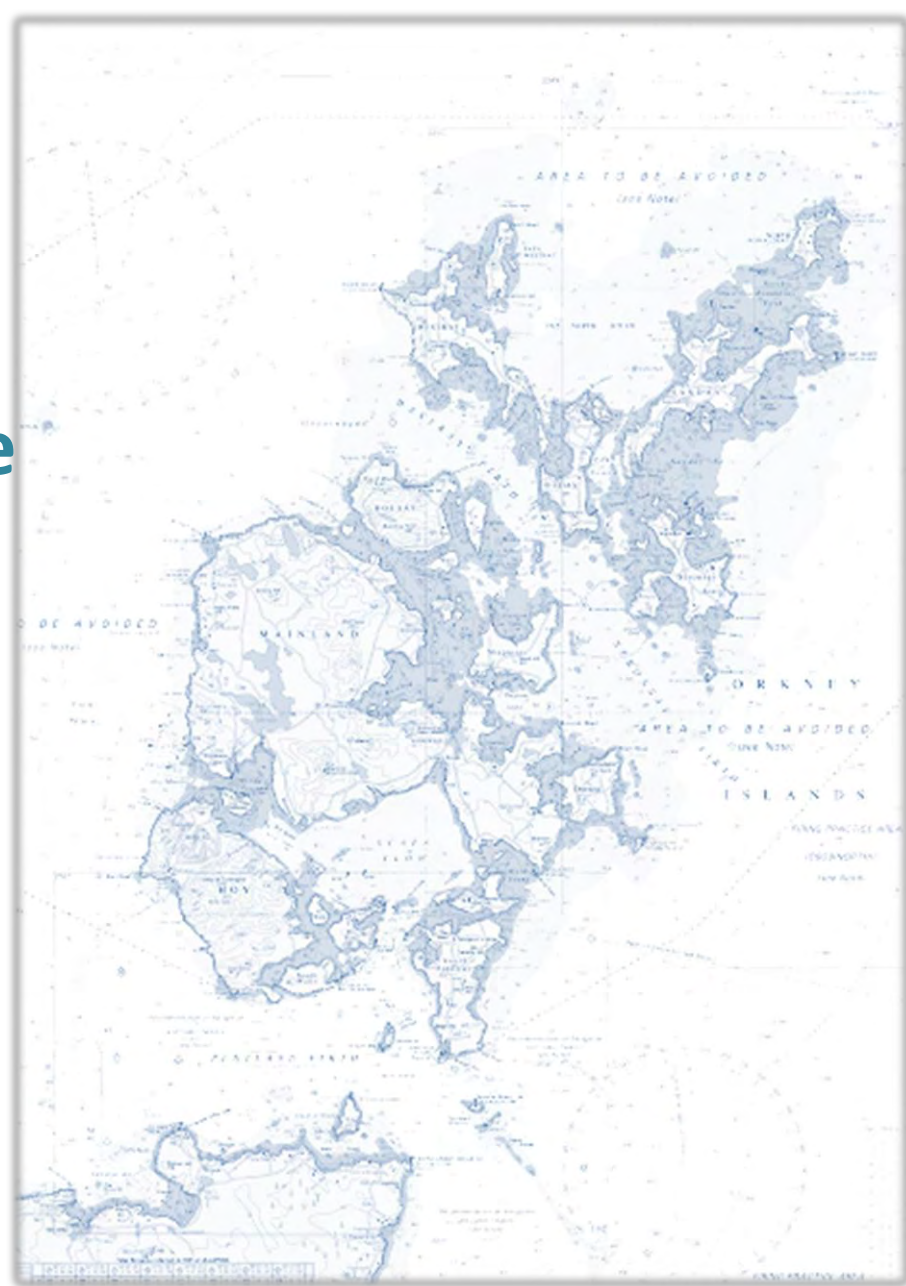


**Two decades to change
the world: 2000-2020**

Orkney's global role in
the drive to harness
energy from the seas

Gareth Davies
Aquatera Ltd



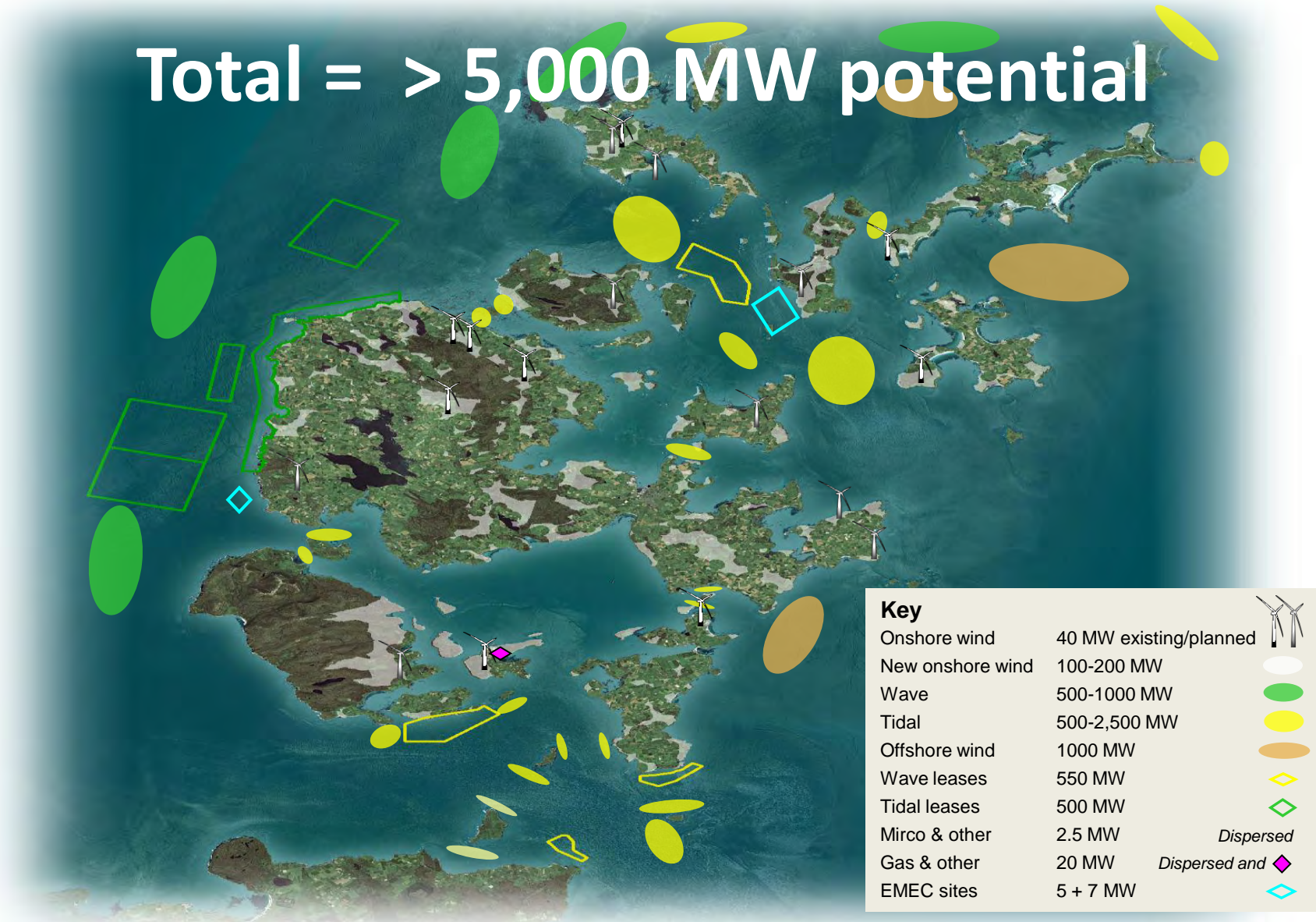
Orkney's strategic energy pedigree

- Early “electro-aero generators” tested in Orkney 1950s & 1980s
- Flotta Oil Terminal delivering 10% UK oil since 1974
- World's largest wind turbine 1984-97 (3 MW)
- Highest per capita CO2 emissions in UK
- Next door Caithness hosts the UK's leading nuclear research facility – now being decommissioned



Orkney's energy resources

Total = > 5,000 MW potential



Decade of preparation: 2000-2010

Committing to marine energy

- Have champions for an energy revolution
- Get organised to push for what was wanted/needed
- Get backing from local authority & Scottish Government to create a marine energy market:
 - EMEC wave site (2002)
 - EMEC tide site (2005)
 - Strategic Assessment (2006)
 - Enhanced ROCs (2006)
 - WATES grants (2008)
 - WATERS grants (2010)
- Global focus on Orkney, *but*, significant hurdles still to be overcome



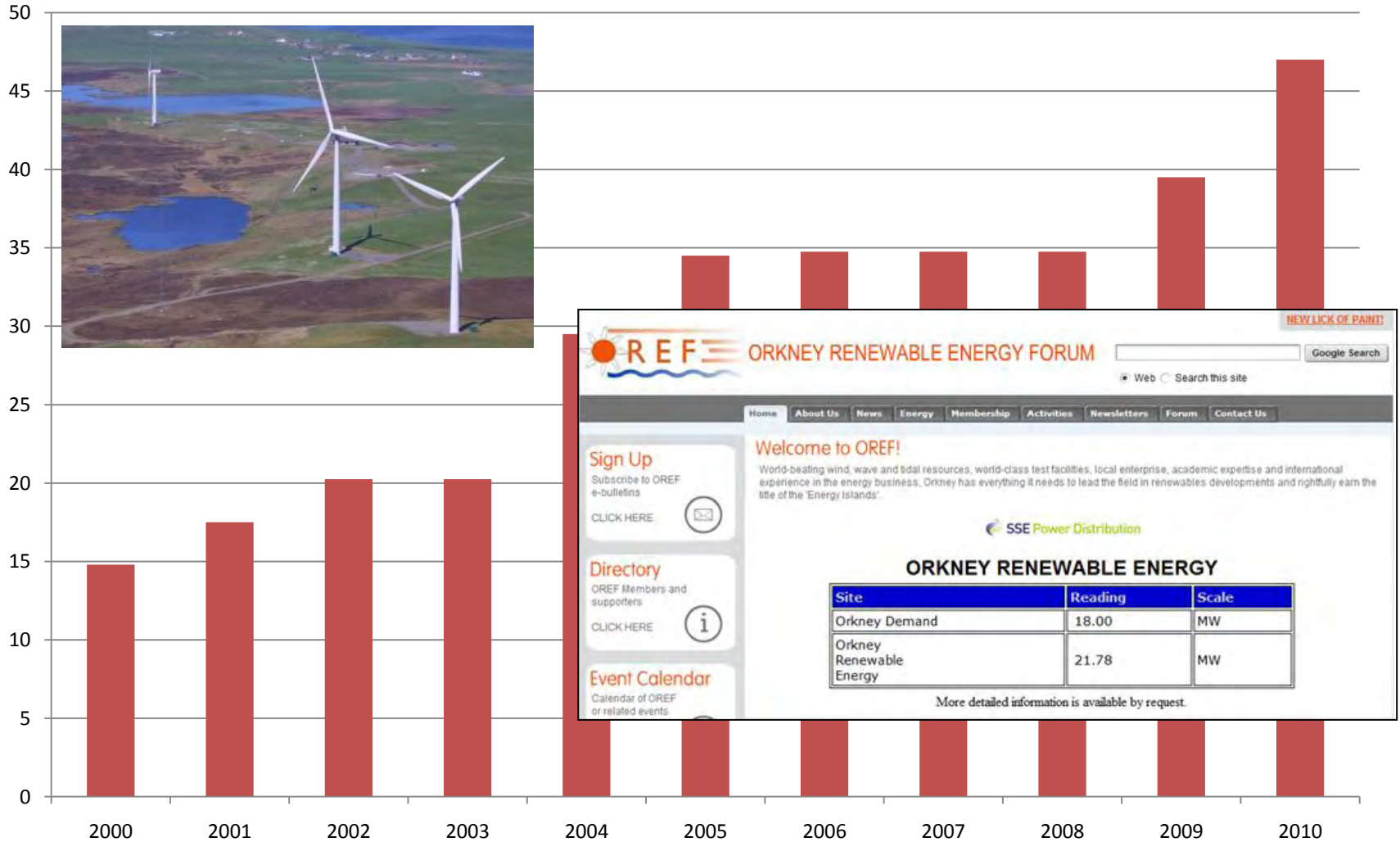
The technology pathway – first decade

- First deployments at wave site:
 - Wave Roller & Pelamis 1 between 2003-5
- Focus moves to tidal site:
 - Open Hydro (2006 ~)
 - TGL (2007~)
- Wave energy devices come again:
 - Aquamarine oyster 1 (2009)
 - EON (Pelamis 2) (2010)
- More tidal technologies
 - Atlantis (2010)
 - Voith monopile (2010)
- 8 technology deployments involving over 50 delivery/recovery operations



Growing generation capacity – now a net exporter

(40 MW large scale, >1 MW micro Installed)



Education and employment

- ICIT students
 - 250 MSc graduates
 - 10 PhD graduates
- Navigation school
 - 100s of mariners, many with global experience
- Archaeology
 - World class expertise
- Environmental
 - International experts across a range of areas
- Marine
 - Pilotage service and numerous master mariners
- Engineering and electrical
 - Full capacity, especially with Caithness partners

Over 250 people now employed for/studying renewables related activity in Orkney



Decade of achievements

Milestones

- World's 1st test centre
- World's 1st grid connected offshore wave energy
- UK's 1st grid connected tidal energy

Activities

- 8 different technologies deployed
- Over 50 individual technology/foundation deployments
- 15 large scale wind turbines erected

Employment

- 150 in marine renewables
- 250 in sustainable energy
- 500 in energy sector

Investment in Orkney

- £200M in renewables
- £150M in marine activity
- £20M invested by Orkney
- Up to £10M in revenue secured so far

Decade of Delivery 2011-2020

Five topics:

Policy

Technology

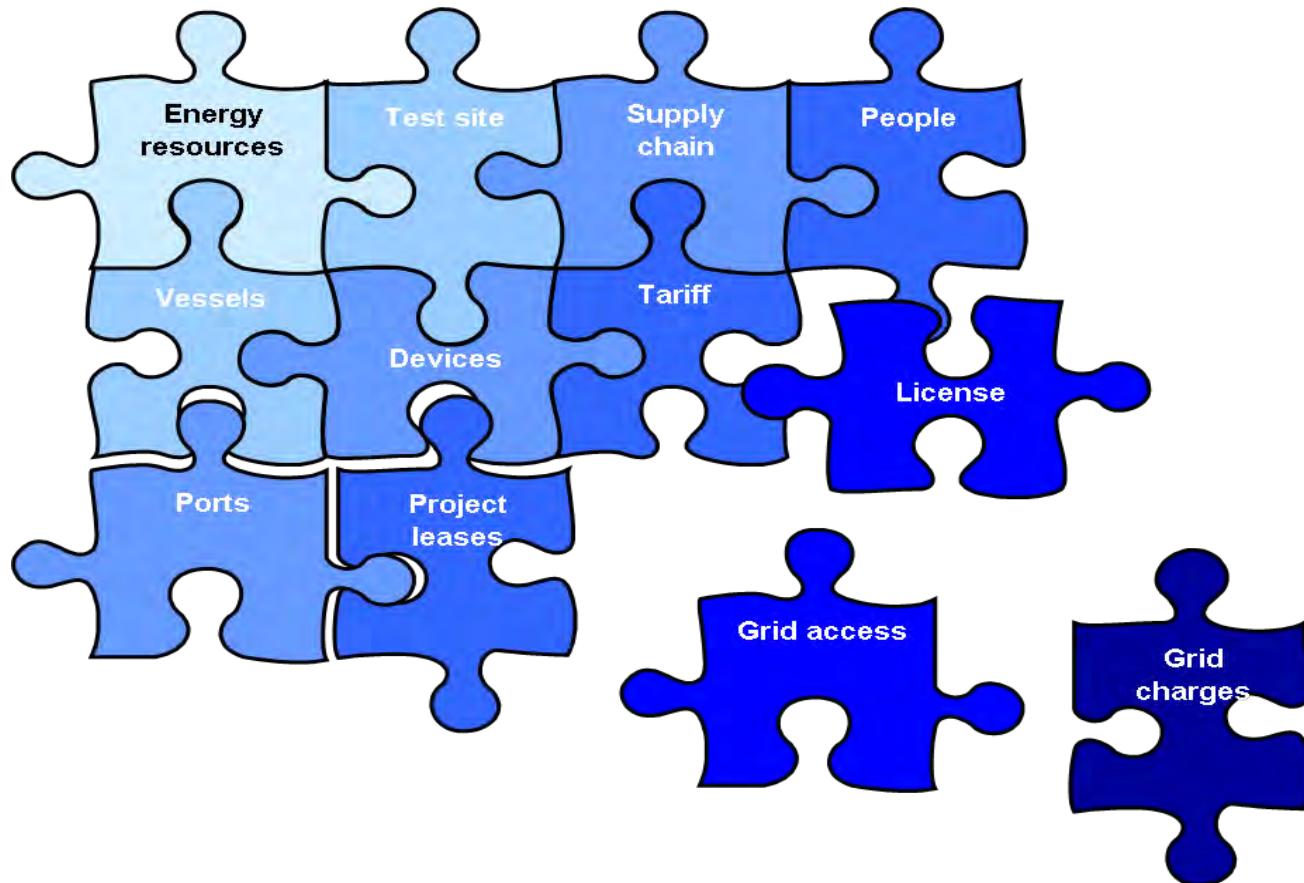
Infrastructure

Education and employment

Co-ordination

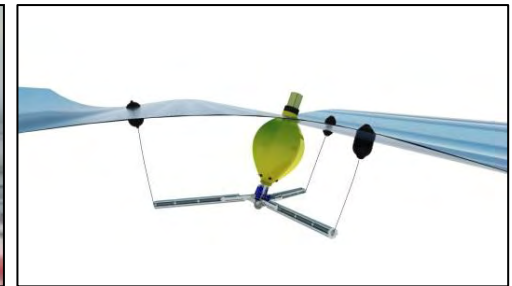
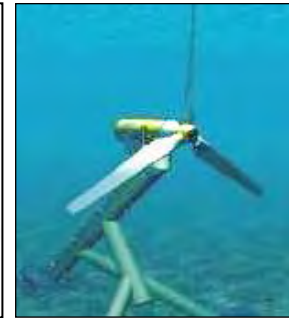
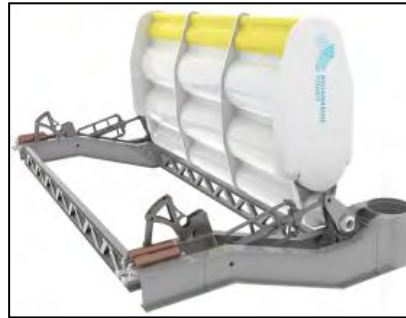
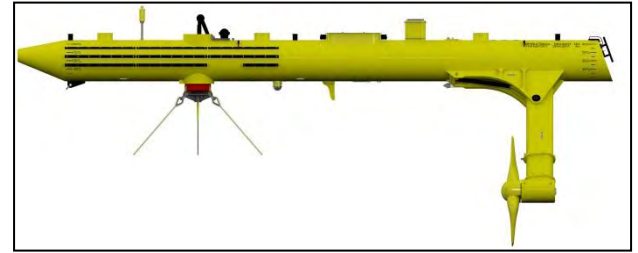
Policy and regulation

- We believe that 1 GW by 2020 is deliverable
- We are not on the right trajectory at present
- Need to prioritise backing for what is already started



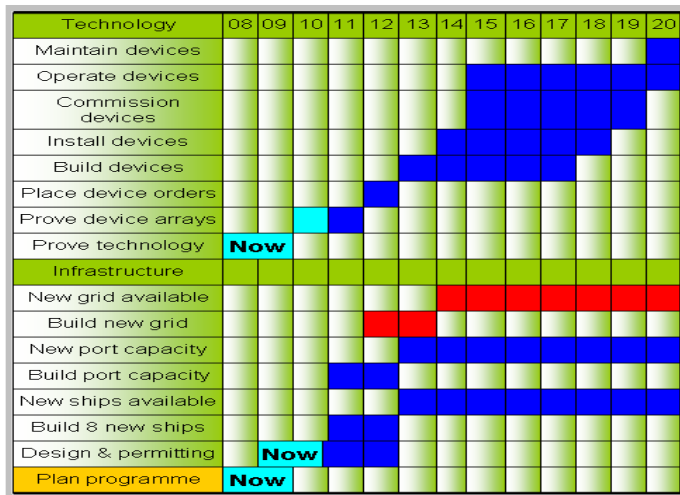
Present & future technology deployments

- In 2011
 - Scorenewables (tide)
 - Wello (wave)
 - Oyster 2 (wave)
 - SPR (Pelamis) 2 (wave)
 - Hammerfest Strom (tide)
 - Voith monopile (tide)
 - Albatern (wave)
 - AN other (tidal)
- Expected in 2012
 - Voith Hytide device (tide)
 - Seatricity (wave)
 - 3 others (wave & tidal)
- Ongoing
 - 5? new technologies per year!



Capacity build-up for marine energy to 2020

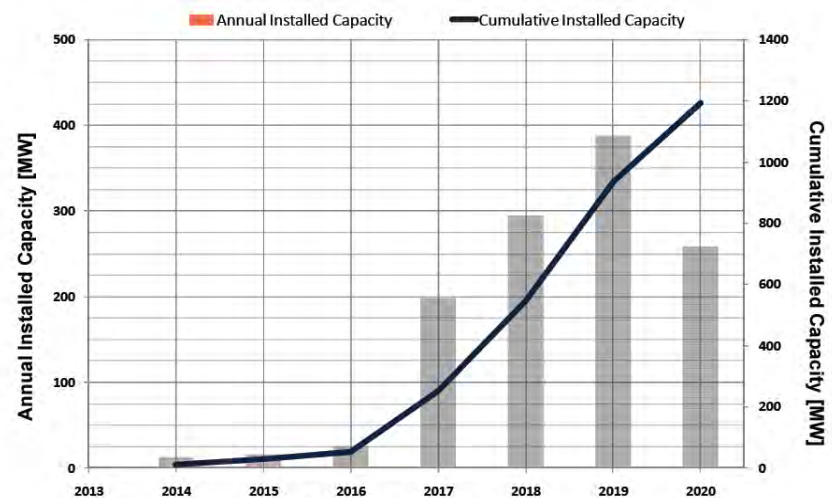
A local view – start 2015 @ 200 MW/yr



- Needs strong technology push
- Need grid for 2015
- Creates a stable capacity profile
- Leads to efficient & cheaper installation with dedicated resources

- Reflects state of technology
- Leave more time for grid
- Creates a boom/bust capacity issue
- Leads to inefficient and costly installation

Present plan – start 2017, max @ 400 MW/yr



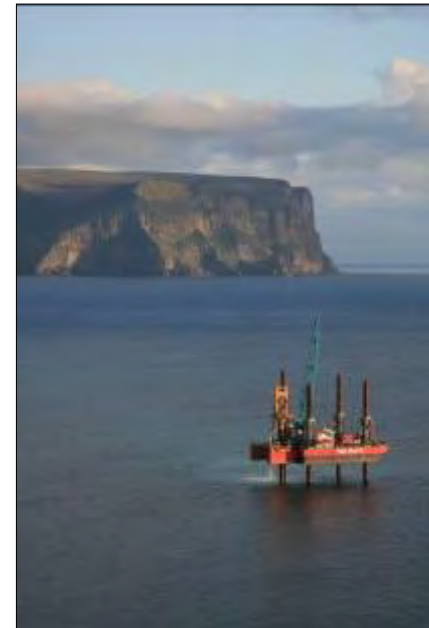
Future commercial scale installations

- There will be five years at most
- There may be 30-40 installation weeks per year



To meet 2020 target

- Need to install 3 wave devices each week from 2015
- Need to install 6 tidal devices each week from 2015
- Installation costs need to decreasing from £5-10M to <£0.5M per MW installed
- Also need storage areas for new devices and those due for maintenance
 - there may be >100 of them!!!



What infrastructure will we need and when ?

What will this region need to deliver 1 GW of marine renewables capacity:

- | | | |
|-------------------------------|-------------|------------|
| • Operations control centre | 1 | 2012 |
| • Prototype/demon. Devices | 50 | Now-2014 |
| • Expanded/new ports | 3-4 | Now-2014 |
| • Assembly/maintenance yards | 2-3 | Now-2014 |
| • Work boats | 20-30 | Now-2015 |
| • Large purpose built vessels | 10 | Now-2015 |
| • Local workforce | 500-1000 | Now - 2015 |
| • New houses | 300-600 | Now-2015 |
| • Expanded and new offices | 50 | 2012-2015 |
| • Emergency tugs | 1-2 | 2014 |
| • Sub stations (off/onshore) | 10-20 | 2014/15 |
| • New 132kv connections | 50-150 km | 2014/15 |
| • Connecting cables | 1000 | 2014-2019 |
| • Commercial energy devices | 1100-1200 | 2015-2020 |
| • Converter stations | 2-3 | 2016/17 |
| • HVDC grid connection | 2 | 2016/17 |
| • Co-gen/ storage | 1-2 schemes | 2016/17 |



Present plans for ports and grid

Scapa Flow, Orkney: 50 square miles of sheltered harbours waters

- Expansion of Hatston Pier Kirkwall (2011/12)
- Expansion of Stromness harbour (2011/12)
- Development of Lyness base Phase 1 (2011)
- Development of Scrabster harbour Phase 1 (2011/12)

New 132kV connection in 2015

New HVDC connections in 2017



Who will be involved – possibly some of you!

- Workforce of 1000 by 2020
... or is it 2015?
- Engineers 200?
- Scientists 100?
- Managers 100?
- Administration 100?
- Mariners 200?
- Manual workers 200?
- 50% need previous relevant experience
- 25% skills transfer
- 25% new recruits
- We have 10-20% of workforce already

The screenshot shows the 'Welcome to Orkney' website. At the top, there's a navigation menu with links: Home Page, Environment, Transport, Housing, Amenities, Employment, Business, Social Life, Education, Healthcare, and Contact Us. A large map of the Orkney Islands is displayed on the right. The main content area features a section titled 'Thinking of relocating to Orkney?' with a sub-header 'Then let this website be your starting point and personal guide! We hope that you will find it packed with useful information and advice on locating here in the islands.' Below this, there's a note: 'Please note that while all the textual information and links on this site are up-to-date, some of the video clips may be slightly out-of-date as they were shot some time ago. New clips are being planned.' There are two video thumbnails: one for 'low quality for low bandwidth connections' and another for 'high-quality for broadband and DSL connections'. A small image of a rocky coastline is also visible.

Helping prepare for incidents & accidents

- 20 near misses to date and one broken leg!!!
- Operational mishaps
 - 1 in 3 operations at present
 - 1 in 100 during deployment= 16
- Structural failure in devices/moorings
 - 1 in 5 at present
 - 1 in 100? During operation = 16/yr
- 3rd party vessel loses control in tidal stream once every 2 years
- Orkney Harbours VTS – worlds first renewables control centre!

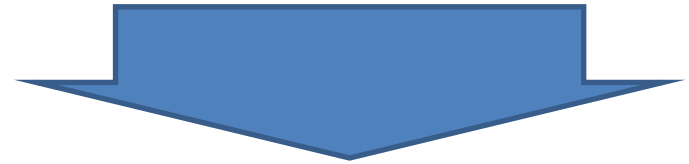


Importance of local content

- Presently

- Employment
 - 50-100% of 150 jobs
 - @ £30k = £2.25-4.5M
- Facility/equipment hire
 - 10-20k/wk = £1M
- Total £3.25-5.5M/yr

Presently ~£5M/yr



2015 onwards ~£100M/yr

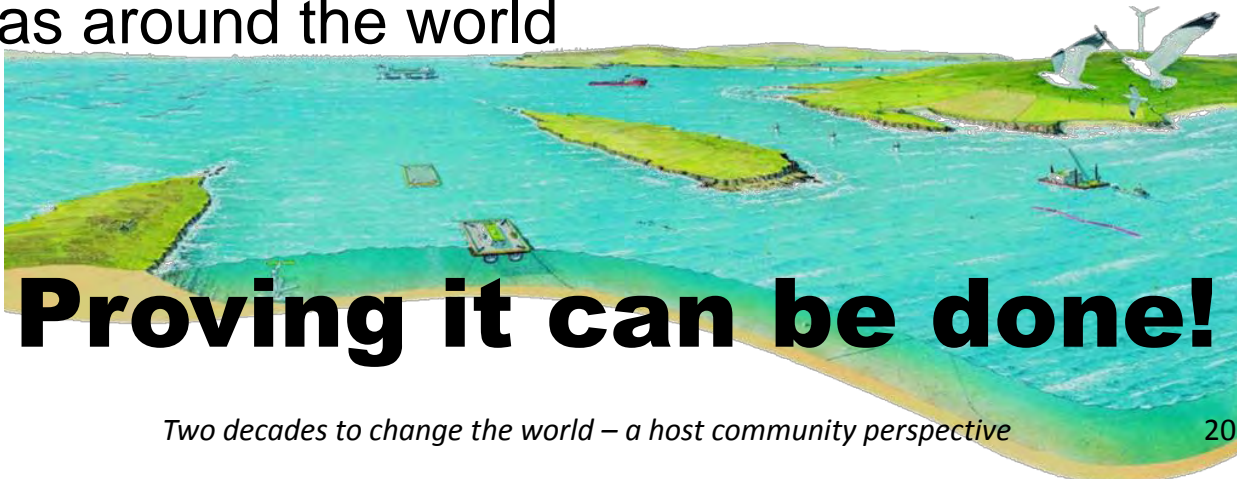
- Future

- 25% of capex installation = £50M/yr
- 50% of opex = £50M/yr



Rising to the marine challenge

- Key timescales for delivering ~ 1000MW in the decade of delivery, by 2020
 - Strategic planning: 1 yrs (2011)
 - Permitting: 2 yrs (2011-12)
 - Infrastructure construction, device fabrication: 3 years (2012-14)
 - Installation: over 5 years (2015-20)
- Success will require more than £5 billion investment
- Orkney is leading the way to commercialisation but is keen to work with others to achieve this and develop success in other areas around the world



Proving it can be done!