

Ocean renewable energy development; experience from the UK

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Ian Hutchison



aquatera

environmental services and products

Overview

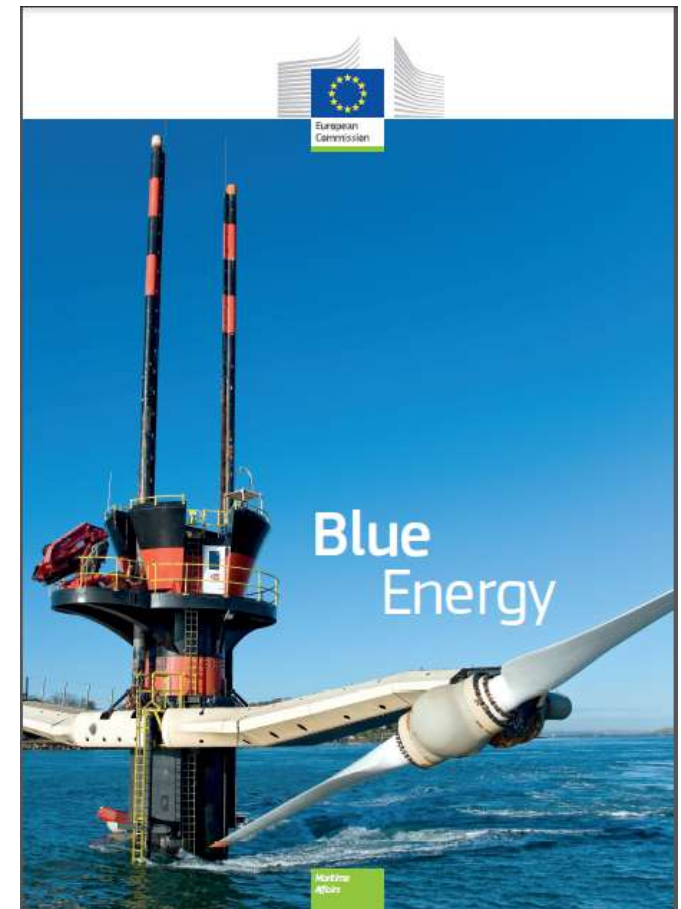
- Why ocean renewable energy?
- Aquatera and ocean renewable energy
- Ocean renewable energy in Orkney
- Ocean energy and the environment
- Key lessons from the UK



Why develop marine energy?

EC Blue Energy Communication

- Source of clean energy
- Vast resource (tidal current, wave, offshore wind, OTEC, tidal range)
- Generate economic growth and jobs in coastal and inland areas
- Contribute to self-sufficiency and replace expensive diesel generated electricity
- Contribute to decarbonisation goals



Aquatera and ocean energy

Aquatera

- Founded in 2000
- Located in Stromness Orkney
- Aquatera Chile established in 2014
- 26 core employees based in Orkney
- ~25 Associates located around the World
- Established network of local and international delivery partners



Stromness base at the heart of the marine industry



Aquatera team



Exporting success



Key activities in ocean renewables

- Resource assessment and site selection
- Environmental impact assessment and permitting support
- Environmental monitoring and management
- Stakeholder consultation
- Construction and operations planning
- Operations and logistics management
- Health and safety management
- Compliance monitoring and regulator liaison
- Project management and turnkey services
- Strategic planning and industry Roadmapping
- Supply chain analysis and socio-economic assessments



Some of our wave and tidal clients

Wave technology



Tidal technology



Some of our other clients

Organisations



Governments



Multinationals



Devices

Openhydro



Scotrenewables



Aquamarine power



Pelamis



Seatricity



Wello

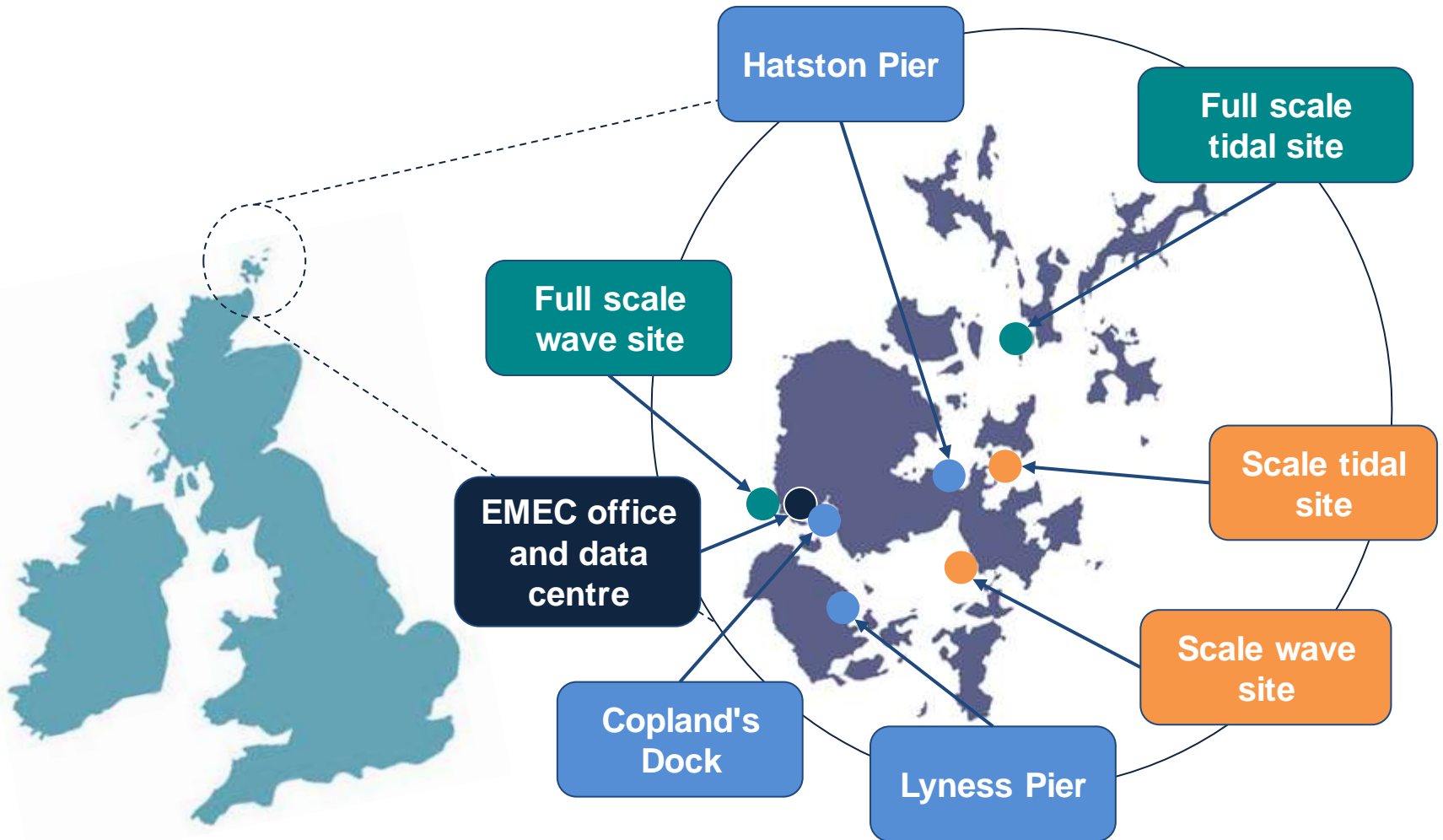


Ocean Renewable Energy in Orkney



European Marine Energy Centre (EMEC)

Where is EMEC?



Wave test site: Billia Croo



Tidal test site: Fall of Warness

The central image shows a yellow tidal turbine being towed by a vessel. Surrounding this are several smaller images: a yellow tidal turbine on a platform, a blue and white turbine, a close-up of a turbine nacelle, and a view of multiple turbines in a field. On the right side, there is a vertical list of logos for various companies involved in tidal energy.

- openhydro
tidal technology
- Tidal Generation
- ATLANTIS
RESOURCES CORPORATE
- Scotrenewables
Tidal Power Ltd
- ANDRITZ
Hydro
Hammerfest
- VOITH
- Kawasaki
- bluewater

Achievement



Marine energy supply chain in Orkney



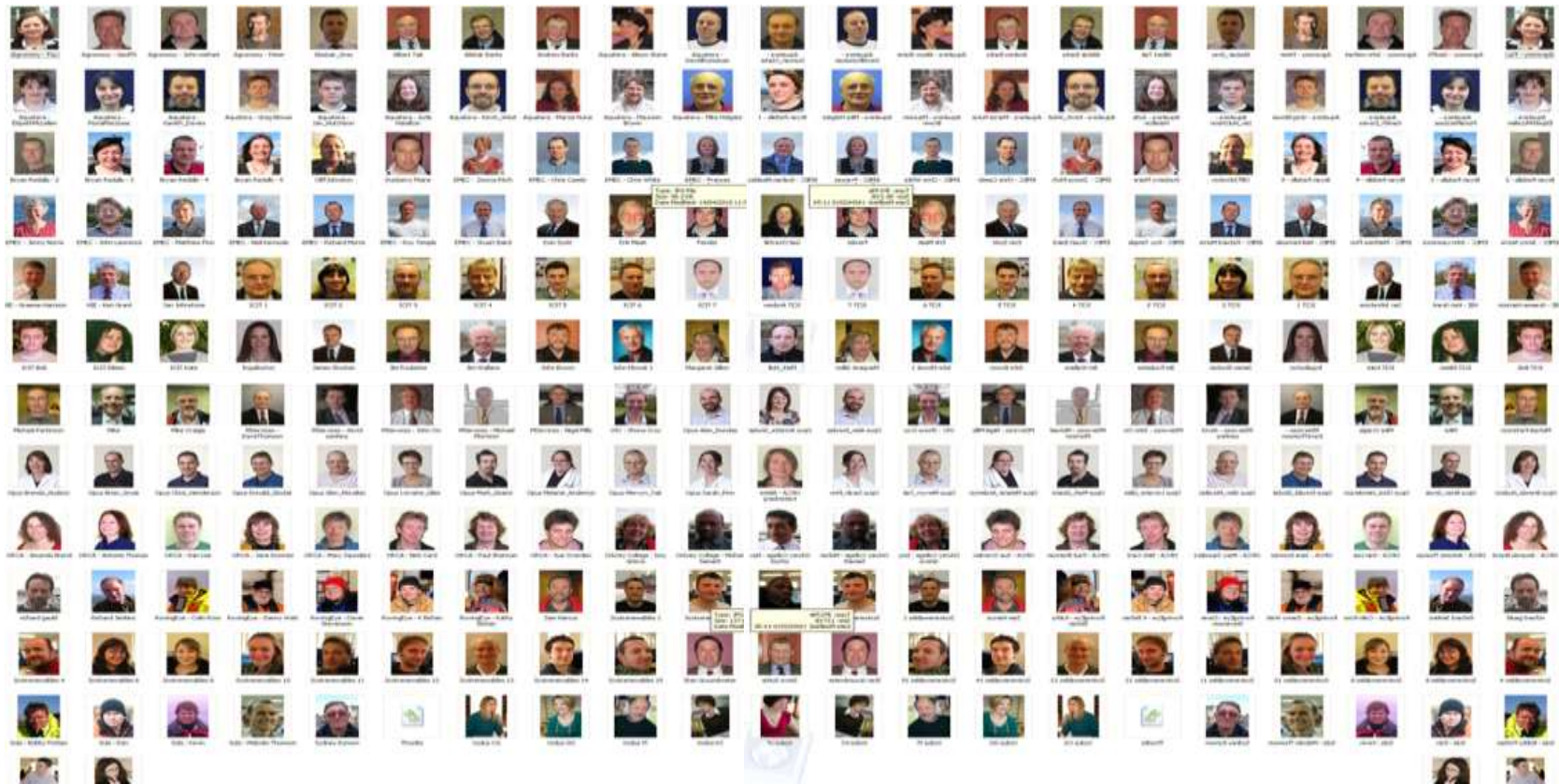
Supply chain experience in Orkney to date

- 18 technology companies operating
- 25 deployments of individual devices
- Over 20 permits obtained
- Over 100 surveys undertaken
- Over 2000 marine operations completed
- Over 30 supply chain companies active

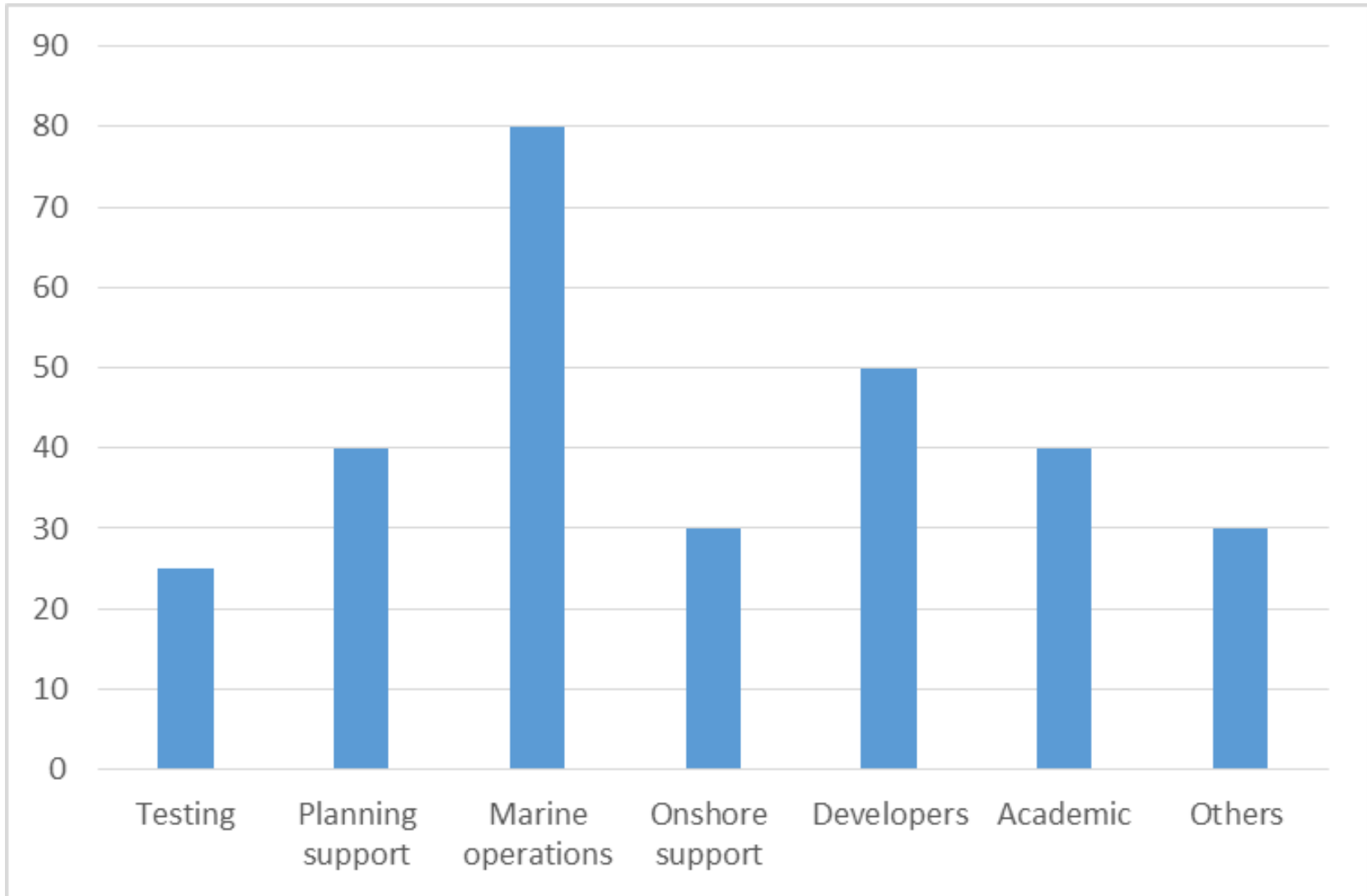


Employment

Around 250 people now working/studying marine renewable energy in Orkney. Total jobs on Orkney 10,000, direct marine energy = ~2.5%



Supply chain breakdown



Total investments in renewables to date (2012)

| Area | Gross investment to date in Orkney | Orkney investment to date | Orkney contribution (%) |
|----------------|------------------------------------|---------------------------|-------------------------|
| Marine (wave) | £100M | £5M | 5% |
| Marine (tidal) | £140M | £10M | 7% |
| Ports | £20M | £10M | 50% |
| Boats | £15M | £15M | 100% |
| New grid | £25M | £5M | 20% |
| Energy demand | £20M | £20M | 100% |
| Total | £318M | £65M | 30% |



Current Status

Current activity in Orkney

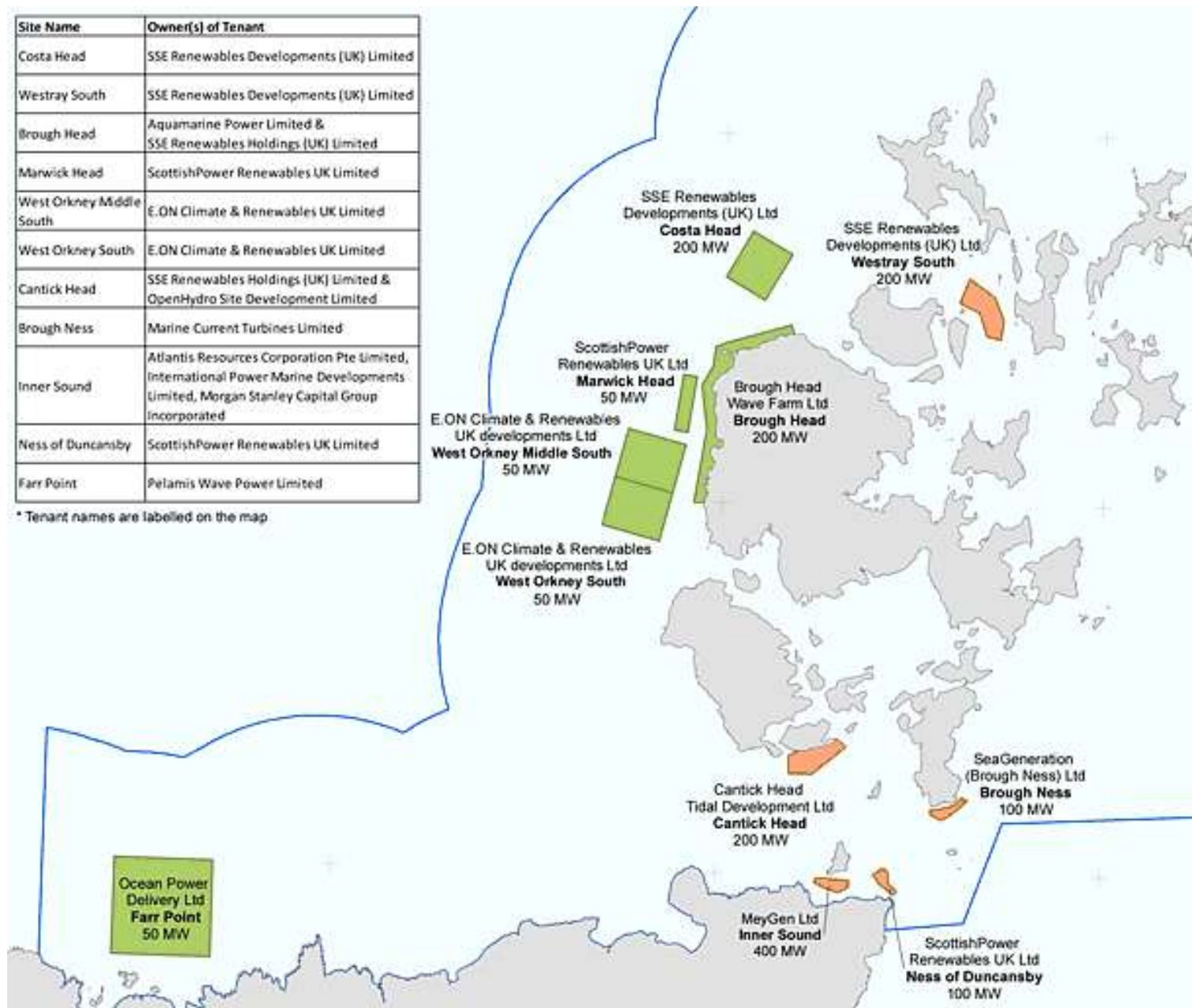
- Operational wave and tidal current devices
- New devices installed in Q4 2015
- R&D into cost reduction
- Infrastructure upgrades in planning
- R&D into energy storage
- Array planning
- Consent applications for commercial scale sites



Planning large scale arrays

| Site Name | Owner(s) of Tenant |
|--------------------------|--|
| Costa Head | SSE Renewables Developments (UK) Limited |
| Westray South | SSE Renewables Developments (UK) Limited |
| Brough Head | Aquamarine Power Limited & SSE Renewables Holdings (UK) Limited |
| Marwick Head | ScottishPower Renewables UK Limited |
| West Orkney Middle South | E.ON Climate & Renewables UK Limited |
| West Orkney South | E.ON Climate & Renewables UK Limited |
| Cantick Head | SSE Renewables Holdings (UK) Limited & OpenHydro Site Development Limited |
| Brough Ness | Marine Current Turbines Limited |
| Inner Sound | Atlantis Resources Corporation Pte limited, International Power Marine Developments Limited, Morgan Stanley Capital Group Incorporated |
| Ness of Duncansby | ScottishPower Renewables UK Limited |
| Farr Point | Pelamis Wave Power Limited |

* Tenant names are labelled on the map



Environmental interactions; lessons learnt to date

Underwater noise

Wello Oy – Penguin

- Acoustic survey (2012) by ICIT and Aquatera
- Ambient background noise levels to be reached within approximately 10m from the device



Current thinking:

- No significant impacts from the operation of single devices and small arrays



Seabed effects from drilling

- Seabed surveys
 - Baseline
 - Post installation
 - Pre-removal
 - Post-removal
- Seabed impacts limited to within 1-2m
- Regulator no longer requires seabed surveys at the test site

Current thinking:

- No significant impacts from the operation of single devices and small arrays



Wildlife interactions with machines



Fish shoaling around tidal turbine

Wildlife interactions with machines



Seabirds on a Pelamis P2 device

No significant adverse effects observed from the deployment and operation of single machines.

Further monitoring and strategic research required to better understand potential interactions and to inform the sustainable development of larger projects.



Key lessons from the UK

Lessons learnt to date

- Understand the available resource – undertake detailed resource assessment work
- Establish long term, stable political and financial support mechanisms e.g. feed-in-tariff, grant funding for R&D
- Undertake a Roadmapping exercise to create a structured development plan for the industry
- Identify opportunities for growing local economy, supply chain and jobs
- Develop a proportionate approach to consenting based upon experience to date
- Develop strong partnerships between stakeholders
- Information, education and communication are essential for social acceptance



Thank you



ian.hutchison@aquatera.co.uk