NHH

TIME TO RETHINK HOW TO SUPPORT INTERMITTENT RENEWABLE ENERGY? LINKING POLICY INSTRUMENTS TO THE VALUE OF ENERGY

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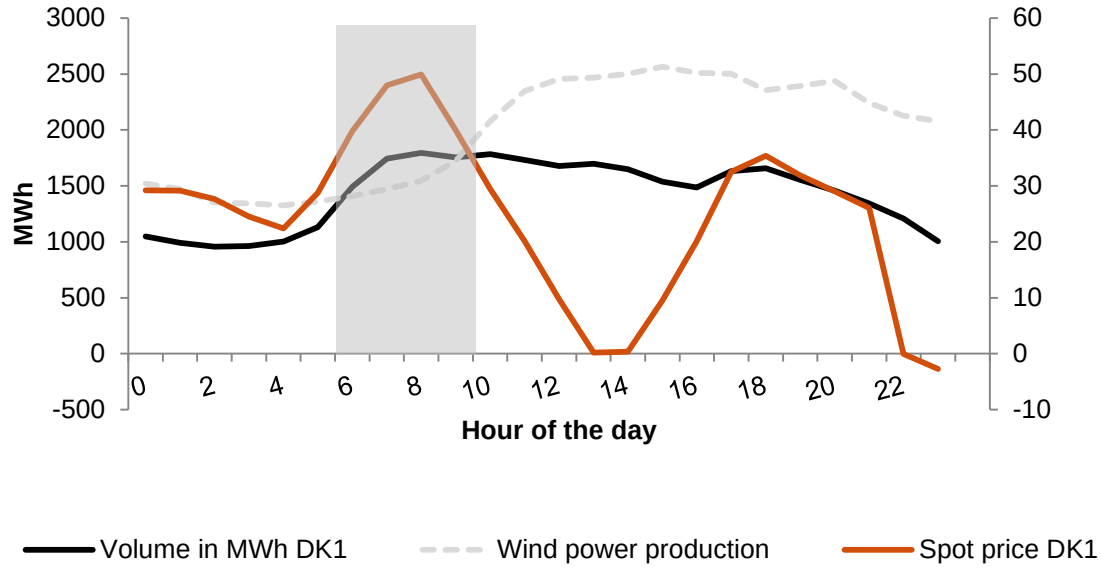
Intermittent Renewables vs Conventional Technologies

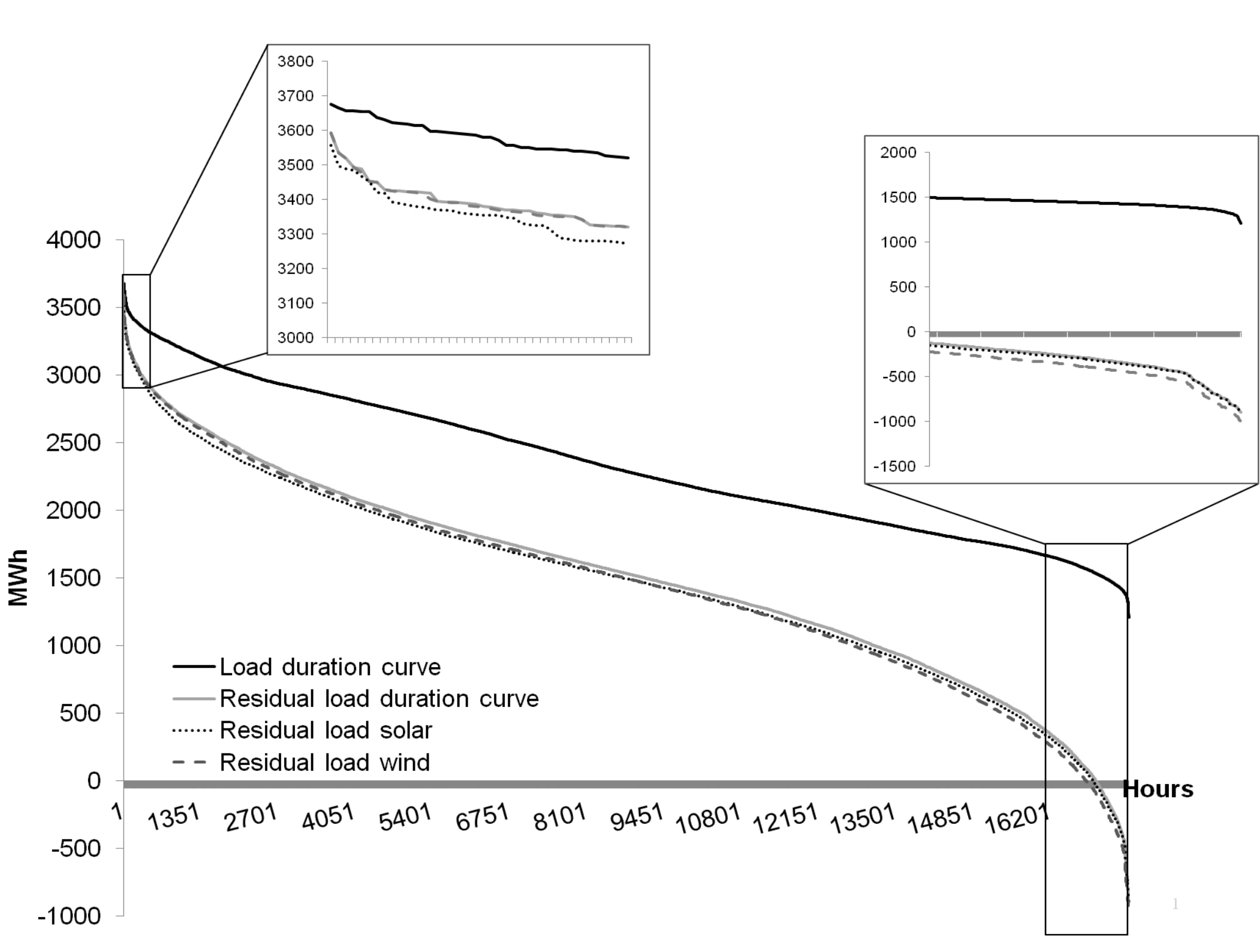
- Intermittent renewables are more expensive than conventional technologies
- If you want them, you need to help with some type of subsidy
  - Feed-in tariff
  - Feed-in premium
  - Competitive process
  - Quota system

- RQ: *Do these policy instruments convey the market needs to investors/plant owners?*
- First, what does society want from the intermittent renewables?

What Type of Intermittent Renewable Energy Society Wants?

- First element:
  - Power shall be delivered during high prices period




MWh
Hours
4000
3500
3000
2500
2000
1500
1000
500
0
-500
-1000
1
1351
2701
4051
5401
6751
8101
9451
10801
12151
13501
14851
16201
Load duration curve
Residual load duration curve
Residual load solar
Residual load wind
3800
3700
3600
3500
3400
3300
3200
3100
3000
2000
1500
1000
500
0
-500
-1000
-1500

What Type of Intermittent Renewable Energy Society Wants?

- A valuable energy is thus:
  - Deliver power when needed
  - Does not threaten the security of supply
  - Cheap

- How do current policy instruments perform at facilitating the deployment of valuable intermittent energy?

Numerical Case Study

- 2011-2012
- Deterministic
- Two plants
- Existing supply fro
  /thermal power plant
- Look at economics +
  under FiT, FiP and Q

	Solar	Wind
LCOE (Euro/MWh)	68	60
Installed capacity (MW)	3.1	1
Power production 2011-2012 (MWh)	8,111	8,111
Net present value	-164,000	-156,800

Table 2: Characteristics of the solar power station and of the wind farm used in the numerical case study. The LCOE data is based on Lazard (2013).

	Thermal plant
Capacity (MW)	3,592.50
Electricity production 2011-2012 (TWh)	26
Capacity factor (%)	42
Capital costs (Euro/MWh)	30
Operational costs (Euro/MWh)	17

Table 3: Characteristics of the thermal power plant used in the numerical case study.

Feed-in Tariff

- FiT: guarantees a price for each MWh sold

	Solar	ΔThermal^{Solar}	Wind	ΔThermal^{Wind}
FiT (Euro/MWh)	68		60	
Electricity prod. (MWh)	8,111	-7,795	8,111	-7,197
Policy cost (Euro)	169,427		162,977	
Policy cost (Euro/MWh)	20.89		20.10	
Thermal capacity (MW)		-0.36		0
Capacity factor (%)		-0.008		-0.011
Missing money (Euro)		164,692		186,443.58
Cost missing money per MWh		20.31		22.99
Total cost (Euro/MWh)	41.20		43.08	

Table 4: Economic characteristics of the solar power station, the wind farm and their impact on the economics of the thermal power plant under a FiT system.

- Investors/plant owners

Feed-in Premium

- FiP: rewards each unit of electricity with a premium

	Solar	ΔThermal^{Solar}	Wind	ΔThermal^{Wind}
FiP (Euro/MWh)	20.72		19.85	
Electricity prod. (MWh)	8,110	-7,795	8,097	-7,197
Policy cost (Euro)	168,024		160,723	
Thermal capacity (MW)		-0.36		0
Capacity factor (%)		-0.008		-0.012
Missing money (Euro)		164,692		186,428
Cost missing money per MWh		20.31		22.99
Total cost (Euro/MWh)	41.20		43.08	

Table 5: Economic characteristics of the solar power station, the wind farm and their impact on the economics of the thermal power plant under a FiP system.

- QS, same but unique price

Multiplicative premium

- None of the existing policy instruments promote the valuable project first
- Alternative: multiply market price by a fix coefficient

	Solar	ΔThermal$^{\text{Solar}}$	Wind	ΔThermal$^{\text{Wind}}$
FiM	1.44		1.49	
Electricity prod. (MWh)	8,109	-7,795	8,074	-7,197
Policy cost (Euro)	188,299		160,050	
Policy cost (Euro/MWh)	23.22		19.82	
Thermal capacity (MW)		-0.36		0
Capacity factor (%)		-0.008		-0.012
Missing money (Euro)		164,692		186,428
Cost missing money per MWh		20.31		22.92
Total cost (Euro/MWh)	41.20		43.08	

Table 6: Economic characteristics of the solar power station, the wind farm and their impact on the economics of the thermal power plant under a multiplicative premium system.

Multiplicative premium

- Benefits
  - Efficient (most valuable energy source built first)
  - Plant owners will react to power prices, hence market needs are conveyed to power plant owners
  - Administrative ease (only one coefficient)

- Drawbacks
  - Does not promote newer technologies (e.g.: wave power)
  - Riskier than a FiT, FiP but less so than QS

Summary

- Society wants intermittent energy:
  - During high priced hours
  - Which does not threaten the security of supply
  - Cheap

- Existing policy instruments are not efficient at promoting the most valuable intermittent renewable energy source first

- A multiplicative premium would promote the most valuable intermittent renewable energy source first

Thank you!

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Back-up: Need for Policy Instruments

- Intermittent renewables are not (yet?) cost competitive
- Use of specific policy instruments justified when:
  - Direction intervention (e.g. carbon tax) not sufficient
  - Carbon tax cannot correct all externalities in the energy sector
  - Implementing a carbon tax is politically difficult
- Use of price-based (FiT, FiP, Bidding Processes) and quantity-based systems (QS)
- Efficient vs efficiency
- Problem: based on a direct cost basis