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ORKNEY RENEWABLE ENERGY FORUM

An introduction to Orkney – the sustainable energy island

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OREF CoChair & Board Member

OREF Aim's and approach

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- Formed in 2000
- Communication forum
  - To identify issues and opportunities
  - To promote solutions and lobby for change where needed
  - To facilitate collaboration
  - To encourage the development of renewables potential in a sustainable way and for the benefit of the whole Orkney community
- Has around 90 members
- Has been instrumental in lobbying for change and overcoming major obstacles, but a number still remain

Orkney Islands Energy Pedigree

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- Historically wind, hydro and biomass used for energy
- 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)
- 1990 ICIT established in Stromness
- 1990s - highest per capita C02 emissions in UK
- 1998-2000 moves to host the worlds first marine energy test centre and embrace wind as energy source

Key messages - Orkney as energy islands

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- Energy has been at the heart of the Orkney economy and society for centuries
- Our pedigree includes renewables as well as oil and gas
- Orkney is an advanced energy community, moving further, faster and more fervently than any other communities towards decarbonisation
- Orkney is a beacon of progressive energy thinking and development

World class resources and major development potential

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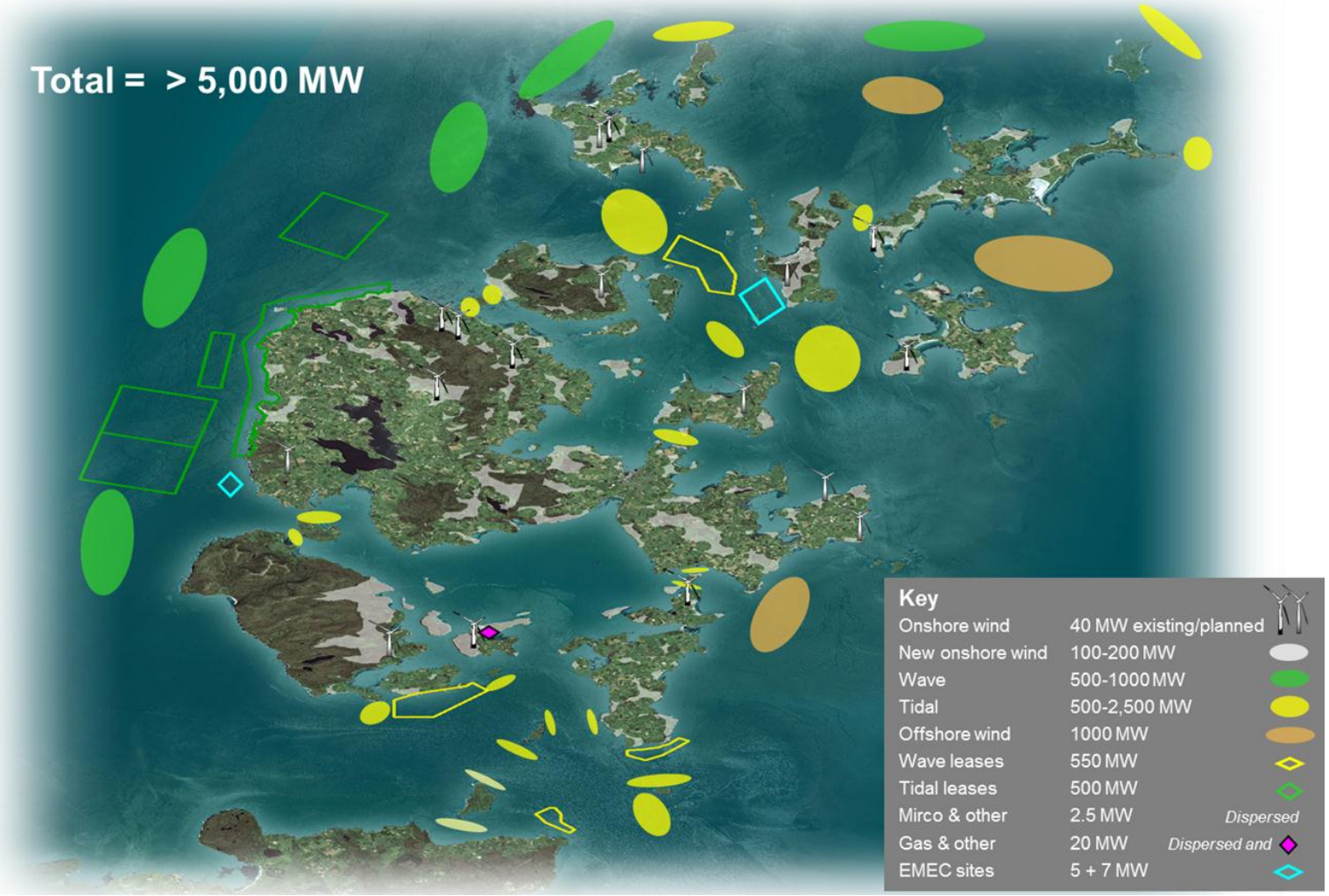

Energy achievements of Orkney, in Orkney and Orkney waters

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Record breaking achievements

- **World's largest wind turbine** (3MW) 1984-95
- **First locally owned** 1MW turbine in Scotland (2003)
- **World's largest** marine energy test centre
- **First** grid connected offshore wave energy
- **First** UK grid connected tidal energy

Energy achievements of Orkney, in Orkney and Orkney waters

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Major energy infrastructure

- **30 large wind turbines** installed
- **700 micro wind turbines** installed
- **400 other micro renewables** and energy efficiency installations
- **Over 70MW** installed renewables capacity
- **Over 60%** of capacity in local and community ownership
- Worlds **largest and most successful** marine test centre
- Globally **leading hydrogen** infrastructure
- Over **120% of electricity demand** from renewables in 2017/8
- Also handled **10% of UK oil** production since 1970's

Energy achievements of Orkney, in Orkney and Orkney waters

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World leading experience and expertise

- Cluster of **10 major marine energy companies**
- **Operating base** for a number of technology and project developers
- **30** marine energy **technologies** tested
- Over **100 technology deployment and recovery** operations
- **3000 vessel days** of maritime support operations
- Home to the worlds **largest planned marine energy projects**
- **Micro generation hot spot**
- **Europe's hydrogen capital**
- **500 MSc** and PhD graduates
- Knowledge transfer and collaborative relationships with over **30 countries and including 50 islands**

Key message – Orkney is a significant energy location

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- In energy terms Orkney is a special place
- It is not just the end of a grid spur it is a strategically important location for Scotland, for the UK and for the wider world
- Orkney has been a major energy hub for the last 40 year through the operation of the Flotta Oil Terminal
- Orkney is the gateway to significant generation capacity – there is at least 5GW of generation potential around the islands (possibly as much as 10GW)
- Orkney has also been the site of numerous technological breakthroughs, the base for introducing many pioneering ways of managing energy supply, an exemplar of how energy awareness within a community can lead to transformational changes in customer behaviour and a leading example of how engaging local investment and involvement can help energy developments progress ay unparalleled rates and scales

How has Orkney earned this opportunity?

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- Unique blend of natural resources - wind, wave, tide, oil, gas, solar, heat ….
- Vision - Oil 1970s; wind 1980's; marine 1990's, efficiency 2000's, hydrogen and storage 2010's, integrated energy solutions 2020s, large scale developments 2020s & 30s
- Commitment - People, money, sites, demand, ideas
- Knowledge and expertise - Unrivalled experience, facilities and cluster of experts and specialists
- Willingness to share know-how and success

Making it all happen - renewable energy people

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Type of activity	Numbers of people
Planning and permitting	30
Technology development	30
Project development	10
Technical services	30
Testing	20
Marine services	60
Insurance and finance	5
Regulation and enterprise	3
Research	40
Teaching and training	10
Students	35
Total	273

- Orkney has a unique cluster of expertise and experience
- Numbers currently around 270 in 2018/19 (previously 400)
- Orkney needs to earn £8-10M per year just to keep these people employed, plus need to sustain facilities, vessels and equipment and also repay investment
- A sustainable target income at present is around £25-30M per year

How much has been spent achieving what we have achieved?

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- Monetary value between 2000 and 2019:
  - Total value of renewables related activity associated with Orkney £700 million (M)
  - Total onshore activity costs £300M
  - Local investment in onshore energy ~£85M
  - Total marine energy programme cost in and around Orkney ~£400M
  - Local investment in marine energy ~£90M
  - Total local investment ~£175M (25%)

Key message – For Orkney energy is about money & jobs

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- Orkney understands energy as generators, as distributors and **as consumers**
- Grid connection to major parts of Orkney was only achieved in the late 1970's, we appreciate the benefits of connectivity in a very tangible way
- Orcadian's use more energy than any other part of the UK due to strong winds, cool temperatures, drafty housing, big sea and air journeys
- Orcadian's pay more for energy due to the amounts of energy used and due also to the excessive locational tariffs added to fuel and electricity delivery
- The quality of supply can be poor with many winter wind induced faults
- Over 270 people currently employed in renewables sector and a further 150-200 in the oil sector, so 420 to 470 people are currently employed in the energy sector across Orkney
- A huge part of Orkney's success has been/is willingness to invest collectively and individually in its own energy future
- That local investment of over £170M, is at risk of becoming a stranded investment due to the ongoing delay in delivering a new grid connection to Orkney

Key message – where do energy customers come from?

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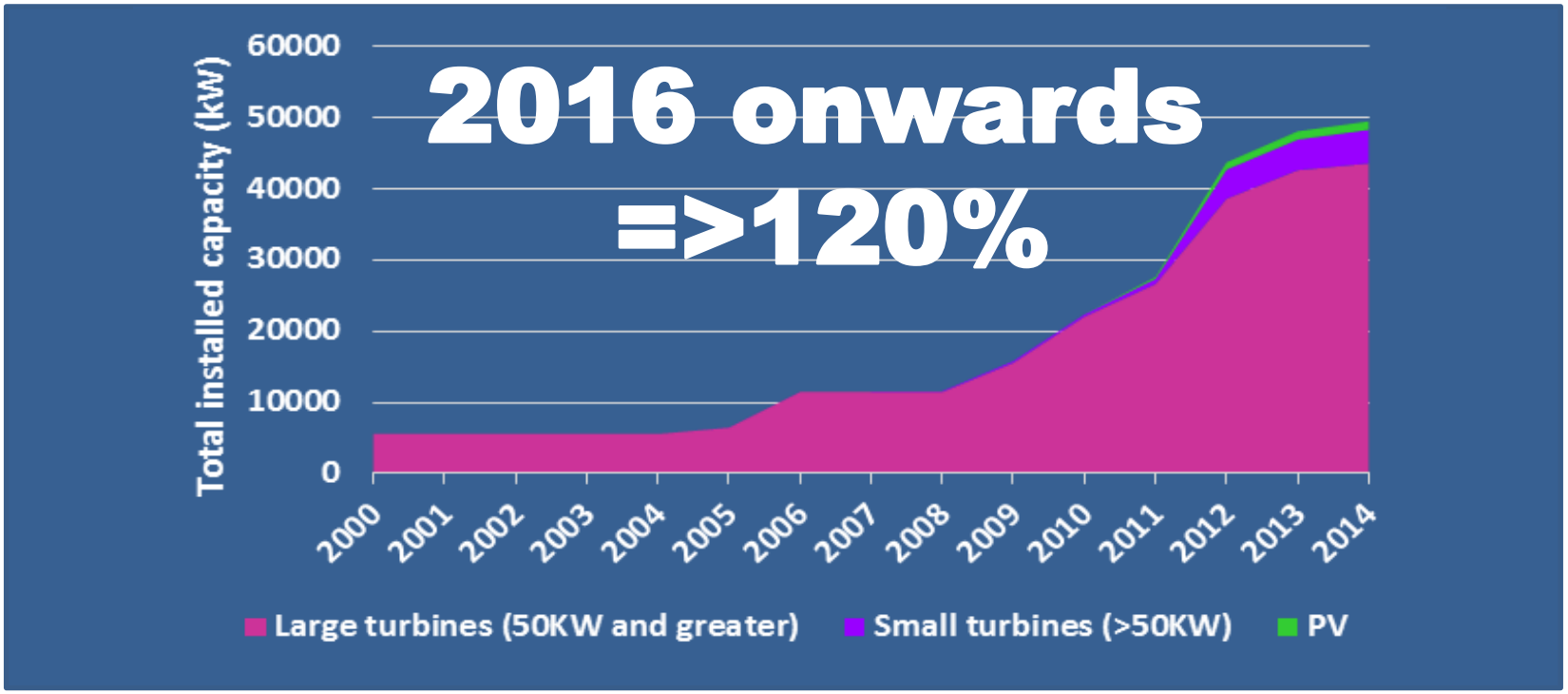
- It is obvious within Orkney, and important to remember, that energy makes our society.
- Energy investors, energy employees and energy service users are also energy customers/consumers.
- Without investment, jobs and services there is no society and there are no customers or consumers for Ofgem to ‘safeguard’
- Unsustainable consumer safeguarding will lead to unsustainable communities and society!!

% of electrical demand in Orkney met by renewables

- July 2008 First net export **month**
- 2013 First net export **year**
- April 2015 **Last** net import month
- April 2017 New export record of 5,000MWh



Smart(*ish*) Grid
Active Network Mgt.

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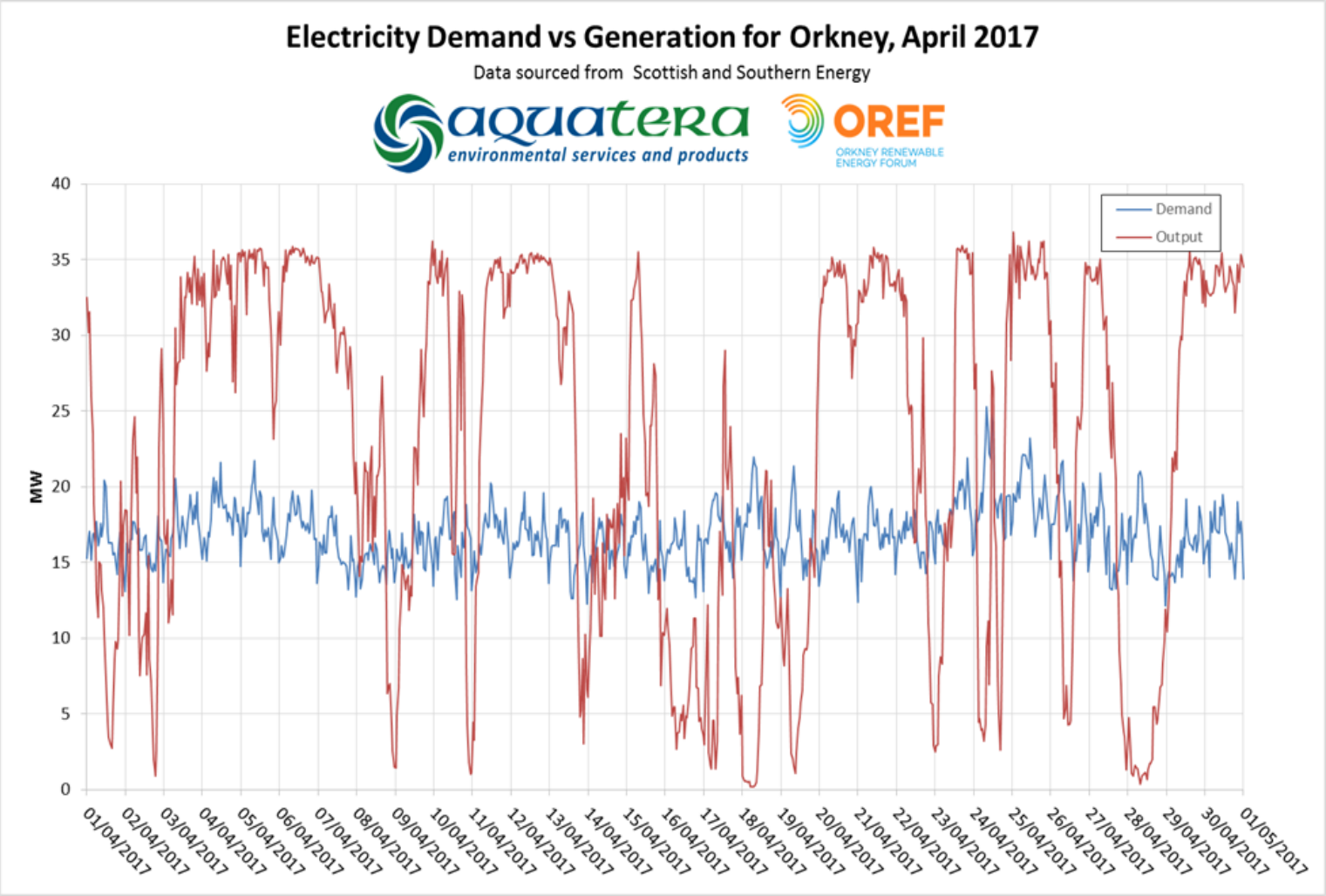

http://anm.ssepd.co.uk/

Micro-generation success story

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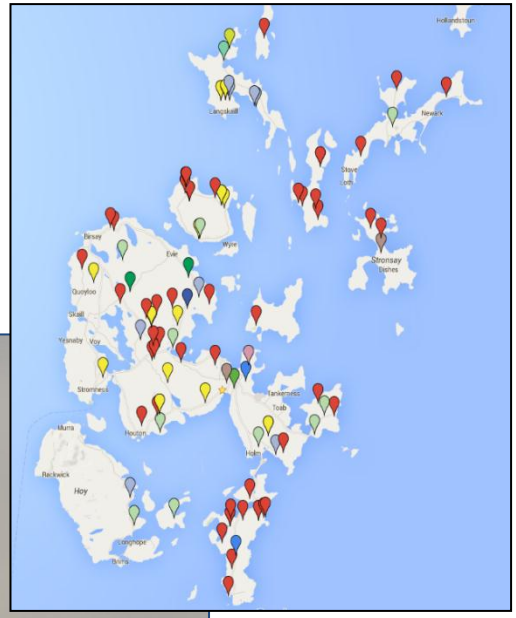
- Over 740 turbines installed
- Most turbines of any county in UK
- 1/9th of UK's domestic turbines (0.07% of UK's solar)
- Income to Orkney economy : >£4M/yr
- Reducing money 'lost'

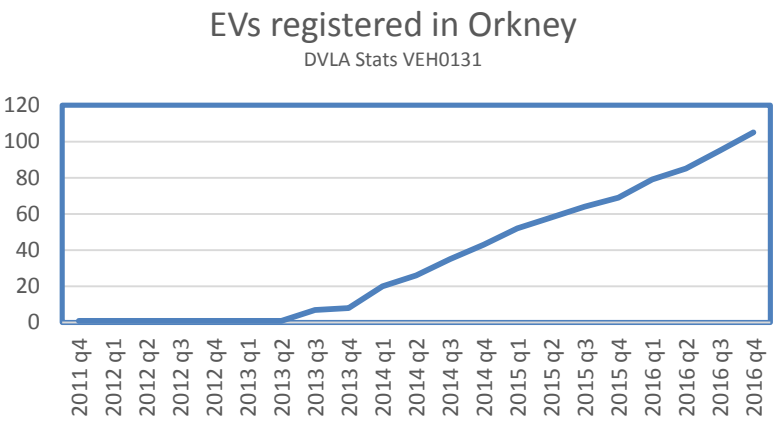
- Squeezing more efficient 'big wind' off!

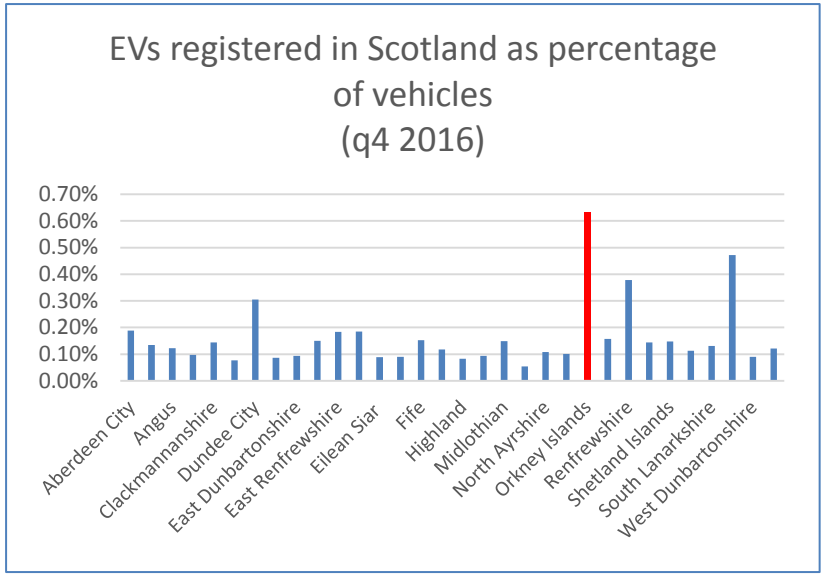
- OREF running a unique database on
- performance & faults. –FREE to join!



Changing electricity use - EVs

- <u>Cars:</u>
- Now over 200 vehicles in the county
- 1 bus + ATVs
- 12 pairs of FAST chargers
- 4 RAPID chargers
- Council EV strategy being refreshed
- EV infrastructure user guide published
- Highest % uptake in Scotland





- OREF data base shows:
- Average per day = 28 miles
- 80% charge at home
- ‘ICEing’ is the biggest problem
- Charger reliability is the biggest concern

Key message – high penetration renewables works

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- Orkney has moved further and faster and in a more coherent way that any other sizable community
- We have shown that renewable energy works
- Not only does it work – it invigorates and empowers people and communities, it delivers true sustainable outcomes
- Orkney has started to prove a pathway towards decarbonisation that other communities and societies can follow
- This service, this gift, this achievement to the UK and the wider world is different and distinctive – it deserves ongoing support – it needs a future connection!

Marine energy - Orkney has hosted

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30 devices • **19** developers • **10** countries

£284m GVA

Tidal and wave progress across the years

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Orbital
(Previously Scotrenewables)

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Marine energy is not dead – it is just taking longer than hoped

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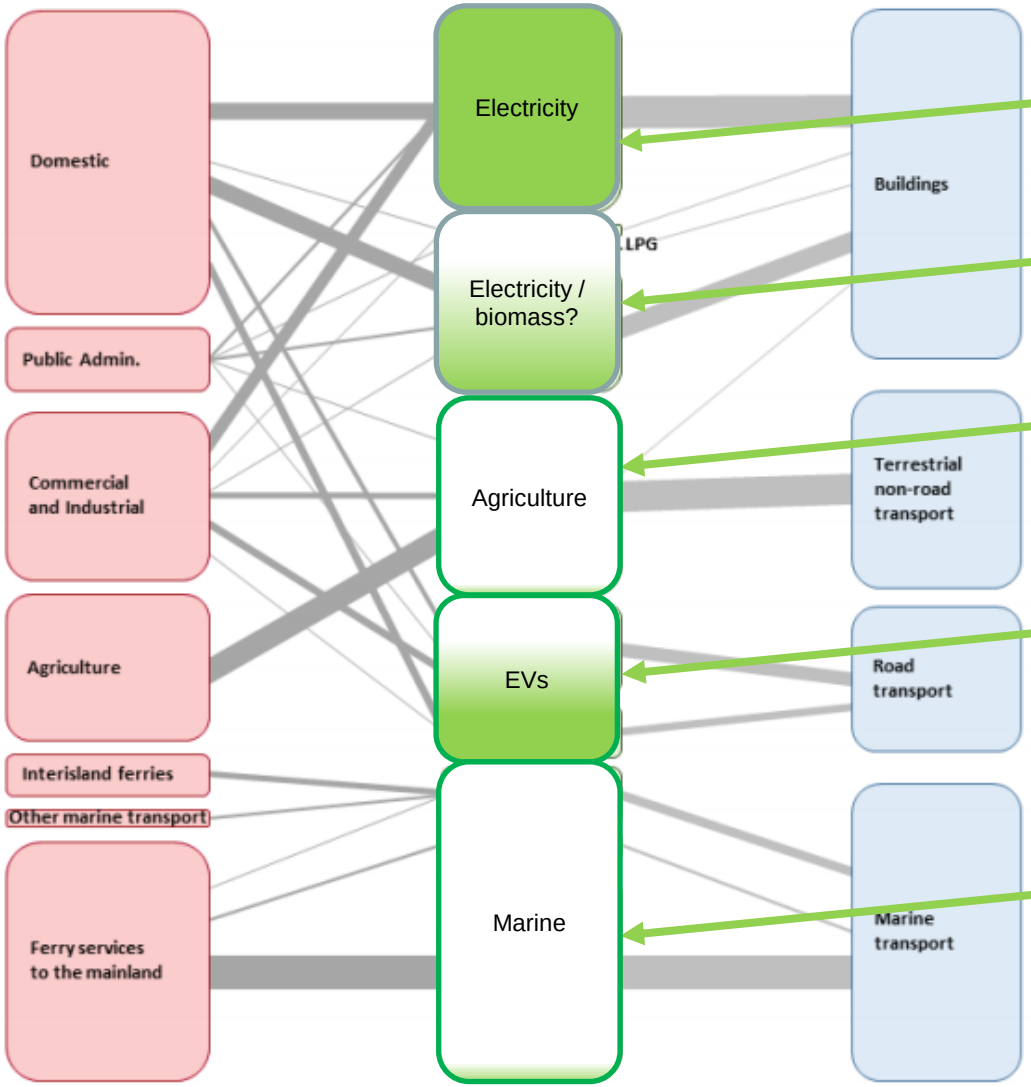
- The UK has led the world since the 1990's regards marine energy
- Orkney has been the hub for this leadership since 2000
- Marine energy has made huge strides forwards, despite very low levels of public funding, high bureaucratic obstacles and anticompetitive fiscal/regulatory processes
- However, marine energy is not as of 2019 ready to compete in a subsidy free environment in grid connected markets
- In 5 years time the situation may be very different
- It is very unlikely that tidal energy will not be competitive within 10 years
- The imperatives of addressing climate change will make marine energy a priority at some time in the future
- The UK has a choice about whether it wants to be a part of that technology future - if so Orkney is the place for it to happen and a new transmission connection is needed

How we use energy now and in the future



Now all renewables

Electrify more heating

Agriculture – it'll come

Next target: Make this green – EVs/Hydrogen/Synthetic diesel

Marine Hydrogen/Synthetic diesel

Source: OREF 2015 Energy Audit by Aquatera

Note: Excludes peat and air travel

Key Message - Decarbonisation Orkney's overall energy demand

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- Electricity makes up only 10% of Orkney's overall energy demand
- Over the next 20 years (half of the lifetime of the proposed cable) Orkney has to decarbonise the other 90% of its energy
- This is because Orkney is an R&D and demonstration hub for such transitions
- Some where needs to be first so that others can follow and the UK government, based upon the R&D funds pouring into Orkney clearly feels that Orkney should be this pioneering community
- The UK's grid connection strategy needs to ensure that it is aligned with the UK's future electricity demand, energy security strategy, industrial strategy, health strategy, regional development strategy, international development strategy
- The connection of Orkney at transmission scale is an essential requirement for delivering against these many strategic objectives

Orkney energy hub – creating connections

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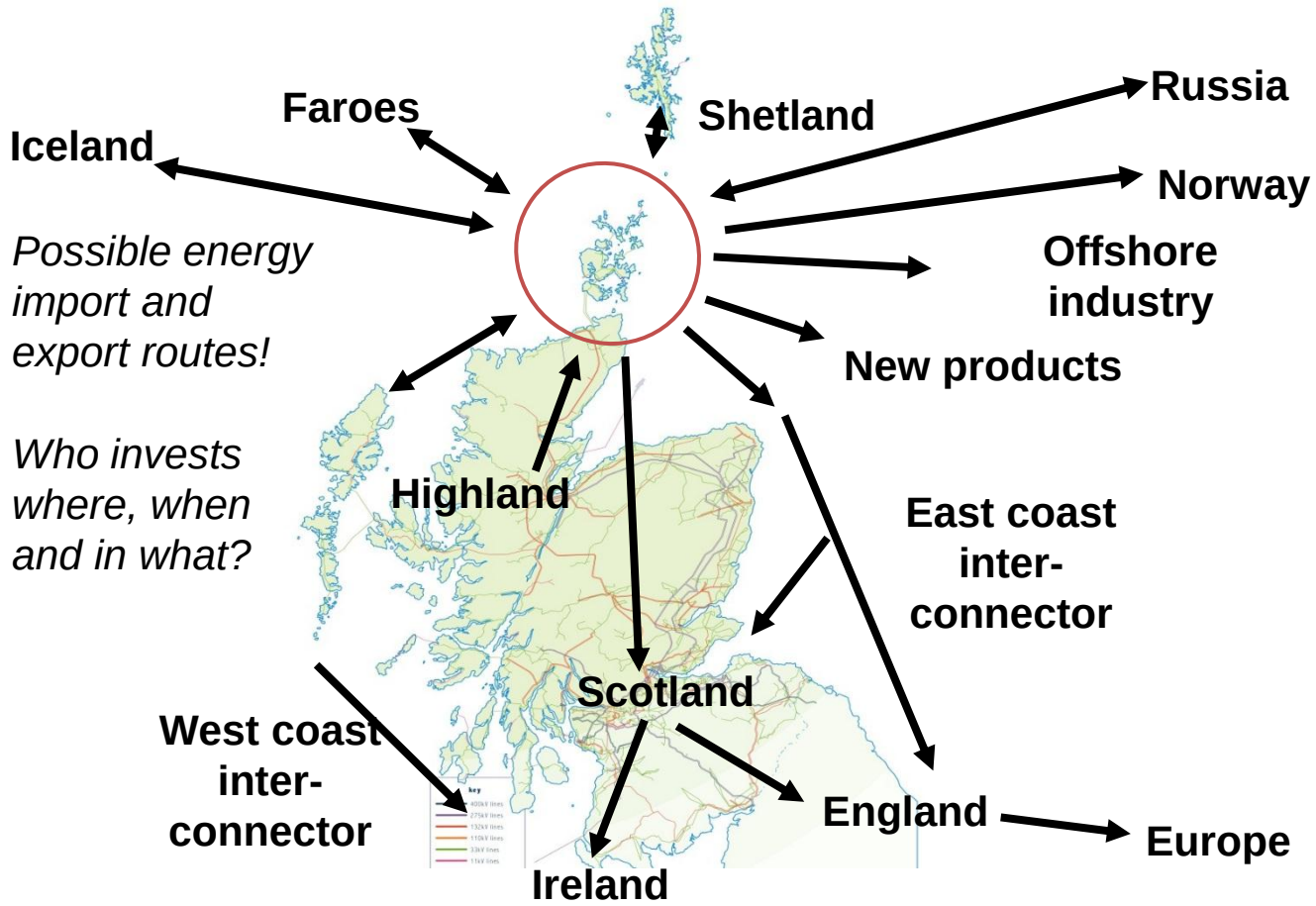

Key message – the first of many connections

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- Looking forward and taking into account Orkney's unique geographical position, its unique and rich energy resources and its unique strategic industrial and energy role will likely lead to many other follow-on connections to Orkney
- These connections may be through other cables, pipelines, shipping etc
- The key point is that in every other respect that the grid, Orkney is a strategic hub not a marginal spur
- Grid connectivity is now limiting the wider role that Orkney can play and therefore limiting the development potential of the UK at a time when the country needs every opportunity it can find

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Planning Orkney's energy future

World class resources and major development potential

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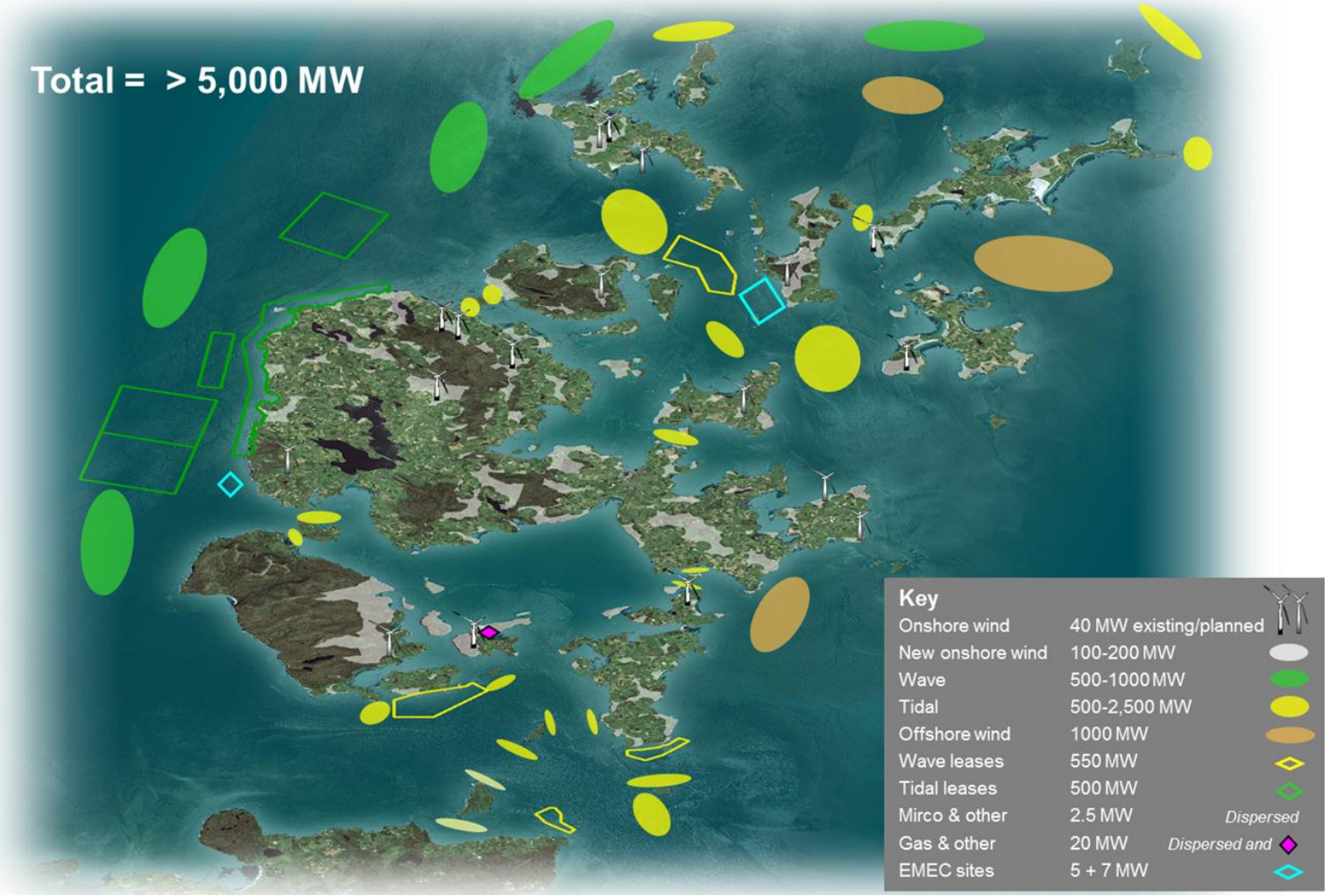

Wide variety of wind sites have been evaluated

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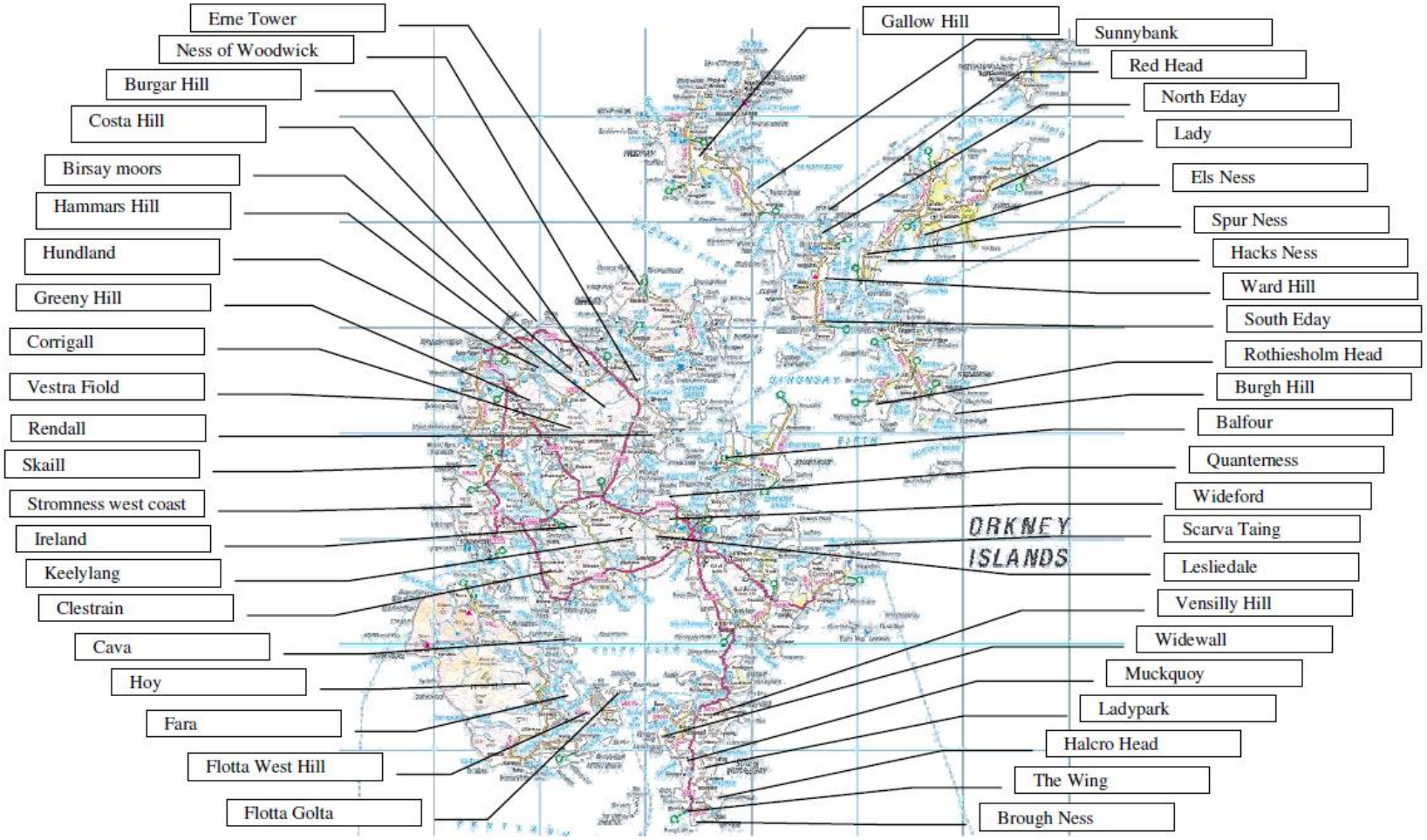
Figure 4 Distribution of sites considered during the site screening stage



Planning guidance

- Many areas of search identified

Picking the best for further consideration

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- Within the development and wider community there is a deep understanding of the character of these sites, their sensitivities and opportunities
- The 50% attrition rate assumed is not really realistic, it is either going to be less due to a change in community strategy or nearer to 100% through good pre-planning

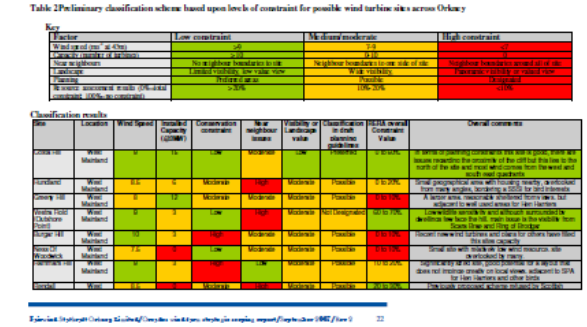


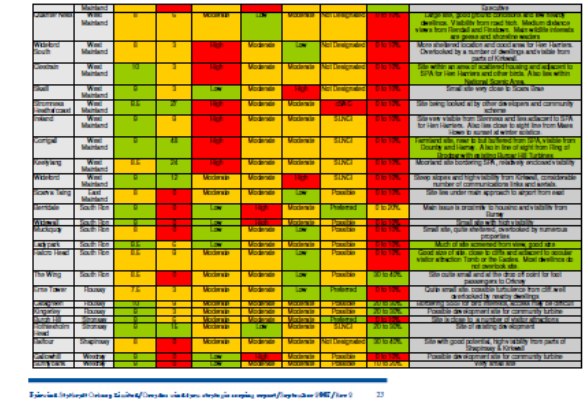
Table 2Preliminary classification scheme based upon levels of constraint for possible wind turbine sites across Orkney

Key

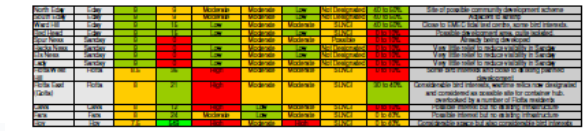
Factor	Low constraint	Medium/moderate	High constraint
Wind speed (m/s at 43m)	>9	7-9	<7
Capacity (number of turbines)	>10	8-10	<8
Near neighbours	No neighbour boundaries to site	Neighbour boundaries to one side of site	Neighbour boundaries around all of site
Landscape	Limited visibility, low value view	Wide visibility	Prominent / visibility or valued view
Planning	Preferred area	Possible	Designated
Resource assessment results (0% = total constraint, 100% = no constraint)	>30%	10%-30%	<10%

Classification results

Site	Location	Wind Speed	Installed Capacity (@50MW)	Conservation constraint	Near neighbour issues	Visibility or Landscape value	Classification in draft planning guidelines	SNH overall Constraint Value	Overall comments
Costa Hill	West Mainland	9	11	Low	Moderate	Low	Preferred	0 to 10%	In terms of planning constraints this site is good, main issues regarding the proximity of the cliff but this lies to the north of the site and most windfarmers from the west and south west quadrants
Hundland	West Mainland	8.5	6	Moderate	High	Moderate	Possible	0 to 20%	Small geographical area with housing nearby, restricted from mark angles, bordering a SSSI for bird interests
Library Hill	West Mainland	8	12	Moderate	Moderate	Moderate	Possible	0 to 10%	A larger area, reasonable sheltered from views, but adjacent to well used areas for Hen Harriers
Grutta Field (Ushmore Point)	West Mainland	9	3	Low	High	Moderate	Not Designated	30 to 70%	Considerable sensitivity and although surrounded by deciduous tree lace the hill, main issue is the visibility from Scara Brae and Ring of Brodgar
Burgar Hill	West Mainland	10	3	High	Moderate	Moderate	Possible	0 to 10%	Recent new mid turbines and plans for others have filled this sites capacity
Nesst Of Woodwick	West Mainland	7.5	3	Low	Moderate	Moderate	Possible	0 to 10%	Small site with visible tip and resource, site overlooked by many
Hillhead Hill	West Mainland	8	3	High	Low	Moderate	Possible	0 to 20%	Significantly far in size, good potential of a signal that does not involve crowds on local views, adjacent to SPA for Hen Harriers and other birds
Grimisdal	West	8.5	3	Moderate	High	Moderate	Possible	0 to 10%	Few roads concerned, Access remains an issue



	Mainland								Sensitive
Quanter Hill	West Mainland	8	3	Moderate	Low	Moderate	Not Designated	0 to 10%	Large site, good potential resource, but few roads, deciduous. Visibility from road north. Medium distance views from Rendall and Finstown. Main wildlife interests are geese and shorebird waders
Wideford South	West Mainland	8	3	High	Moderate	Low	Not Designated	0 to 10%	More sheltered location and closer area to Hen Harriers. Overlooked by a number of dwellings and visible from parts of Kirkwall
Cleeshill	West Mainland	10	3	High	Moderate	Moderate	Not Designated	0 to 10%	Site within an area of scattered housing and adjacent to SPA for Hen Harriers and other birds. Also lies within National Scenic Area
Stoal	West Mainland	9	3	Low	Moderate	High	Not Designated	0 to 10%	Small site very close to Scara Brae
Stromness Heathcroal	West Mainland	8.5	27	High	Moderate	Moderate	SPA C	0 to 10%	Site being looked at by other developers and community scheme
Hobland	West Mainland	8	9	High	Moderate	Moderate	SINCI	0 to 10%	Site was visible from Stromness and lies adjacent to SPA for Hen Harriers. Also lies close to eight lies from Mans Howe to sunset at winter solstice
Corrigal	West Mainland	8	48	High	Moderate	Moderate	SINCI	0 to 10%	Farmland site, new to but sufficient from SPA visible from Dounby and Harray. Also in line of sight from Ring of Brodgar with a visible Burner Hill Turbines
Aweshyang	West Mainland	8.5	24	High	Moderate	Moderate	SINCI	0 to 10%	Moorland site bordering SPA, relatively enclosed visibility
Wideford	West Mainland	9	12	Moderate	Moderate	High	SINCI	0 to 10%	Steep slopes and high visibility from Kirkwall, considerable number of communications links and airfield
Scara o Twing	West Mainland	8	3	Moderate	Moderate	Low	Possible	0 to 10%	Site lies under main approach to airport from east
Sandale	South Ron	8	3	Low	High	Moderate	Preferred	0 to 20%	Main issue is proximity to houses and visibility from Burray
Kirkwall	South Ron	8	3	Low	High	Moderate	Possible	20 to 30%	Small site with high visibility
Muckquoy	South Ron	8	3	Low	Moderate	Low	Possible	0 to 10%	Small site, sheltered, overlooked by numerous properties
Lady park	South Ron	8.5	3	Low	Moderate	Moderate	Possible	0 to 10%	Much of site screened from view, good site
Ness Head	South Ron	8.5	3	Moderate	Moderate	Low	Possible	0 to 10%	Good size of site, close to OPA and adjacent to popular visitor attraction Tomb of the Eagles. Most deciduous do not overlook site
The Wing	South Ron	8.5	3	Moderate	Moderate	Low	Possible	20 to 40%	Site quite small and at the drop off point for foot passengers to Orkney
Ness Tower	Hoxsay	7.5	3	Moderate	Moderate	Low	Preferred	0 to 10%	Quite small site, possible turbulence from cliff, well overlooked by nearby dwellings
Lyrawgen	Hoxsay	10	3	Moderate	Moderate	Moderate	Possible	20 to 30%	Considering for SPA interests, access, risk of opacity
Kingsmill	Hoxsay	9	3	Moderate	Moderate	Moderate	Possible	20 to 30%	Possible site equipment site for community turbine
Mount Hill	Stromsay	9	3	Moderate	Moderate	Moderate	Possible	20 to 30%	Site is close to a number of visitor attractions
Hoxbeachdmi Head	Stromsay	9	15	Moderate	Low	Moderate	SINCI	20 to 30%	Site of existing site equipment
Balfour	Shapinsay	8	6	Moderate	Moderate	Moderate	Not Designated	30 to 40%	Site with good potential, highly visible from parts of Shapinsay & Kirkwall
Galtwhill	Wyre	9	3	Low	High	Moderate	Possible	0 to 10%	Possible site equipment site for community turbine
Wing Farm	Wyre	9	3	Low	Moderate	Moderate	Possible	10 to 20%	Very small site



North Ling	Eday	9	3	Moderate	Moderate	Low	Not Designated	20 to 30%	Site of possible community development scheme
Mount Kelly	Eday	9	3	Low	Moderate	Low	Not Designated	20 to 30%	Adjacent to airstrip
Ward Hill	Eday	9	15	Low	Moderate	Moderate	SINCI	20 to 30%	Close to SNCI, little land on site, some bird interests
Mid Hoxel	Eday	9	15	Low	Moderate	Low	SINCI	0 to 10%	Possible site equipment area, quite isolated
Our Ness	Sanday	9	3	Low	Moderate	Moderate	Possible	0 to 10%	Already being developed
Garbo Dunes	Sanday	9	3	Low	Moderate	Low	Not Designated	0 to 10%	Very little relief to reduce visibility in Sanday
Ness	Sanday	9	3	Low	Moderate	Low	Not Designated	0 to 10%	Very little relief to reduce visibility in Sanday
Lady	Sanday	9	3	Low	Moderate	Moderate	Not Designated	0 to 10%	Very little relief to reduce visibility in Sanday
Hollaness (Ness Lot)	Hoy	8.5	36	High	Moderate	Moderate	SINCI	0 to 10%	Some land available and closer to existing partner development
Hoy Hill (Cattle)	Hoy	8	21	High	Moderate	Moderate	SINCI	20 to 30%	Considerable bird interests, wildfire radio now designated and considered as possible site for container hub, overlooked by a number of Hoy residents
Cairn	Lamb	9	12	High	Low	Moderate	SINCI	0 to 10%	Relatively remote but no existing infrastructure
Hack	Hack	9	24	Moderate	Low	Moderate	SINCI	0 to 10%	Possible interest but no existing infrastructure
Kirk	Kirk	7.5	12	Low	Moderate	Low	SINCI	0 to 10%	Considerable peat but also considerable bird interests

We have a detailed understanding of where developemnt could take place

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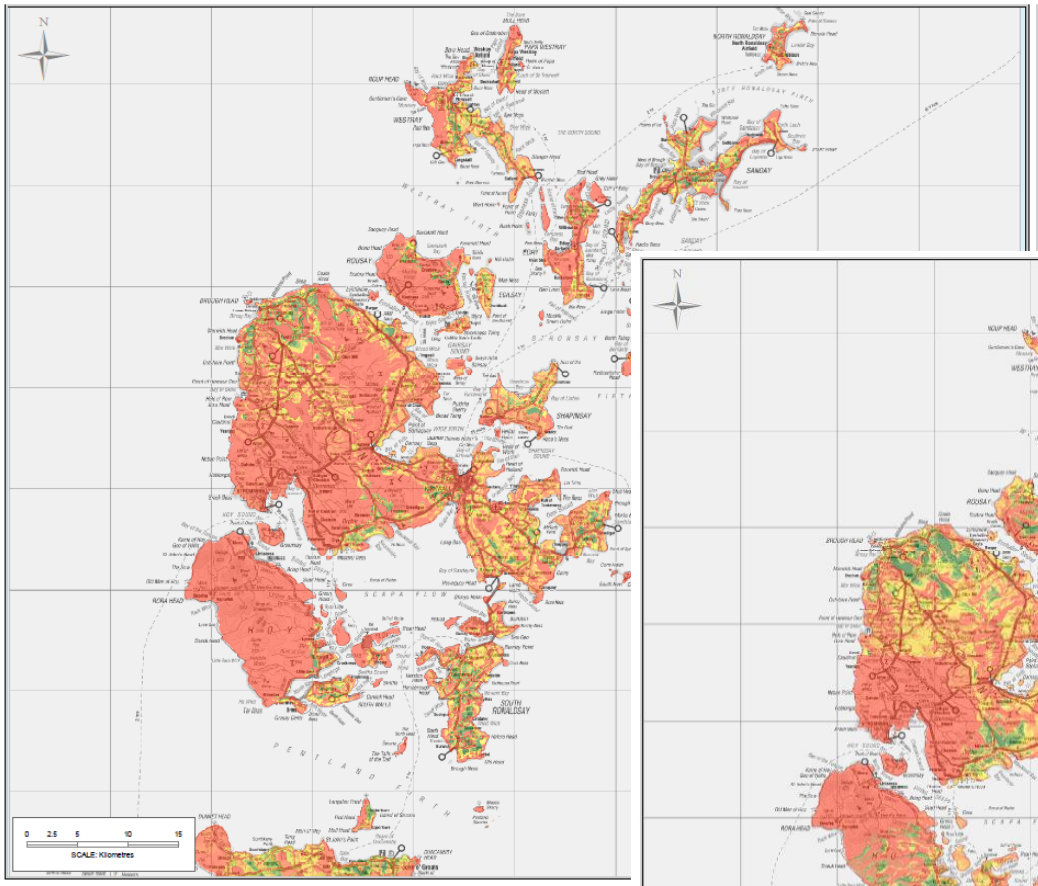
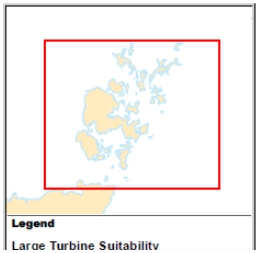
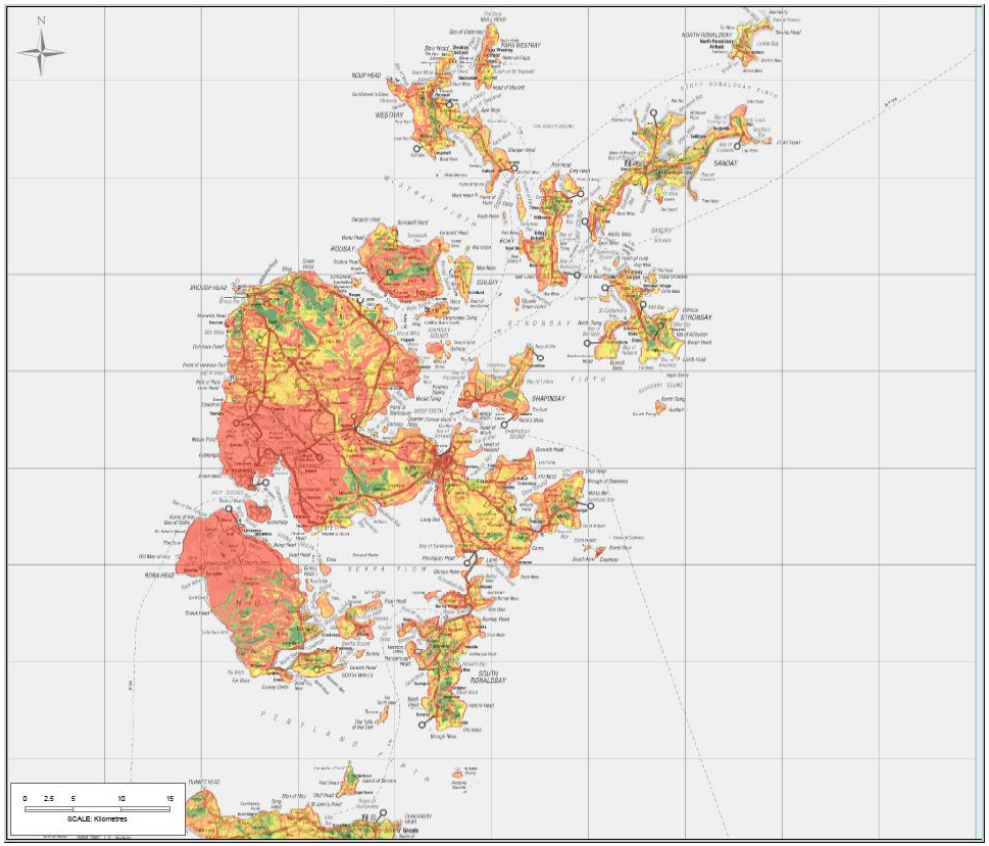
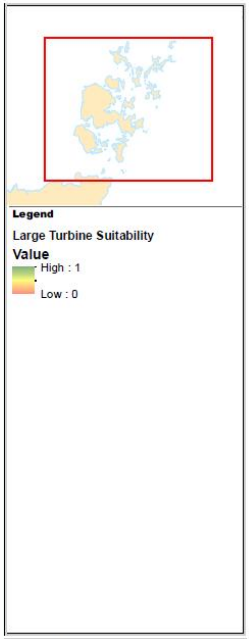




Managed constraints





All constraints

For all aspects of development

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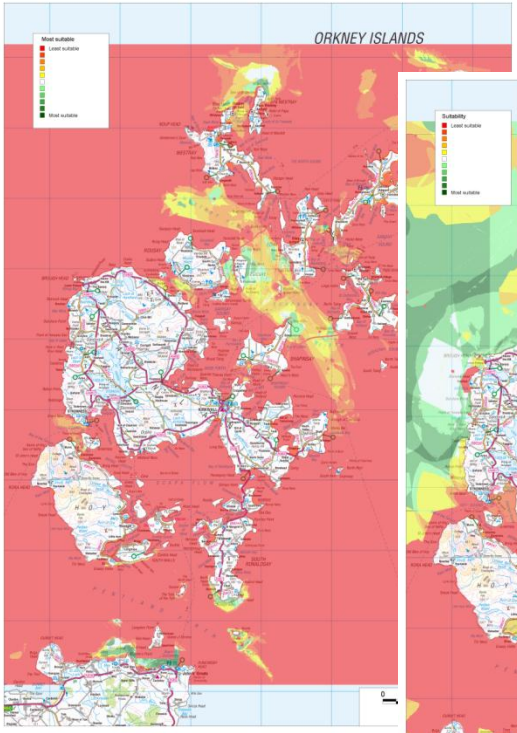
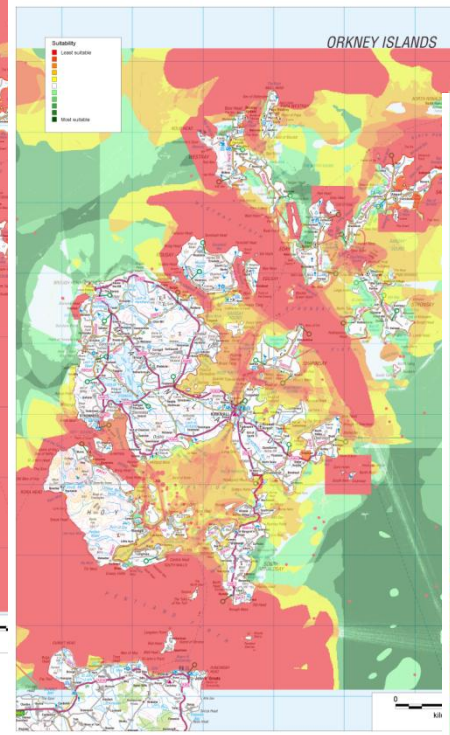


Tide



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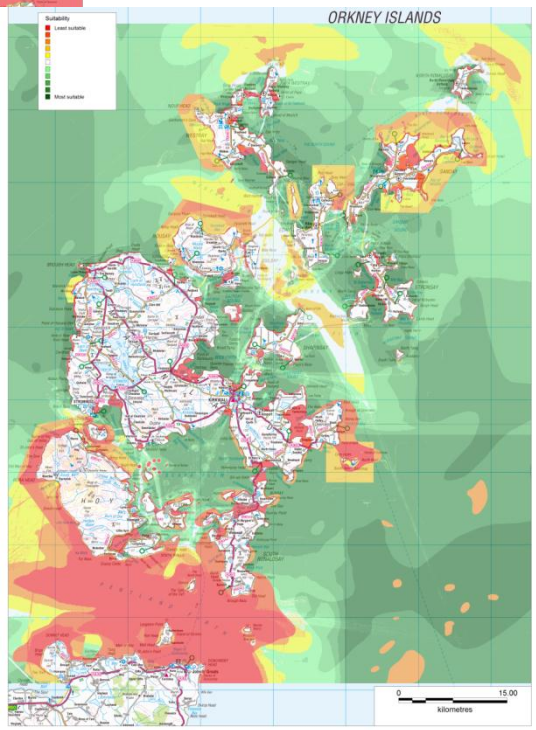
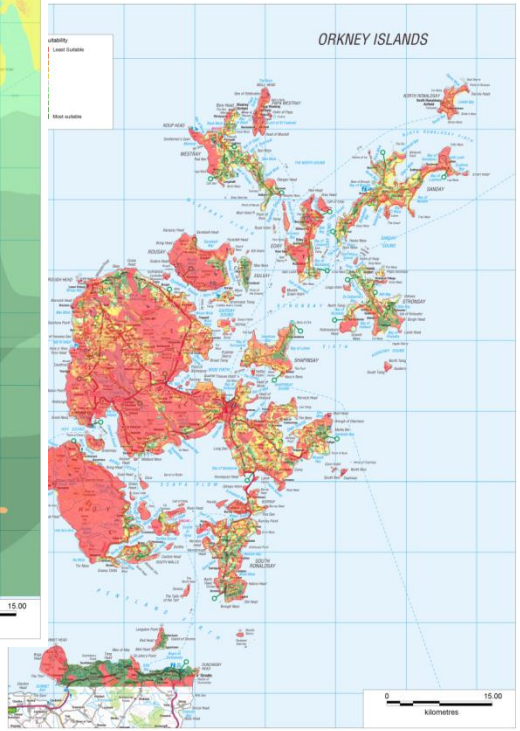


Cables



Substations

Key message - World class energy planning in Orkney

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- Orkney is blessed with some leading practitioners in energy planning at a community, national and international level
- The planning environment is probably better understood here than in any other part of the UK
- The capacity and knowledge exists to de-risk and strategically plan most future energy developments in Orkney now
- At present the local development planning process has become somewhat misaligned with a more strategic and informed approach
- In addition the need case process is not responsive enough nor structured in a way to integrate with such planning insights
- An overhaul of the process and a better recognition of the relationships between demand, generation, connections, the needs case process, the planning process, development financing process needs to take place

Renewables and landscapes

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Renewables and wildlife

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Renewables and archaeology

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Renewables and tourism – a win:win equation

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Renewables and wealth distribution?

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How many people in Orkney benefit directly from generating energy

- 300 people employed in the renewables sector.
- 500 households with micro wind turbines installed
- 400 homes with solar and heart pump technology installed
- 5 large scale community turbines operating covering some 800 households;
- 40 local investors in two locally owned schemes
- 100 electric cars running locally

Consequently there are likely to be around 700 ‘enterprises’ and 2000 or 20% of households that have a direct link with and benefit from renewables.

(There were 690 farming and fishing enterprises in 2011)

Public opinion – do we like renewables or not?

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Orkney survey – completed by Com Res surveying 1000 people, Jan 2017

Question	Level of support	Level of objection
Development of renewable energy in Orkney	89%	6%
Upgrade to grid connection allowing greater use in future	94%	4%
Future wind farms in Orkney within the energy mix	70%	26%
Potential for government support	87%	10%

UK government survey – completed annually

Energy category	**Support**	**Oppose**
Solar	85%	5%
Offshore wind	75%	7%
Marine (wave & tidal)	75%	3%
Onshore wind	65%	10%
Shale gas	20%	30%
Nuclear	35%	25%

Key message – good options, benefit to & supported by many

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- Orkney has proven that it is possible to develop major wind farms without undue environmental, landscape and heritage effects
- Such developments can provide benefits to many people in the community who and also energy consumers as well
- The clear and settled desire of most people is to favour renewables, including onshore wind and marine over other more conventional energy options

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Orkney – the UK's energy laboratory

Leading the way to decarbonisation

Orkney's world class expertise

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- Collective experience of:
  - Work with and for over 40 local communities
  - Work with over 1000 micro generation installations
  - Work on 60 onshore wind farms
  - Work on 20 offshore wind farms
  - Work with around 40 tidal and 20 wave technology developers
  - Work on 20 marine energy array projects
  - Work with 32 governments, agencies, test centres
  - Work in 50 countries
  - Work on over 30 EU projects
  - Work on many 100s of R&D projects
  - Teaching of 500 MSc students and 20 PhD students

Leading the energy revolution

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- Who will step forward?
- Orkney has demonstrated its capacity time and again to be a pioneer, a leader
- This is not always easy, there are setbacks – some of our own making, some made by others!
- Somewhere has to be first, being first often means being different – even when it comes to Needs Cases

UK energy futures

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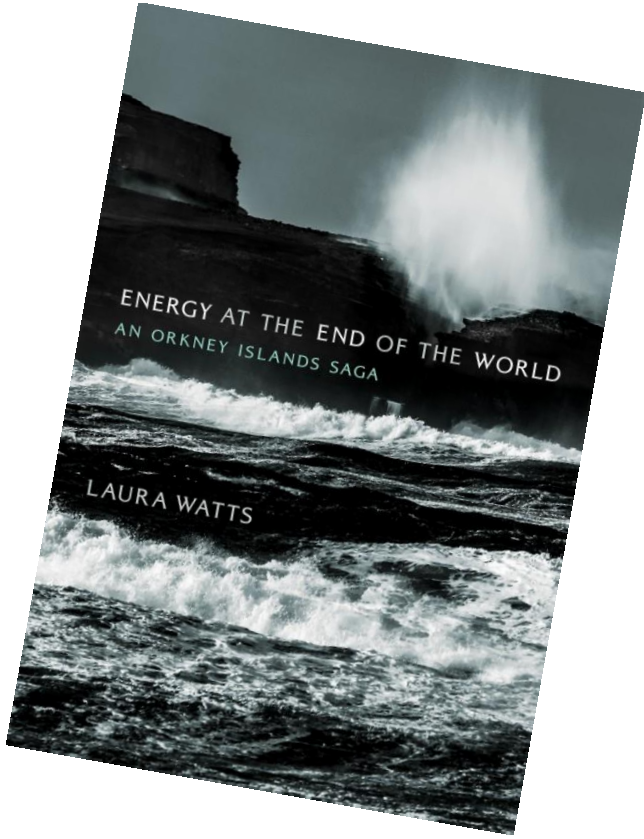
Orkney is where our energy future is being imagined and delivered

- We believe it & back it
- The EU believe it & back it
- Innovate UK believe it & back it
- Scottish government believe it & back it
- Even UK government believe it & back it (mostly)
- There are stories being written about it!
- The key question is whether Ofgem believe it and will back it?



Ofgem Remit

Ofgem remit – words from the Ofgem website

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These phrases are used by Ofgem to describe what it does and how:

- promoting **value for money**
- promoting **security of supply** and **sustainability**, for present **and future generations** of consumers, domestic and industrial users
- the supervision and **development of markets** and competition
- regulation and the **delivery of government schemes**

There are however a number of arising questions?

Key messages – exactly what is Ofgem's remit?

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In order to fully understand and work towards these objectives further clarity is needed otherwise the words are meaningless. For example:

- promoting **value for money** (for who and when)
- promoting **security of supply** (domestic vs imported) and **sustainability** (What aspects: the UN SDGs; CO2 conc, jobs, economic development?), for present **and future generations** (facing BREXIT, economic centralisation, climate change, wealth reduction, energy supply issues etc**)** of consumers, domestic and industrial users (who are also energy investors, energy workers, energy service users – how are their interests considered)
- the supervision and **development of markets** (for "all parts of our country", on a level or sloping playing field regards locational charging levels) and competition (UK vs international supplies; carbonfull vs carbon free; local vs centralised – how are these forms of competitiveness addressed – don't seem to figure currently)
- regulation and the **delivery of government schemes** (Including industrial strategy and national cohesion for example – these don't seem to figure).

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Grid the missing link

Where has Orkney got to?

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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

Total cost £5-8 billion

Spent £0.5 billion to date, so 10% of the way to 1000MW!

The current transmission needs case and associated decisions and issues

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- Generation ownership and investment issues
- Local planning policy
- Availability of onward transmission network capacity after Dec 2019
- Financial securities arrangements Network use of system charges for T & D connections
- UK CfD tariffs and bidding mechanisms
- Hydrogen pipeline to St Fergus (flow and storage)
- Export of other non-electrical energy commodities
- **SSEN transmission link Finstown to Dounreay Needs Case**
- Private wire solution to Moray/Aberdeen
- Growing local demand for electricity under decarbonisation programme
- Strengthened distribution links to ANM connected projects
- Strengthened distribution links to small scale pro-sumers
- Strengthened distribution links to consumers
- New distribution links to generators
- Kirkwall power station
- Existing ANM scheme generation
- Existing firm generation
- Possible gas powered balancing
- NEW onshore generation
- NEW marine generation (wind, floating wind, tide, wave)
- Availability of sites and resources
- Readiness of cost effective technology
- Public understanding, attitudes , desires and issues
- Basic costs of generation, reserves, balancing and T&D charges to customers

Key message – efficient energy systems need smart planning

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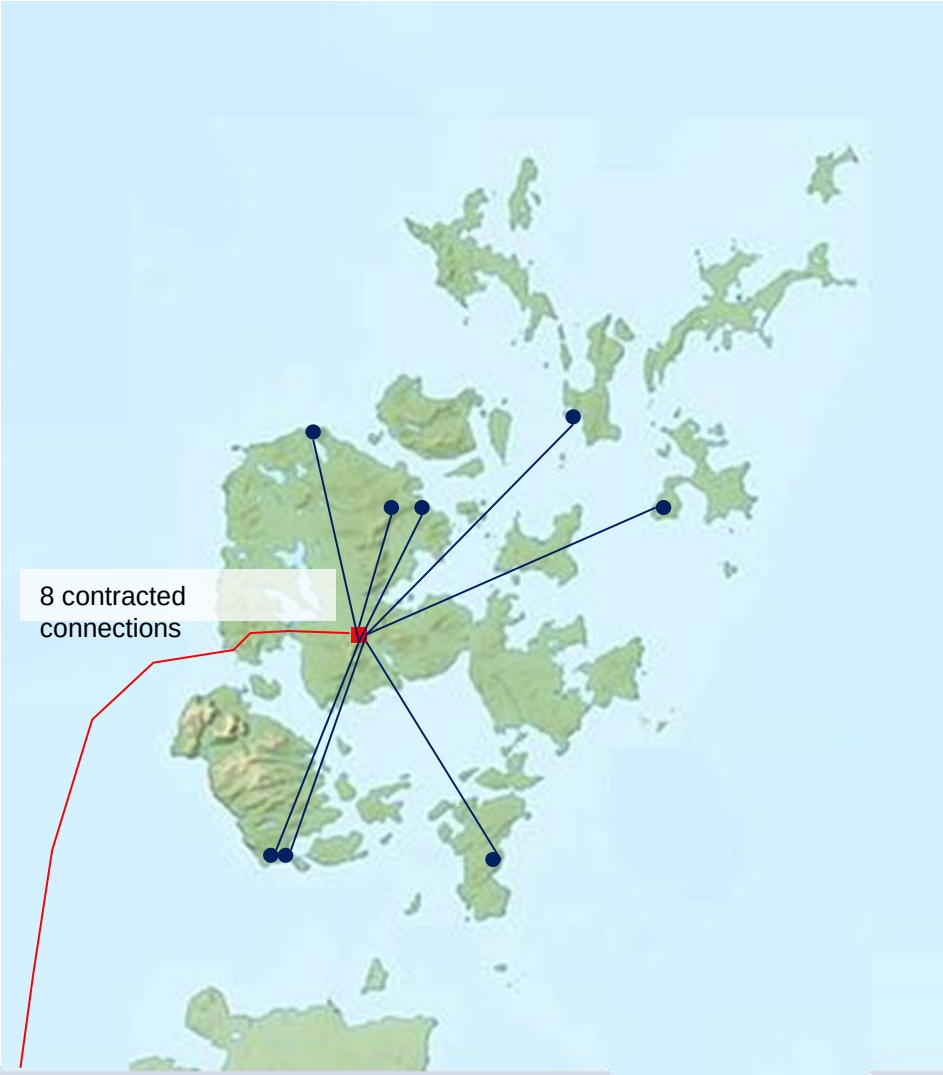
- The present needs case addresses only a small – but essential – part of the Orkney energy system
- The needs case process seems oblivious to the associated and linked issues
- These issues would in almost every instance strengthen the case for connection and de-risk the potential for any stranding of assets
- The needs case should be owned by the whole electricity/energy system not just the transmission operator
- The scope, timing, secrecy and input into a needs case all need to be urgently reviewed and changed to meet modern day requirements, challenges and opportunities

Needs case scope vs overall acceptability

- Currently the issues addressed in any needs case are limited to:
  - Contracted capacity
  - Likelihood of planning permission/licensing
  - Cost (roughly estimated)
  - Optimisation approach taken

Needs case scope vs overall acceptability

- Issues not addressed include:
  - Infrastructure required to deliver contracted capacity
  - Potential level of future use
  - Use beyond 2032
  - Economic benefits industrially and in terms of jobs
  - Landscape suitability
  - Ecological and social acceptability
  - Relationship to distribution network
  - Relationship to future transmission network
  - Real costs and savings
  - Etc, etc



Optimal design - 33 kV grid now (2 ring) and future (3 ring)

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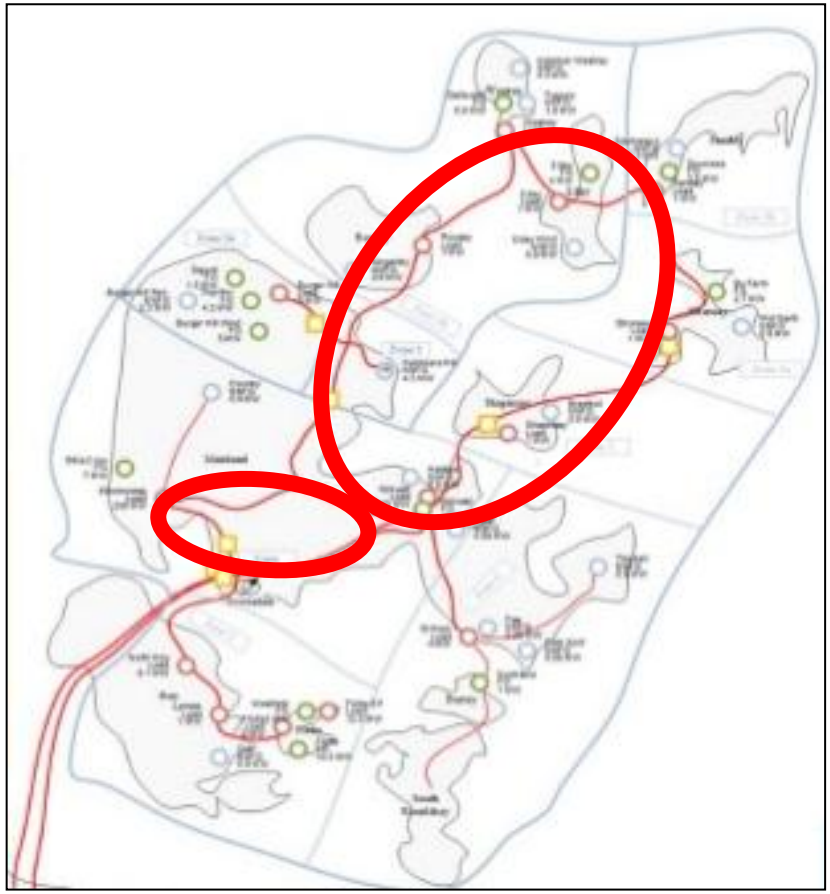
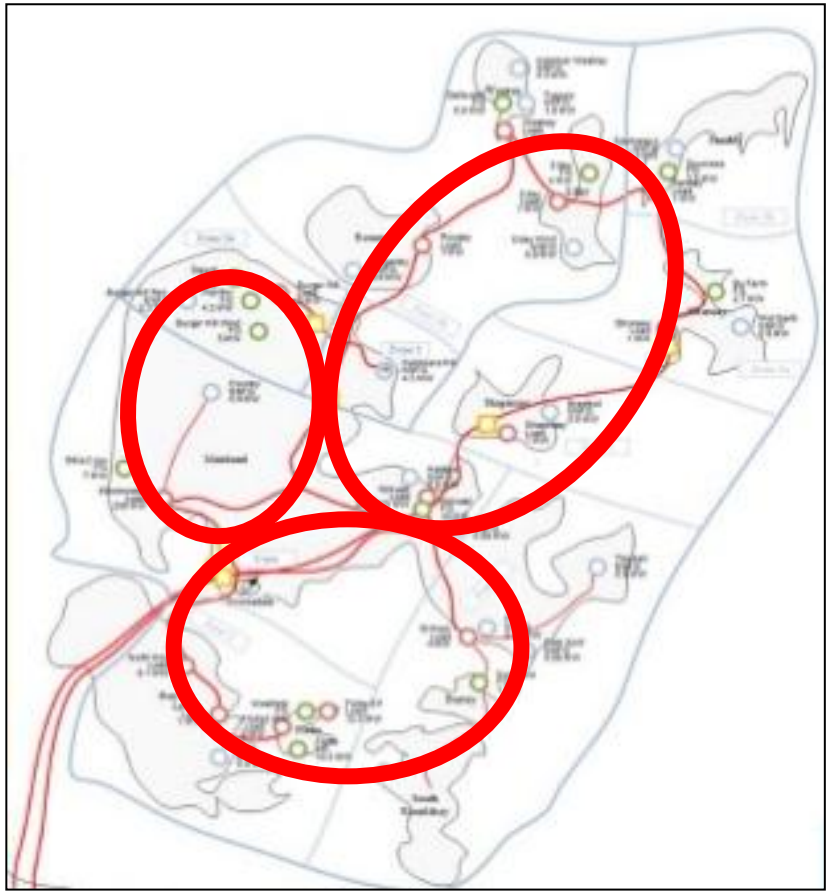
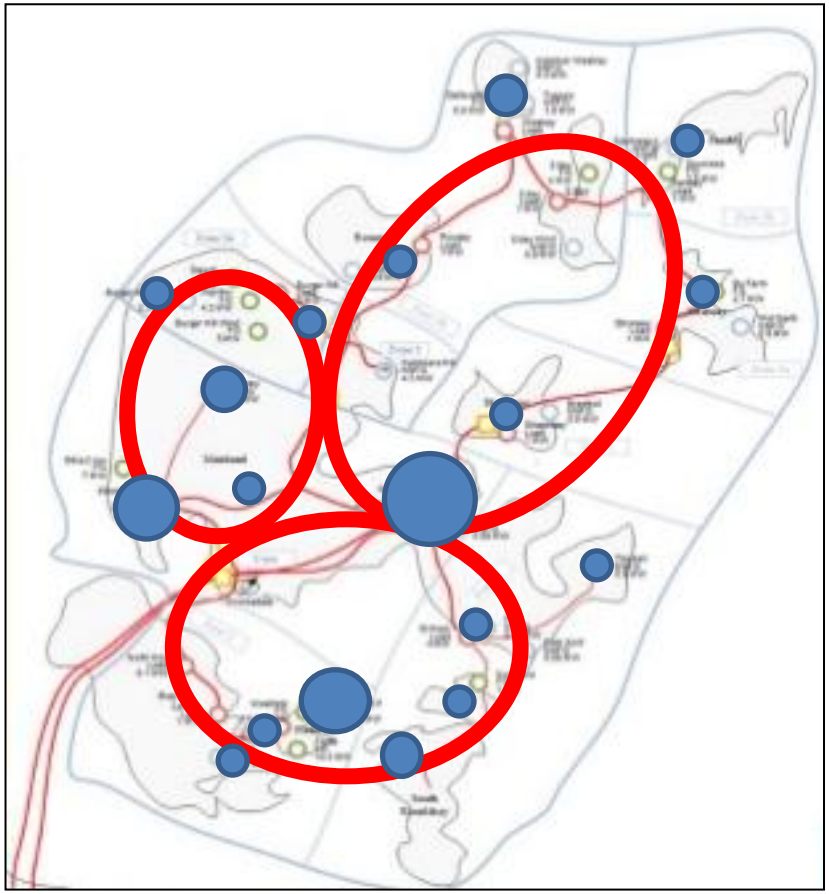


Now

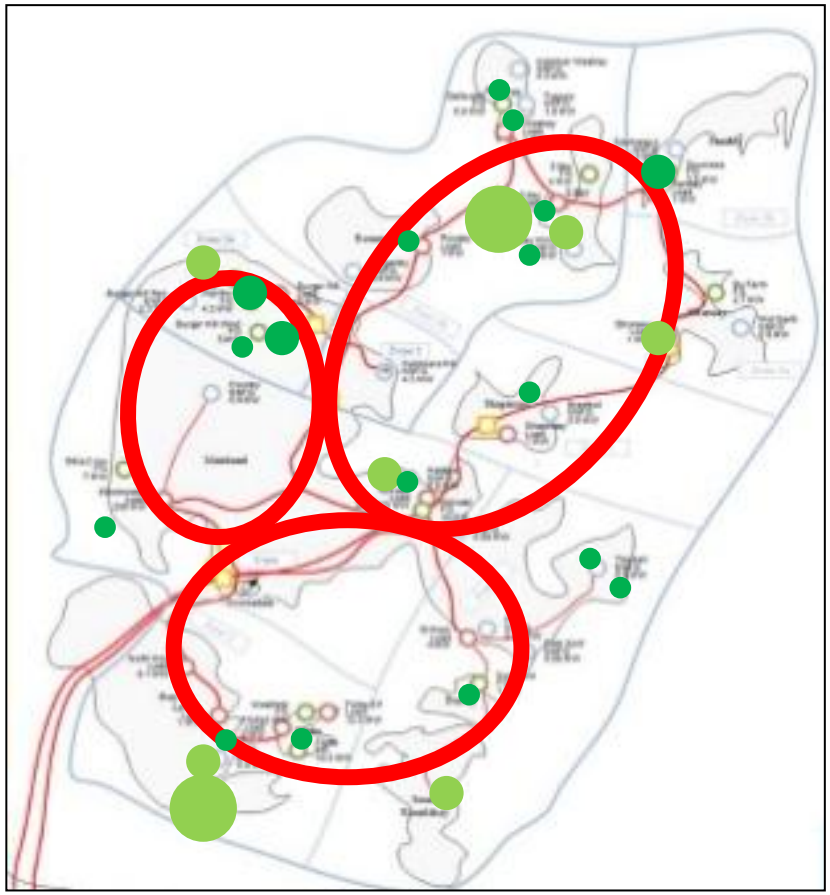


Future

Load & generation centres now



Load



Possible generation

Load & export concepts for future

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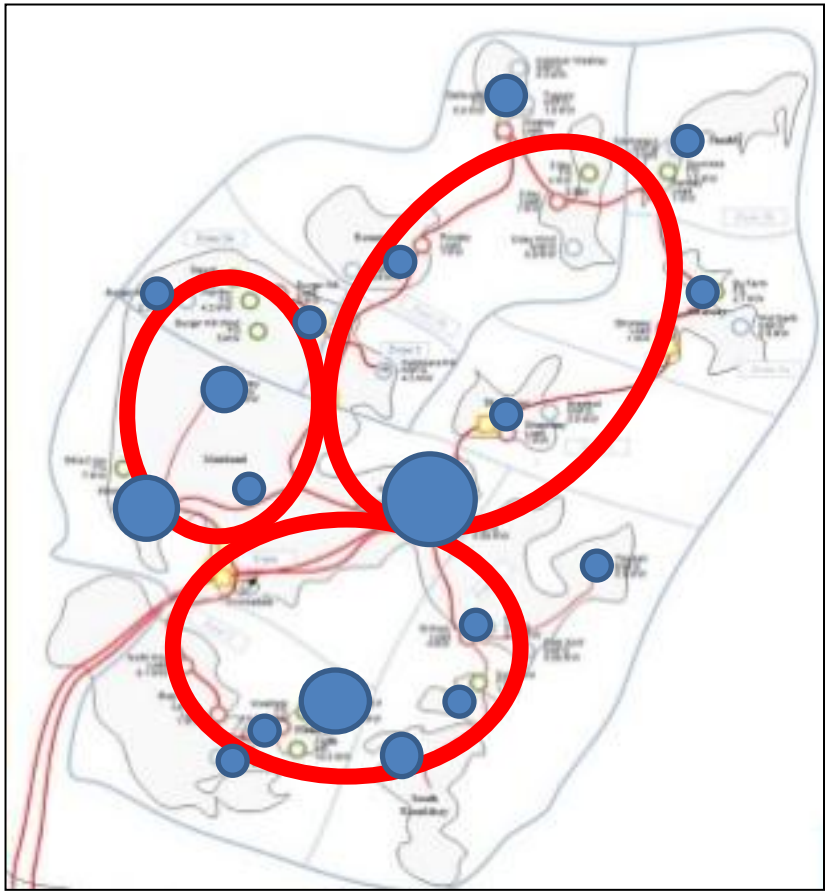
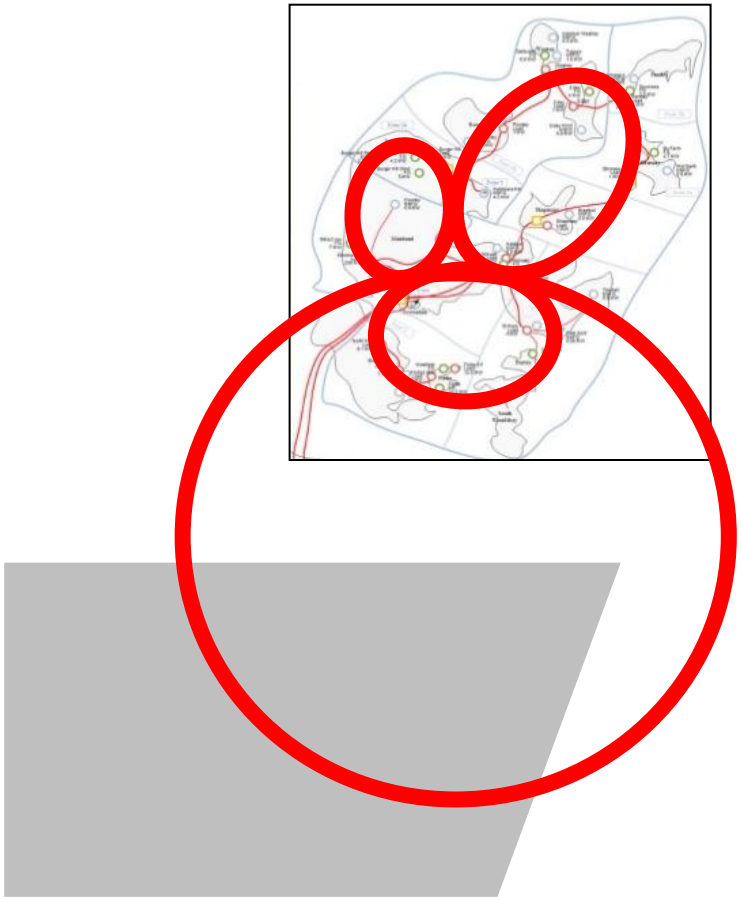


Ferries, vehicles, commodities, new heating, aquaculture, industrial processes



Need a robust and sizable connection strategy

Key messages need to link D & T planning

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- Is it appropriate or acceptable that there is no future/strategic grid plan for Orkney?
- Is it appropriate/acceptable to go through a bit by bit process to plan and approve an integrated grid based energy system?
- Future needs case should consider all distribution and transmission connections and all other grid infrastructure nodes
- Current approach can lead to duplication (132kV beside 33kV new + existing distribution)
- Rationalisation of aerial infrastructure could target burial of low voltage lines
- Need to carefully consider air/space/ground interaction where connection routes cross or converge
- Need to consider strengthening existing grid – providing service improvement to consumers – alongside new connections
- Reliability of connections in local conditions needs to be addressed
- Early replacement of some aging D assets can help underwrite costs of T capacity
- Need to consider how a MITs can be located on Orkney

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‘Customers’ and value for money!

Not every consumer is the same

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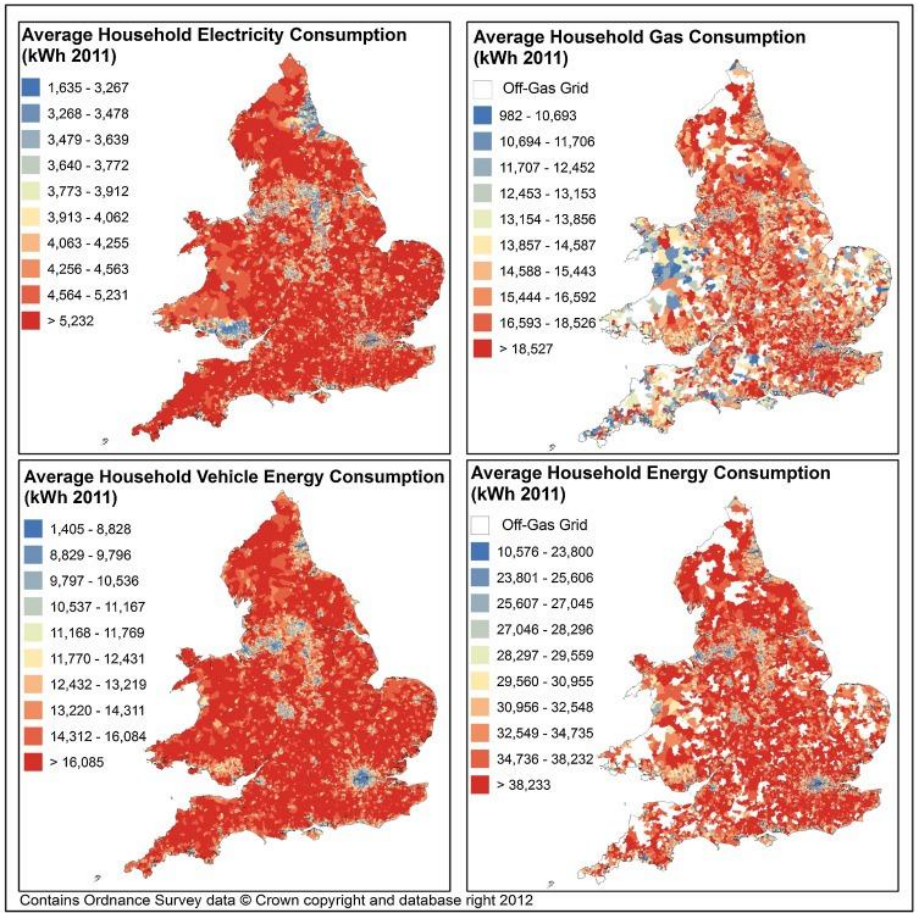
- We consume different amounts of energy
- We have different options available to supply energy
- We pay different amounts for that consumed energy
- We have different levels of income to pay for that energy



What about the Orkney consumer – what do we need

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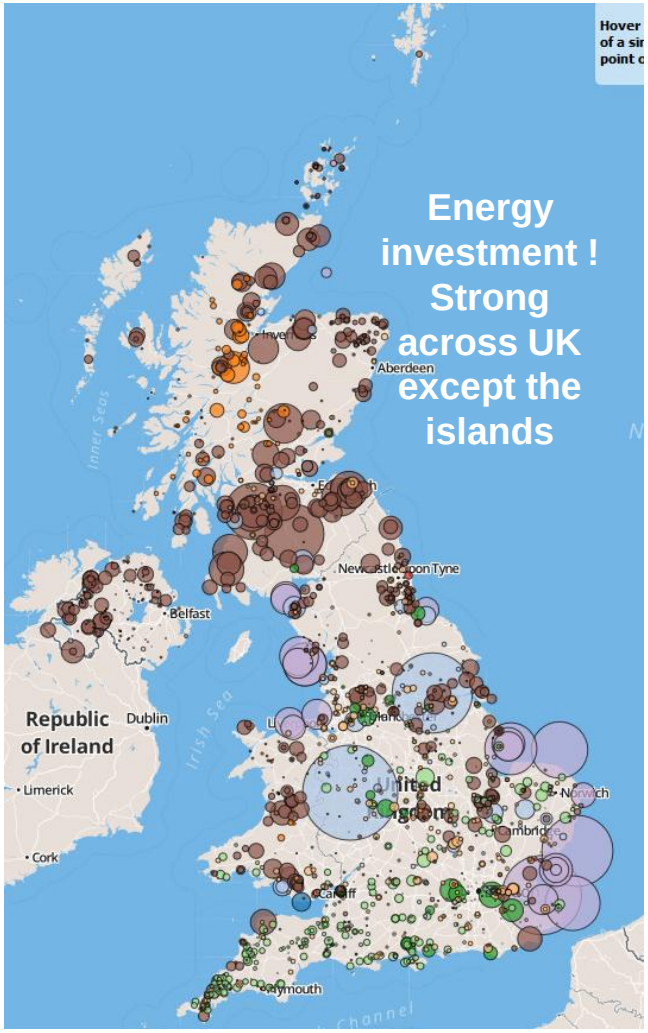
- We are already paying for:
  - ‘Special’ service that grid electricity offers the north of Scotland and islands (2p per KWh = £235/yr/household)
  - Spittal/Kenmore and Beauly/Denny
  - Other mainland UK grid strengthening
  - London undergrounding
  - Hinckley Point
  - European Inter-connectors
  - Southern solar
  - North & Irish Sea wind & inefficient southern wind
- The rest of the UK has benefitted from these developments, the jobs, the wealth – that is how they pay for energy
- **NOW ITS ORKNEY’S TURN – ‘A COUNTRY THAT WORKS FOR EVERYONE!’**



What does the UK customer need?

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- Who is the UK customer
  - Mr and Mrs average – who don't exist
  - The fuel poverty struck customers?
  - The profligate affluent customers?
  - The past, present or future customer?
  - The too hot customer?
  - The too cold customer?
  - The flooded customer?
- Do they need Orkney island energy?
- We believe they do because it will be very, very beneficial to them!

Key message – time to look after the Orkney consumer

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- Orkney energy consumers are especially vulnerable with high levels of fuel poverty
- The issues with fuel poverty is more about poverty and less about fuel
- So one of the best ways of addressing fuel poverty is to create more jobs, redistribute wealth and lift everyone's income
- Another way of reducing fuel poverty is to use less energy. This may require better house insulation etc
- Creating a pathway to more community owned and locally invested energy generation provides a possible pathway for providing more jobs, as well as creating funds to address house insulation.
- Many other parts of the UK have benefitted from grid upgrades and new generation opportunities – it is now the turn of Orkney and the other major island groups to have their opportunity. Orkney has had to chip in for everybody else's benefits now its Orkney's turn

Wind farm output correlation with separation distance

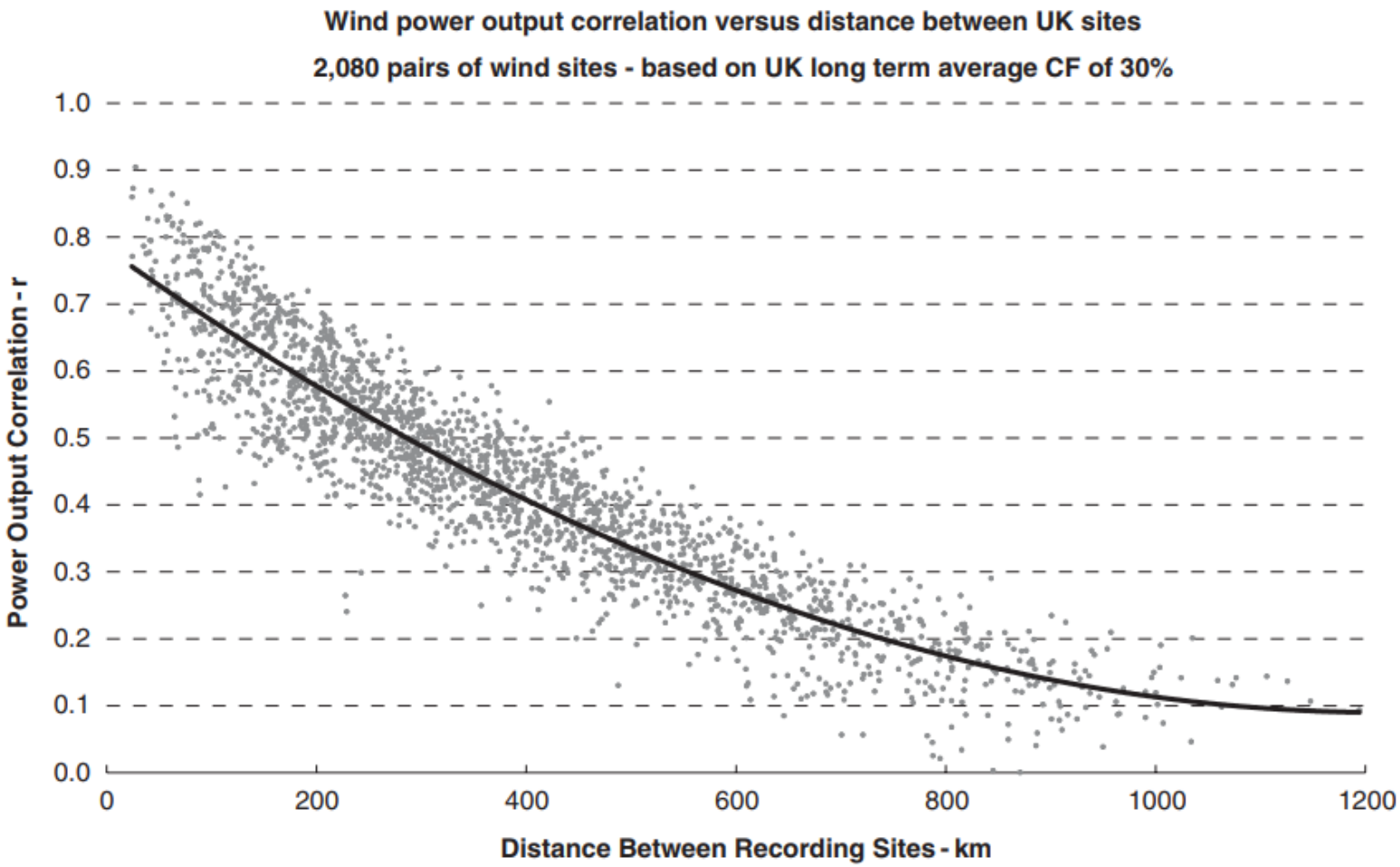

Fig. 5. UK wind speed correlation by distance between recording sites.

Wind power output correlation - Orkney with other parts of the UK

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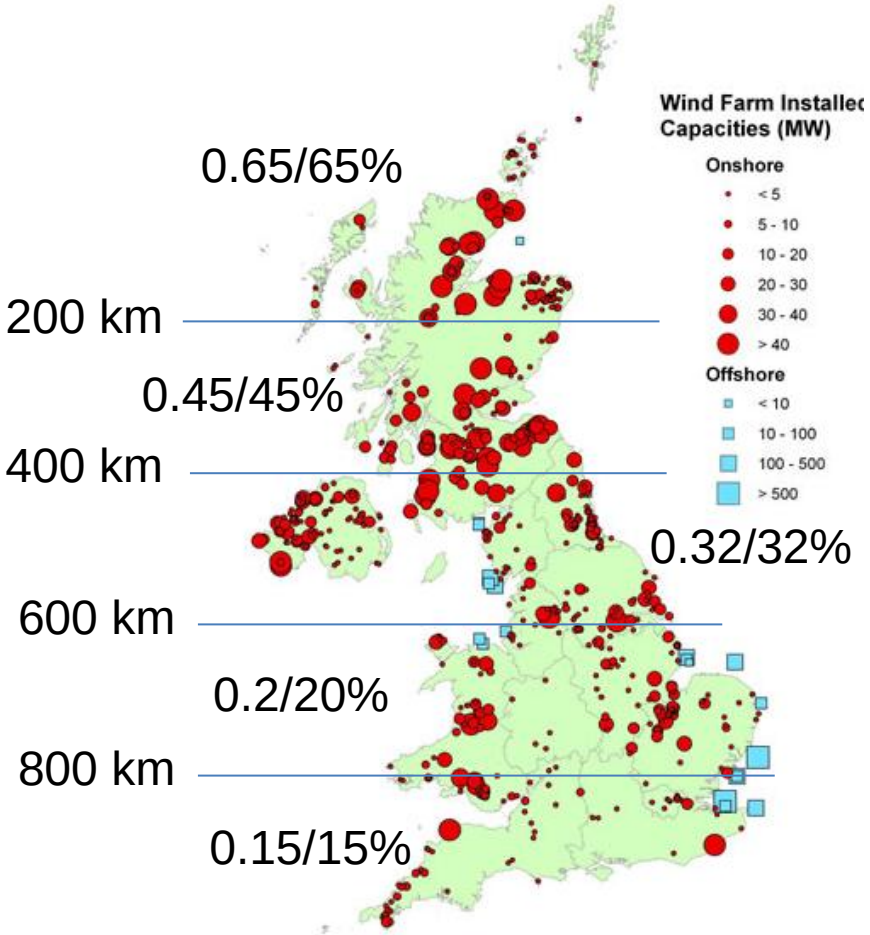
- The value of Orkney wind energy to the UK grid is very high in terms of balancing potential
- Only a 15% correlation with 'Londonshire' wind outputs
- Wind capacity factors are likely to be over 40% onshore and probably 50%-60% offshore



Based upon work by G Sinden (2005-7)

Key message – realising the value of system balancing

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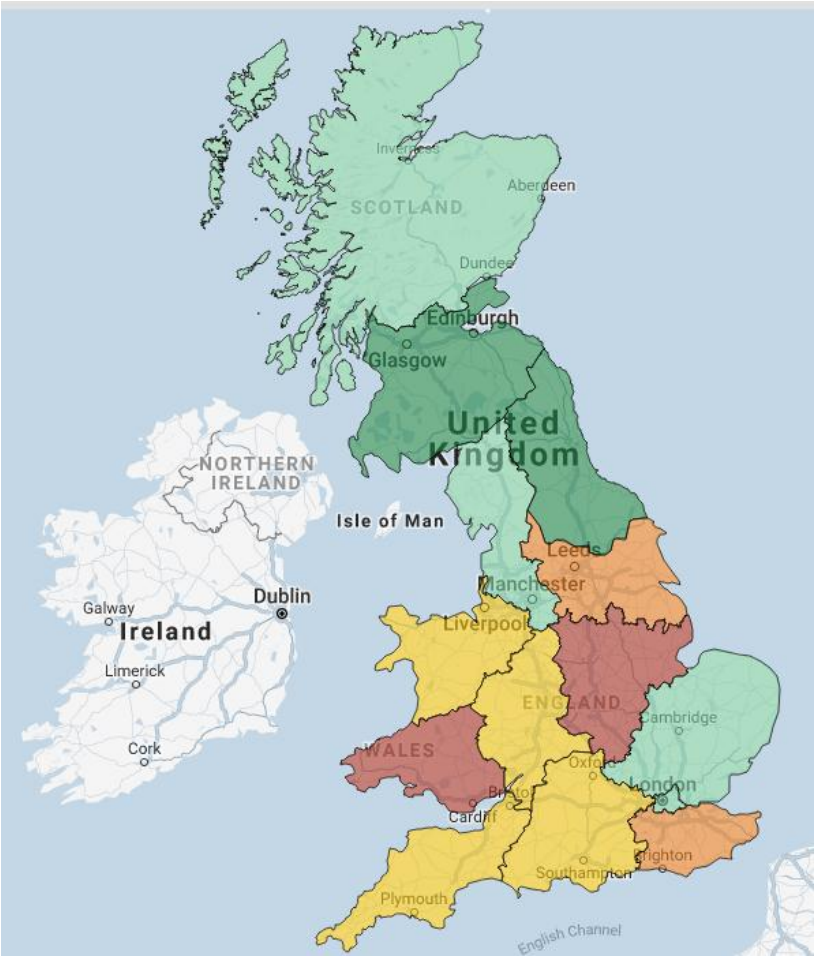
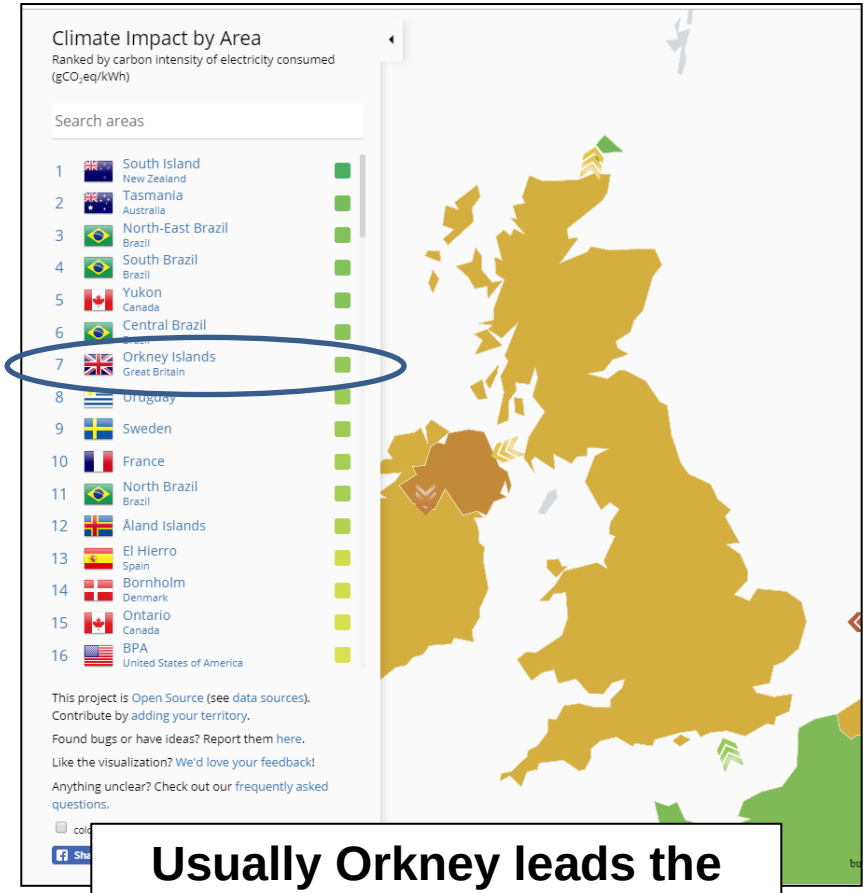
- Nowhere in the analysis that is available to the public has the capacity factor and timing of Orkney energy output been evaluated in relation to the capacity factors and timing of other key system sources of renewables
- It is clear that the greater the separation distance the greater the offset in the timing of wind outputs
- There are also opportunities for tidal offsets
- The capacity factors involved also mean that the great UK consumer gets more MWh from and Orkney connection that they do from many other connections that they have or might invest in

Carbon intensity – increasingly the most important energy metric

https://carbonintensity.org.uk/



https://www.electricitymap.org



Usually Orkney leads the world ranking!

Lifecycle carbon savings

Possible cable utilisation scenario

- 40 yrs at 70 MW,@ 40% = 9.7 TWh
- 35 yrs at 40 MW, @ 40% = 4.8 TWh
- 30 yrs at 110 MW, @ 40% = 11.5 TWh
- Total value = 25 TWh
- Carbon savings at 100g/kWh average over 40 years = 2.5 million tonnes
- Associated carbon cost savings @ £18/t of **£4.5B**

Key message – realising the value of low carbon energy

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- The principle that emitting carbon costs money is now well established
- Obviously then Orkney's carbon free electricity will help the overall UK system save money
- There is a comment in the consultation document Section 2.44.1 that Ofgem do "do not consider that there is sufficient evidence….to connect wind production in one area …. With non-renewable generation elsewhere" Since this relationship would seem to be the key basis upon which the move to renewable energy is being adopted in the UK and across the world it is difficult to understand why Ofgem would be unaware of or blind to this relationship. Since our own calculations suggest that Orkney renewables production may be worth some £4.8 Billion at current carbon prices we strongly suggest that Ofgem either takes this estimate into account or finds a better way of making this calculation and applies it to its evaluation.
- Unfortunately since the public are not able to see the needs case the manner in which SSEN have addressed this issue cannot be comments on.
- THIS ALSO SHOWCASES A MAJOR FAILING IN THE CURRENT CONSULTATION PROCESS DUE TO THE FACT THAT THE NEEDS CASE IS NOT PUBLISHED

Issues of proposed interconnectors

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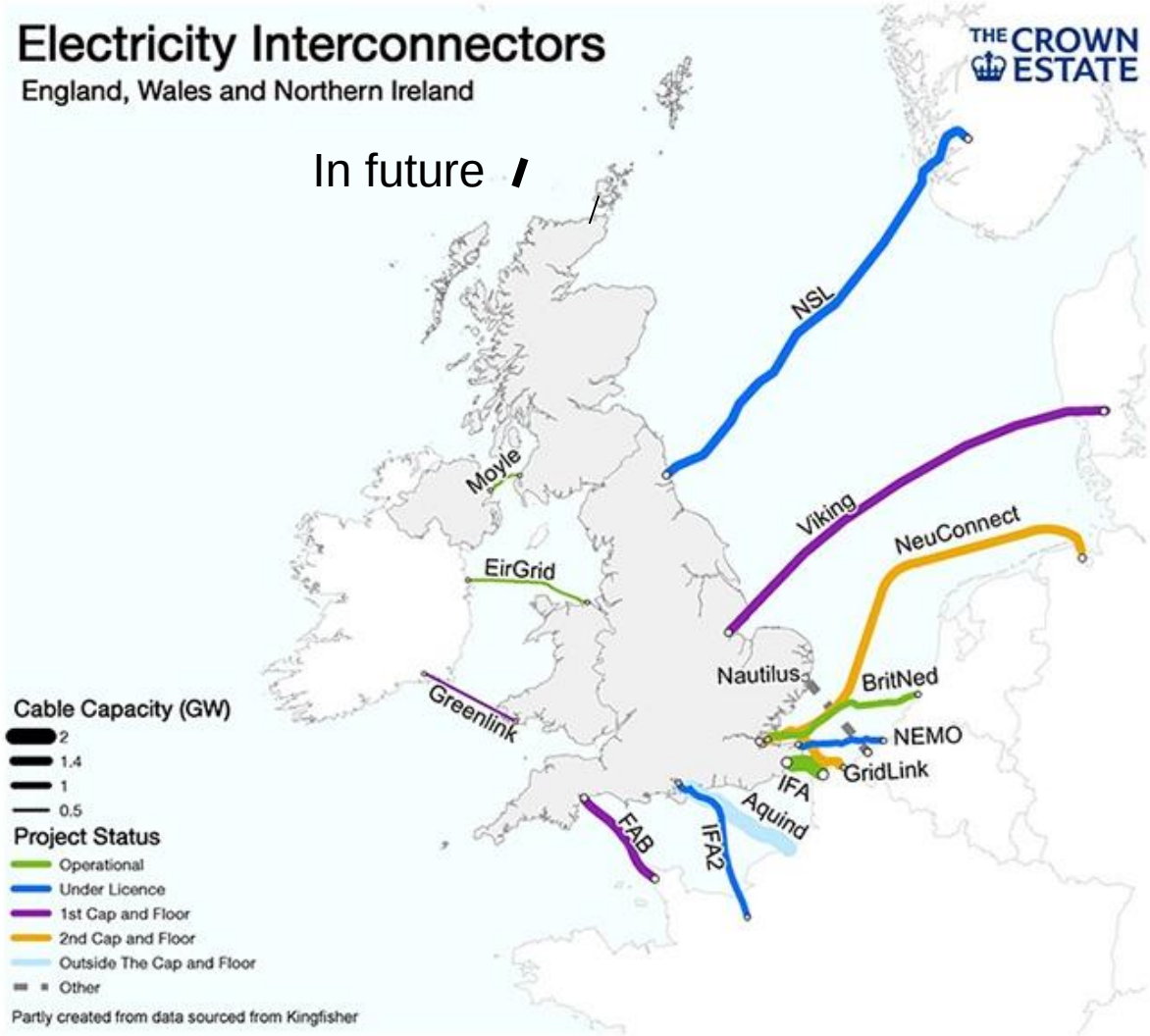

Key message – invest in UK energy as a priority

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- The previous slide graphically shows the large number of continental interconnectors that have been considered and their length – which is roughly equivalent to their cost
- None of these interconnectors exploit UK resources, none create UK jobs, none support UK technology, none will pay UK tax on generation and none provide national energy security – especially at a time when we are reducing reliance on European systems
- The Orkney "interconnector" is a fraction of the length and despite its relatively low capacity a fraction of the costs of these other interconnectors.
- The Orkney connection will use UK resources and will create UK jobs, technology, taxes and security
- Far better to invest in the UK as a priority
- Also noteworthy that however these wider connections are initially funded their costs will eventually be borne by the UK consumer

TNUoS - Network financing cash cow!

- Assumptions 70 MW by 2023; 135 MW by 2028; 220 MW by 2033. Revenue 5 p/kWh. TNUoS £100/kW. Cable life 40 yrs. CAPEX: £1.1M/MW; OPEX @ 2%CAPEX/yr; 40% to 45% CP.

- **Total revenue = £487M+£395M+£443M = £1325M - £1490M**

- CAPEX – £264M x 2 = £484M
- OPEX - £61M+£54M+£61M = £176M
- TENUoS @ £100/kW - £280M+£227M+£255M = £762M

- **Total project cost = £1422 (not profitable)**

- Applying actual total connection cost of say £500M makes the scheme profitable?

A fair TNUoS – is that an unreasonable ask?

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- These are indicative numbers only and need to be fully road tested – but someone needs to be doing this regularly!
- Present TENUoS estimates provide a wider network system windfall of nearly 50% above actual connection costs
- This can make any scheme unprofitable
- Need to look at how economics stack-up in current and future market place

Value of Orkney electricity - not MW but MWh

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- Slightly higher costing MWh (£100M over 28M for 20 yrs = 18p/yr/household)

- *TENUoS paying (£750M-£1B)*
- *Tax paying MWh (not imported - £10M profit @ 20% = £2m/yr = £80M)*
- *Secure MWh (part of UK & decommission Kirkwall power station = >£20M)*
- *Carbon and radioactivity free MWh (saving £4.5B in carbon costs, probably £2B+ waste costs of lifecycle nuclear (ref Hincley)*
- *High availability/capacity MWh (40-45%)*
- *System balancing MWh (out of phase with other generation)*
- *Demand servicing MWh (Orkney future 100-150 MW)*
- *Job providing MWh (Moving from 100s to 1000s jobs = 10% of £30M/yr = £120M)*
- *Community sustaining MWh (OIC income = £2M/yr = £80M)*
- *Innovation & technology stimulating MWh (£100Ms in R&D)*
- *Export generating MWh (£100Ms over 40 years)*
- *Globally impacting MWh (Whole world knows about the Orkney Grid Saga!)*
- ***TOTAL SAVING - £3.8B or £135/household***

Key message – use a real CBA!

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- The methods – to the extent that we can see them – do not adequately consider the variety of cost benefits arising to the UK consumer from developing Orkney wind.
- For a differential cost over alternative options of £100M the cost to each consumer would be £0.18/yr
- The value that would be created to UK plc is equivalent to £135/yr
- The ration between these two values is 1 to 750!!!

Methodological analysis

Comments about specific questions in the consultation

- The following comments and observations are made

Q2 Generation assets & opportunities that should be considered

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Needs case considerations

- New/repowered wind
  - CfD supported
  - Subsidy free
- Tide
  - IPPA supported
  - Subsidy free (when)
- Wave
  - IPPA supported
  - Subsidy free (when)

Additional local reality that should be considered

- Other new/repowered wind
  - Sanday, Burger Hill, etc
- Offshore wind
  - Floating & founded
- Gas (power barge)
  - Terminal or CNG ship based delivery
- Diesel/gas/hydrogen
  - Kirkwall power station
- Demand security

Q2 Likelihood of marine energy

- Chicken and egg situation, unless grid is provided we will never get investment and the capacity to bring down costs – this is a wider political issue clearly BUT a grid connection would secure and stimulate investment in the UK – opportunity is being lost to Canada, France and SEA

Q2 Wider energy system developments

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These factors need to be taken into account

- Decarbonised local electricity
  - 120%+ renewables
- Improving energy efficiency of buildings
  - Added insulation, draft control, thermally efficient new builds
- Decarbonising heat
  - Heat pumps in domestic and public buildings
  - Smart electric heating and storage systems
  - Fuel-cell based heating and power
- Decarbonising road transport
  - EV cars, buses, commercial vehicles
- Decarbonising ferries
  - Hydrogen and electric ferries
- Decarbonising aircraft
  - Electric planes
- Decarbonising agriculture and industry
- Delivering integrated energy services rather than simple power supply

Q2 Future local demand scenarios – under a system revolution

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- Nominal demand on average about 23 MW, varying between 12 MW and 32 MW
- New project about to be launched will add new demand and balancing resources
- Ongoing decarbonisation, storage and balancing will likely take demand up over 100MW within 7-10 yrs
- Energy commoditisation may also create flexible demand for energy – eg hydrogen
- Does the Needs Case consider these major system developments?
- Appears that it does not, but it should do!

Q3 Design processes

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- Clear that network operators feel expectations from Ofgem to consider the lowest cost solutions and the adapt as problems arise
- This approach leads to planning conflicts that destabilise opinion and can lead to disruptive planning outcomes
- Starting point should be an optimal approach that takes account of local planning sensitivities

Q3 Key base cost and asset sweating questions for Ofgem

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- What is an acceptable build costs for new transmission connections
  - Should subsea cables be buried?
  - Should pylons be considered as the default base case support mechanism?
  - Should over land cables be buried?
  - What measures should be allowed to hide key buildings etc?
  - Default cost factors being used?
  - What level of installed capacity is considered acceptable (ie what %)?
  - How many years project lifetime are taken into account?
  - How many years cable life time are taken into account?
  - What capacity factor is considered acceptable (ie what %)?
  - How do Ofgem consider the benefits of generation diversity on transmission infrastructure?
  - How do Ofgem consider the balancing value of power from different parts of the country?

Q3 Design – T & D integration

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- Network integration applies both on land and subsea
- Ofgem highlight the lack of subsea network optimisation, DNV also highlight the lack of onshore network optimisation
- As a community, demand customers and a mix of generators we see and deal with all parts of the network
- We strongly believe in one system network planning and would urge urgent changes to push such streamlining through

Q3 Comments on DNV assessment of costs

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Our response to these costs has been redacted due to confidentiality Issues!!!

Table 6: Estimated cost DNV GL

Option	Tech-nology	Item	SHE Transmission Cost Estimate (£m)	DNV GL Cost Estimate (£m)	Difference
1	HVAC	Dounreay/Finstown Substation (incl voltage regulation)	[redacted]	[redacted]	[redacted]
		Link (Subsea/Land cable)	[redacted]	[redacted]	[redacted]
2	HVAC	Dounreay/Finstown Substation (incl voltage regulation)	[redacted]	[redacted]	[redacted]
		Link (Subsea/Land cable)	[redacted]	[redacted]	[redacted]
3a	HVAC	Dounreay/Finstown Substation (incl voltage regulation)	[redacted]	[redacted]	[redacted]
		Link (Subsea/Land cable)	[redacted]	[redacted]	[redacted]
3b	HVAC	Dounreay/Finstown Substation (incl voltage regulation)	[redacted]	[redacted]	[redacted]
		Link (Subsea/Land cable)	[redacted]	[redacted]	[redacted]
4	HVDC	Dounreay/Finstown Substation	[redacted]	[redacted]	[redacted]
		Link (Subsea/Land cable + Converter Stations)	[redacted]	[redacted]	[redacted]
5	HVDC	Dounreay/Finstown Substation	[redacted]	[redacted]	[redacted]
		Link (Subsea/Land cable + Converter Stations)	[redacted]	[redacted]	[redacted]

The confidential status of the needs case makes a travesty of the consultation process

Q3 Noted that …

- DNV see subsea cable costs as high
- Ofgem comment on underground cabling costs
- Ofgem also comment on contingency and risk cost
- We are keen to understand the costs of subsea burial – locally risks are considered low for most of the route

CAPEX = level of securities

CAPEX = level of TENUos

Previously calculated that Orkney TENUoS~1ROC or £50/MWh

3 Sub-station costs

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- 15% to 30% variation of substation costs of ■ are considered reasonable!
- From a design perspective there would be significant advantages from a stakeholder acceptability perspective from dropping the ground level of the substation by a few metres
- We believe that the cost of such a design accommodation would be significantly less than the 15-30% of ■ outlined above as acceptable noise!

5 Additional CBA

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- Due to redaction of numbers meaningful comment is very difficult
- Cost vs constraints – suggests various breakeven points above 70 MW? What are they?
- System balancing value – not considered by anybody
- Value from demand security – rejected because of too little analysis! This must be taken into account. Absence of analysis should not penalise the host community, SSEN should be required to complete this
- Given the power is for export what about also considering other supply vulnerable areas nearby – eg system failures between Beauly and Dounreay!
- Need to consider how decarbonised communities – benefit from R&D
- TENUoS charges – inadequately considered in value calculation
- Carbon savings – if no relationship then why are we decarbonising?

Question 6

- i – No disagree
- ii – No disagree
- Iii – Yes if achieved but possible that CfD system does not work for islands, therefore may not be a useful tool. subsidy free also an option along with offering system balancing services through added storage
- Vi - Yes this is a good indicator but should not be the only indicator posting securities should be viewed as an additional and alternative commitment
- v - What is adequate? Real question is whether any projects will come forward with ‘certainty’. Yes they will IF the opportunity is provided – as a community we have proved that many times over

i Do we agree no value to GB customers at 70 MW?

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- No and No – these higher than usual thresholds are unjust and unwarranted
- Table 2 assumes a CfD cost, if we go for significant subsidy free capacity then the costs reduce
- The build cost is fixed, it could probably be reduced if there was a 70 MW capped capacity – but that is not realistic
- Value added through system balancing and higher capacity factors
- See earlier points about value of connection - - £0.18/yr cost verses £135/yr benefit

Needs case scenarios

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- The outcome of the process at present is once in time, one capacity outcome offered on a pass or fail basis
- Within the analysis carried out there are some gross assumptions that totally fail to recognise the reality of the situation
- For example:
  - If the conditional needs case is agreed there will be renewed efforts to find generation to back up the cable capacity required
  - If the conditionality is reached there will be even greater interest in bringing forward projects to fill the available capacity
  - If conditionality is reached by securities for wind projects there will be a very strong belief in the viability of subsidy free generation for wind
  - There is therefore no conceivable scenario where generation would halt at 70 MW or indeed 100 MW

Compounded disadvantages

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- Orkney and other islands were excluded from the UK grid system in 2004
- Customers asked to pay more for electricity, no gas alternative
- Delivery dates have often changed
- Securities required before Needs Case, plus out of phase with CfD cycles
- CfD pot rules not appropriate for island energy – we will still try
- Orkney has been subject to unknown but excessive TENUoS rate schemes for decades
- False promises, extended delivery dates, changing ground rules

Alternative outcomes

- If subsidy free generation can be delivered it will also open up additional local energy use opportunities whereby transmission charges and losses will be avoided and added value PPAs may be available
- If local high value demand was created the cable could be used to import rather than expert energy

Summary 1

- 1) We agree that the network to Orkney and the network on Orkney both need major reinforcing
- 2) The generation scenarios report on what was in play at the time but do not include shorter term additional capacity associated with more onshore wind, offshore wind and gas generation which could be added if necessary to reach capacity targets. The scenarios grossly underestimate the medium (2025-30) and longer term (2030+) generation potential. The scenarios also fail to address the local demand trends – likely increasing to ~150MW
- We believe that a series of capacity options should be considered within the needs case with approval given to each option depending upon the conditionality reached – this would guarantee at least some kind of connection

Summary 2

- 3) The basic design of the routing and placement of infrastructure is understandable. We support the undergrounding from Warbeth to Finstown; we would seek the base level for the sub-station to be as low as practical, not the cheapest option; we suggest that burial of the subsea cable is unnecessary along much of its route based upon past cable damage and failure experience with similarly unburied cables.
- We cannot comment on costs since we have not been given the opportunity to review them – THIS IS A KEY FAILING IN THE NEEDS CASE PROCESS
- 4) We strongly disagree with Ofgems concerns about the CBA. We do not see how the responsibility held under Ofgems remit are adequately or appropriately considered within the current CBA and the rejection of SSEN's suggested additional factors which, in part, seek to address the wider issues seems blinkered. We would advocate a much more realistic and holistic approach to value (Our own assessment suggests a margin consumer cost of £0.18/yr compared to a benefit of £135/yr

Summary 3

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- 6i) We disagree with Ofgem's conclusion we believe that any connecting transmission cable will be filled to capacity within 10 years of it being announced and with in 5 years of it being installed. The only real uncertainties associated with this are the ones created by Ofgem's own proposed changes to the access charging regime and other 'market' influences of the regulatory framework. Essentially the biggest risk to the success of the cable is Ofgem itself!
- 6ii) We believe that the alternative approach is a sensible way of getting better queue management and would contend that all developers who embark upon project development in Orkney are fully committed to see things through. The greatest difficulties have been caused by changes in/absence of UK government policy!
- 6iii/iv) There are many indicators of developers commitment, any one of which should be taken into account as an indication of intent depending upon circumstances. There are also a number of back up opportunities should any one scheme fail.