

Analysing climate impacts on wind energy assets



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Executive summary

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Climate change is projected to significantly alter global wind patterns

2



Funded by the UK Space Agency, Equitix partnered with Sust Global to analyse the impact of climate change across its wind investments

3



Sust Global's geospatial AI approach enabled climate-informed insights



How climate change could affect the wind industry

Climate change is set to transform global weather systems and disrupt industries worldwide. While public attention has largely focused on catastrophic weather events and rising sea levels, a subtle yet significant shift is occurring: changes to wind speeds.

Climate models project that wind resources will deviate by more than 30% from their historical patterns. These changes are not expected to be uniform across geographies; some regions will experience significant increases in wind speeds while others will see decreases.¹

Currently, asset performance is predicted based on historic wind speed patterns which feed investment, construction, and operating decisions. This assumes that wind speeds will maintain consistent patterns over long-time horizons.

This assumption has been valid over the ~40 year history of the wind industry enabling historical observations to be an effective and sufficient dataset for predicting future asset performance. However, climate change is set to cause wind pattern changes which could disrupt standard industry practices.



¹ D. Carvalho et. al, Wind energy resource over Europe under CMIP6 future climate projections: What changes from CMIP5 to CMIP6, Renewable and Sustainable Energy Reviews, Volume 151, 2021

Using climate models in wind investing

As a leading global infrastructure investor, developer and fund manager, Equitix believes that understanding forward-looking climate models is conducive to long-term responsible investment.

By partnering with Sust Global, a geospatial AI company, Equitix sought to assess how changing wind patterns could present emerging opportunities and risks to its wind portfolio. This has been supported by the development of tools which facilitate the smooth integration of future wind speed projections into analysis.

Building high-resolution wind speed models

Developing advanced forward-looking wind speed models to guide wind investment decisions demanded significant innovation from Sust Global. Although previous attempts at creating such projections existed, they often suffered from low resolution and poor accuracy, rendering them less effective for investment decisions. Sust Global's breakthrough approach has revolutionised this process.

By using Sust Global's geospatial AI capabilities, we were able to build high-resolution and high-performance wind speed projections that could power site-level analysis.

Sust Global leveraged Denoising Diffusion Probabilistic Models – a generative artificial intelligence approach that learns to reconstruct high-resolution images by estimating and removing noise through a controlled diffusion process. This process integrates disparate geospatial datasets including but not limited to climate simulations, satellite observations, terrain attributes, and on-site historical performance.

This approach yielded wind speed projections that significantly outperformed other climate models. A graphic comparing Sust Global's and an alternative model's resolutions can be observed in Figure 1.

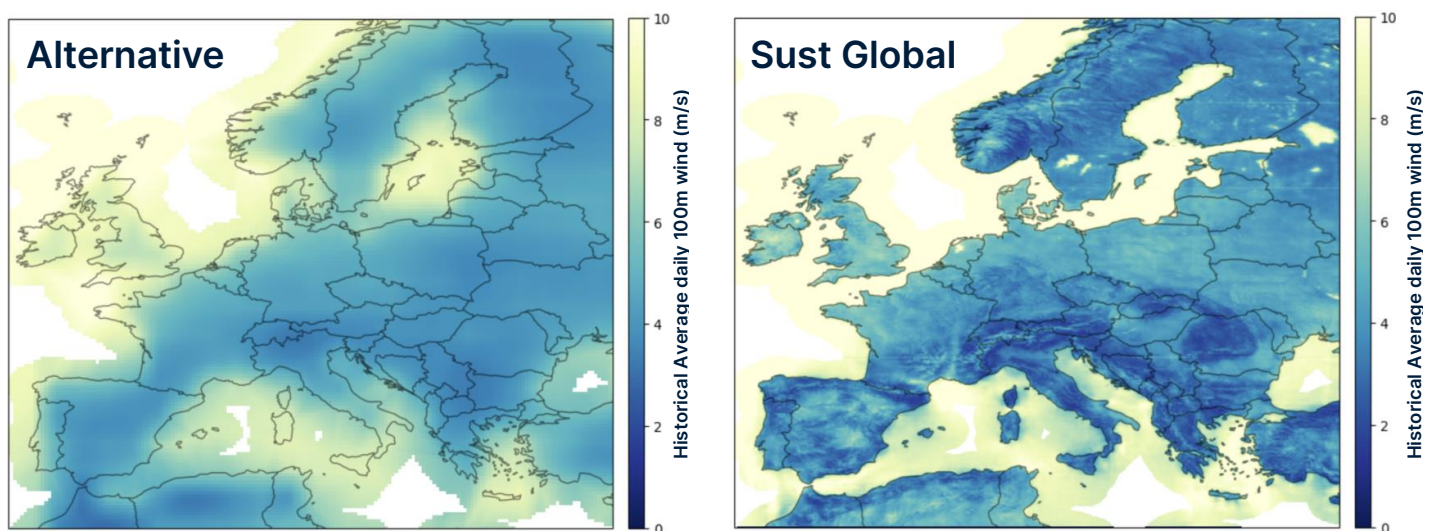


Figure 1: Previous state-of-the-art forward-looking wind speed model resolution (left) compared to Sust Global's forward-looking wind speed model resolution (right).

Translating climate data to performance outputs

To make the climate models decision-useful, further steps were required to develop meaningful outputs which could be directly integrated into investment processes.

Sust Global collaborated with Equitix's asset management team to understand individual asset operating contexts, such as turbine specifications, to develop power generation projections from the initial wind speed models. The complete workflow can be seen in Figure 2.

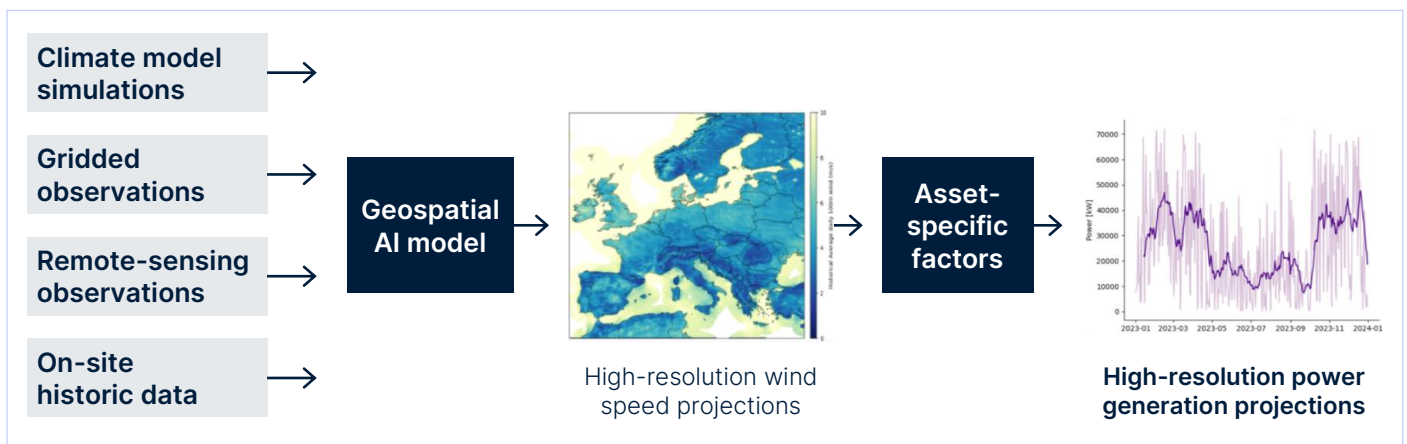


Figure 2: Sust Global's geospatial AI workflow to project wind asset power generation

The construction of power generation projections, a wind industry-native data set, enabled climate change impacts on wind speeds to be analysed with explicit consideration of Equitix's asset management practices.

Data in action: A closer look at an Equitix wind site



With Sust Global's data now available to offer insights into site-level performance, Equitix conducted a deep dive analysis into an operational wind asset to assess potential emerging risks and opportunities driven by changing wind patterns.

Sust Global's data provided forward-looking projections of daily wind speed until 2050 analysing:

Long-term energy yields

The total amount of electricity generated by the site

Asset performance volatility

The variability in energy generation due to wind speed fluctuations

At the site, no statistically significant change in either energy yield or performance volatility is expected opposed to, enabling Equitix to continue operating the asset with confidence.

Site risk assessment		
	Future performance analysis	Risk exposure
Yield analysis	No statistically significant change	Low
Volatility analysis	No statistically significant change	Low

Figure 3: Climate change analysis of prospective energy yields and yield volatility at an anonymous Equitix site. The asset analysis shows low risk exposure with regards to energy yield and performance volatility.



Integration into investment processes

As part of our approach to responsible investment, Equitix integrates the recommendations of the Task Force on Climate-related Financial Disclosure (TCFD).

To develop our TCFD strategy further, Equitix has sought ways to quantify the impact of climate change on investment performance across the portfolio, with our offshore and onshore wind portfolio being a key focus.

While climate risk data alone can facilitate the identification of portfolio-wide hotspots in climate risk exposure, qualitative climate findings can fall short in providing actionable insights for asset management and investment teams.

Quantifiable data—such as impacts on revenue, operational costs, asset lifetimes, and insurance costs—are therefore essential for making informed investment and asset management decisions.

The three primary value-add levers enabled by incorporating forward-looking climate data were:

- 1 Investment strategy** Identifying potential target investment regions based on predicted future wind patterns
- 2 Acquisition due diligence** Including a climate review step in project acquisition to mitigate climate-related risks and capture opportunities
- 3 Asset management** Updating asset performance guidance and asset management processes to optimise operating decisions

By leveraging the learnings from this project, Equitix intends to apply this approach to sectors beyond wind generation, continuing to strengthen our portfolio-wide climate strategy.



Joe Robinson

Director of ESG &
Sustainability, Equitix

"Our commitment to researching the quantification of climate impacts on renewable generation assets underscores our strategy to ensure sustainability risks and opportunities are considered in investment and asset management decisions. By leveraging climate data, we can continue to develop comprehensive tools which enhance our ability to identify, monitor and mitigate climate-related risks whilst optimising opportunities."

Looking forward: Geospatial insights for a resilient wind sector

Wind energy will continue to grow in strategic importance as global economies accelerate their net zero ambitions. To ensure energy security amidst changing climate patterns, it is vital to move away from historical observations. Advances in artificial intelligence will enhance the wind industry's ability to understand future conditions and take actions to mitigate risks and maximise emerging opportunities.

Equitix is committed to continuing its collaboration with Sust Global, combining Sust Global's innovative climate modelling techniques with Equitix's extensive industry expertise and financial acumen. This dynamic partnership aims to generate valuable insights into integrating climate data into investment processes, paving the way for a more informed future.





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