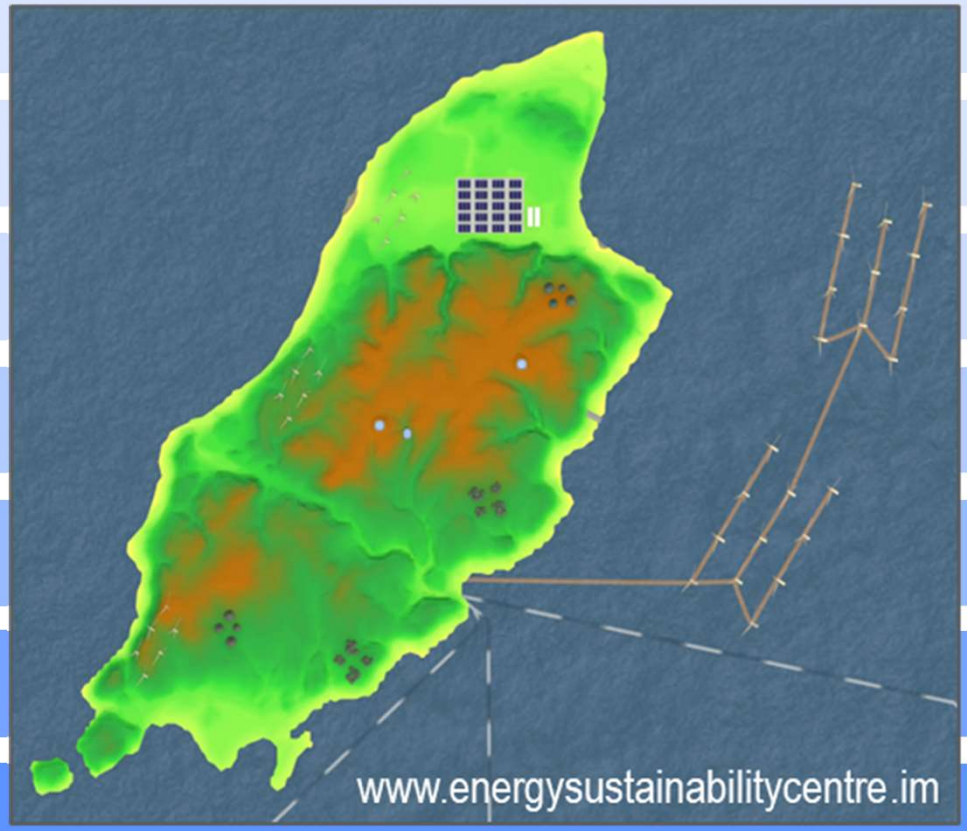
What other islands are doing to secure their energy future

- Energy Transition League
- Who are we?
- Energy transition?
- Current situation
- What would work on the Isle of Man
- Anything else?
- Conclusions



Energy and Sustainability Centre, IoM

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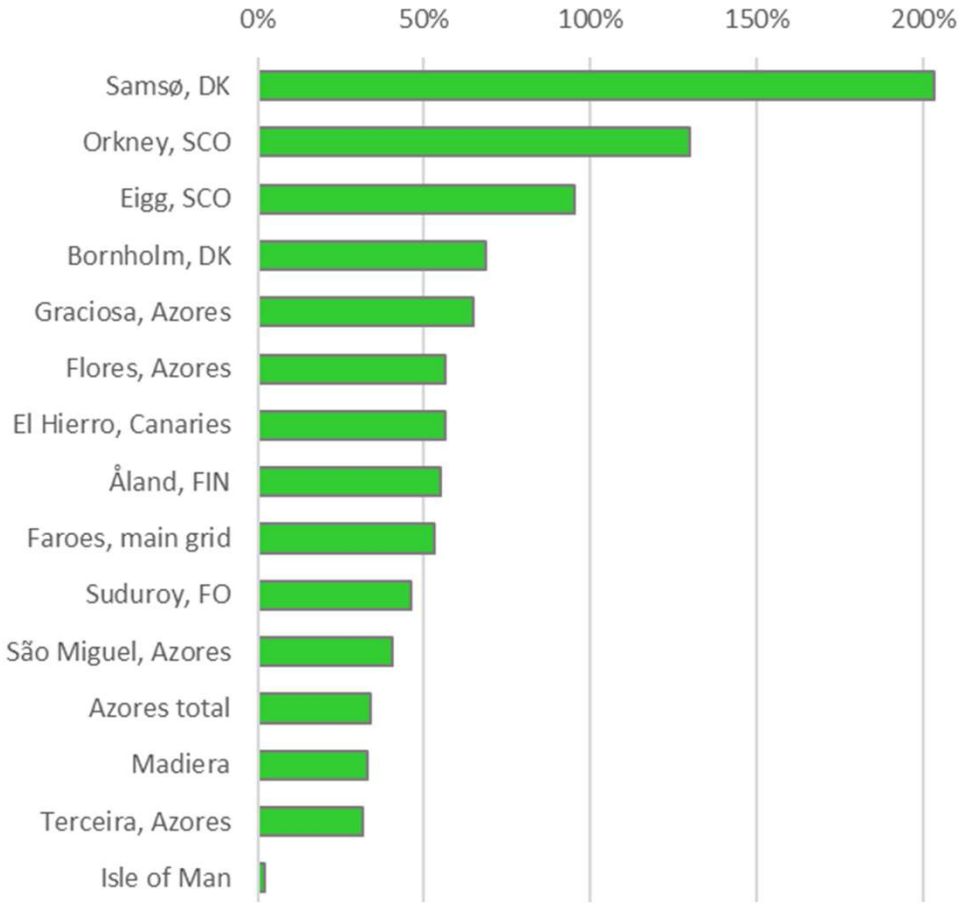
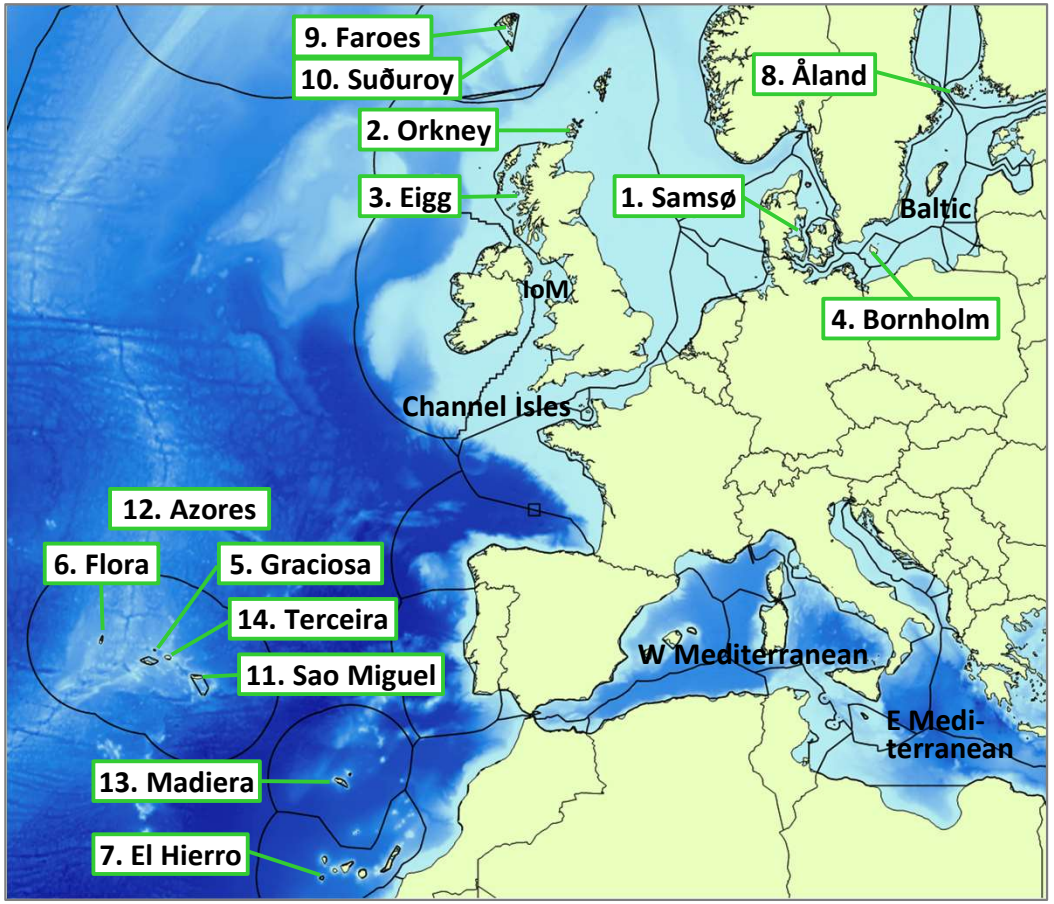
Island ranking: 2022 local renewable power relative to electricity demand





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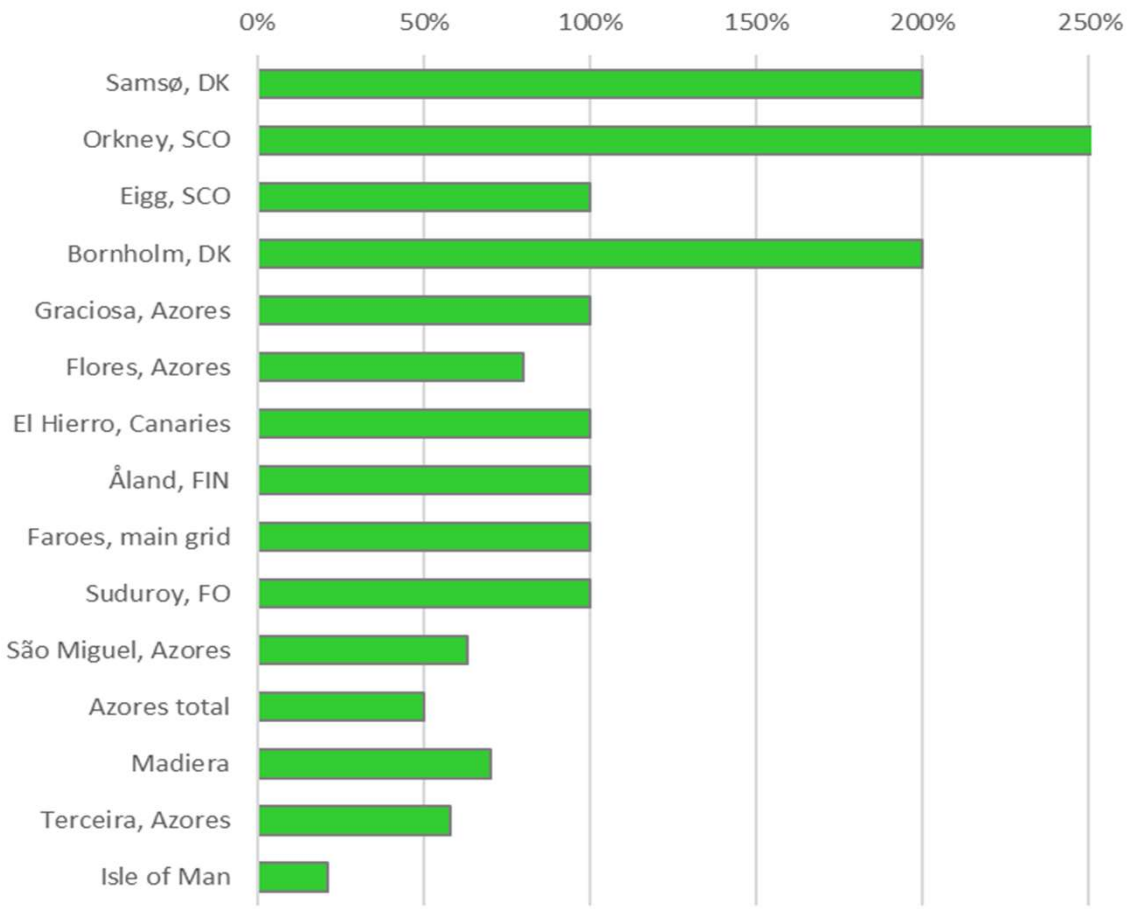
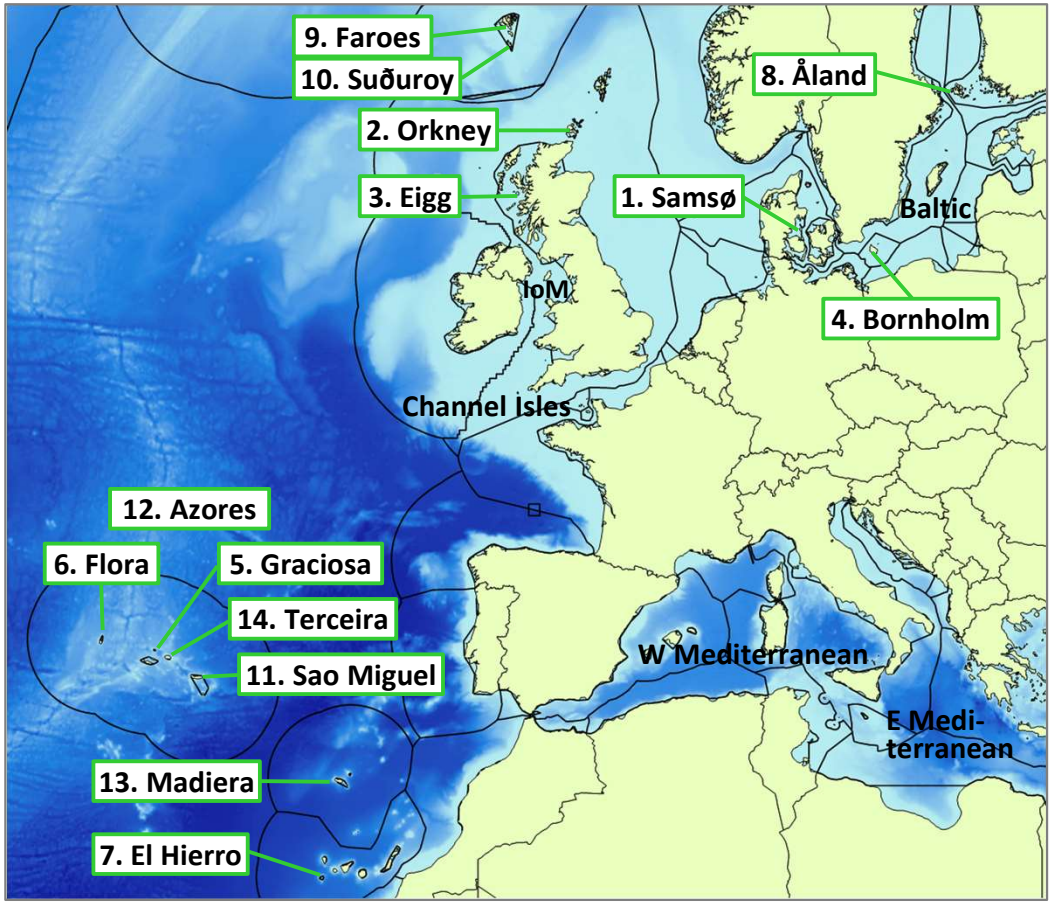
Island ranking: 2030 local renewable power relative to electricity demand





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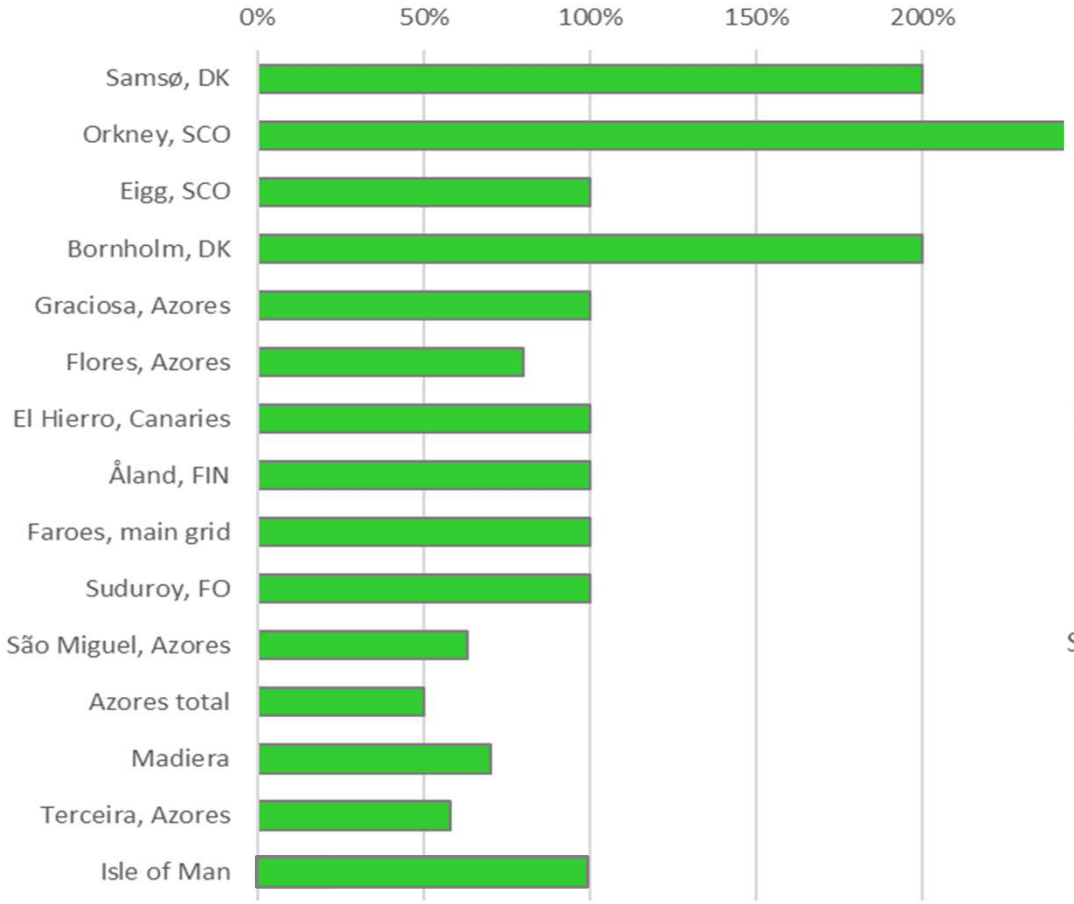
With a mix of public & private sector funding



Samsø, DK	1997 plan to be 100% renewable by 2007 (wind, straw, dist heat)
Orkney, SCO	self-sufficient by 2013; 4x elec by 2030; 600 jobs, EMEC test centre
Eigg, SCO	community-instigated, sustainable self-sufficient electricity grid
Bornholm, DK	plan 100% renewable electricity by 2025 (wind, PV, biomass, dist heat)
Graciosa, Azores	wind-PV with one of the world's largest battery storage systems
Flores, Azores	wind, hydro, flywheel
El Hierro, Canaries	world-leading hybrid wind-pumped hydro scheme
Åland, FIN	60 islands; 20% elec from wind in 2014; needs H2 for ferries for NZE
Faroes, main grid	2014 plan for 100% RE elec on all 16 islands by 2030; tender process
Suduroy, FO	stable grid with 100% wind using batteries & synch cond ± hydro
São Miguel, Azores	wind, geothermal, hydro, minor PV
Azores total	planned expansion of wind, geothermal, hydro & PV by 2025
Madiera	2012 sustainable energy action plan incl EVs; focussed on hydro
Terceira, Azores	wind, geothermal, minor hydro, minor PV
Isle of Man	100% self-sufficient with 100 MW wind + 40 MW PV + 4.8 GWh PHS

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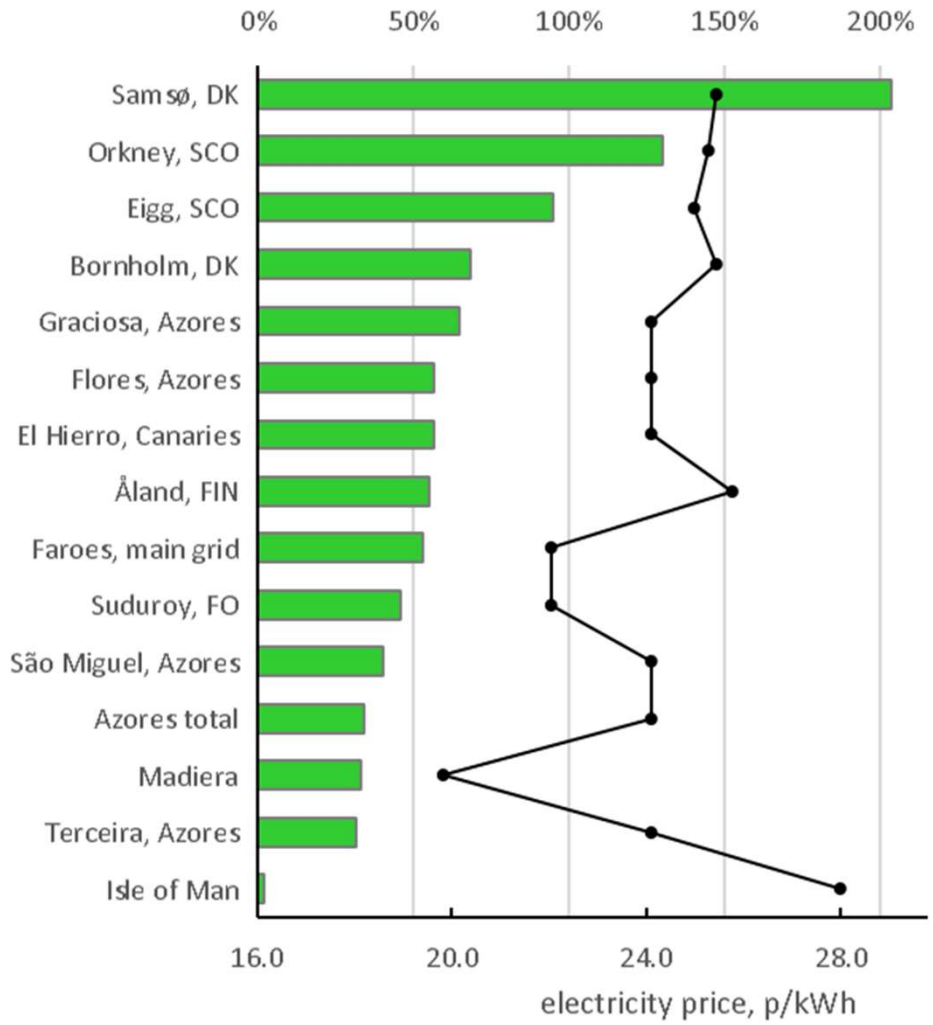
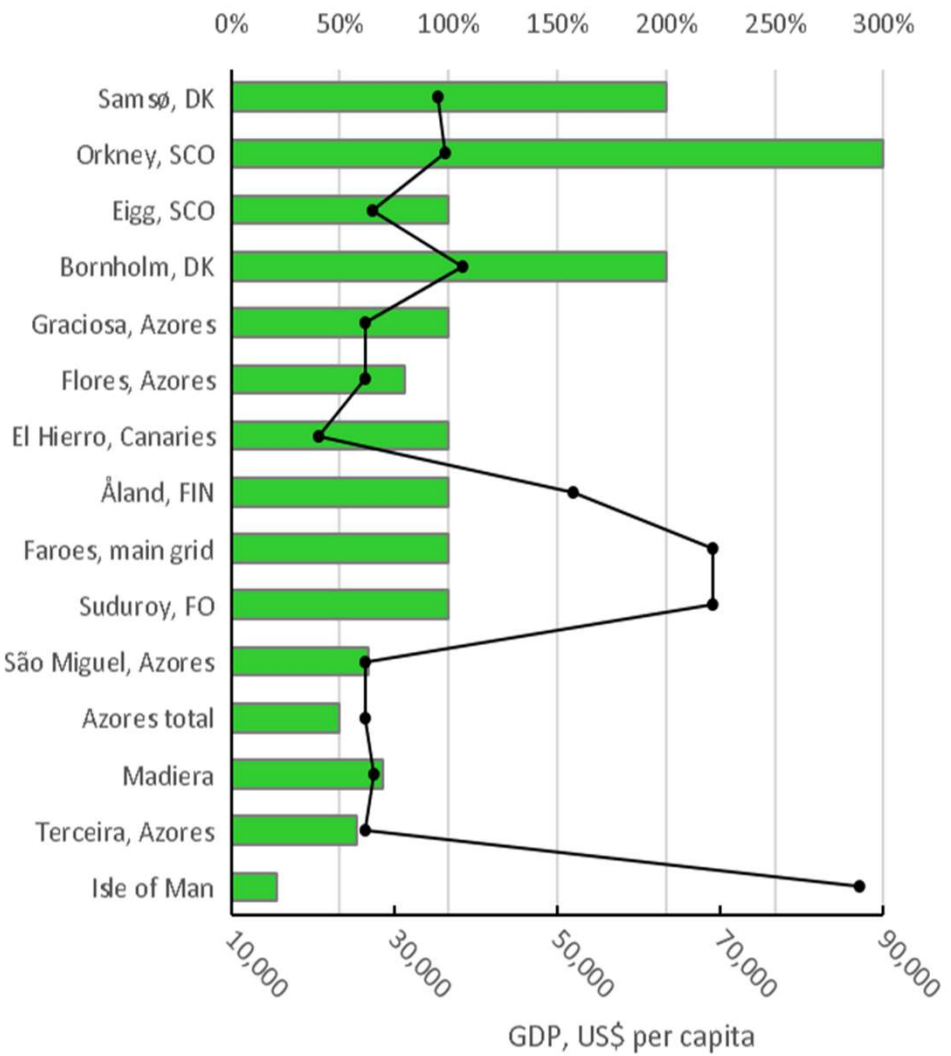
2022 ranking cf electricity price



2030 ranking cf 2021 GDP/capita



Who is the Energy & Sustainability Centre & what do we do?

- Not-for-profit NGO focussed on promoting economic solutions to achieve net zero emissions
  - Motivated by climate change & the fact that c.60% of global emissions are from oil & gas
- IoM options for self-sufficiency in renewable energy, affordable heat, sustainable transport
- Research, training, advice, public engagement, intermediary between Govt & businesses
- Emphasis on working together to maximise the benefit of the green transition

dquirk@dtu.dk – DTU Offshore (DOTC)
Technical University of Denmark trains 60% of Danish engineers & is ranked top research institute in Nordic region

PEEL ZURICH MMC KPMG

What are we currently working on?

- Now two things are driving the energy transition – costs & security of supply
- Energy system modelling with emphasis on affordable “off-the-shelf” technologies
- Focus on replacing Pulrose with on-Island renewables as alternative to imported energy

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What are we currently working on?

- Now two things are driving the energy transition – costs & security of supply
- Energy system modelling with emphasis on affordable “off-the-shelf” technologies
- Focus on replacing Pulrose with on-Island renewables as alternative to imported energy

- Current initiatives
  - White paper (facilitating private investment through fit-for-purpose regulations)
  - Public engagement (exhibition, townhall, online, energy transition cards)

Collaboration vs competition; integration vs self-sufficiency; private sector vs public sector

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Changing world

- What were challenges to Island life – weather, size, distance from land – are now assets
- Wind, solar, hydro are standard technologies & affordable
- Need appropriate regulations & commercial approach

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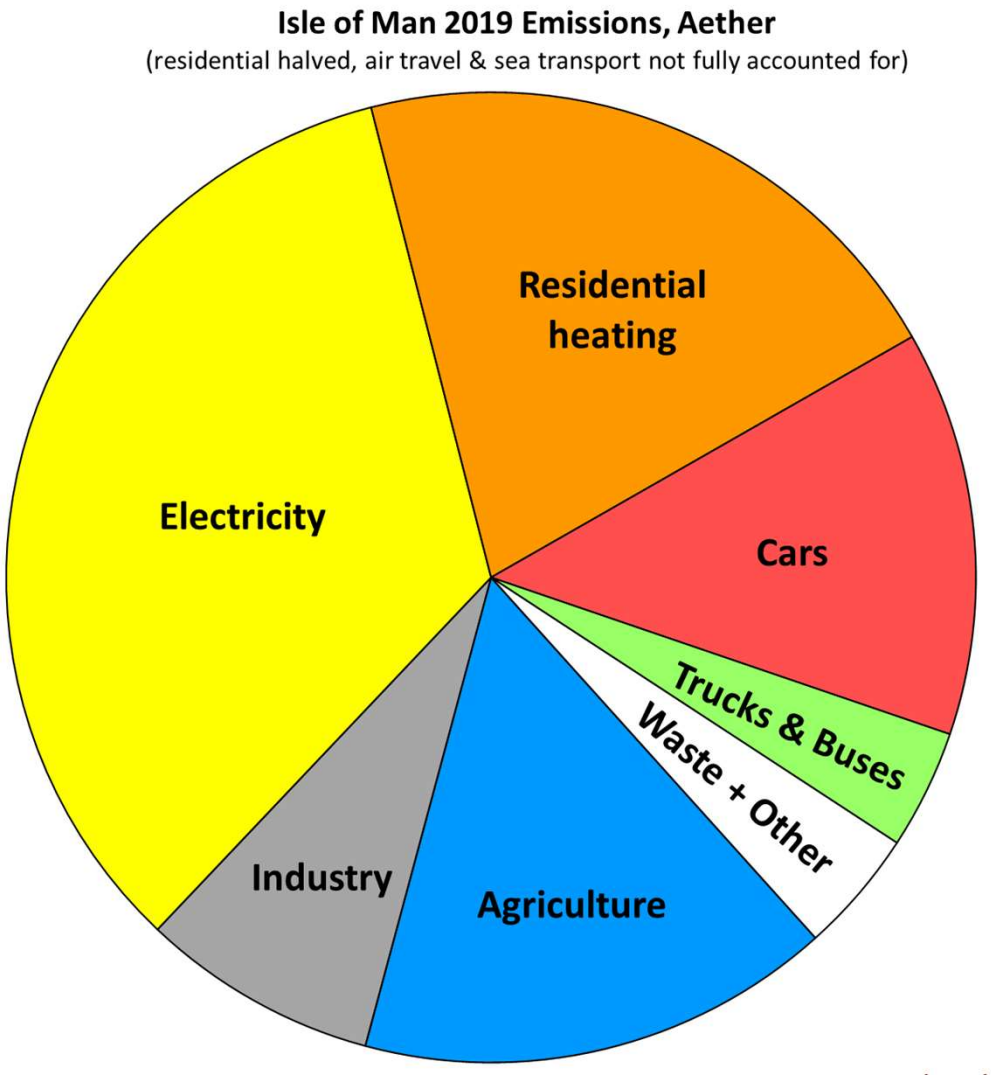
80% of IoM emissions are from oil & gas (550,000 t CO_{2e} per year)



Energy and Sustainability Centre, IoM

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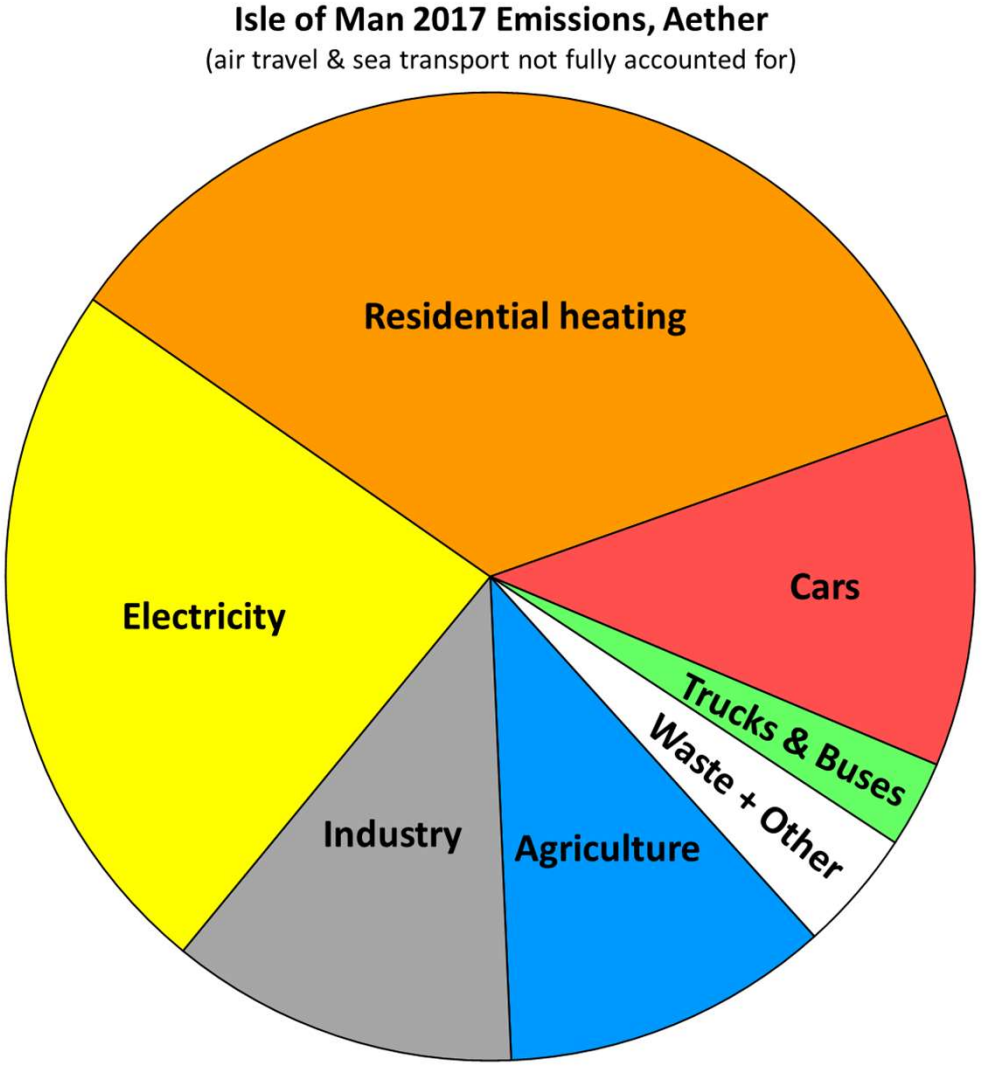
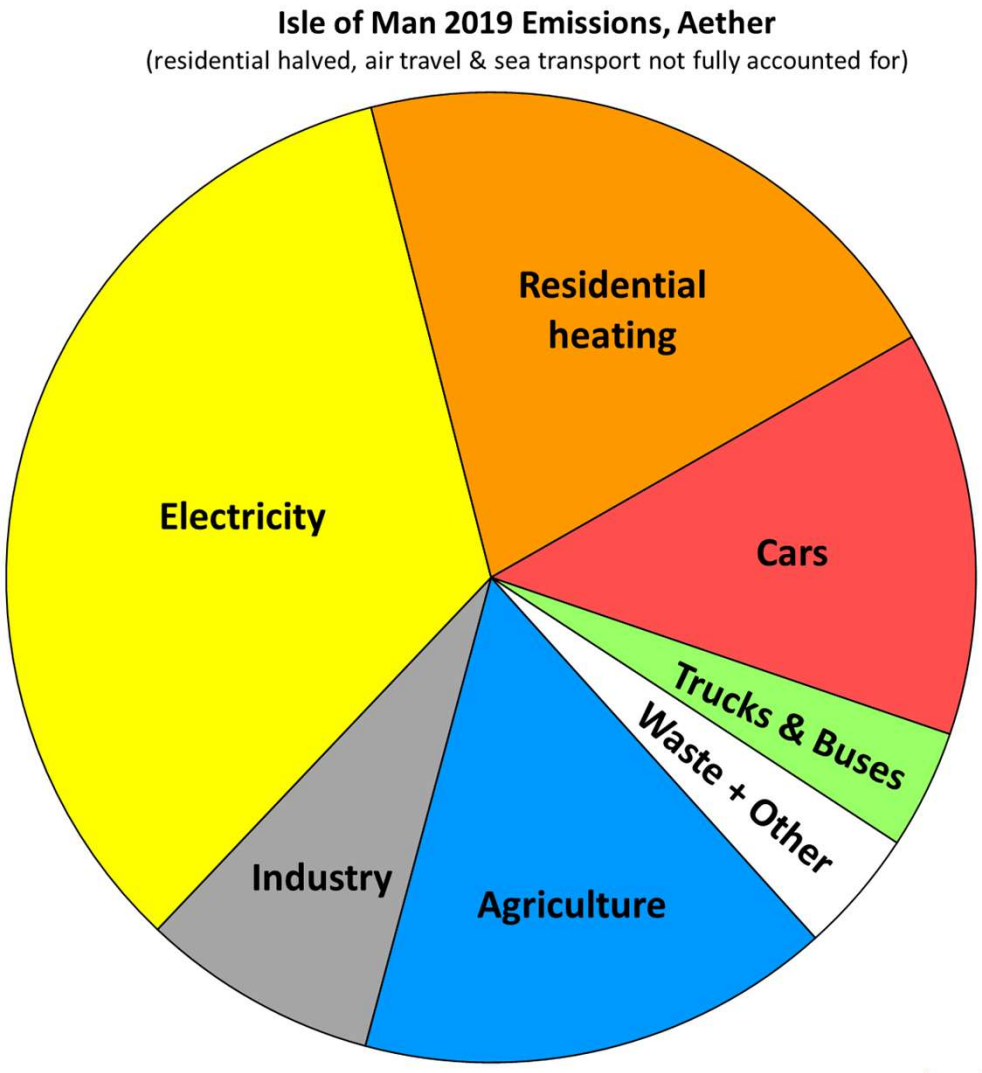
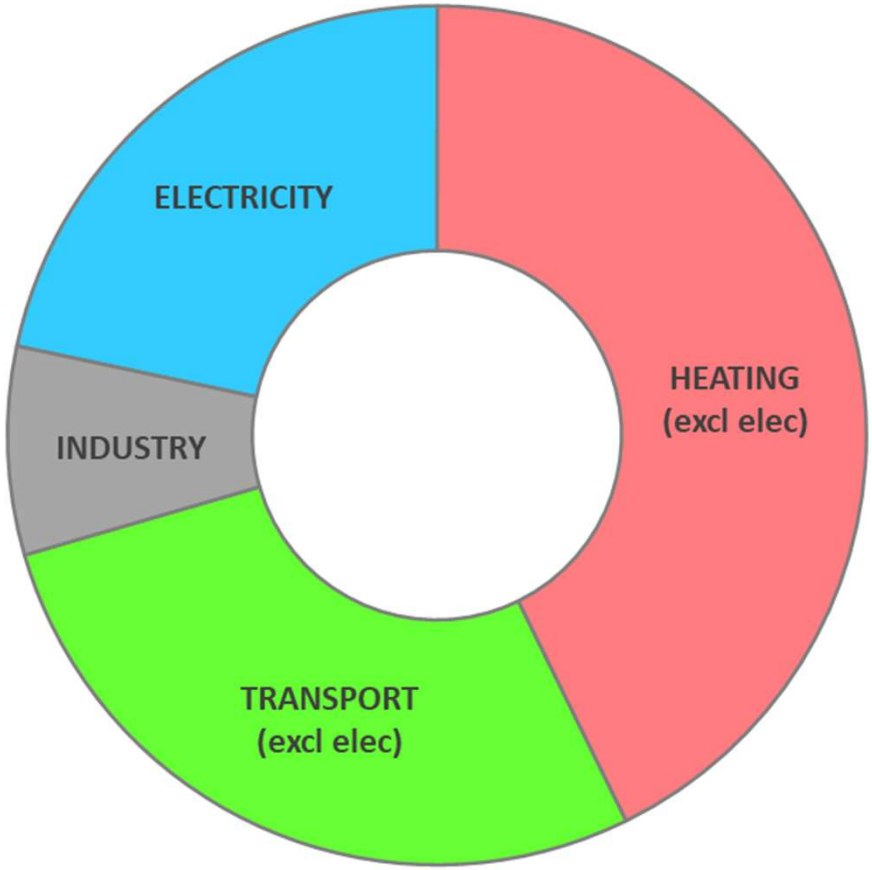




IoM energy consumption – 97% from oil & gas…



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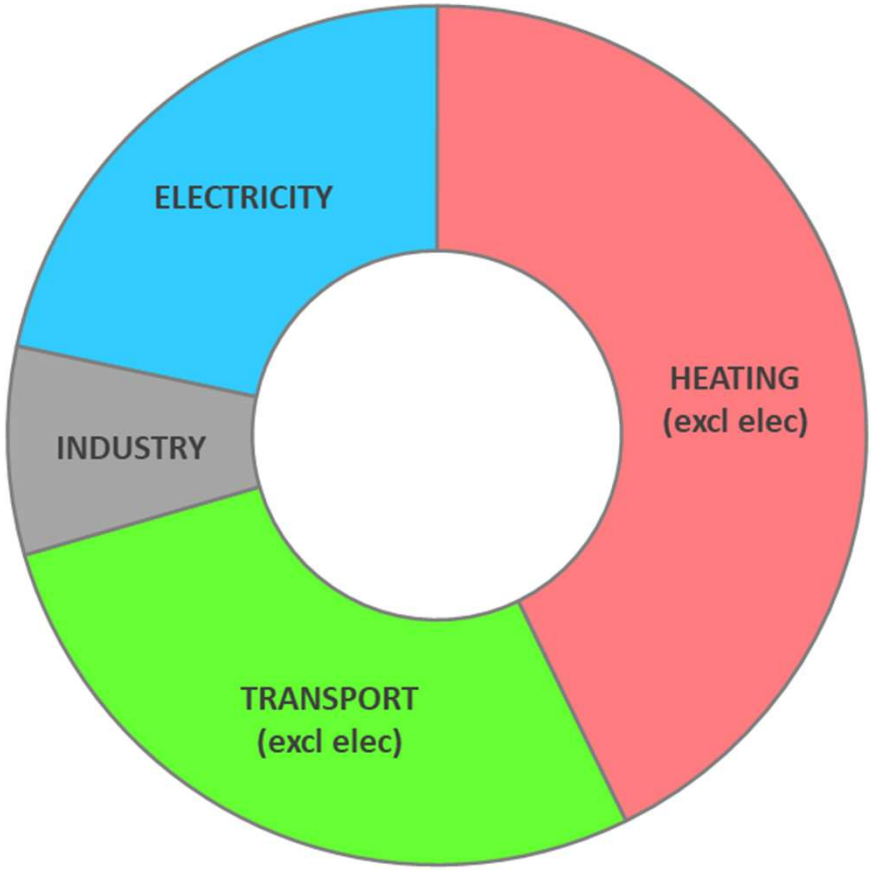
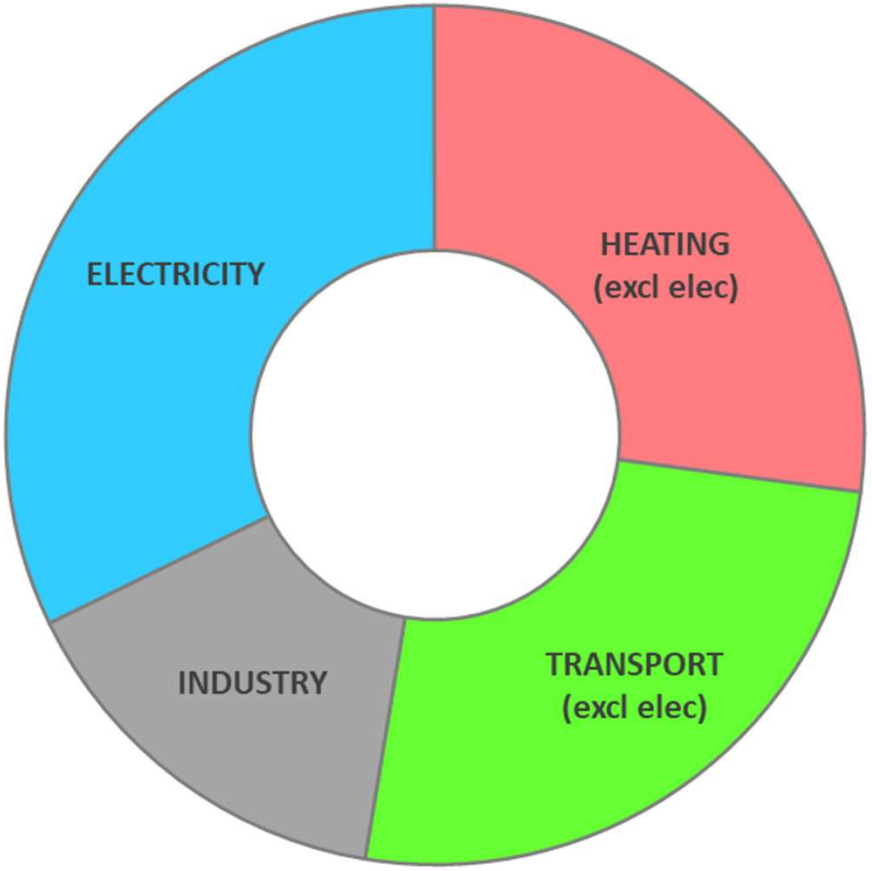
IoM energy consumption – 97% from oil & gas… 68% Denmark





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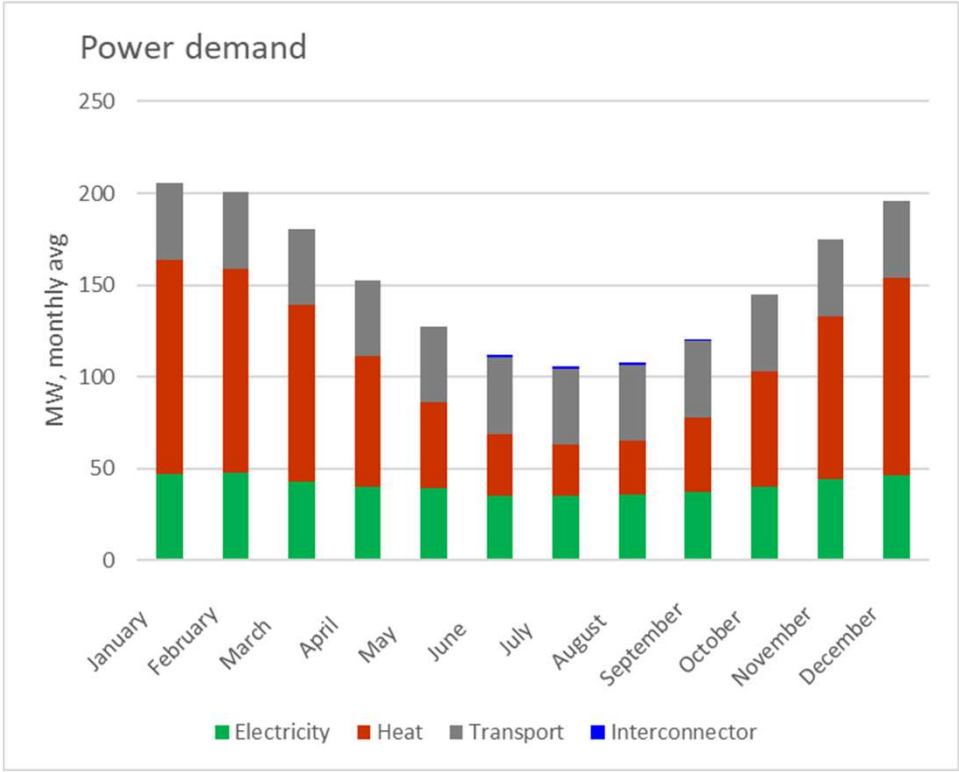
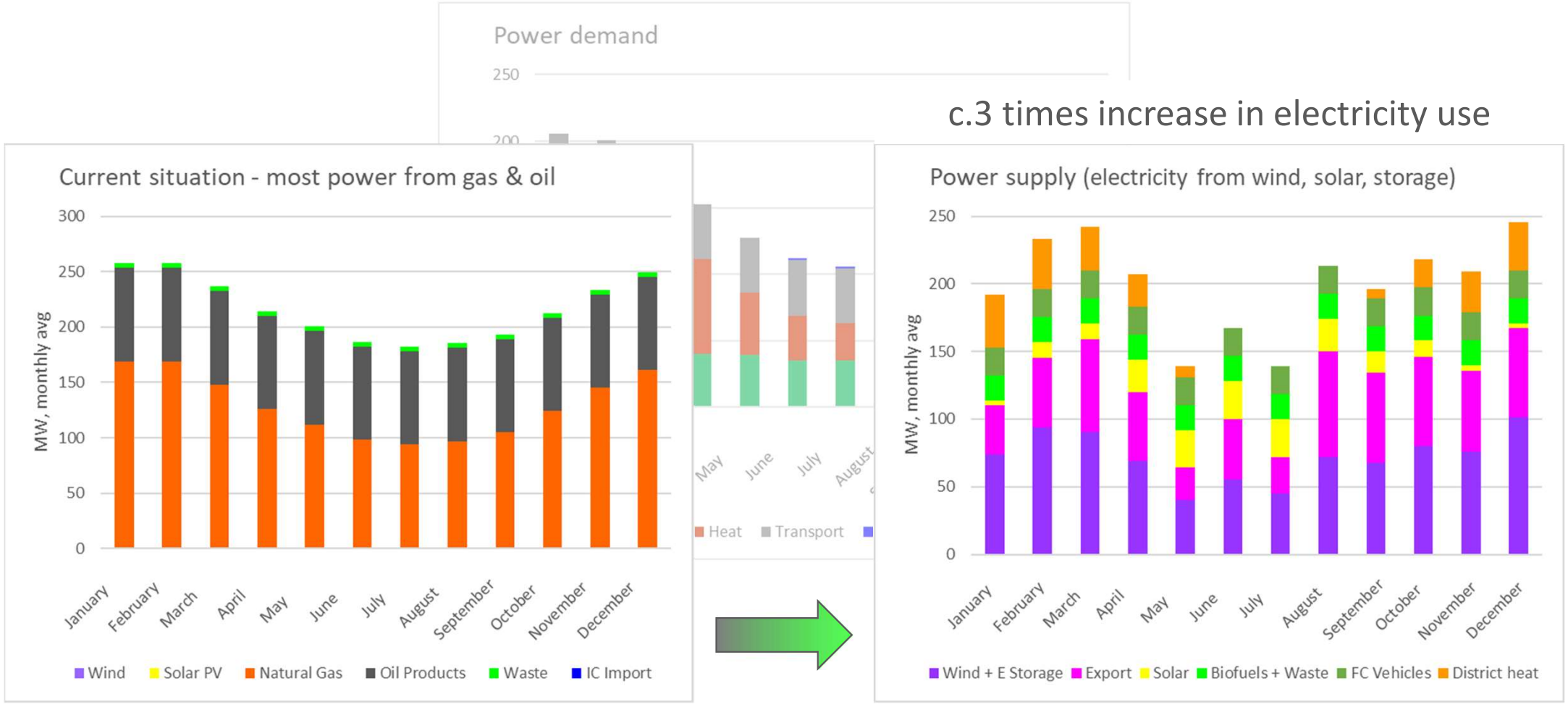
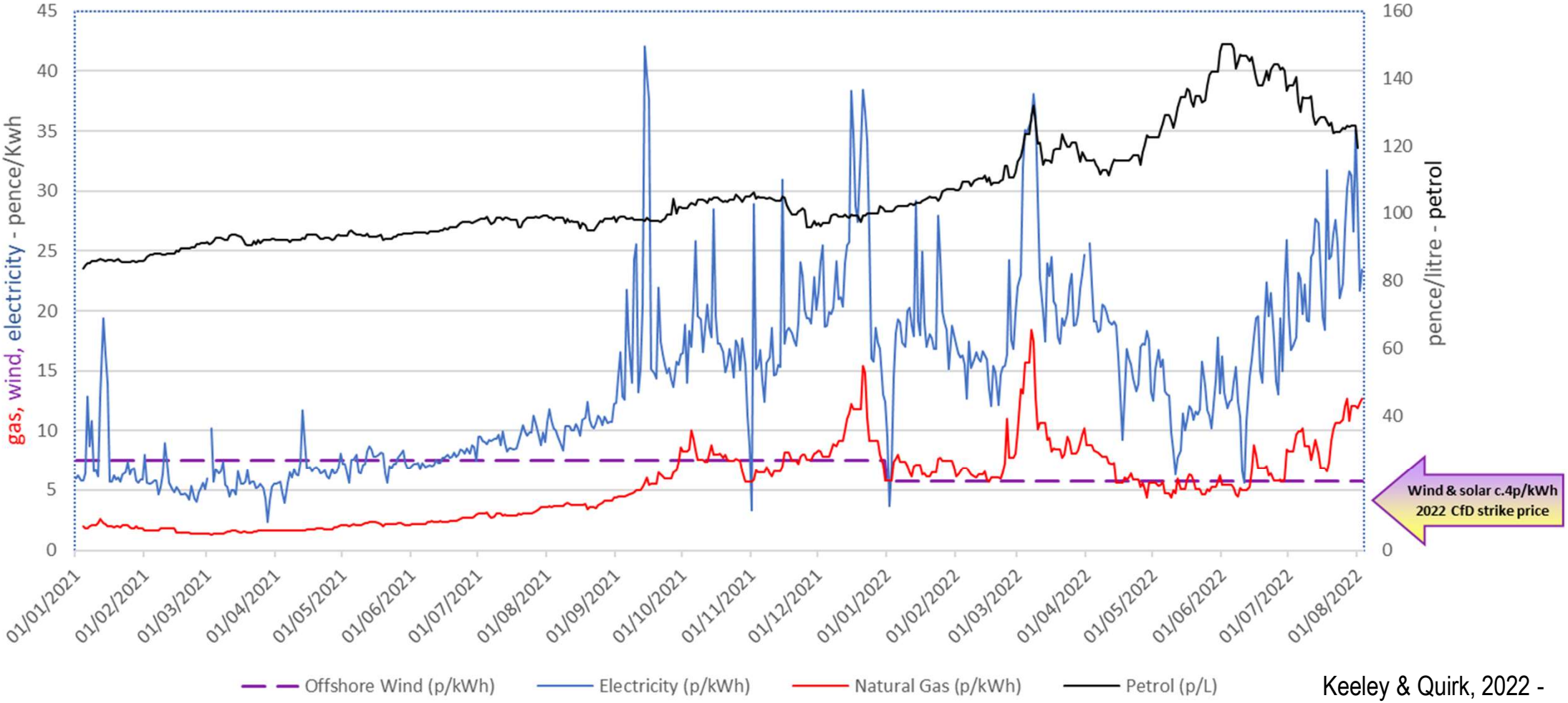
What is the energy transition?



What is the energy transition?



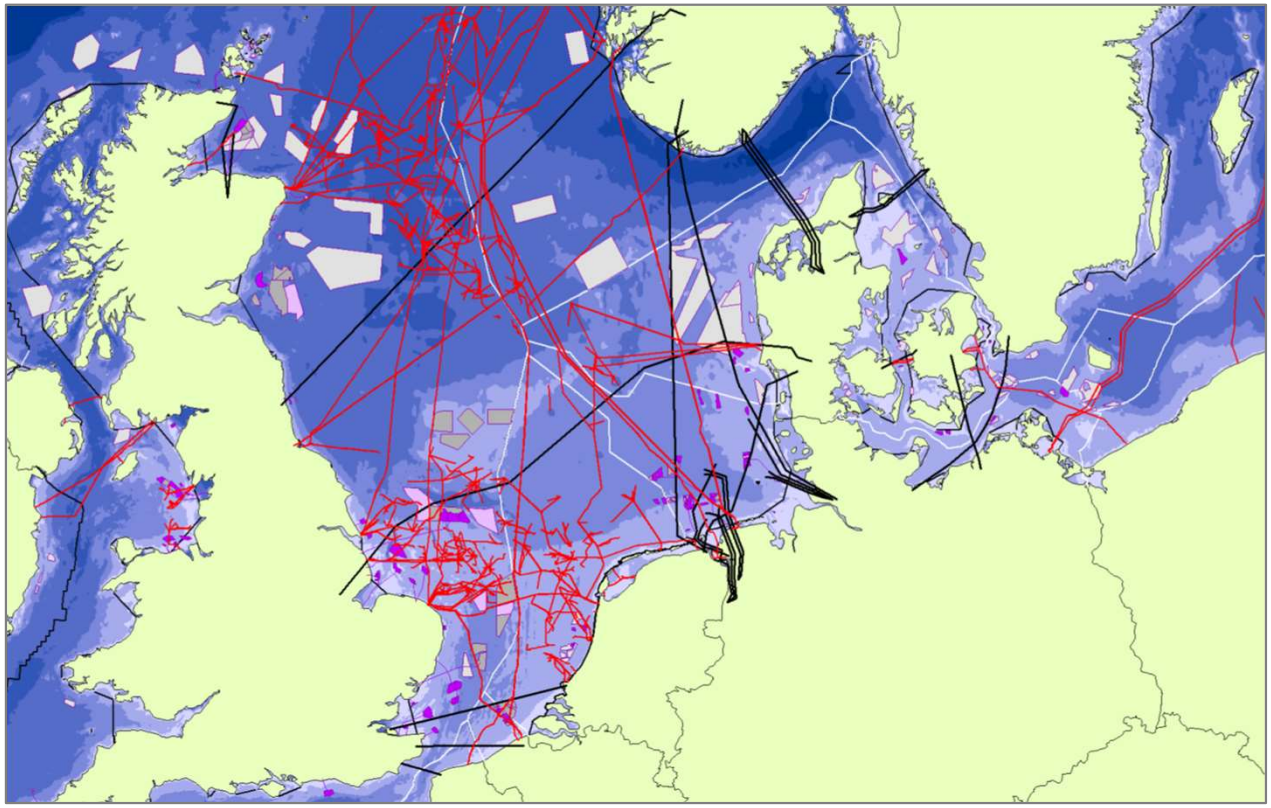
Renewable energy provides stable prices, green business...



Keeley & Quirk, 2022 - www.energysustainabilitycentre.im/news

Renewable energy provides stable prices, green business & security

Nord streamgas pipe lineevent 28th Sept. 2022



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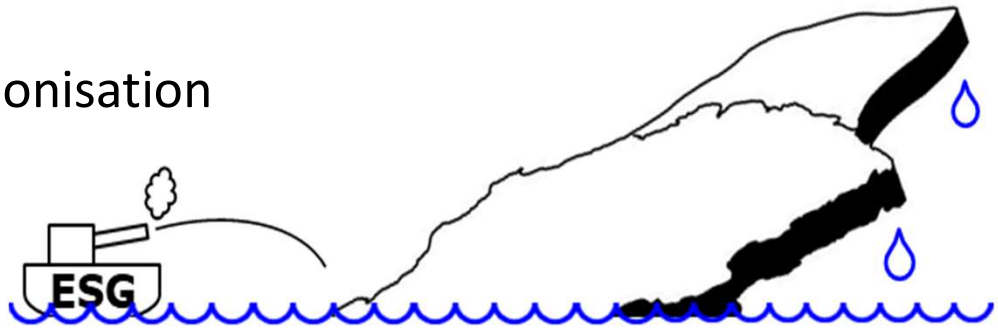
IoM Government Energy Strategy 2023

- Future vision:
  - Optimise use of our own abundant natural resources
  - Promote independence, energy security & resilience against future price shocks
  - Support sustainable economic strategy (35% emissions reduction by 2030, 5000 new jobs + £200 mill/yr additional revenue by 2032, infrastructure for 100,000 residents by 2037)
- Strategic aims:
  - People & businesses gain benefit from decarbonisation
  - Maintain resilience of power system
  - Meet climate commitments & ESG needs



- Commitments:
  - Carbon-neutral power by 2030, 30 MW onshore renewables, 2nd interconnector (size?)

What is missing?

- Plan for the remaining 110 MW
- Public engagement
- Regulations
- Private investment
- Full scale electrification
- Energy storage
- How to phase out gas?
- How to heat homes?
- Reality on bioenergy
- Off-island transport
- Irish Sea hub
- Integrated roadmap to net zero emissions

But what has been achieved so far?

CLIMATE CHANGE
ANNUAL PROGRESS REPORT

March 2023 GD 2023/0044

NET ZERO
ISLE OF MAN

Isle of Man

Isle of Man should rediscover its innovative past

Risk taken by private enterprise

17 kWh energy from Snaefell ≡ 8 hours total power for 1 Manx person

≥1500 Laxey Wheels needed to power the Island

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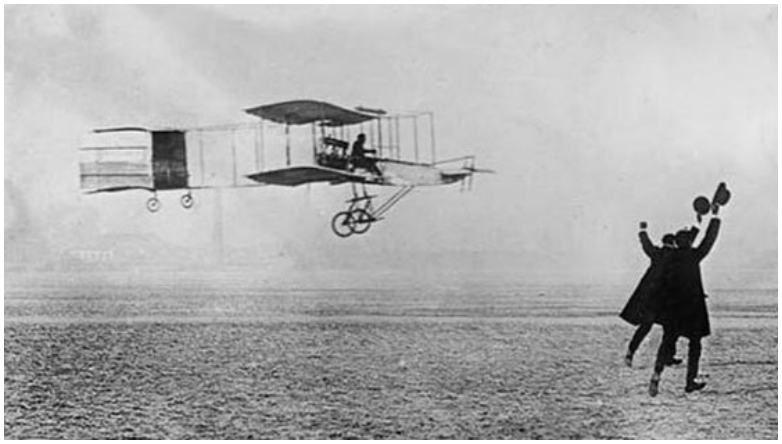
Why renewable energy on the Isle of Man?

- Commitment to net zero emissions in 27 years
- ½ million tonnes of CO_2/year from IoM using oil & gas
  - Same as CO_2 captured by 1250 km^2 forest
- High & volatile energy prices + supply worries

- **So what would work on the Isle of Man?**



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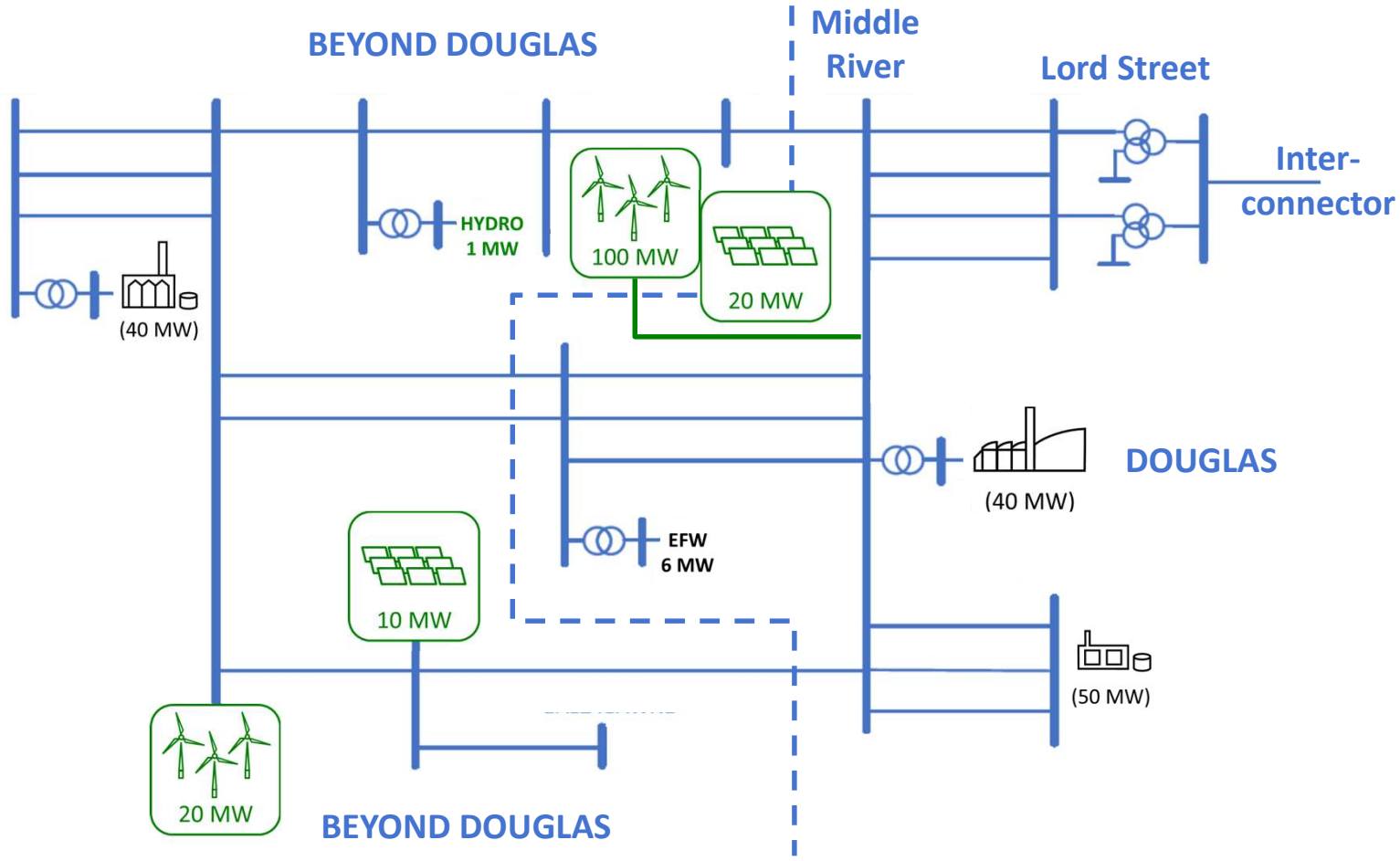
120 MW wind + 30 MW solar provides same as annual electricity demand



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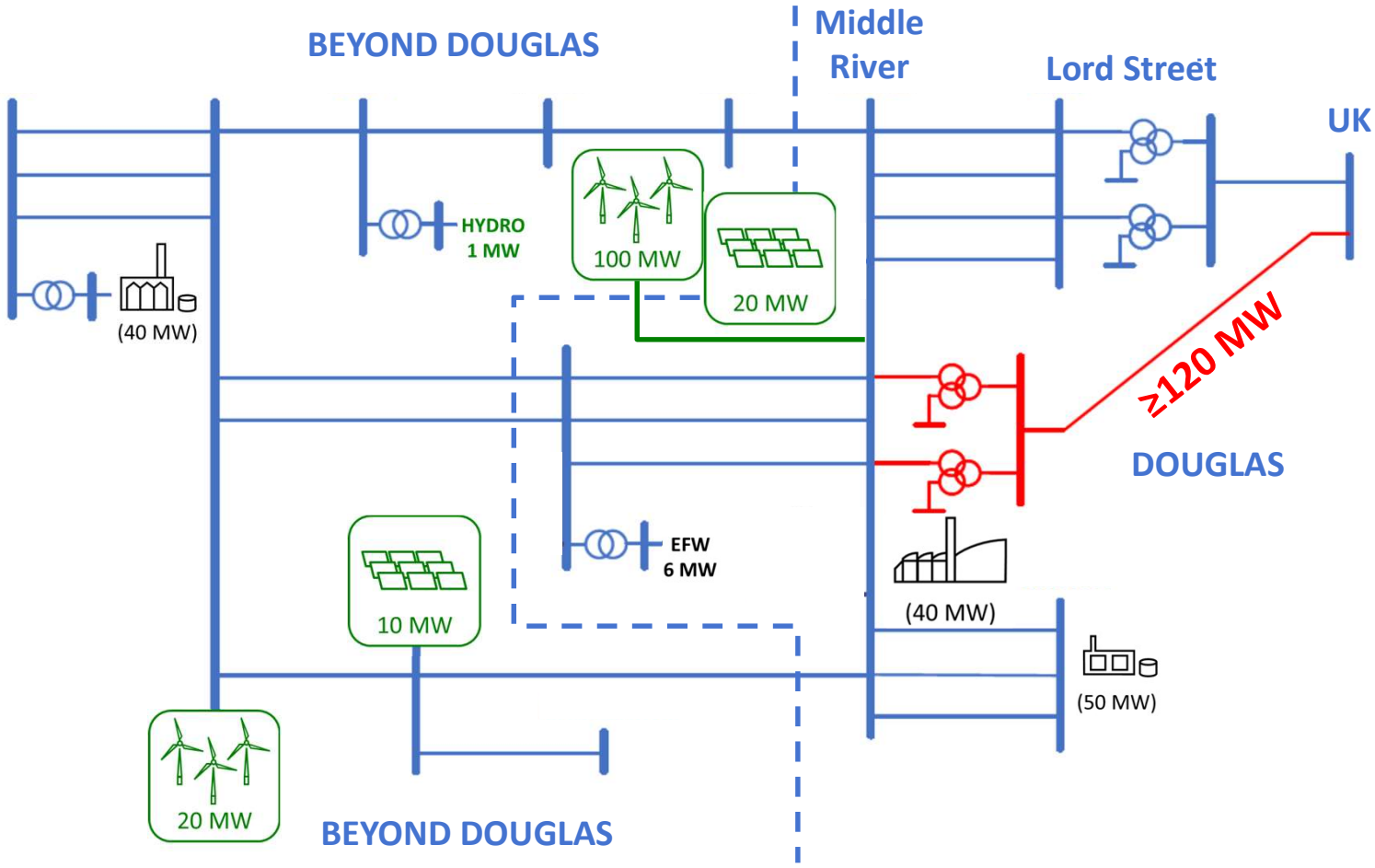
AALBORG UNIVERSITY DENMARK

120 MW wind + 30 MW solar needs grid strengthened in Douglas & to UK



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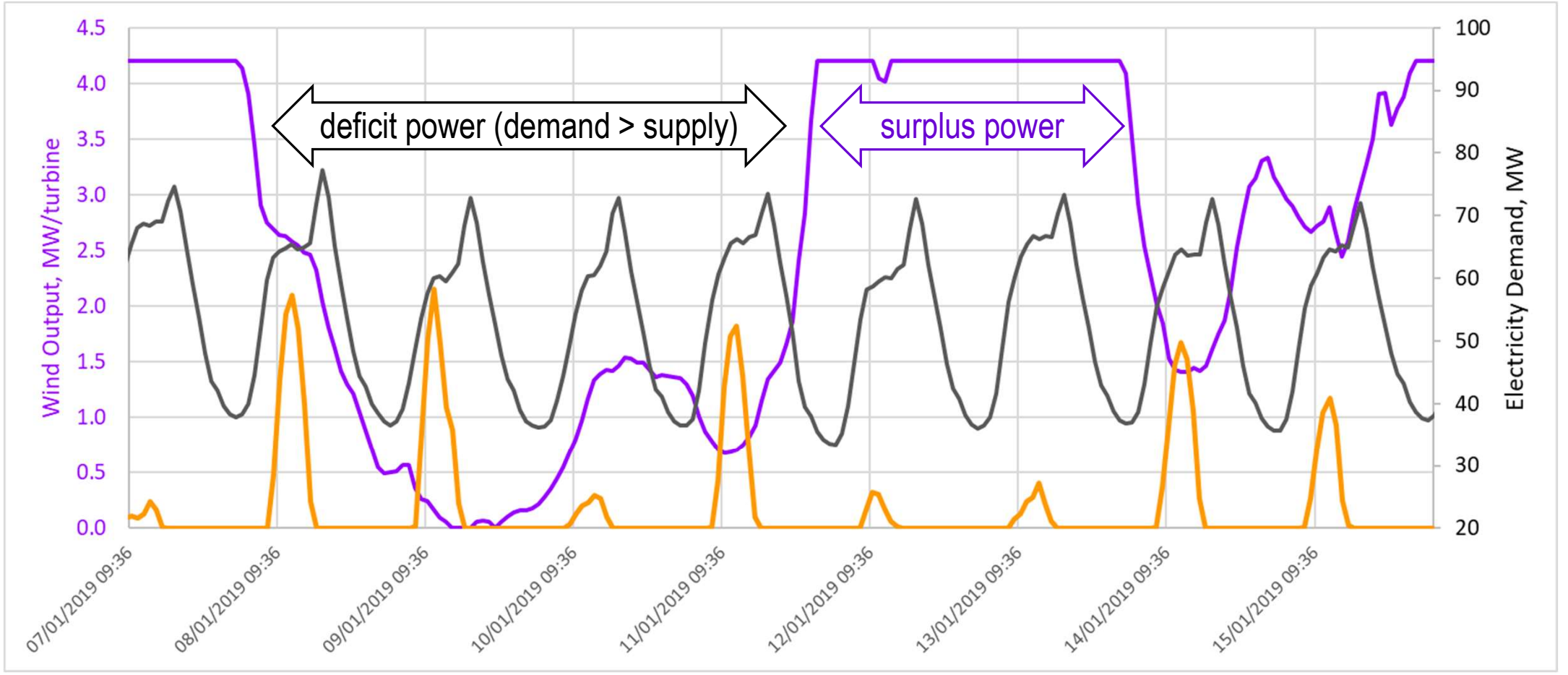
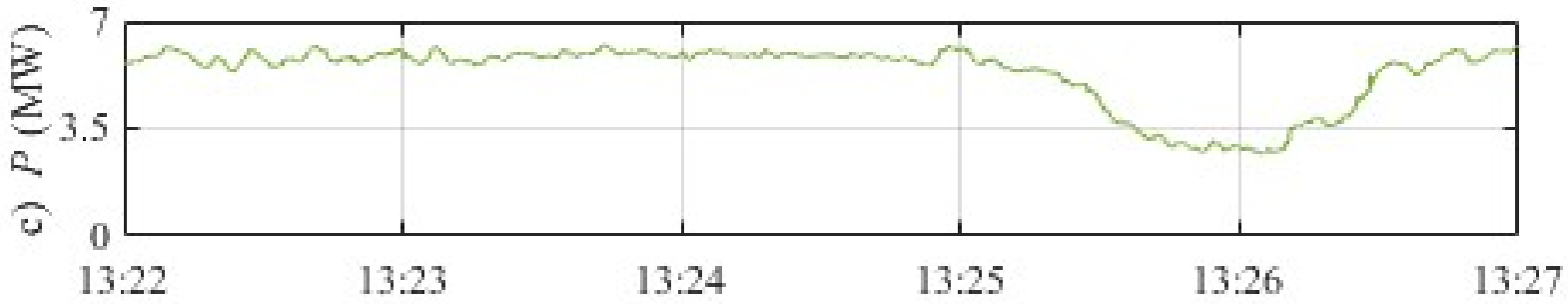
Nine days in January – electricity demand, wind power, solar power



The grid can be kept stable despite intermittent generation



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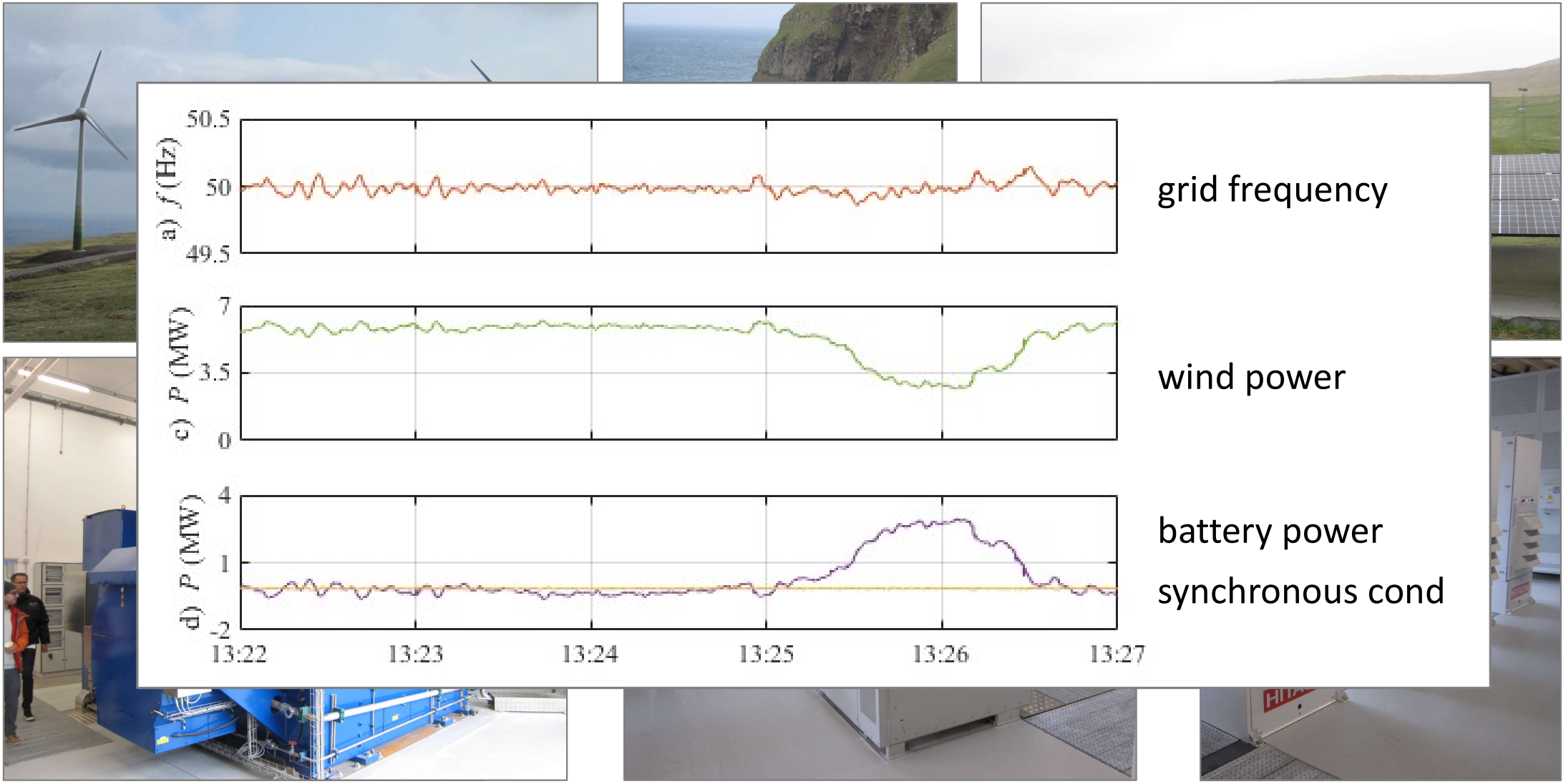
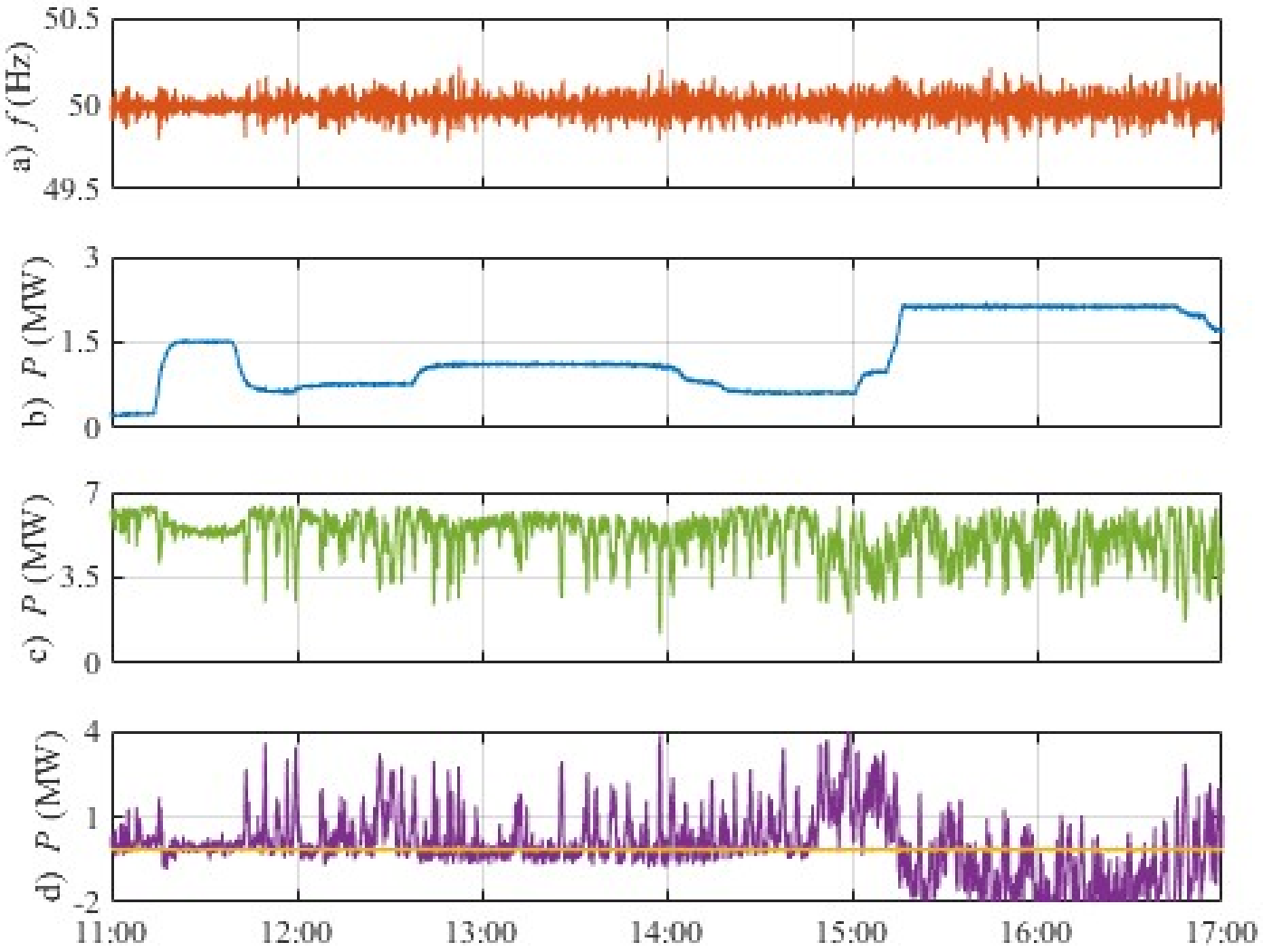


Suðuroy balanced power production – 6 hours, 25 May 23



grid frequency

hydro power

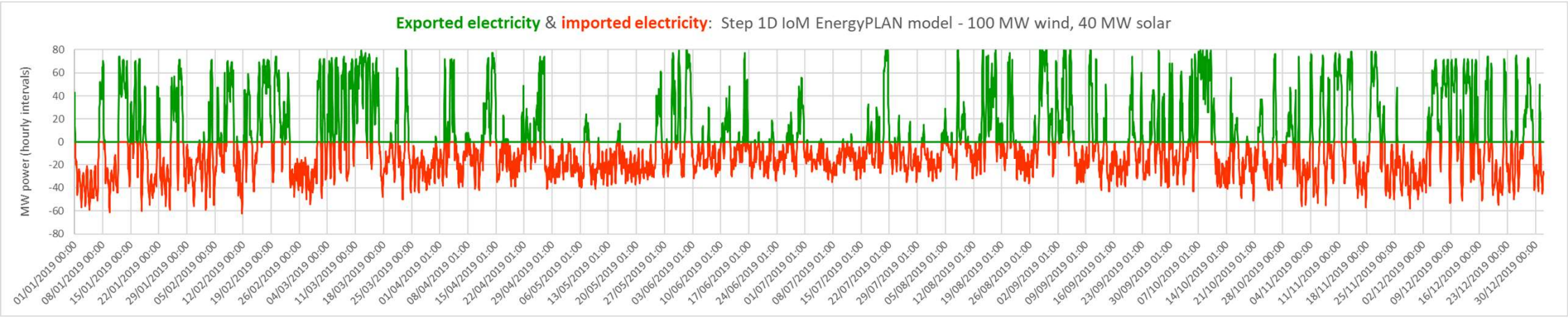
wind power

battery power

synchronous cond

100 MW wind, 40 MW solar meets IoM annual electricity demand…

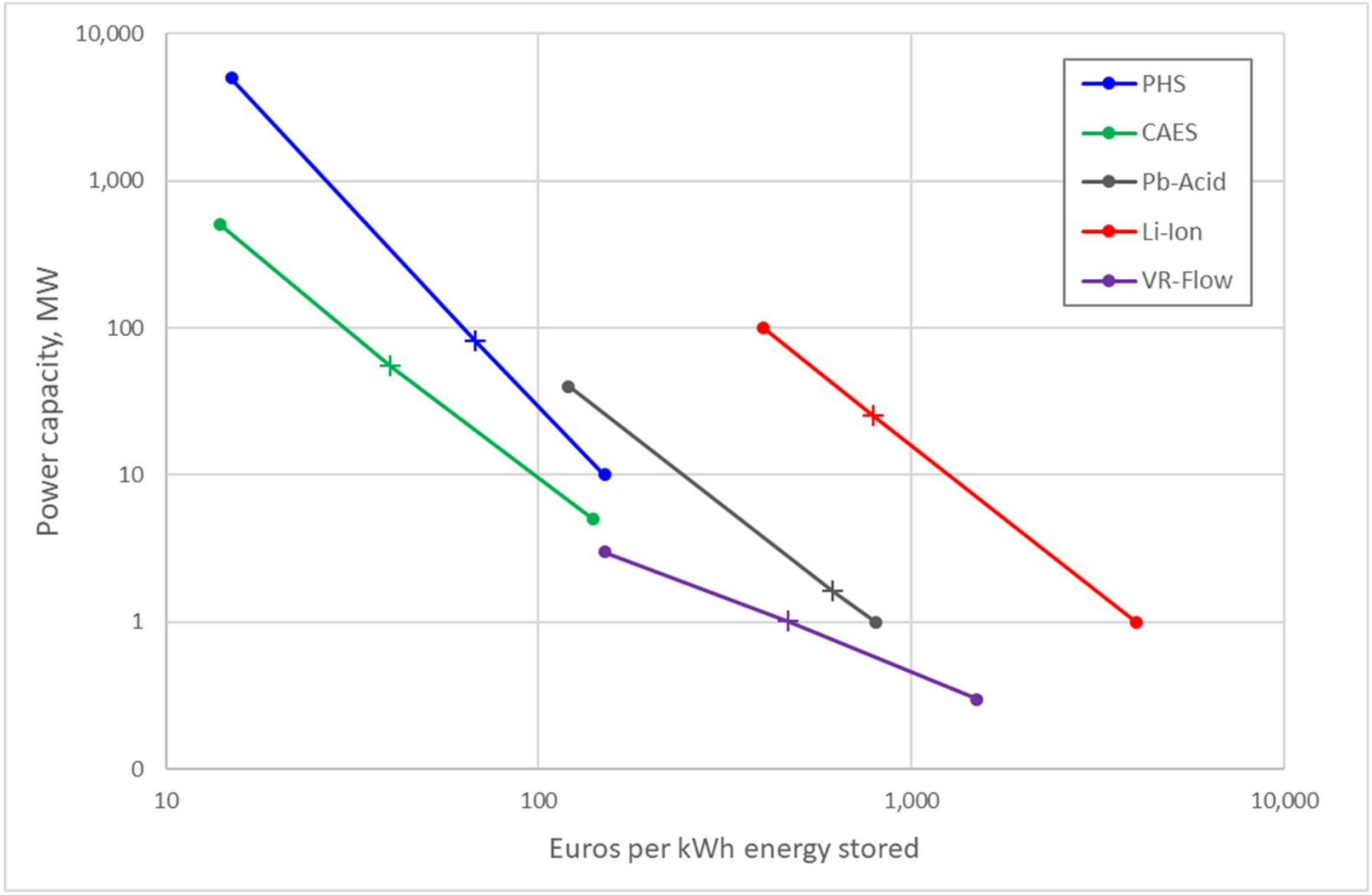
…but only 65% of the energy can be used when it is generated



during the year 120 GWh surplus is exported whilst 120 GWh is imported - when IoM demand exceeds the supply of renewable energy in this model

- unpredictable import prices can be avoided with on-Island energy storage

Energy storage options – power versus cost per kWh



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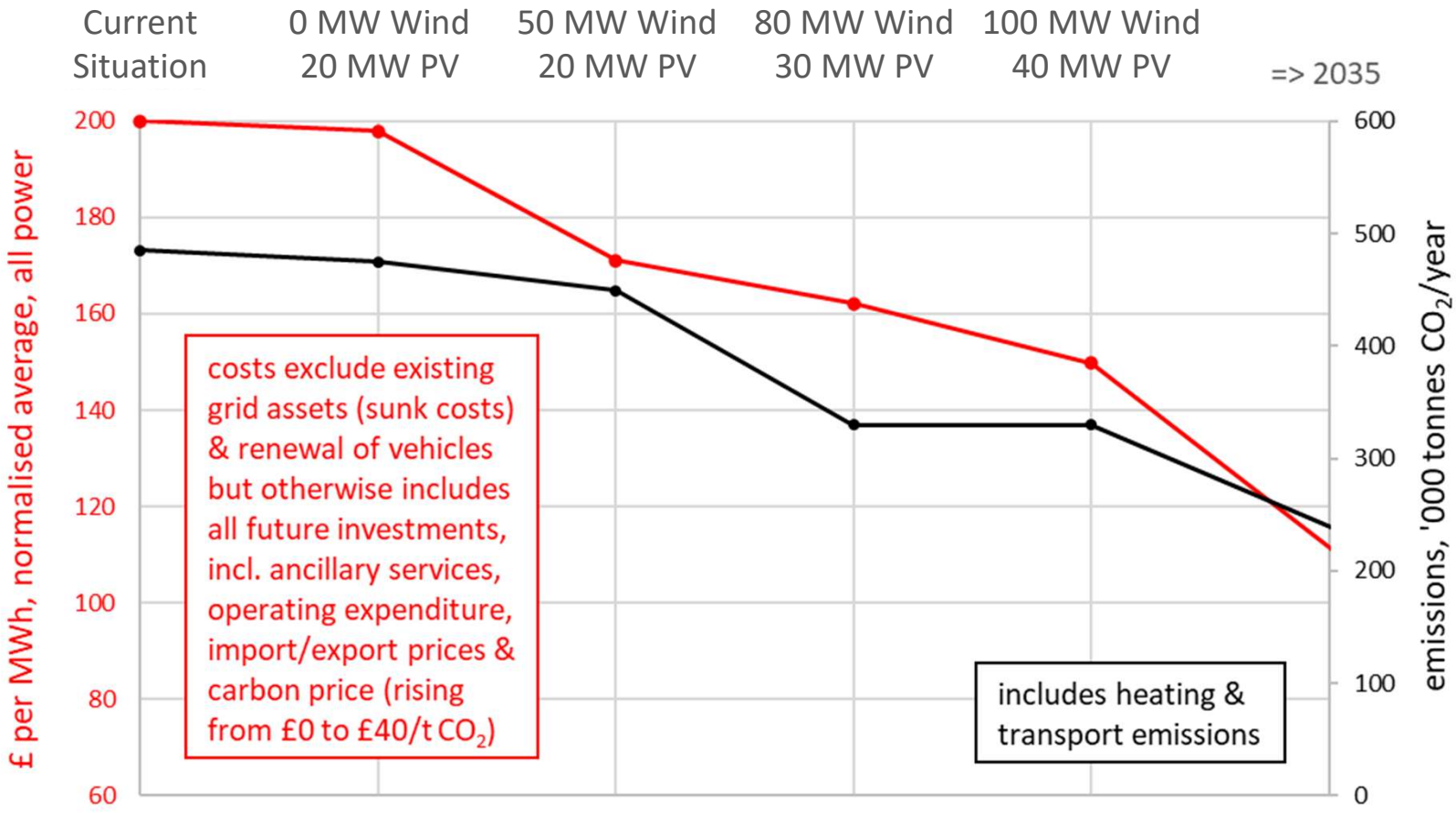
IoM self-sufficient energy pathway to net zero emissions (electricity only)



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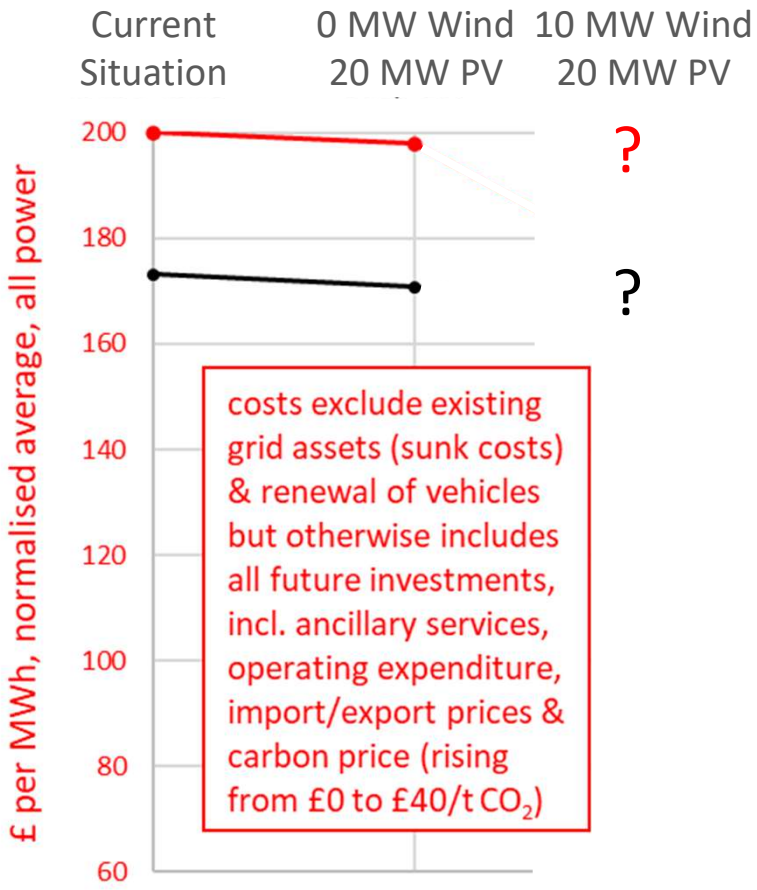
Uncertain benefit with small amount of renewables + interconnector



Could be worse of both worlds:

– dependence on UK

– unpredictable prices

– no energy security

– no control on emissions

Self-sufficiency in green energy offers:

– certainty

– new jobs

– revenue

– positive publicity

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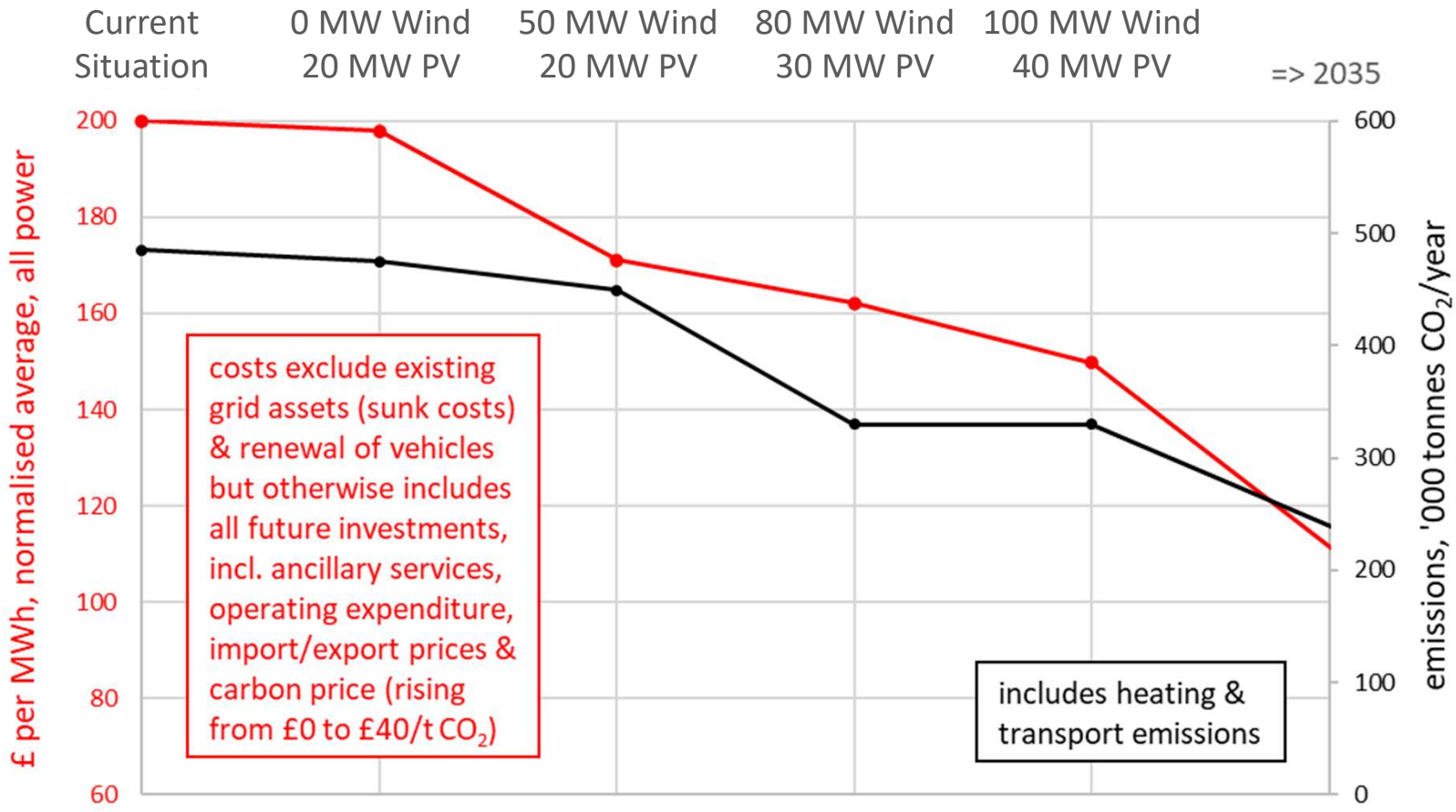
IoM self-sufficient energy pathway to net zero emissions



Next steps?

- Full-scale electrification
- District heating
- Green hydrogen?

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Conclusions

16 years since first iPhone

- The Island is far from net zero emissions
- No economic future without green energy
- Deal with the big-ticket items first
- Imported energy is a security risk & prices are unpredictable
- Need to be in control of all our low-carbon power, not relying on UK
- The grid won't collapse with renewable energy but the grid needs upgrading
- Risk capital from private sector – avoids cost overruns (e.g. tender turnkey projects)
- The Island needs to open for business quickly – 35 % emissions reduction by 2030
- Future electricity consumption is underestimated, even with a Danish model
- Energy storage is critical… as is size of interconnector
- Need to build & maintain a Manx energy system model (including on- & off-Island transport)
- And the public needs to be engaged

Reserve slides

In addition

- The Isle of Man could become an energy hub for offshore wind…
  …especially with large scale energy storage
  …offering arbitrage & trading
- How to phase out gas (coordinating Pulrose & domestic heating)?
- Need to convince decision-makers & traditional engineers that the lights will stay on
- Need commitment to streamline permitting & facilitate renewable investments
- Need one stop shop with centralised, integrated plan
- Visual impact of onshore wind turbines may require compensation
- Green H_2 offers flexibility & a more sustainable transport solution than Li-ion batteries
- Why not tender for all onshore renewable energy projects (incl. storage solutions)?

Can we expect residents to make the changes themselves

- Few people will voluntarily change their lifestyle… unless the advantages are clear
  - needs Government action (to foster sustainable energy system)
  - needs incentives for residents & businesses (to change habits)
- Heat pumps represent large investments for individuals, with both risk & uncertainty
- Deal with the big-ticket items first - economies work at network scale
- Need clear roadmap on source of energies & future prices
- Decisive Government will lead to an enterprising private sector

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Heating

- 35% of emissions from heating – needs more focus
- Individual heat pumps + extras are expensive, uncertain & require network upgrades
- 53% DK heat provided by district heating – economies of scale, worry-free, storage, industry

- Are we too focussed on electricity?
- Hydrogen is coming – huge investment in Denmark, Netherlands & SE Asia

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District heating

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Transport

- ICE engines are inefficient
- Battery-powered EV's are heavy, require network upgrades & supply chain issues
- Fuel-cell EV's may make more sense – storage, Island demonstrator

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Azores electricity achievements

1900 - São Miguel - 1st Hydro Plant

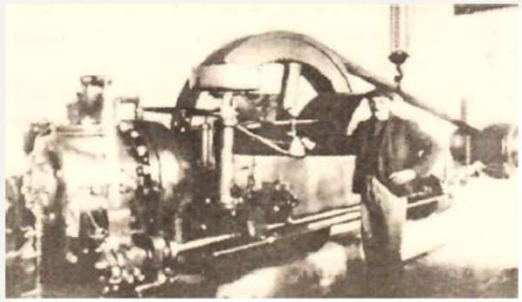
1980 - São Miguel - 1st Geothermal Plant

2005 - Flores - 1st Flywheel

1906 - São Miguel - 1st Energy Storage System

1988 - Santa Maria - 1st Wind Farm

2019 - Graciosa - 1st Photovoltaic Power Plant



1908 - Terceira - 1st Thermal Power Plant

1999 - Pico - 1st Wave Energy Plant

2019 - Graciosa - 1st Battery Energy Storage System

SEV, Faroes – 100 by 2030

Terji Nielsen, Helma Trondheim

- 17 islands, 1400 km^2, 54,000 people, very similar avg power use to IoM
- No fossil fuel resources – but wind, elevation, water, tides & bit of sun
- SEV – similar to MUA – TSO & DSO non-profit company owned by municipalities

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- SEV – similar to MUA – TSO & DSO non-profit company owned by municipalities
  - 1921 conventional hydro (40 km of tunnels)
  - 1970's heavy oil power plants
  - 2003 first onshore wind turbine
  - 2009 wind projects really kicked off (+ smart grid & batteries for stabilisation)
  - 2014 green vision announced – clear direction – independent from pipelines & cables

  - 2022 - 30% wind, 20% hydro, smart grid, 3 MW batteries (costly only for frequency)
- Renewable developments prioritized; industry & public incentivised (solar, EVs, heat pumps)

SEV, Faroes – Costs

Terji Nielsen, Helma Trondheim

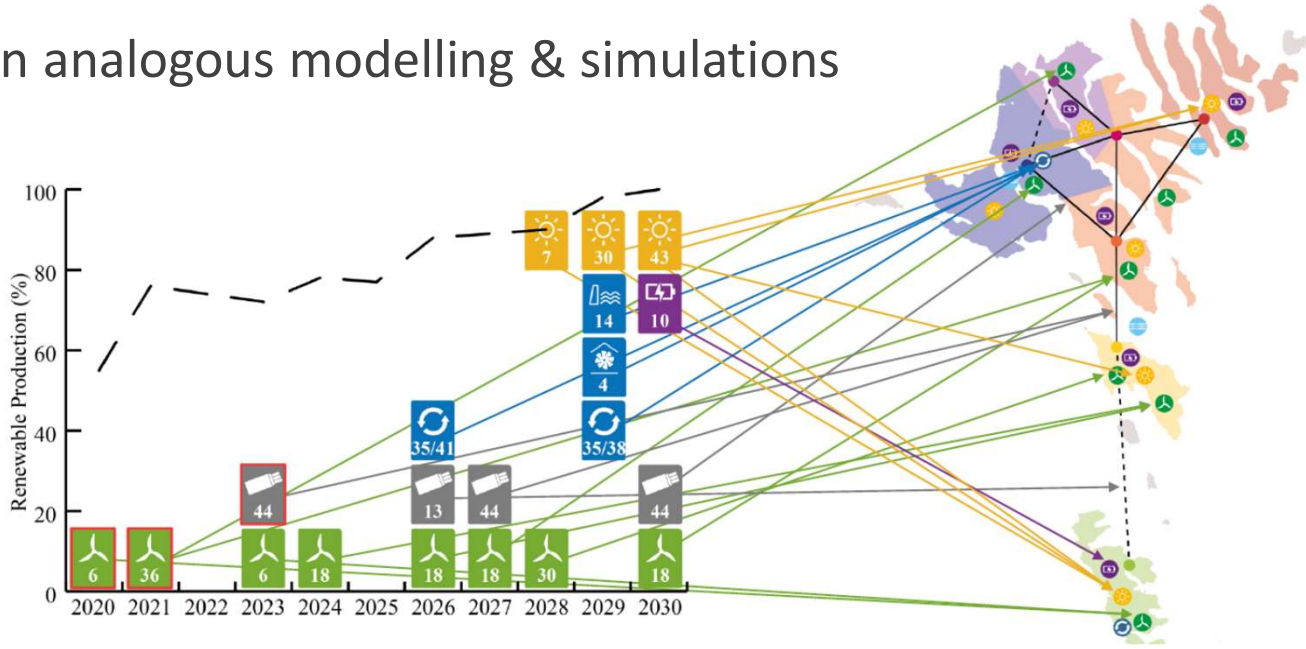
- Generation costs
  - 3p/kWh wind (30%)
  - 13p/kWh oil (£120 million/year)
  - 18p/KWh tidal (2x 100 kW pilot)
- Customer price
  - 18p/kWh private
  - 14p/kWh businesses
- Learnings, costs & efficiencies improving with time

Pumped storage project in Vestmanna

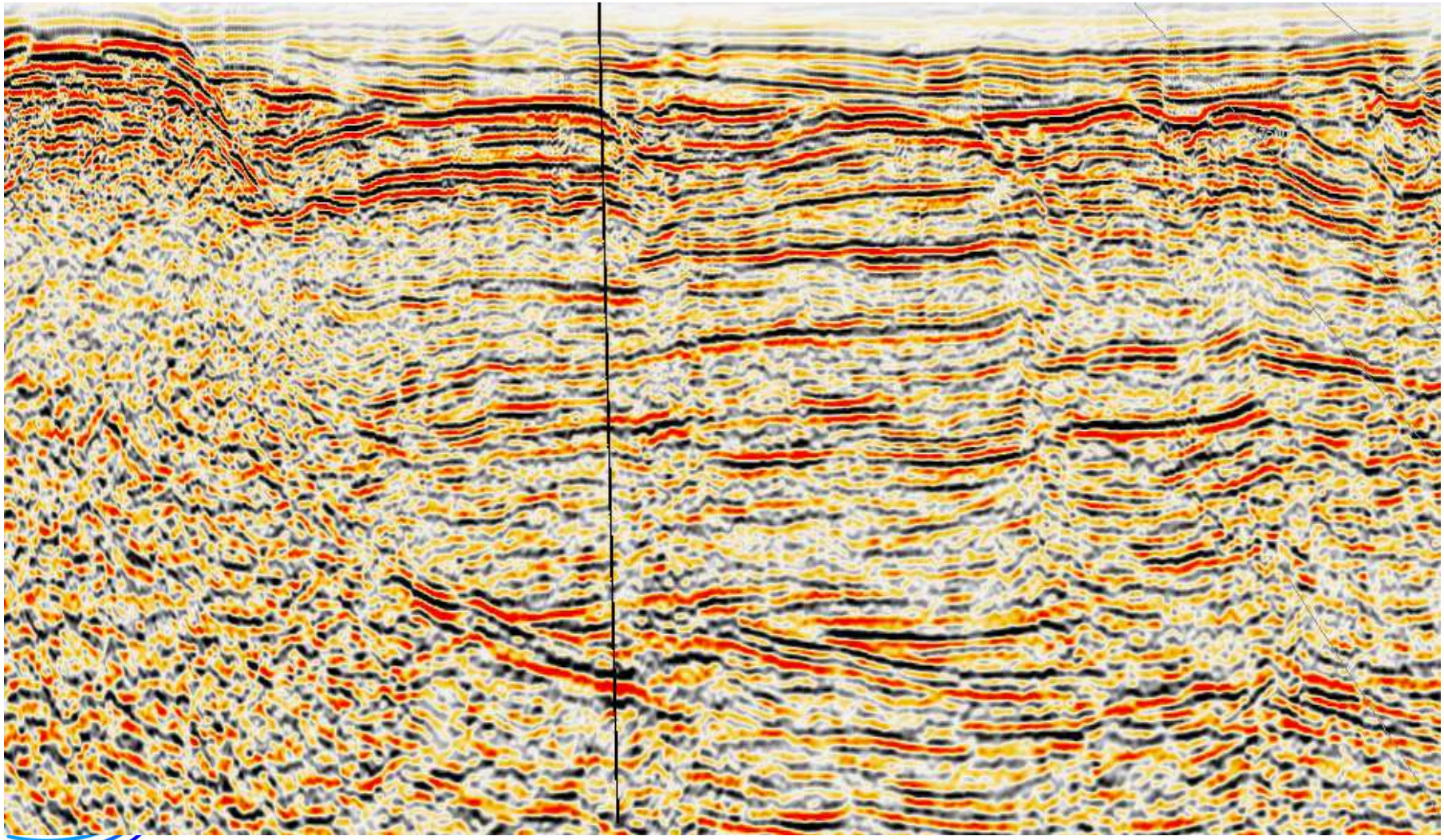
SEV, Faroes – Roadmap

Terji Nielsen, Helma Trondheim

- Enacting similar plan to ESC based on analogous modelling & simulations
  - Optimised for most economic (90% renewables by 2028)
  - Doubling in electricity by 2030
  - £150 million investment in grid (cables, batteries, ancillaries)
  - £150 million in 2.1 GWh pumped hydro storage (40 MW turbines, 70 MW pumps)



2D seismic line GMB92-104 through well 112/25-1



Calder gasfield, East Irish Sea