Energy storage and investments in the future energy systems

ZEP's 3rd Temporary Working Group Market Economics

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ALSTOM

Zep
Zero emissions platform

Energy Storage Seminar, October 21, 2014, Trondheim

Outline

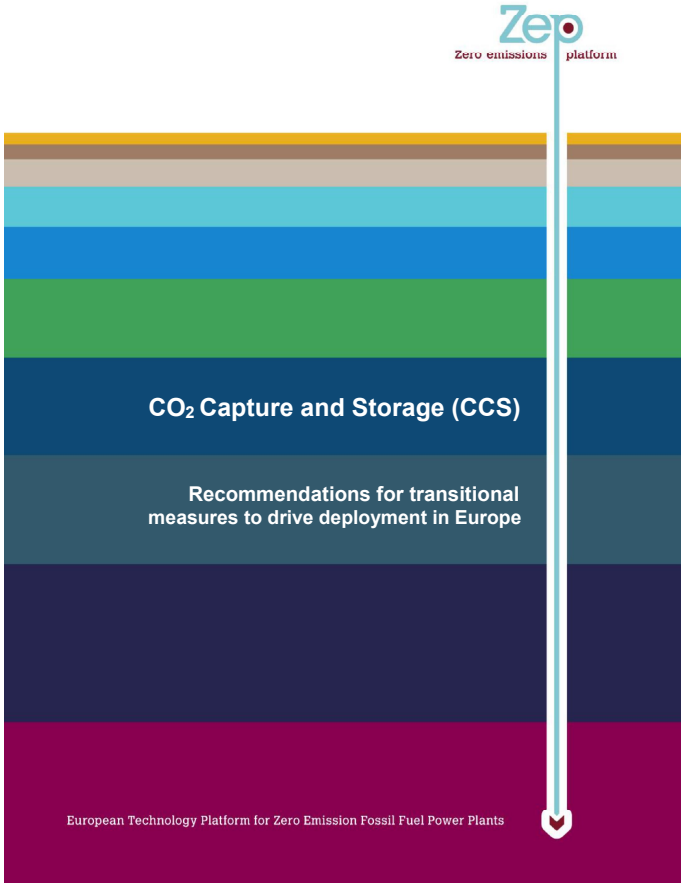
Zero emissions platform (ZEP)

- Founded in 2005
- Coalition of European utilities, petroleum companies, equipment suppliers, scientists, academics and environmental NGOs supporting CCS.
- ZEP serves as advisor to the European Commission on the research, demonstration and deployment of CCS.

ZEP Temporary Working Group Market Economics

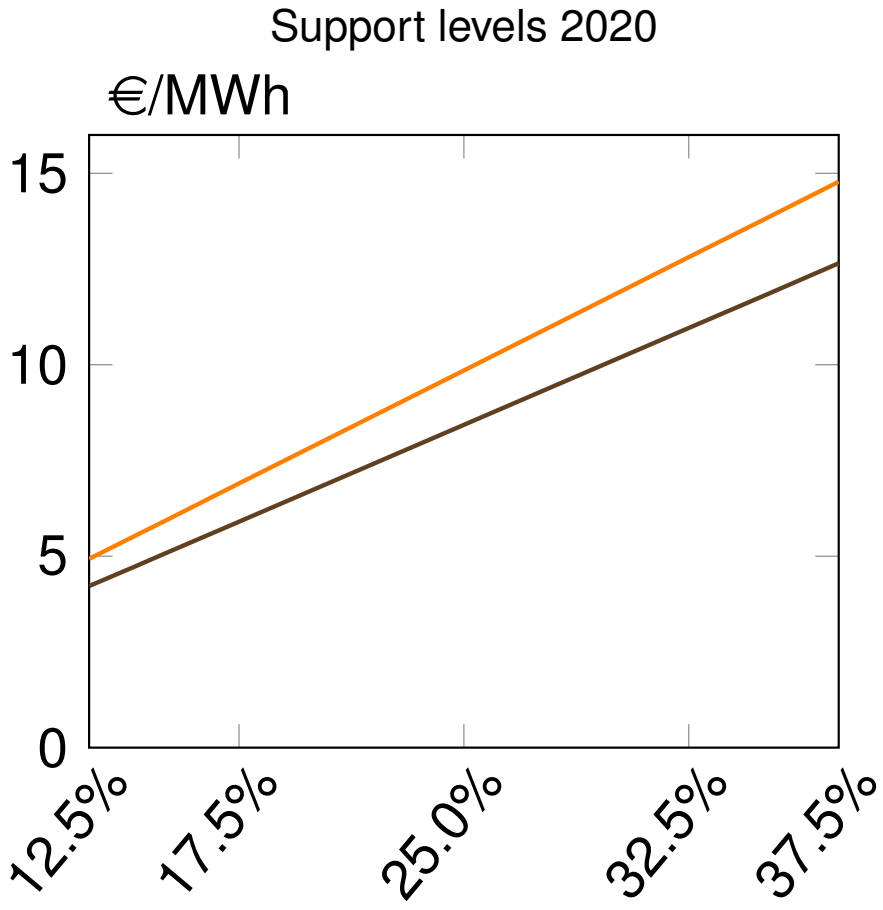
- ZEP has initiated three rounds of market economics studies of CCS
- Representatives from different ZEP companies (Alstom, Shell, BP, Bellona, RWE, EdF, NTUA, etc.)
- First report
  - A qualitatively study of CCS support measures
- Second report
  - Numerical study of CCS in a future European power market and incentive mechanisms for investments
- Third report (just finalized)
  - Investigate the cost trade-off of not allowing CCS and only rely on renewables and storage to achieve emission reduction

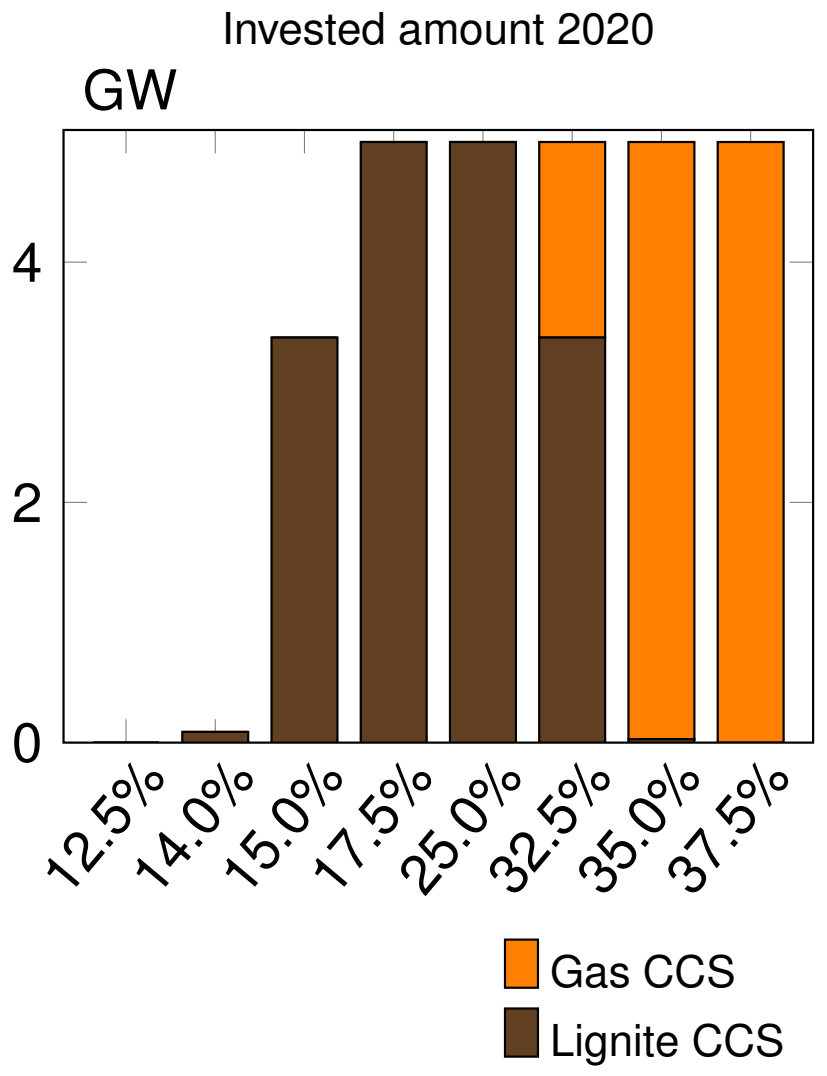
Second working group market economics



http://www.ntnu.no/censes/publikasjoner

CCS OPEX support cases

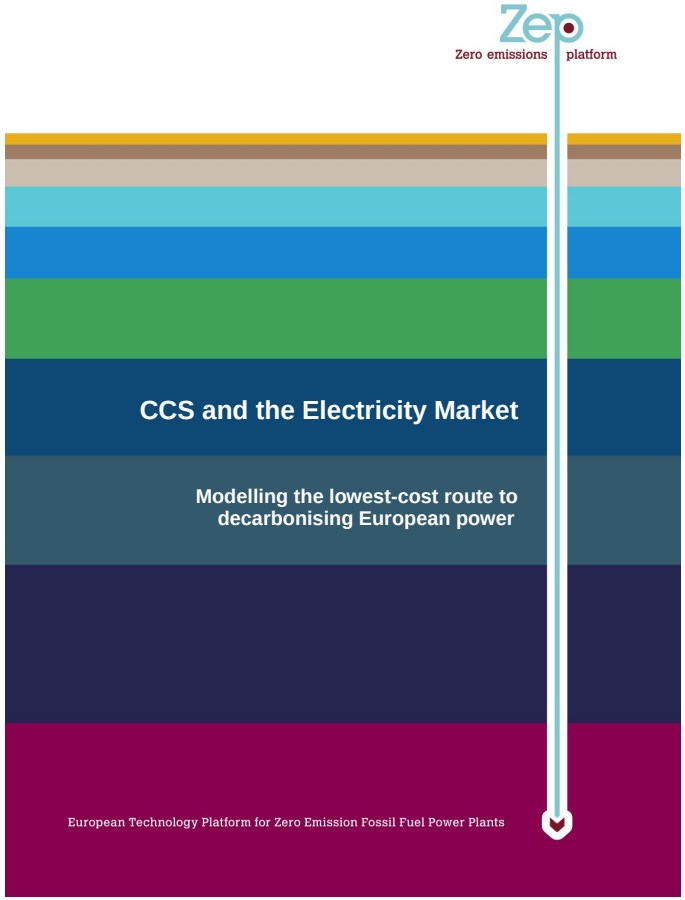




A few key conclusions from TWG ME II

- Modeling shows lowest-cost route to decarbonising European power
- By 2030, CCS will play a critical role in reducing CO_2 emissions - driven by the ETS
- Transitional support measures are essential to ensure CCS is widely deployed by 2030
- Public grants need to cover capex and opex to incentivise CCS 'first movers'
- Feed-in tariffs (FiTs) offer investors the greatest security of income
- Emission performance standards (EPS) in the short term will not incentivise CCS in Europe
- Urgent policy actions are needed to deliver EU energy and climate goals for 2030

The follow up report, ZEP's third working group market economics



Final version completed October 2014 (not yet published)

Motivation

What if we cannot use CCS?

theguardian

News | Sport | Comment | Culture | Business | Money | Life & style

Environment › Carbon capture and storage (CCS)

Not under our backyard, say Germans, in blow to CO2 plans

German carbon capture plan appears to be a victim of 'numbyism' - not under my backyard

Terry Slavin and **Alok Jha**
theguardian.com, Wednesday 29 July 2009 10.40 BST

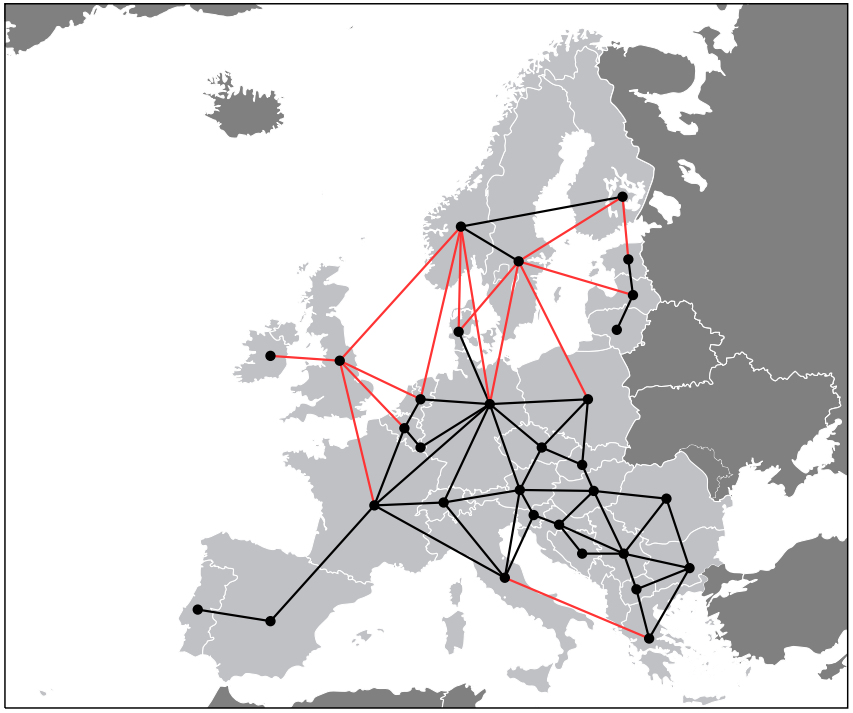
It was meant to be the world's first demonstration of a technology that could help save the planet from global warming – a project intended to capture emissions from a coal-fired power station and bury them safely underground.

But the German carbon capture plan has ended with CO_2 being pumped directly into the atmosphere, following local opposition at it being stored underground.

The scheme appears a victim of "numbyism" – not under my backyard.

- Nuclear has a public relations issue in Europe
- Only leaves renewable energies (with storage)
- What is the cost?

EMPIRE modeling assumptions



- Perfect competition
- Generation capacity aggregated per technology (i.e. do not model individual plants)
- Investments are continuous
- Lines are independent (i.e. transportation network)
- Inelastic demand
- Perfect foresight about fuel prices, carbon price, and load development.

Analysis setup

Six scenarios

- Constraints on RES potential in Europe
  - Stringent constraints: 270 GW wind, 1000 GW PV
  - Weak constraints: 850 GW wind, 1000 GW PV
  - Unlimited
- PV cost development (current cost assumed to be $\sim 1700 - 1900$ €/kW)
  - High cost: 1000 €/kW in 2050
  - Low cost: 200 €/kW in 2050

Three variants

A Baseline: with CCS and storage

B No CCS and same specific emissions (gCO_2/kWh) as in A

C No CCS, no storage, and same specific emissions as in A

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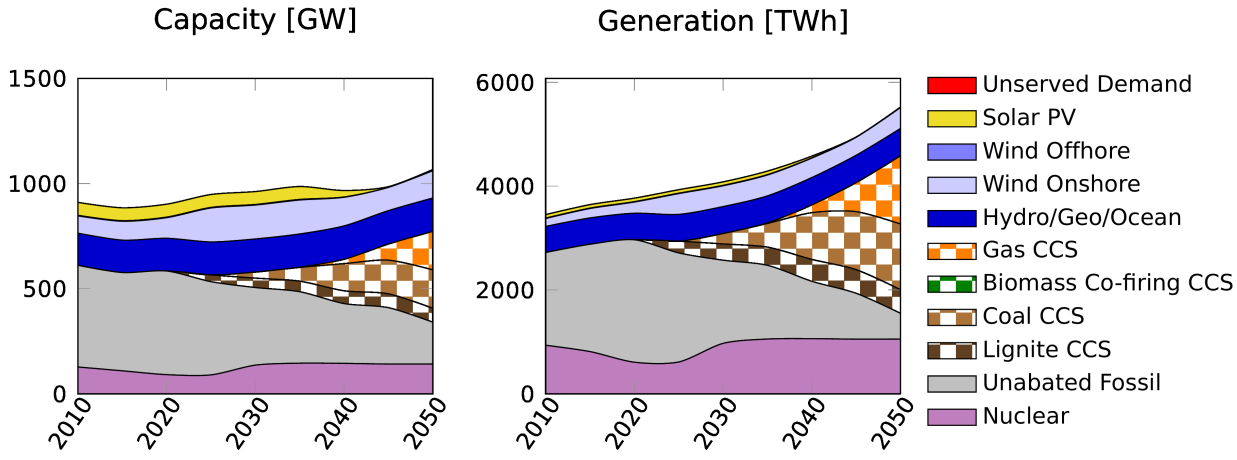
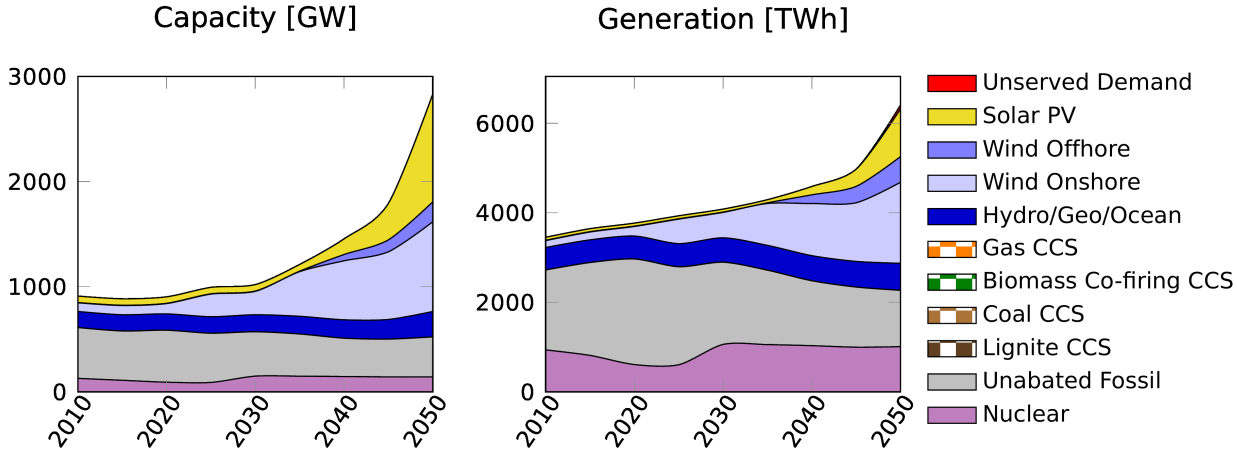
Europe electricity sector: Baseline vs no CCS variant

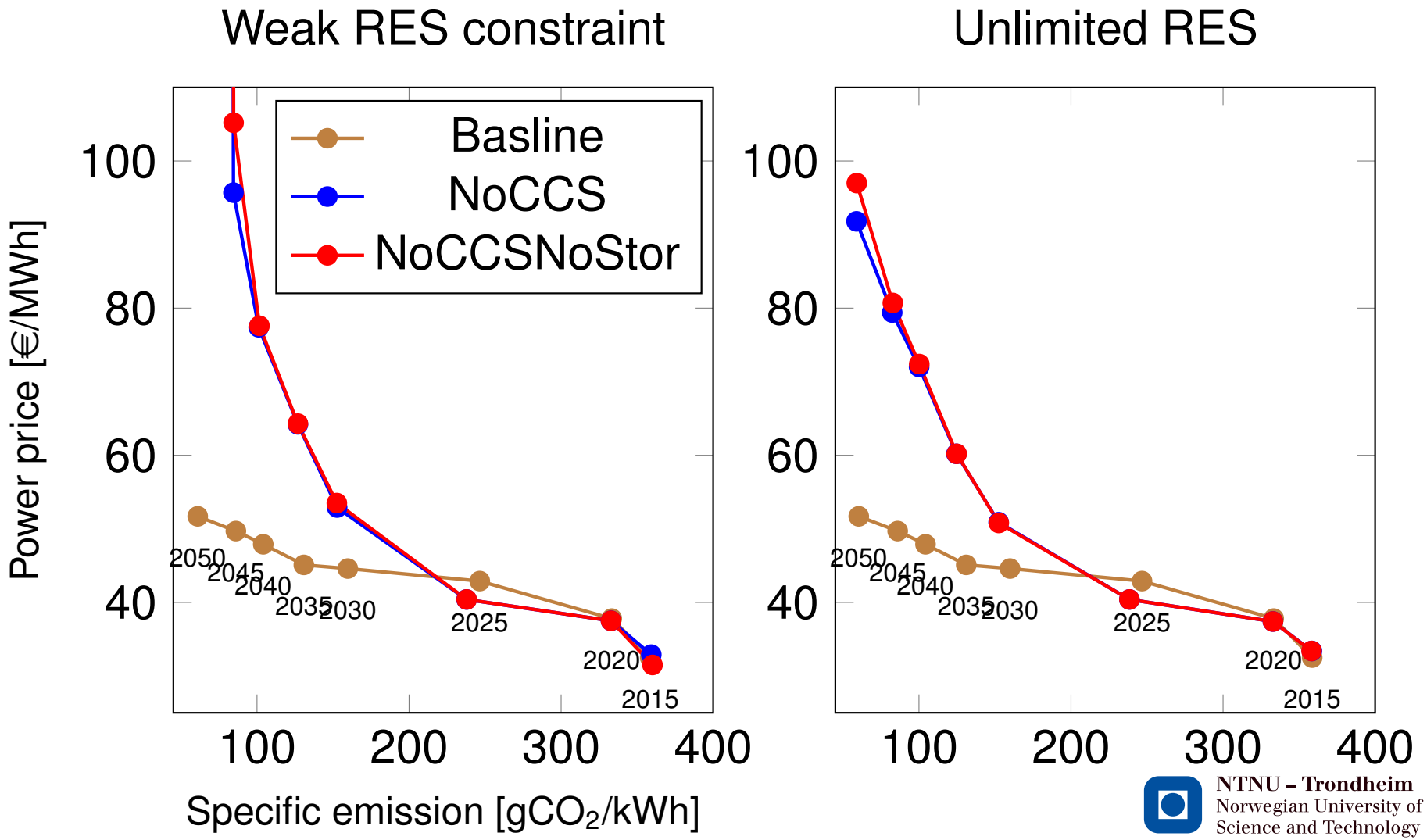
Baseline



No CCS



Price (LRMC) vs specific emission: Weak constraints, high PV cost



Key figures

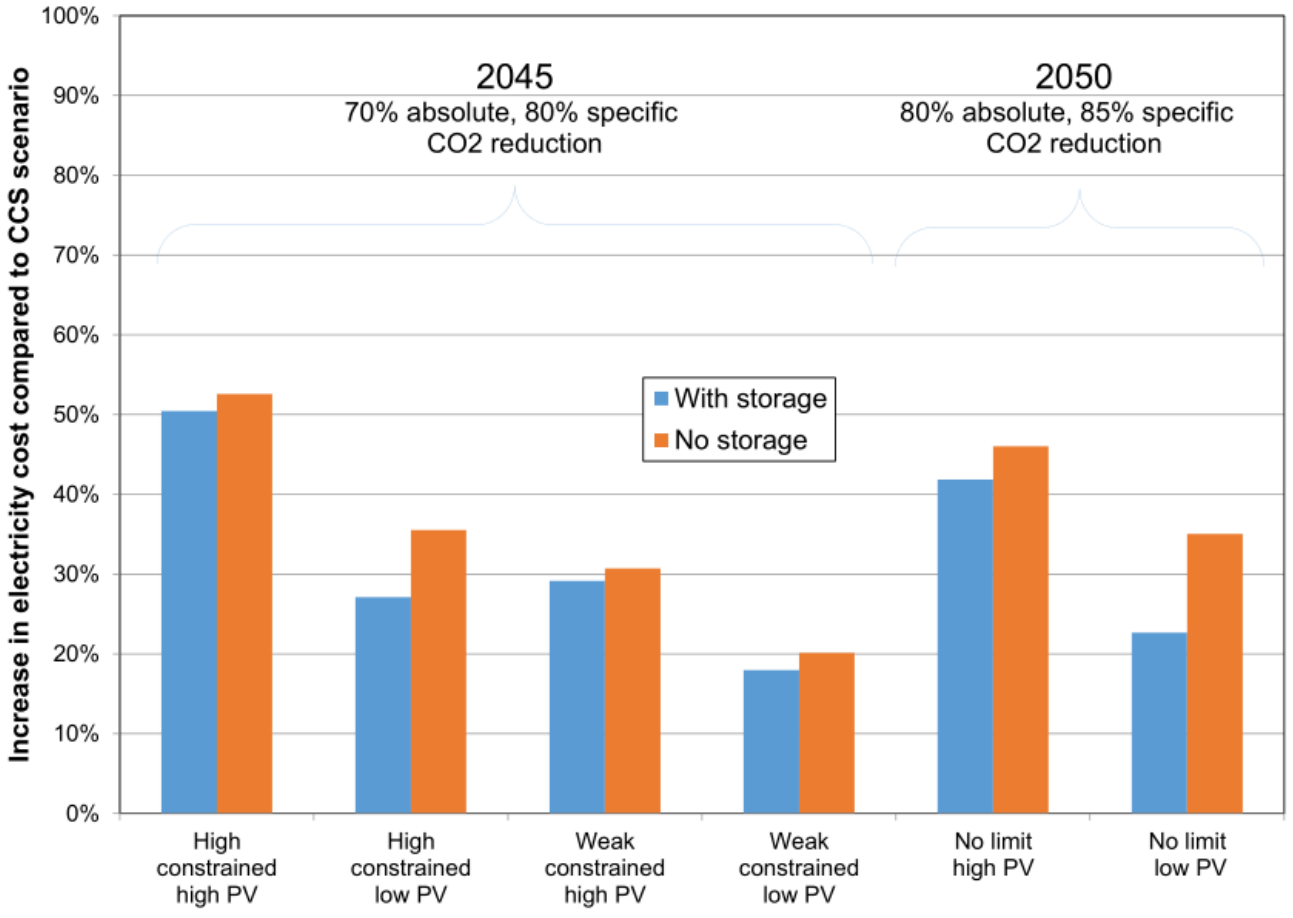
Table: Key figures from analysis 2050: Weak constraints

Variant	Spec. Em [g/kWh]	LRMC. [€/MWh]	Stor cap [GW]	Stor en [GWh]	New RES [GW]	Res Gen [TWh]
Baseline	61	51.7	5	21	151	412
NoCCS	61	N.A.	1056	5410	2083	3450
NoCCSNoStor	61	N.A.	0	0	2083	2759

Table: Key figures from analysis 2050: Unlimited

Variant	Spec. Em [g/kWh]	LRMC. [€/MWh]	Stor cap [GW]	Stor en [GWh]	New RES [GW]	Res Gen [TWh]
Baseline	60	51.7	5.8	22	166	453
NoCCS	60	91.8	110	1062	1774	3051
NoCCSNoStor	60	97.0	0	0	1848	3049

Increase in electricity cost compared to Baseline



Conclusions

- The most cost-effective way of meeting future electricity demand while have an aggressive reduction of emissions includes significant use of CCS
- According our simulation results the price of electricity doubles in the non-CCS cases. Cumulative costs are 20–50% higher without CCS.
- Use of storage does reduce costs, but only slightly

Thank you for your attention

Questions?