

Wave Energy Scotland

1st Annual WES Conference

Pollock Halls, Edinburgh

2nd December 2016

Agenda

Time	Programme
09:30	Registration
10:00	<u>Overall WES programme summary</u>
10:15	<u>Current call- Structural Materials and Manufacturing Processes</u>
10:25	<u>Next call - Controls</u>
10:30	<u>Key-note speaker, Ross Henderson</u> – Wave Energy Control in Practice
10:50	Break – NVEC and PTO poster sessions
11:20	<u>Power Take-Off programme participants - 3 minute pitches</u>
12:10	<u>NVEC programme participants - 3 minute pitches</u>
12:50	Lunch – NVEC and PTO poster sessions
13:40	<u>Novel Wave Energy Converter (NVEC) call - Stage 2</u>
14:00	<u>10 commandments of Wave Energy Technology Development - workshop</u>
15:00	Networking and Drinks
16:00	Close

1st Annual WES Conference

WES Programme Summary

Tim Hurst – Managing Director, WES

Content

❑ WES

- Objectives, activities and funding

❑ The Programme

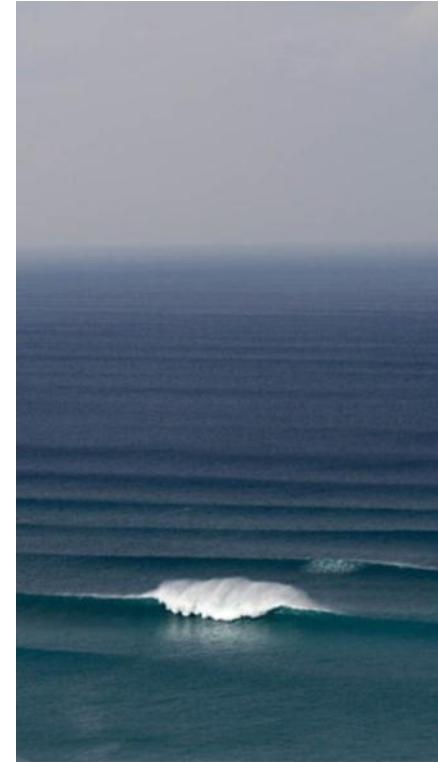
- Innovation Calls
- Landscaping Studies

❑ The Technologies

- Active projects

❑ Other activity

- International collaboration
- Metrics and standards
- Knowledge Management System



Wave Energy Scotland

A Research, Development and Innovation Programme that will:

- Support the development of key sub-system and component technology that can deliver a step change in performance
- Capture the learning from previous technology programmes
- Draw on knowledge from other sectors through effective knowledge exchange
- Foster collaboration between industry/academia
- Continuity of funding through to proven concept
- Ensure Commercial Focus – Advisory Group



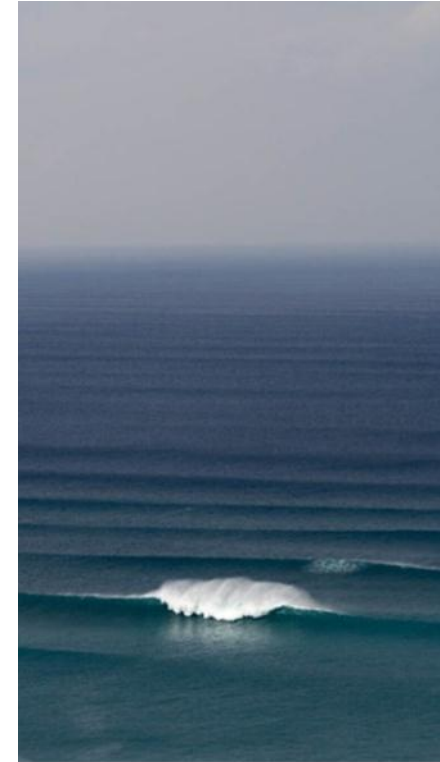
Wave Energy Scotland

❑ WES Activities

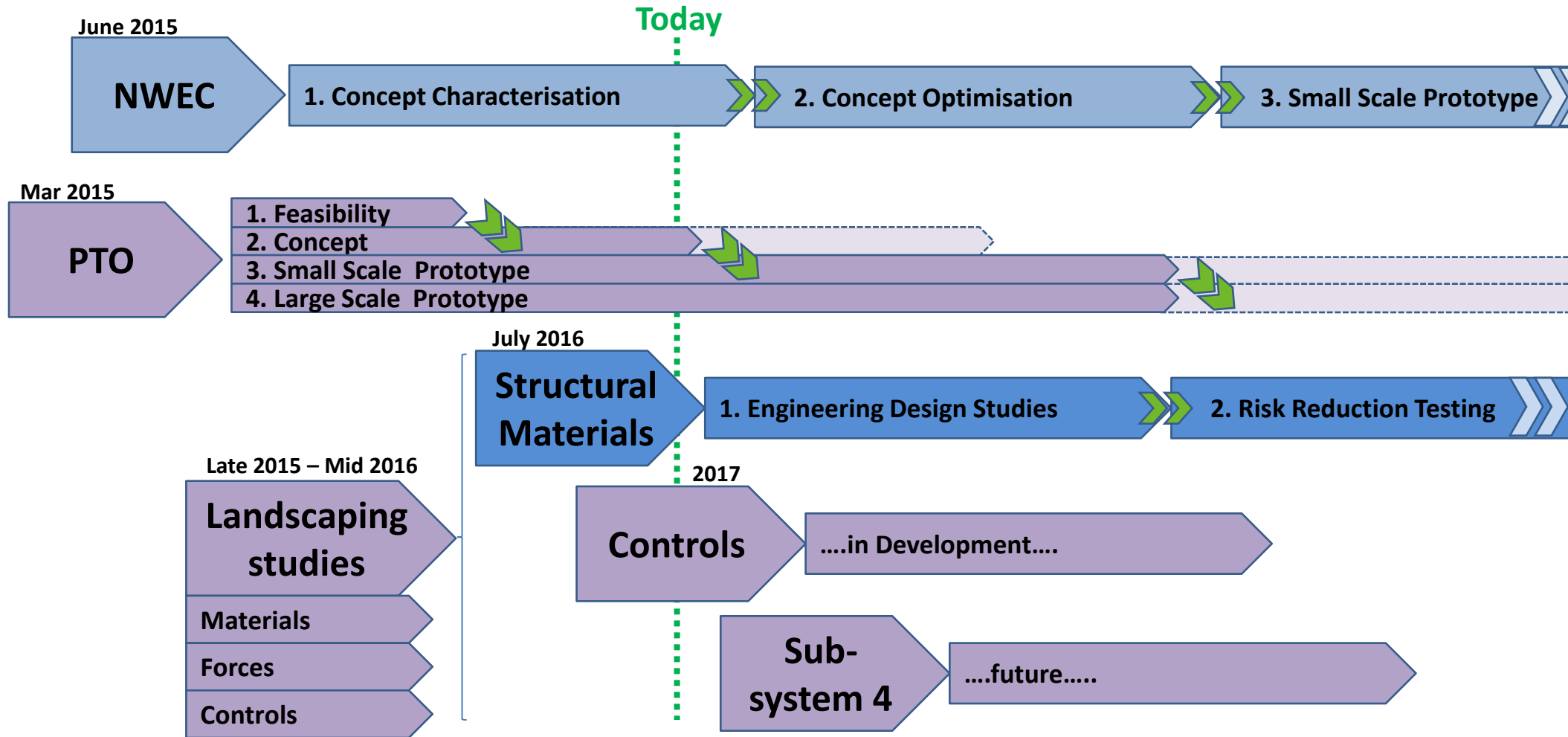
- Innovation Calls
- Strategic Projects
- Industry engagement and collaboration

❑ WES Funding

- Up to 100% funding for R&D services
- Pre-commercial procurement (PCP)
- Competitive, stage-gated programmes



WES Programme



Supported Technologies

PTO

NWEC

Materials

*Di-electric
Generator*



Electric



Hydraulics



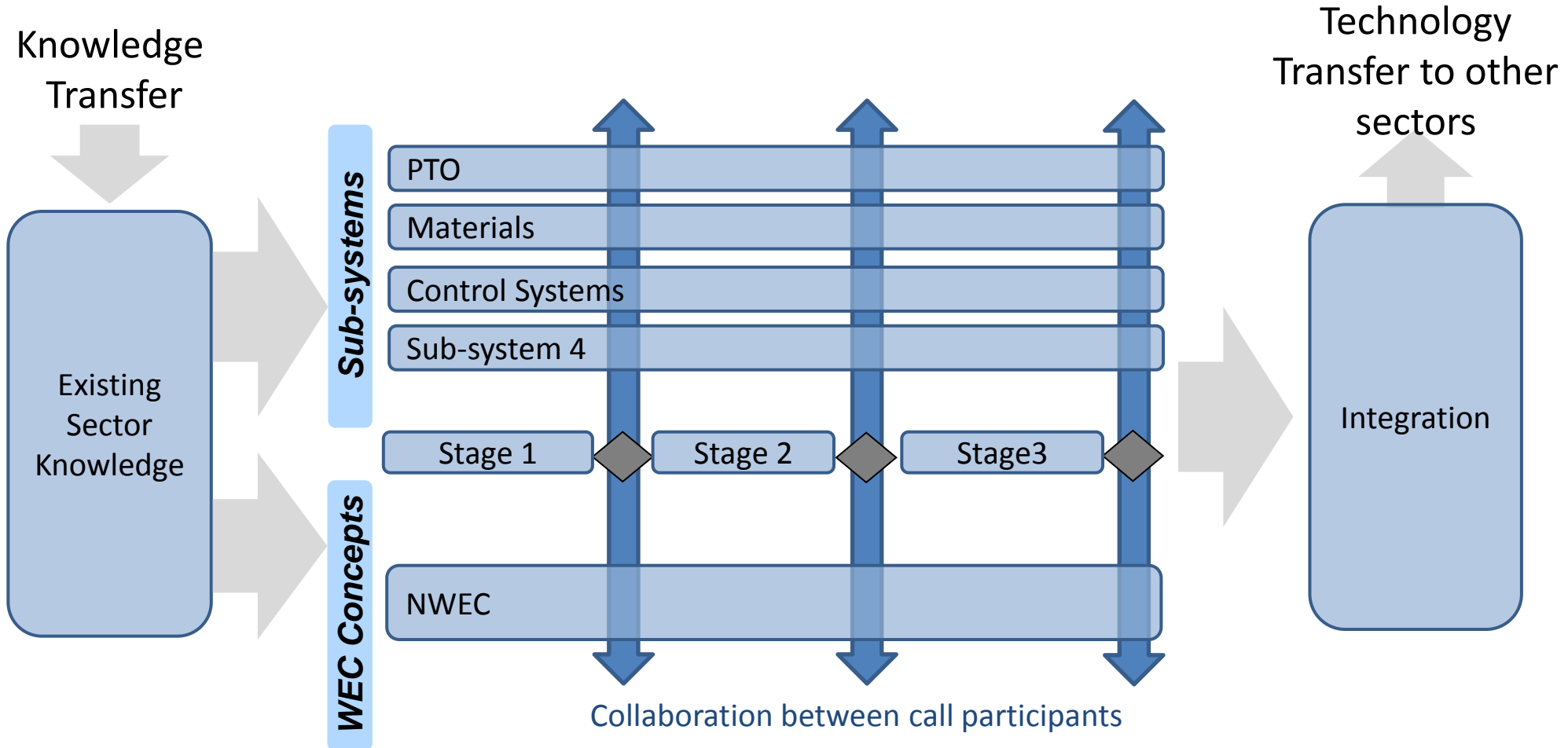
Gearbox



Polymer Spring



WES Programme



Participation (lead companies)



□ 129 companies, 30 projects

International Collaboration

- Avoid duplication
- Encourage collaboration
- Foster standardisation

- Activity on
 - Metric development
 - Industry standards



Metric topic areas

Controllability

Acceptability

Reliability

Maintainability



Installability

Energy Capture



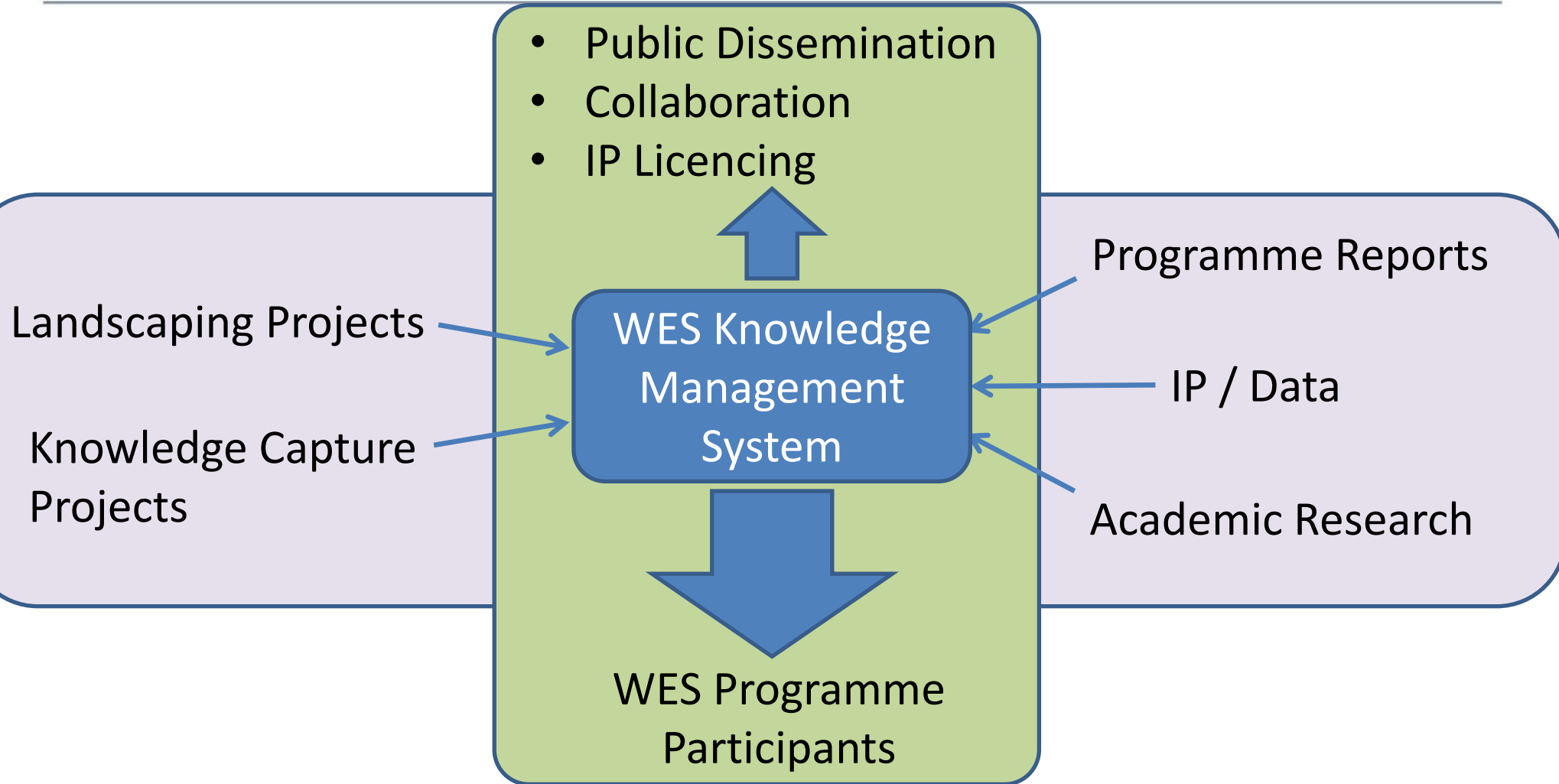
Manufacturability

Energy
Conversion

Affordability

Survivability

WES Knowledge Management



OCEANERA-NET COFUND

- 5 year programme – joint calls + other activities
- Cofunded joint call for transnational, collaborative demonstration projects
- Open March 2017, 2 Stage process, project start 2018
- Total budget €18m
- Funding available in Scotland, Brittany, Pays de la Loire, Ireland, Spain, Basque Country, Sweden
- Minimum 2 independent entities from 2 different countries

Co-funded by the Horizon 2020
Framework Programme of the European Union



Draft Scope (to be confirmed)

Projects should involve demonstration and validation one or more of the following:

- Novel and improved energy conversion devices
- Components and subsystems
- Foundations, Moorings
- Grid Connection and Power Systems
- Materials and Structures
- Installation, Maintenance and Marine Operations

Contact: karen.fraser@scotent.co.uk

Agenda

Time	Programme
09:30	Registration
10:00	<u>Overall WES programme summary</u>
10:15	<u>Current call- Structural Materials and Manufacturing Processes</u>
10:25	<u>Next call - Controls</u>
10:30	<u>Key-note speaker, Ross Henderson</u>
10:50	Break – NWECC and PTO poster sessions
11:20	<u>Power Take-Off programme participants - 3 minute pitches</u>
12:10	<u>NWECC programme participants - 3 minute pitches</u>
12:50	Lunch – NWECC and PTO poster sessions
13:40	<u>Novel Wave Energy Converter (NWECC) call - Stage 2</u>
14:00	<u>10 commandments of Wave Energy Technology Development - workshop</u>
15:00	Networking and Drinks
16:00	Close

1st Annual WES Conference

Current Call – Structural Materials and Manufacturing Processes

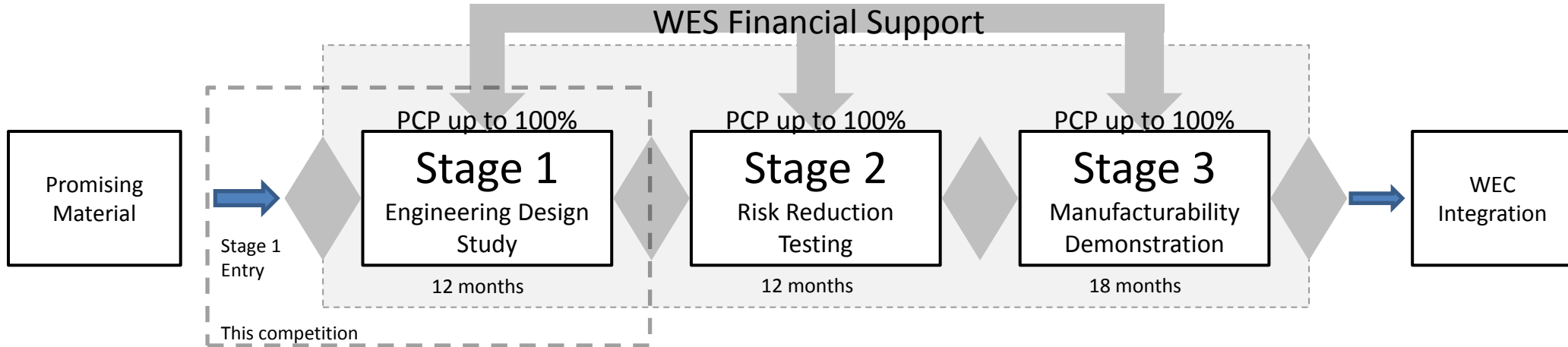
Angus Morrison – Project Engineer, WES

Call Update

- ❑ WES believes that an opportunity exists to carry out research into the impact of alternative materials on WEC construction
- ❑ Landscaping studies have been carried out and these show that there may be potential in other materials



This Competition :SM & MP



Material Categories

- Hybrid Structures using rotational moulding of polymers
- Elastomers
- Concretes
- Other alternative materials that could provide a step change in LCOE

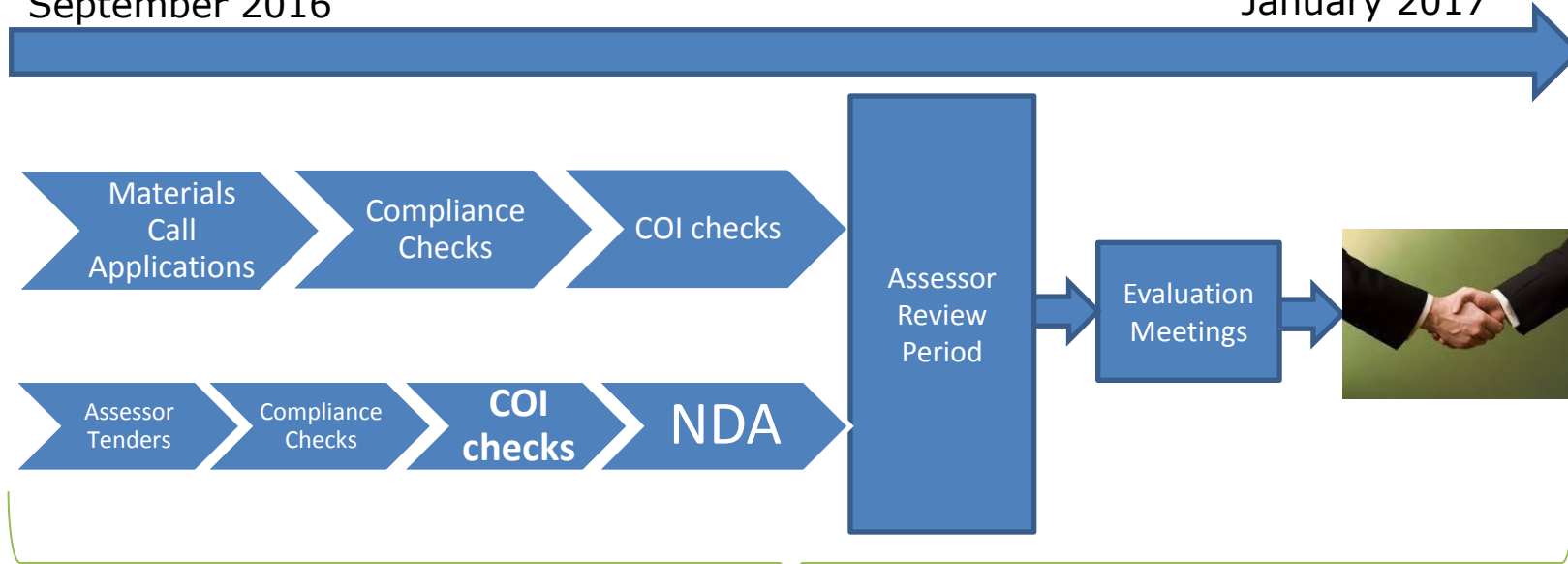
Key Dates

Description	Dates
1. Contract Note Published	18 th July 2016
2. Deadline for applications through PCS	8 th September 2016
3. Assessment Process	9 th September – 13 th December
4. Preferred applicants advised/Unsuccessful advised	14 th December 2016
5. Contracts Awarded to Successful applicants	January 2017

Assessment Process

Application Deadline 8th
September 2016

Contract Award
January 2017



Assessment Process

- ❑ Fair and unbiased assessment of assigned applications
- ❑ Scoring of applications using specified scoring criteria



- Criterion 1: Credibility of application
- Criterion 2: Commercialisation prospects
- Criterion 3: Project Design and Deliverability
- Criterion 4: Costs

Scoring Criteria

Score	Criteria
0 Unacceptable	Nil or inadequate response. Fails to demonstrate an ability to meet the requirement.
1 Poor	Response is partially relevant but generally poor. The response addresses some elements of the requirement but contains insufficient/limited detail or explanation to demonstrate how the requirement will be fulfilled.
2 Acceptable	Response is relevant and acceptable. The response addresses a broad understanding of the requirement but may lack details on how the requirement will be fulfilled in certain areas.
3 Good	Response is relevant and good. The response is sufficiently detailed to demonstrate a good understanding and provides details on how the requirements will be fulfilled.
4 Excellent	Response is completely relevant and excellent overall. The response is comprehensive, unambiguous and demonstrates a thorough understanding of the requirement and provides details of how the requirement will be met in full.

Evaluation and Selection

- Evaluation meetings held to discuss the scores given to each application
- Opportunity to identify areas which require further clarification
- Scores can be altered by individual assessors at this stage
- WES selection committee meets to confirm the overall rankings
- HIE Finance department undertakes Economic/financial review of successful applicants



Agenda

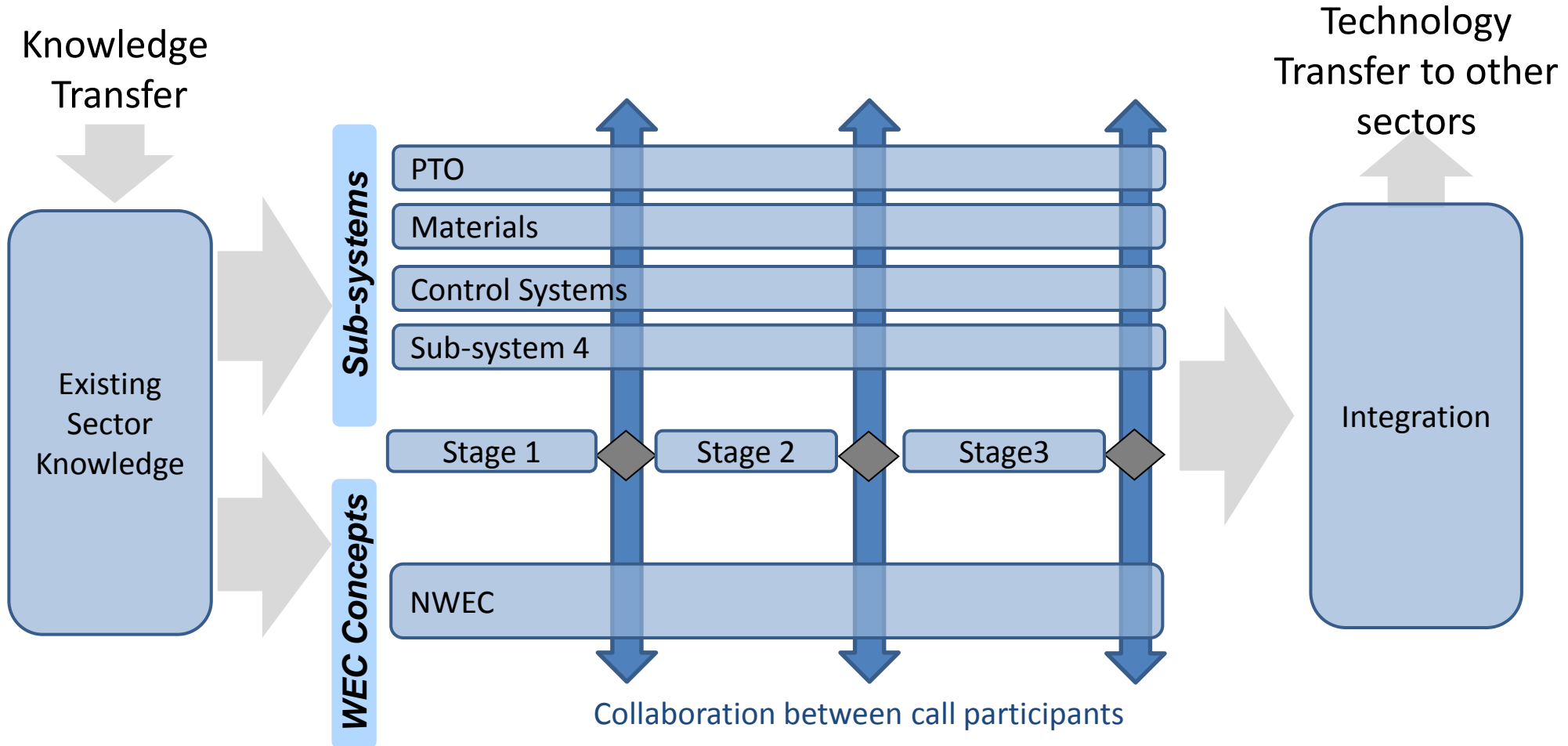
Time	Programme
09:30	Registration
10:00	<u>Overall WES programme summary</u>
10:15	<u>Current call- Structural Materials and Manufacturing Processes</u>
10:25	<u>Next call - Controls</u>
10:30	<u>Key-note speaker, Ross Henderson</u>
10:50	Break – NWECC and PTO poster sessions
11:20	<u>Power Take-Off programme participants - 3 minute pitches</u>
12:10	<u>NWECC programme participants - 3 minute pitches</u>
12:50	Lunch – NWECC and PTO poster sessions
13:40	<u>Novel Wave Energy Converter (NWECC) call - Stage 2</u>
14:00	<u>10 commandments of Wave Energy Technology Development - workshop</u>
15:00	Networking and Drinks
16:00	Close

1st Annual WES Conference

Next Call – Controls

Jonathan Hodges, Senior Innovation Engineer, WES

WES Programme – Controls call



Supported Technologies

PTO

NWEC

Materials

*Di-electric
Generator*



Electric



Hydraulics



Gearbox

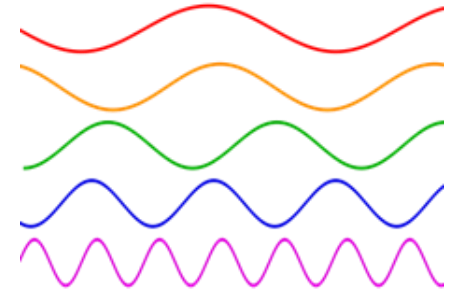


Polymer Spring



Introduction – Controls call

- ❑ Stage 1 call release Q1 2017
- ❑ PTO and NWECC stage gates approaching
 - Increased controls activity in next stages
- ❑ Opportunity for collaboration
 - PTO/NWECC/Controls
 - Networking sessions
- ❑ Guidance on engagement with controls
 - Ross Henderson



1st Annual WES Conference

Wave Energy Control in Practice

Ross Henderson – Senior Consultant, Quoceant

Slides shared
separately

Agenda

Time	Programme
09:30	Registration
10:00	<u>Overall WES programme summary</u>
10:15	<u>Current call- Structural Materials and Manufacturing Processes</u>
10:25	<u>Next call - Controls</u>
10:30	<u>Key-note speaker, Ross Henderson</u>
10:50	Break – NWECC and PTO poster sessions
11:20	<u>Power Take-Off programme participants - 3 minute pitches</u>
12:10	<u>NWECC programme participants - 3 minute pitches</u>
12:50	Lunch – NWECC and PTO poster sessions
13:40	<u>Novel Wave Energy Converter (NWECC) call - Stage 2</u>
14:00	<u>10 commandments of Wave Energy Technology Development - workshop</u>
15:00	Networking and Drinks
16:00	Close

Break

1st Annual WES Conference

3 minute elevator pitches

Power Take-Off call participants (PTO)

Running Order

1. Trident Energy
2. Scuola Superiore Sant'Anna
3. Romax Technology
4. Oscilla Power
5. University of Edinburgh
6. Ecosse Subsea
7. BluePower Energy
8. Artemis Intelligent Power
9. CorPower Ocean
10. Umbra Cuscinetti
11. Exceedence

Slides shared
separately

1st Annual WES Conference

3 minute elevator pitches

Novel Wave Energy Converter call participants (NWECC)

Running Order

1. Zyba
2. Joules E. E. S.
3. Mocean Energy
4. AWS
5. 4c Engineering
6. Anaconda (Checkmate)
7. Quoceant

Slides shared
separately

Agenda

Time	Programme
09:30	Registration
10:00	<u>Overall WES programme summary</u>
10:15	<u>Current call- Structural Materials and Manufacturing Processes</u>
10:25	<u>Next call - Controls</u>
10:30	<u>Key-note speaker, Ross Henderson</u>
10:50	Break – NWECC and PTO poster sessions
11:20	<u>Power Take-Off programme participants - 3 minute pitches</u>
12:10	<u>NWECC programme participants - 3 minute pitches</u>
12:50	Lunch – NWECC and PTO poster sessions
13:40	<u>Novel Wave Energy Converter (NWECC) call - Stage 2</u>
14:00	<u>10 commandments of Wave Energy Technology Development - workshop</u>
15:00	Networking and Drinks
16:00	Close

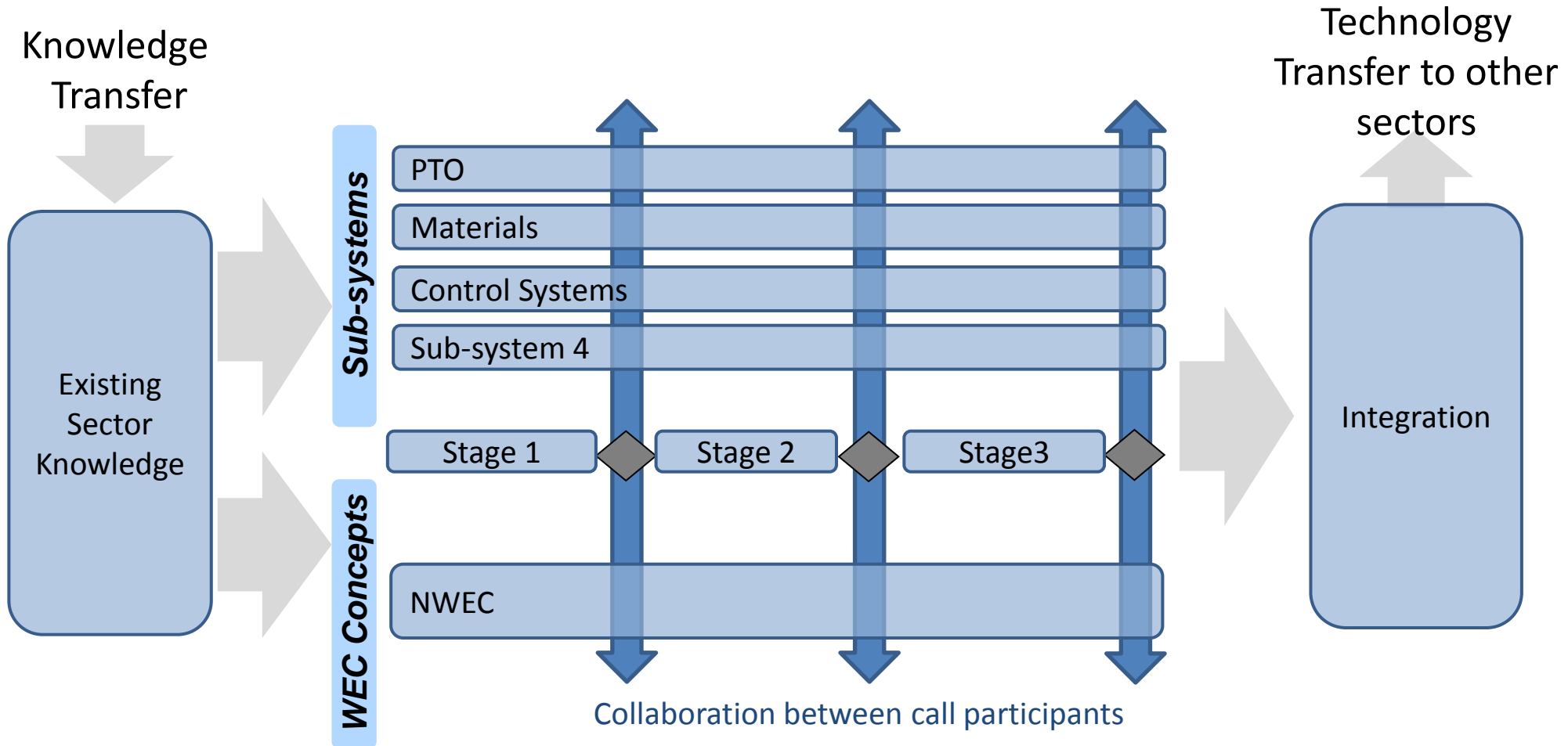
Lunch

1st Annual WES Conference

Novel Wave Energy Converter call – Stage 2

Matthew Holland –Project Engineer, WES

WES Programme – Controls call



Technology Development Pathway

Research Needs

Engineering Needs

Commercial Needs

TRL 1-2

TRL 1-3

TRL 4

TRL 5-6

TRL 7-8

Concept Creation &
Feasibility Work

Stage 1

Concept
Characterisation &
Refinement

Stage 2

Concept Optimisation
& Demonstration of
Engineering
Specification

Stage 3

Small Prototype
Development

Large Prototype
Demonstration

◆ Stage Gate /
Technical Milestone
/ Defined
Performance

Overview – Novel WEC – Stage 2

- ❑ What is happening in Stage 1 of Novel WEC?

- ❑ What are the requirements for Stage 2?
 - Objectives
 - Activities
 - High Level Target Outcomes



Novel WEC Stage 1

- ❑ Characterisation and development of the prime mover and structure of novel WEC concepts.
- ❑ Basic technical properties of concept are well defined and understood
- ❑ Performance assessment through independently verified tank tests in mandatory sea states.
- ❑ Long term target of achieving £150/MWh at 1GW global market maturity.



Novel WEC Stage 1



4c Engineering



Albatern Ltd



AWS Ocean Energy Ltd



Checkmate Seaenergy Ltd



Joules Energy Efficient Services Ltd



Mocean Energy Ltd



Quoceant Ltd



Zyba Renewables Ltd

Novel WEC Stage 1 – To be completed

Indicative Stage 1 project timeline	Month from start											
	1	2	3	4	5	6	7	8	9	10	11	12
Design development	█											
Analytical studies		█										
Numerical modelling studies		█										
Model & Telemetry Design, Build & Testing		█										
Small scale tank testing/learning			█									
Standardised performance test						█						
System simulation and optimisation studies					█							
Concept engineering								█				
Costing and LCOE/related metrics										█		
Programme workshops	█										█	█
Review meetings					█	█					█	█
Key: Third party verification ★												

Performance Testing	█
Concept Engineering Activity	█
Events	█

Overview – Novel WEC – Stage 2

- ❑ What is happening in Stage 1 of Novel WEC?

- ❑ What are the requirements for Stage 2?
 - Objectives
 - Activities
 - High Level Target Outcomes

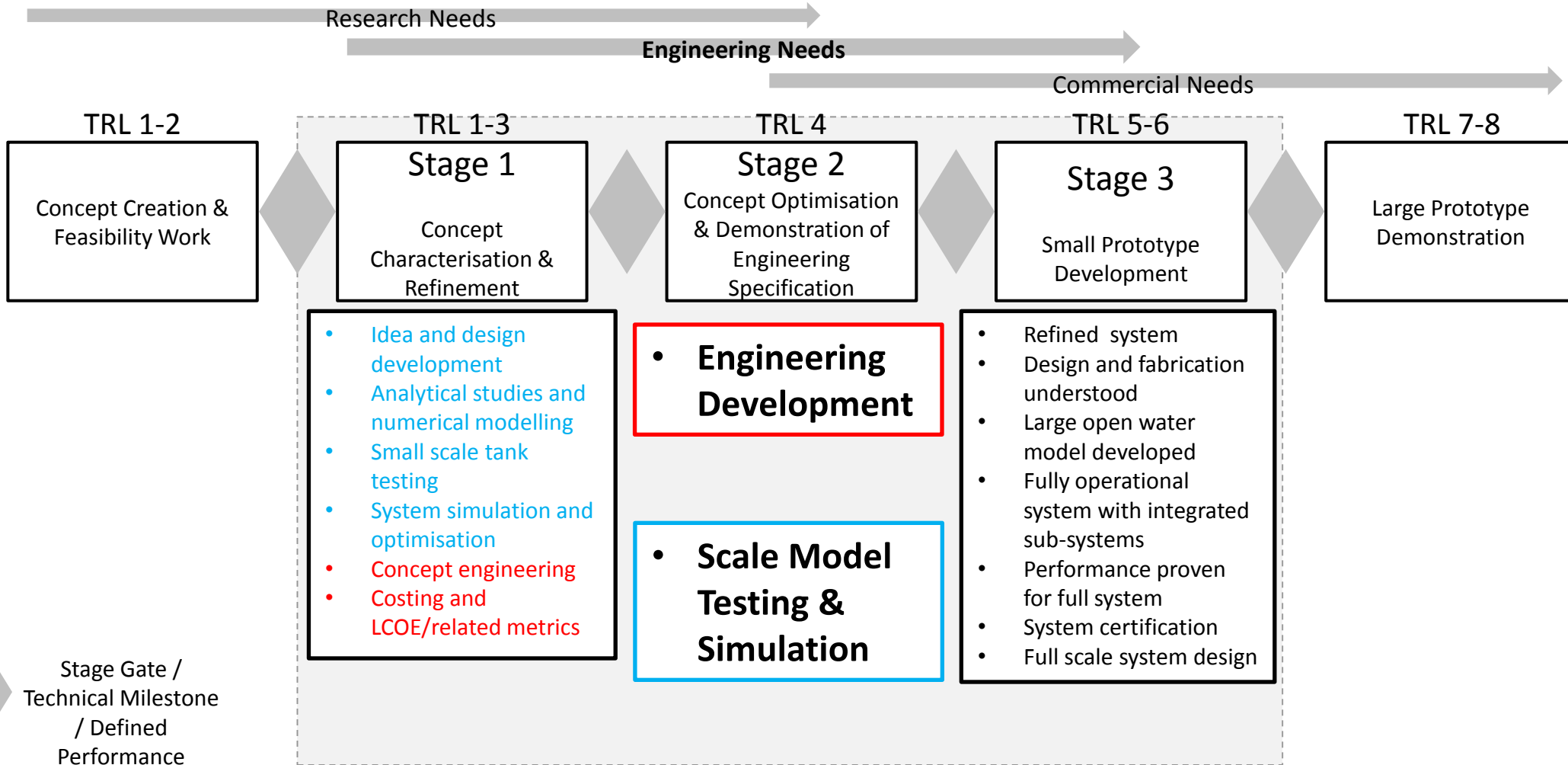


Novel WEC Stage 2 – Aims

- ❑ Investigate device reliability, survivability, installability and manufacturability
- ❑ Confirm that the concept has maintained its potential to have a significant impact in the sector and meet the overall WES objectives



Technology Development Pathway



Engineering Development

- ❑ Address and mitigate main technology challenges
 - ❑ Complete concept and FEED
 - ❑ Present credible, robust solutions, justified by evidence, calculation and testing.
-
- (Full Scale) Concept refinement
 - FEED (Small Sea-Going Prototype)
 - Operations planning
 - LCOE modelling



Scale Model Testing & Simulation

- ❑ Characterise the device ultimate and fatigue loads
- ❑ Fully validate numerical models
- ❑ Plan Stage 3 programme for scale tank testing and open water testing

- Technology performance optimisation
- Technology Loading Characterisation
- Numerical model validation
- Numerical / Analytical Modelling
- Open water & subsystem test planning



Next Steps

- ❑ Application process opens January 2017
 - Similar to NWEK Stage 1
 - Will ask to reference back to Stage 1 deliverables

- ❑ Scope out required Stage 2 activities
 - Activities, objectives, targets
 - Chance to develop consortium prior to Stage 2 application

Agenda

Time	Programme
09:30	Registration
10:00	<u>Overall WES programme summary</u>
10:15	<u>Current call- Structural Materials and Manufacturing Processes</u>
10:25	<u>Next call - Controls</u>
10:30	<u>Key-note speaker, Ross Henderson</u>
10:50	Break – NWECC and PTO poster sessions
11:20	<u>Power Take-Off programme participants - 3 minute pitches</u>
12:10	<u>NWECC programme participants - 3 minute pitches</u>
12:50	Lunch – NWECC and PTO poster sessions
13:40	<u>Novel Wave Energy Converter (NWECC) call - Stage 2</u>
14:00	<u>10 commandments of Wave Energy Technology Development - workshop</u>
15:00	Networking and Drinks
16:00	Close

1st Annual WES Conference

10 Commandments of Wave Energy Converter Design

Brian Holmes

Slides shared
separately

Topic Areas from Metrics Workshop

Controllability

Acceptability

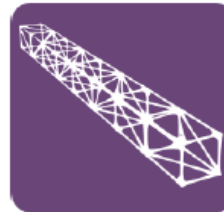
Reliability

Maintainability



Installability

Energy Capture



Manufacturability

Energy Conversion

Affordability

Survivability

Topic Areas for this workshop

Installability and
Maintainability



Reliability

Energy Capture
and Conversion



Scalability

Survivability

Workshop

- ❑ Place post-its in “MUST” and “MUST NOT” boards
- ❑ WES team at each station to feedback and summarise
- ❑ Collate after workshop



Agenda

Time	Programme
09:30	Registration
10:00	<u>Overall WES programme summary</u>
10:15	<u>Current call- Structural Materials and Manufacturing Processes</u>
10:25	<u>Next call - Controls</u>
10:30	<u>Key-note speaker, Ross Henderson</u>
10:50	Break – NWECC and PTO poster sessions
11:20	<u>Power Take-Off programme participants - 3 minute pitches</u>
12:10	<u>NWECC programme participants - 3 minute pitches</u>
12:50	Lunch – NWECC and PTO poster sessions
13:40	<u>Novel Wave Energy Converter (NWECC) call - Stage 2</u>
14:00	<u>10 commandments of Wave Energy Technology Development - workshop</u>
15:00	Networking and Drinks
16:00	Close

Summary of the day

❑ WES context

- What are the objectives?

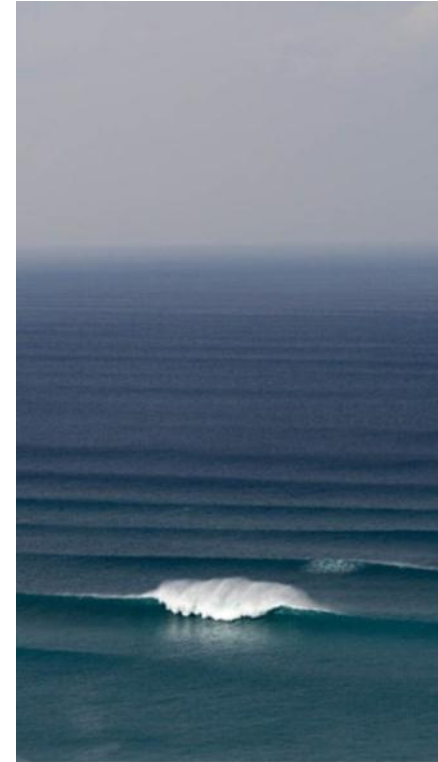
❑ WES Programme

- What calls are we running?
- Who's in the programme?
- What technologies are being developed?
- How are calls and projects managed?

❑ International collaboration

- And why...

❑ Measuring success and sharing



Drinks!

Have a good weekend!

1st Annual WES Conference