

# Informed Public Opinions and Decision Making through Digital Twins

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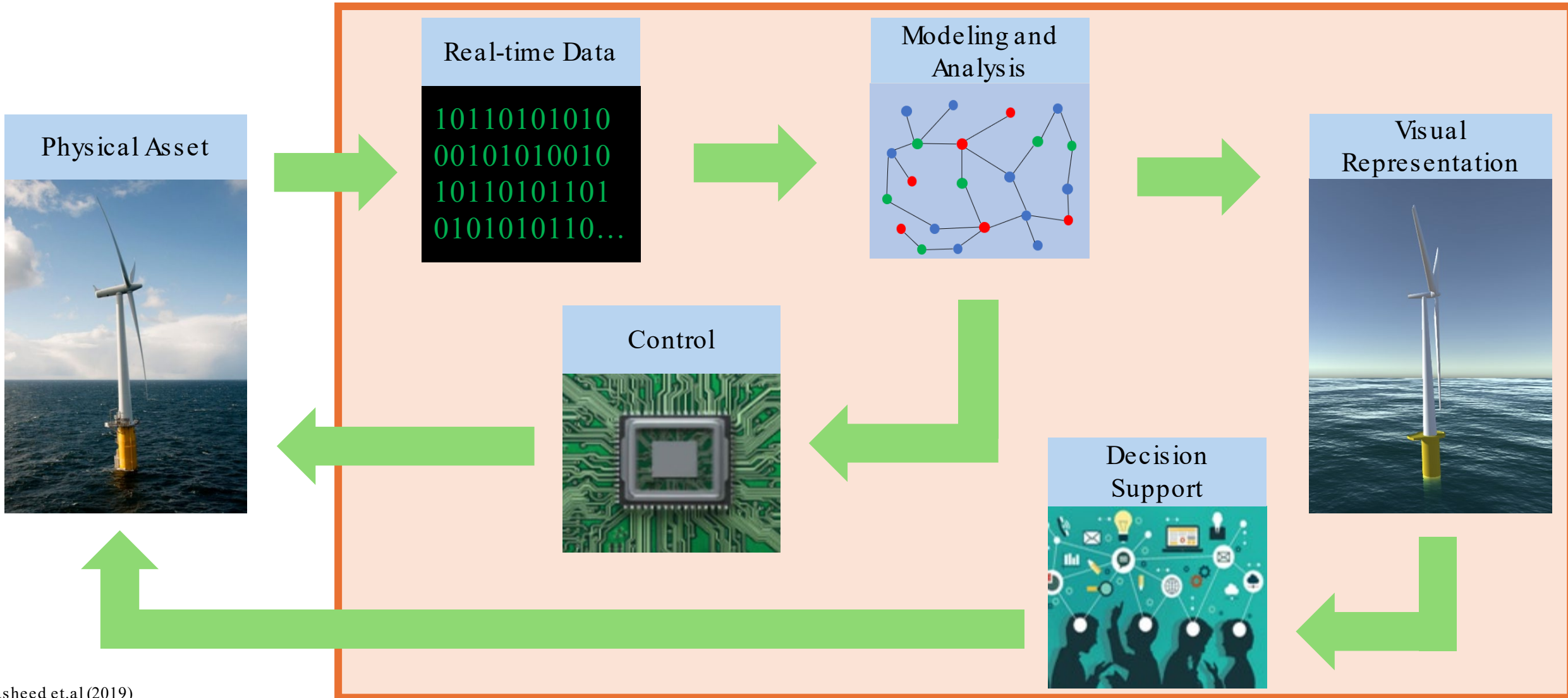
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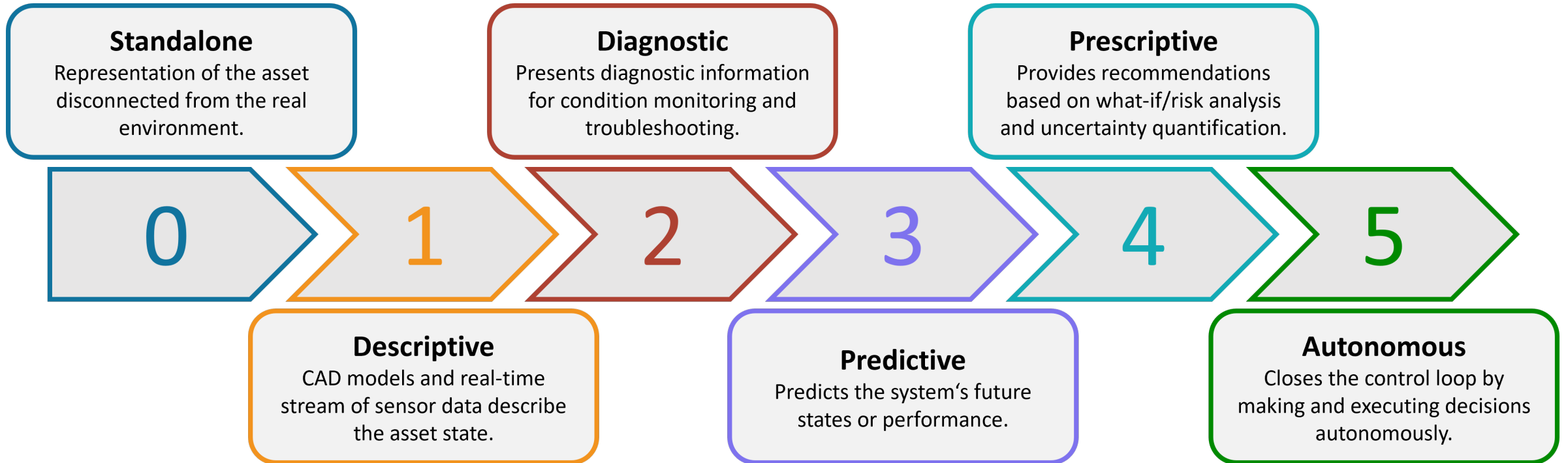
# Digital Twin - A tool to communicate

- A virtual representation of a physical object enabled through real-time data and models [...].
- Origins in engineering
- Strong applications for planning, data aggregations, operations, etc.
- Can be adapted to education and public outreach

# Digital Twin



# Capability Level Scale

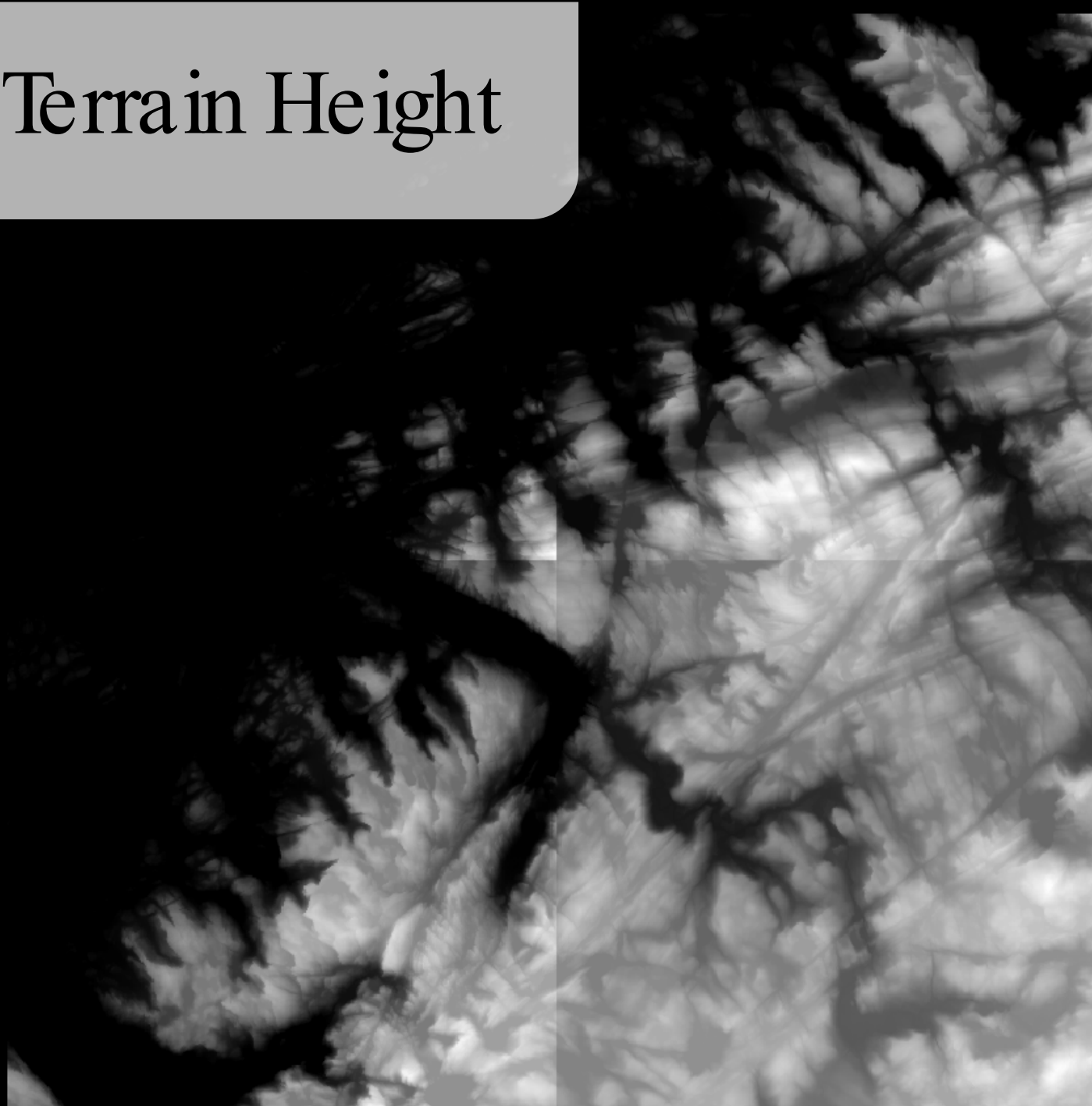


# User Cases

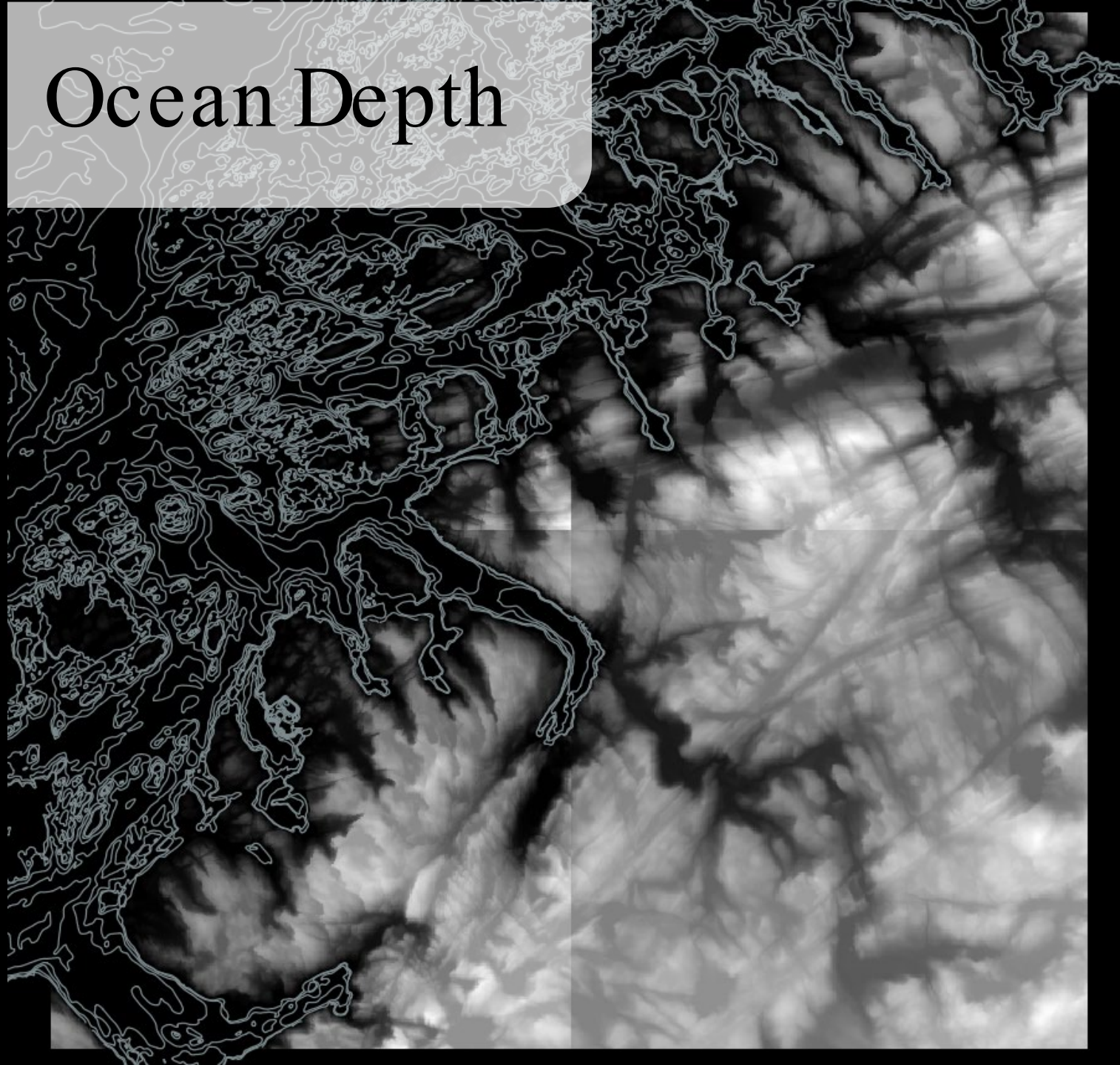
- 3 user cases (Bessakerfjellet, Zephyros, generic farm)
- 3d interface integrated for desktop and virtual reality headsets
- Terrain, land cover, turbines, components, etc.

# Integration

# Terrain Height

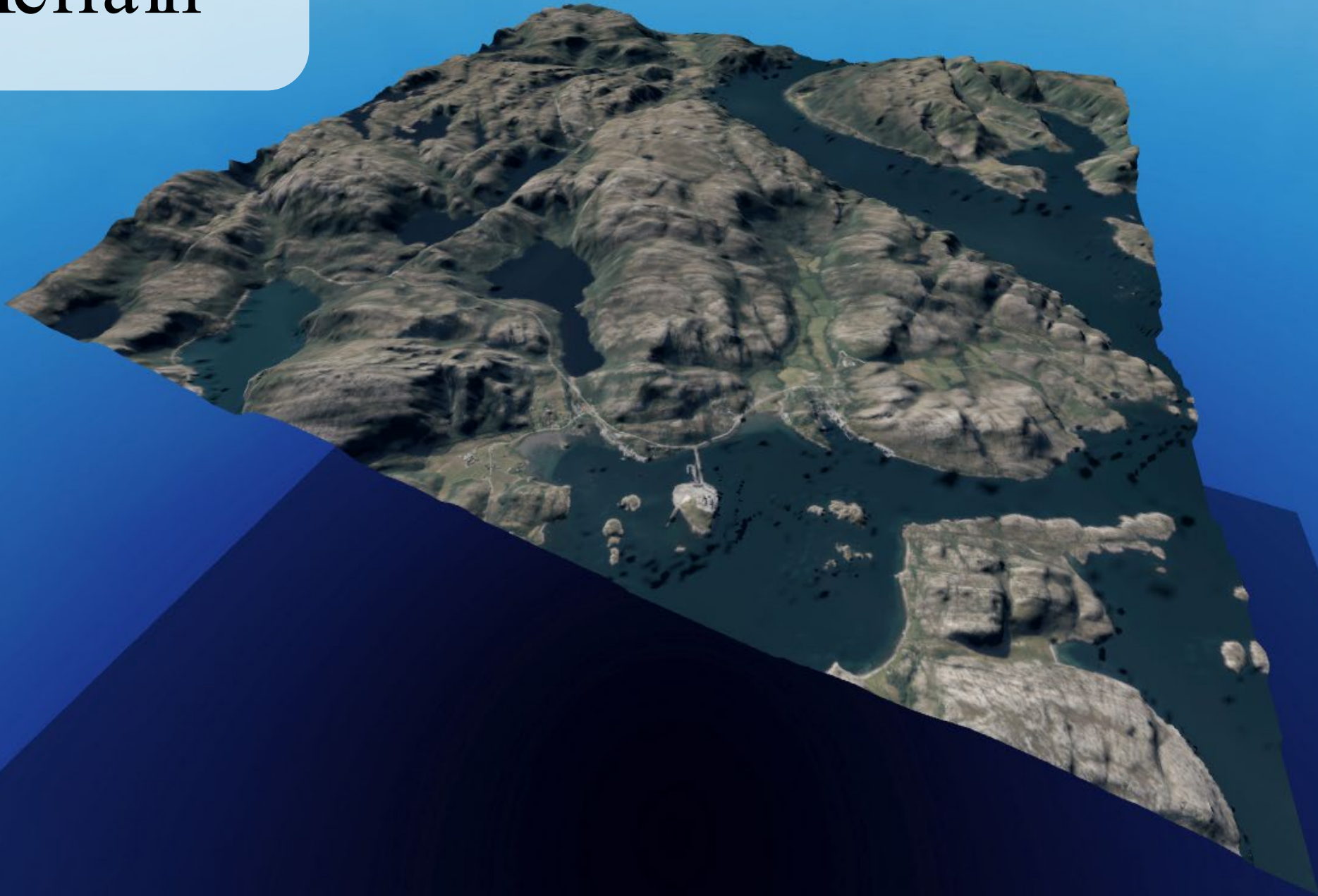


# Ocean Depth

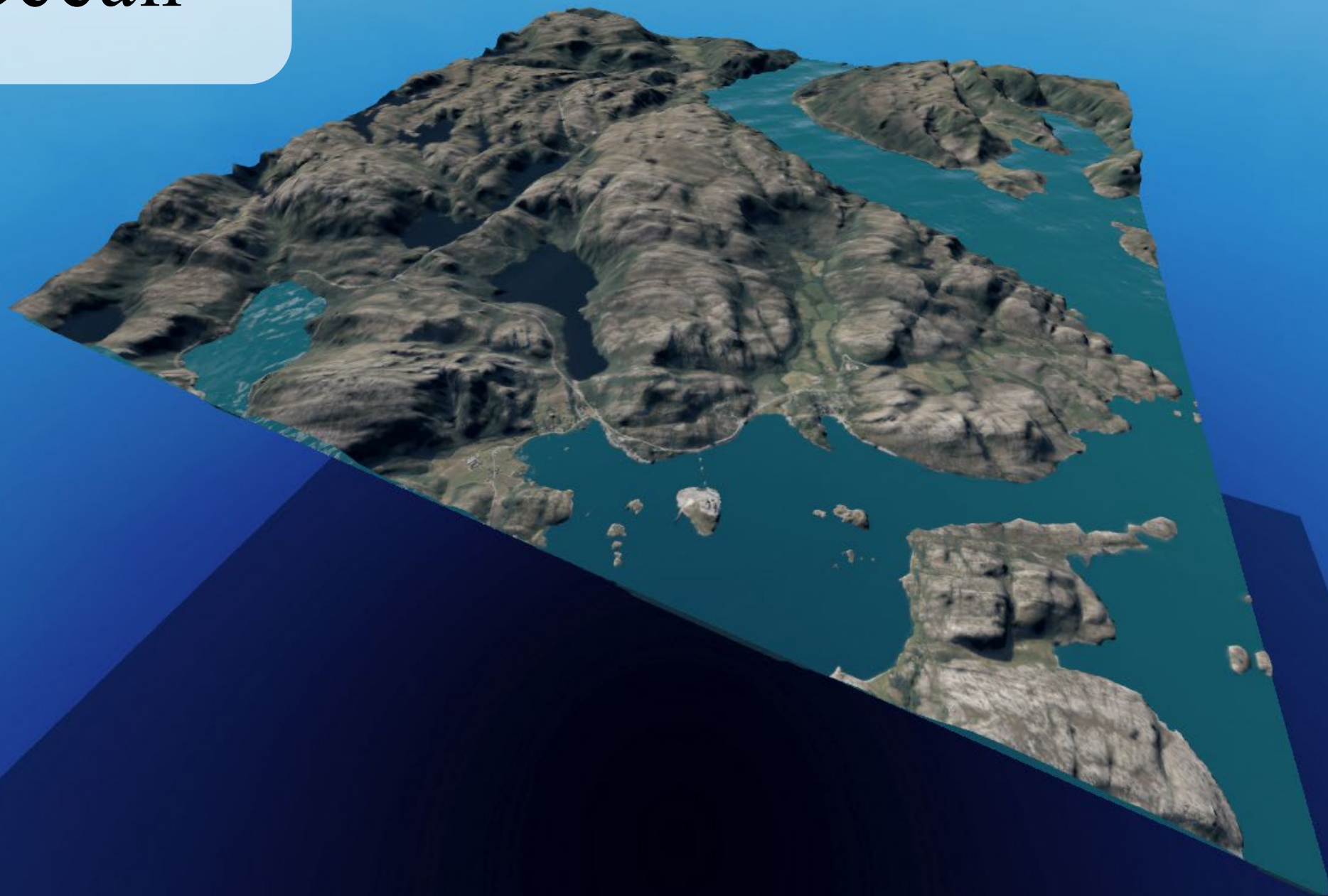




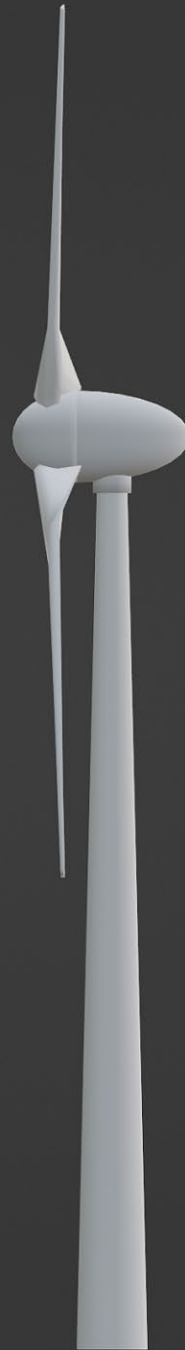
# Terrain



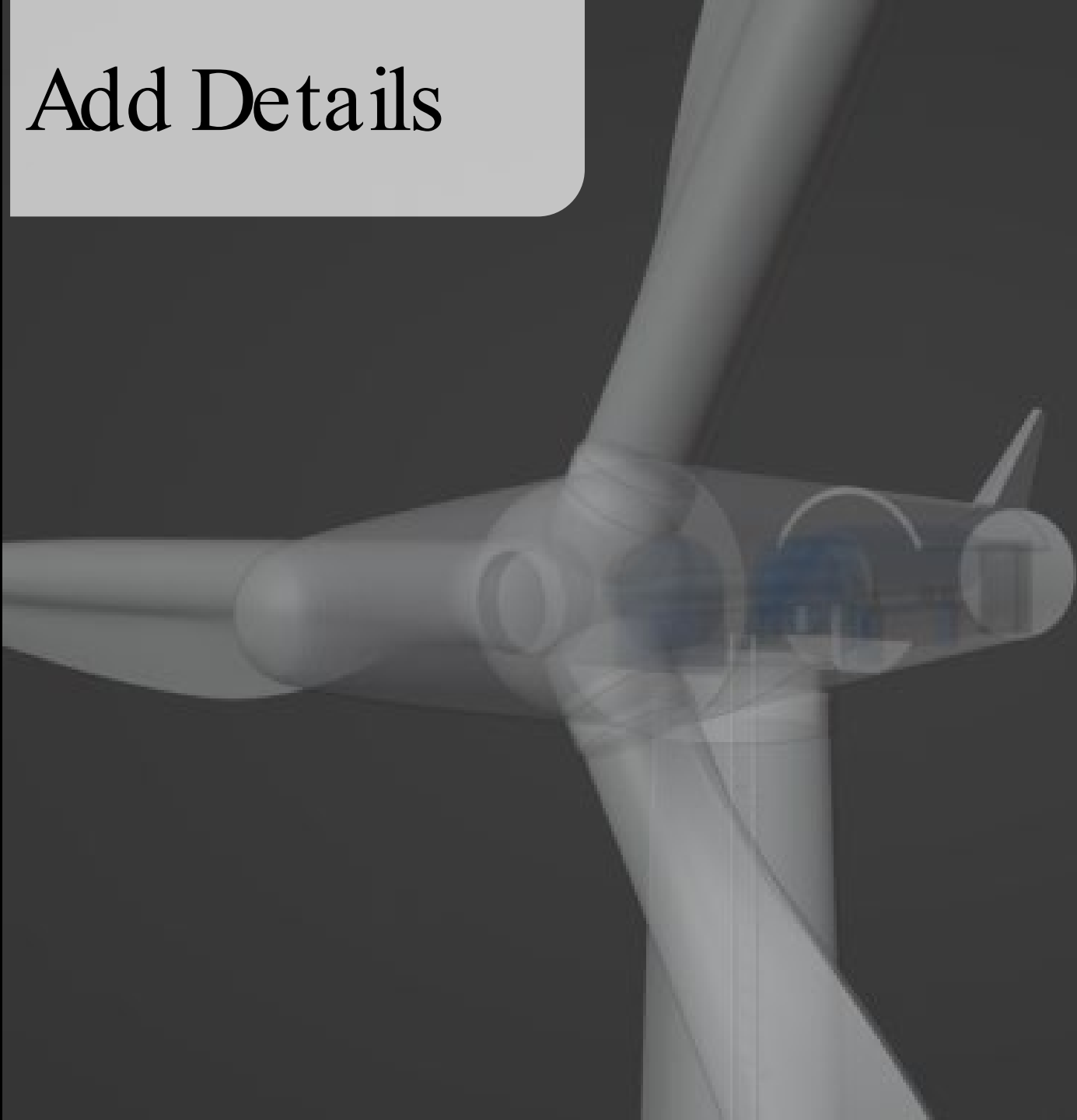
# Ocean



# Turbine Model



Add Details



Add inspector, ambient, etc.



# Applications

# Scenic Impact



# Scenic Impact

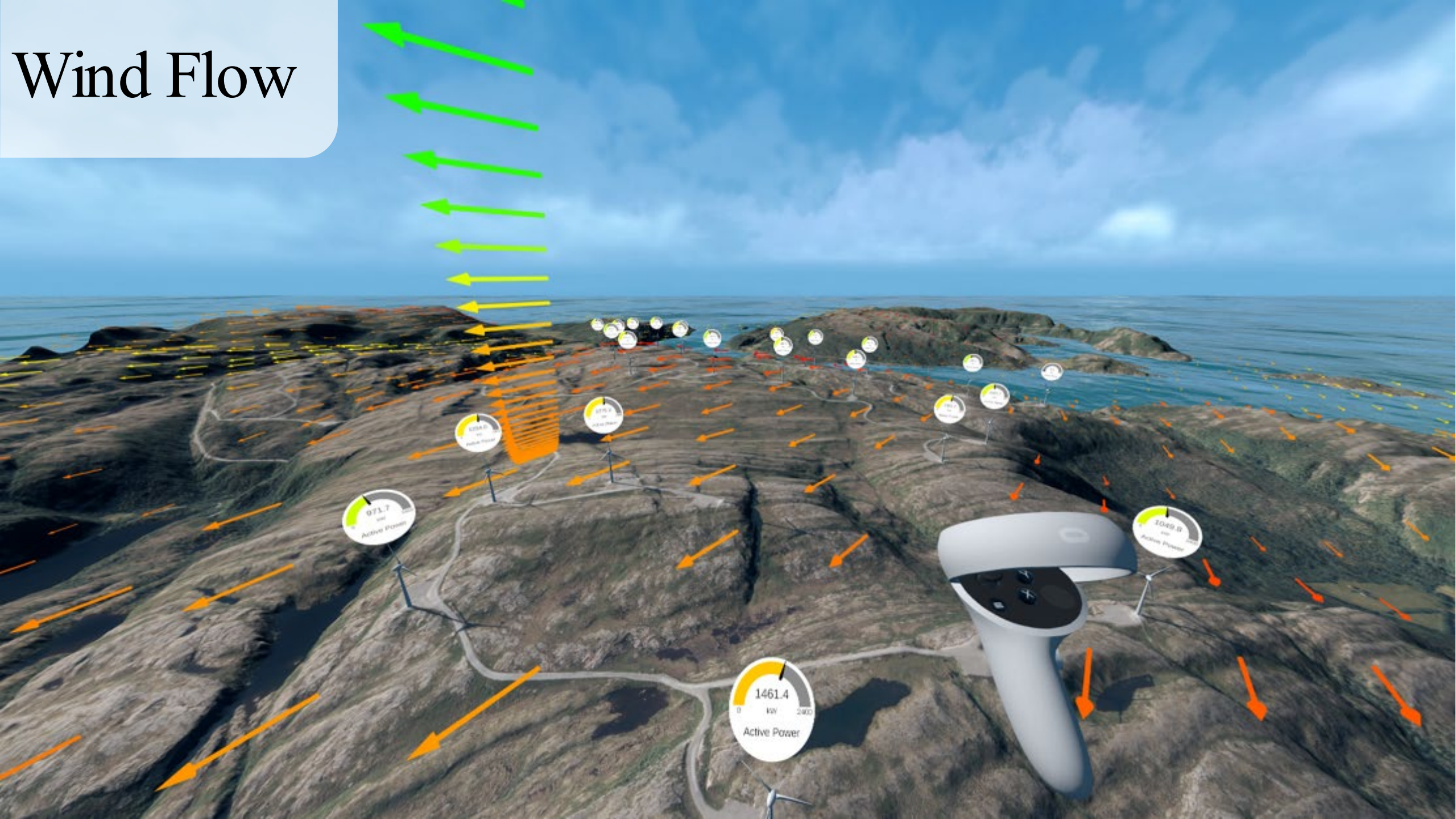




# Shadows



# Wind Flow



# Blade Smear



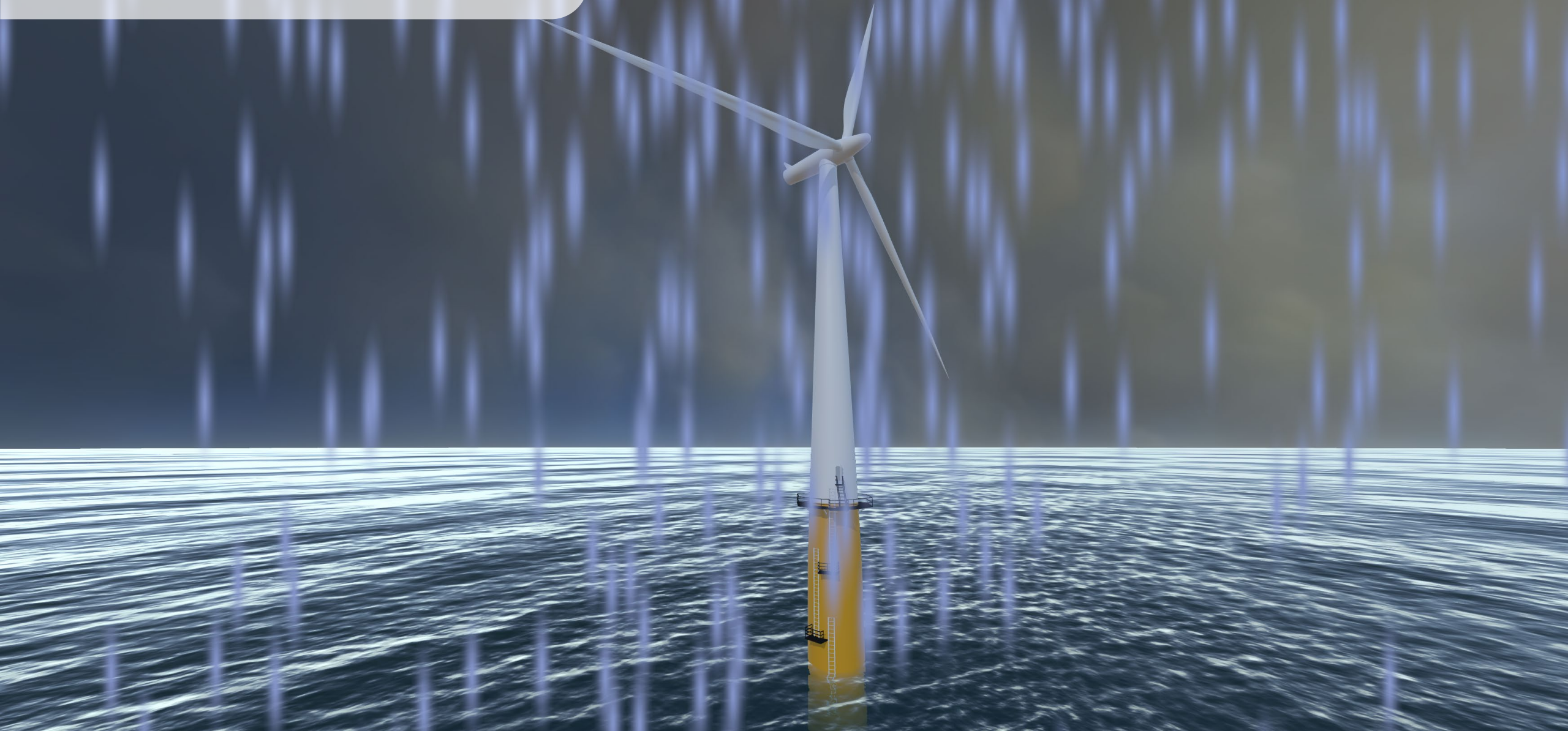
# Bird Damage Mitigation



Bird damage  
mitigation -  
A gamified learning  
experience  
Work in  
collaboration with  
EiT master  
students



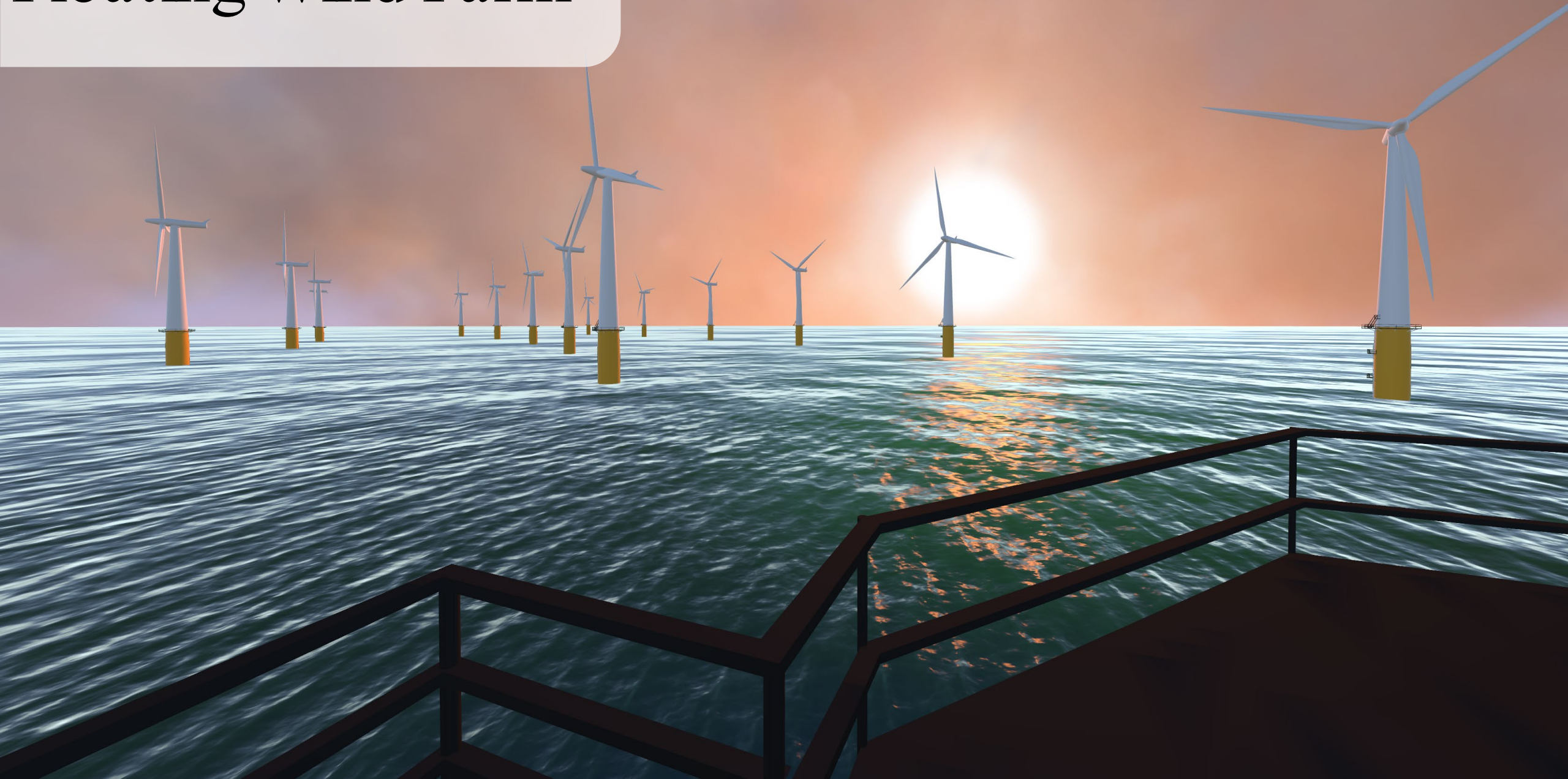
# Floating Offshore



# Floating Offshore

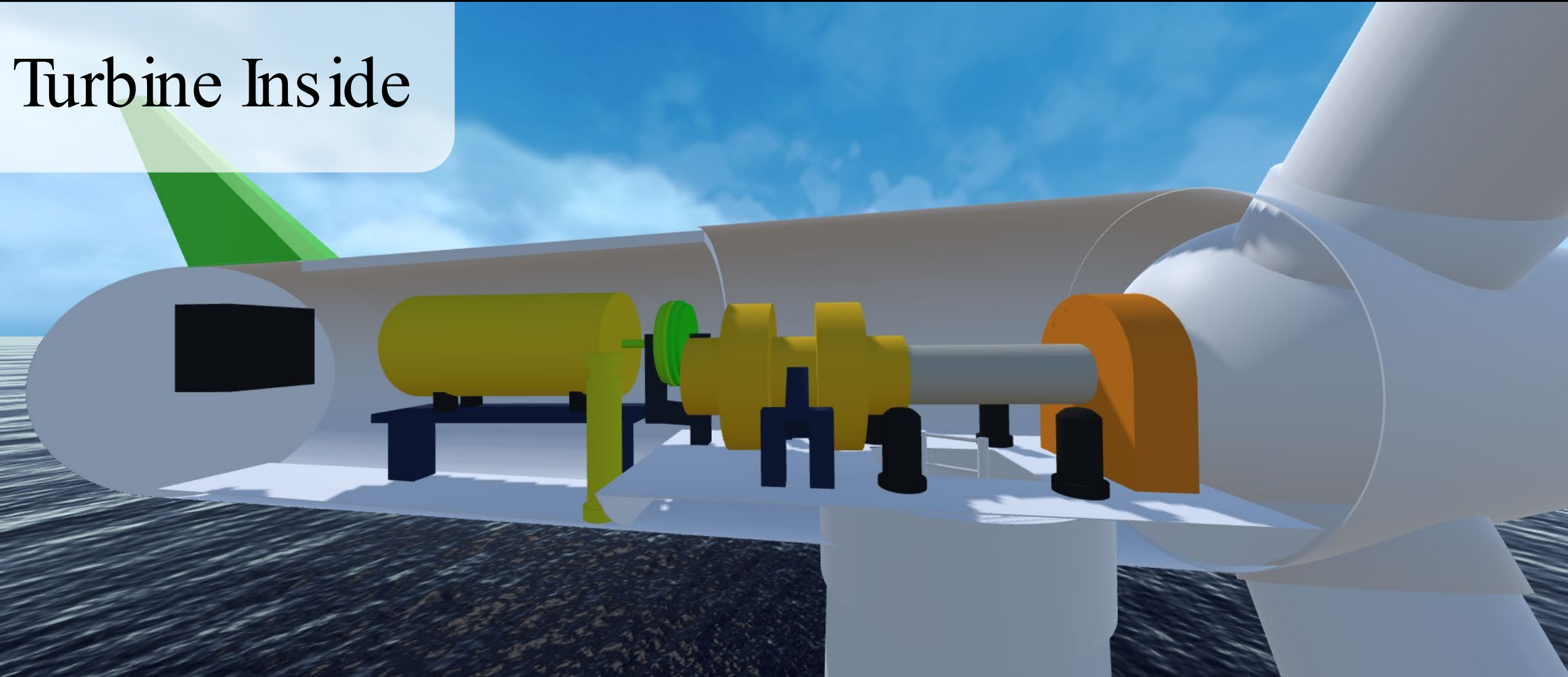


# Floating Wind Farm

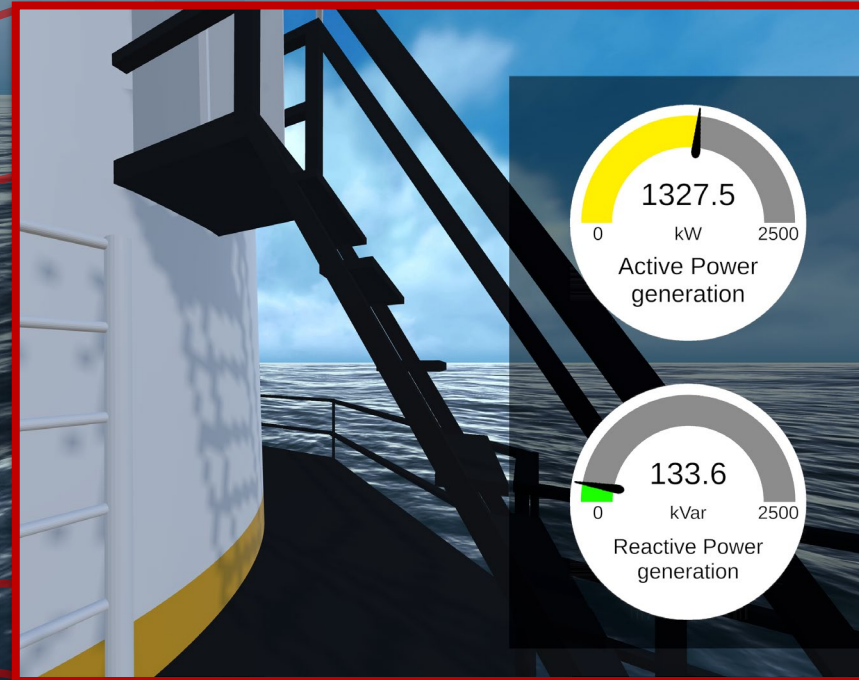
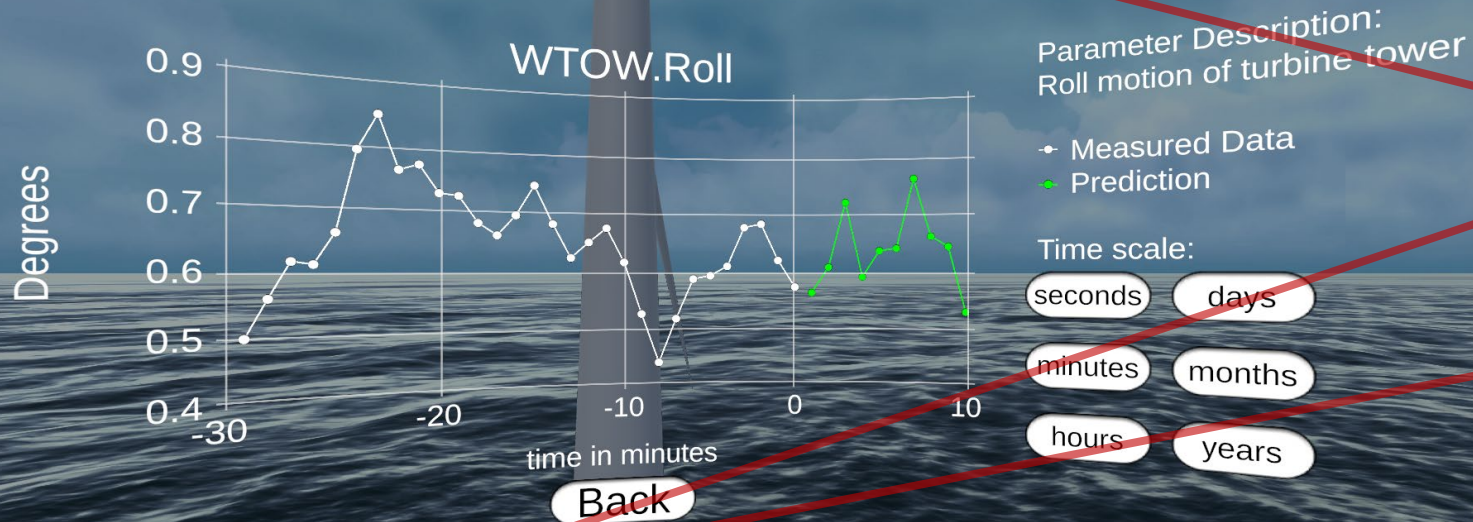
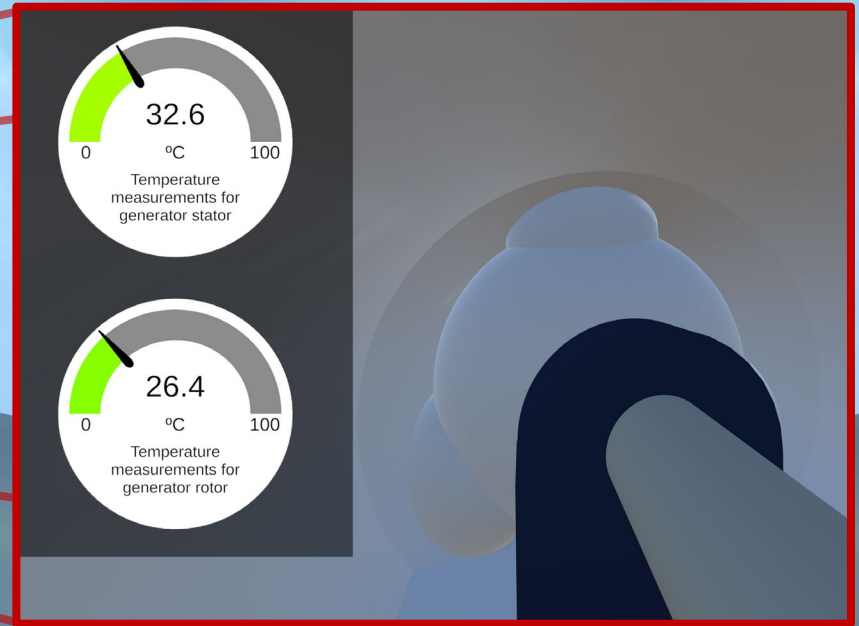




# Turbine Inside

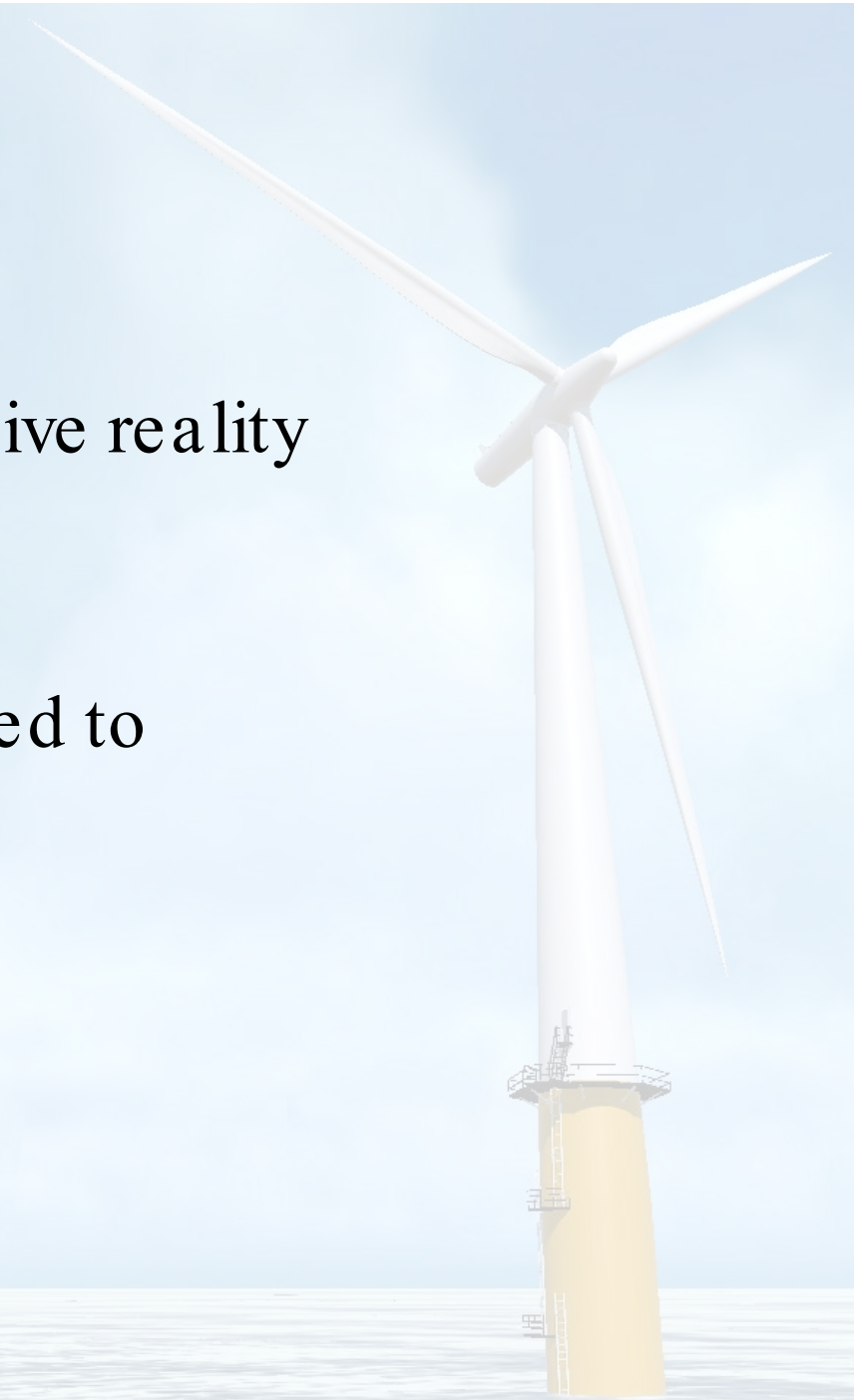


# All the Data



# Need for validated models

- Generative artificial intelligence and immersive reality make it easy to fake results
- Digital twins need to be validated and certified to ensure the correctness of integrated models



# Conclusion and Outlook

- Digital twins are strong visualization and communication tools for public outreach and education
- Easy to use, but also easy to misuse
- Need to be validated

## Future Research:

- Integration of more features
- Quantitative studies

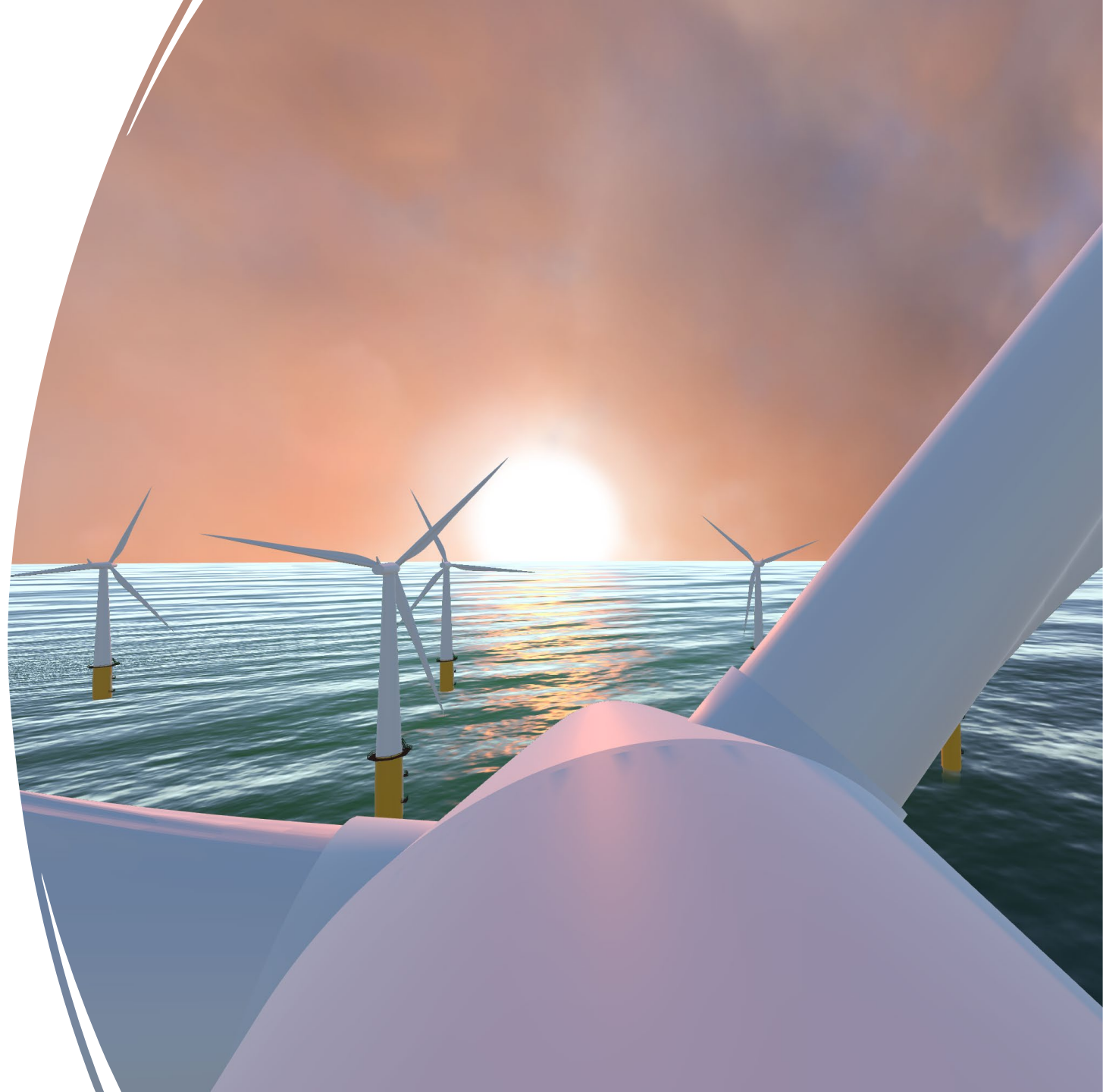


# Thank you for your attention

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# Contact & References

Contact: [florian.stadtman@ntnu.no](mailto:florian.stadtman@ntnu.no)

- **Digital Twin:** Stadtmann, Florian; Rasheed, Adil; Kvamsdal, Trond; Johannessen, Kjetil Andre; San, Omer; Kölle, Konstanze. (2023) [Digital Twins in Wind Energy: Emerging Technologies and Industry-Informed Future Directions. \*IEEE Access\*](#)
- **Offshore:** Stadtmann, Florian; Wassertheurer, Henrik Gusdal; Rasheed, Adil. (2023) [Demonstration of a Standalone, Descriptive, and Predictive Digital Twin of a Floating Offshore Wind Turbine. \*Proceedings of the ASME 2023 42nd International Conference on Ocean, Offshore and Arctic Engineering. Volume 8: Ocean Renewable Energy\*](#)
- **Onshore:** Stadtmann, Florian; Rasheed, Adil; Rasmussen, Tore. (2023) [Standalone, Descriptive, and Predictive Digital Twin of an Onshore Wind Farm in Complex Terrain. \*Journal of Physics: Conference Series \(JPCS\)\*](#)
- **Data Integration:** Stadtmann, Florian; Mahalingam, Hary Pirajan; Rasheed, Adil. (2023) [Data Integration Framework for Virtual Reality Enabled Digital Twins. \*IEEE IEEE 9th World Forum on Internet of Things\*](#)