

HET 2: Curtailment: an option for cost-efficient integration of variable renewable generation?

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Hot Energy Topic (HET)

Time: 4 weeks
Pages: 1 - 5
Issues: 18 - 21
in 3 years

Rapid Response Energy Brief (RREB)

Time: 6 weeks
Pages: 4 - 10
Issues: 12
in 3 years

Policy Report (PR)

Time: 6 months
Pages: 60 - 100
Issues: 12
in 3 years

OVERVIEW

Wind and PV boom in some Member States

Accommodation of high shares of renewables requires major infrastructure investments

System security issues: network congestion, system stability, operating reserve, voltage control

Are we better off when we don't accommodate every kW of renewable feed-in in times of surplus production ("economic" curtailment)?

Or do we risk missing our targets when we allow that?

Outline of HET 2

- Situation concerning curtailment to date
- The case of Germany, Denmark, Spain, Portugal, Ireland and Italy
- The way towards high shares of renewables: upcoming challenge
- Economic curtailment: desirable in the target energy system?
- Conclusion and recommendations

Situation concerning curtailment to date

European Directive 2009/28/EC:

- Renewable energy systems are given **priority in so far as the secure operation** of the national electricity system **permits**.

Definition:

- The limitation of the electricity output of renewable plants for system security reasons is referred to as **technical curtailment**.

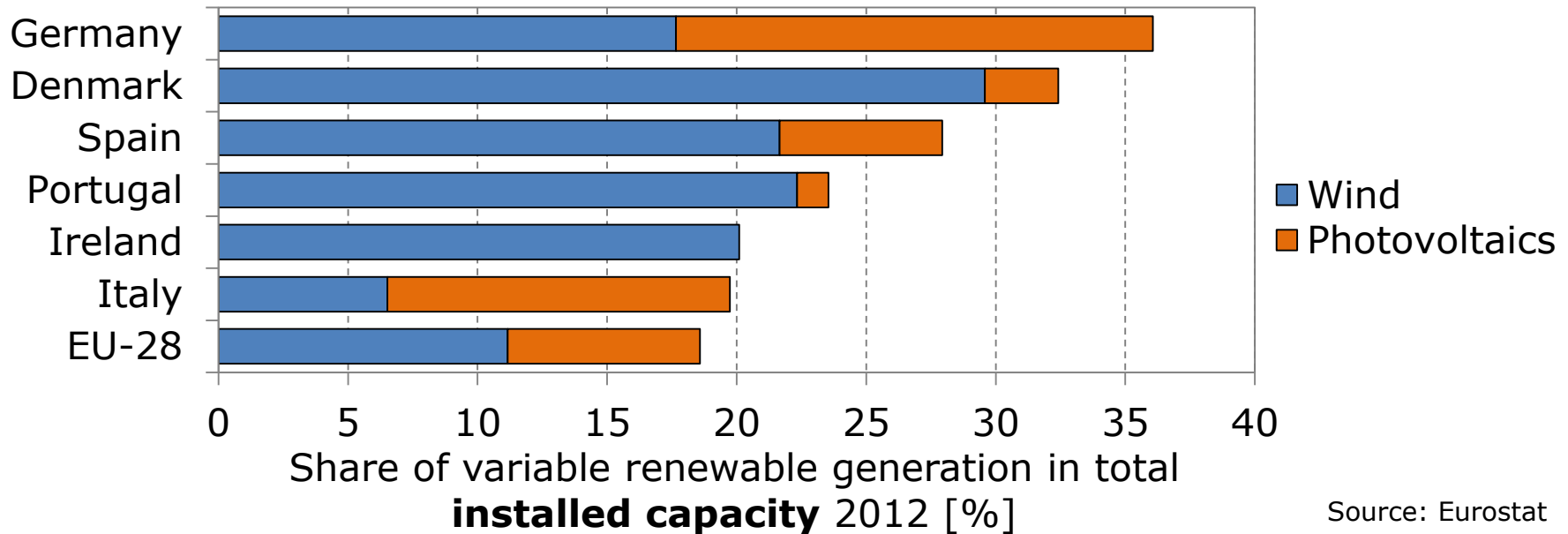
Situation to date:

- High installed capacities of wind and photovoltaics induce **temporary local overproduction** in some European regions.
- Technical curtailment occurs when **local network constraints or system wide security limits are violated**.
- In the years 2009-2012 **about 1 TWh a year or 0.3 - 0.6 % of the electricity production from wind and PV** was curtailed for system security reasons in the EU, most part of it from wind.

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In what extend and for what reasons are the different Member States concerned by technical curtailment so far?

Situation concerning curtailment to date in the concerned Member States



Curtailed energy [GWh]	2009	2010	2011	2012
Germany	74 (0.2%)	127 (0.3%)	421 (0.6%)	385 (0.5%)
Spain	40 (0.1%)	320 (0.6%)	202 (0.4%)	148 (0.3%)
Ireland	n.a.	26 (1.0 %)	106 (2.4%)	103 (2.5%)
Italy	700 (9.7%)	527 (4.8%)	264 (1.3%)	166 (0.5%)

No considerable amounts of renewable feed-in have been curtailed in Denmark and Portugal.

Reasons for technical curtailment in the concerned Member States

Country	Reason for technical curtailment	
	local network constraints	system wide violation of security limits
Germany	mainly congestion of distribution network in the North	minor issue
Spain	congestion on both distribution and transmission level	important issue because of poor interconnection with France
Ireland	Mainly congestion of transmission network in the Northwest and the Southwest	important issue because of poor interconnection with Great Britain
Italy	mainly congestion of transportation network between South and North	minor issue

- **Denmark:** renewable surplus production can be transported to Germany or Norway (hydro resources)
- **Portugal:** renewable surplus production can be transported to Spain

The way towards high shares of variable renewables: upcoming challenge

European Directive 2009/28/EC:

- „Member States shall ensure that **appropriate grid and market-related operational measures** are taken in order to **minimise the curtailment** of electricity produced from renewable energy sources.”

Definition:

- The limitation of renewables output to reduce the costs for renewables accommodation is referred to as **economic curtailment**.

Challenge:

- Accommodating ever increasing shares of volatile renewable feed-in requires **substantial investments in network capacities and facilities for buffering surplus generation** such as electricity storages.
- As renewable peak production at times of low demand occurs only rarely, a part of these investments might be concerned by **inadequate capacity utilization** and not pay off (micro- and macro-economic perspective).

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Is **economic curtailment** a reasonable measure for a cost-efficient integration of high shares of volatile renewables?

Economic curtailment: desirable in the target energy system?

The idea: by cutting down the renewable power output in some 100 hours a year (loosing < 5% of the renewable feed-in) the costs for the integration of renewables might decrease significantly.

	opportunities	risks
CAPEX	Possible substantial reduction of the investment need in grid and buffering capacities	More investment in renewables plants required to reach the same renewables target
OPEX	Possible reduction of the costs for regulating energy thanks to better forecasts	Increase of fuel use and CO ₂ emissions as curtailed energy has to be replaced by conventionals
Competitiveness	Possible decrease of energy costs	Possibly less stimulation of innovation in fields like storages
Social	Possible decrease of retail prices	Negative affection of investors confidence
Environmental	Reduction of grid and storage impact on landscape	See OPEX, renewables targets might be reached later

List is qualitative and incomplete.

Recommendation: model-based assessment considering all relevant flexibility options

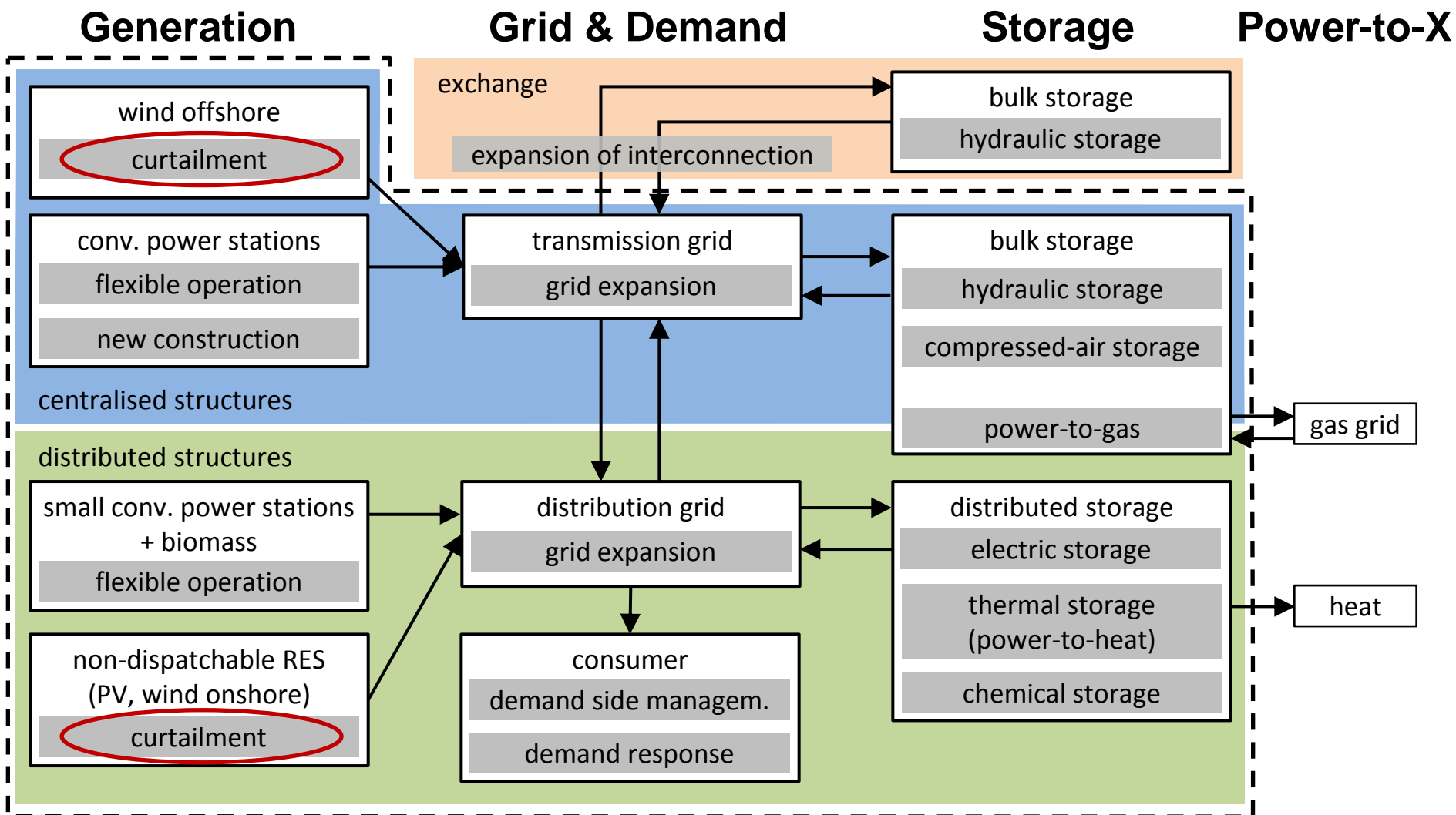
From a theoretical perspective, curtailment should take place up to the point where the marginal system cost of avoiding this curtailment equals the marginal value of spilled energy (including externalities).

For an adequate economic evaluation, the use of curtailment has to be assessed in the context of all **other relevant options for balancing variable renewable feed-in**.

Recommendations:

- To conduct an assessment of the economically optimal use of curtailment supported by a **comprehensive optimization model**
This optimization model should
 - have a high temporal and regional resolution
 - consider all relevant flexibility options
 - cover the whole EU
- To **consider carefully all relevant impacts** of the use of curtailment including renewables investment security and innovation stimulation
- To assure **uniform and transparent rules** concerning curtailment between countries to avoid asymmetrical impacts

Curtailment in the context of flexibility options for the integration of variable renewables



Thank you for your attention

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