

Hybrid Wind Turbine Power Model for Efficient Operation and Maintenance

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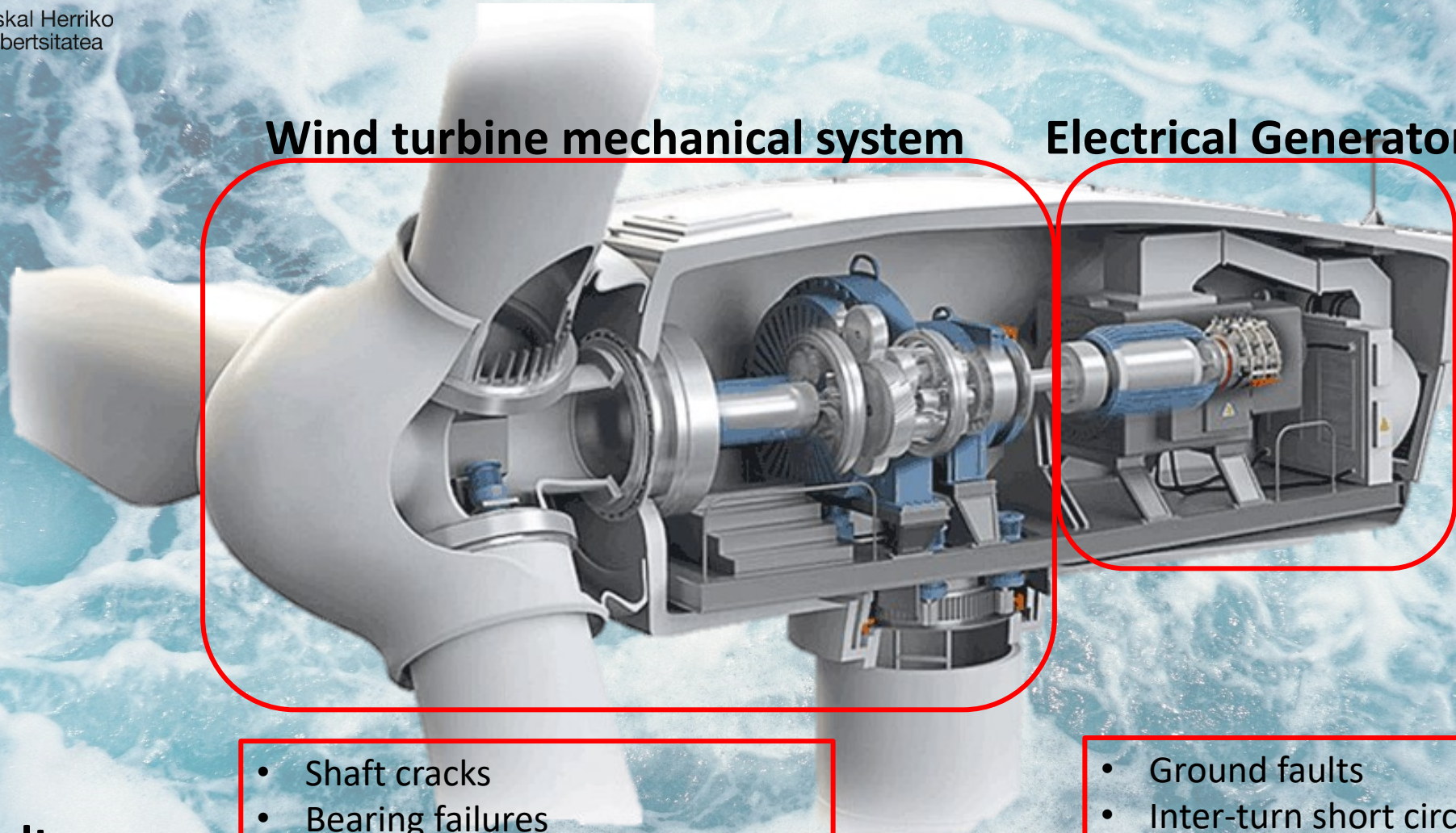
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Wind turbine mechanical system

Electrical Generator



- Shaft cracks
- Bearing failures
- Vibrations
- Overheating

- Ground faults
- Inter-turn short circuits
- Winding Insulation Failure
- Converter/Inverter Faults

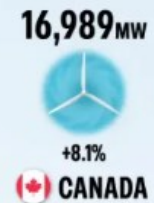
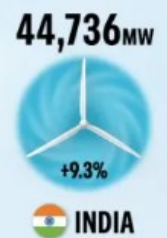
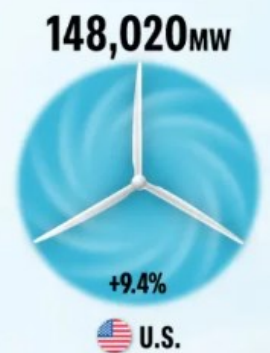
Typical Faults



WIND INSTALLATIONS AS OF 2023

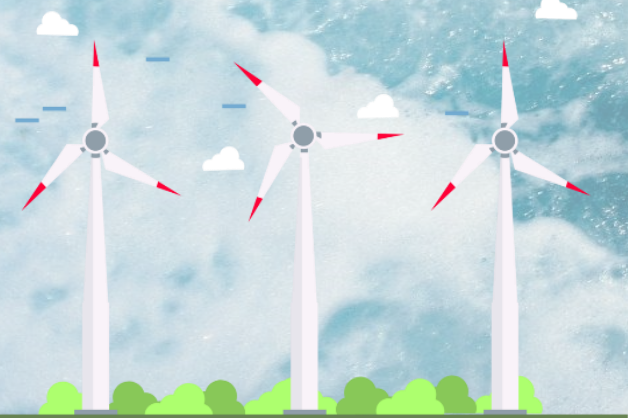
441,895MW TOTAL INSTALLED WIND TURBINE CAPACITY IN MEGAWATTS (MW)

SHADING BASED ON ANNUAL GROWTH RATE (2013-2023)
0% 5% 10% 15% 20% 25% 30%



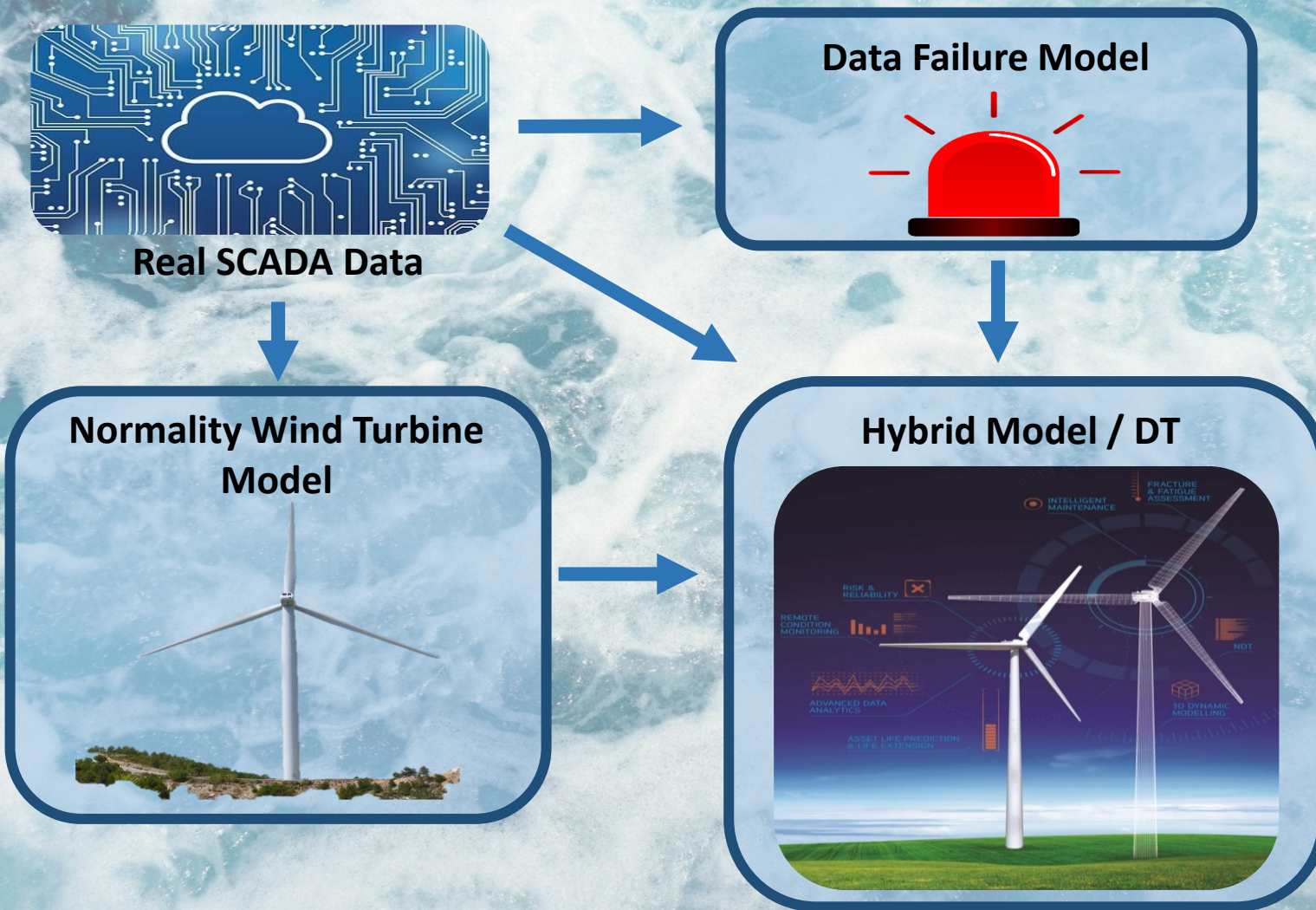
Capacity figures include both onshore and offshore wind are on an alternating current basis.

Source: Energy Institute, 2024 Statistical Review of World Energy





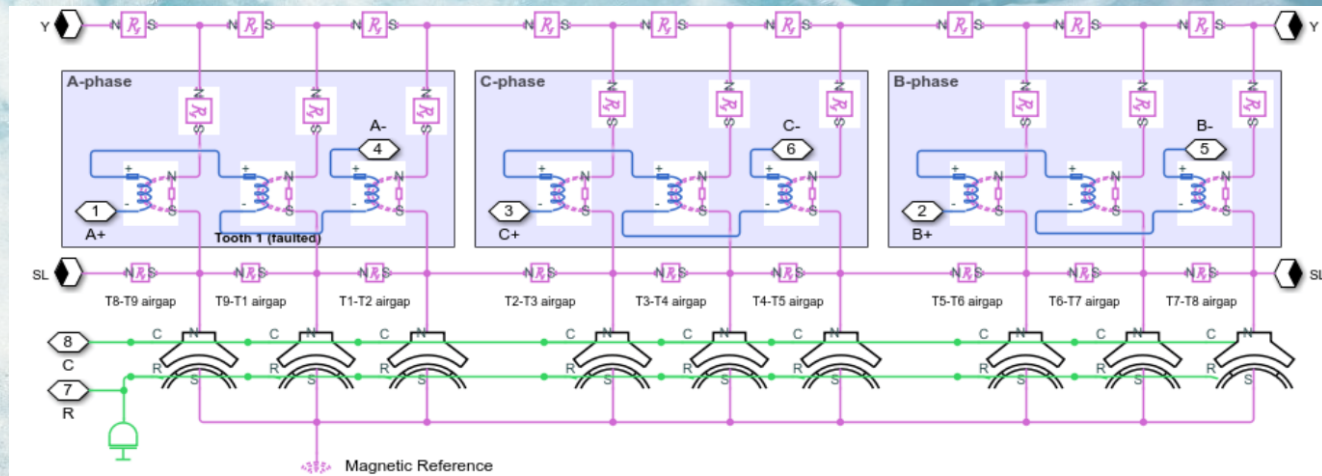
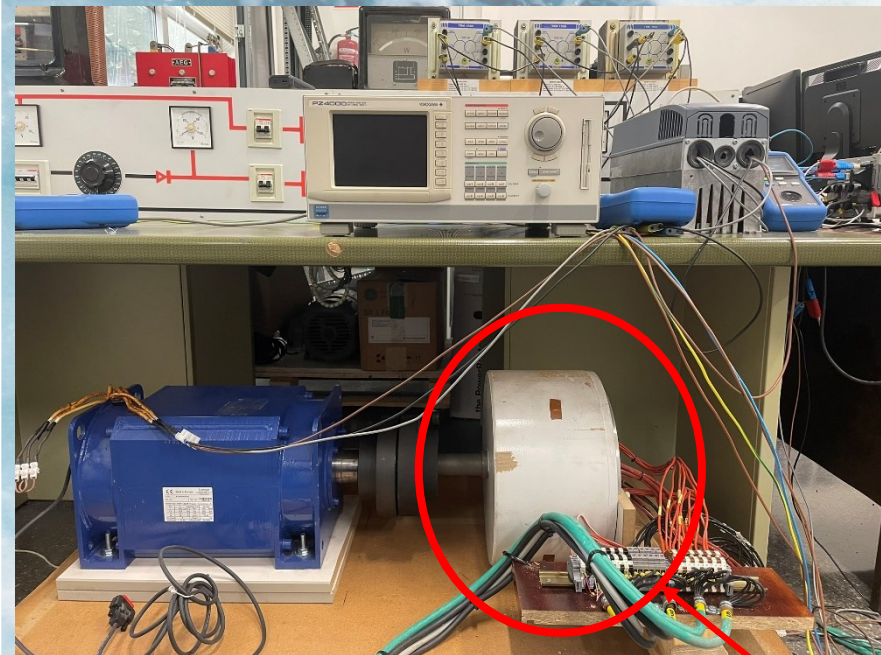
Digital Model





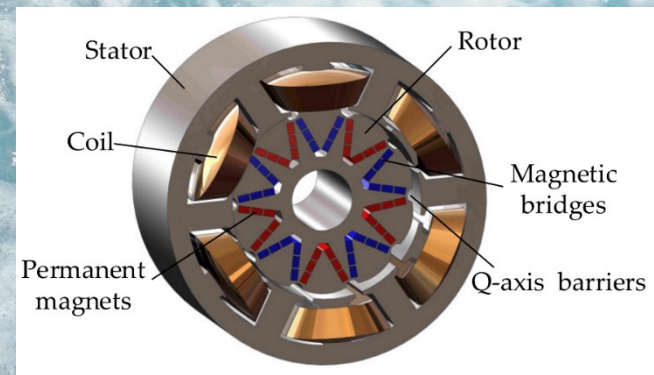
Test Bench

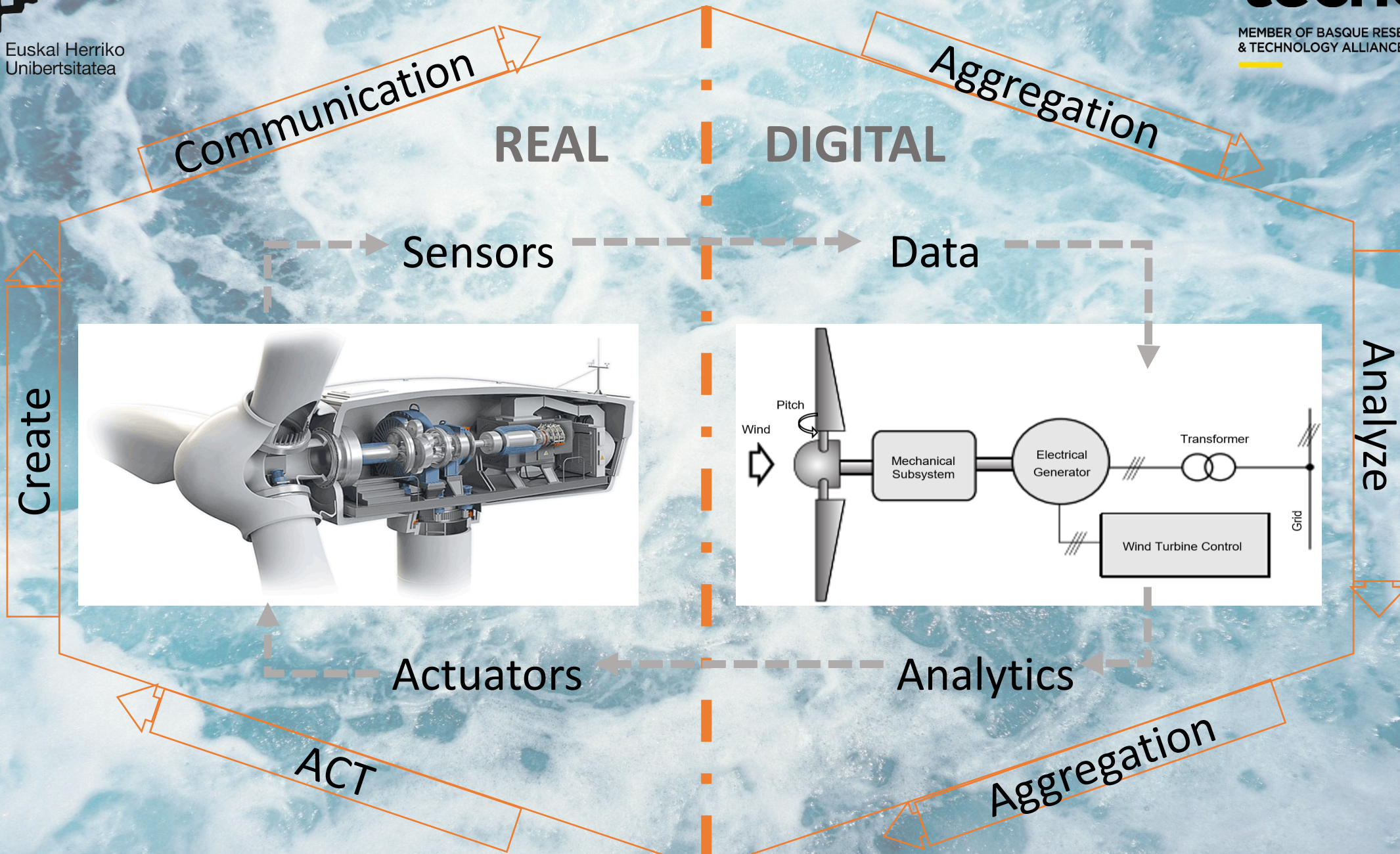
Digital Model



Object of Study

Student of the Object





Communication

REAL

DIGITAL

Aggregation

Sensors

Data

Create

Analyze

Actuators

Analytics

ACT

Aggregation



So far, this research has led to several outcomes:

- Two patents have been developed related with electrical fault detections
- Three papers have been presented at international conferences
- I have completed an international research visit
- And we are currently in the process of submitting two journal articles for publication



Thank you for your attention

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