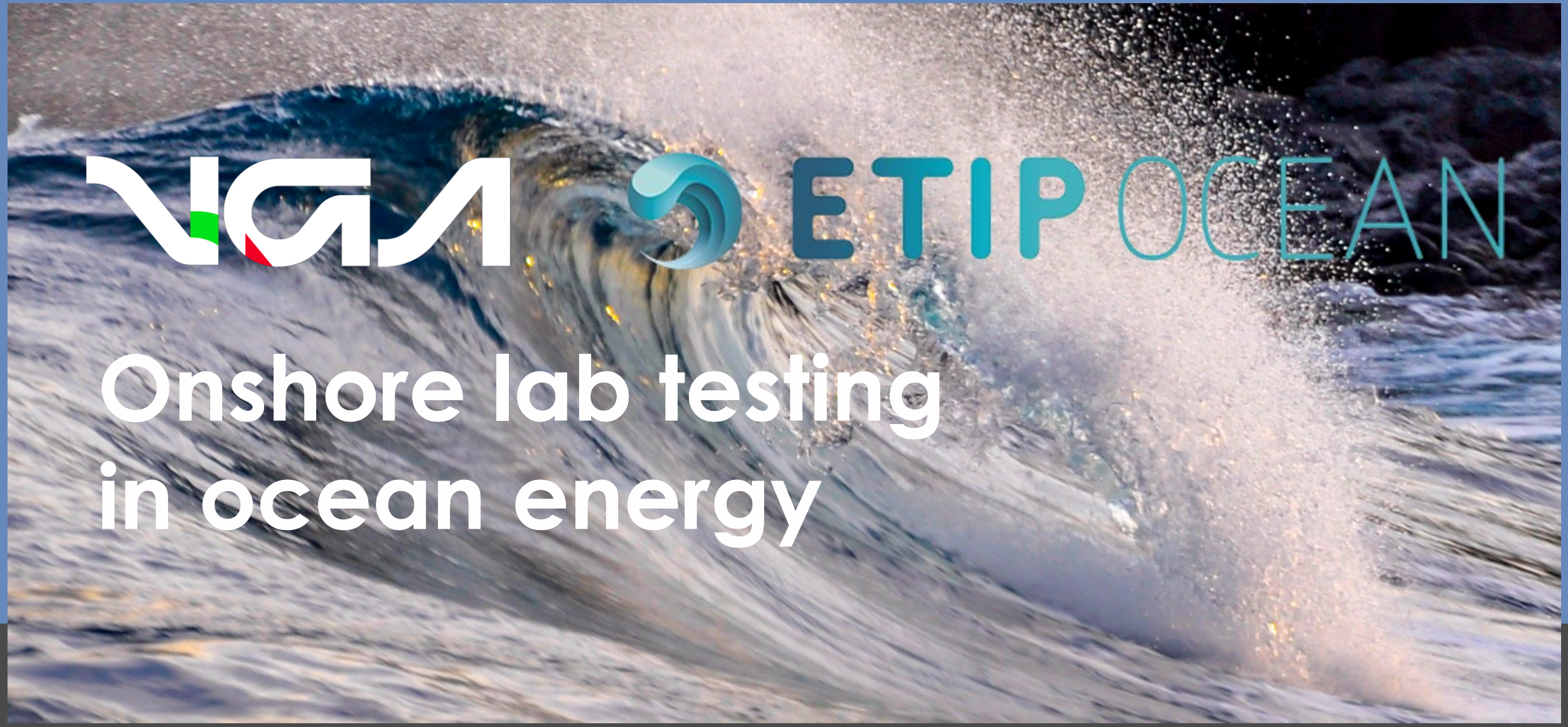


Onshore lab testing in ocean energy

Ocean Energy Testing Facilities – ETIP Ocean webinar

Giacomo Alessandri, Senior R&D Engineer, VGA S.r.l.

18/02/2025

Onshore lab testing in ocean energy

Agenda

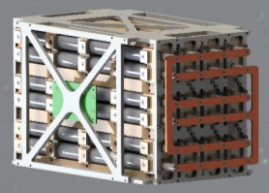
- VGA introduction
- Challenges in ocean energy
- VGA's SWEET lab
- Testing and assessment methodologies: HIL, Dual HIL and Accelerated Life Testing
- Upgrade/expansion plans

Get your second wind

PRODUCTS

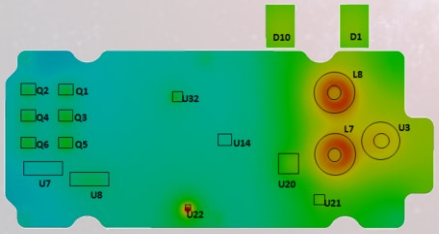
- Test rigs
- Energy Storage Systems
- Robotic Arms & Actuation
- Ground Service Equipment

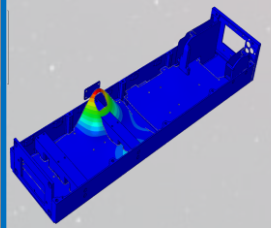
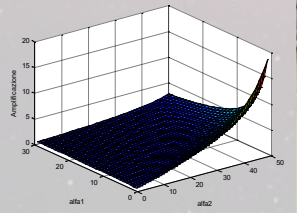
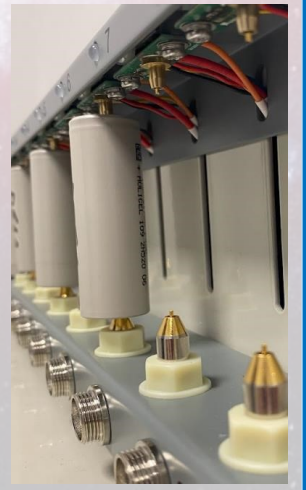



SERVICES

- Design
- **Testing**
- Qualification
- Manufacturing



R&D

- Aerospace Electrification
- **Ocean Energy**
- Energy Storage
- Patents



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Challenges in ocean energy

- **Variable input conditions** → performance validation
- **High peak-mean load ratio** (wave energy mainly) → oversizing and control optimization
- **Harsh environment** → corrosion, biofouling
- **High deployment & maintenance costs** → few chances of iterating concepts at sea
- **Lack of specific componentry for ocean applications** → required R&D
- **Competition** with other **more-advanced renewables** (wind and PV) → few time to reach market

Onshore lab testing in ocean energy

Comprehensive onshore lab testing

=

reducing risks at reasonable time & costs

(especially prior at-sea deploymets)

Onshore lab testing in ocean energy

IMPACT → SWEET LAB

Structured Wave Energy Equipment Test Lab

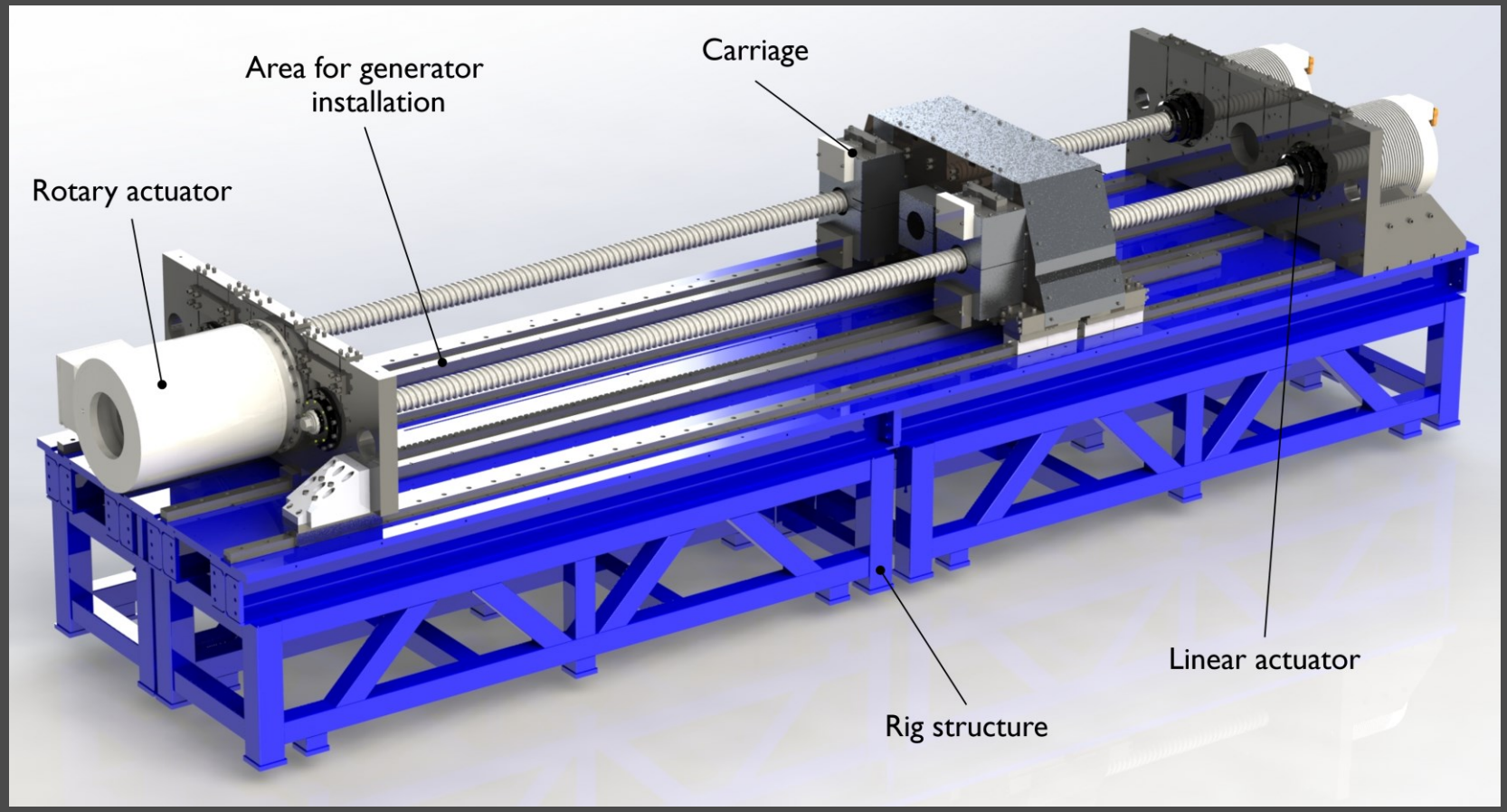
Targeted technology evaluation areas
(ref. IEA OES International Evaluation and Guidance Framework for Ocean Energy Technology):

- Power conversion
- Controllability
- Reliability
- Survivability
- Maintainability
- Affordability

Onshore lab testing in ocean energy

Drivetrain test rig

- Mechanical drives
- Electrical generators
- Power converters
- Control systems
- Storage systems
- Grid-interface units



Drivetrain test rig layout. Find more at https://vga-srl.webflow.io/news-post/discover-sweet-lab

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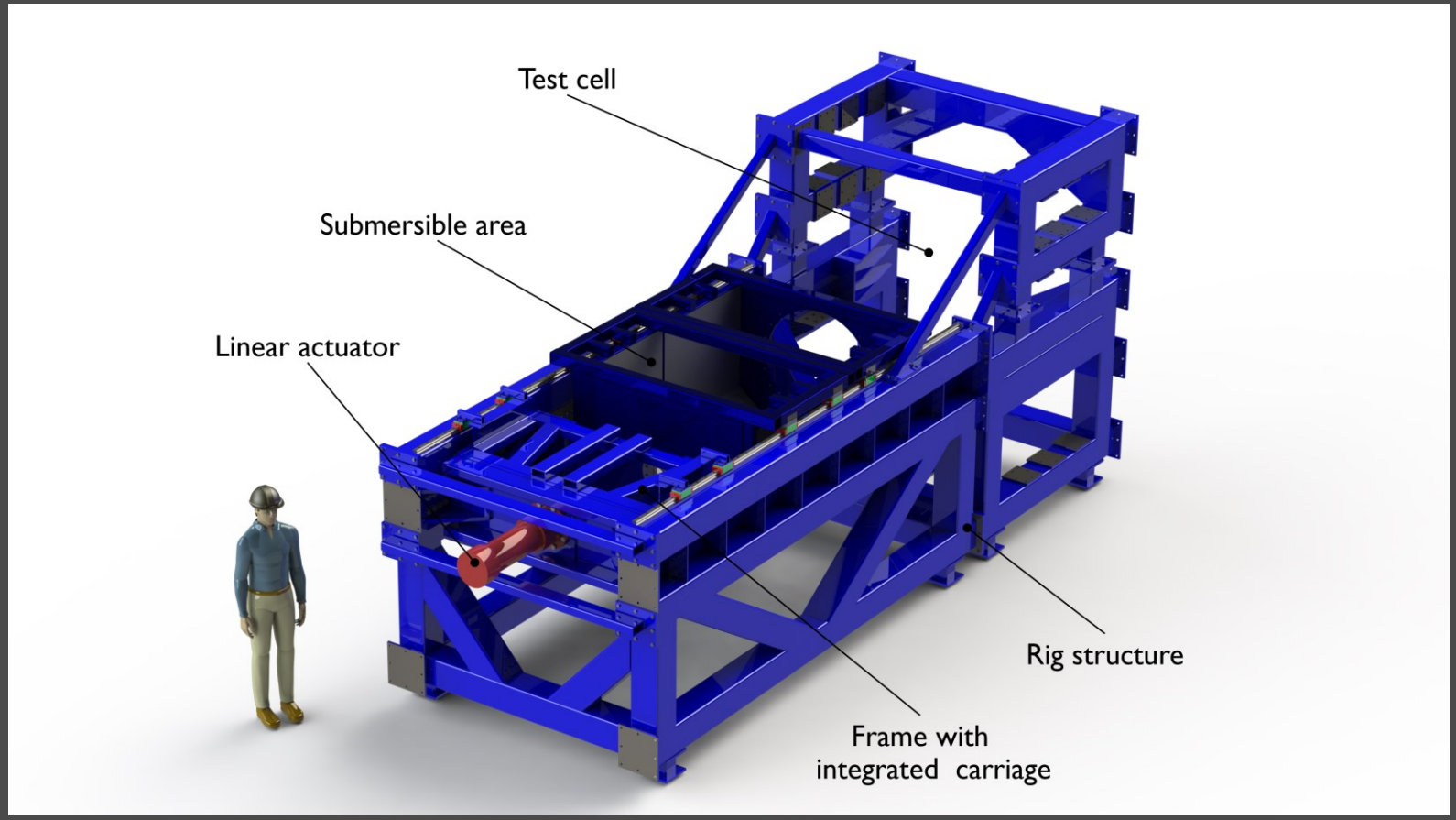
Structural components test rig

- (part of) device hull
- Mooring lines
- Power cables
- Sealing systems
- Mechanical interfaces



Structural components test rig layout. Find more at https://vga-srl.webflow.io/news-post/discover-sweet-lab

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Testing and assessment methodologies

A structured process in which **test facility** and **ocean energy developer collaborate** for:

- Understanding **customer needs and development status** → identifying subsystems/components to test
- Agreeing on test plan:
  - Baseline tests: characterization of component/subsystem, proof of functionality
  - "Advanced" tests: targeting one or more technical evaluation areas
- Checking if **target KPIs are reached** at end of tests → if not, why?
- **Applying standards** throughout the process

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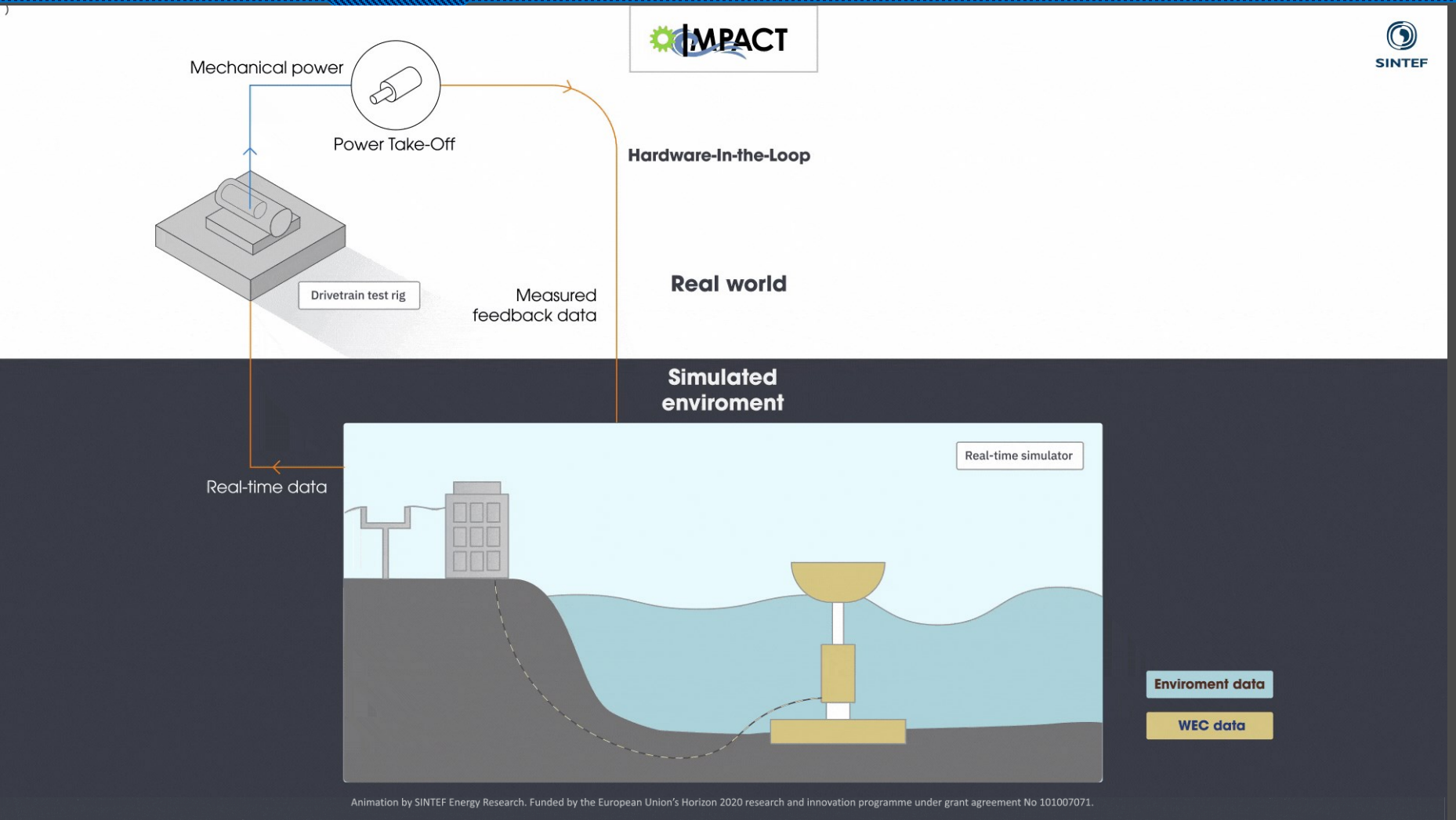

Hardware-In-the-Loop (PTO example)

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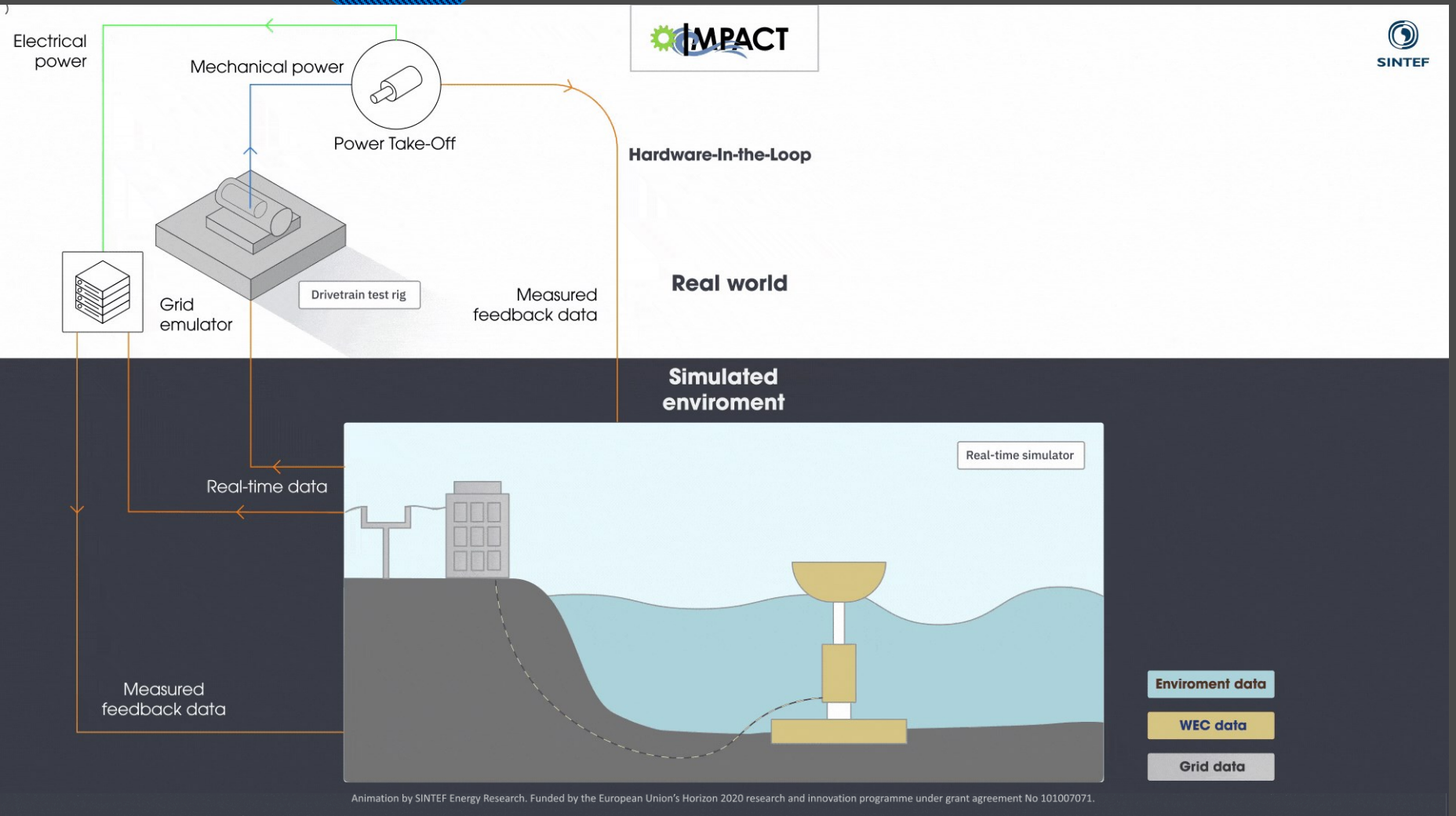

Hardware-In-the-Loop (PTO example)

- Assessing the **performance and functionality of the subsystem under representative loads**
- **increasing the fidelity** of the numerical model, by **integrating the characterized hardware**
- Verifying the **response of the overall WEC numerical model** integrating the real subsystem

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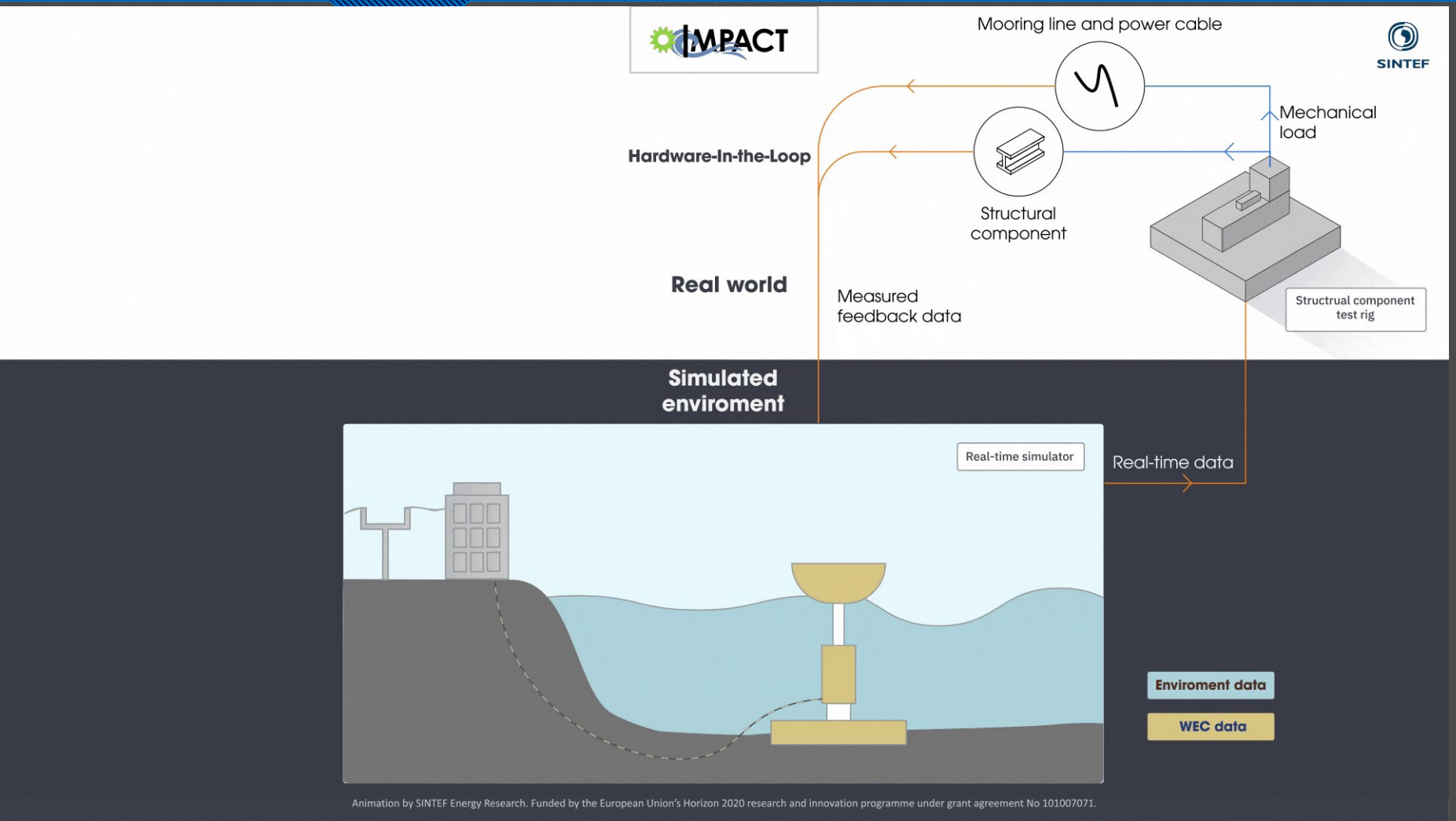

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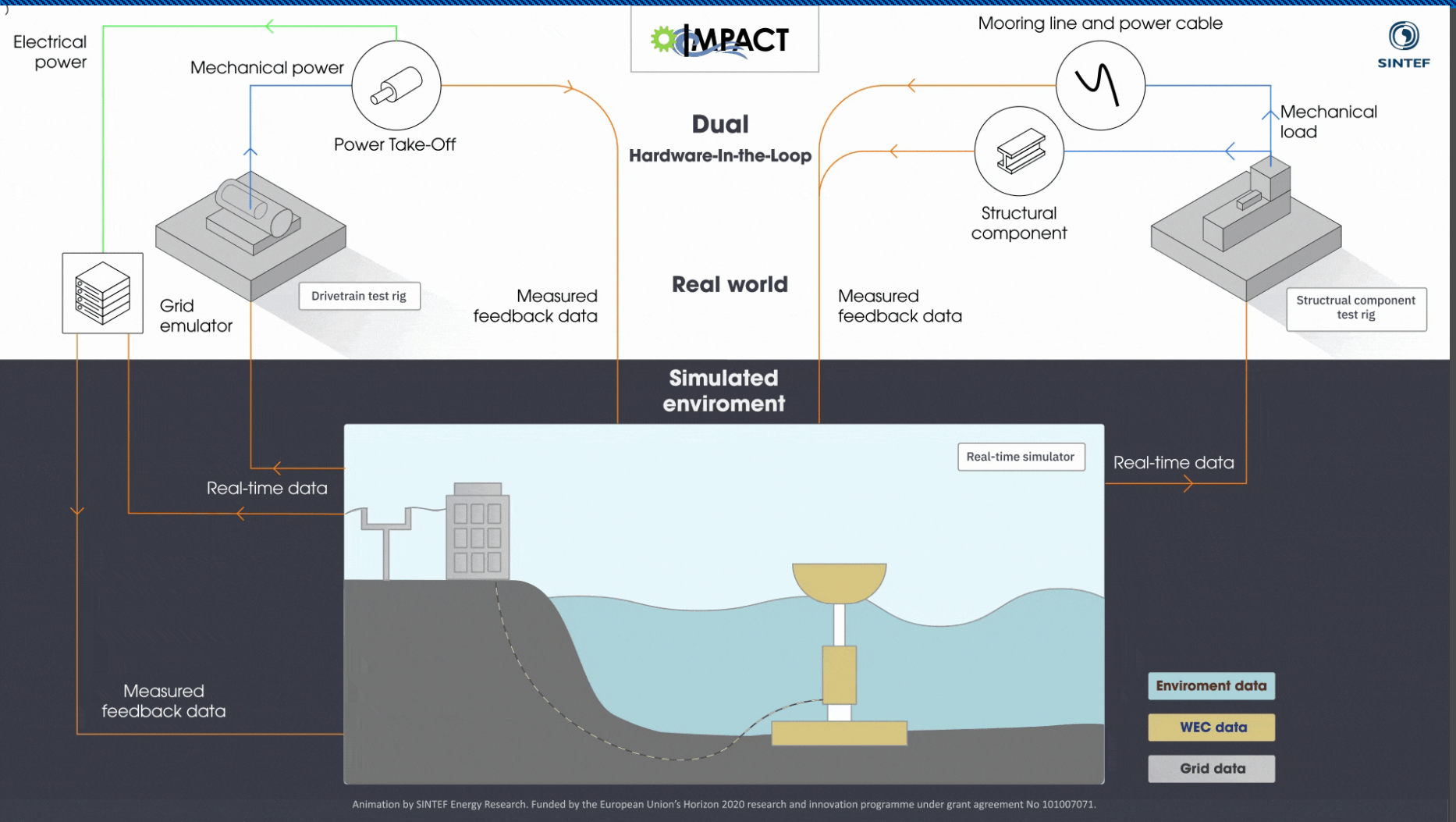


Animation by SINTEF Energy Research. Funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 101007071.

Dual Hardware-In-the-Loop (combining both rigs)

- Identifying and characterizing **interdependences between subsystems**
- Verifying the **response of the overall WEC model** integrating **two real subsystems**
- Furtherly **increasing the fidelity of the numerical model**
- Studying **critical key load paths** e.g. from PTO to seabed (through moorings)

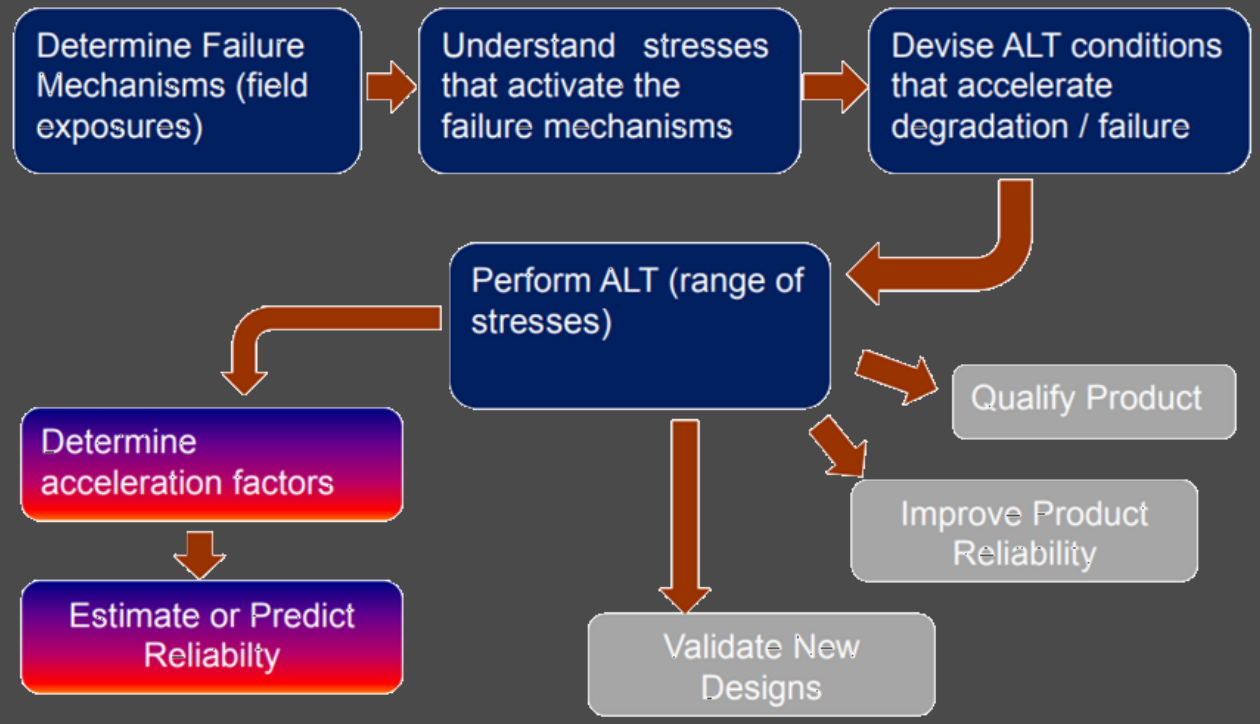
Dual HIL test setup. Find more at https://www.impact-h2020.eu/about/dual-hardware-in-the-loop-dhil/

Onshore lab testing in ocean energy

Accelerated Life Testing (ALT)

Assessing reliability of a subsystem/component in a **reduced amount of time**

- Early TRL → identify design issues or main failure modes
- High TRL → define key parameters (e.g. MTBF or MTTF), identify defects
- Test not easy to set up and carry out: requires a **deep knowledge of the component** and how different type of **stresses** (use rate, load, environmental) **affect its degradation**.
- **Higher costs** than other tests
- Relevant **benefits**:
  - **results specific for your product/application**.
  - Useful for **validating/calibrating O&M models**.



Sorensen, R. (2015). Corrosion and Accelerated Testing. Sandia National Laboratories. Available online at: https://www.nrel.gov/pv/assets/pdfs/2015_pvmrw_132_sorensen.pdf

Onshore lab testing in ocean energy

Future plans

- Drivetrain rig:
  - Increase power of grid simulator (e.g. actuation of PTO)
- Structural components rig:
  - Add interfaces for specific tests (e.g. universal joint for mooring lines and dynamic power cable multi-bending)
- ISO 17025 (Certification for competence of testing and calibration laboratories)
- Keep all the systems well maintained

VGA's SWEET Lab is accessible through the RISEnergy project: https://risenergy-project.eu/ri/ucc-vga-vgatl/

IMPACT

Innovative Methods for wave energy Pathways Acceleration through novel Criteria and Test rigs

This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101007071

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