Wind power expansion in Brazil: socio-environmental and economic implications

Conference: The coming of age of renewable energy

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Wind power in the context of the Brazilian electricity system
Socio-environmental challenges of wind power
A way forward: land-neutrality of renewable energy expansion
Electricity consumption in Brazil

Source: ONS, EPE
Electricity generation capacity in Brazil

Source: ONS, EPE
Electricity generation in Brazil

Source: ONS
The spatial distribution of wind power generation

Source: Aneel
Auction results 2019

Source: CCEE
Roadmap for offshore wind in Brazil published by EPE.

Public energy planning company EPE does not foresee offshore wind until 2027 in Brazil.

Still, 5 ongoing active development initiatives, in Ceará, Rio de Janeiro, and Rio Grande do Sul (Brazilian, Italian, and Spanish investors).

Source: Xavier et al. (2020).

https://www.researchgate.net/publication/345726759_Energia_eolica_offshore_e_pesca_artesanal_impactos_e_desafios_na
Wind and hydro-power complementarity

Hydropower, Windpower, Solar

Multi-annual variability of renewables in Brazil

Hydropower, Windpower, Solar

An electricity system with high shares of renewables in Brazil

Environmental challenges

- Wind turbines in particular in Bahia and Ceará built on native vegetation and sand dunes
- Highly sensitive ecological areas
- Observed land-use change in wind park areas low on average, but high variation
- Will other development follow?

Source: Turkovska et al. (2021).
Land tenure challenges
Case study: Gentio de Ouro
Documented conflicts
Case study: Gentio de Ouro


- 46 communities close to Xique-Xique threatened by illegal land titles ("grilagem de terra"). Wind power companies, are among others, interested in respective land (2015).

- Complexo Eólico Capoeiras e Assuruá (implemented in 2016): Illegal appropriation of 8,000 hectares of public land.

Sources:
Land neutrality as way forward?

Brazil uses substantial amount of land for biofuel production.

- In combination with wind/solar PV output increase by 50%.
- With Direct Air Capture of $CO_2$, output increases 10 times
- Observation: concurrent expansion of biofuels & possibly green ammonia

Some tentative conclusions

- Brazilian wind power sector growing strongly. Until 2030: projected to double. PV as competitor?
- Main focus in North-East Brazil, offshore wind power earliest in 2027
- Wind resources and environmentally and socially sensitive areas overlap
- Taking socio-environmental criteria in the energy transition seriously
  - Complexity of existing land tenure situations
  - Participation, active decision taking, and compensation of hosting communities
  - Accounting for environmental impacts, in particular on biodiversity
  - Reducing land use for land-intensive biofuel production to open room for wind power and solar PV