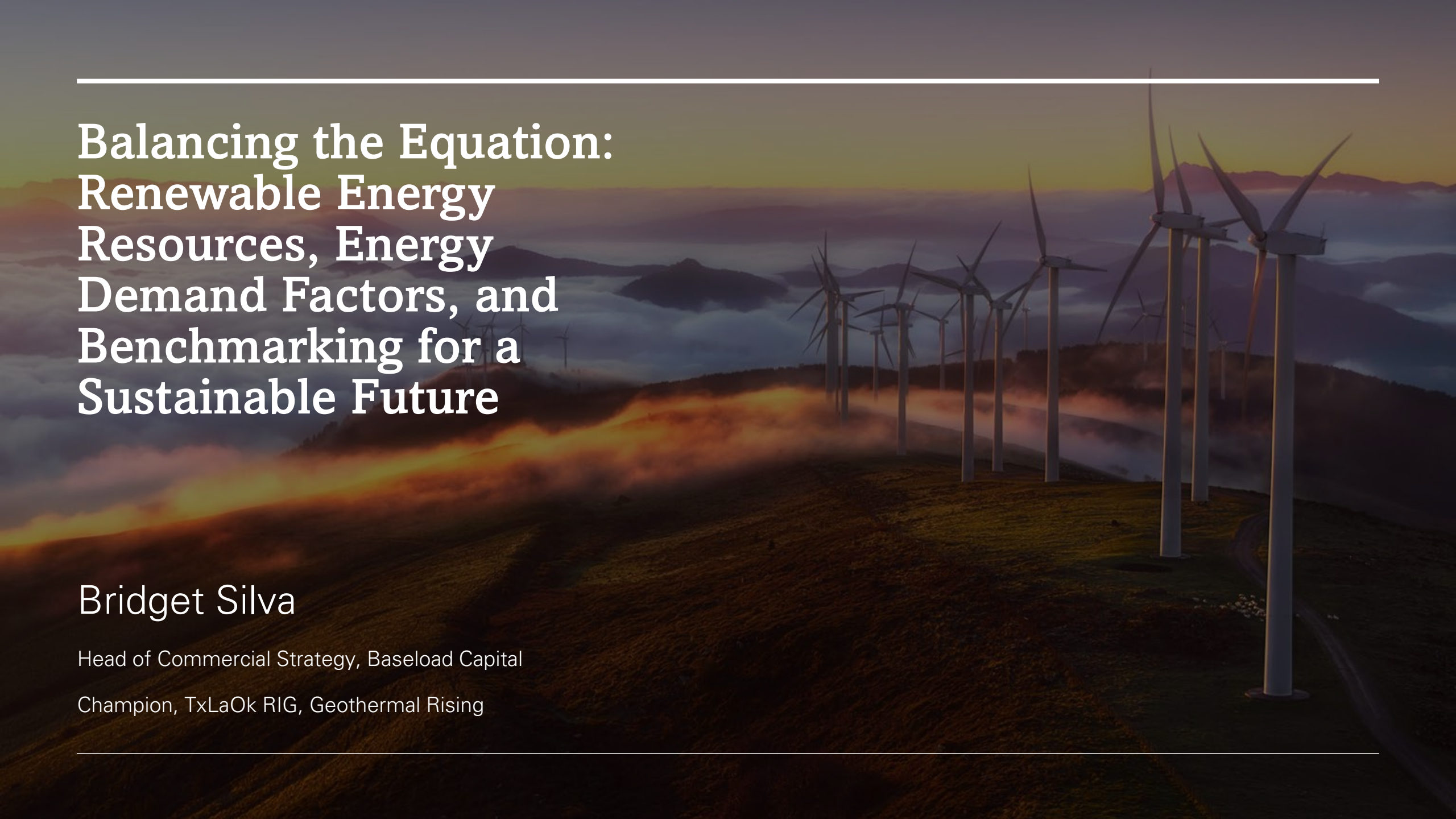


Balancing the Equation: Renewable Energy Resources, Energy Demand Factors, and Benchmarking for a Sustainable Future

Bridget Silva

Head of Commercial Strategy, Baseload Capital

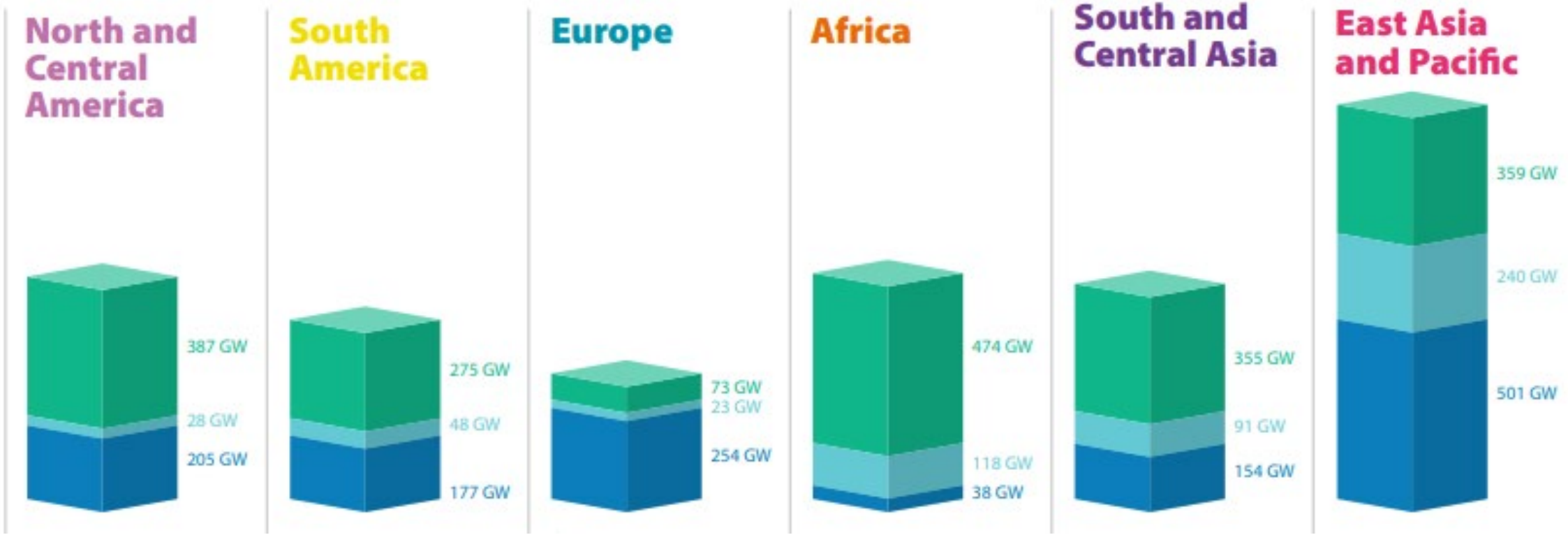
Champion, TxLaOk RIG, Geothermal Rising

Drivers of Renewable Energy Sourcing (Commercial)

- Climate Change & Carbon Emissions Regulations
- Growing Demand of Natural Resources
- Increased Stakeholder Scrutiny in Corporate Environmental Performance
- Innovations in Technology & Business Processes
- Decreases in Costs for Renewable Energy

Natural Renewable Resources: Hydropower

Energy sourced when water flow is combined with gravity to create a force as the water falls onto a turbine. The turbine produces electricity because of the water flow, and its functional application is power generation. There are currently 1,360 gigawatts of hydropower installed worldwide, but this is only a fraction of the potential installation, which is around 3,721 gigawatts



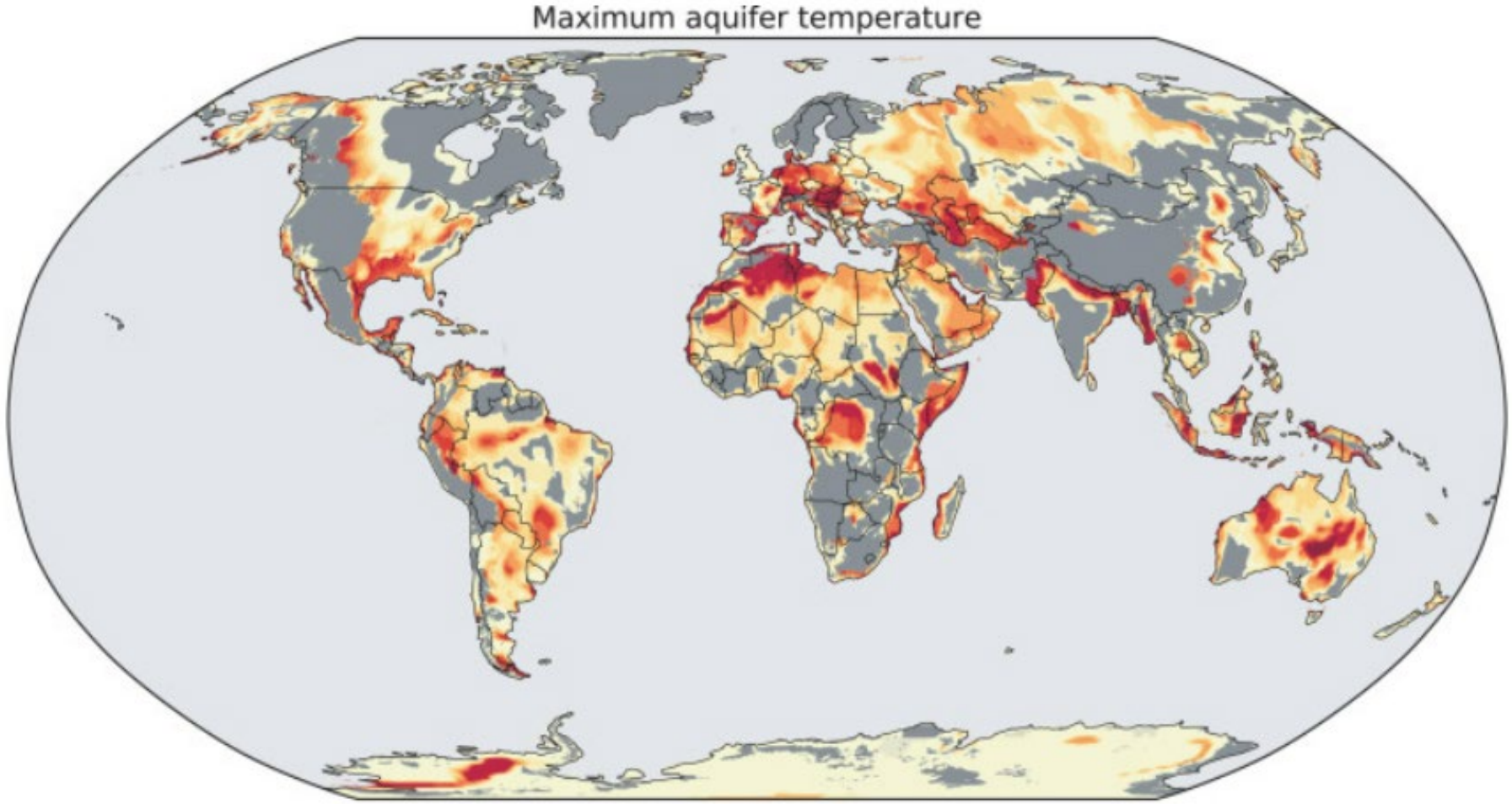
Source: IHA, 2022

Natural Renewable Resources: Geothermal

Geothermal is sourced from heat below the surface of the earth and can be used for urban heating, power generation, and in conjunction with a water source that creates hydrothermal applications.

Geothermal depends on availability of technology and geological attributes which are not evenly distributed.

16,127MW installed worldwide at the end of 2022.



Source: Limberger, et. al., 2018

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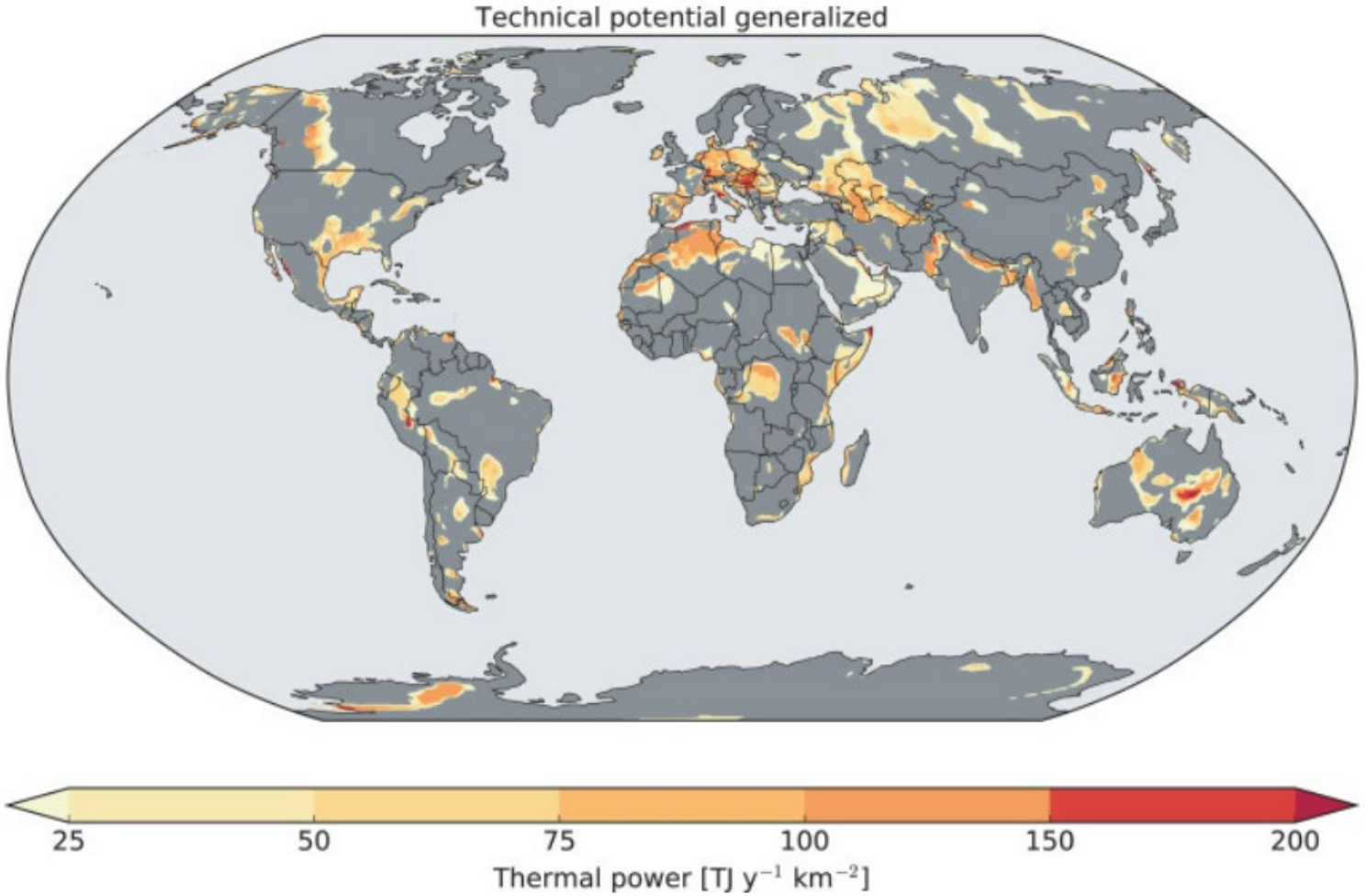
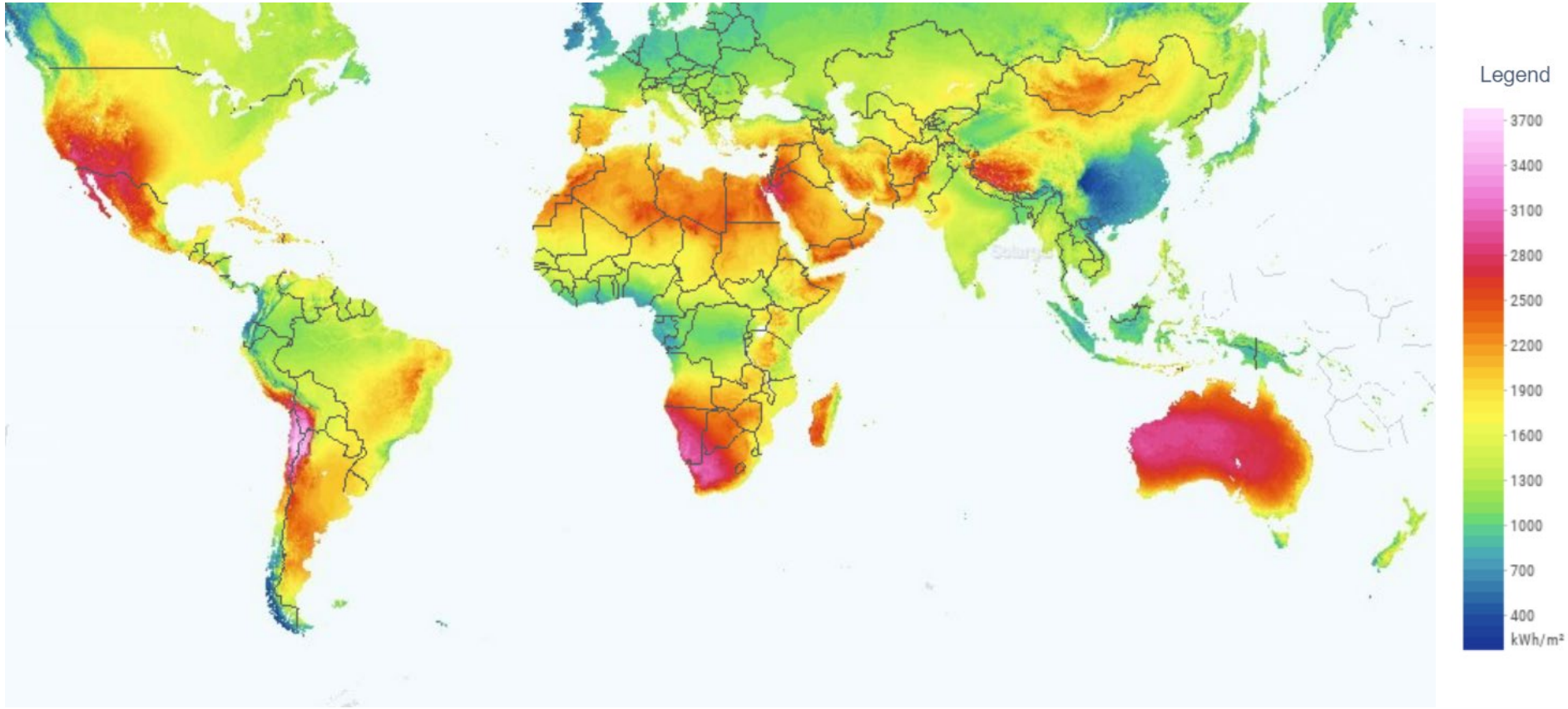


Source: Limberger, et. al., 2018

Natural Renewable Resources: Solar Irradiation

Solar energy can be directly integrated into products, such as patio lighting, solar powered dryers, and other direct applications used in the home. Photovoltaics can also be used to convert solar energy into utility scale power. This flexibility creates a wide range of potential markets for solar energy products and services and as a result, several solar energy companies have emerged to exploit this potential.

1,177 GW installed as of 2022.

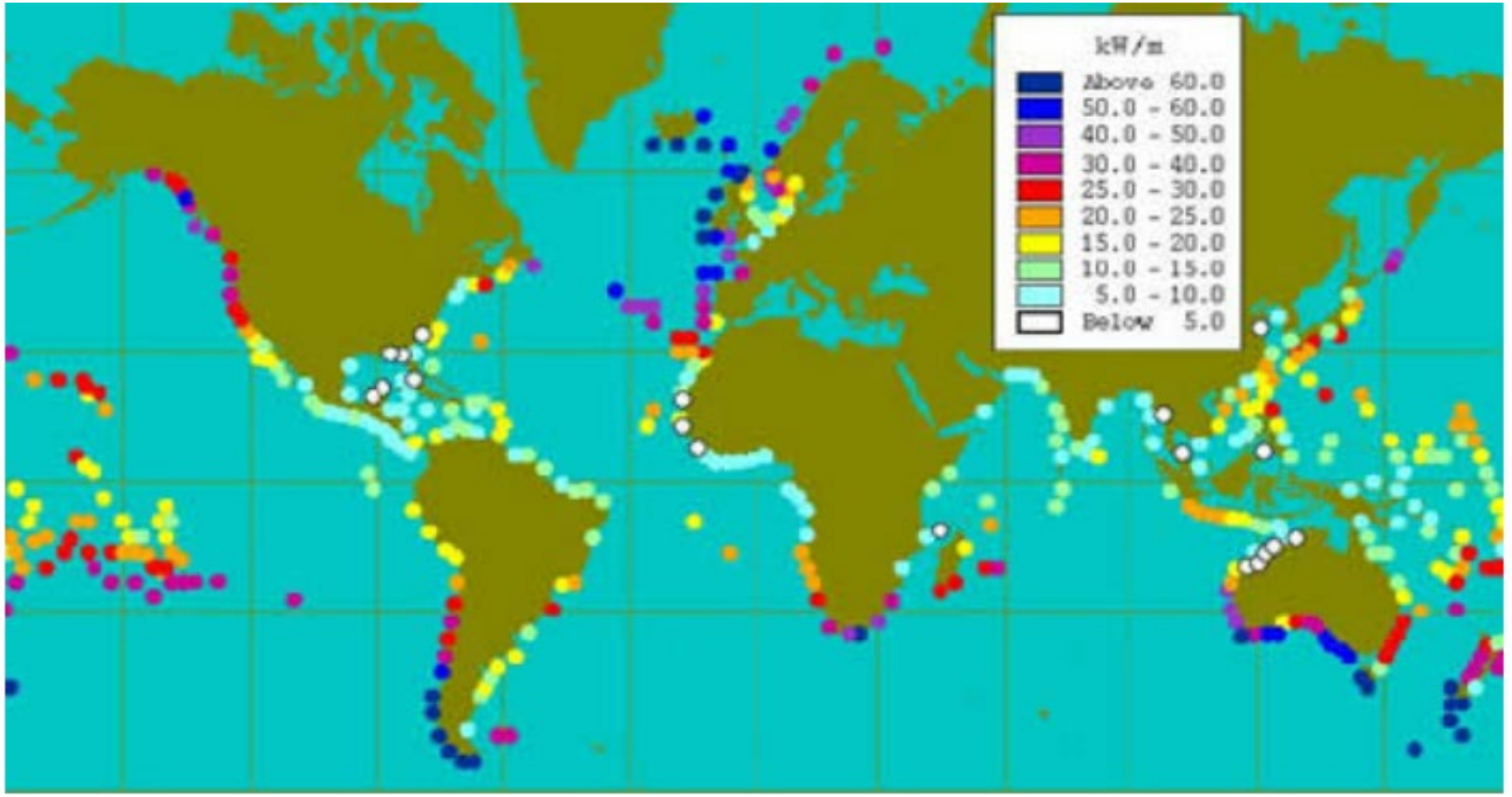


Source:Global Solar Atlas, 2022

Natural Renewable Resources: Tidal

Tidal energy is developed by capturing the force of ocean waves and converting this force into energy. Like many other resources, tidal is geographically limited to shorelines and is impacted by changes in wind and tectonic activities.

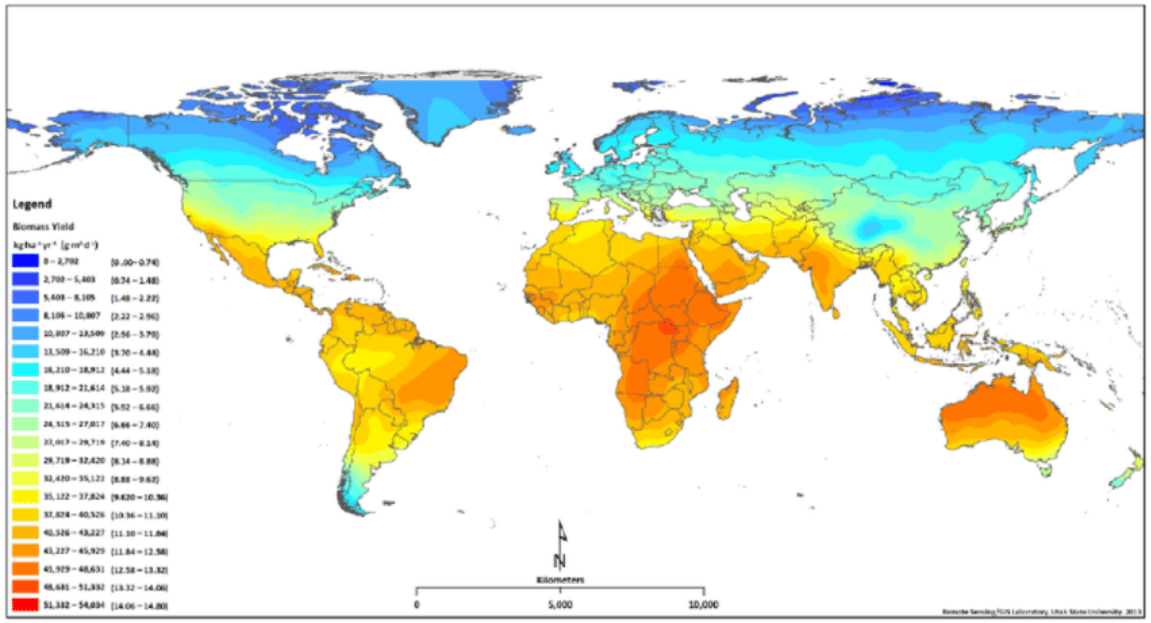
524MW capacity in 2022.

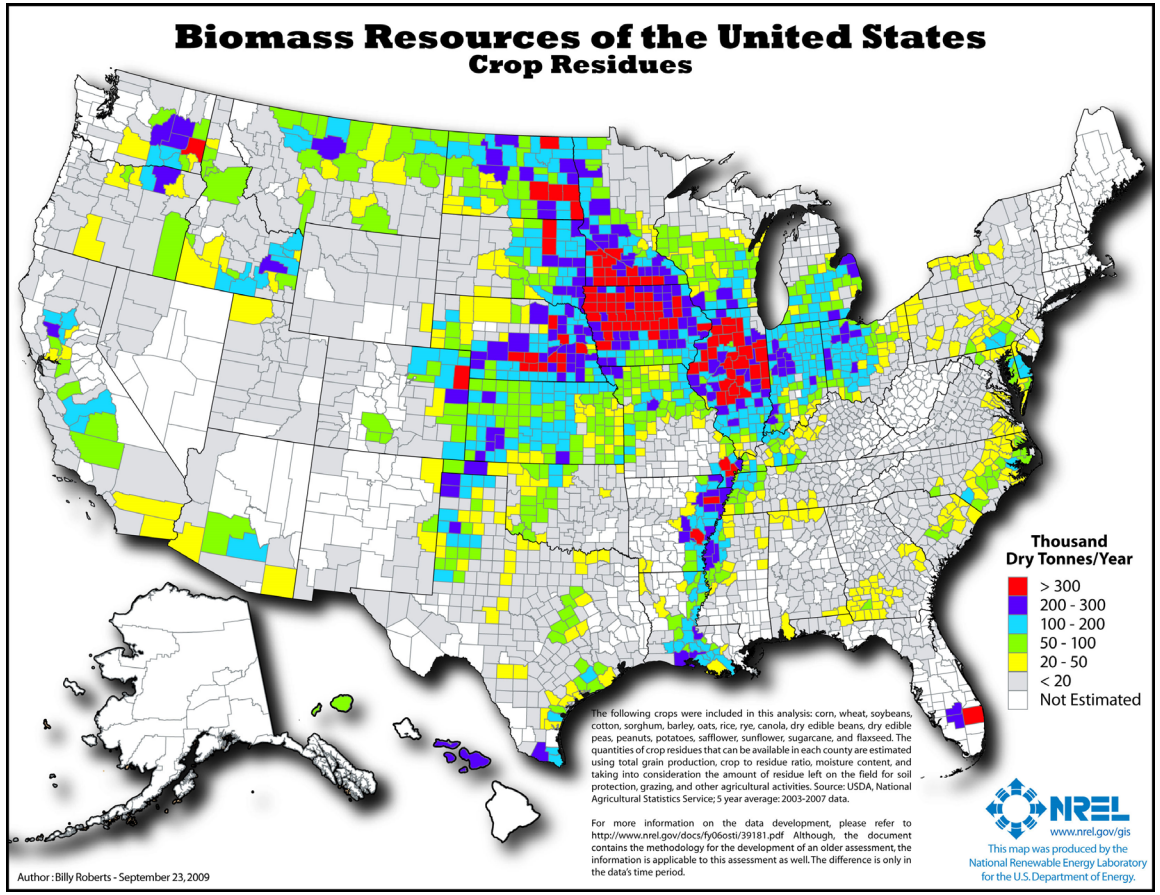


Source: GENI, 2017

Natural Renewable Resources: Biomass

Bioenergy is sourced from a large range of sources and offers a wide variety of functions, including small scale heating, power generation, and gasification for use in cooking. This energy source originates as a byproduct of other processes and therefore is difficult to produce, predict or forecast. It is also difficult to identify how much energy is currently produced by biomass.

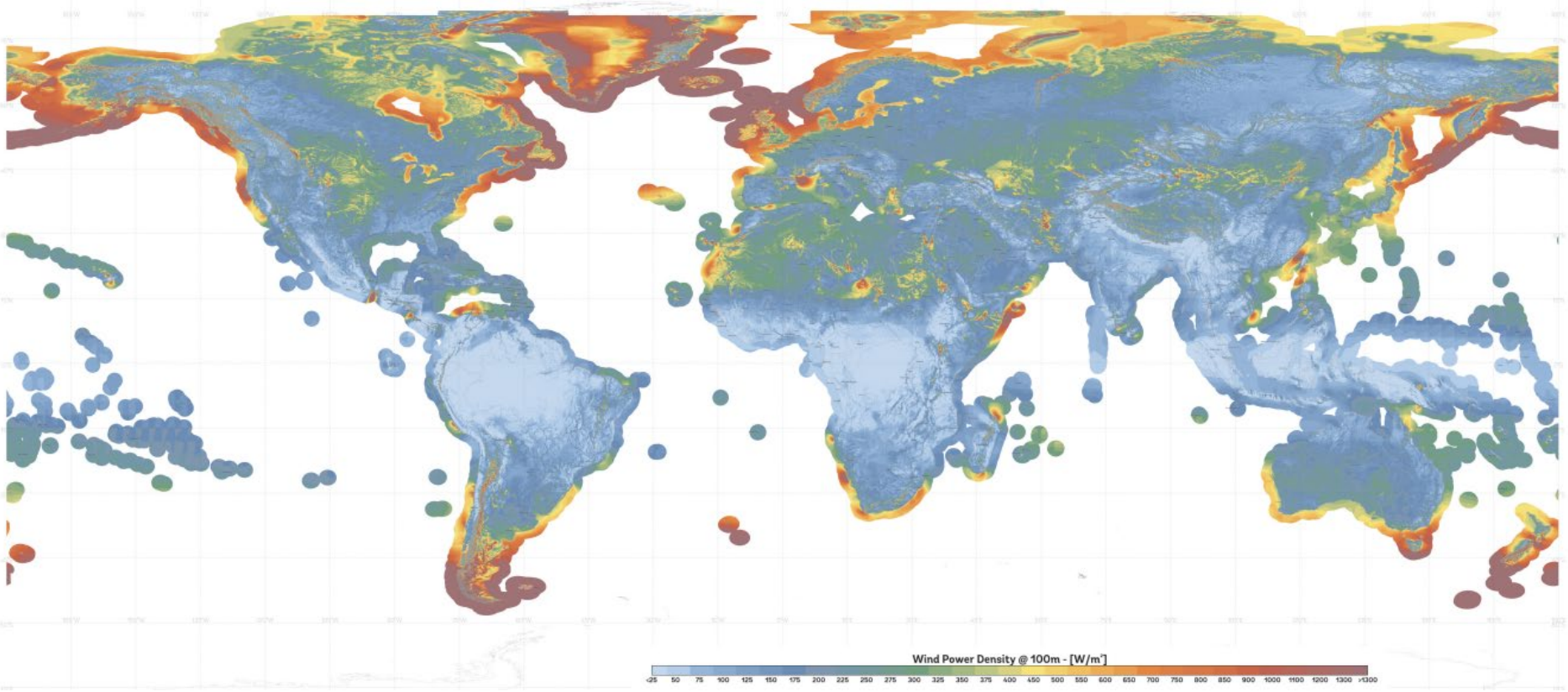




Natural Renewable Resources: Wind Power Density

This wind resource map provides an estimate of mean wind power density at 100 m above surface level. Power density indicates wind power potential, part of which can be extracted by wind turbines. The map is derived from high-resolution wind speed distribution based on a chain of models, which downscale winds from global models (~30 km), to mesoscale (3km) to microscale (250m).

~77.6MW online globally at the end of 2022.



Source: Global Wind Atlas, 2019

Natural Renewable Resources: Mean Wind Speed

This wind resource map provides an estimate of mean wind power density at 100 m above surface level. Power density indicates wind power potential, part of which can be extracted by wind turbines. The map is derived from high-resolution wind speed distributions based on a chain of models, which downscale winds from global models (~30 km), to mesoscale (3 km) to microscale (250 m).

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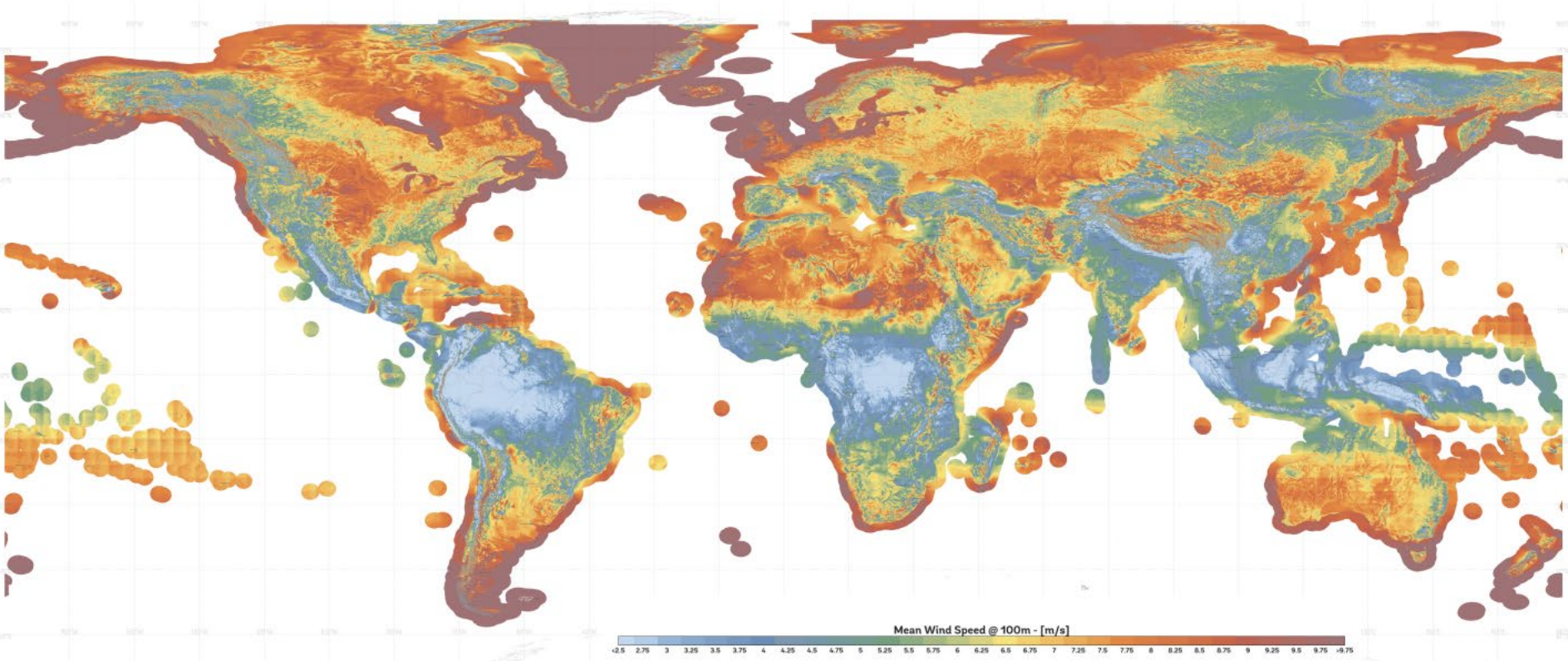
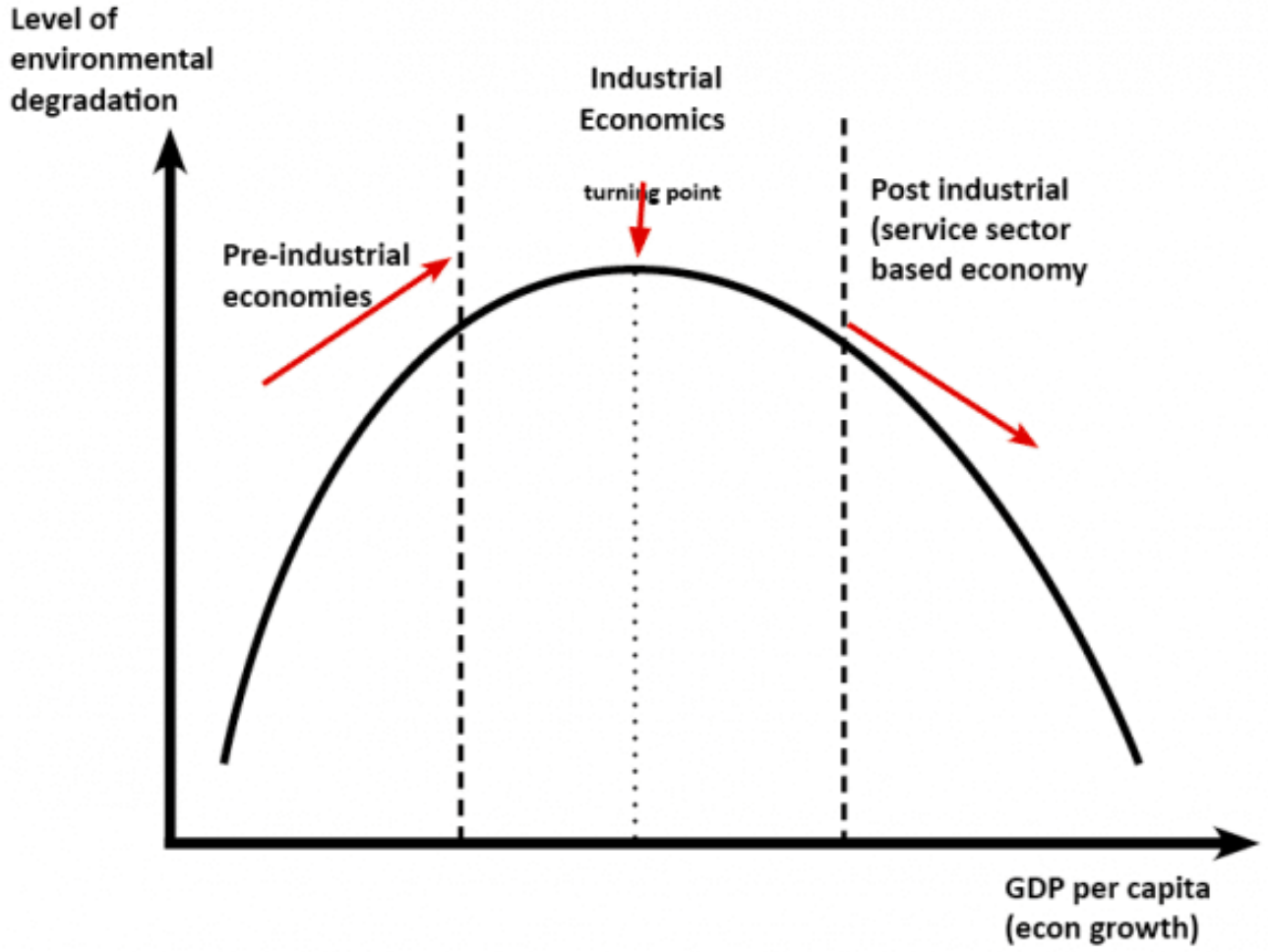


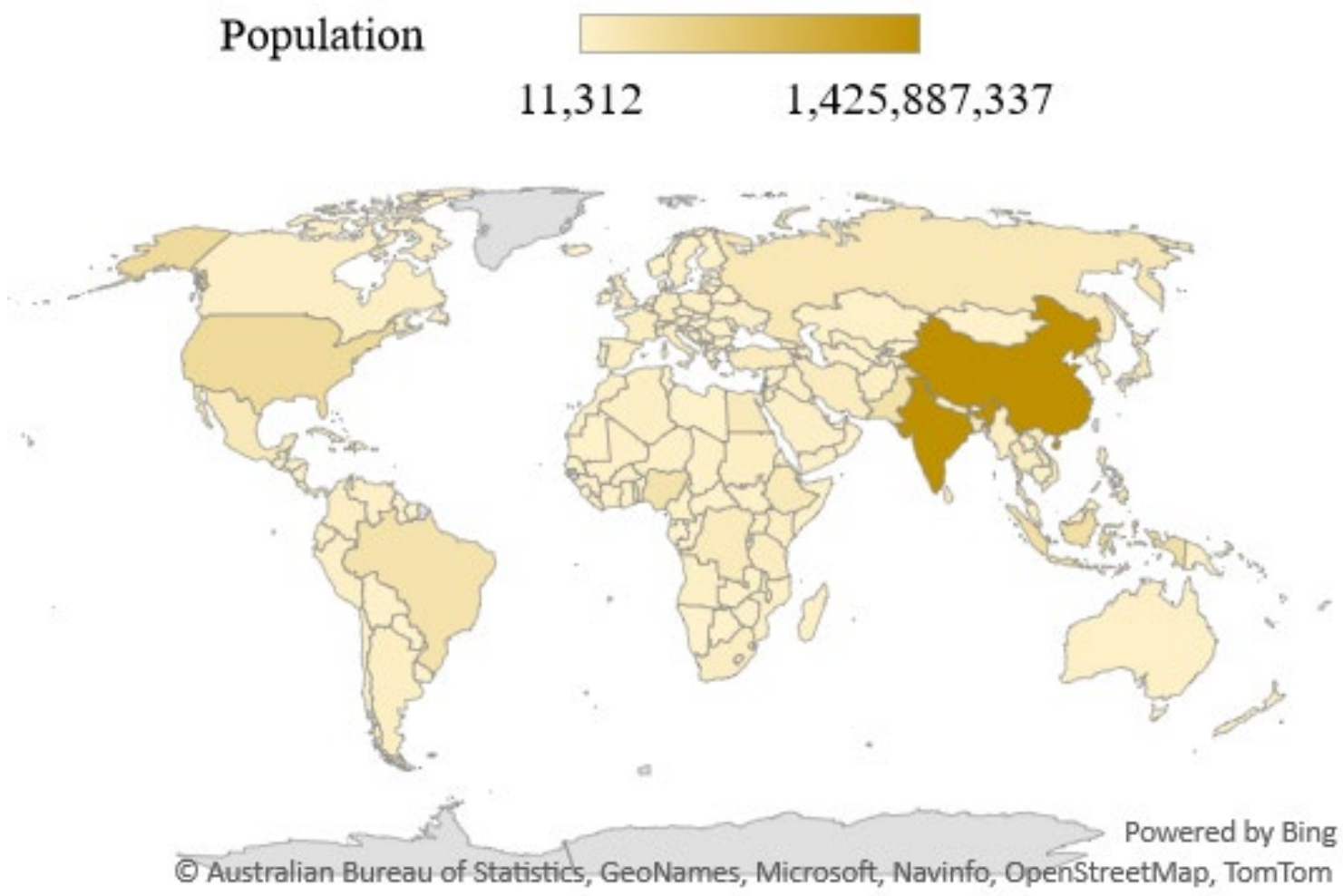
Source: Global Wind Atlas, 2019

Renewable Demand: Environmental Kuznets Curve



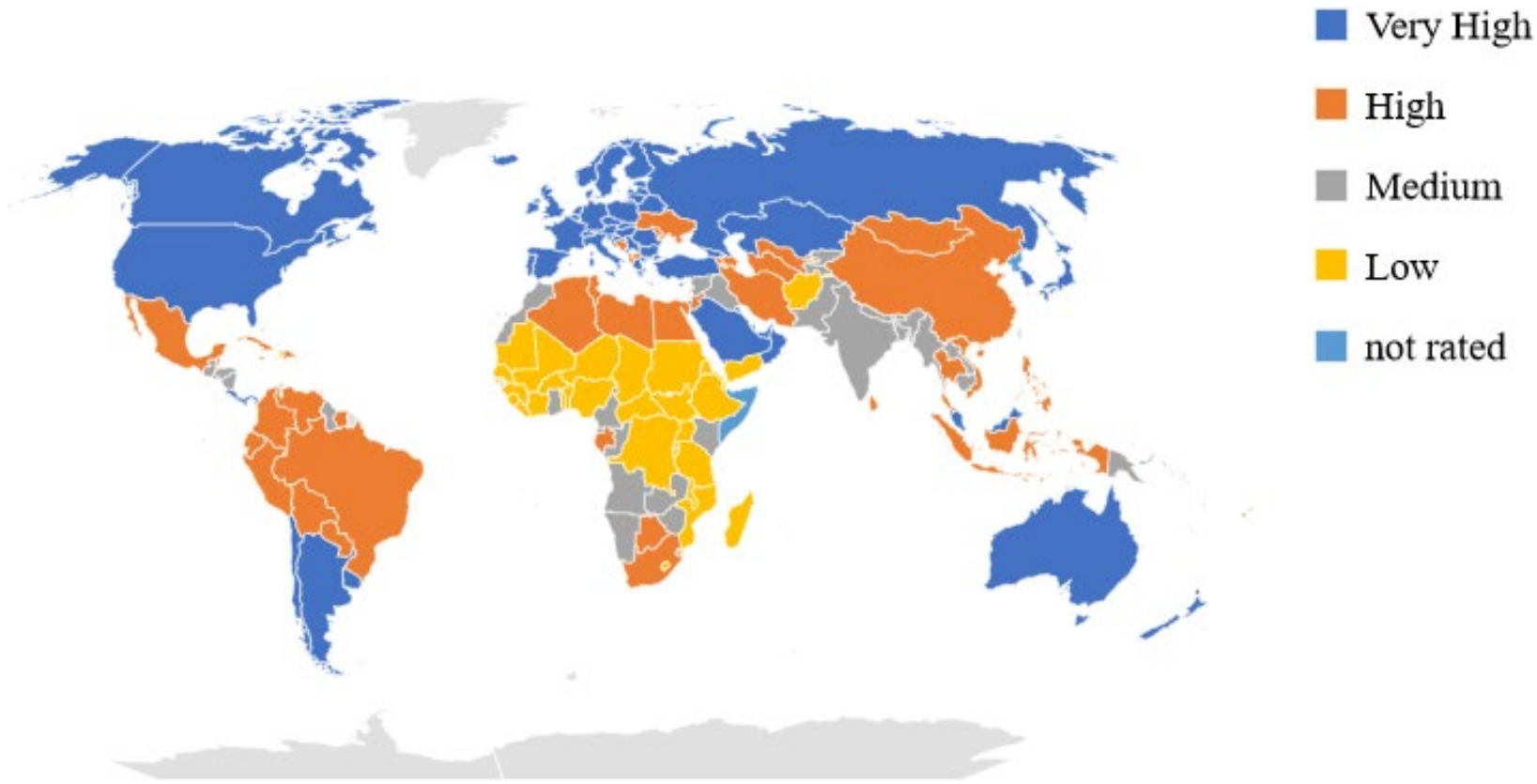
Source: Stern, 2018

Renewable Demand: Relative Population



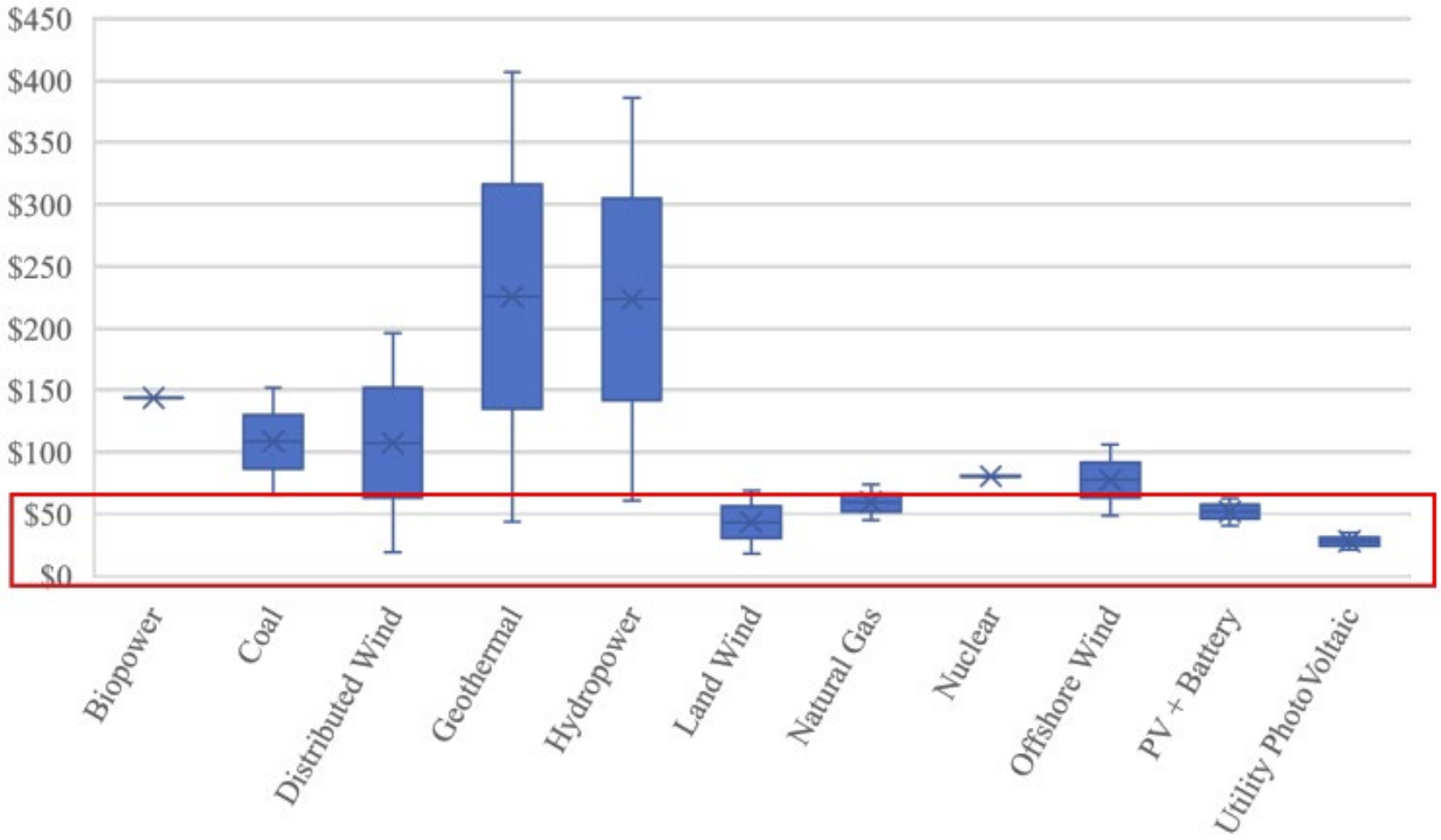
Source: UNDP, 2022

Renewable Demand: Human Development Index 2022



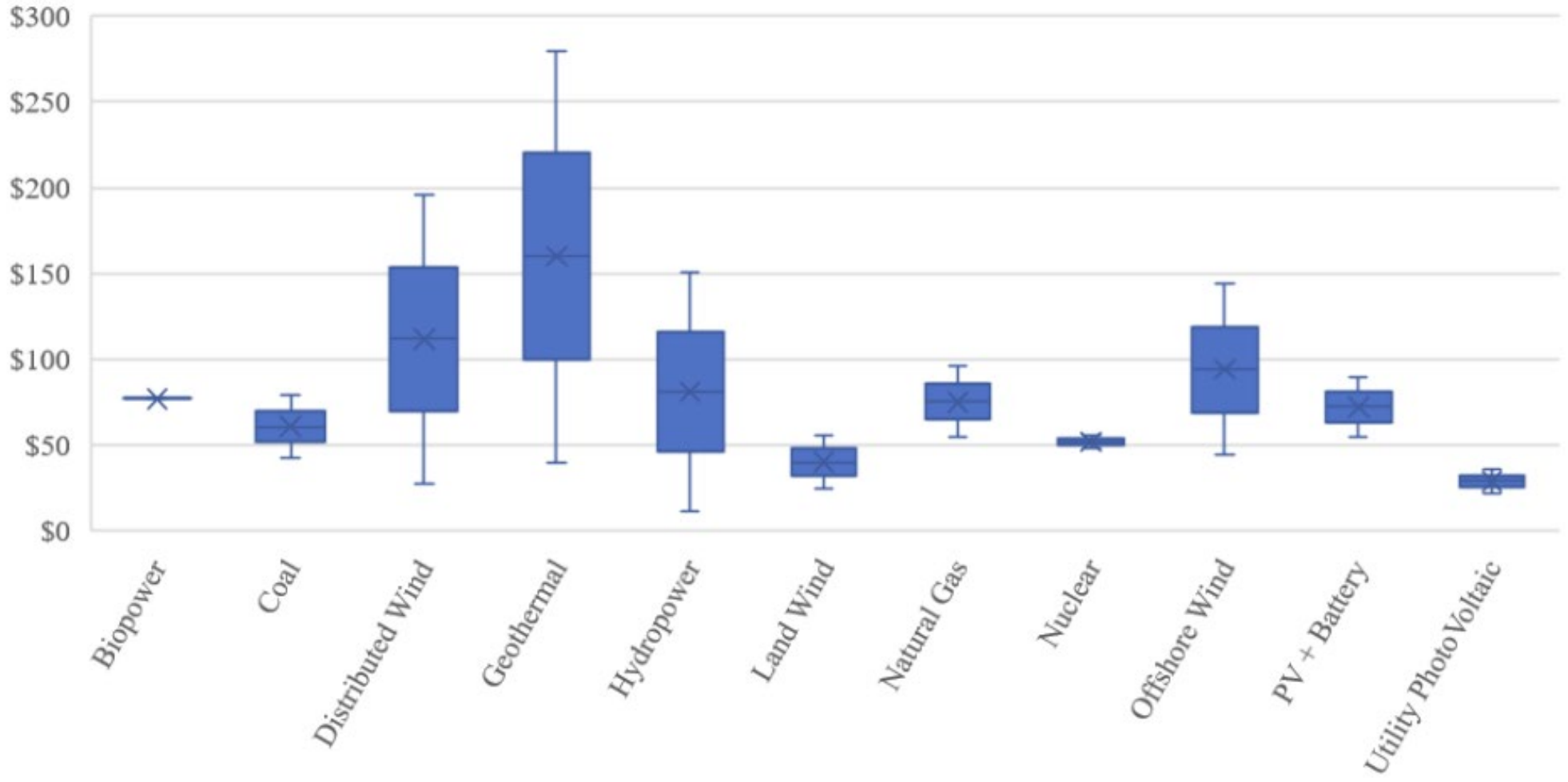
Source: UNDP, 2022

Benchmarking Renewable Value: LCOE/MWh



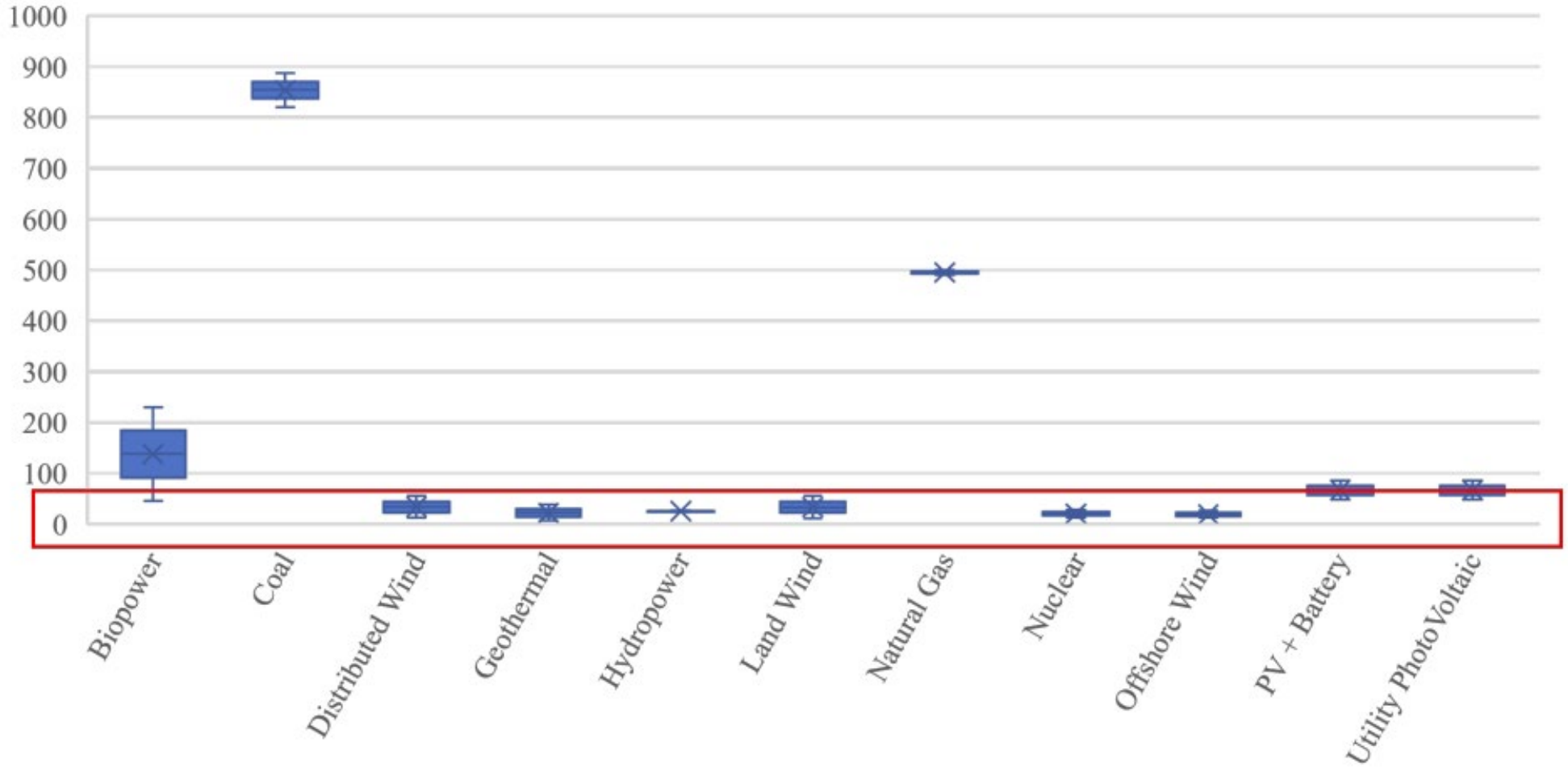
Source: NREL, 2022

Benchmarking Renewable Value: TCOE/MWh



Source: NREL, 2022; Theis, 2021

Benchmarking Renewable Value: CO_2 mt (t)/GWh



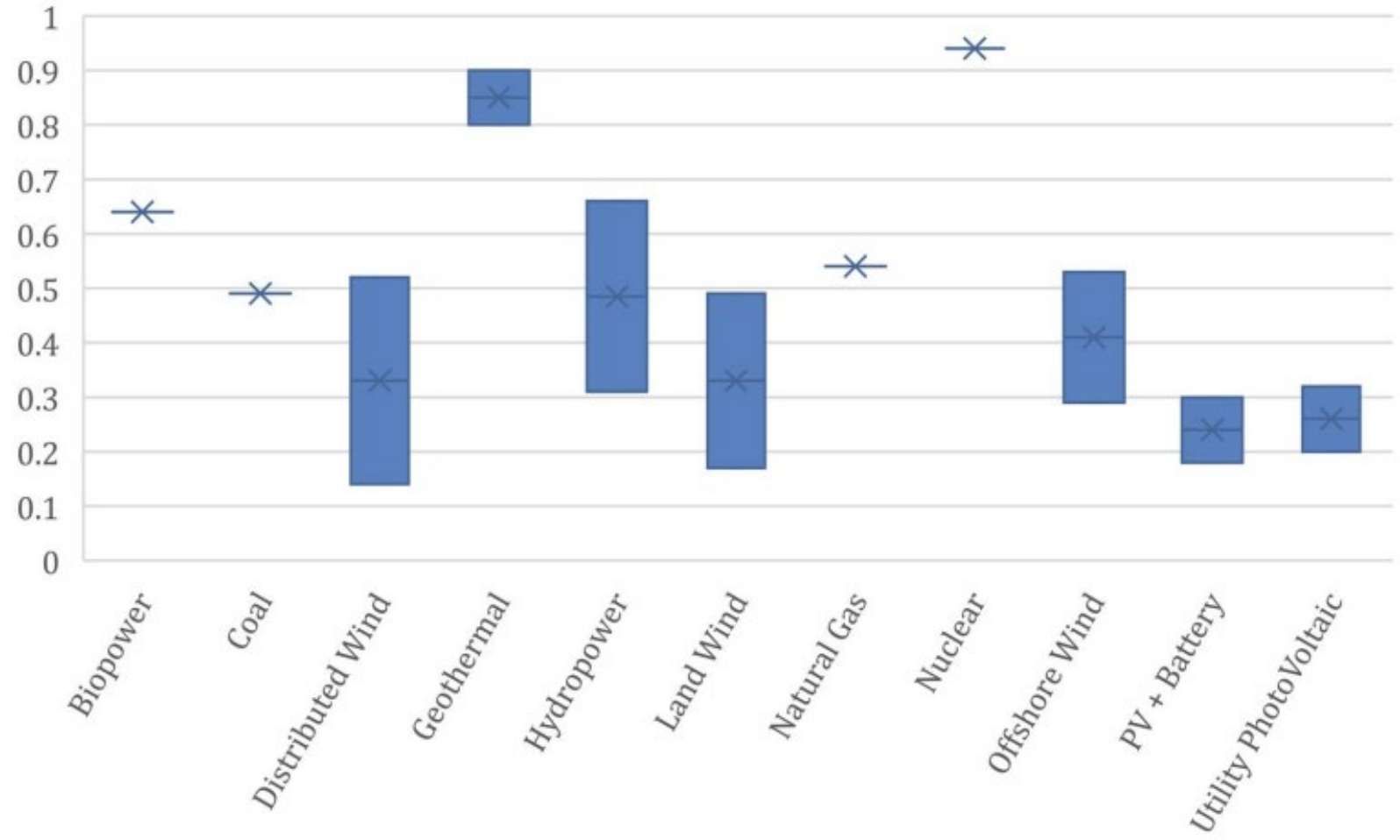
Source: EPA, 2022; Engels & Wilson, 2022

Benchmarking Renewable Value: LCCA (ex. ERCOT)

Renewable Baseline Summary			Illustrative Case Study #1: Levelized Cost of Carbon Abatement in ERCOT		
Total Cost Benchmark		Carbon Emissions Low (mt CO2e/GWh)****	ERCT Grid Power Current Cost Q1 2022 - Industrial Sector ($/MWh)	ERCOT Grid Power Current Emissions (mt C02/GWh)	Levelized Cost of Carbon Abatement ERCT ($/mt C02)
Biopower	$77	45	$62.00	371.3	$0.05
Biopower	$77	230	$62.00	371.3	$0.11
Coal	$42	820	$62.00	371.3	NA
Coal	$79	888	$62.00	371.3	NA
Distributed Wind	$27	12	$62.00	371.3	-$0.10
Distributed Wind	$196	55	$62.00	371.3	$0.42
Geothermal	$40	6	$62.00	371.3	-$0.06
Geothermal	$280	38	$62.00	371.3	$0.65
Hydropower	$11	24	$62.00	371.3	-$0.15
Hydropower	$150	26	$62.00	371.3	$0.26
Land Wind	$25	11	$62.00	371.3	-$0.10
Land Wind	$55	55	$62.00	371.3	-$0.02
Natural Gas	$55	490	$62.00	371.3	NA
Natural Gas	$96	500	$62.00	371.3	NA
Nuclear	$49	12	$62.00	371.3	-$0.04
Nuclear	$55	28	$62.00	371.3	-$0.02
Offshore Wind	$45	12	$62.00	371.3	-$0.05
Offshore Wind	$144	26	$62.00	371.3	$0.24
PV + Battery	$55	48	$62.00	371.3	-$0.02
PV + Battery	$90	85	$62.00	371.3	$0.10
Utility PhotoVoltaic	$22	48	$62.00	371.3	-$0.12
Utility PhotoVoltaic	$36	85	$62.00	371.3	-$0.09

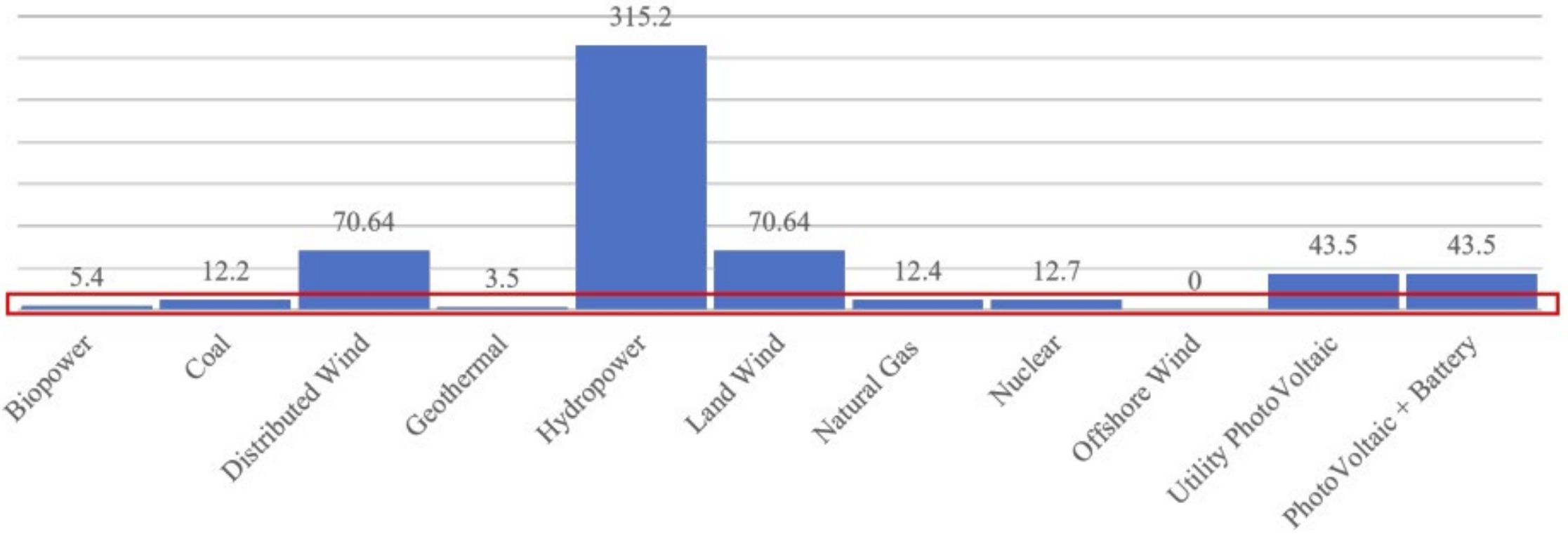
Source: Friedman, et. al., 2020; NREL, 2022; Theis, 2021; EPA, 2022; Engels & Wilson, 2022

Benchmarking Renewable Value: Capacity Factor



Source: EIA, 2022

Benchmarking Renewable Value: Land Acres/MW



Source: van Zalk & Behrens, 2018; U.S. Department of Energy, 2022

Thank you.

bridget.silva@gmail.com

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