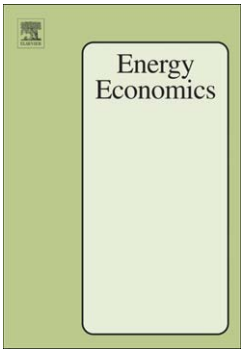


# Application of a high-detail energy system model to derive power sector characteristics at high wind and solar shares

Yvonne Scholz, Hans Christian Gils, Robert Pietzcker

PII: S0140-9883(16)30168-2
DOI: doi: 10.1016/j.eneco.2016.06.021
Reference: ENEECO 3373

To appear in: *Energy Economics*

Received date: 13 October 2015
Revised date: 1 May 2016
Accepted date: 29 June 2016

Please cite this article as: Scholz, Yvonne, Gils, Hans Christian, Pietzcker, Robert, Application of a high-detail energy system model to derive power sector characteristics at high wind and solar shares, *Energy Economics* (2016), doi: 10.1016/j.eneco.2016.06.021

# Application of a high-detail energy system model to derive power sector characteristics at high wind and solar shares

Yvonne Scholz[a*], Hans Christian Gils[a], Robert Pietzcker[b]

[a] Institute of Engineering Thermodynamics, German Aerospace Centre, Wankelstrasse 5, 70563 Stuttgart, Germany
[b] Potsdam Institute for Climate Impact Research, Germany

[*] Corresponding author. Email: yvonne.scholz@dlr.de, Tel.: +49 711 6862 296.

## Abstract

Solar irradiation and wind speed vary with climatic, as well as seasonal and daily weather conditions. In order to represent these variable renewable energy (VRE) resources in specialized energy system models, high temporal and spatial resolution information on their availability is used. In contrast, Integrated Assessment Models (IAM), typically characterized by long term time scales and low temporal and spatial resolution, require aggregated information on VRE availability and balancing requirements at various levels of VRE penetration and mix. Parametric studies that provide such information typically regard solar energy synonymously with photovoltaic power generation. However, solar energy can also be harvested with Concentrating Solar Power (CSP) plants, which can be dispatchable if equipped with thermal storage. Accounting for this dispatchable use of the variable solar resource can change the balancing requirements at any solar energy penetration level. In this paper, we present an application of the high resolution energy system model REMix to a set of European supply scenarios with theoretical VRE shares ranging from 0-140%, three solar-to-wind ratios, with CSP included in the solar share. We evaluate balancing measures, curtailments and costs and compare the findings to previous results in which CSP is regarded a backup option among other dispatchable power plants. The results show that CSP potentials in Europe are widely exploited in most scenarios. System costs are found to be lowest for wind dominated systems or balanced mixes of wind and solar and for an overall VRE share between 40% for a low and 80% for a high scenario of the future $CO_2$ emission certificate price. The comparison with previous results shows that storage capacity is the only system variable that is significantly affected by allocating CSP to the VRE resources category. It is reduced by 24% on average across all VRE shares and proportions and by around 80% at most.