

SUSTAINABLE ENERGY WEEK
17-21 JUNE 2019

Challenges in pathways towards a 100% renewable energy system

RE-INVEST project: Exploiting sector synergies and countries interconnections to decarbonise the energy systems
Marta Victoria – Aarhus University

AALBORG UNIVERSITY DENMARK UCL LUT University reINVEST INN:PATHS sEEnergies

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How to integrate renewables?

- Extend transmission capacities
- Storage
- Sector coupling

TWO-DIMENSIONAL APPROACH

reINVEST

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EnergyPLAN Power Flow

Strategies to counterbalance renewable generation need to be simultaneously modelled


WEB BASED INTERFACE

INPUTS




Select countries, technologies & sectors
Define interconnection capacities


EnergyPLAN model for every country



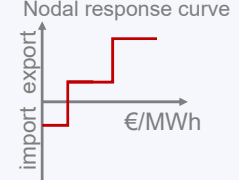
POWER FLOW minimizes total system cost



OUTPUTS



Nodal response curve



Icons made by Maxim Basinski from www.flaticon.com

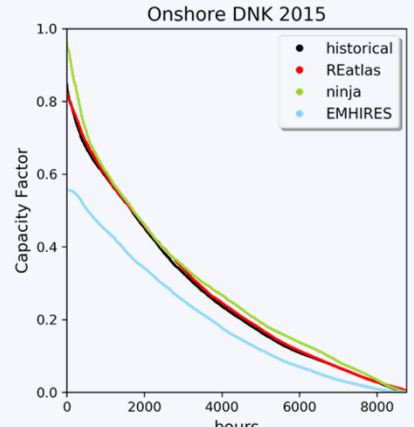
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Modelling wind generation at national scale

- Using weather data and to model onshore and offshore wind generation
- 1 grid cell every 40x40km², aggregated by country
- 39 years-long time series with hourly resolution
- Validated with historical data

Onshore DNK 2015

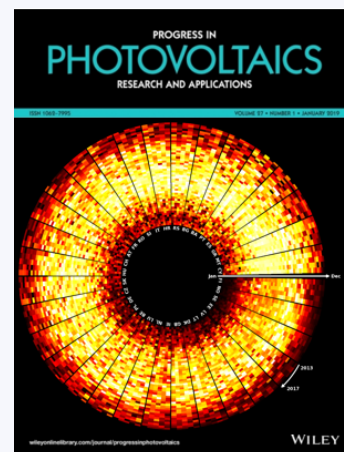


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Modelling solar PV generation at national scale

- Using weather data to model solar PV generation
- 1 grid cell every 40x40km², aggregated by country
- 39 years-long time series with hourly resolution
- Bias-corrected irradiance with satellite images and validated against historical data
- Time series for every European country, 39 years and 4 PV configurations openly available [10.5281/zenodo.1321809](https://doi.org/10.5281/zenodo.1321809)



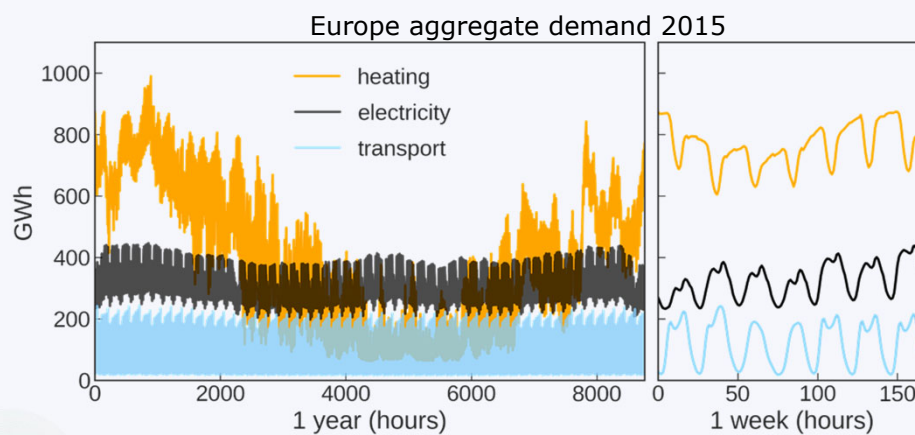
Victoria & Andresen, *Progress in Photovoltaics: Res. & App.* (2019)

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Sector coupling

Sector coupling brings opportunities and challenges

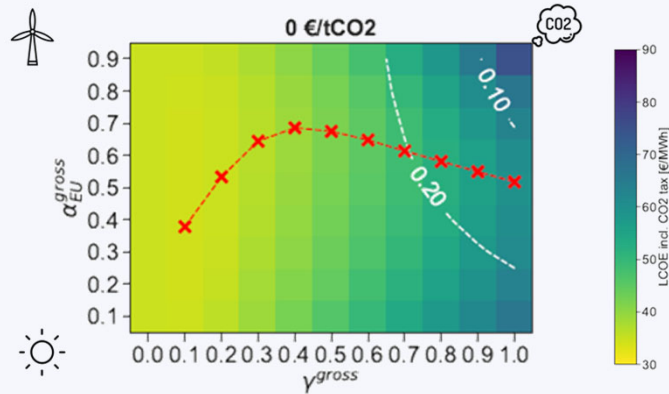


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Preliminary results: Electricity+Heating sectors

Preliminary analyses with PyPSA show the large impact of CO₂ prices on the coupled electricity and heating sector.



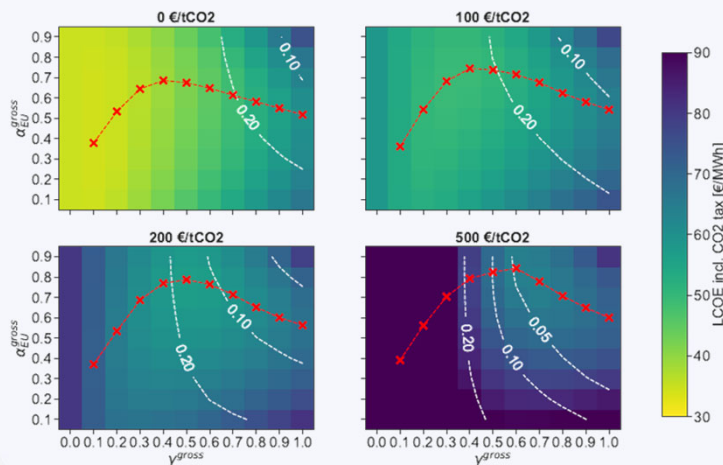
K. Zhu, et al., Applied Energy 236 (2019)

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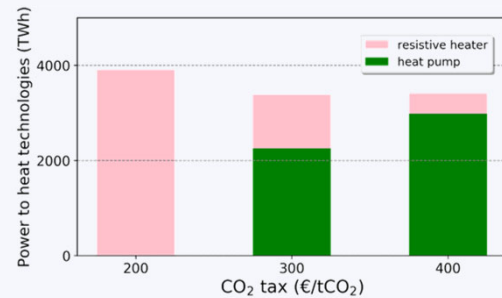
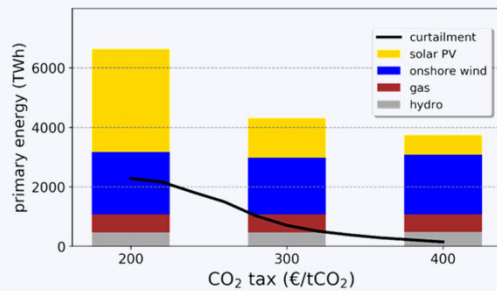
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Preliminary results: Electricity+Heating sectors

Preliminary analyses show the large impact of CO₂ prices on the coupled electricity and heating sector. High CO₂ prices lead to more efficient although more expensive system.



K. Zhu, et al., *Applied Energy* 236 (2019)

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Summary

- Strategies to counterbalance renewable generation need to be simultaneously modelled. EnergyPLAN Power FLOW (tool under development).
- Country-wise wind and solar PV time series modelled and validated.
- Sector coupling present opportunities and challenges (large seasonality in heating demand, high CO₂ price or alternative policies required to decarbonise heating sector).

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