Implications of RES in the EU

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30 May 2013

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

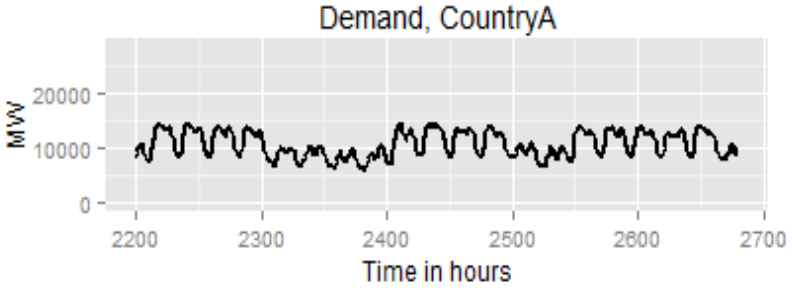
Simulation exercise

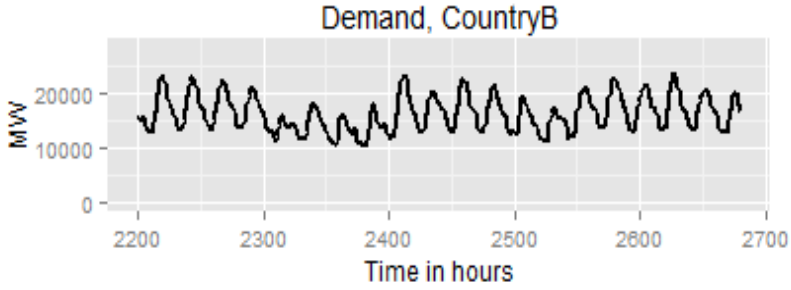
- **Two countries**
  - Solar correlation 98%,
  - Wind correlation 76.5%,
  - Demand correlation 78%
  - 28 h are among the 100 h with the highest residual demand in both countries
- **Four technologies**

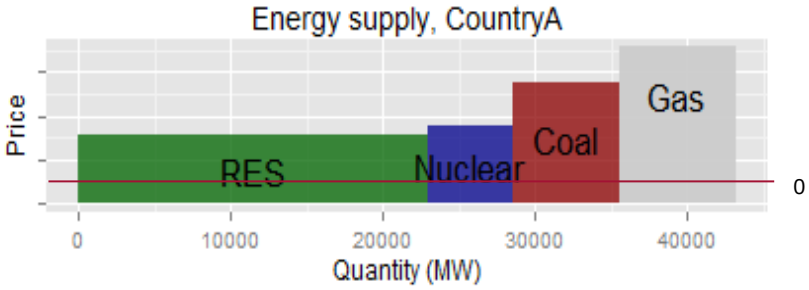
	Capacity, Country A (MW)	Capacity, Country B (MW)	Fixed cost in Euro/MW/y	Variable cost in Euro/MWh
Renewables	23,000	13,000	120,000	0
Nuclear	5,500	3,900	190,000	10
Coal	7,100	22,600	100,000	21
Gas	7,600	10,600	40,000	35

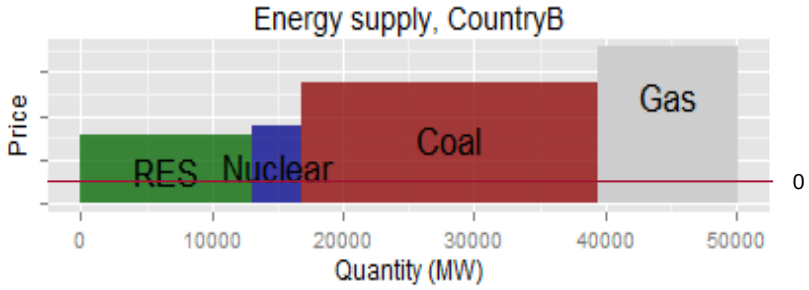
- **Four scenarios:**
  1. No trade
  2. Limited trade
  3. Full trade
  4. Reoptimisation of power plant park (excl. RES and nuclear)

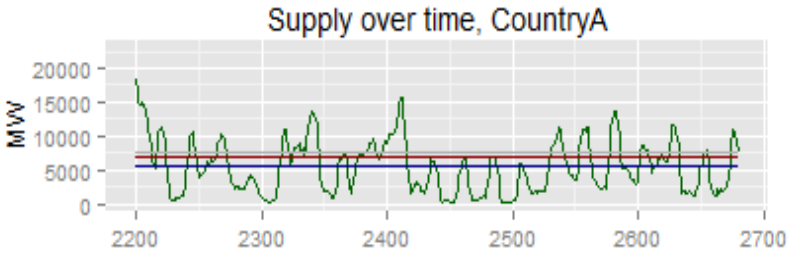
Static efficiencies of integration

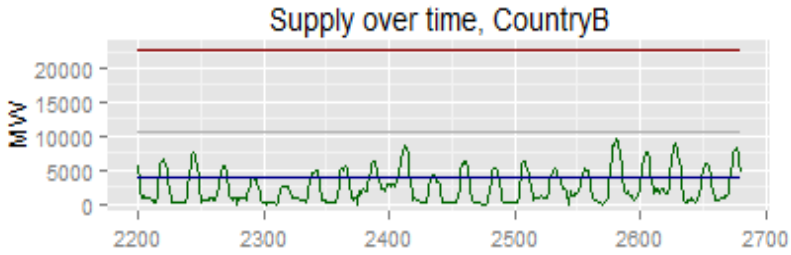








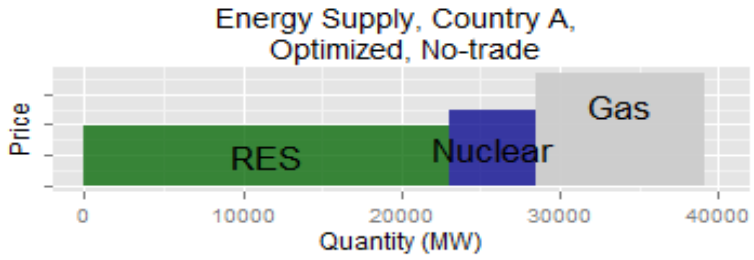


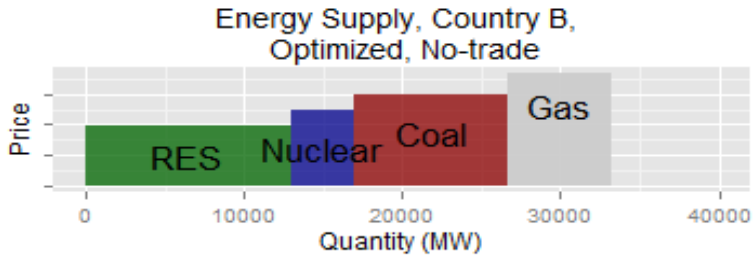


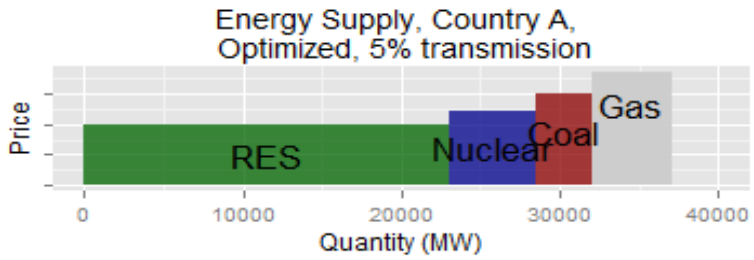
System cost under different scenarios

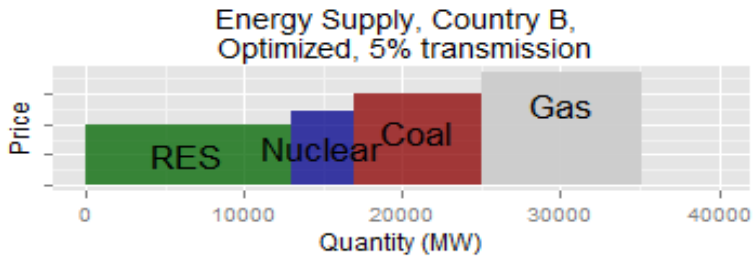
	No Integration	5% Transmission	Full Integration
Total costs	100	99.1	98.1

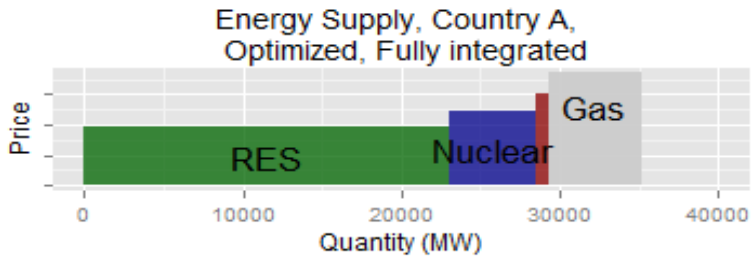
Going from an individuallly to jointly optimised system

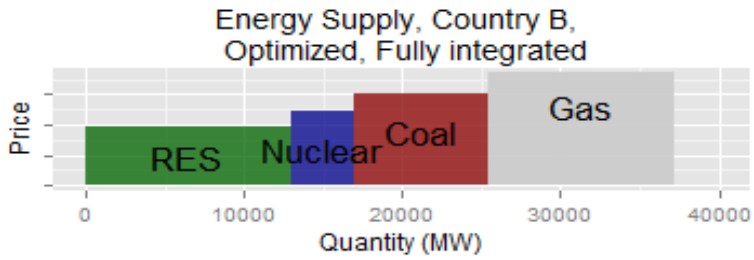












	No Integration	5% Transmission	Full Integration
System cost	100	98.9	97.5

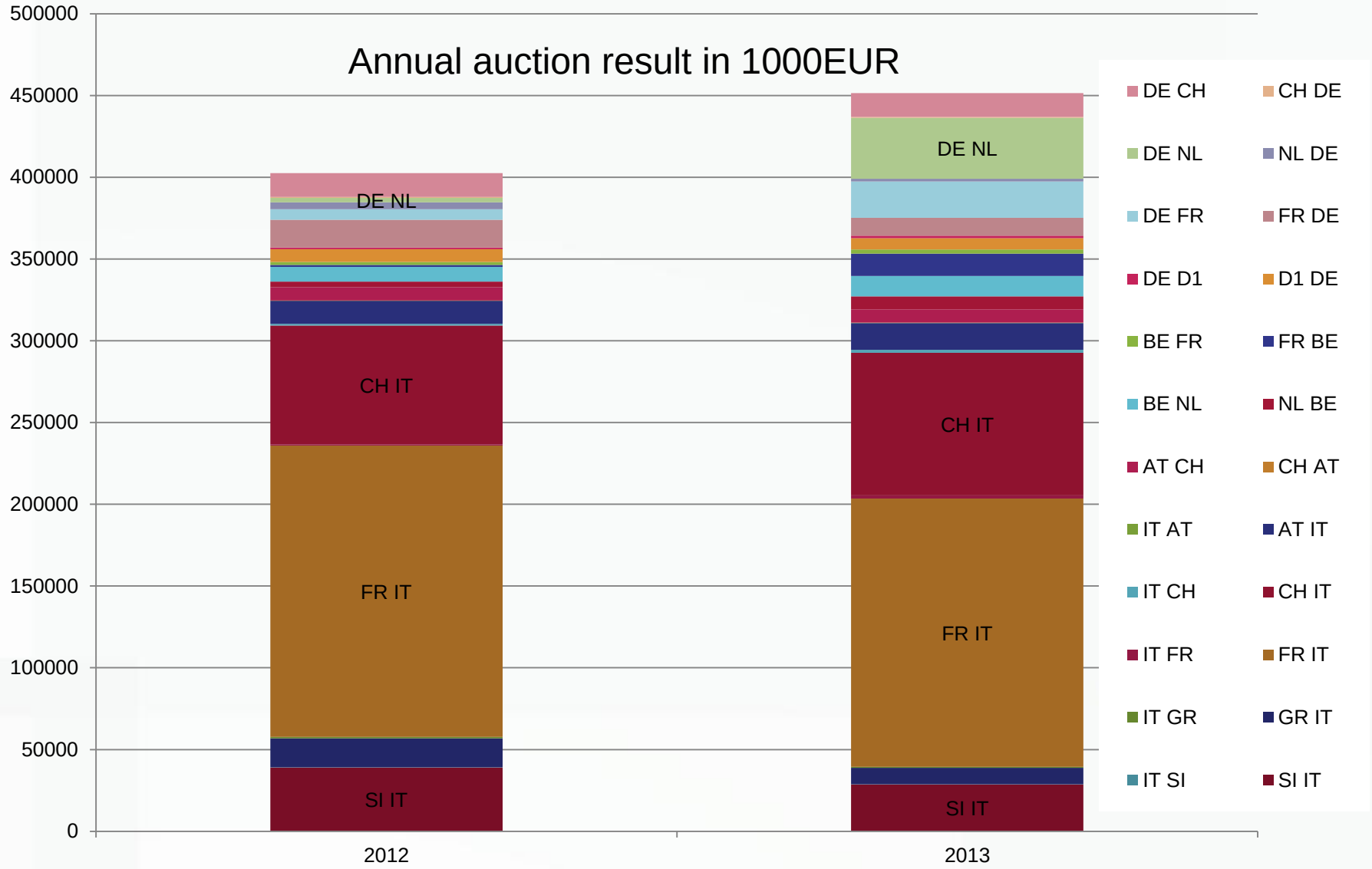
Gains of integration at higher shares of RES

	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

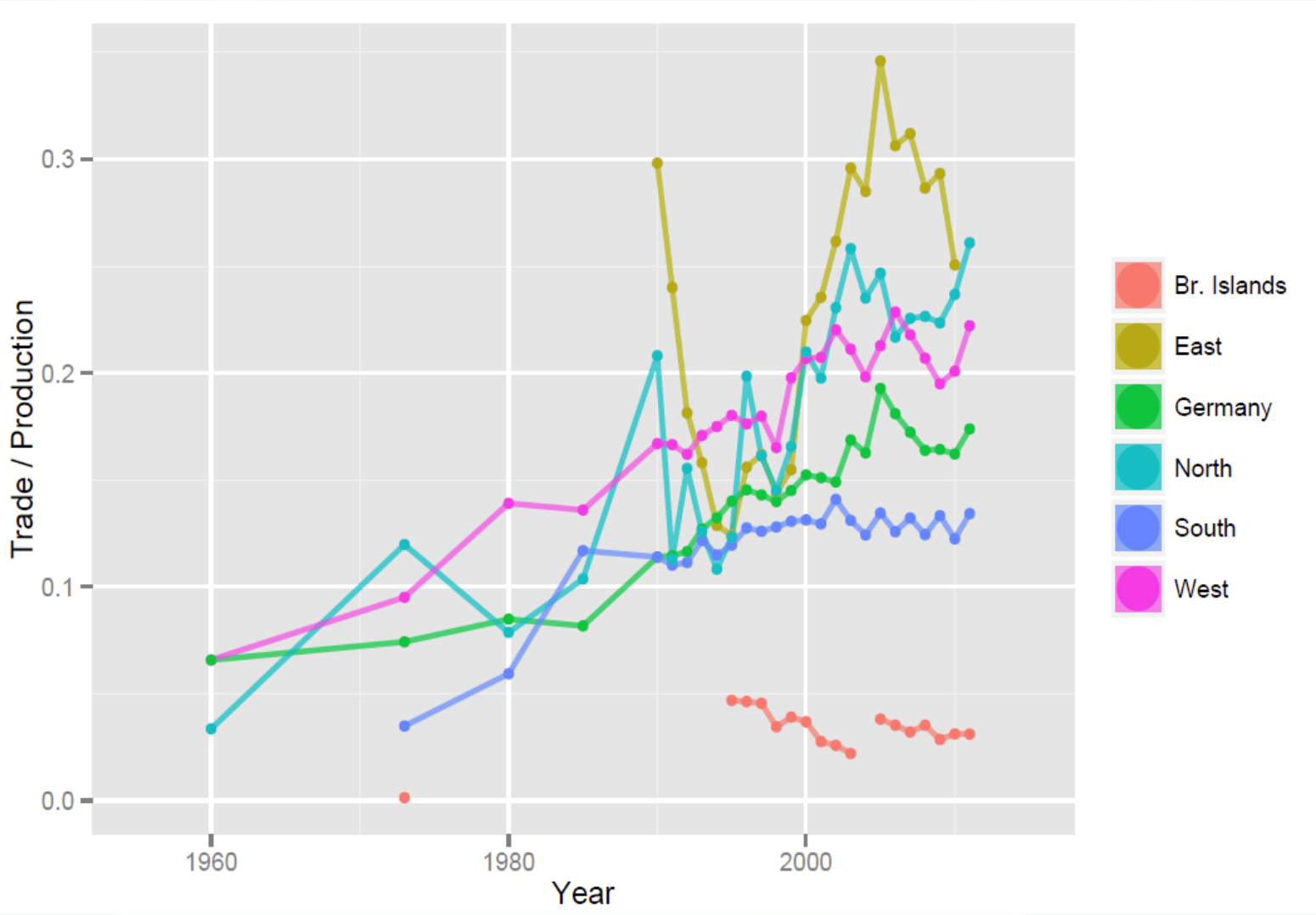
Willingness to pay for interconnectors



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?

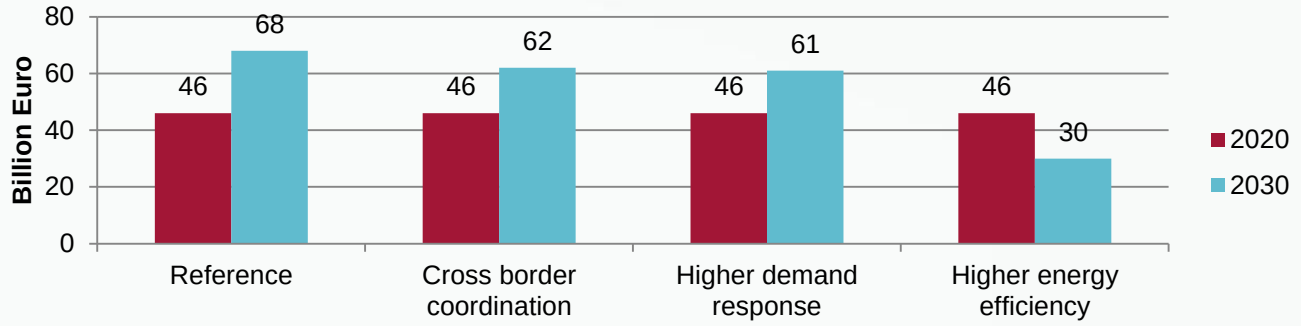
=> Estimates are largly assumption driven and barely comparable

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)**

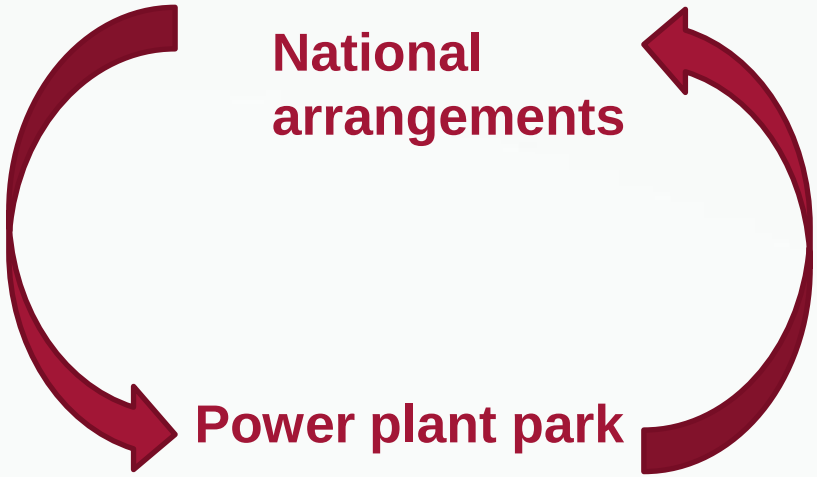


- **Hirschhausen et al. (2012)**
  - Total investment costs for transmission capacity in Europe 2011-2050 of "80% GHG reduction" scenario: EUR 57 bn

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

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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

Back-up

Day-ahead wind forecast error in Germany 2012 in MW