STRUCTURED INNOVATION

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Wave Energy Roadmapping Workshop, Plymouth

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wave energy SCOTLAND

HIE
Highlands and Islands Enterprise
Iomairt na Gàidhealtachd 's nan Eilean

WES Overview

Established in November 2014 as a subsidiary of Highlands and Islands Enterprise

5 competitive programmes
- Power Take-Offs
- Wave Devices
- Structural Materials
- Controls Systems
- *Quick connection Systems*

200 Organisations
88 Projects

Developing cost competitive wave technology

wave energy SCOTLAND

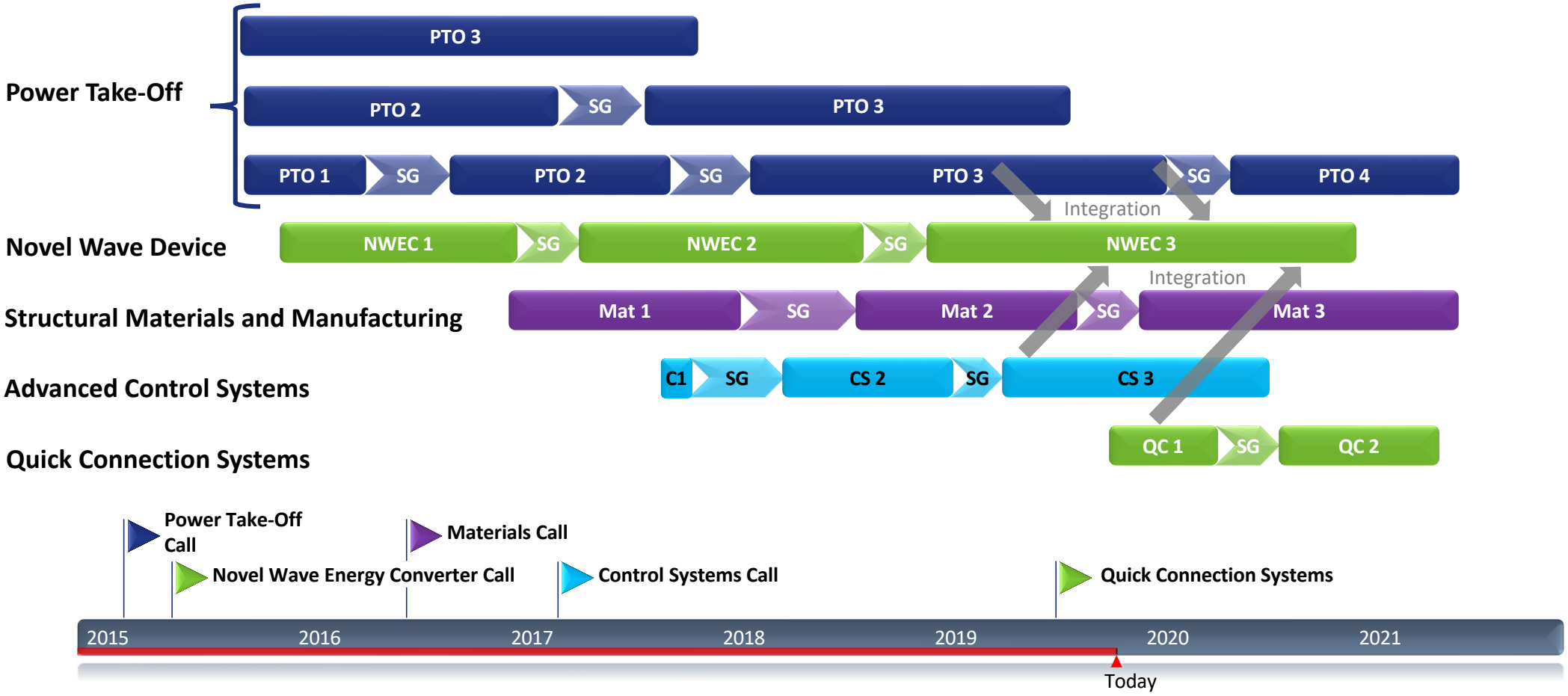
£39.6M committed expenditure

Delivering objectives through Research, Development & Innovation Programmes

13 Countries

Funded by the Scottish Government

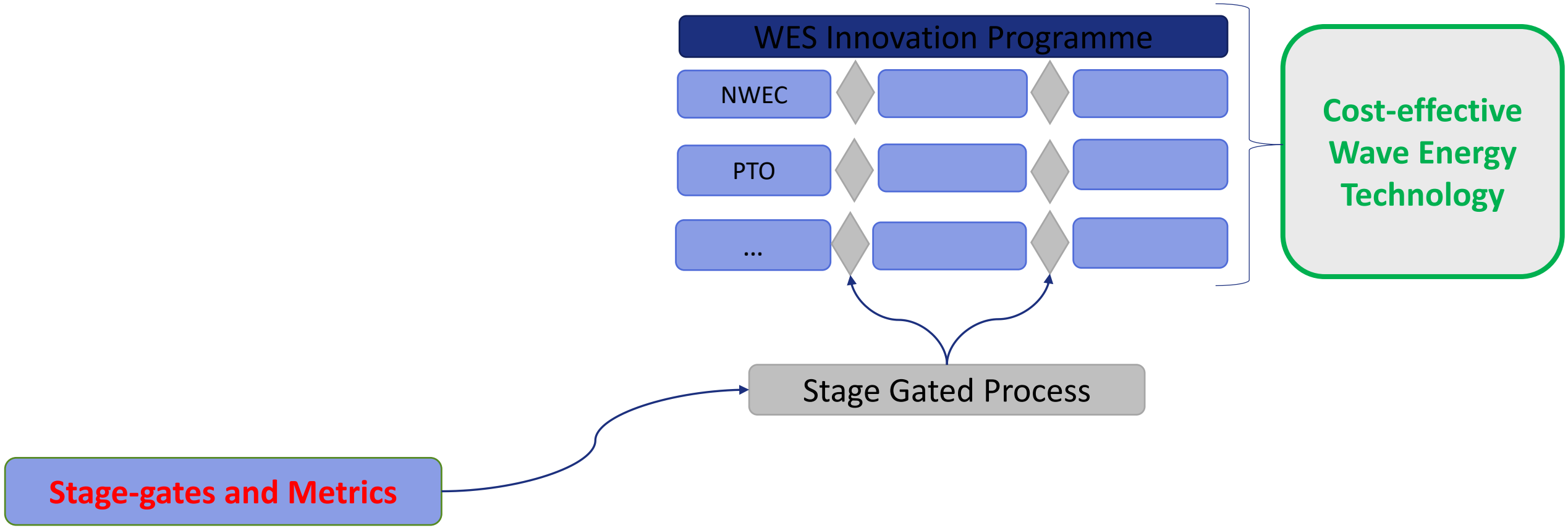
WES Technology Programmes



Structured Innovation

- **WHO?** Exxon, Visa, Microsoft, Guinness, NASA… Wave Energy Scotland
- **WHAT?** – A set of systematic thinking tools to help you improve systems in structured and innovative ways e.g. Stage Gate process, Systems engineering, QFD, TRIZ, Multi-disciplinary optimisation…
- **WHY?** "Success is more likely to result from the systematic pursuit of opportunities than from a flash of genius." – Peter Drucker

Structured Innovation



Why use structured innovation?

- No technology consensus
- No full set of defined standards
- How to compare technologies which look, perform, behave and cost completely differently to each other

- Structured innovation – to generate new ideas in a structured way

Structured Innovation techniques

Systems Engineering

A logical sequence of activities and decisions that transforms an operational need into a description of system performance parameters and a preferred system configuration

Quality Function Deployment (QFD)

Facilitates the definition of the innovation problem space, representing the voice of the customer, help make objective assessments

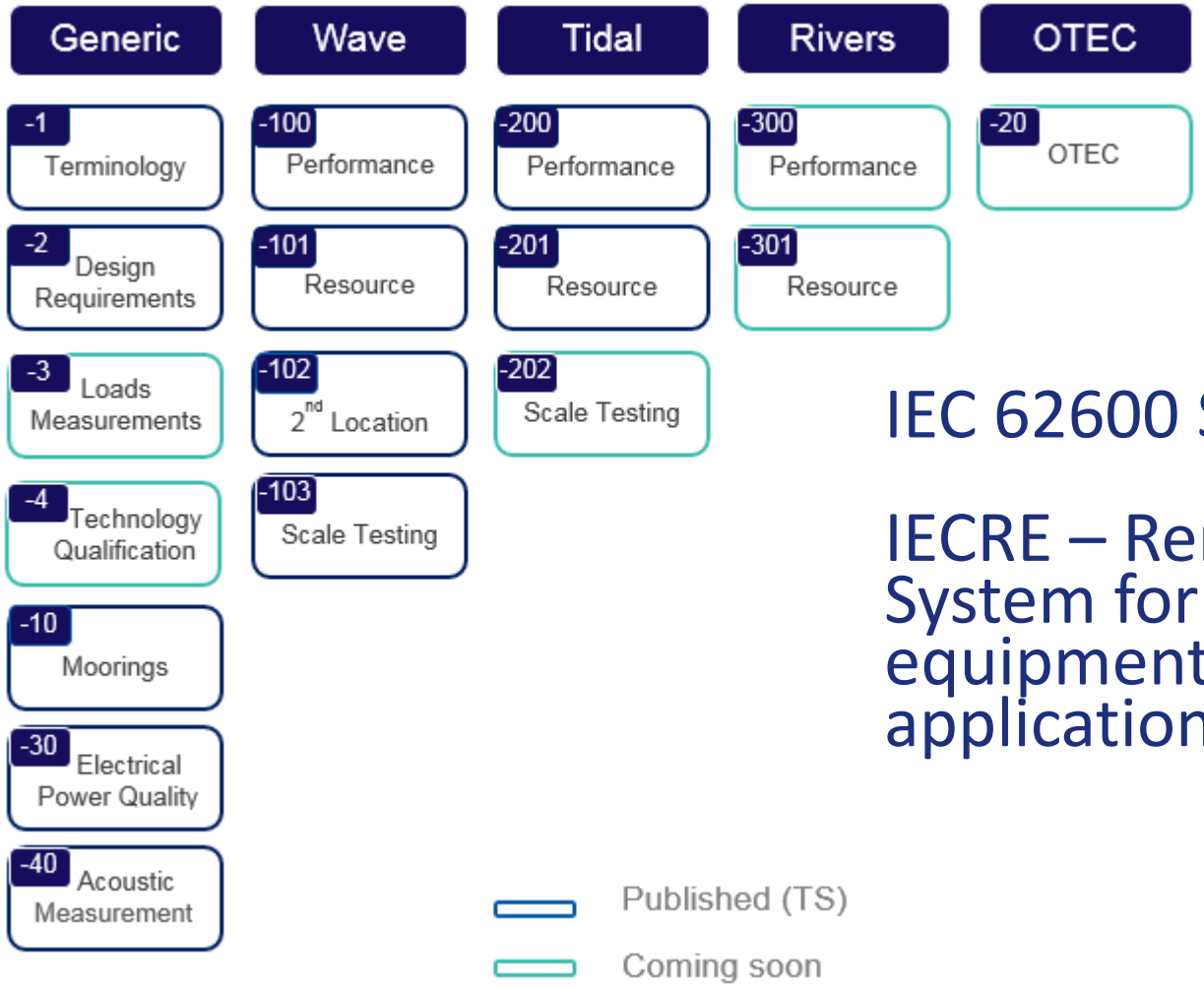
TRIZ

Inventive problem solving – the outcome of a review of 40,000 patents to create the inventive principles for problem solving

MDO

Multidisciplinary optimisation uses optimisation methods to solve design problems incorporating several disciplines

Technical Specifications



IEC 62600 Series

IECRE – Renewable Energy
System for certification to standards relating to equipment for use in renewable energy applications

International Projects - IEA-OES Task 12

- “International Technology Evaluation Framework for Ocean Energy”
- Aim: to achieve consensus on method to evaluate ocean energy technology
- IEA-OES Task 12 has 25 contracting parties from different countries around the world.

Why do we use metrics?

- Measure success
- Manage competitive innovation calls
- Allocate funding appropriately
- Demonstrate progress
- Gain confidence of investors and stakeholders
- Cross funder comparisons

- Cost per install/removal cycle
- Installation/MW

- Capture factor
- Capture width

- % Availability
- Mean Time Between Failures
- Mean Time to Failure
- # single point failure modes
- Fatigue life

- Rated Capacity
- Capacity factor
- Annual Average Yield
- Conversion efficiency
- ACE

- Mean Time to Repair
- Time to Replace
- # interventions/ year
- Overhaul/refit period

- LCOE
- CAPEX/MW
- OPEX/MW
- Cost/Device
- Cost per annual MWh

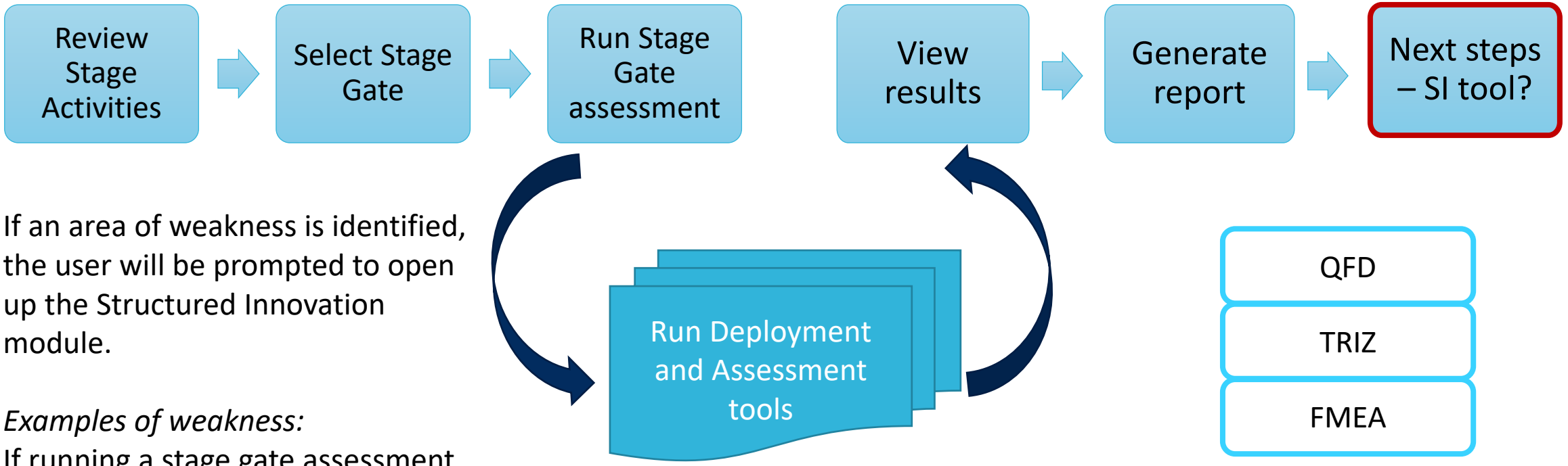
DTOcean+

Advanced Design Tools for Ocean Energy Systems Innovation, Development and Deployment

- 3-year project
- €8m budget
- 18 partners in 8 countries
- WES leading Stage Gate tool
- Energy Systems Catapult leading Structured Innovation tool

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 785921

2. Stage Gate process for ocean energy



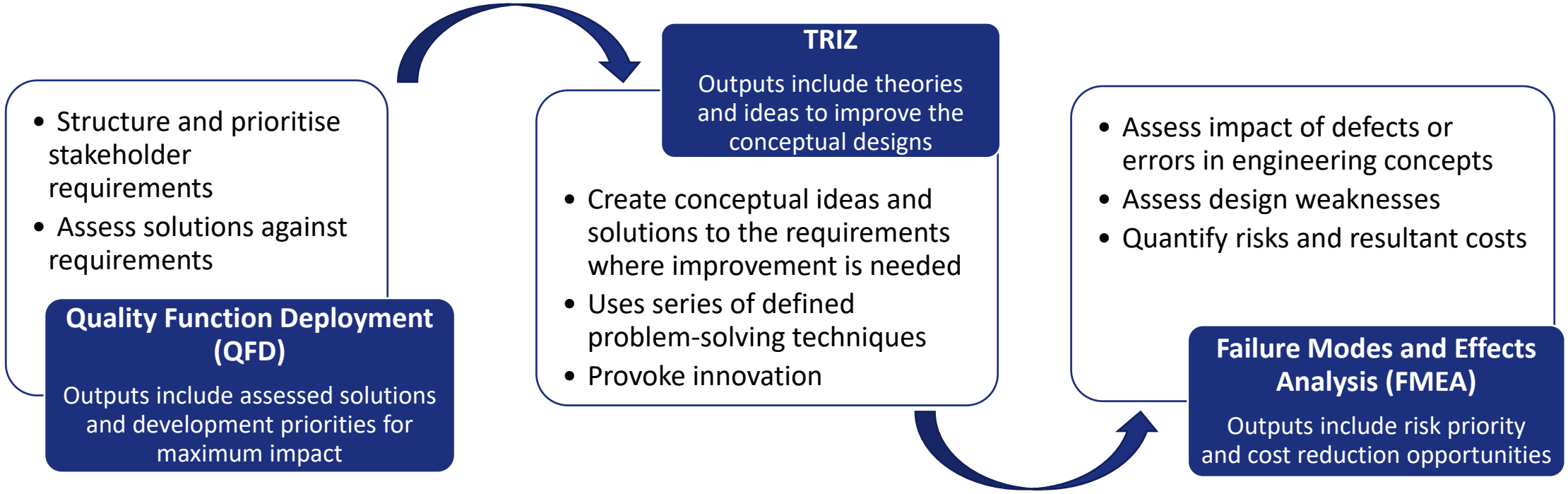
If an area of weakness is identified, the user will be prompted to open up the Structured Innovation module.

Examples of weakness:
If running a stage gate assessment identifies a missing Evaluation area

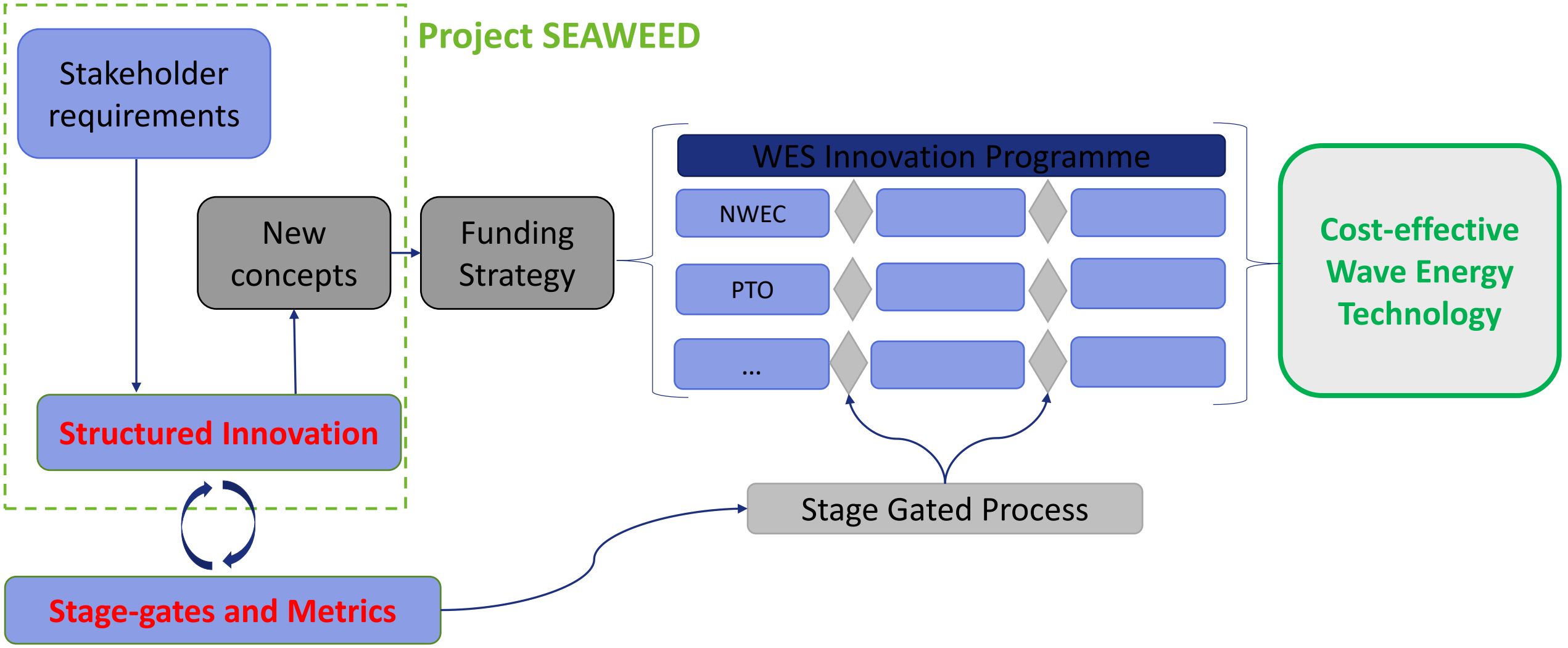
If the metric results deviate significantly from the thresholds set by the user

Structured Innovation tool

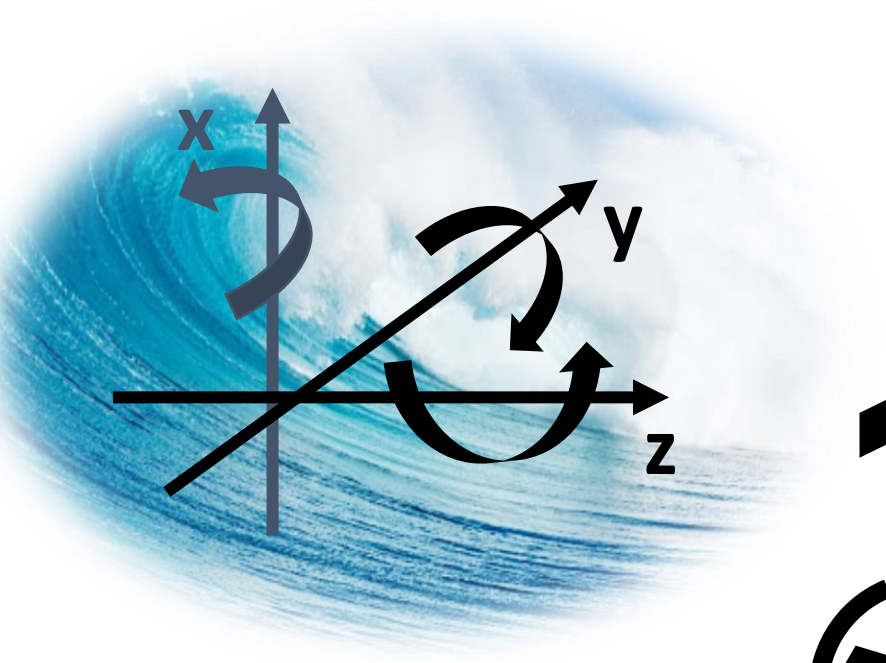
- This work package aims to develop a structured innovation design tool for concept creation and selection in ocean energy systems including sub-systems, energy capture devices and arrays.



Structured Innovation



Project SEAWEED



Ocean energy technology concepts

All possible solutions

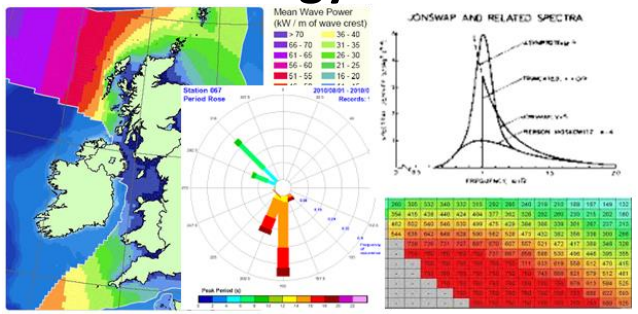
Specific solutions

Concept Creation

Concept Selection

Project SEAWEED

Wave Energy Resource



Project Design

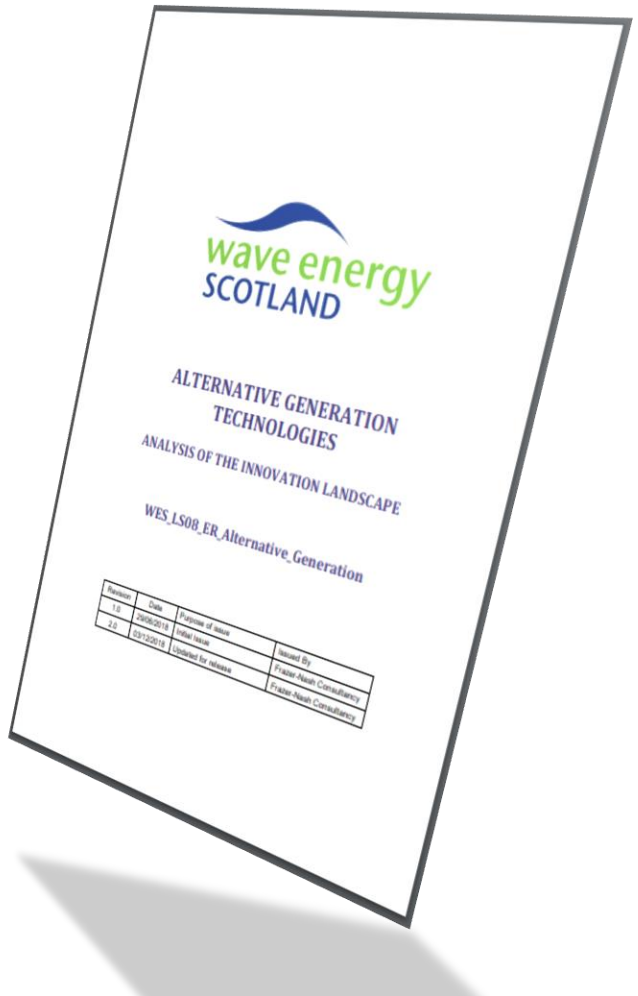
Device Design

?

Commodity/Market

Future markets and technologies

- Cost reduction is key
- Innovation by necessity
- Alternative generation technologies being considered
- Can heavy, steel, rotary generators be replaced by lightweight alternatives
  - Electroactive polymers
  - Triboelectric nanogenerators
  - Piezoelectrics
  - Magnetostriction



Knowledge Library

Wave Energy Scotland is managing the most extensive technology programme of its kind in the wave energy sector. The Knowledge Library provides access to key information and documents generated through this world leading commercial and academic research & development.

Access world leading R&D in wave energy technology

- → Discover the projects supported through the Wave Energy Scotland Programme
- → Find Potential collaborators in your own or other fields
- → Search project reports on work completed through Wave Energy Scotland Programme
- → Find information on previous wave energy technology development in Scotland

library.waveenergyscotland.co.uk

MAXiMAR:
MAXIMISING THE MARINE ECONOMY IN THE HIGHLANDS AND ISLANDS

A Science and Innovation Audit Report sponsored by the Department for Business, Energy and Industrial Strategy

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Scottish Aquaculture Innovation Centre
National Oceanography Centre
UNIVERSITY of STIRLING

Examining the effectiveness of support for UK wave energy innovation since 2000

Matthew Hannon, Renée van Diemen & Jim Skea

Lost at sea or a new wave of innovation?