The potential for repowering US wind turbines

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Introduction

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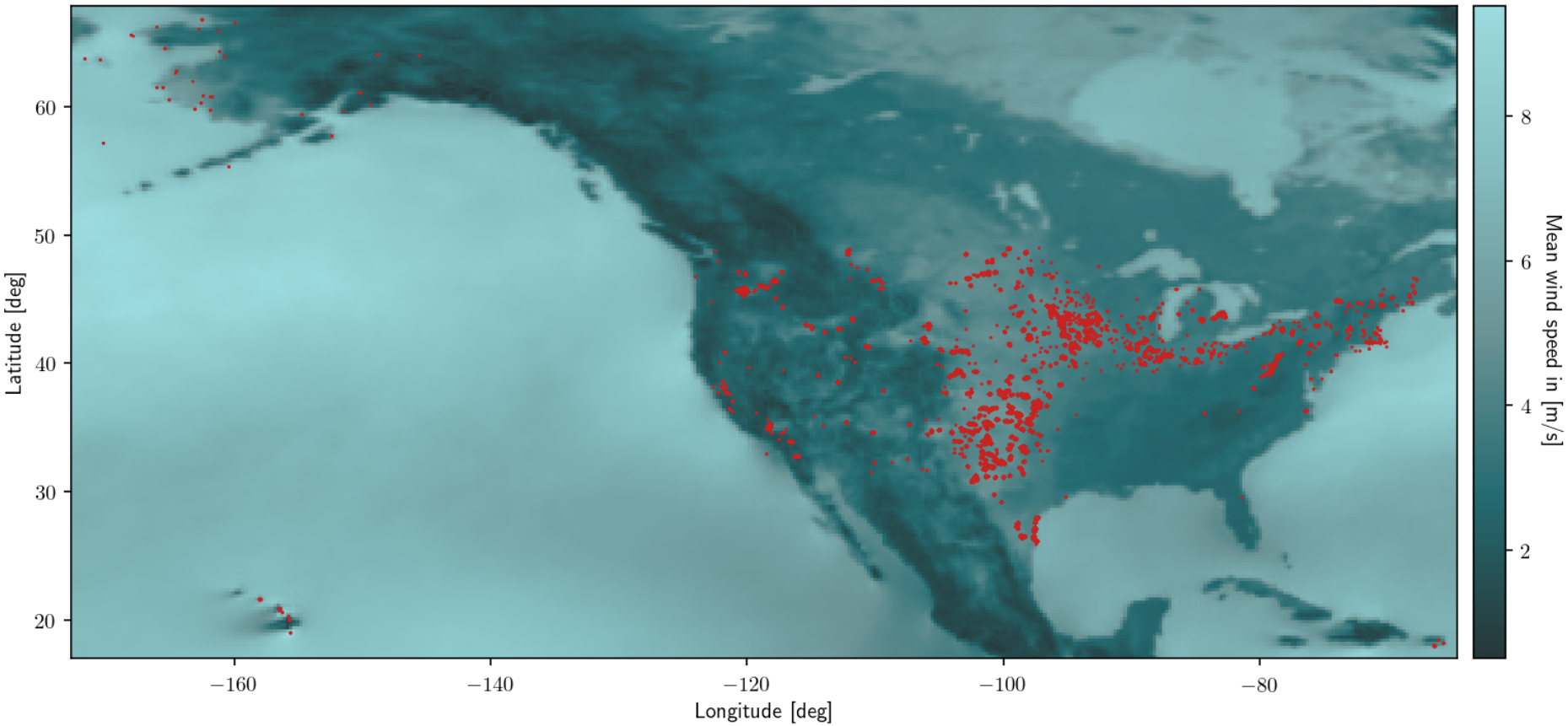
- How much power generation gain can be expected in the US with newer wind turbine models?
- How many wind turbines will be installed?

Data


Latitude [deg]
60
50
40
30
20
−160
−140
−120
−100
−80
Longitude [deg]
Mean wind speed in [m/s]
8
6
4
2

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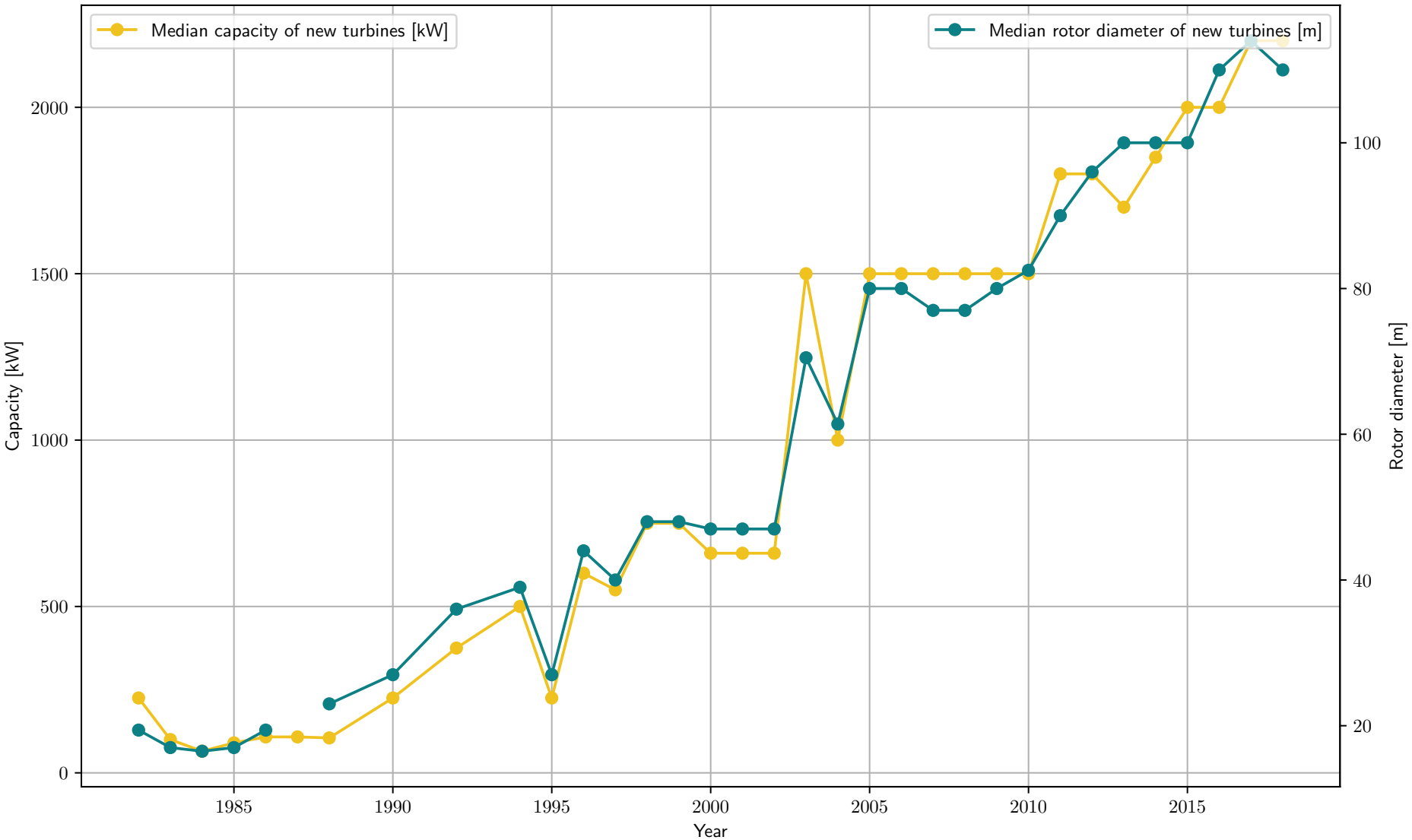
- Data sheets for turbine models: **rotor diameter**, **power curve**

Historical development of wind turbine characteristics



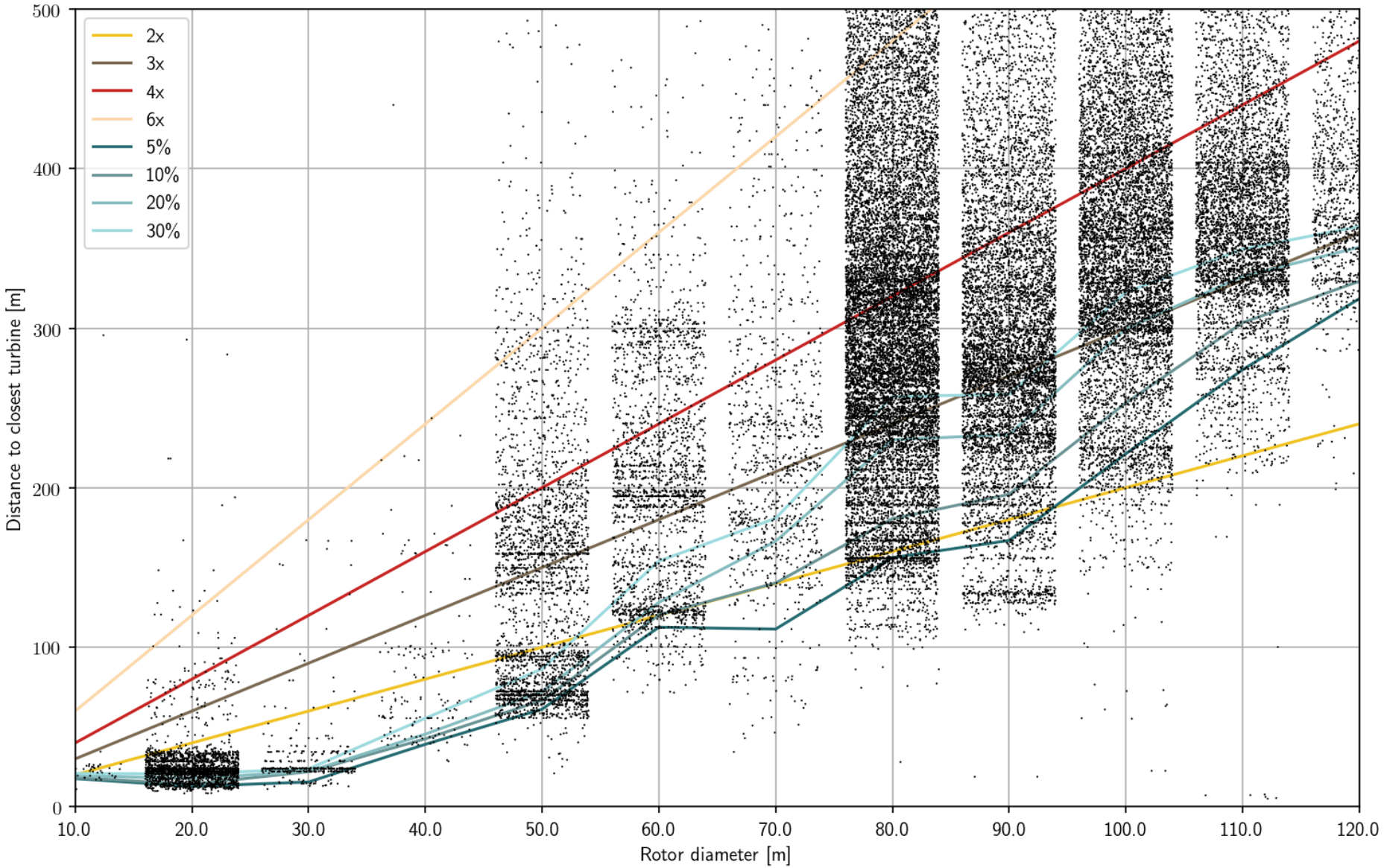
Maximum power generation with different turbines

Optimization problem:

Existing turbines are replaced by newer ones at the location of the old turbines, such that:

- objective function: total power generation is maximized
- constraints: distance between turbines is not below a threshold

Minimum distances between turbine locations

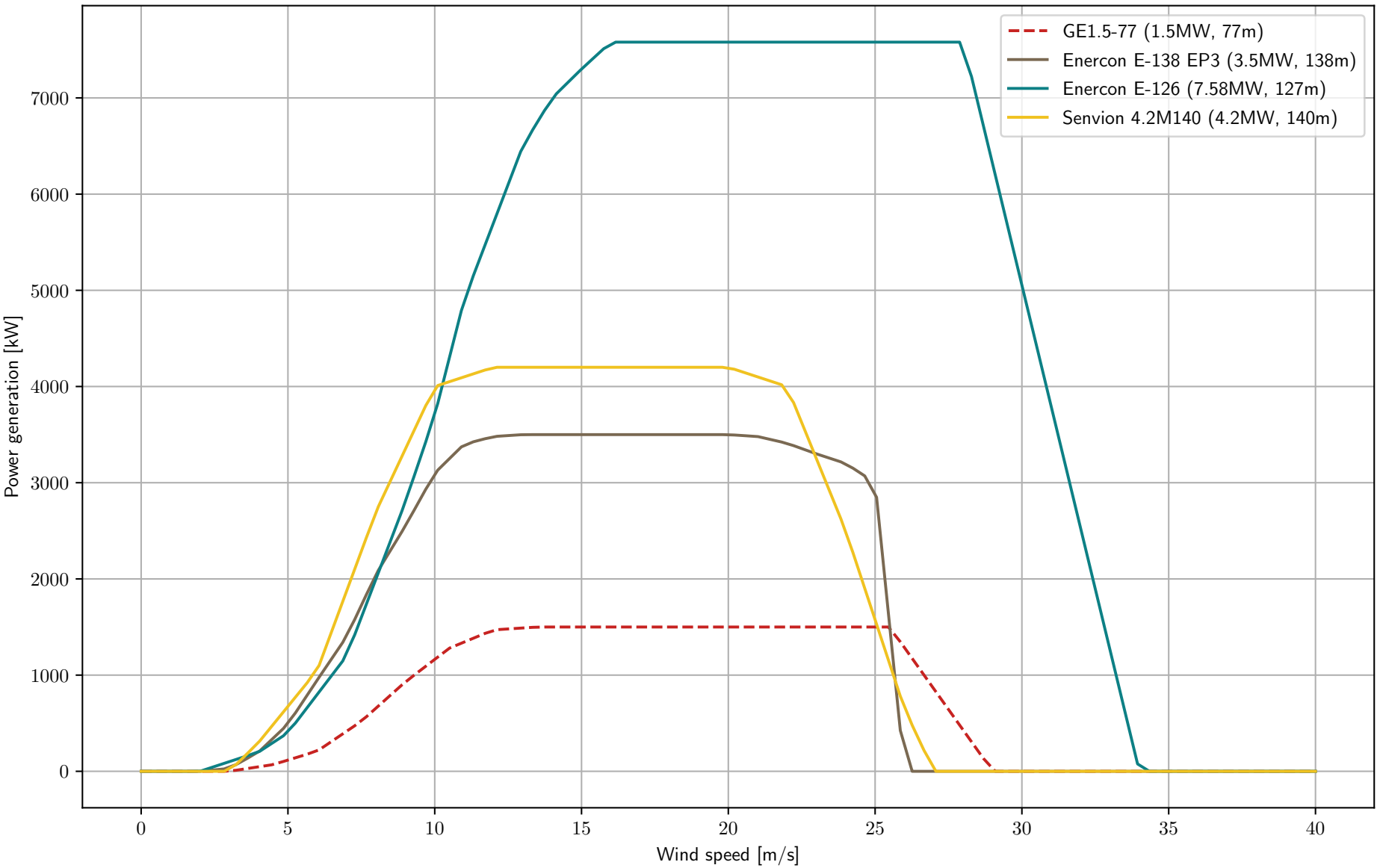


Turbine models

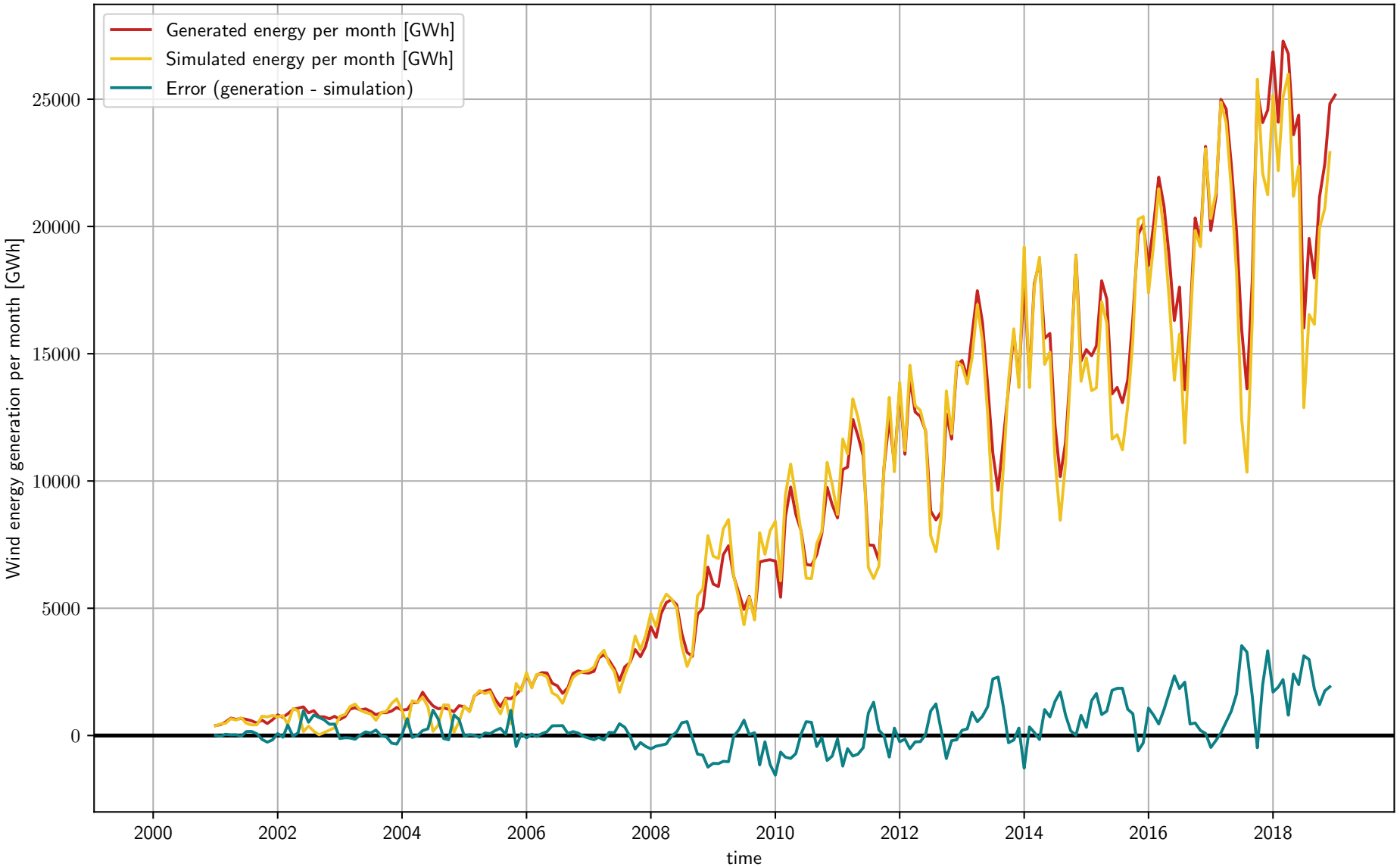
Model name	**Rated capacity**	**Rotor diameter**
GE-1.5 77	1.5 MW	77 m
Enercon E-138 EP3	3.5 MW	138 m
Senvion 4.2M140	4.2 MW	140 m
Enercon E-126	7.58MW	127 m

GE-1.5 77 is the most frequent model in the U.S. (14.7% of all turbines).

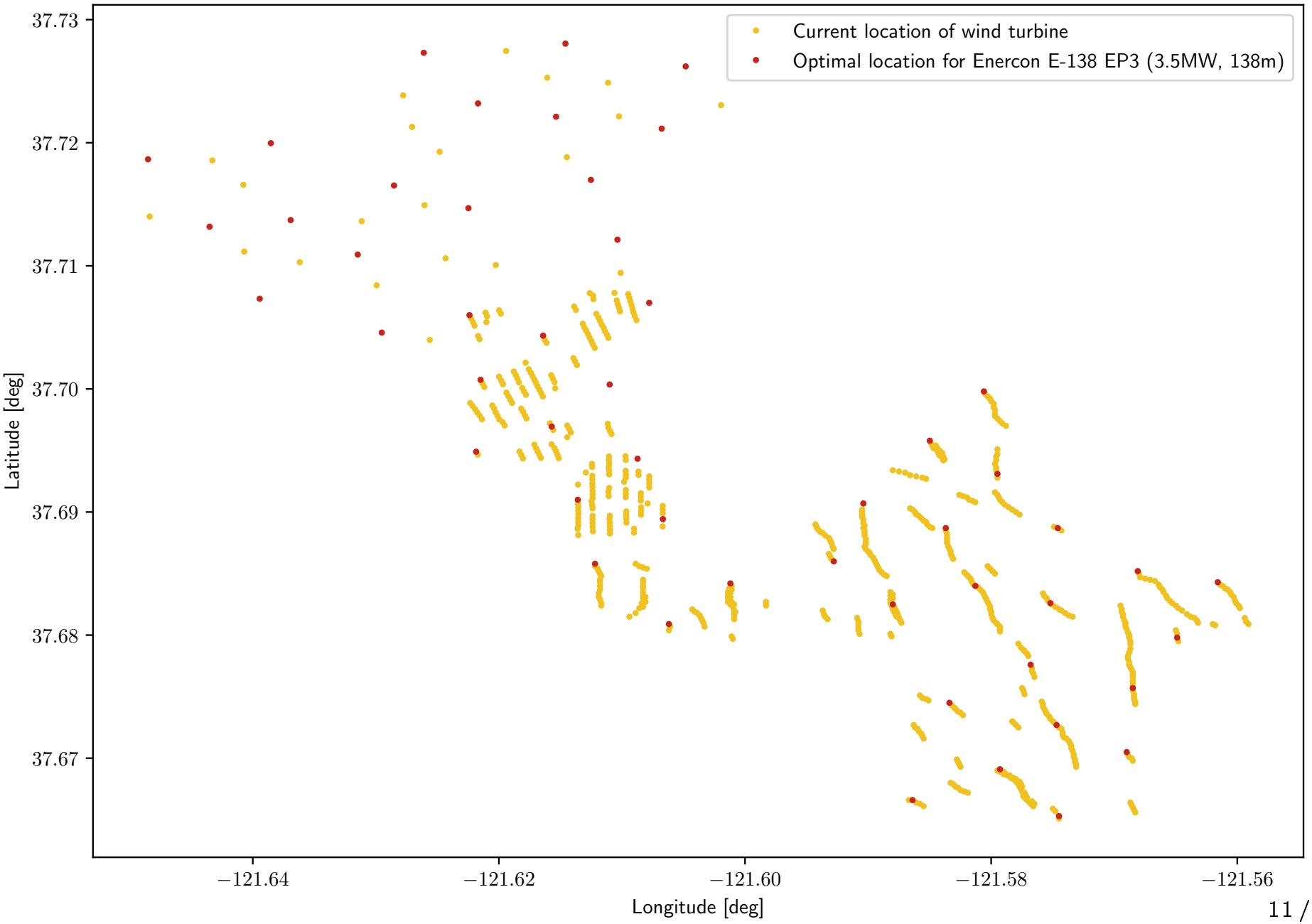
Power curves



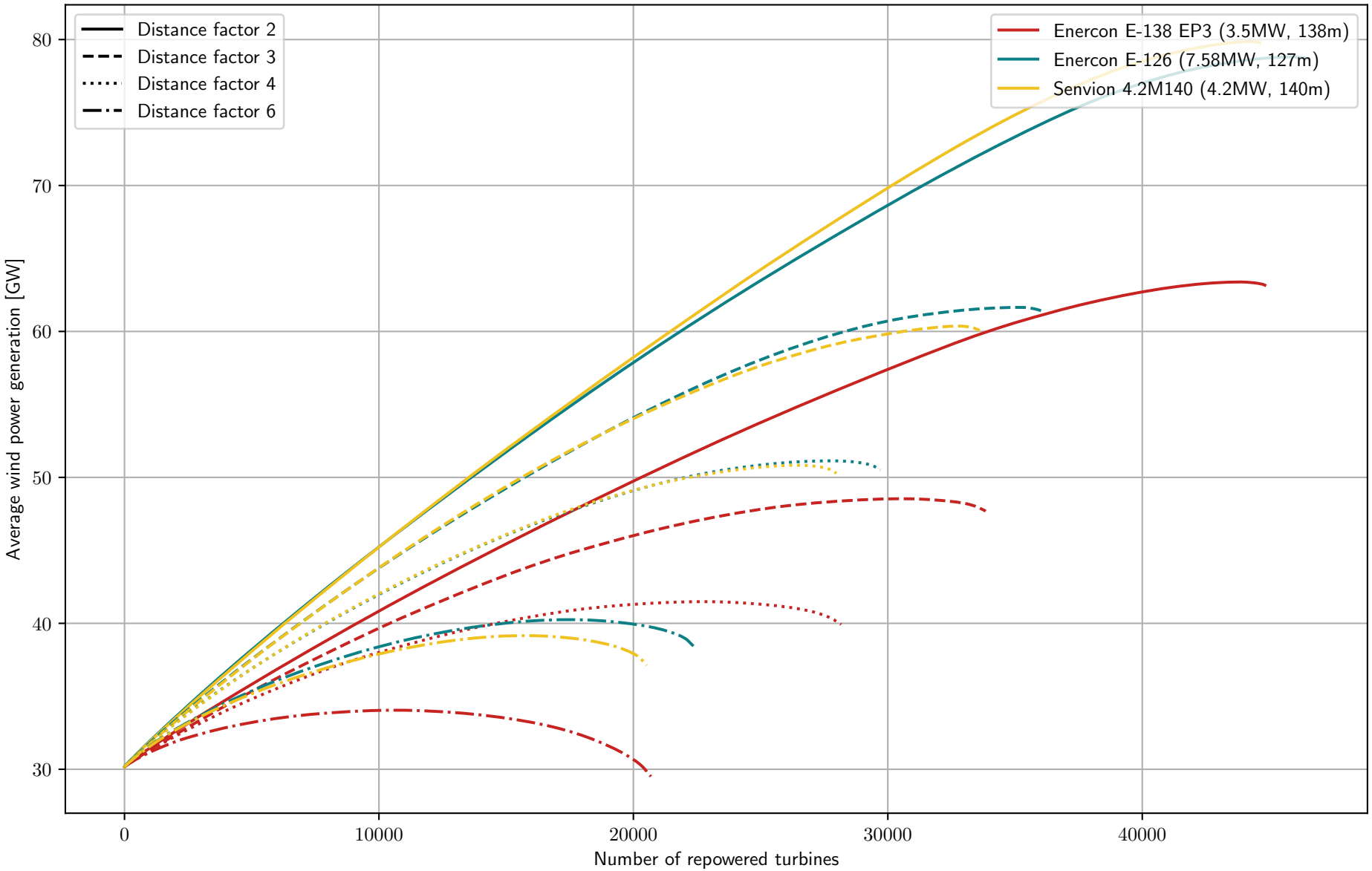
Simulation of power generation



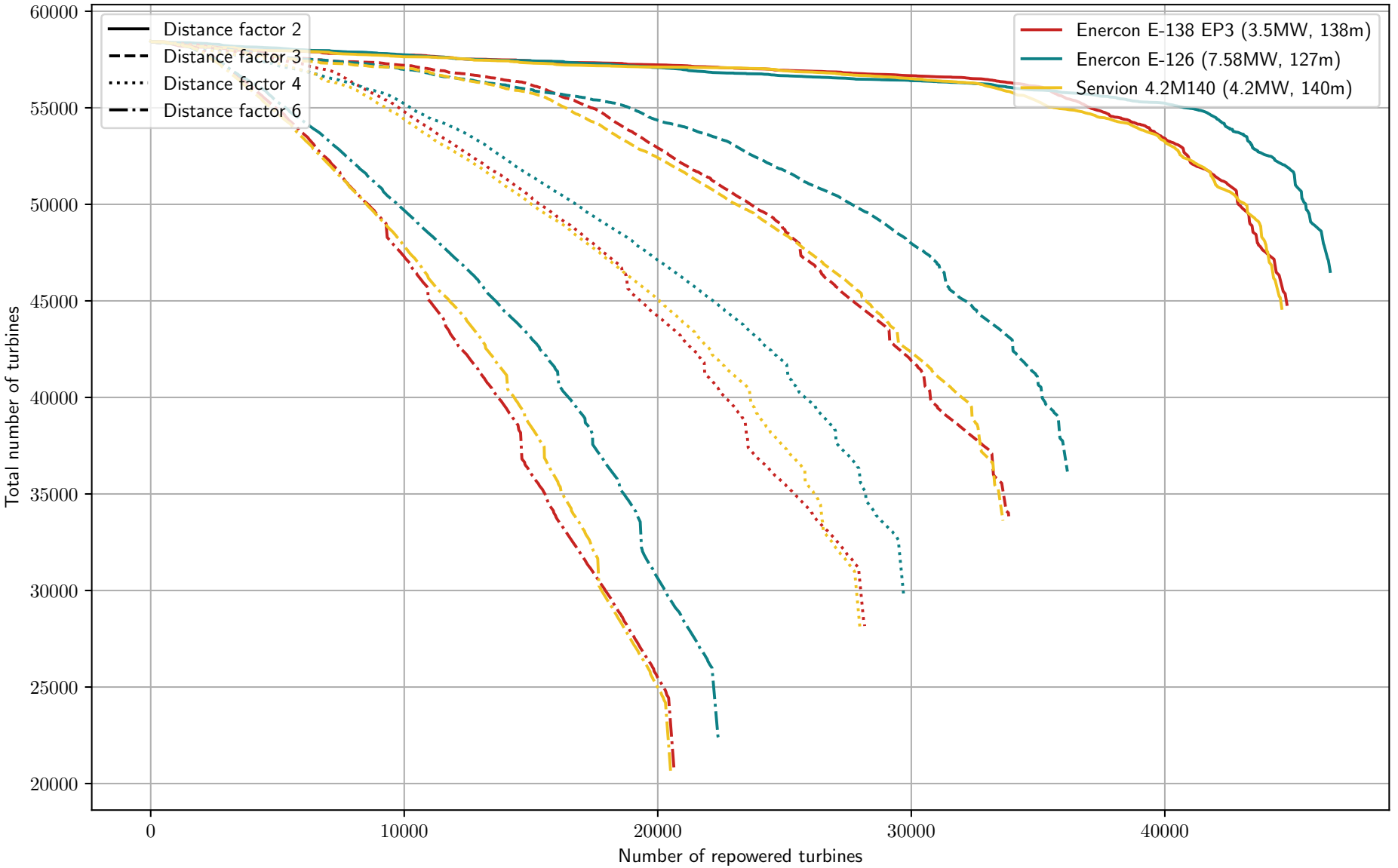
Optimal locations for new wind turbines



Repowering potential: power generation



Repowering potential: number of turbines



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- address economical questions
- assess complexer models, e.g. allowing different turbine types
- take land-use or different locations into account

Thank you!

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http://bit.ly/wind-repower-us
https://refuel.world/

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