WES Annual Conference 2017

Programme Update

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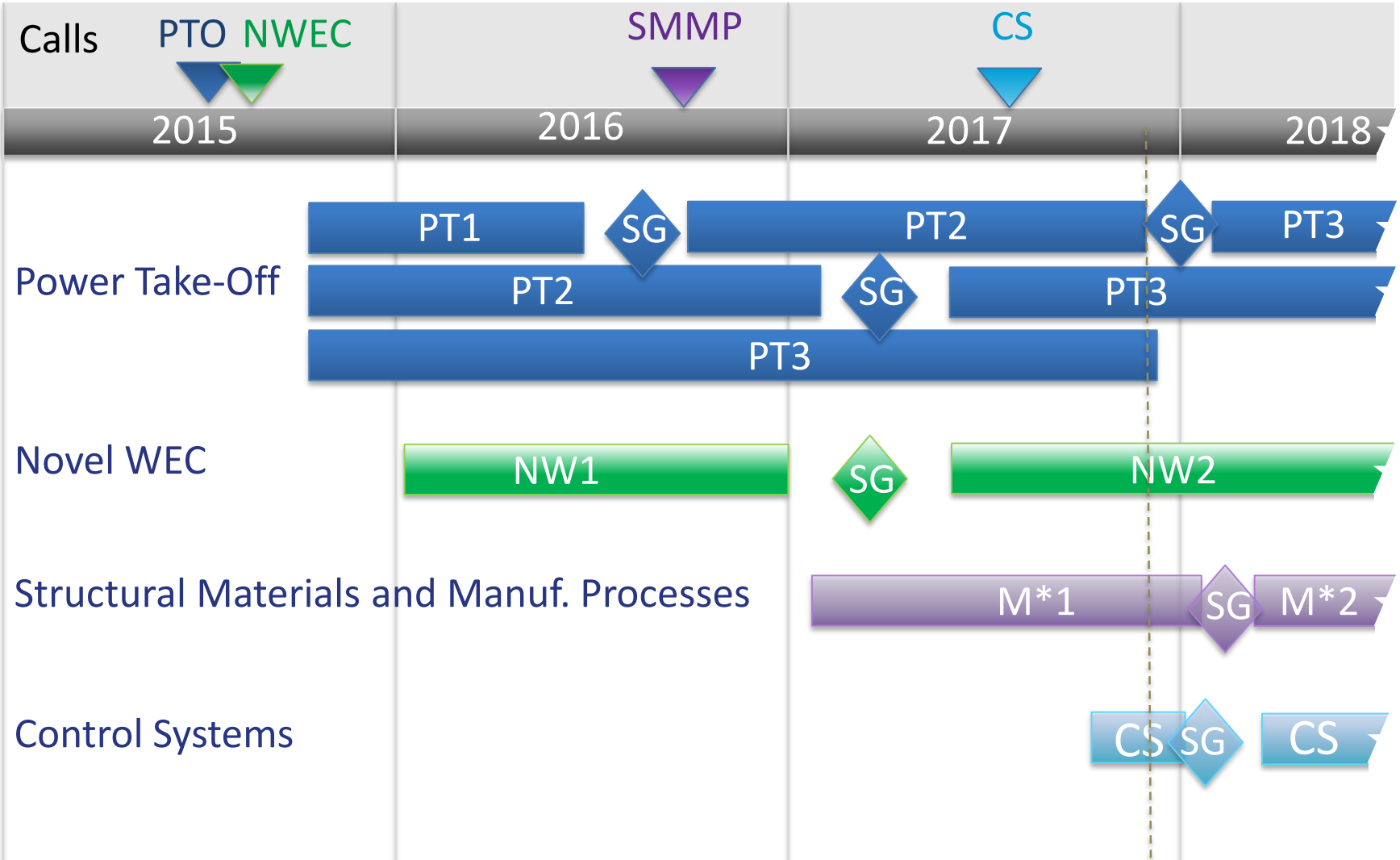
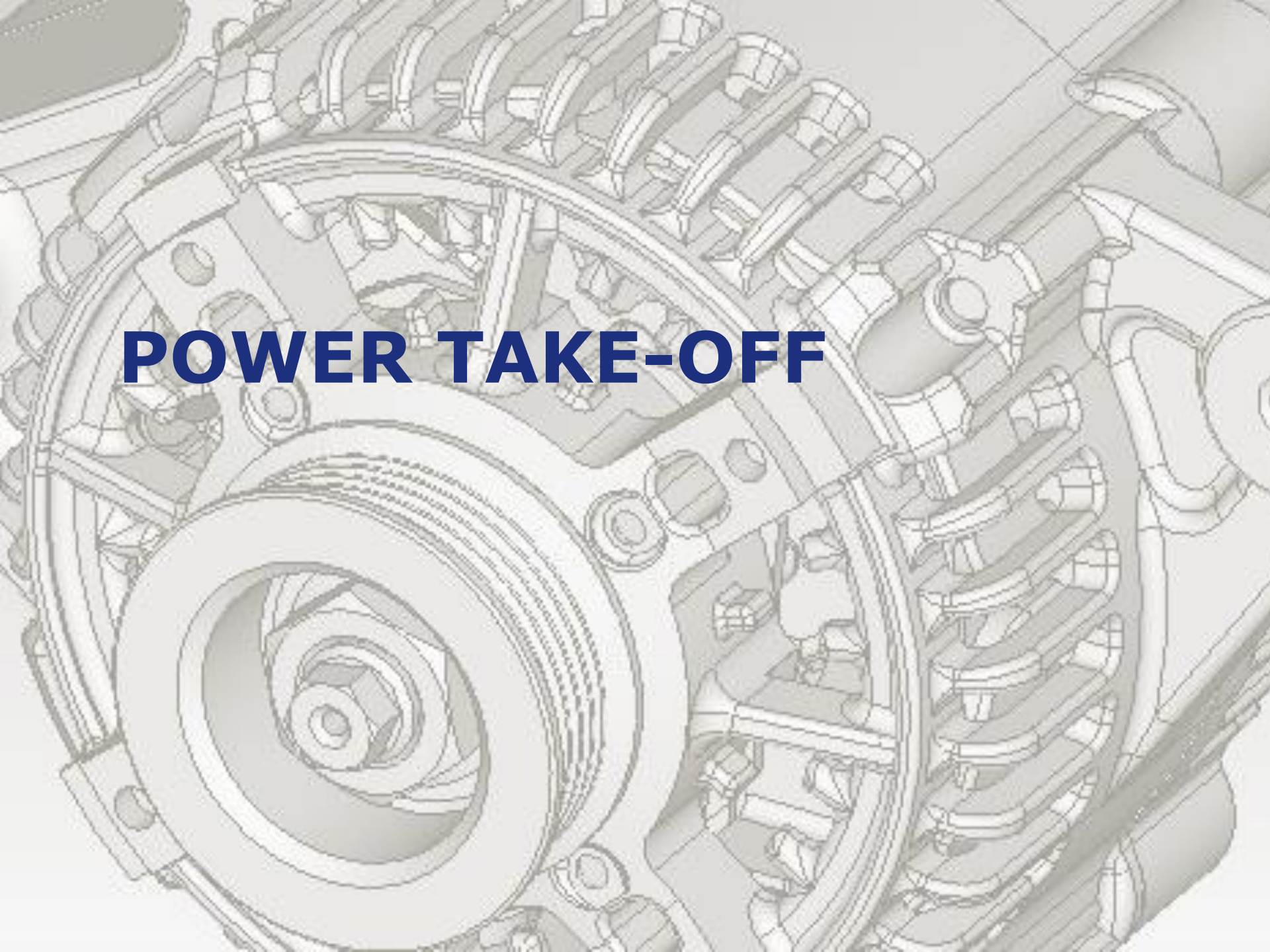
Programmes Summary

- 4 Programmes
  - PT Power Take-Offs
  - NW Novel Wave Energy Converters
  - M* Structural Materials and Manuf. Processes
  - CS Control Systems
- 59 contracts
- £23.6m spent or committed to projects
- 175 organisations involved

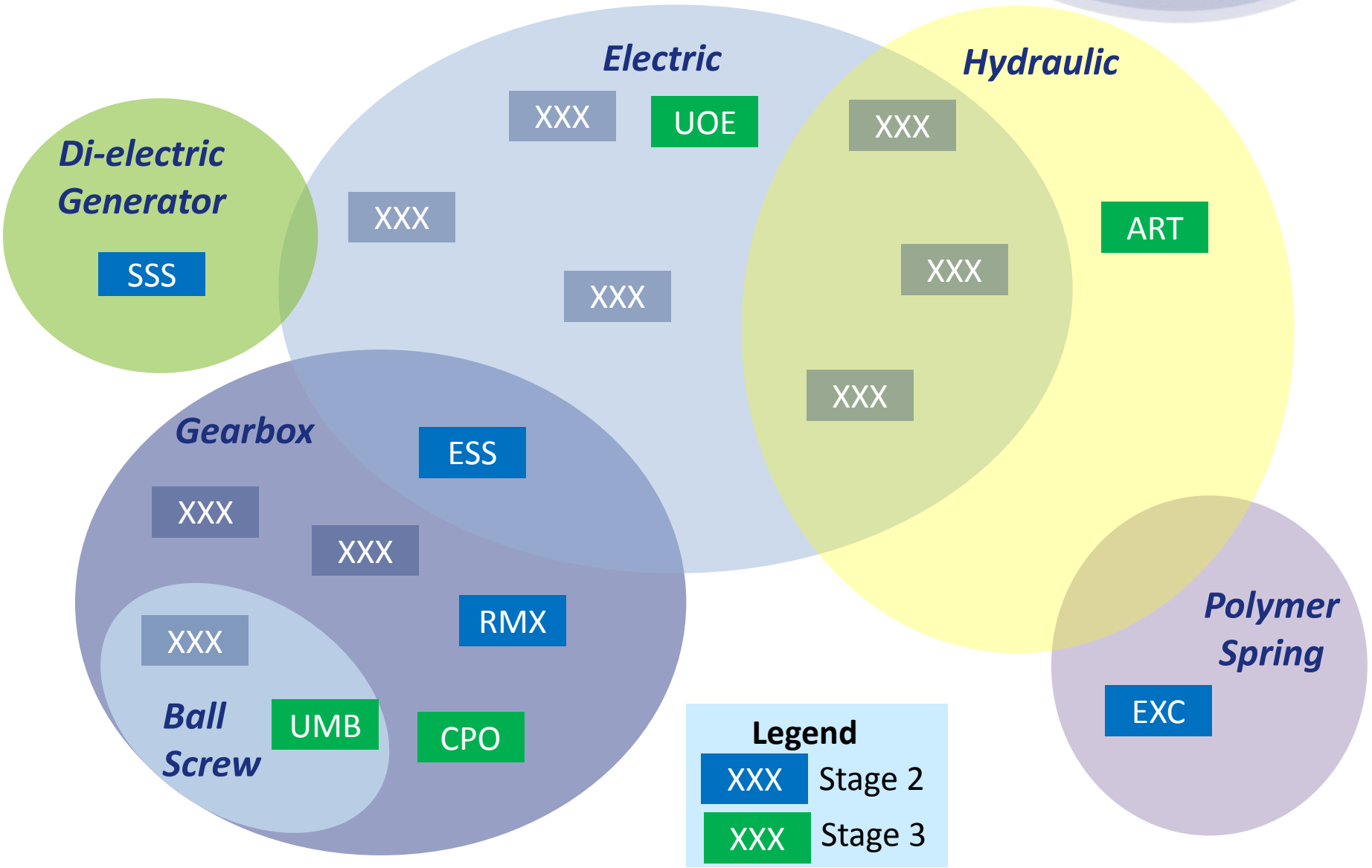
WES Timeline



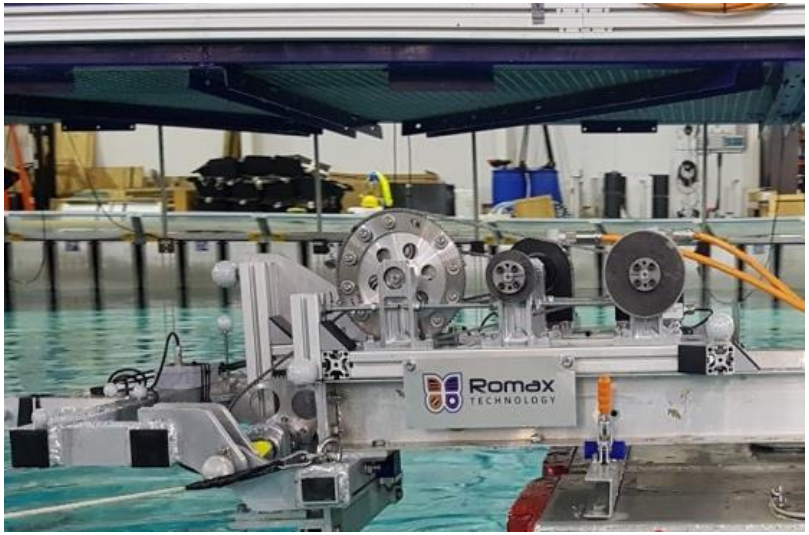


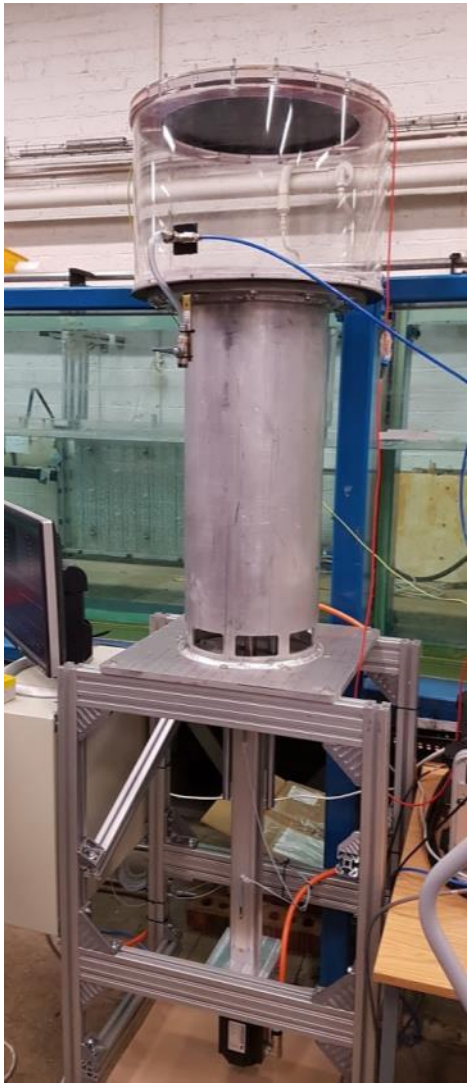
POWER TAKE-OFF

Technologies in PTO programme

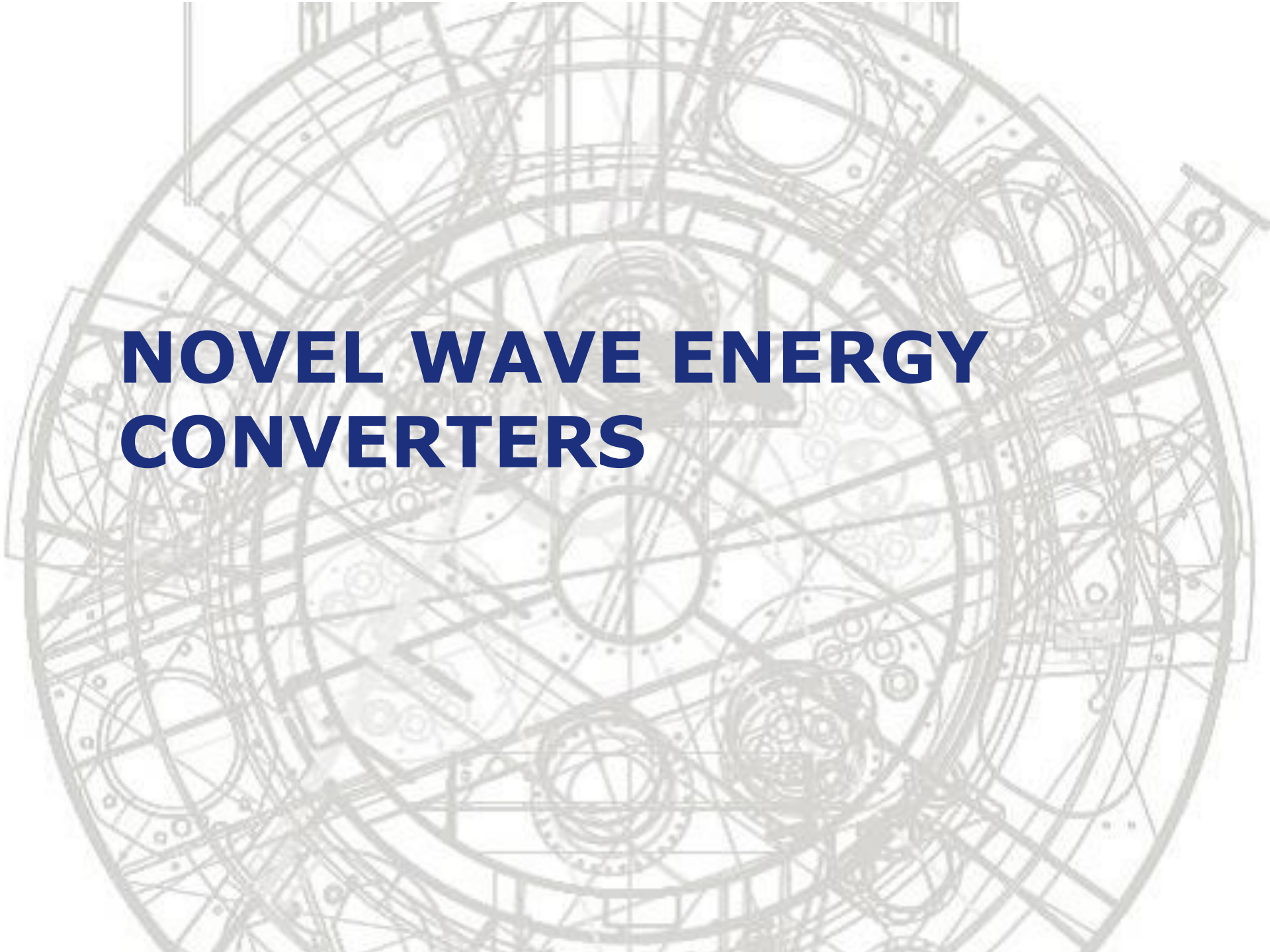


PTO2 Projects



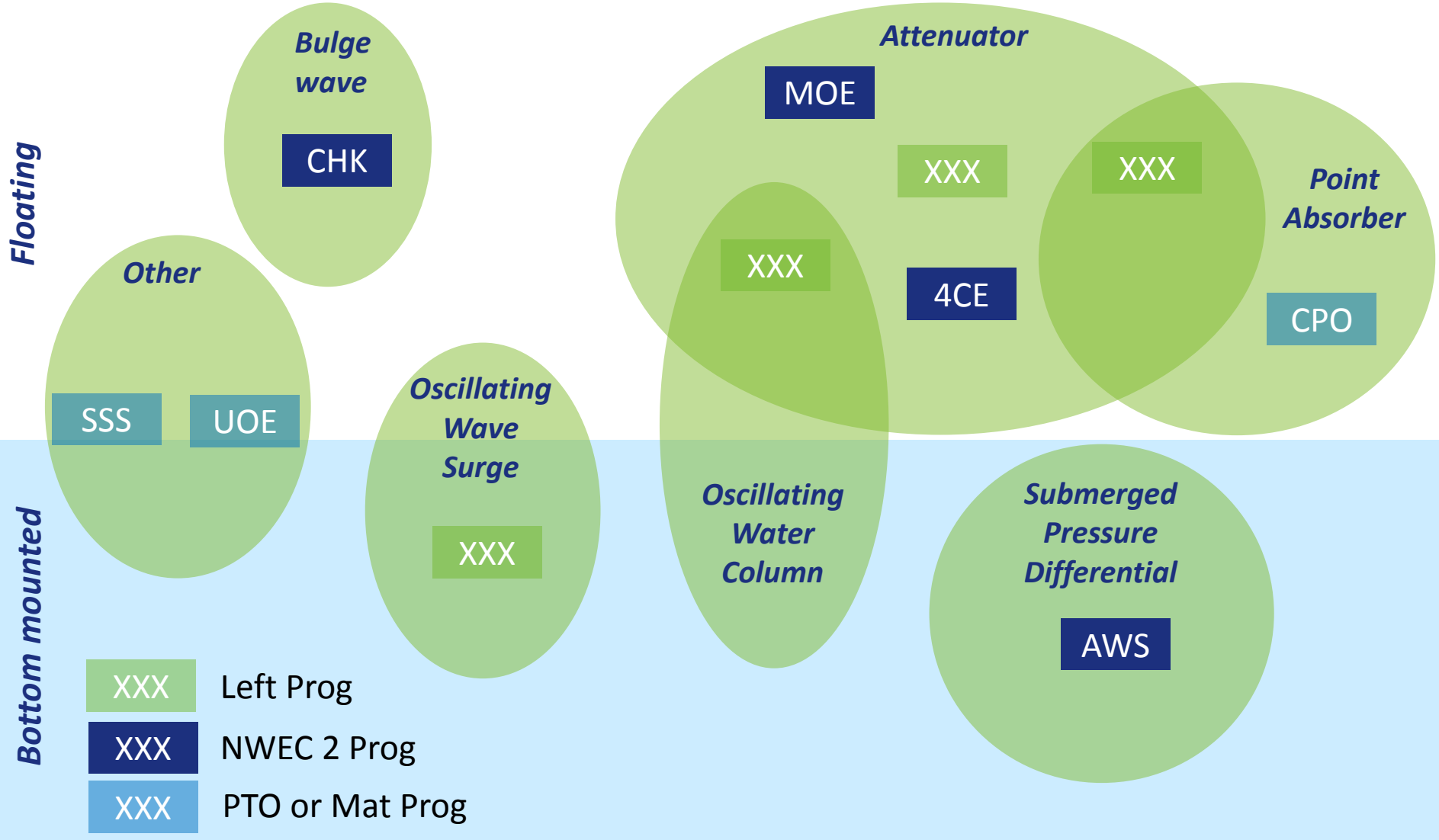


PTO3 Projects

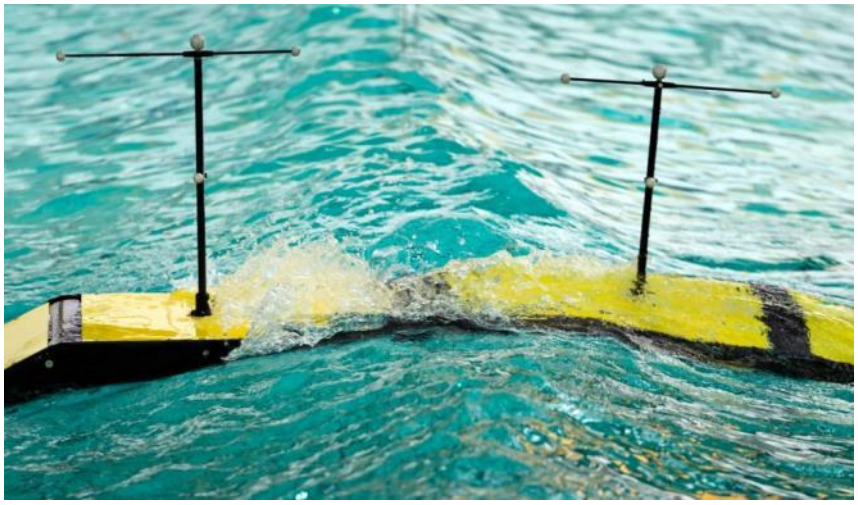


NOVEL WAVE ENERGY CONVERTERS

WEC Types


Floating
Bottom mounted
Bulge wave
CHK
Attenuator
MOE
XXX
XXX
XXX
4CE
Point Absorber
CPO
Other
SSS
UOE
Oscillating Wave Surge
XXX
Oscillating Water Column
Submerged Pressure Differential
AWS
XXX Left Prog
XXX NWEC 2 Prog
XXX PTO or Mat Prog

NWEC 2 Projects



STRUCTURAL MATERIALS AND MANUFACTURING PROCESSES

SMMP 1 Projects

Concrete

ARUP

Quoceant
Specialists in Marine Energy & Technology

Elastomer

THE UNIVERSITY of EDINBURGH

tfi

Hybrid

haydale
Composite Solutions

THE UNIVERSITY of EDINBURGH

PolyGen

Other

cruz atcheson
CONSULTING ENGINEERS

CORPOWER OCEAN

CONTROL SYSTEMS

Control Systems - Status

- Short Stage 1
- Stage Gate process underway
- Applications due on 6 February

Control Systems - Stage 1

Adaptive Control

Data analytics and Supervisory Control

Reinforcement Learning Control

Linear Quadratic Control

Control for DEGs

Non-linear Optimal Control

Software tools and Algorithms

Survival and load reduction Control

CPower Alba

Multi-Layer Control Architecture

END

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WES Future Calls and Innovation Landscaping

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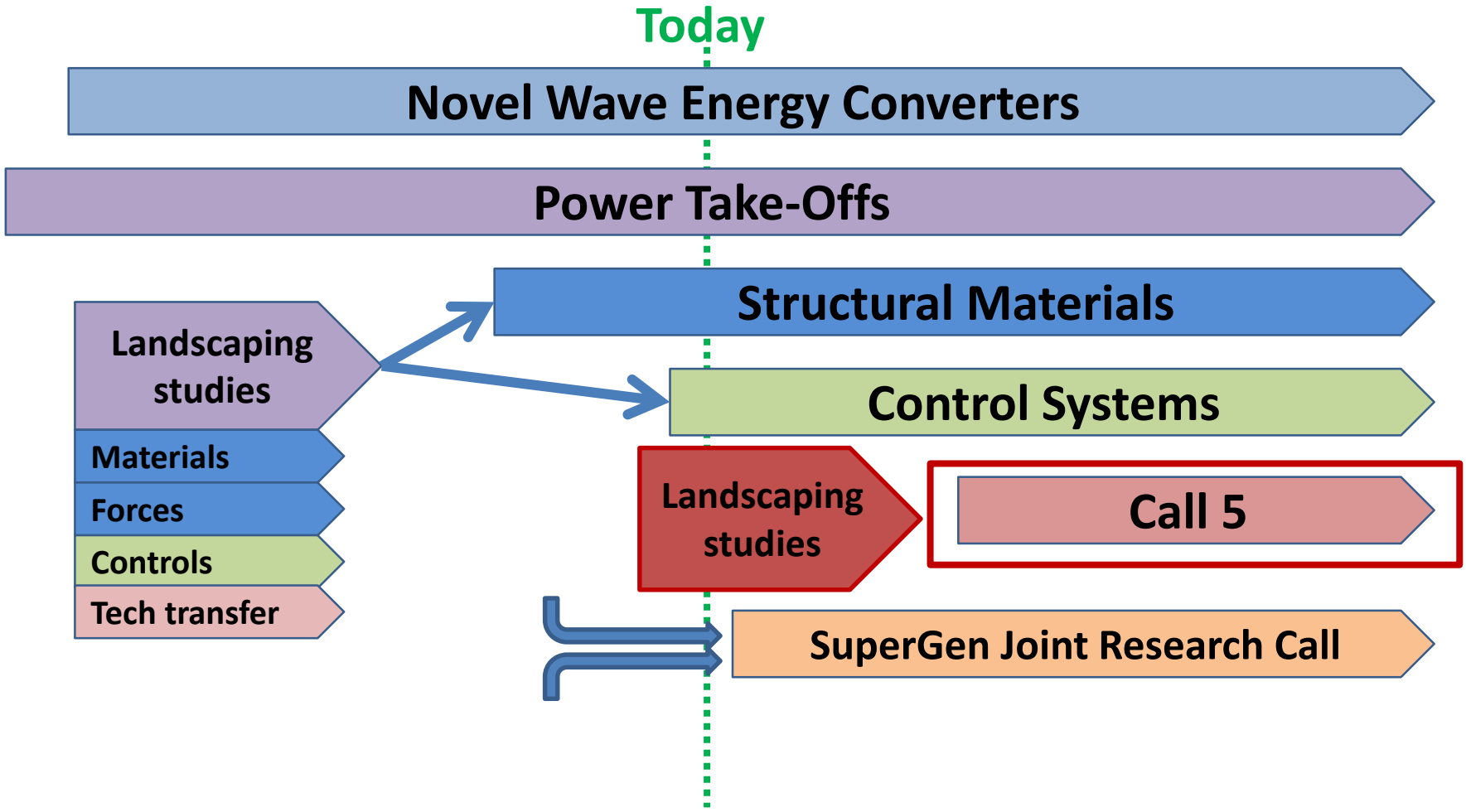
WES Work Programme



Innovation Landscaping

Four Innovation Landscaping projects

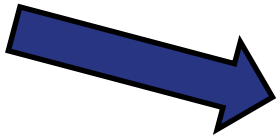
- Cost Reduction in Supporting Infrastructure
  - Electrical Connection
  - Moorings & Foundations
- Very Large Scale Wave Energy Generation
- Alternative Generation Technologies

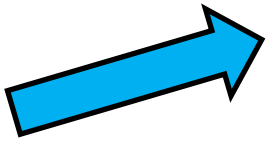
Innovation Landscaping

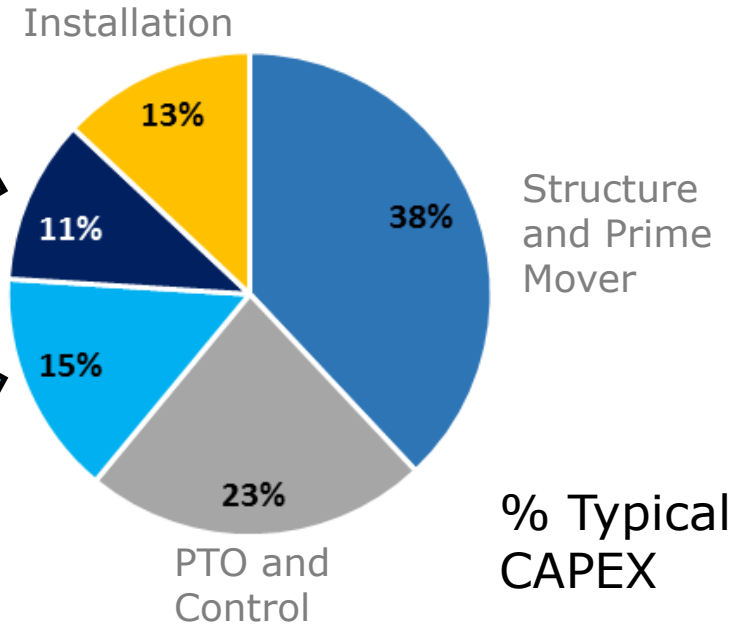
Cost Reduction in Supporting Infrastructure

1. Electrical Connection

2. Moorings & Foundations







Innovation Landscaping

Cost Reduction in Supporting Infrastructure

1. Electrical Connection

Contractor TBC

2. Moorings & Foundations

with

UNIVERSITY OF EXETER

BLACK & VEATCH

Innovation Landscaping

Objective:

- Opportunities for step-change cost reductions
  - Infrastructure sharing
  - Combination of sub-systems and/or their functions
  - Resulting component/sub-system deletion, re-sizing or replacement
  - Application of innovative or novel techniques or technologies

- Scope

Electrical generation
to
Grid Connection

Entire station
keeping function

Innovation Landscaping

Next generation of competitive solutions:

3. Very Large Scale Wave Energy Generation

4. Alternative Generation Technologies

Innovation Landscaping

Very Large Scale Wave Energy Generation

Objective:

- Opportunities for step-change cost reductions

- Scope
  - Other renewables
  - Theoretical limits
  - Suitability of existing or novel device types
  - Impact, benefits and practical considerations
  - CAPEX, OPEX and LCOE benefit to common baseline

Innovation Landscaping

Alternative Generation Technologies

Objective:

- Opportunities for step-change cost reductions

- Scope
  - Generation capacity and scale opportunities
  - Suitability for a realistic wave energy environment
  - Technology readiness and availability
  - R&D activity
  - Supply chain
  - Physical routes to implementation
  - CAPEX, OPEX and LCOE benefit to common baseline

Innovation Landscaping

- 4 projects (2 open for tender now)
- 3-4 months duration each
- £70-80k each excl. VAT each
- Open tender via Public Contracts Scotland

public contracts scotland

publiccontractsscotland.gov.uk

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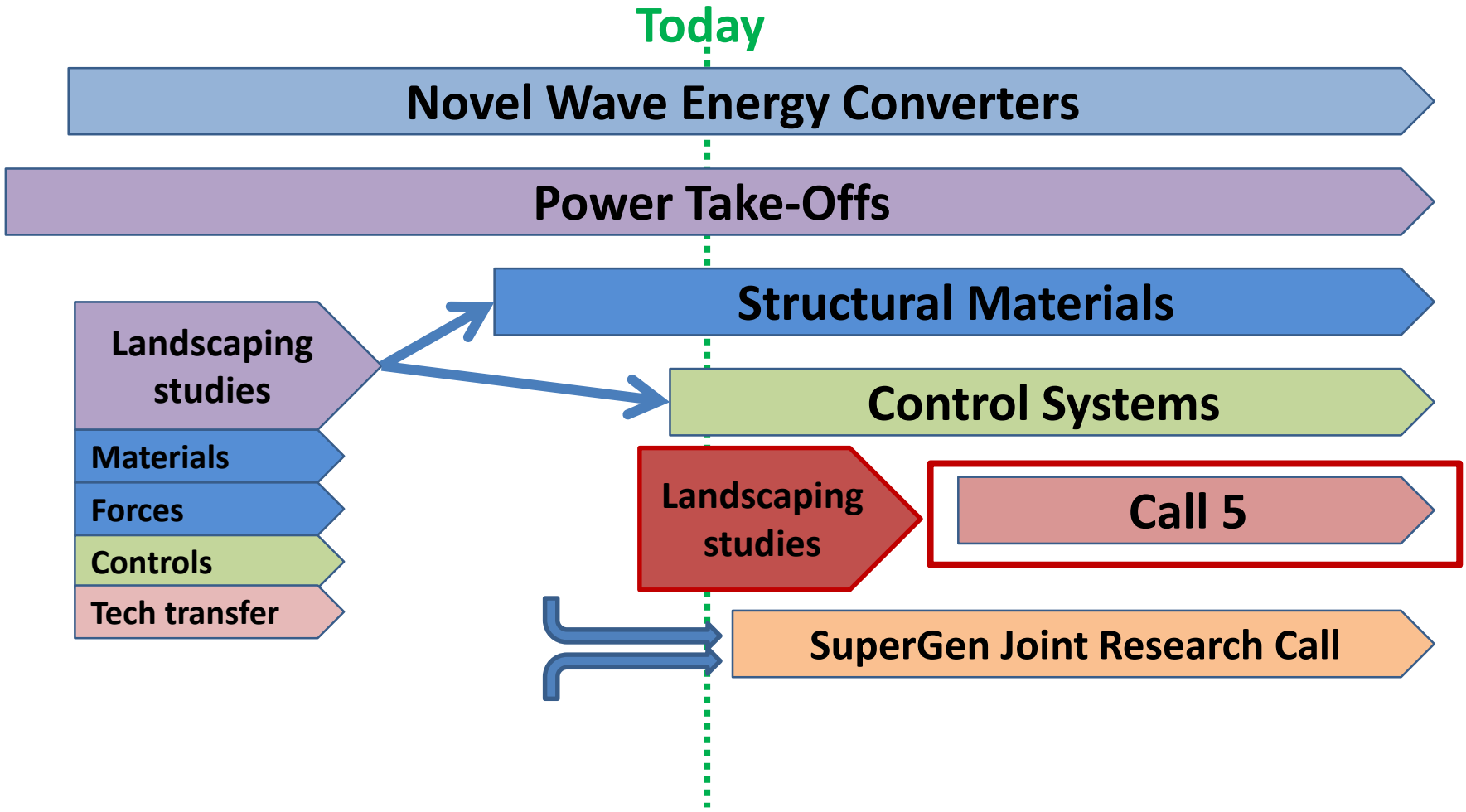
waveenergyscotland.co.uk

twitter.com/waveenergyscot

WES Work Programme



Thank you

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Metrics and SEAWEED

28th November 2017

Structured approach to wave energy technology

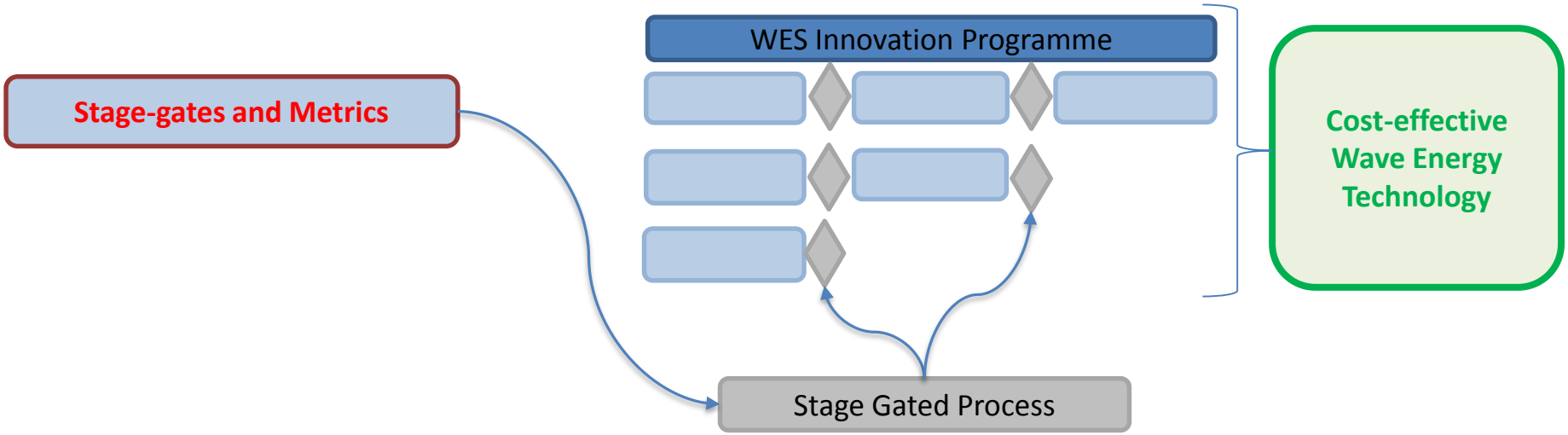
The WES programme uses a structured approach for:

- ❑Technology development: Metrics
- ❑Concept generation: Project SEAWEED

Why?

- ✓Fund the right technologies
- ✓Increase likelihood of success

Technology Development



Metrics Development

Feb 2016
US Department
Of Energy

Sept 2016
EERA, Ocean ERA-NET,
IEA OES

Tomorrow
Ocean ERA-NET

Future

Functional Requirements & Capabilities

Areas for measurement of success

Defined Metrics

Cross- sector approval
→ Key stakeholders

Global Consensus

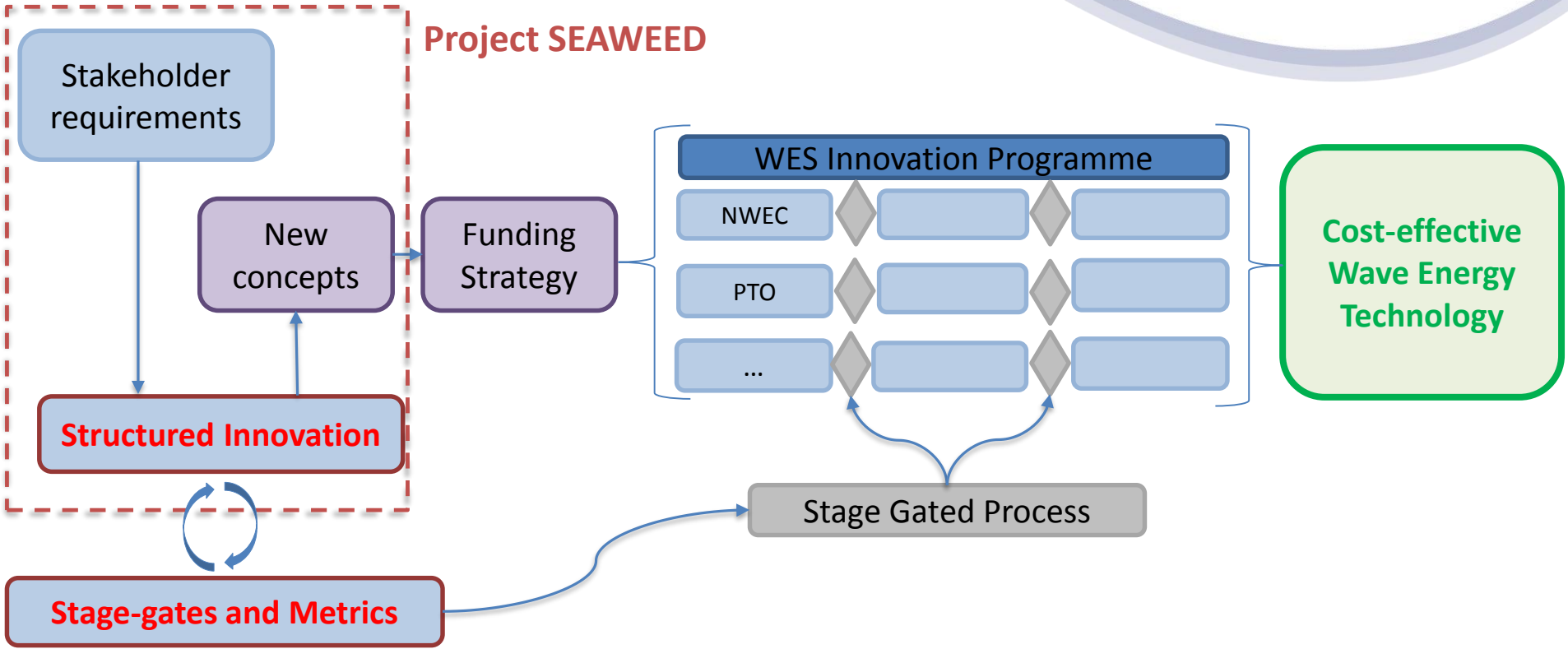
OES OCEAN ENERGY SYSTEMS

Collaboration

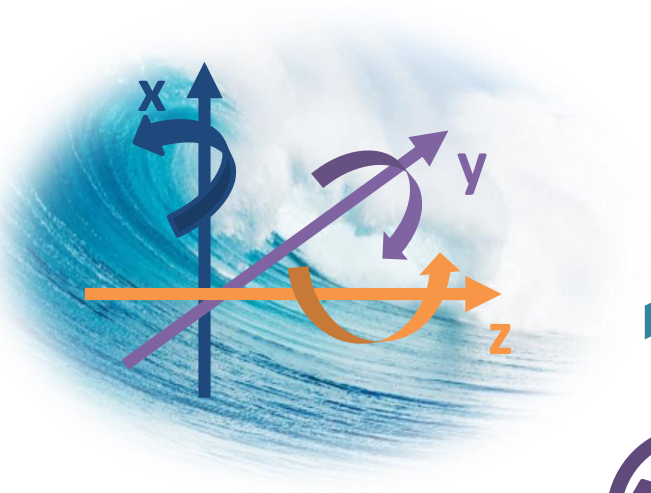
- Network of international collaboration on metrics to support stage- gated development

- UK: Wave Energy Scotland
  Ireland: WestWave
  USA: Department of Energy

Technology Development



Project SEAWEED



Ocean energy technology concepts

All possible solutions

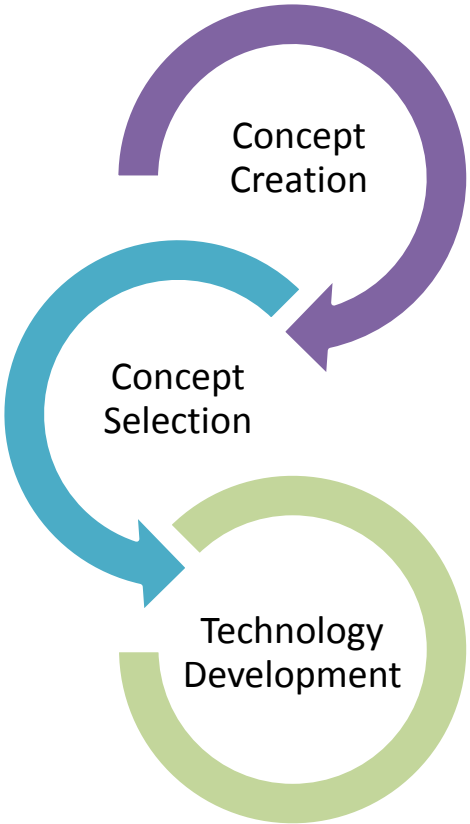
Specific solutions

Concept Creation

Concept Selection

SEAWEED - Collaboration

- Project SEAWEED
- International Metrics Development
- Stage Gate Process



- Wave- SPARC
- Technology Performance Levels
- The Wave Energy Prize

Thank you

Jillian.Henderson@hient.co.uk

28th November 2017

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Interactive Session

Elva Bannon

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WES Objectives (25/11/2014)

- Seek to retain the **intellectual property and know-how** from device development in Scotland for future benefit;
- Enable Scotland's indigenous technologies to reach **commercial readiness** in the most efficient and effective manner, and in a way that allows the **public sector to exit** in due course;
- Ensure that the learning gained from support for wave device development and deployment to date, in particular the learning from Scotland's leading wave technologies, is retained and used to **benefit the wave energy industry**;
- **Avoid duplication in funding**, encourage collaboration between companies and research institutes and foster greater standardisation across the industry;
- Ensure **value for money** from public sector investment; and
- Promote greater **confidence** in the technical performance of wave energy systems in order to encourage the return of private sector investment.

Interactive Session

What are we looking for?

- Ideas from you about
  - What WES could do, or do more of.
  - What we can do to support projects in our programme more.
  - What would help the wave energy sector gain confidence of investors.
  - Identify common challenges which WES can directly address
- Feedback on what we are doing well and should continue with

Topics

- 4 boxes at the back of the room labelled with following topics
  - KNOWLEDGE CAPTURE
  - COLLABORATION
  - LANDSCAPING
  - OTHER

Topics

- 4 boxes at the back of the room labelled with following topics
  - KNOWLEDGE CAPTURE
  - COLLABORATION
  - LANDSCAPING
  - OTHER

- Offshore operational experience
- Corrosion and protection
- Tanks testing of WECs
- Cost modelling
- PTO
- Moorings and connections
- Modelling and simulation
- Economics
- Guidance on Compliance
- Guidance on Installation

Topics

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  - LANDSCAPING
  - OTHER

- Energy Technology Partnership
- SuperGen
- US Department of Energy
- Ocean Energy Europe
- Ocean ERA-NET
- IDCORE
- Stage Gate Metrics
- BSI / IEC

Topics

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  - KNOWLEDGE CAPTURE
  - COLLABORATION
  - LANDSCAPING
  - OTHER

- Structural Materials, Coatings and Manufacturing Processes
- Structural Forces and Stresses for Wave Energy Devices
- Technology Transfer
- Control Requirements for Wave Energy Converters
- Electrical Infrastructure
- Moorings and Foundations

Topics

- 4 boxes at the back of the room labelled with following topics
  - KNOWLEDGE CAPTURE
  - COLLABORATION
  - LANDSCAPING
  - OTHER

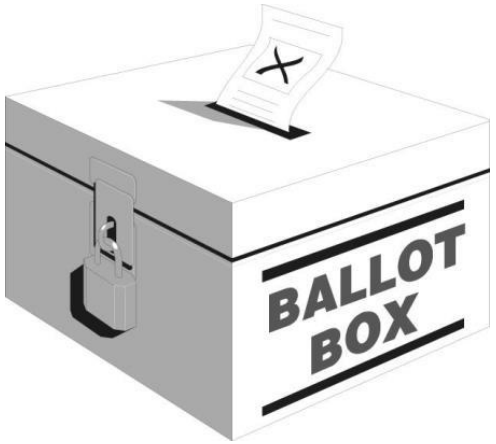
- Brokerage events
- Newsletter
- Call information webinar
- Conference presentations
- Workshops
- Knowledge library

- **WES Annual Conference**

Instructions

- Have a chat and bounce ideas off each other
- Using one of the topics as your guide, complete your card and place it in the appropriate box
- Leave it anonymous if you wish
- Complete before **end of lunch**
- (Initial feedback by end of day*)

  * not guaranteed



Topics – already covered. What's missing???

- Offshore operational experience
- Corrosion and protection
- Tanks testing of WECs
- Cost modelling
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- **WES Annual Conference**