i>P***</i>

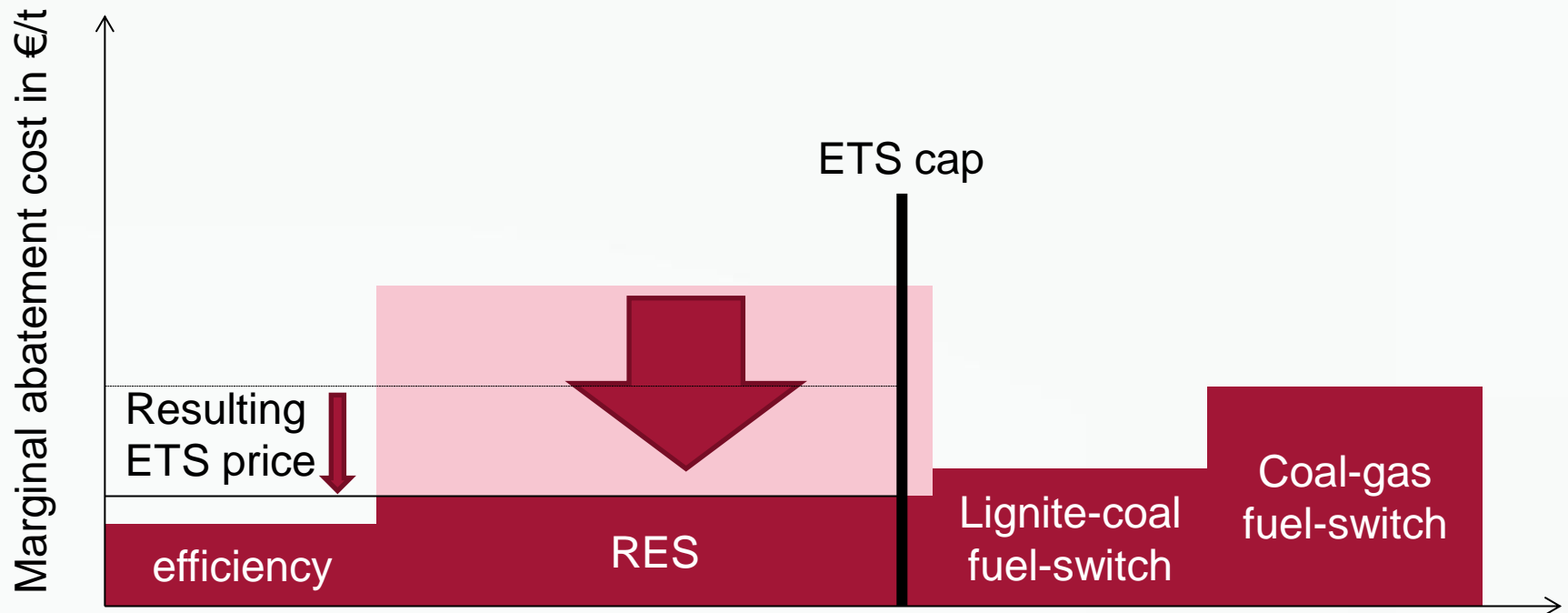
Stylised example – a crowded policy space

		Decarbonisation		Energy efficiency	Renewables	Environment
		ETS	Non-ETS			
Targets:		EU	MS	EU	MS	MS
Electricity		>20 MW	<20 MW	EED	RES-E	LCPD, IED
Transport	Aviation	com'ial flights		/	biofuels directive, ...	
	Road	EV's	x	EPS		NECD, Euro VI, ...
	Maritime		x	/		Marine fuels Directive, ...
Heating		District heating	x	EED	RES-H	...
Agriculture			x		/	...
Industry		Cement, paper ...				LCPD, IED

Are overlapping instruments a problem?



Are overlapping instruments a problem?



- **Subsidising the cost of RES reduces the carbon price -> lignite and coal plants continue to work (“green serves the dirtiest”)**
- **Also true in the long-term (support to one tech prevents others)**
- **Risk: Increasing energy price differentials -> energy consumption off-shores -> decarbonisation in EU -> ETS collapse**

But there are reasons for overlap's

- **If the cap is not binding there could be emission reductions**
- **If the cap is binding, RES support might resolve other externalities**
 - Technology externality
 - Security of supply
 - Non-ETS emissions
 - effectively address relevant market failures (information barriers, market power, split incentives)
 - Industrial policy

How can overlaps be dealt with?

- **Ignore overlaps** (targets will be fulfilled)
- **Prevent overlaps** (ETS vs. non-ETS sectors)
- **Include overlaps in the target setting** (20-20-20?)
- **Require “sterilization” of additional effects** (CCS draft communication)

The ETS

1. A crowded policy space
2. The ETS – an efficient tool in troubled water
3. RES-support – deployment is not everything
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Optimal decarbonisation pattern

- **In the short-term:**
 - Trade-off between different uses of carbon (e.g., electricity vs. heat) and different technologies (gas vs. coal)
- **In the long-term:**
 - Trade-off between cheap early abatement and expensive late abatement
 - Price gives visibility for investments with long lifetimes and investments in new technologies
- **The ETS ensures that a fixed amount of carbon is optimally allocated to technologies and time**

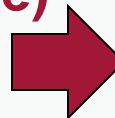
ETS Design

- **A number of allowances is distributed**
 - For free to selected companies
 - Auctioned by member states
- **Each company in a covered sector has to surrender one allowance per tonne of CO₂ emitted**
- **Allowances can be traded**
- **Allocation rules are decided in multi-year phases**

The first two phases of the EU ETS

■ 2005-2007: trial phase (first phase)

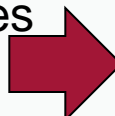
- Grandfathering of allowances
- No banking



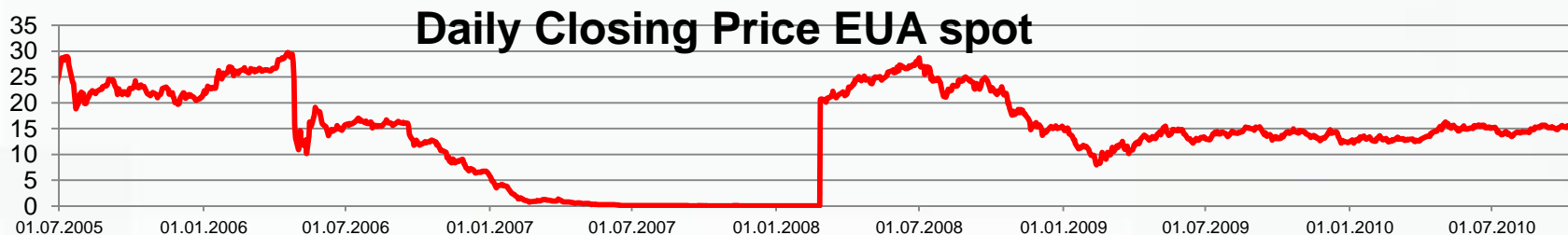
emissions in the regulated sectors increased by 2 % due to a high cap and the import of offsets

■ 2008-2012: second phase

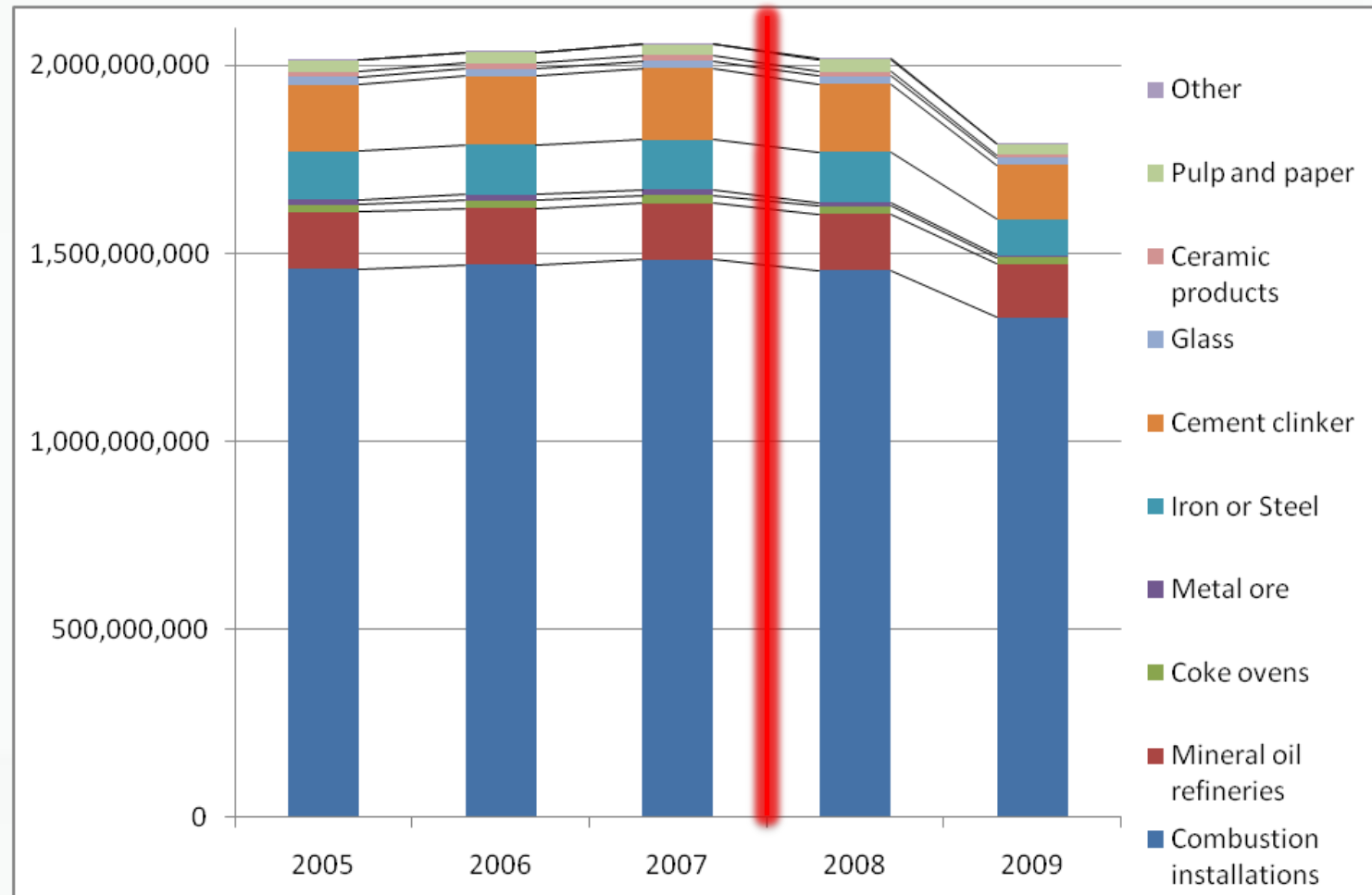
- Mainly Grandfathering of allowances
- Banking



Tighter cap, the amount of allowances distributed was reduced from 2007 to 2008 by about 11 percent



ETS emissions by sector



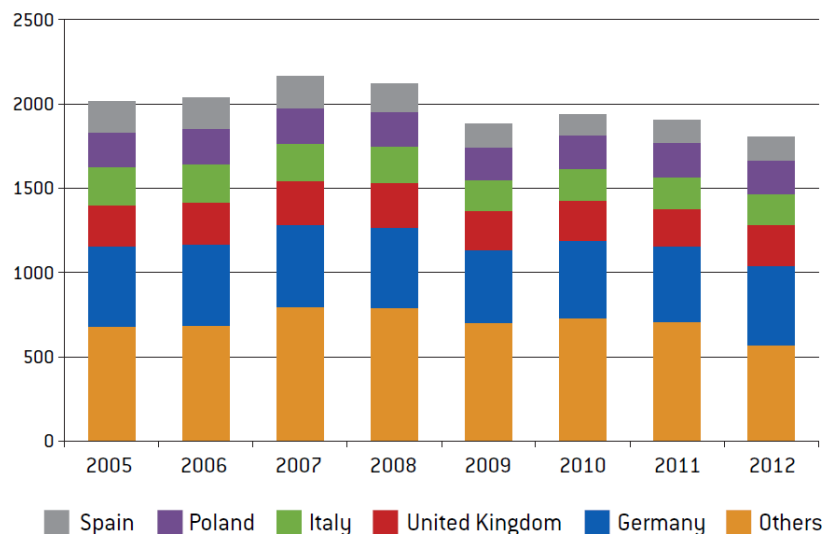
Third phase

- The ETS entered its third phase, at the beginning of 2013, as a more mature system.
- It covers
 - more sectors,
 - more countries
 - more greenhouse gases
- Allocation of allowances has become less distorting.
- Stricter treatment of international credits
- Fraud has been made more difficult

The ETS works!

1/2

Figure 1: Country-level verified ETS emissions, million tonnes CO2



Source: Bruegel based on CITL.

Table 1: Relative change in the growth rate of emissions between (2005-05) and (2007-08)

Reductions caused by the shift to the second period	-3.6%**
Control variables	
Changes in turnover	19.1%***
Changes in employment	0.07%

Source: Abrell *et al* (2011). Note: significance: ** at 5% and *** at 1%.

=> ETS is effective, i.e., caused additional emission reductions

Table 2: Relative change in the growth rate of emissions between (2005-06) and (2007-08) by sector

		Pulp & paper	Non-metallic minerals	Basic metals	Electricity & heat
Reductions caused by shift to the 2nd period		-2.9%	-8.7%***	-9.5%*	-0.1%
Control variables	Changes in turnover	15.4%**	29.9%***	8.9%	13.6%**
	Changes in employment	-6.2%	-4.6%	9.9%	1.2%

Source: Abrell *et al* (2011). Note: significance: * at 10%, ** at 5 % and *** at 1%.

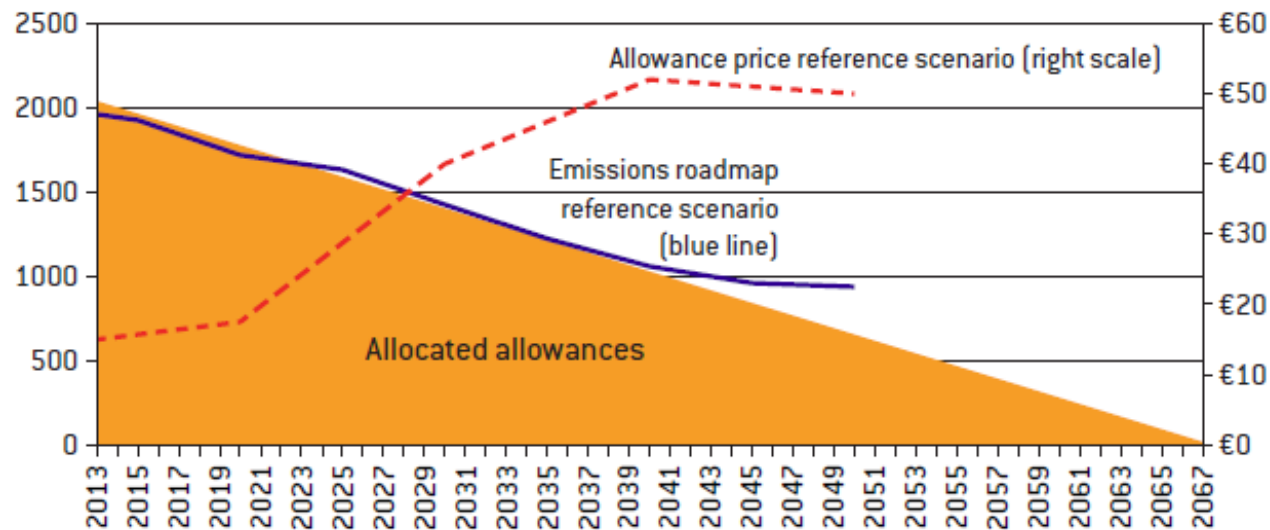
=> ETS discriminates between sectors

A surplus in 2013

- **Recession:** industrial production grew from 2003 to 2007 by almost three percent per year, but decreased by almost two percent per year between 2008 and 2012 [up to 500 million tonnes of CO₂].
- **Substituting policies:** 20 percent energy efficiency target as well as the 20 percent renewables target [increase in efficiency + renewables would imply a carbon reduction of up to 150 + 200 million tonnes of CO₂ in 2012]
- **International credits:** 1420 million tonnes in phase II
- **exceptional** allocation in 2012/2013: some additional 500 million allowances brought to the market (NER, NER300, early 3rd)

The existing ETS implies high prices

Figure 3: Future development of the ETS (million tonnes CO₂, left scale)



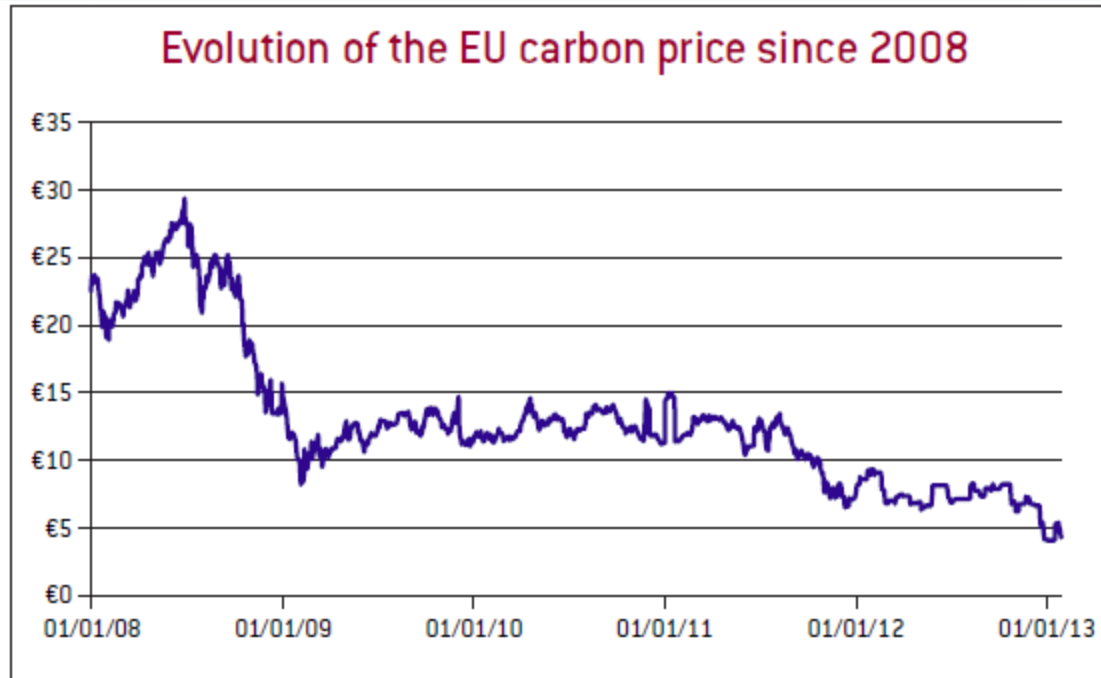
Number of allocated allowances 2013-2067: 56.6 billion

Number of allocated allowances until 2050: 51.2 billion

Number of allowances needed in the reference scenario up to 2050: 52.6 billion

- System tightens constantly
- Intertemporal arbitrage should induce higher prices today

But, surplus translated into a price slump



Source: Datastream. Price per EU emission allowance.

- **Two possible reasons:**
 - Structural oversupply (low growth, new technologies)
 - No credible commitment (tools and incentives to deviate ex post)

Regulatory uncertainty in the ETS

- **Future of decarbonisation**
 - International agreement (COP 2015, bilateral linking)
 - EU ambition for 203 / 2050 / beyond
- **Future of the ETS**
 - Renationalisation
 - A European carbon tax
- **Design of the system**
 - International Credits
 - Future treatment of “carbon leakage”:
 - Free allowances
 - Border carbon adjustment
 - Sectoral coverage
 - Allocation rules / Allocation timing / bankability
 - ...
- **Overlapping instruments**

Low prices are a problem!

- Risk of **locking-in** high future emission patterns
 - Encourages **national** emission reduction policies
 - Encourages **sectoral** emission reduction policies
- => self-fulfilling prophecy

Reestablishing confidence

- **Need for a long-term commitment device**
- **Selling guarantees on the future minimum carbon price (i.e., a put-option):**
 - Public money at stake -> market participants reassured of the long-term nature of the ETS
 - Targeted intervention -> can encourage investments today
 - In the central scenario a positive cash-flow for the public sector
 - Otherwise, cost of changing policies are socialised

Example

- **EIB auctions off guarantees for buying 1 bn emission allowances in the year 2030 at €40**
- **At current carbon price the value of the guarantee is about €25 => significant upfront revenues**
- **Confidence in the system increases => present carbon price rises [risk free price is about €28]**
 - Enables low-carbon investment
 - Increases allowance auctioning revenues
 - Makes national decarbonisation measures redundant
 - Gives time for discussing structural tightening
- **If politically stabilising ETS by 2030 is successful, public sector makes money**
- **If politically stabilising the ETS by 2030 fails, the cost of early low-carbon investments is partly socialised**

Conclusion

- **Emission Trading System can perform well**
- **Tool for synchronizing decarbonisation across**
 - sectors,
 - countries
 - and time
- **A short-term surplus of allowances emerged**
- **ETS freight with political uncertainty -> Lack of confidence breaks inter-temporal arbitrage**
- **Subsequent price slump endangers the system**

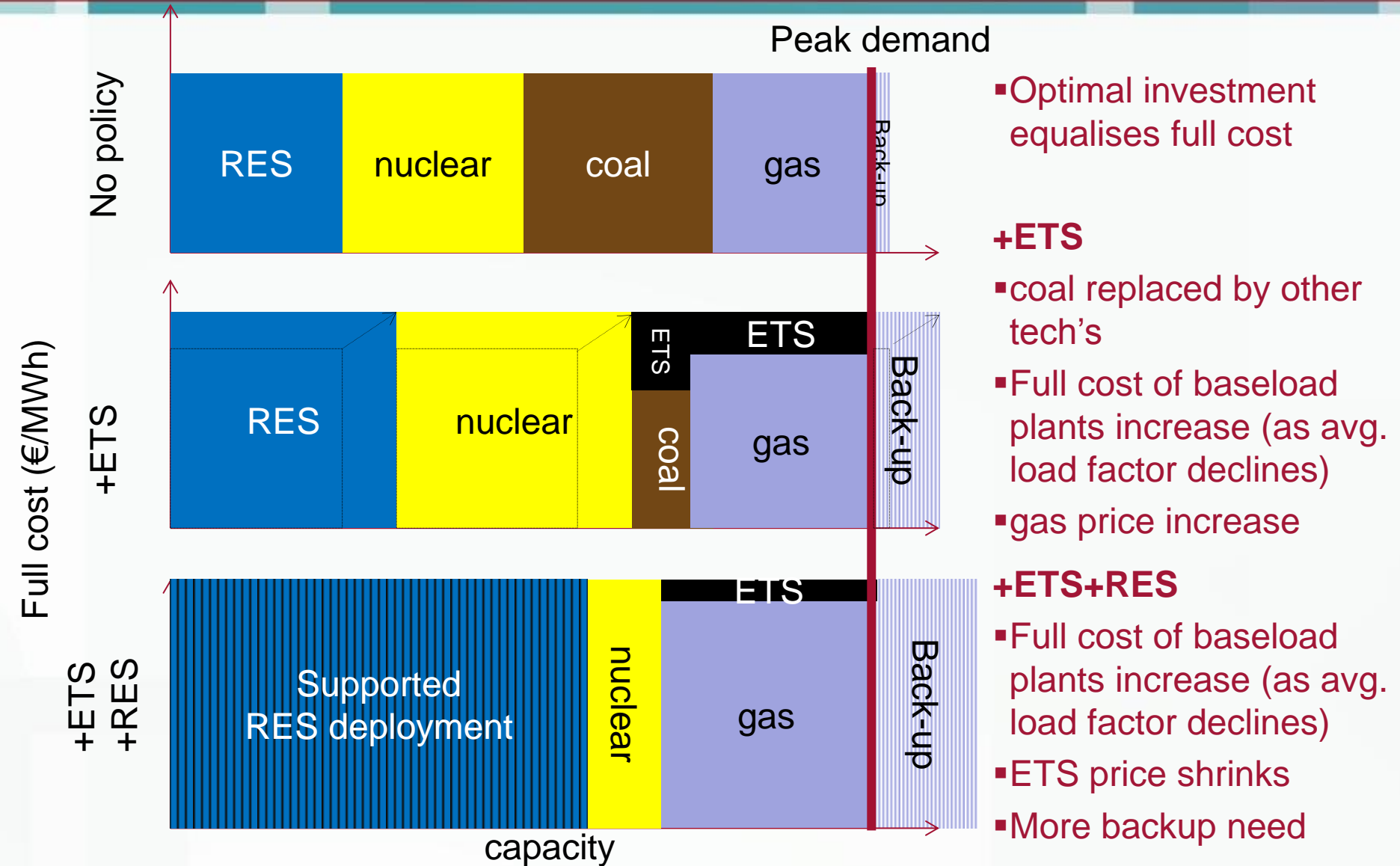
RES support

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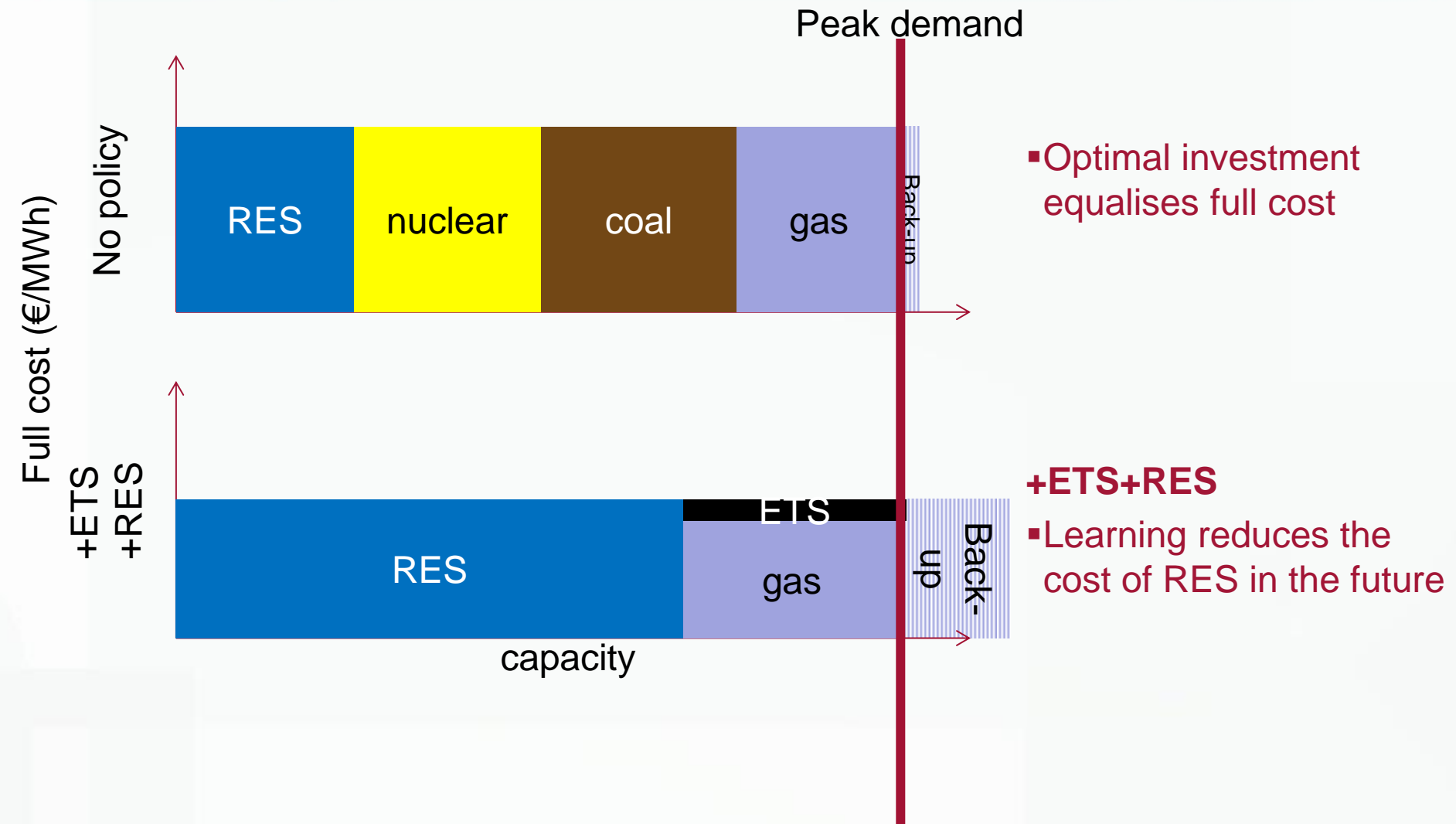
Why public support for renewables?

- Emission reduction
 - Direct: lower emission per Joule
 - **Indirect: lower emission reduction cost (learning)**
- Security of supply
 - Lower energy import dependency
- Industrial policy
 - Local value content
 - Infant industry

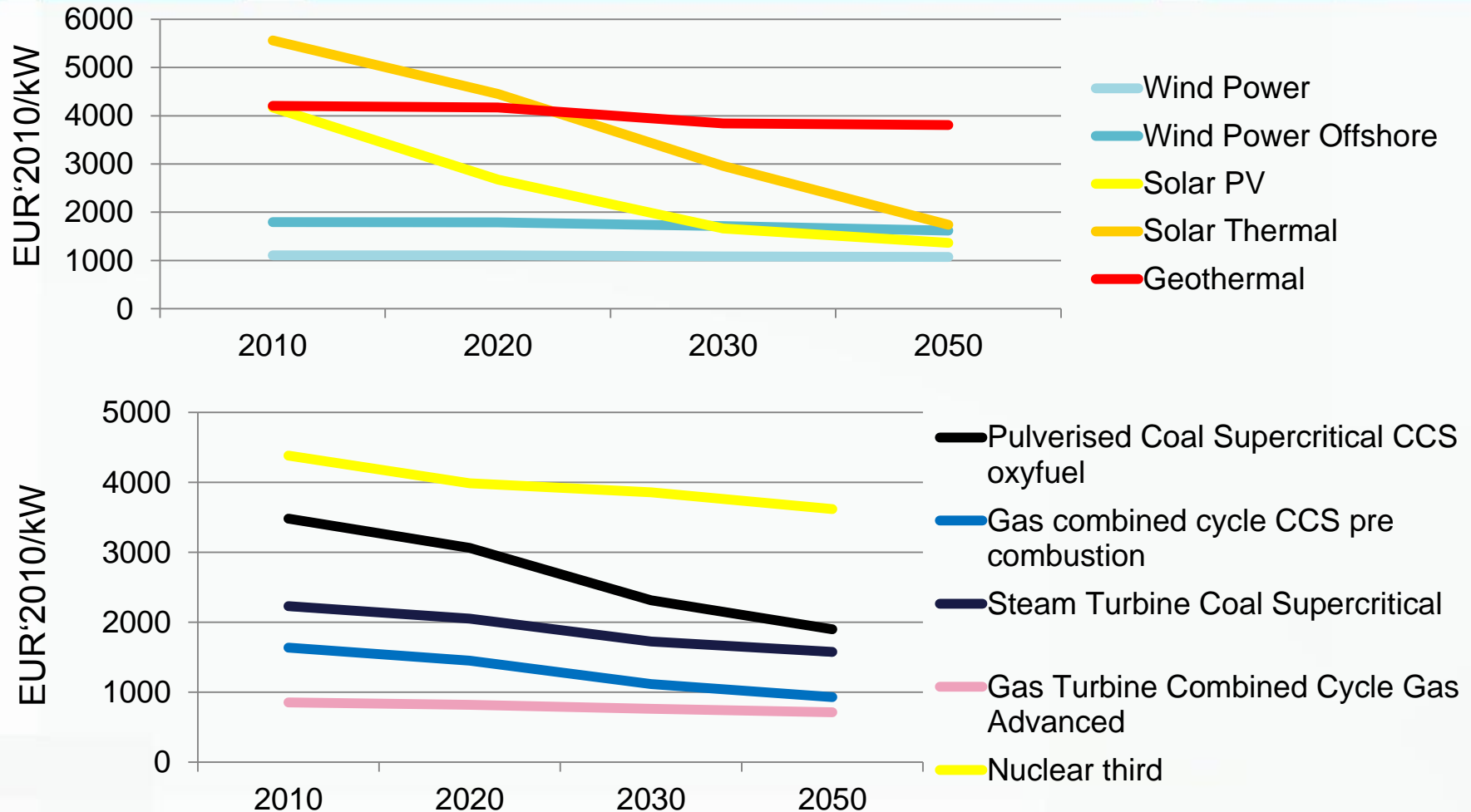
Stylized Electricity System cost - static



Stylized Electricity System cost - dynamic



Innovation needs – Energy Roadmap assumptions on capital cost



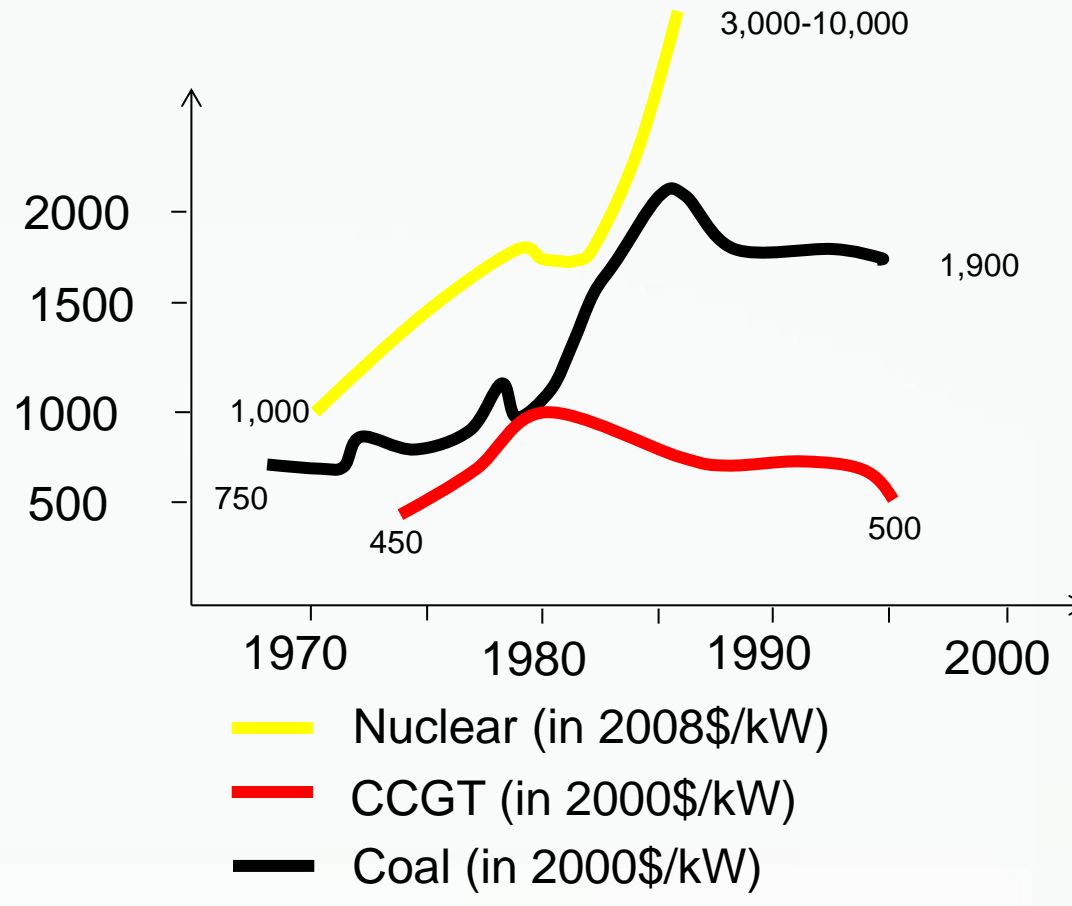
A large gap ...

Capital cost reduction 2010-2050

Pulverised Coal Supercritical CCS oxyfuel	-45%
Integrated Gasification Combined Cycle Coal	-30%
Gas combined cycle CCS pre combustion	-43%
Steam Turbine Coal Supercritical	-29%
Gas Turbine Combined Cycle Gas Advanced	-17%
Nuclear third	-17%
Wind Power	-3%
Wind Power Offshore	-10%
Solar PV	-67%
Solar Thermal	-69%
Geothermal	-9%

... when compared with the past

Capital cost of major technologies 1970-1995



Δ1970-1995

+500%

+/-0%

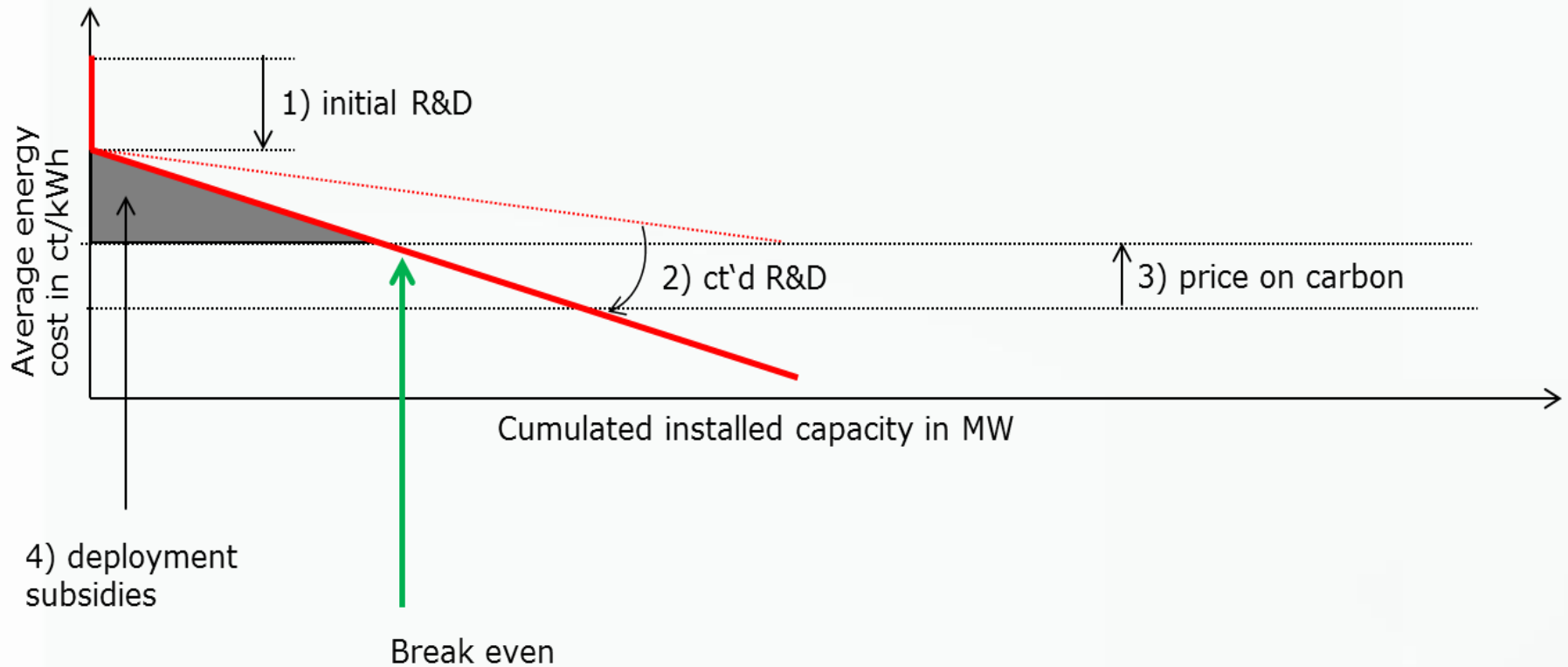
+150%

Source: Jim Watson 2001, Diesendorf 2010

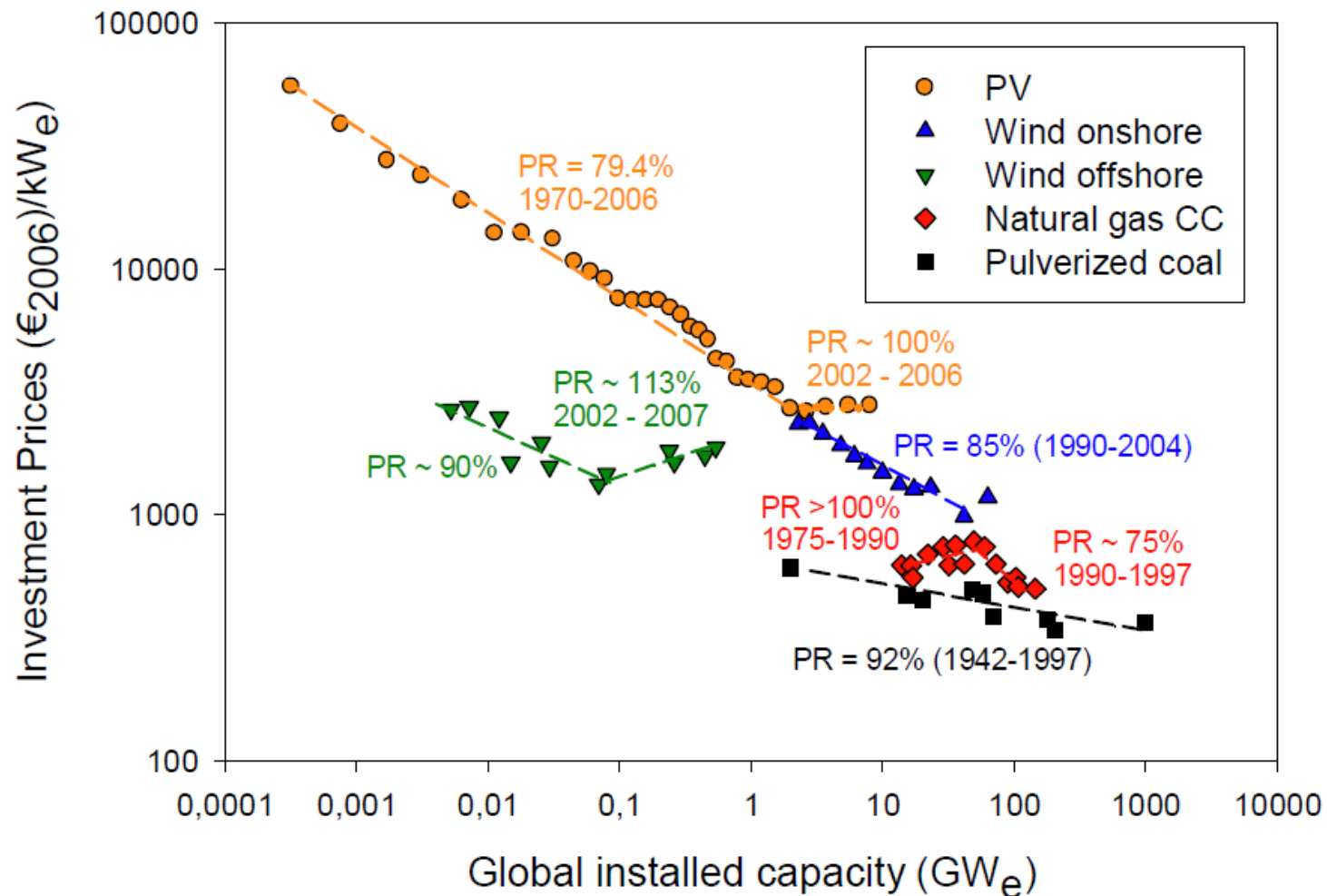
Green Innovation policies

- **Supporting green R&D: „technology push“**
 - Tax breaks
 - Public private partnerships
 - Public R&D
 - ...
- **Increasing demand for green technology: „market pull“**
 - Emission pricing
 - Renewables support (feed-in, quota, ...)
 - Regulation (fuel emission standards, light bulb, ...)
 - Public procurement
 - ...

Technology support

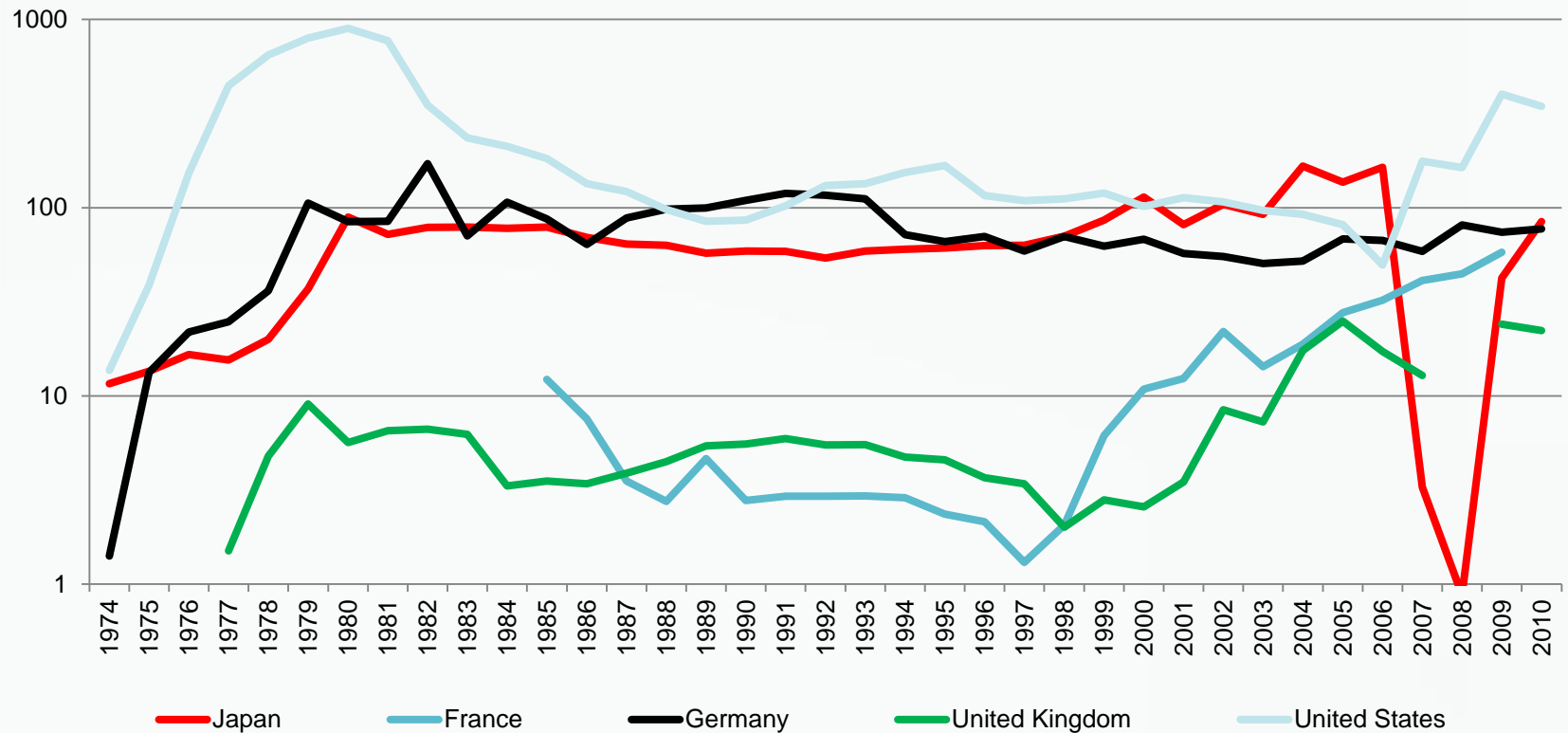


Experience curves



Source: ECN University Utrecht 2008: Technological learning in the energy sector

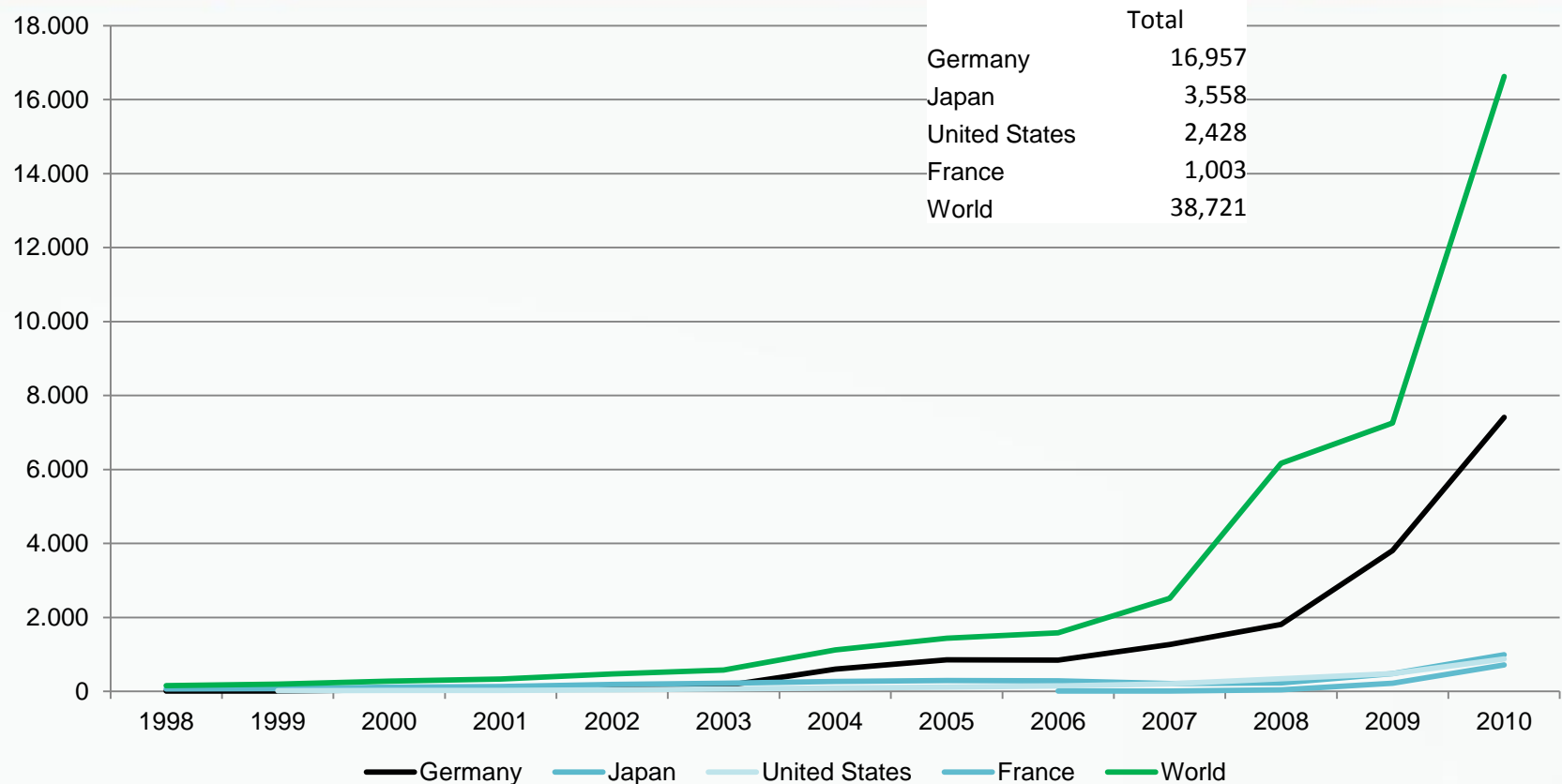
Push: Solar R&D



in Million USD (2010 prices and PPP)
Source: IEA 2012

	Total
Japan	2,466
France	341
Germany	2,724
UK	253
US	8,141

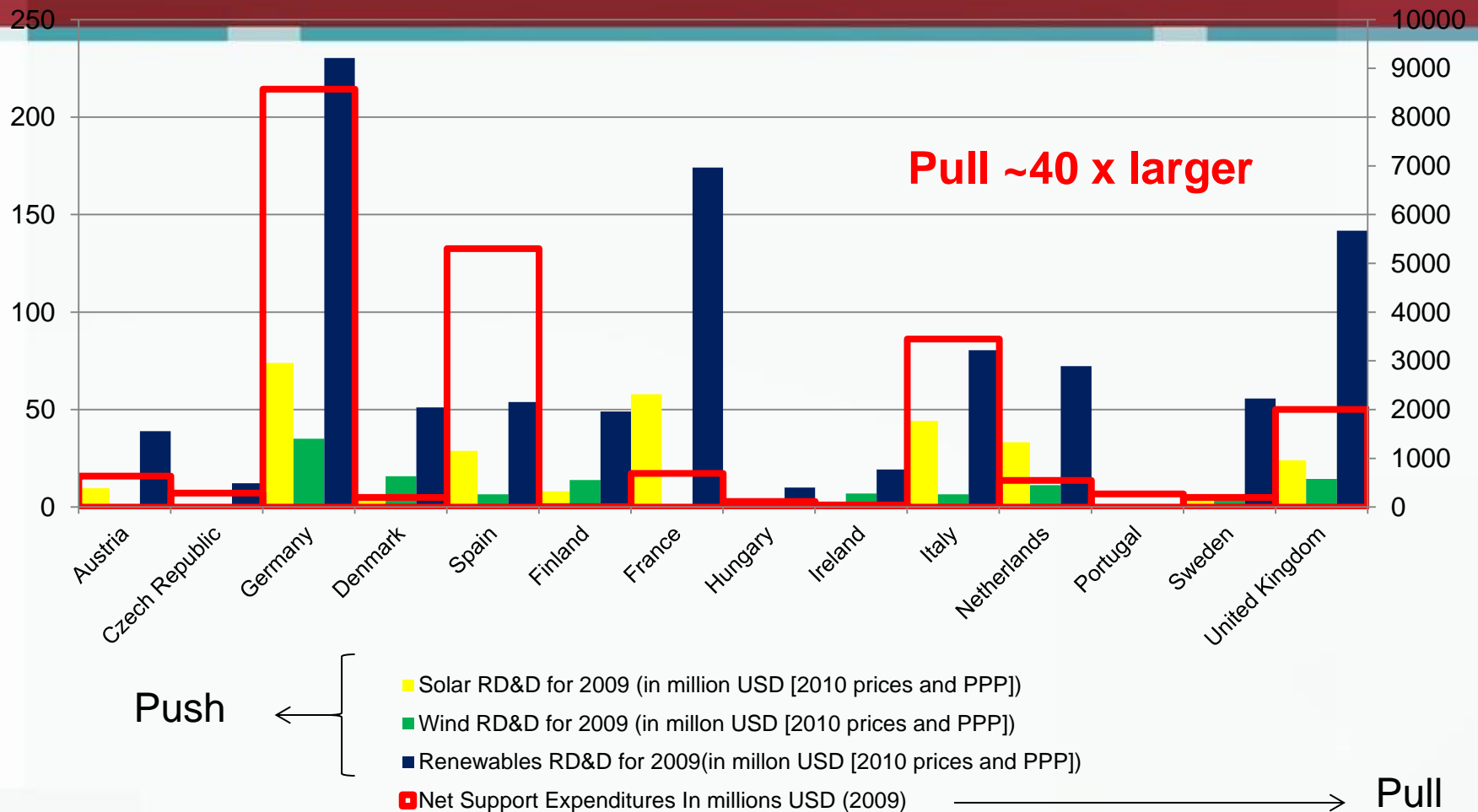
Pull: Annual Photovoltaic Installed Capacity



in Megawatts

Source: Earth Policy Institute Data Center. Retrieved from
http://www.earth-policy.org/data_center/C23 on April 17, 2012

2009 Net Support Costs vs RD&D


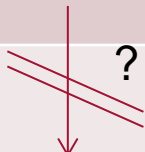


Source: IEA 2012; EcoFys, Fraunhofer ISI, TU Vienna EEG, and Ernst & Young Report: "Financing Renewable Energy in the European Energy Market"

Some naive questions:

- **Should we not spend more on research capacity?**
- **Why have so many PV firms left the market?**
- **Are short-term deployment programmes sufficient to generate the breakthrough technology innovations?**

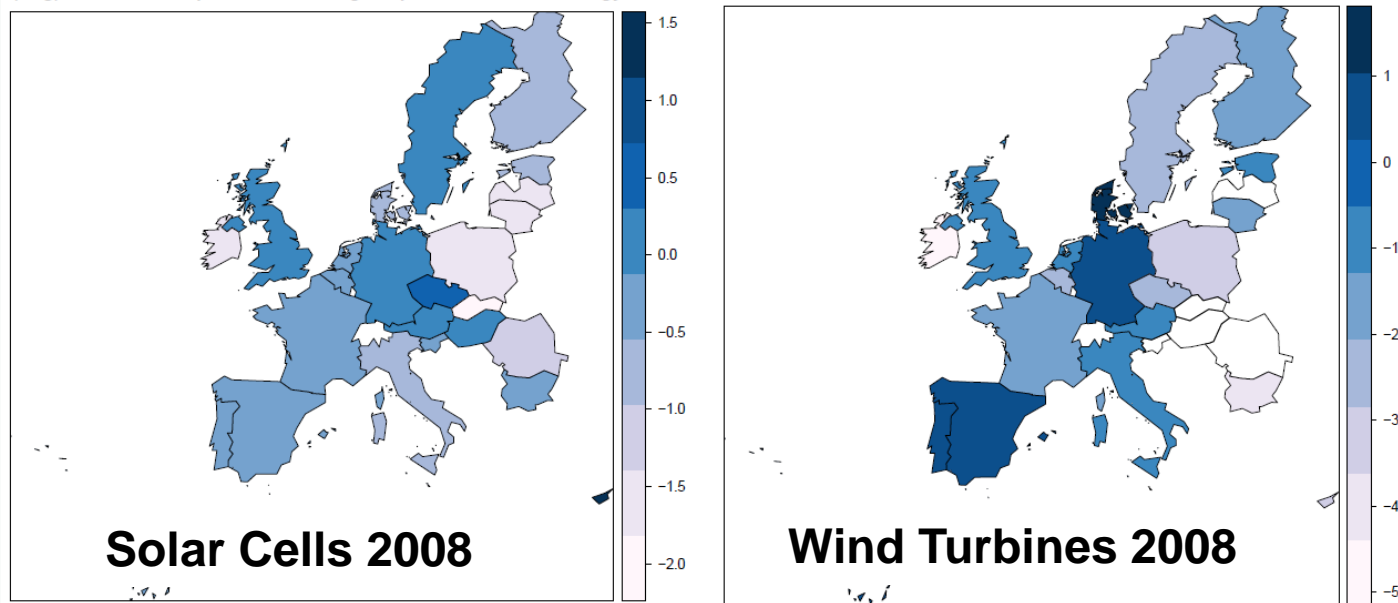
Technology stages for electricity generation technologies

Stage	PV	Off-shore	On-shore	...	Nuclear fission	Nuclear fusion	CCS	Policy
theoretical						X	X	Public Basic research
Experimental								Support Industry R&D
Pre-commercial	X	X			X			Support deployment
Commercial			X					Appropriate market design
Potential								

Why public support for renewables?

- Emission reduction
 - Direct: lower emission per Joule
 - Indirect: lower emission reduction cost (learning)
- Security of supply
 - Lower energy import dependency
- Industrial policy
 - Local value content
 - **Infant industry**

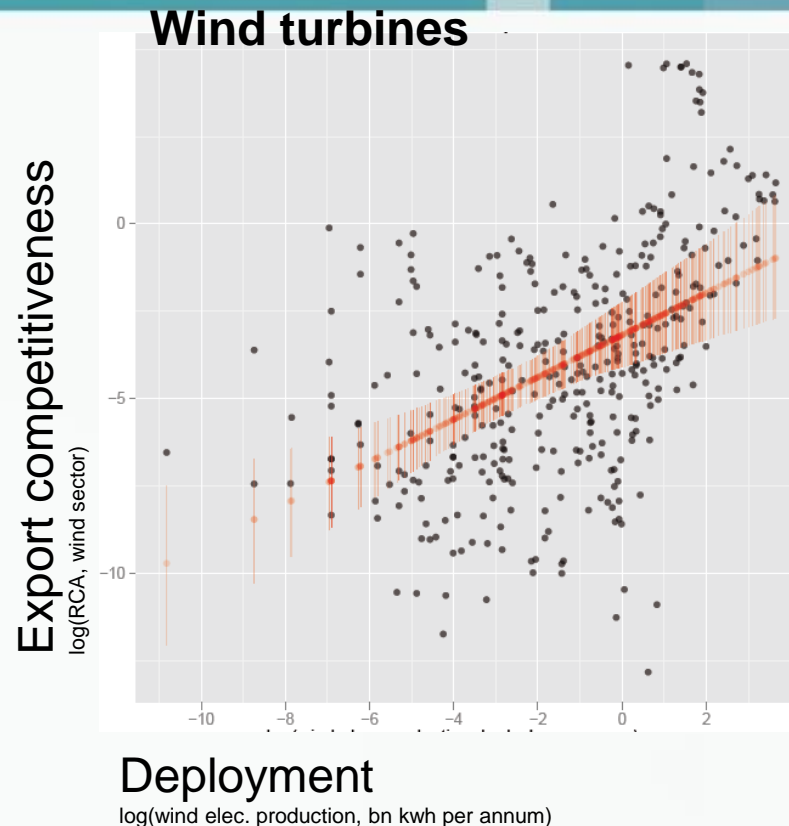
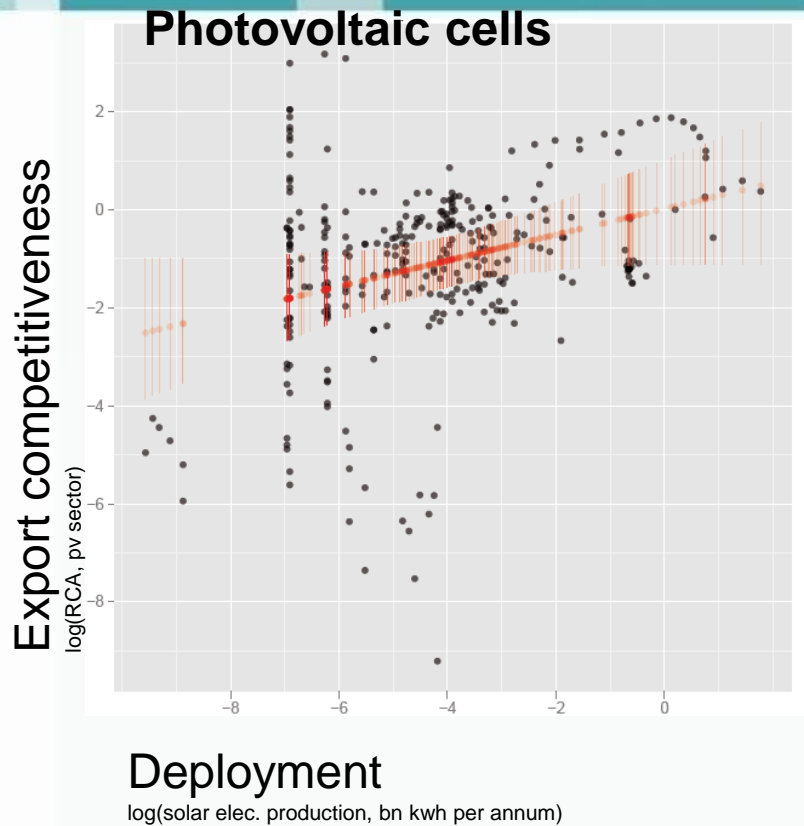
Does market size drive competitiveness?



Data: UN COMTRADE

- Countries with large **wind** turbine deployment are particularly good at exporting turbine (DE,DK,ES,PT)
- For solar less clear

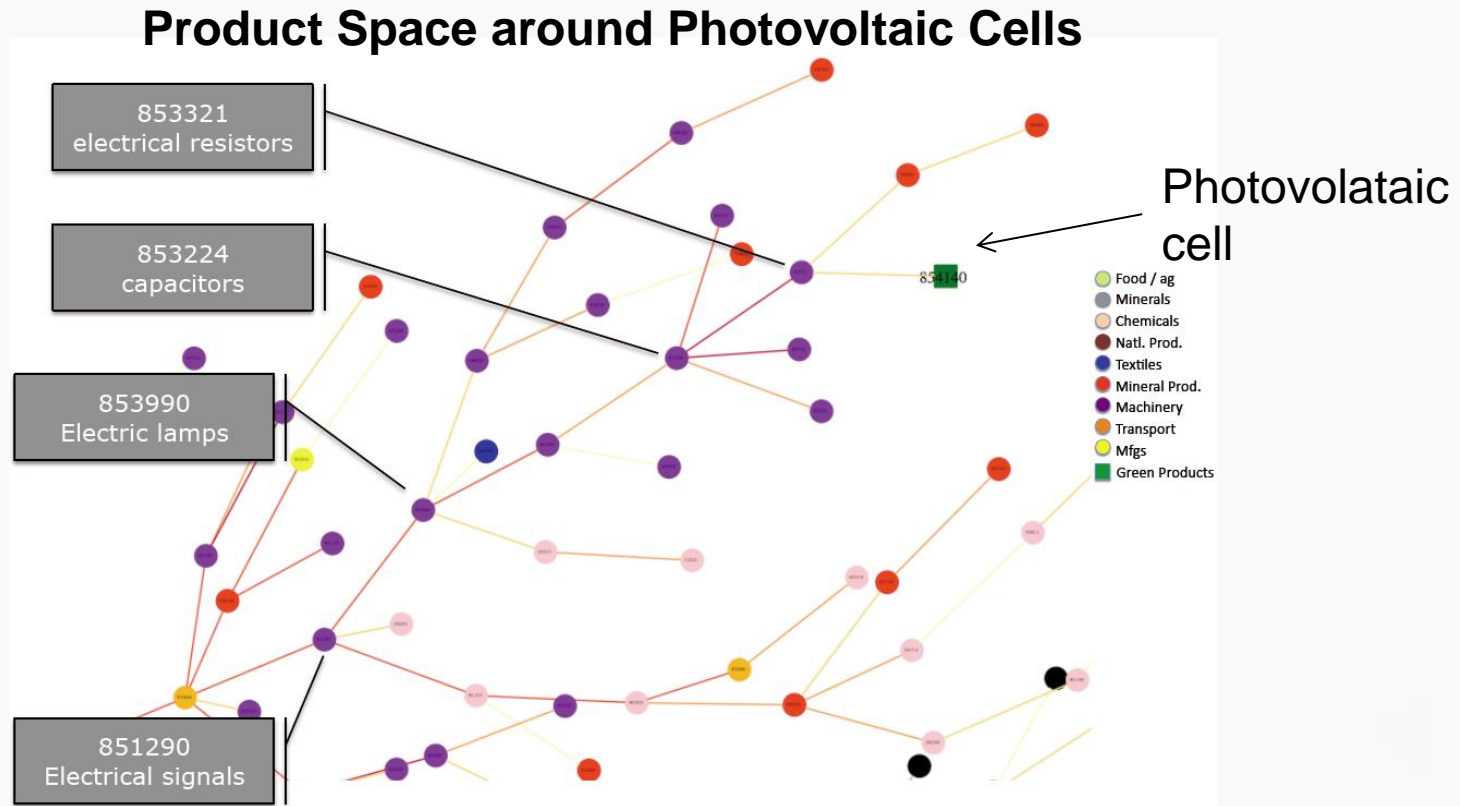
Did deployment drive export competitiveness?



⇒ **Yes, clear effect for wind, less for solar**

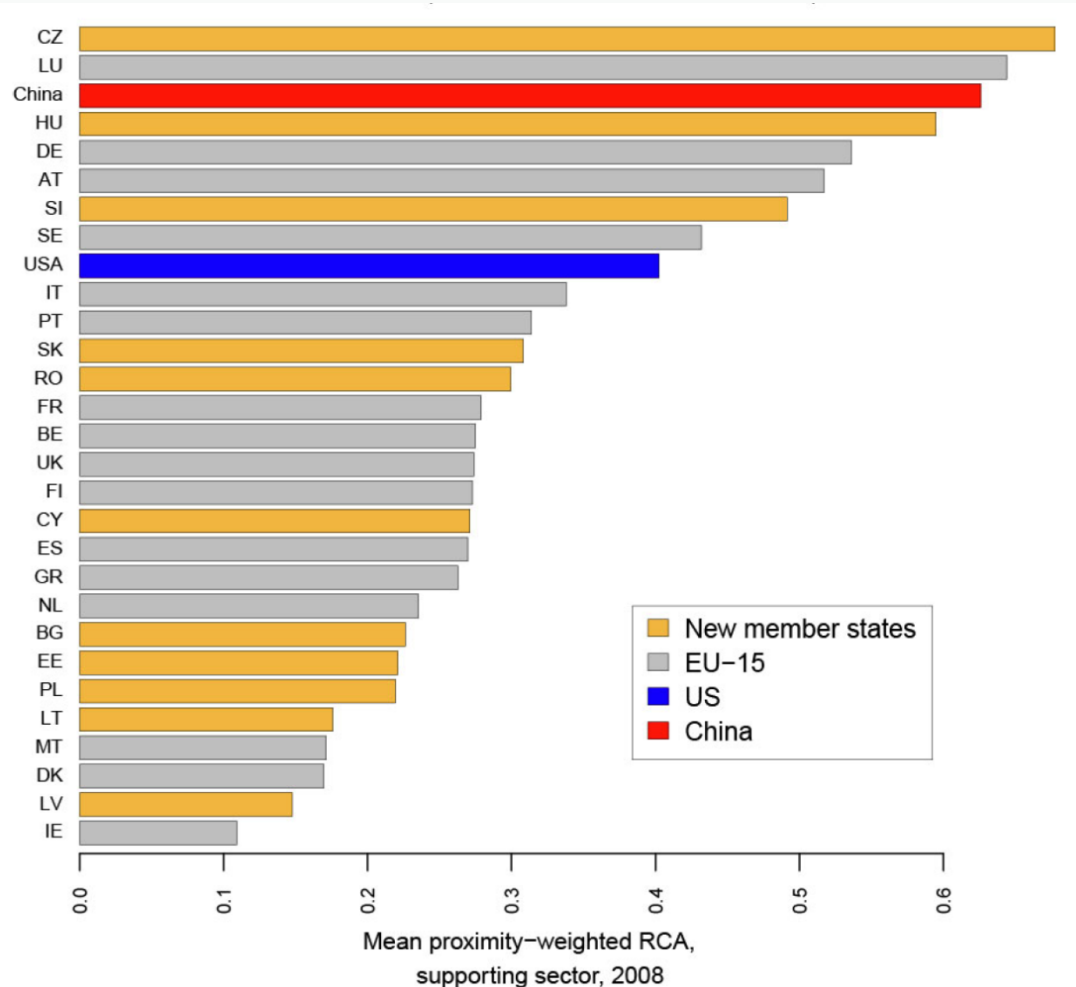
⇒ **Success depends on technology (learning rates, tradability)**

Not all countries have the same industrial capabilities

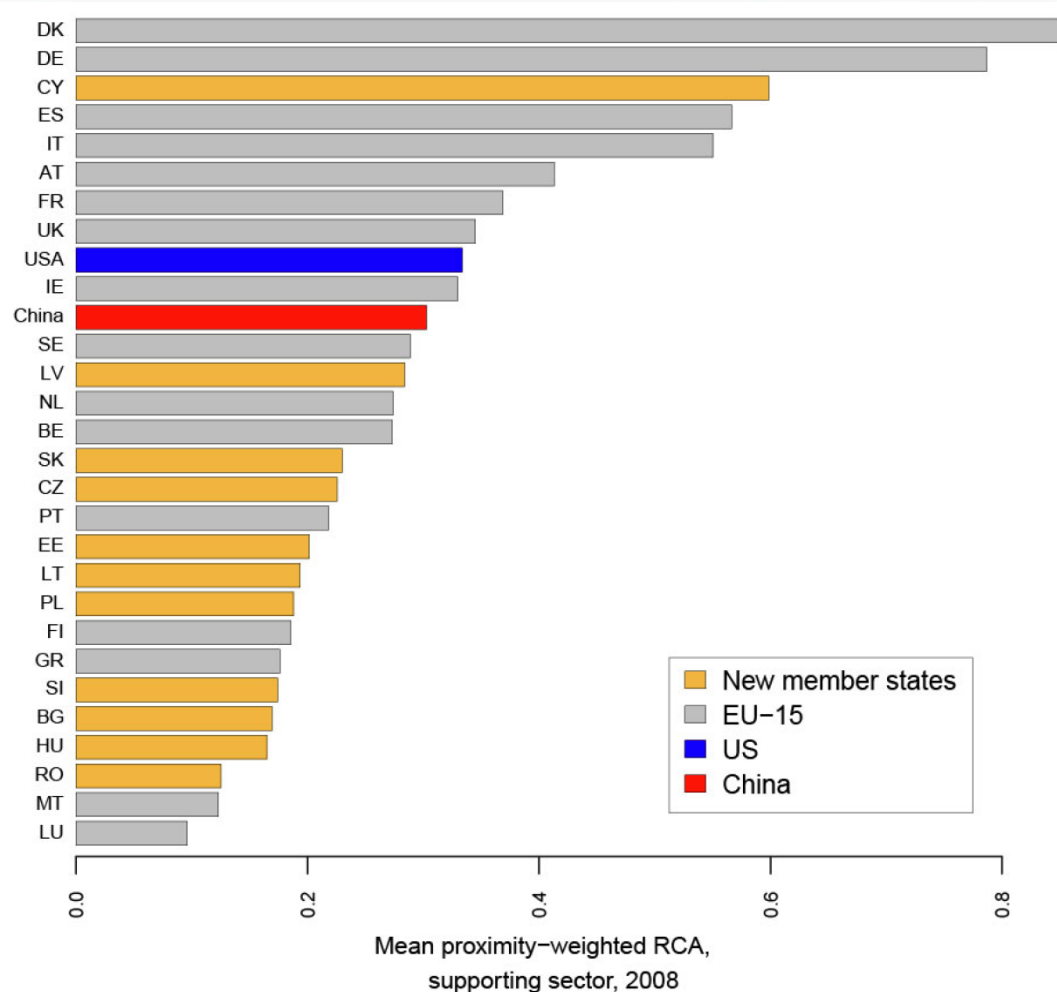


The Product Space maps correlation in export competitiveness of different products.

Which countries have strong PV-supporting sectors?



Which countries have strong wind-supporting sectors?



The case for “green industrial policy” is complex.

Conclusion

- **Optimal volume, targeting and timing of innovation policies impossible to determine**
- **Currently a „shot in the dark“ based on predictions by vested interest**
- **Uncertainty makes support more expensive**

Agenda

1. A crowded policy space
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3. RES-support – deployment is not everything
4. Potential Lessons
 - a) Match instruments and objectives
 - b) Reduce regulatory risk

a) Match instruments and objectives

First principles:

- **Target well identified externalities** (otherwise risk to only cause distortions)
- **Clear accounting of which instruments serve which objectives in order to evaluate**
- **Redistribution through transfers, not through compromising efficiency** (ETS auctioning revenues and free-allocation vs. RES burden sharing)

b) Reduce regulatory risk

- Long-term objectives require long-term investments
- But, many *ad hoc* policies (RES support, EED)

Some tools for reducing regulatory risk:

- A credible and transparent long-term vision (see b1)
- Transparent reaction functions (see b2)
- Provisions for compensating losses caused by political changes
- Financial commitment devices (see ETS example)

b1) EU Energy modelling

- **Many policy choices should be informed by modelling:**

1. Long-term Roadmaps
2. Public support to competing technologies
3. Network planning
4. Market design choices

=> Multi-billion Euro questions

- **Current EU situation**

- 1-3 are based on the PRIMES model
- For 4(&2) modelling is provided by (interest sponsored) consultants

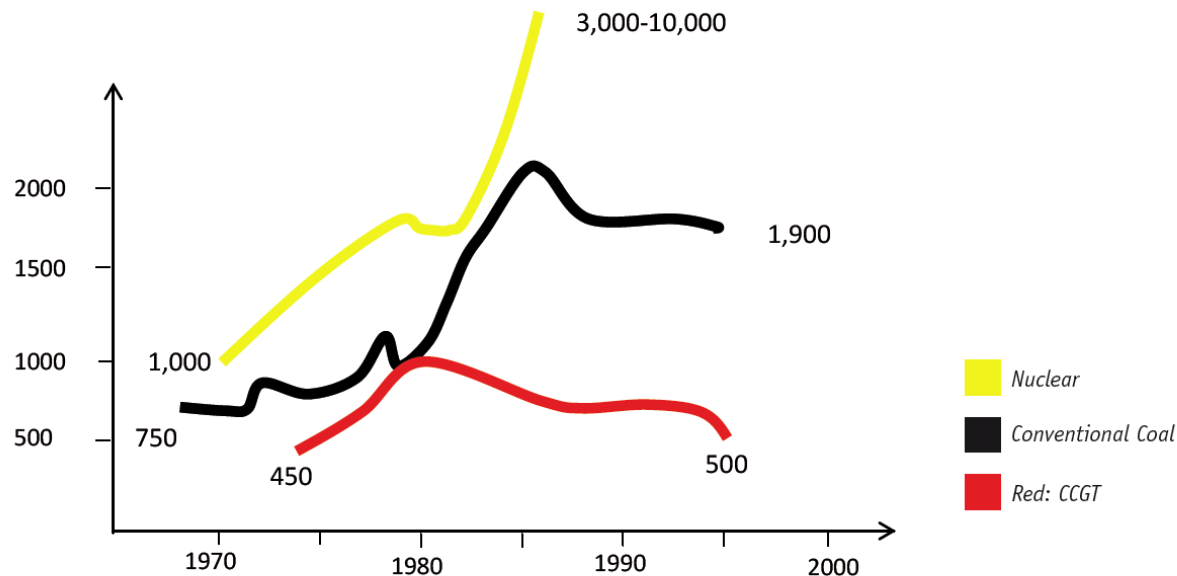
=> Assumptions and modelling rarely disclosed and not comparable

=> Modelling results are perceived as “politically predetermined”

Input data are crucial

=> A reference model with a reference data set to structure the debate could improve the policy discussion and eventually policies at comparatively low cost.

Capital cost of major technologies 1970-1995 in USD/kW



Source: Watson (2001)¹⁰, Diesendorf (2010).¹¹ Nuclear in 2008 dollars; gas and coal in 2000 dollars.

A benchmark process exists

- **US EIA (DOE) publishes the Annual Energy Outlook**
- **Its general modelling methodology is made transparent in**
 - an overview,
 - documentation of the individual modules,
 - an annually reviewed assumptions report for each of the modules,
 - most parts of the National Energy Modeling System are in the public domain
- **The EU could go beyond, by structuring a transparent process of**
 - Gathering assumptions
 - Determining scenarios

b2: Transparent and predictable support policy 1

- A consistent policy should primarily comprise of **a set of horizontal policies to resolve existing market failures** (eg, carbon pricing).
- But support instruments for R&D and deployment are technology-specific => technology choice is critical
- **excessive support to one technology might slow down the development of others**

Transparent and predictable support policy 2

- **Predictability and technology-neutrality** can only be ensured when
 - Technology choice is based on metrics and priorities defined by politics
 - Stakeholders are incentivised to provide unbiased forecasts of the capabilities of their technology
 - Technology choice is based on a open multi-technology model to provide guidance for the targeting of support
 - A corresponding model is built, maintained, extended and published by an independent public institution.
- would ensure that stakeholders can predict public technology decisions,
- thus find it easier to commit to the needed long-term and risky investments
- **To achieve the enormous cost-reductions necessary for the Energy Roadmap, not only technology needs to learn – also support policies have to improve based on experience!**

References

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Back-up: internal energy market

Messages

- **Benefits of cooperation increase**
- **To reap these benefits:**
 - Market design needs to be updated
 - System operation needs to be Europeanised
 - Network development needs to follow welfare-optimisation
- **Alternatively, scope for markets will vanish**

Agenda

- 1. Benefits of cooperation**
- 2. Reaping the benefits**
- 3. Discussion**

Effects of integrating renewables

- Renewables will make the residual demand more volatile
 - Renewables will be produced at different location
 - At some hours almost no renewable unit will run
 - Significant shift of supplies might happen at rather short notice
- ⇒ sufficient complementary technologies needed (transmission, demand response, conventional generation, storage)
- ⇒ Appropriate market design to remunerate the investment and operation of these technologies needed

More integration is part of the least cost solution

- **Geographic averaging of individual resources**
- **Pooling of national resources**
- **Pooling of reserves**
- **For small and medium countries**
 - Larger portfolio of plants possible (reactiveness, marginal cost, fix cost, fuels)
 - Competition at all steps of the merit order curve

Simulation exercise

■ Two countries

- Solar correlation 98%,
- Wind correlation 76.5%,
- Demand correlation 78%
- 28 h are among the 100 h with the highest residual demand in both countries

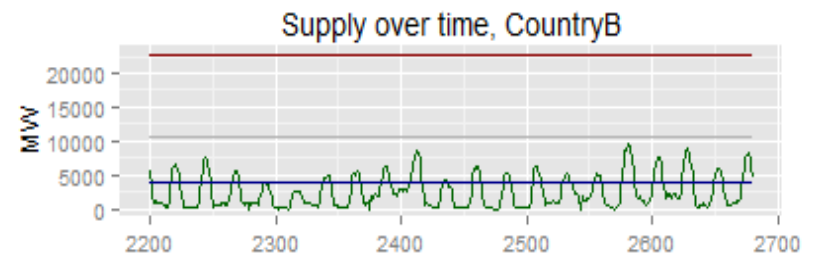
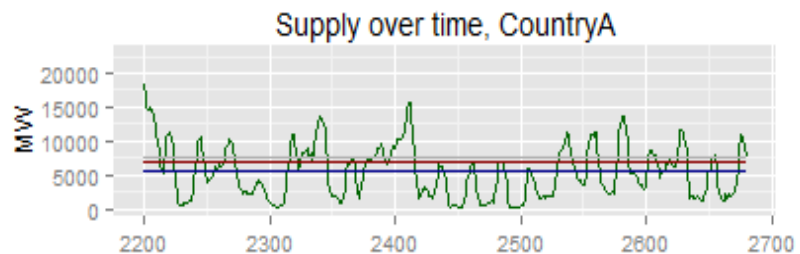
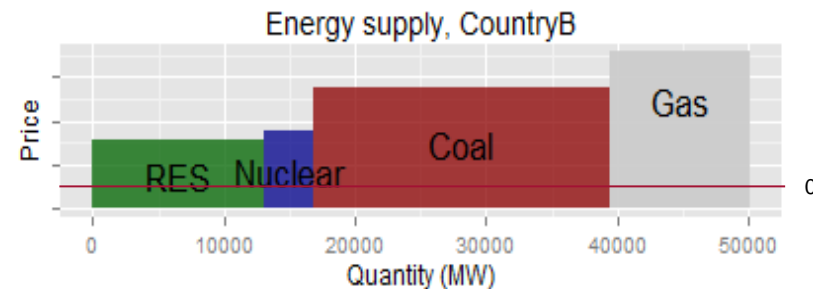
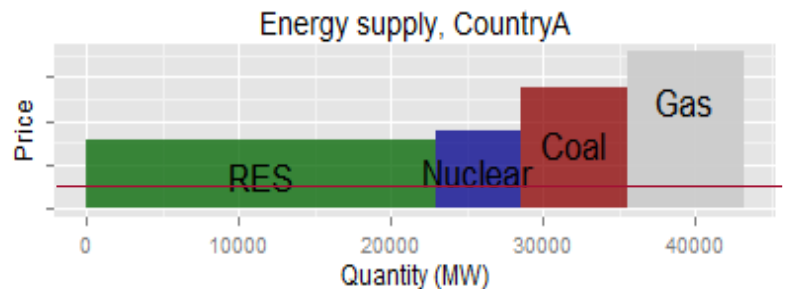
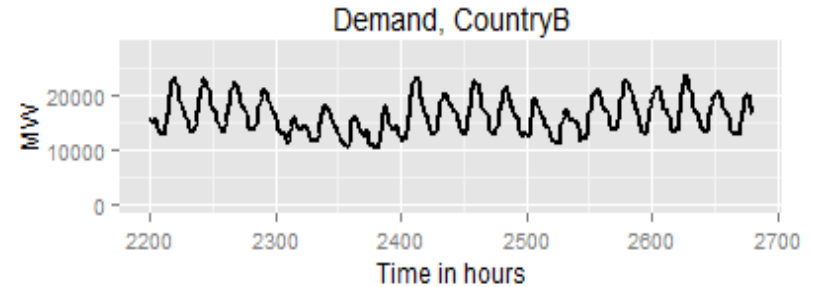
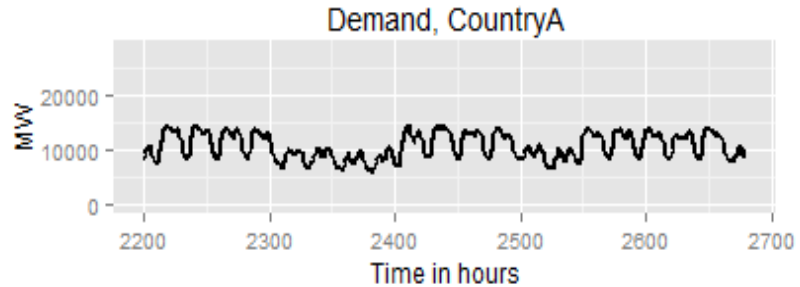
■ Four technologies

	Capacity, Country A (MW)	Capacity, Country B (MW)	Fixed cost in Euro/MW/y	Variable cost in Euro/MWh
Renewables	23,000	13,000	120,000	0
Nuclear	5,500	3,900	190,000	10
Coal	7,100	22,600	100,000	21
Gas	7,600	10,600	40,000	35

■ Four scenarios:

1. No trade
2. Limited trade
3. Full trade
4. Reoptimisation of power plant park (excl. RES and nuclear)

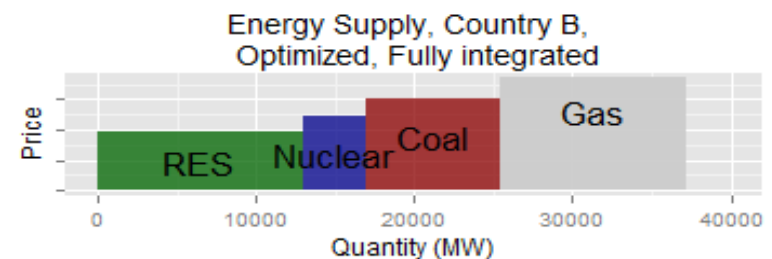
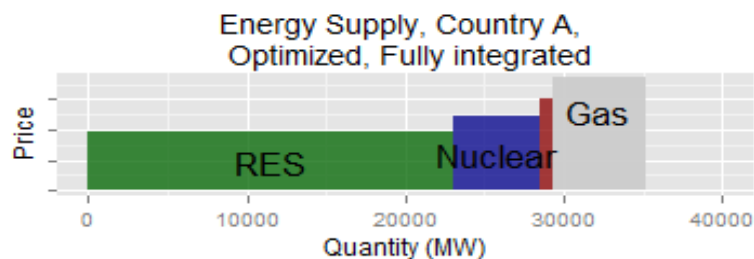
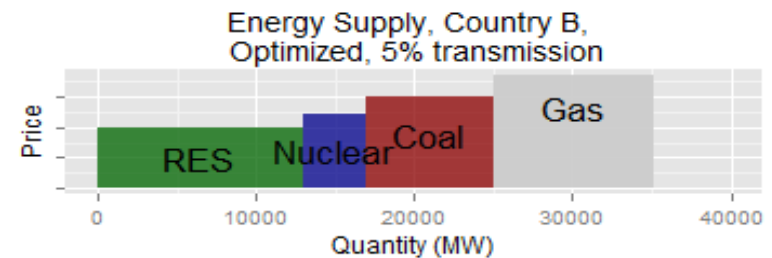
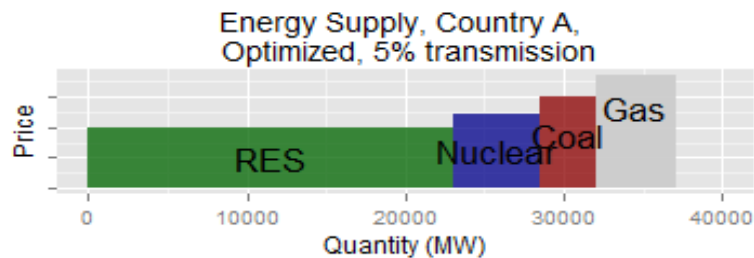
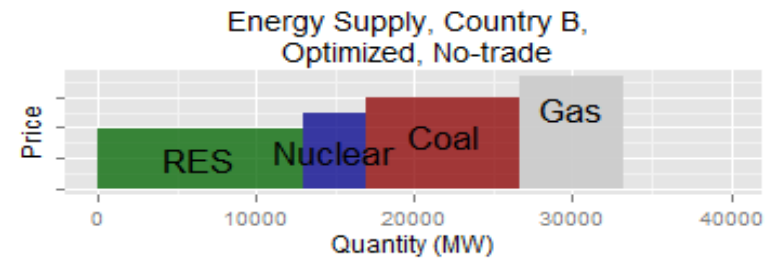
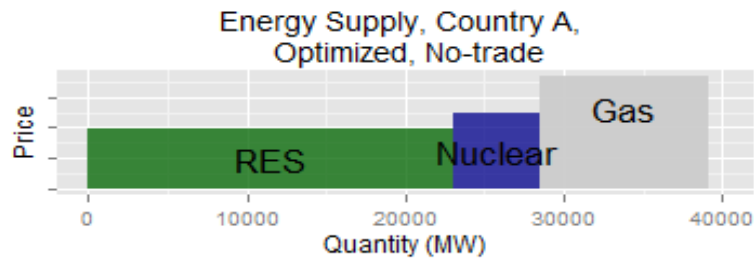
Static efficiencies of integration



System cost under different scenarios

	No Integration	5% Transmission	Full Integration
Total costs	100	99.1	98.1

Going from an individually to jointly optimised system



	No Integration	5% Transmission	Full Integration
System cost	100	98.9	97.5

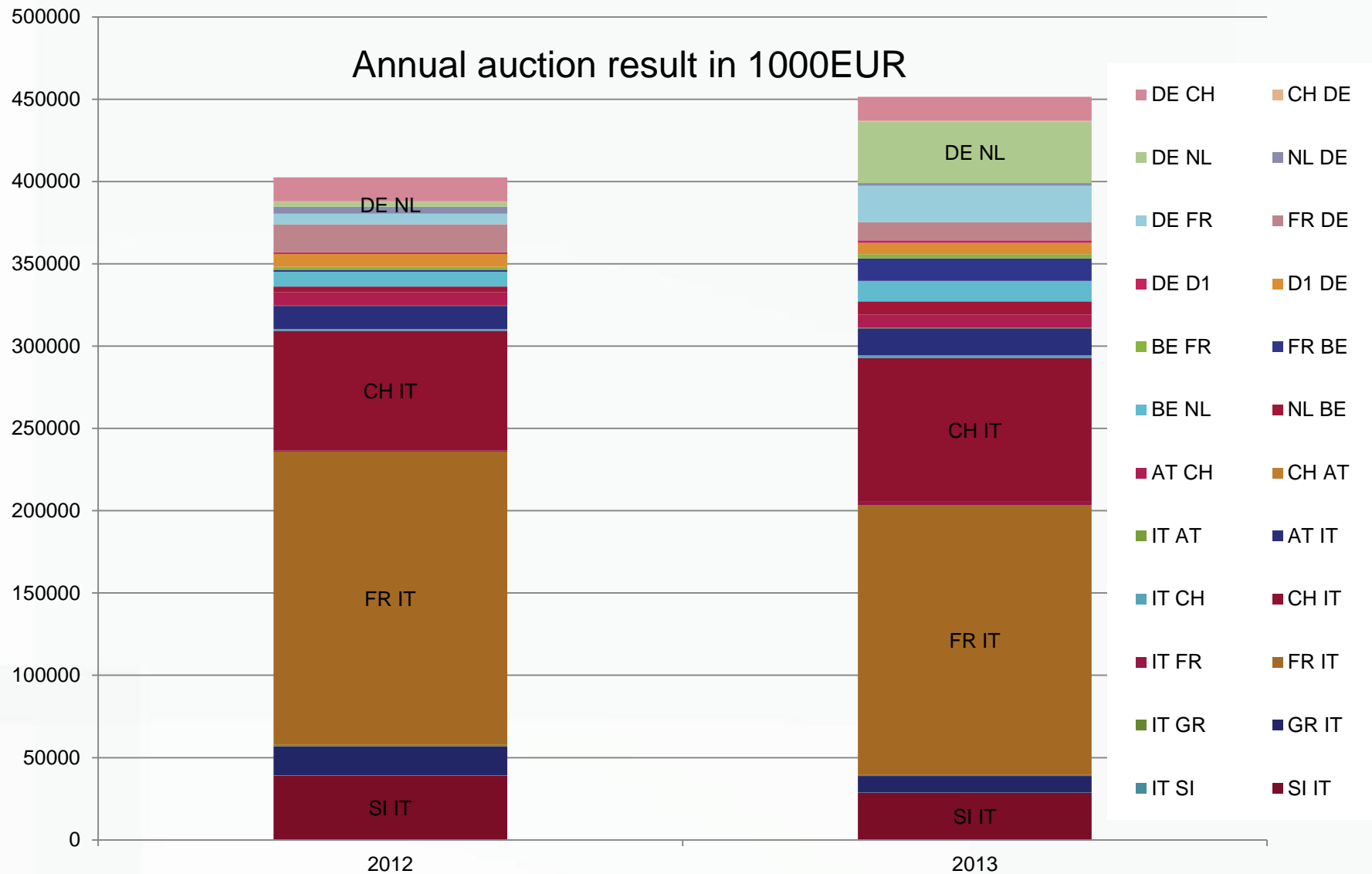
Gains of integration at higher shares of RES

	No Integration	5% Transmission	Full Integration
Current Renewables	100	98.9	97.5
High Renewables	100	97.5	95.4

Interpretation

1. Most (static) trade benefits accrue already at limited trade
2. Full trade has some marginal benefits
3. Additional gain in Reoptimisation of power plant park
4. Increasing RES share increases the value of interconnection

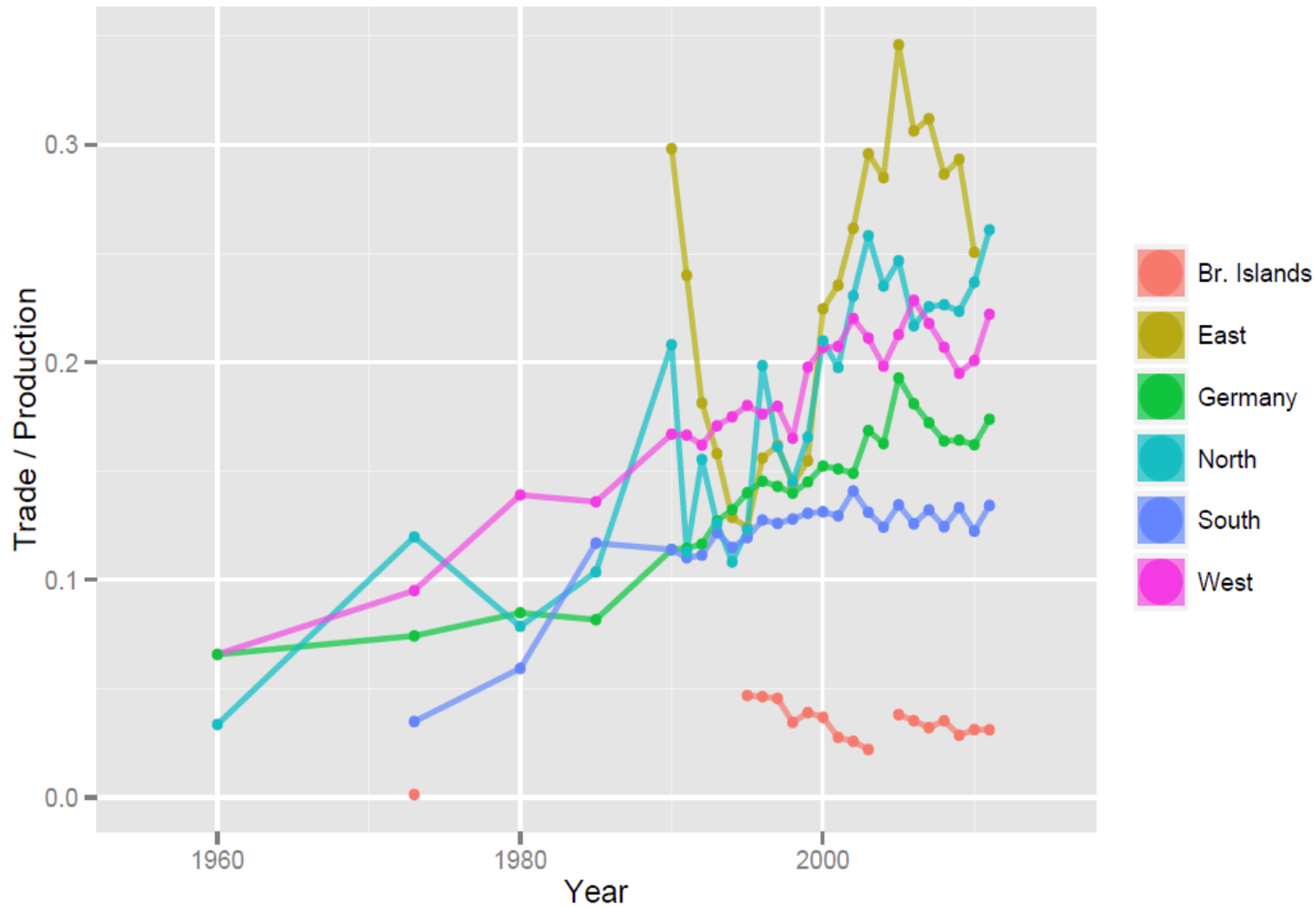
Willingness to pay for interconnectors



Reaping the benefits

1. **Benefits of cooperation**
2. **Reaping the benefits**
3. **Discussion**

Important benefits have been reaped in the past



Reaping the benefits

Requirements

- The **physical network** and its operation have to reliably ensure the optimal cross-border exchanges
- **Market Design** has to ensure that production, consumption and investment decisions do depend on the cost (incl. externalities) and not on the country

Determining optimal infrastructure

- **Determining optimal infrastructure need is a challenging exercise that crucially depends on a number of assumptions.**
 1. Which measure should be optimised by the infrastructure investment?
 2. Which development of the energy system in the coming decades is considered?
 3. Which technical options are considered?
 4. What cost assumptions for the different options?
 5. Which market design is assumed?
- => Estimates are largely assumption driven and barely comparable**

Infrastructure cost studies

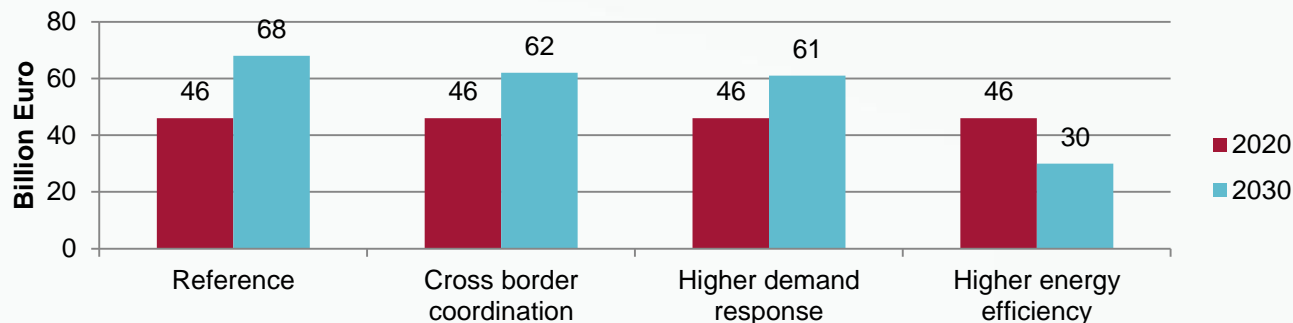
- **Roland Berger's report (2011)**
 - distribution and transmission together will require around EUR 400 billion + EUR 200 billion for 2010-2020 (65% electricity, 35% gas)
- **The European Infrastructure Priorities (2010)**
 - 2011-2020: EUR 70 billion for transmission infrastructure, EUR 32 billion for offshore grid infrastructure and EUR 40 billion for smart grid infrastructure.
- **2013 OECD working paper**
 - Grid shortage would make renewables deployment 38 billion dollars more expensive
- **The Energy Roadmap 2050**
 - 2011-2050 infrastructure requirements reach EUR 1269 billion in the reference and EUR 2195 billion in the high RES scenario

Infrastructure cost studies

- **Ten Year Network Development Plan 2012**

- increasing the total length of the network by 17 % over the coming ten years

- **ECF's study (2011)**



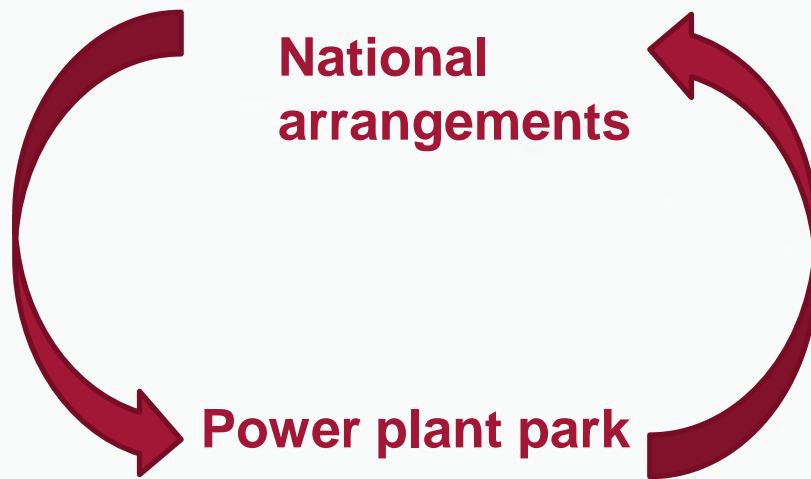
- **Hirschhausen et al. (2012)**

- Total investment costs for transmission capacity in Europe 2011-2050 of “80% GHG reduction” scenario: EUR 57 bn

Electricity has multiple dimensions that can be individually traded

	Nationally administered	National market	National market with an interface for imports/exports	European market	Expected change in Importance
Ancillary services					+
Intraday & Balancing			Nordic+		+
Day-ahead delivery of electricity					-
Supply Adequacy					+
Location			Nordic		+
“Greenness”		Quotas			+
Emissions				ETS	

- Dimensions interact: => „grand design“ or complex set of interfaces
- Existing national arrangements and national plant park



-> cross-border harmonisation produces losers

Discussion

1. **Benefits of cooperation**
2. **Reaping the benefits**
3. **Discussion**

Discussion: Governance

Different regional settings

- EU 27+ (ENTSO, ACER, EU)
- NWE
- Penta-lateral
- Bilateral (FR-DE)

Different institutional frameworks

- Merger of TSOs
- Independent system operator
- Merger of PX
- Joint regulator