Low-Carbon Island Economy Conference, 27 October 2022

Energy transition – Introduction

Aalborg University – Wrote the ET book

Professor James Curran – IMPACT report

Simon Nicholas, KPMG – IoM Economic Strategy

SEV, Faroes – 100% renewable electricity by 2030

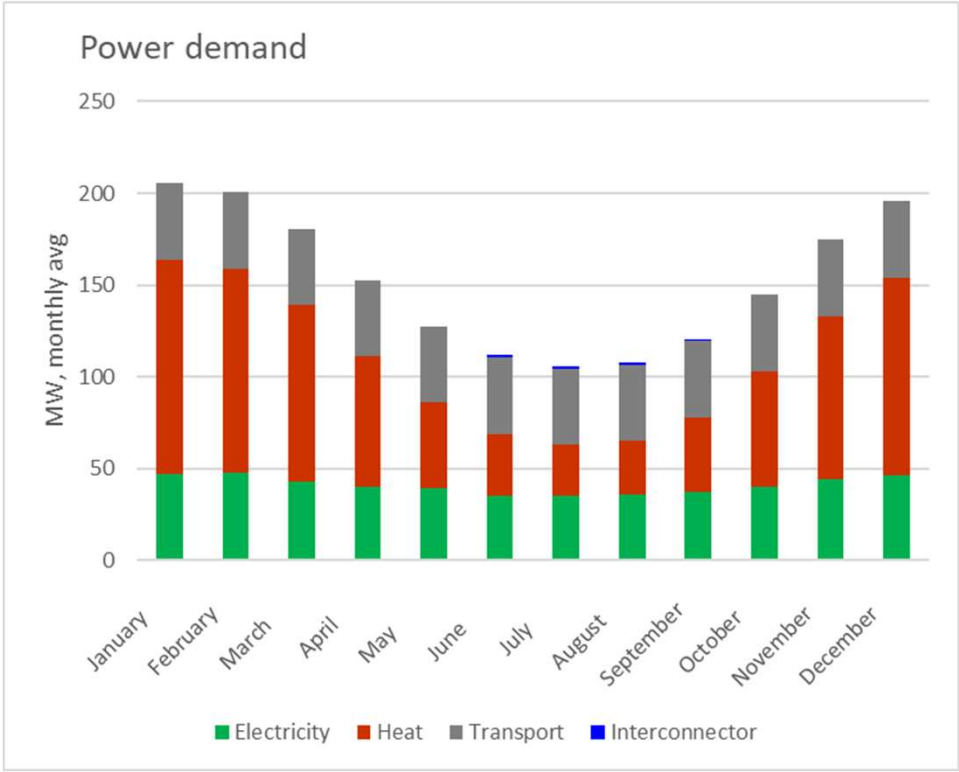
ESC – Options for Sustainable Power on the Isle of Man

Summing up - Jane Poole-Wilson

Energy and Sustainability Centre, IoM

DTU

What is the energy transition?



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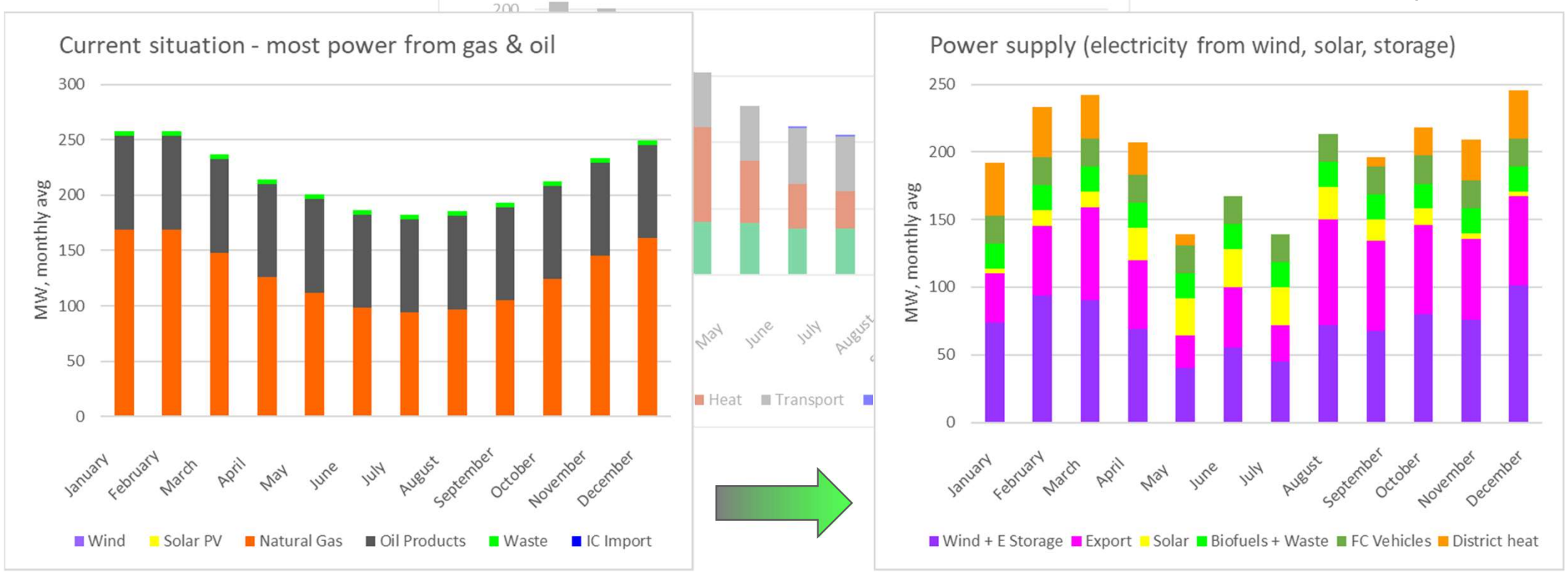
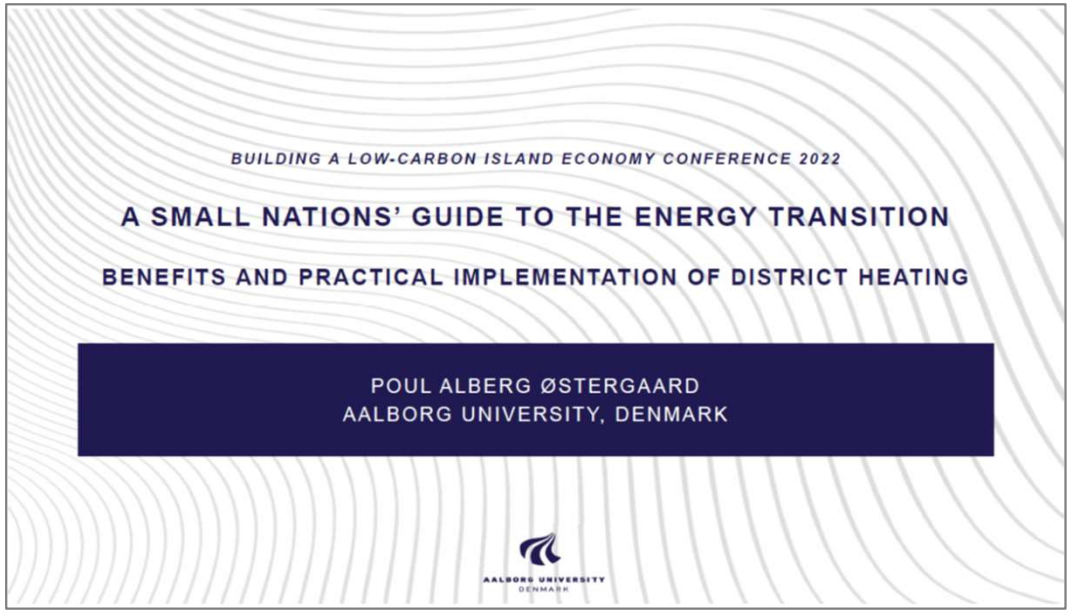
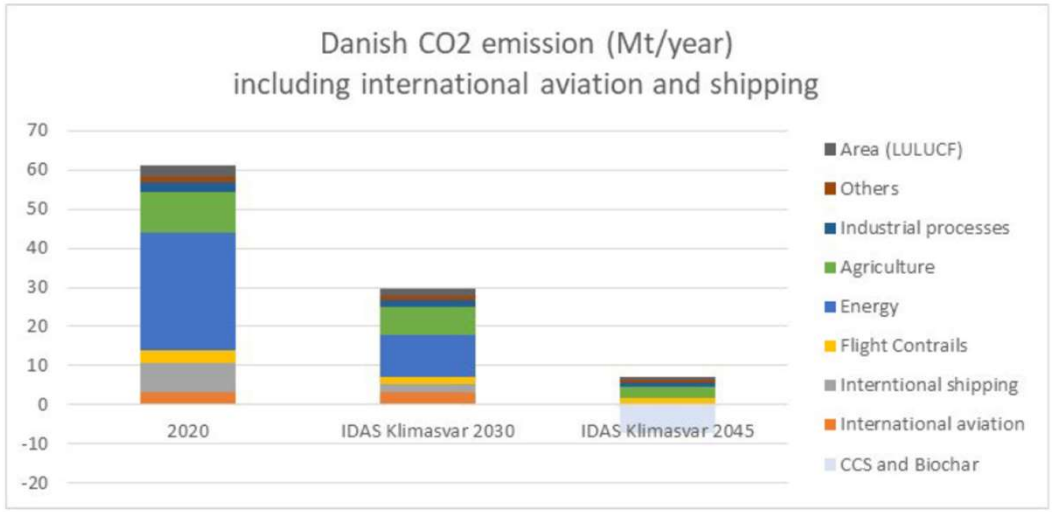


Aalborg University, DK

Profs Henrik Lund & Poul Østergaard



A fully decarbonized Denmark 2045



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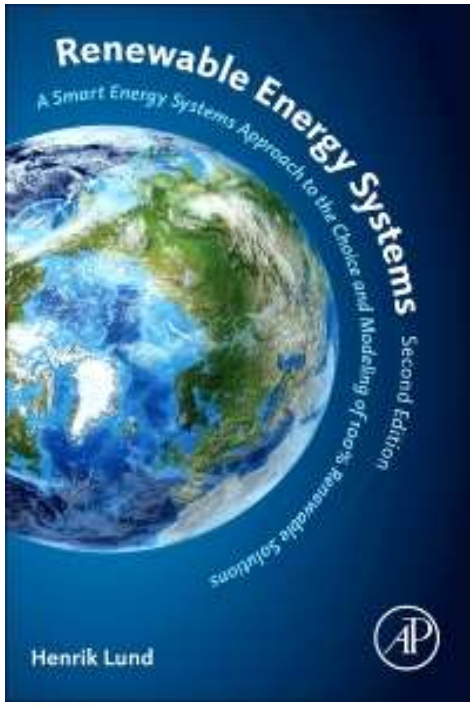
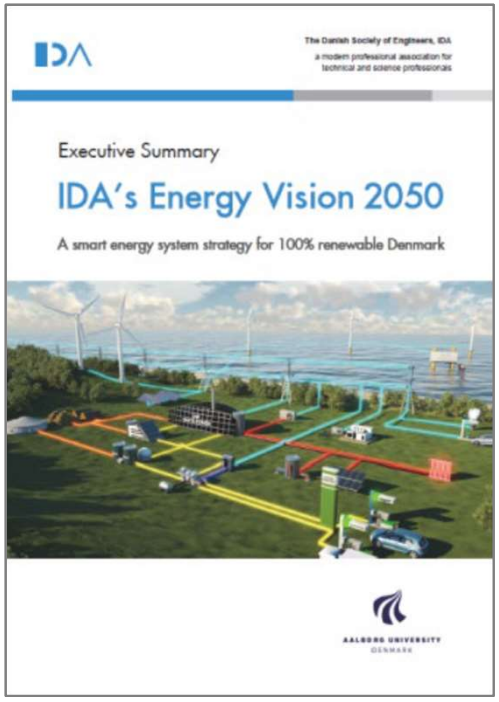
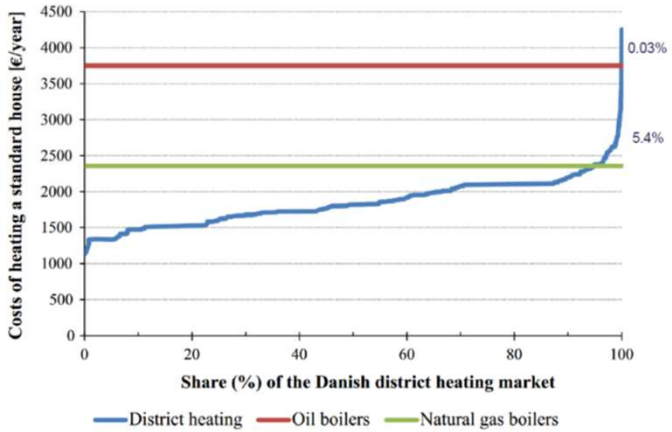
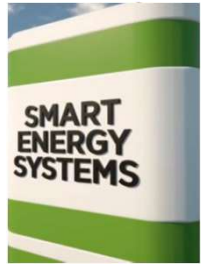
Profs Henrik Lund & Poul Østergaard

- Best to take holistic approach
- Integrated energy system is key
- For heating – much more efficient to store energy as heat than in batteries
- District heating much more efficient & convenient than individual (& empowers communities)

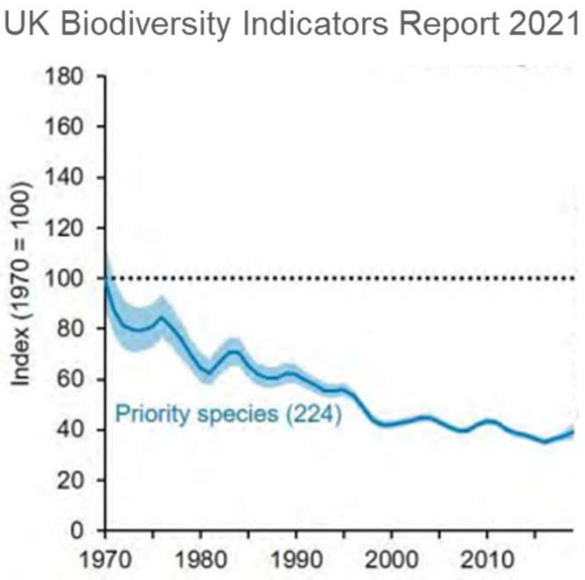






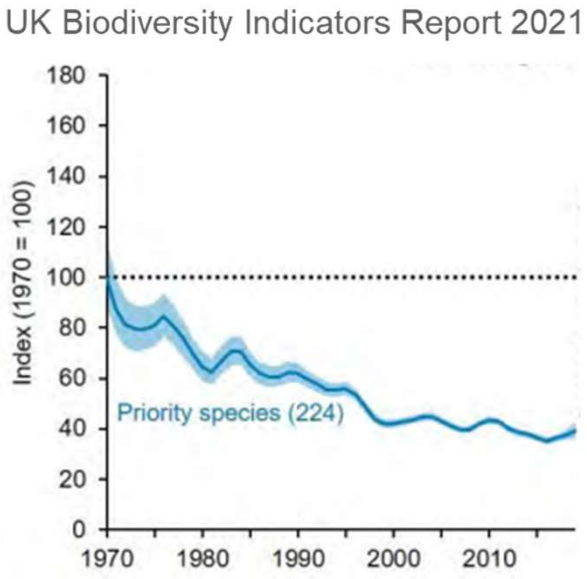


Professor James Curran



Professor James Curran

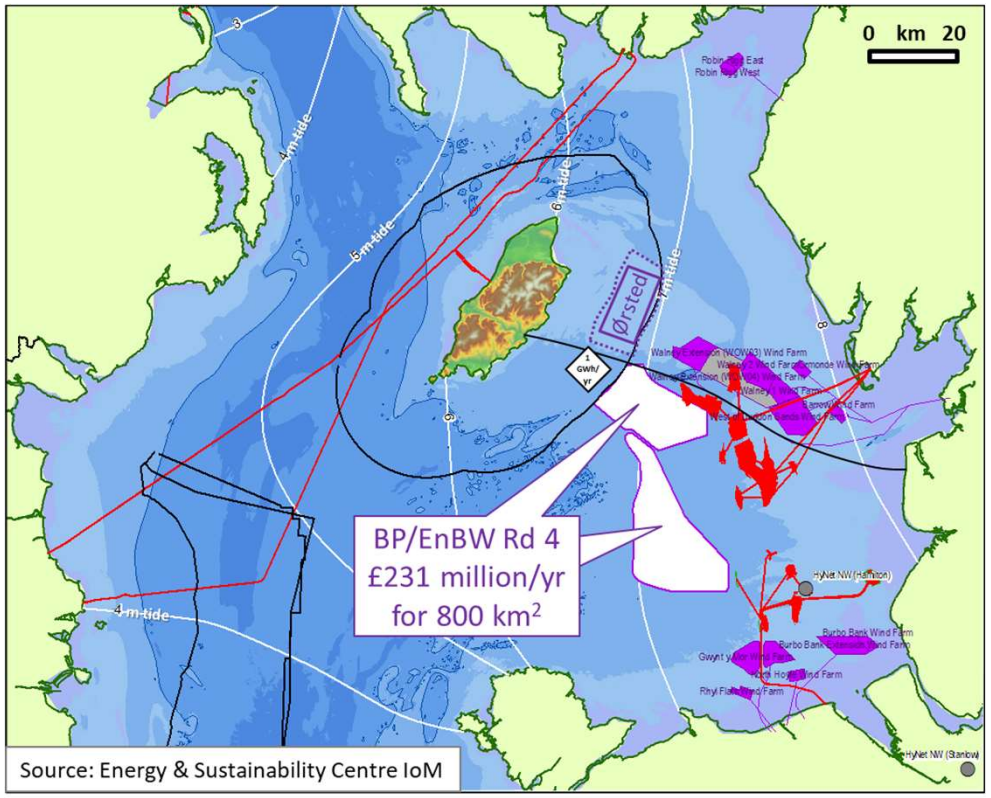
- No economy if not a green economy
- Customers will embrace the green transition (& predictable prices are truly valuable)
- $200 trillion available in private investment funds but not enough green projects…



KPMG, IoM

Simon Nicholas

- …£400 million IoM sustainable bonds
- Companies like Microsoft are choosing not to come to IoM because of Scope 2 emissions
- Right infrastructure, right legislation brought the gaming industry to IoM
- UK 4th Offshore licence round – £900 million/yr
- Estimate 12 GW potential in IoM Territorial Sea (≡ 4x BP-EnBW = £924 million/yr)



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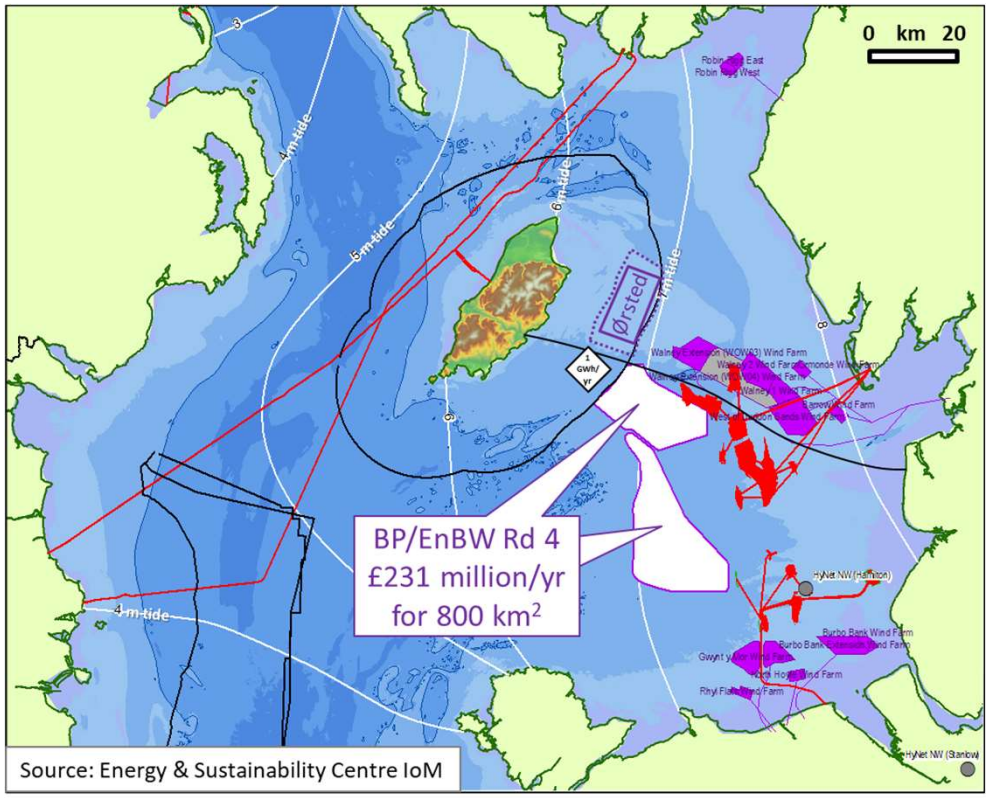
- Estimate 12 GW potential in IoM Territorial Sea (≡ 4x BP-EnBW = £924 million/yr)
- IoM as test bed for low-carbon technologies *(e.g. compact PHS, green H_2 for transport?)*
- IoM is missing carbon offsetting opportunities
- Sustainable data centres & green agriculture
- 1.1 t CO_2/year per KPMG employee



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% of supply)
  - 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

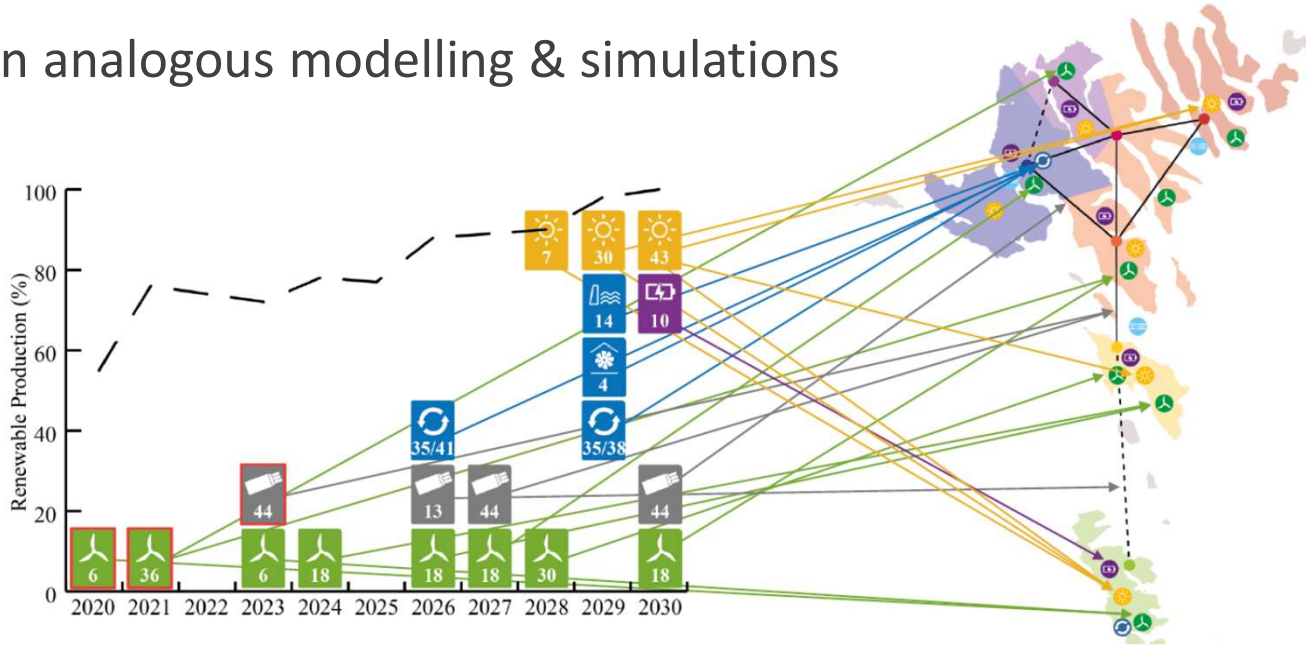
* IoM 3 month avg price of electricity generated from gas is c.15p/kWh

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)



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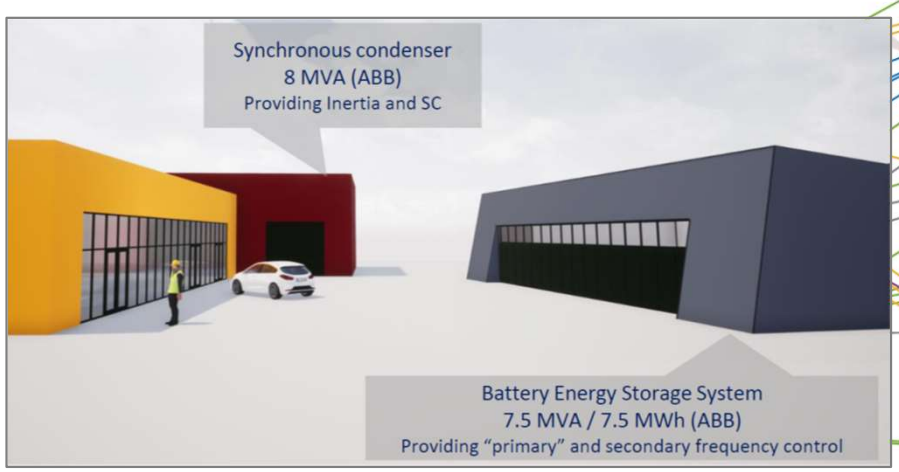
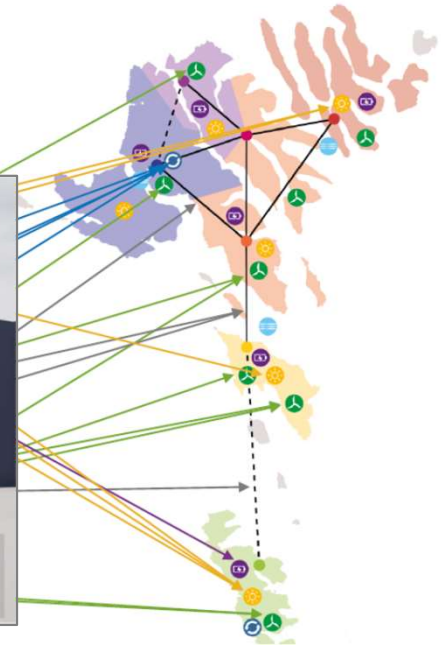


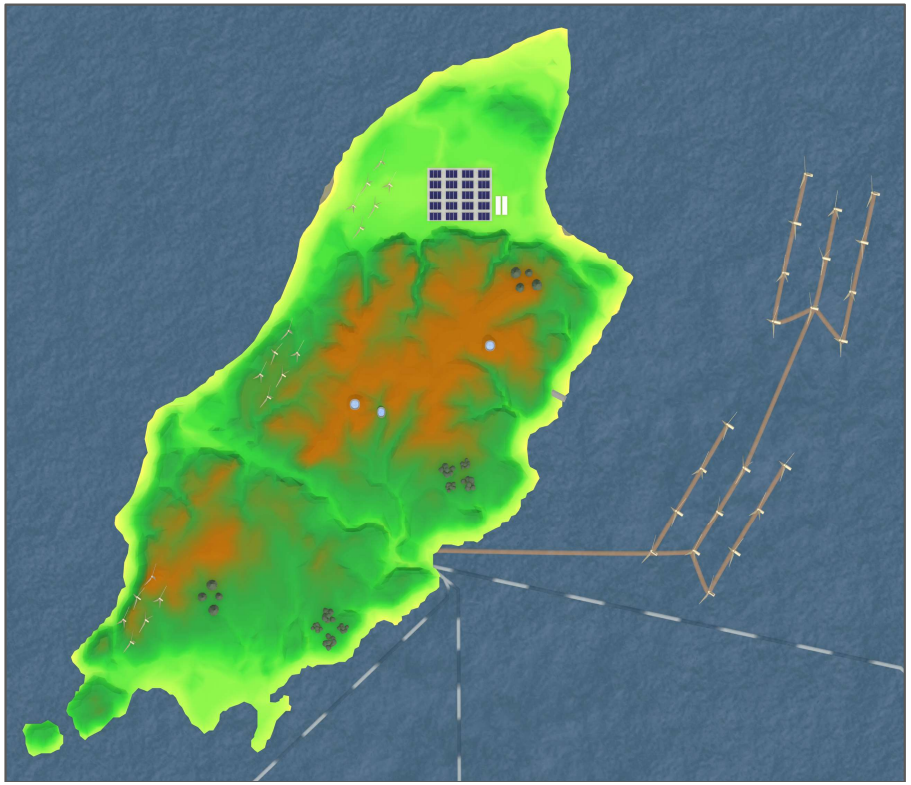


- Suduroy runs successfully on 100% wind (+ synchronous condenser)
- Next tidal kite R&D is 1.2 MW - 20% more expensive than oil but could provide baseload
- After 2030 will need green fuels for ships (fishing) convert power plant to methanol or NH_3

ESC, Isle of Man

Dave Quirk, John Boucher, Ralph Peake

- IoM can be entirely self-sufficient in renewable power with net zero emissions
  - Enviable combination of wind, mountains, water, sun



Green Energy Island videos released at www.energysustainabilitycentre.im/news

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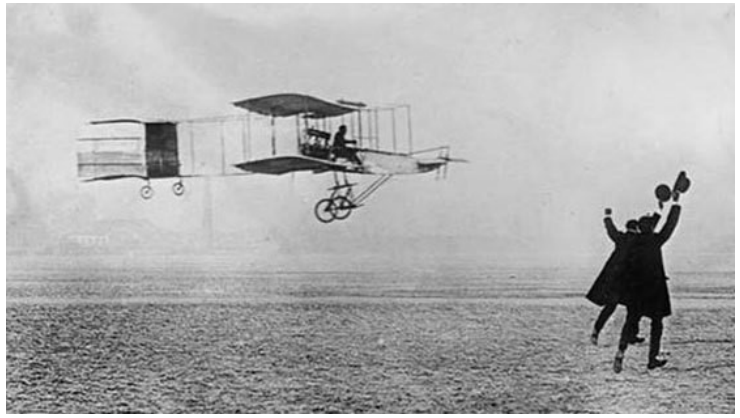
DTU

Introduction

- Commitment to NZE in <28 years
  - We can benefit from renewable energy now
  - Time is of the essence
  - Which path offers most benefit?



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Lots of valid reasons why low-carbon power looks difficult
But changing perceptions of what is affordable & resilient

- Can Island's gas & oil power plants be replaced by renewables?

- No regret decision
  - Wind & solar power
  - Energy storage
  - Export facility

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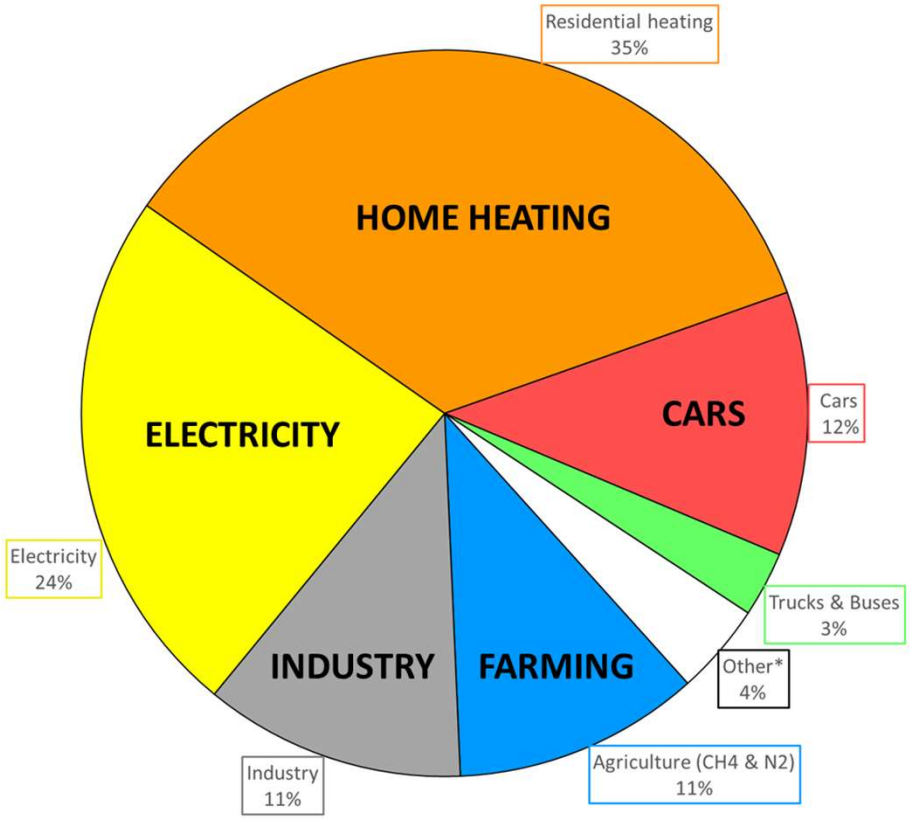
Isle of Man's situation

- Annual ½ million tonnes of CO_2 from use of fossil fuels
  - Power consumption c.1300 GWh per year



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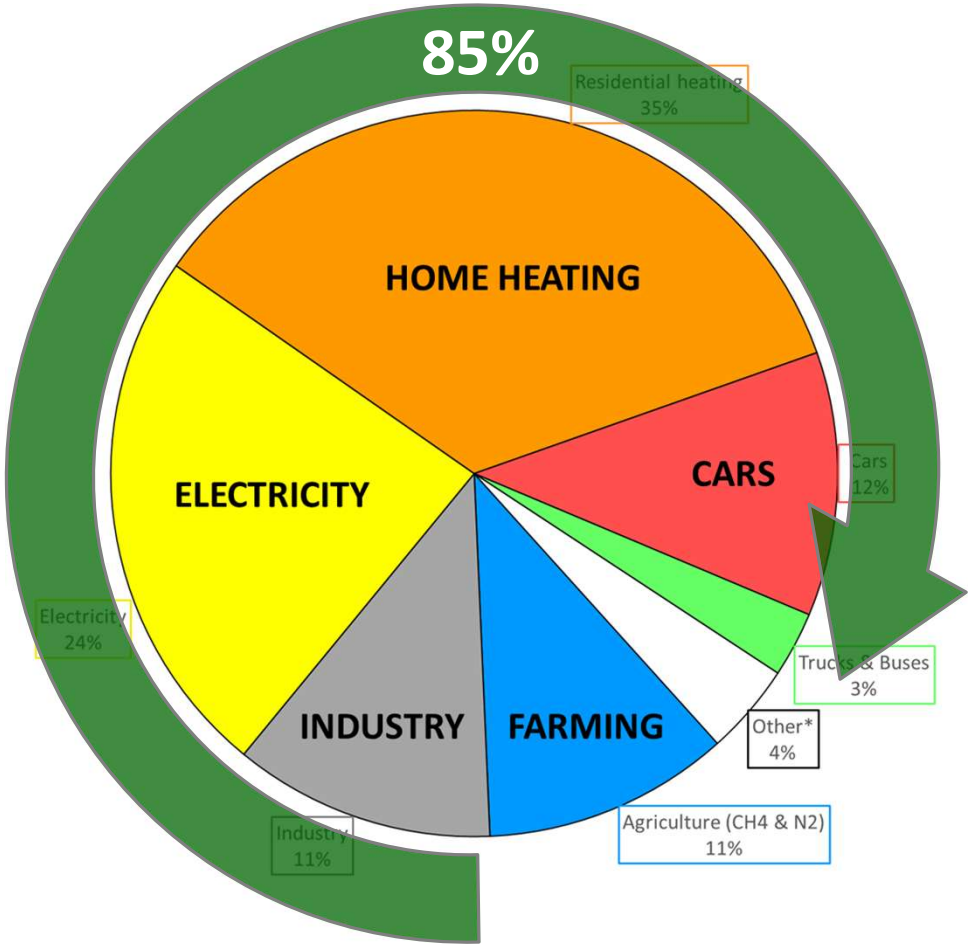
Isle of Man's situation

- Annual ½ million tonnes of CO_2 from use of fossil fuels
  - Power consumption c.1300 GWh per year
- Enviable renewable energy resources*
  - Predictable costs & value

Wholesale electrification



* Wind & solar is the cheapest generated power

Isle of Man's situation

- Annual ½ million tonnes of CO_2 from use of fossil fuels
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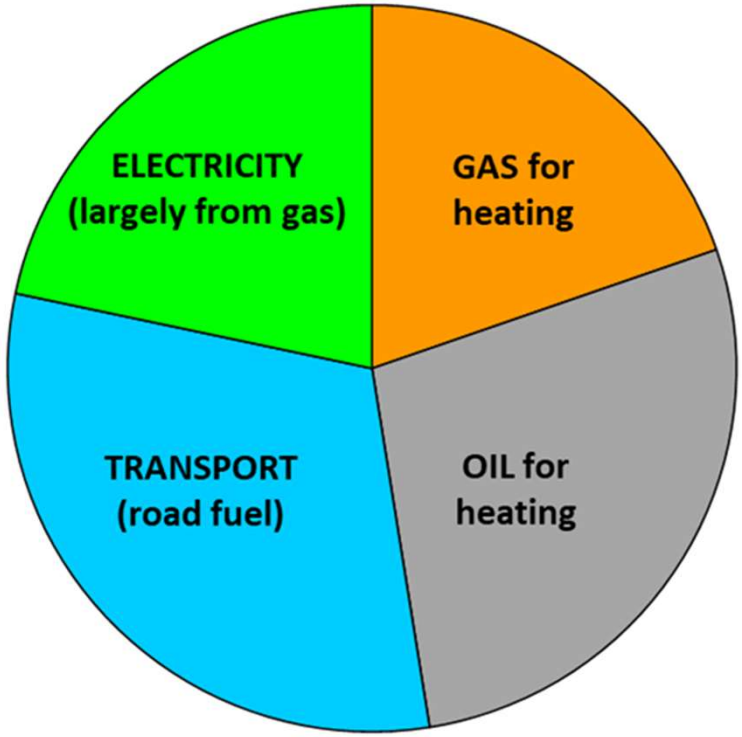
- High & volatile gas & oil prices
  - Winter supply worries

Manx renewable energy resource ≈70,000 GWh/yr



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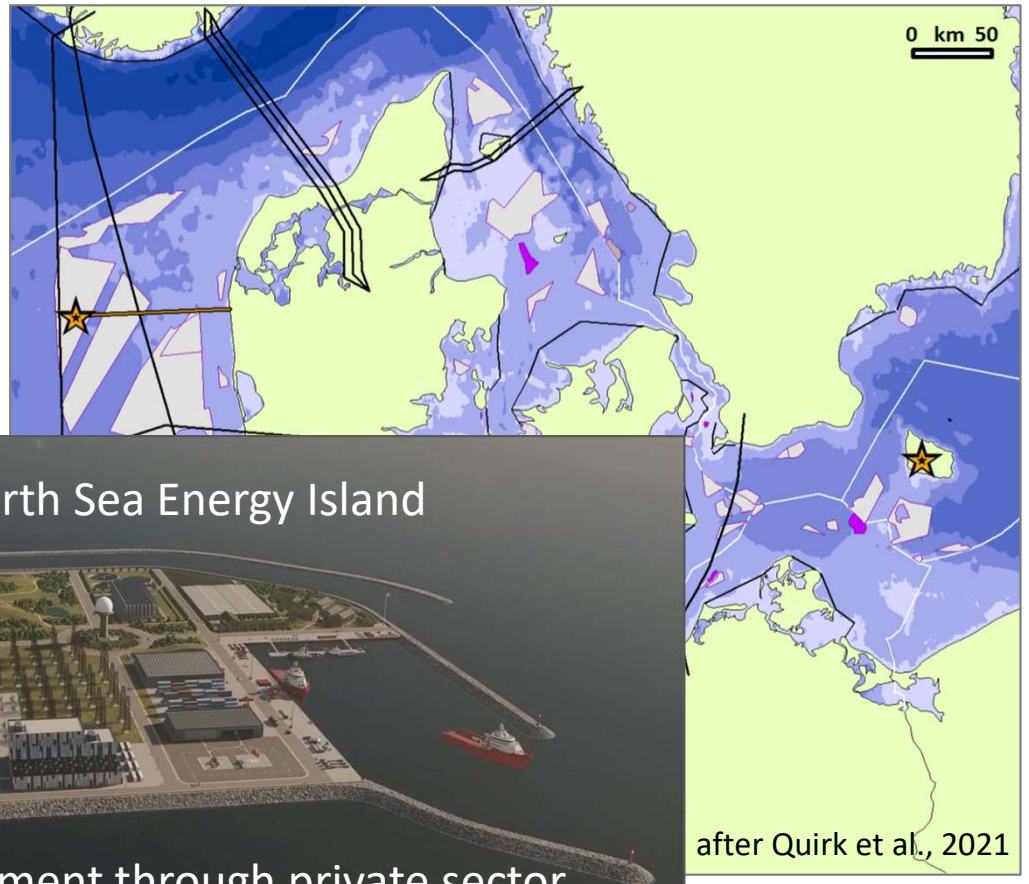
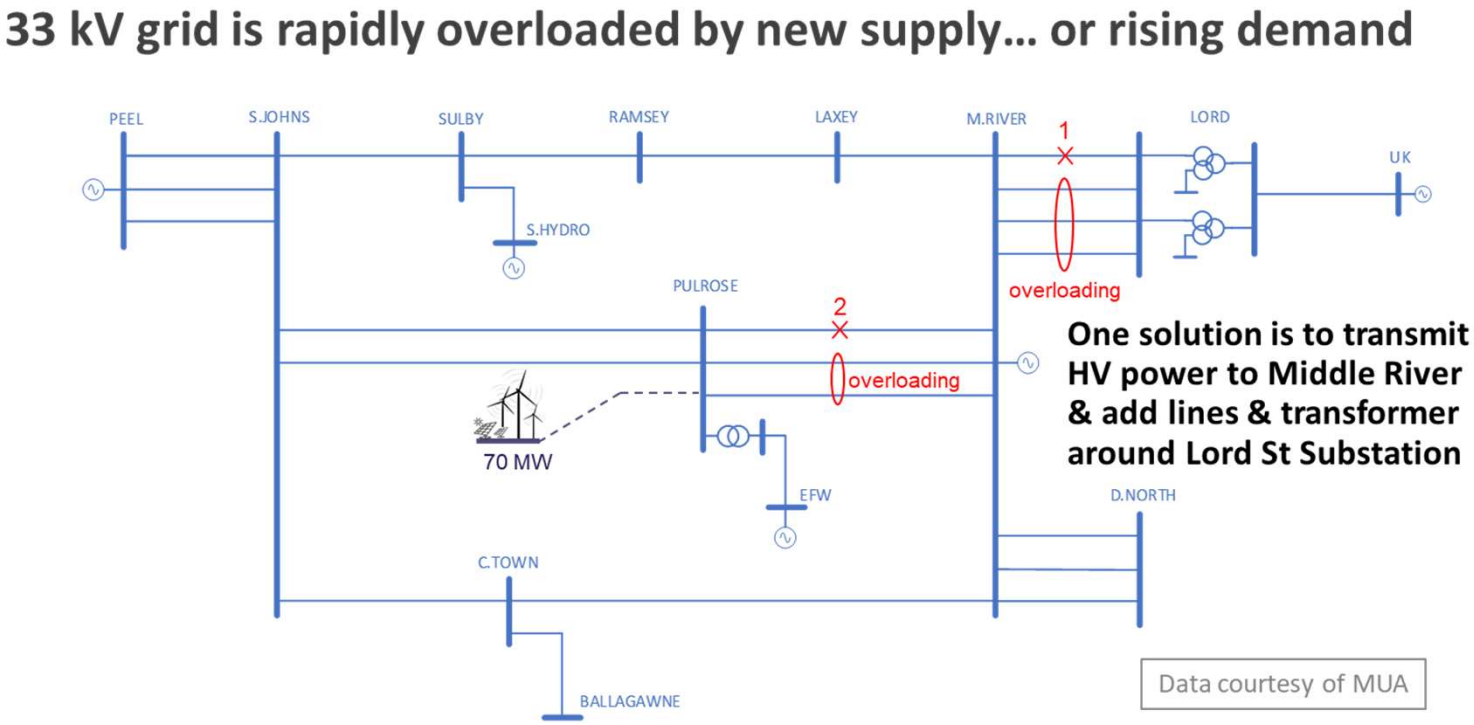
Isle of Man's situation

- Annual ½ million tonnes of CO_2 from use of fossil fuels
  - Same as CO_2 captured by 1250 km^2 forest
- Enviable renewable energy resources
  - Predictable costs & value
- High & volatile gas & oil prices
  - Winter supply worries
- Value of Island's location



But not that simple

- The electricity grid is truly a wonder
  - Power at a flick of a switch
  - The largest, most complicated human construction



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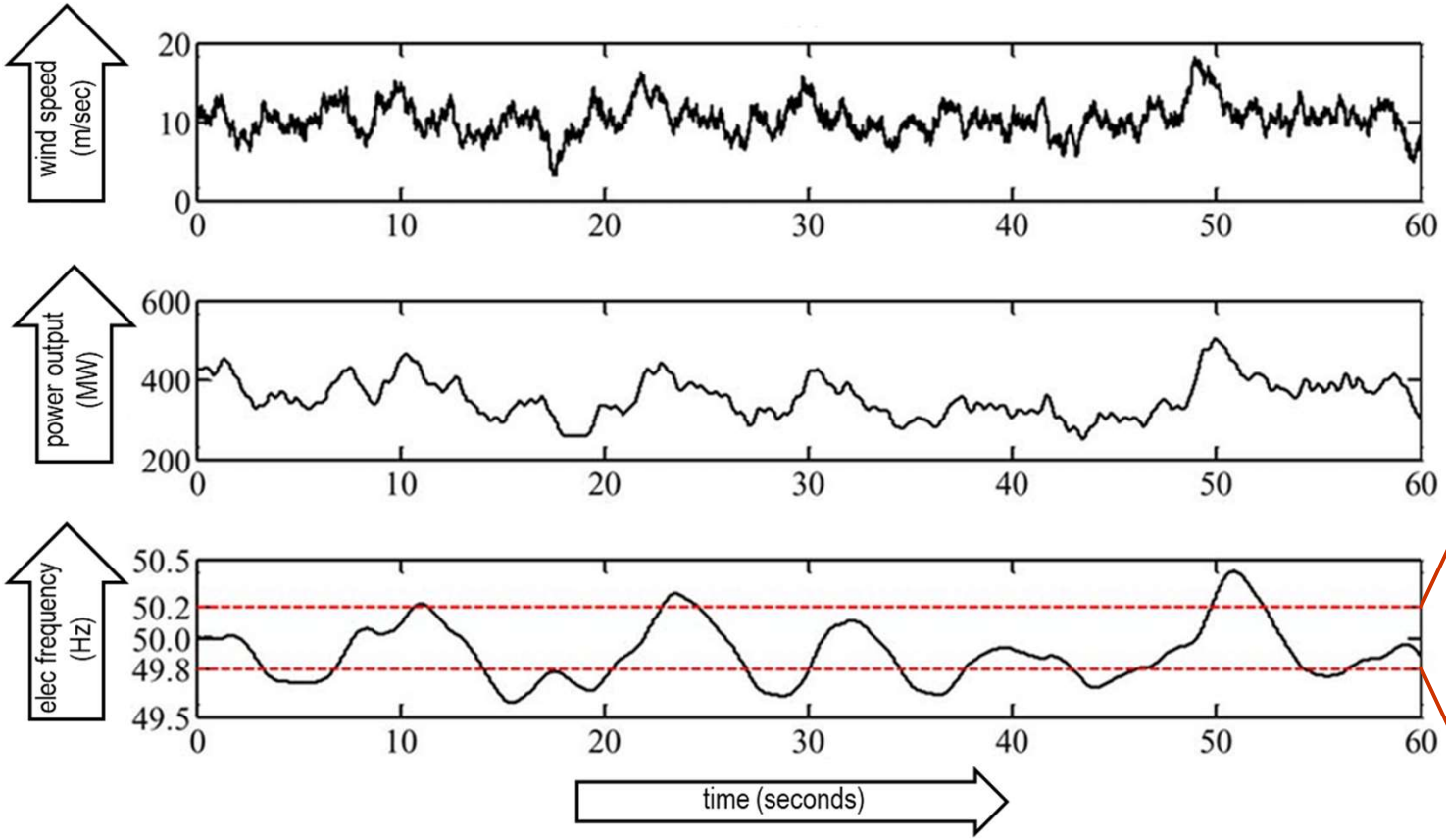
DENMARK

But not that simple

- The electricity grid is truly a wonder
  - Power at a flick of a switch
  - The largest, most complicated human construction
- Fossil fuel power plants are flexible & provide heat

  …ignoring emissions & costs
- Wind & solar energies are intermittent

Any variation in supply or demand can affect the stability of the grid



From www.energy sustainabilitycentre.im after Jiang et al., 2014

Ancillary services are used to avoid blackouts (batteries, synchronous condensers, power electronics, etc.)

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- Wind & solar energies are intermittent
- Electricity demand is variable

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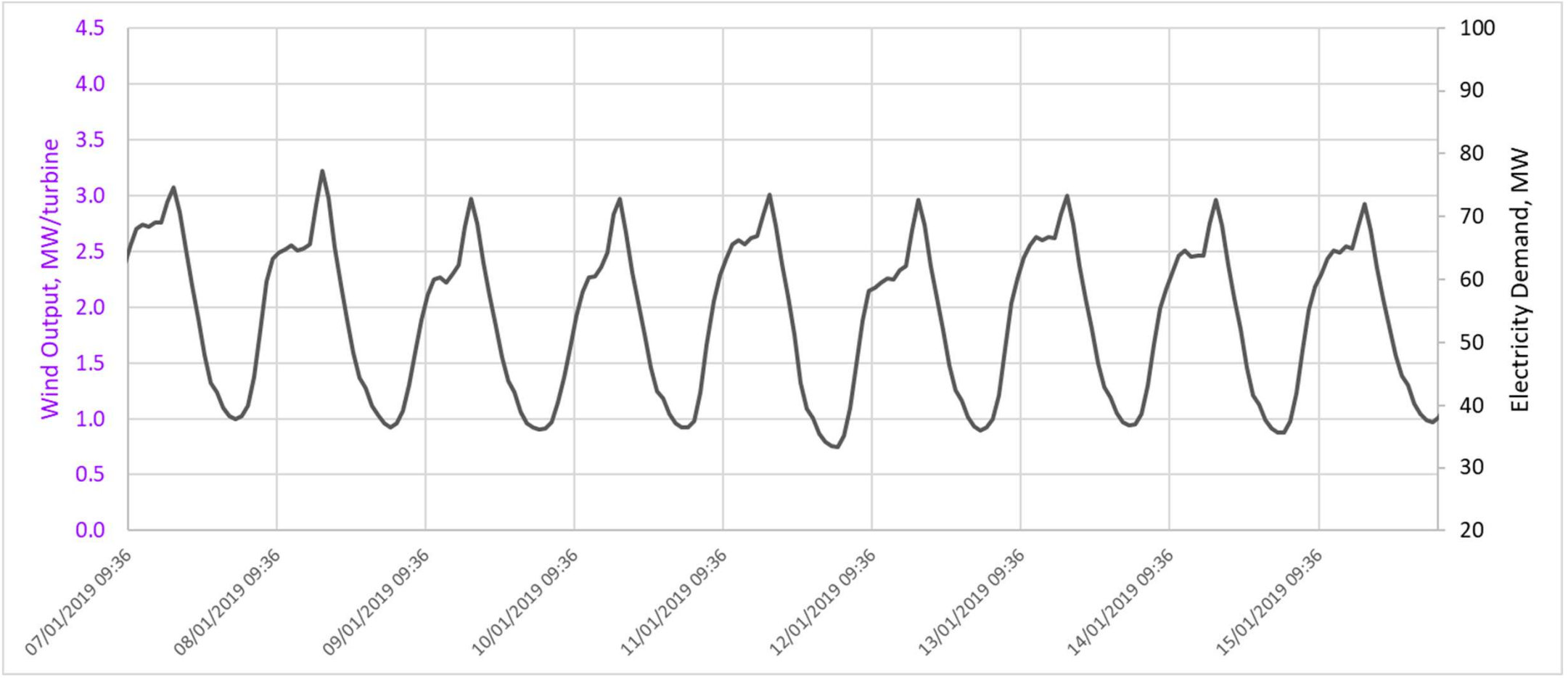
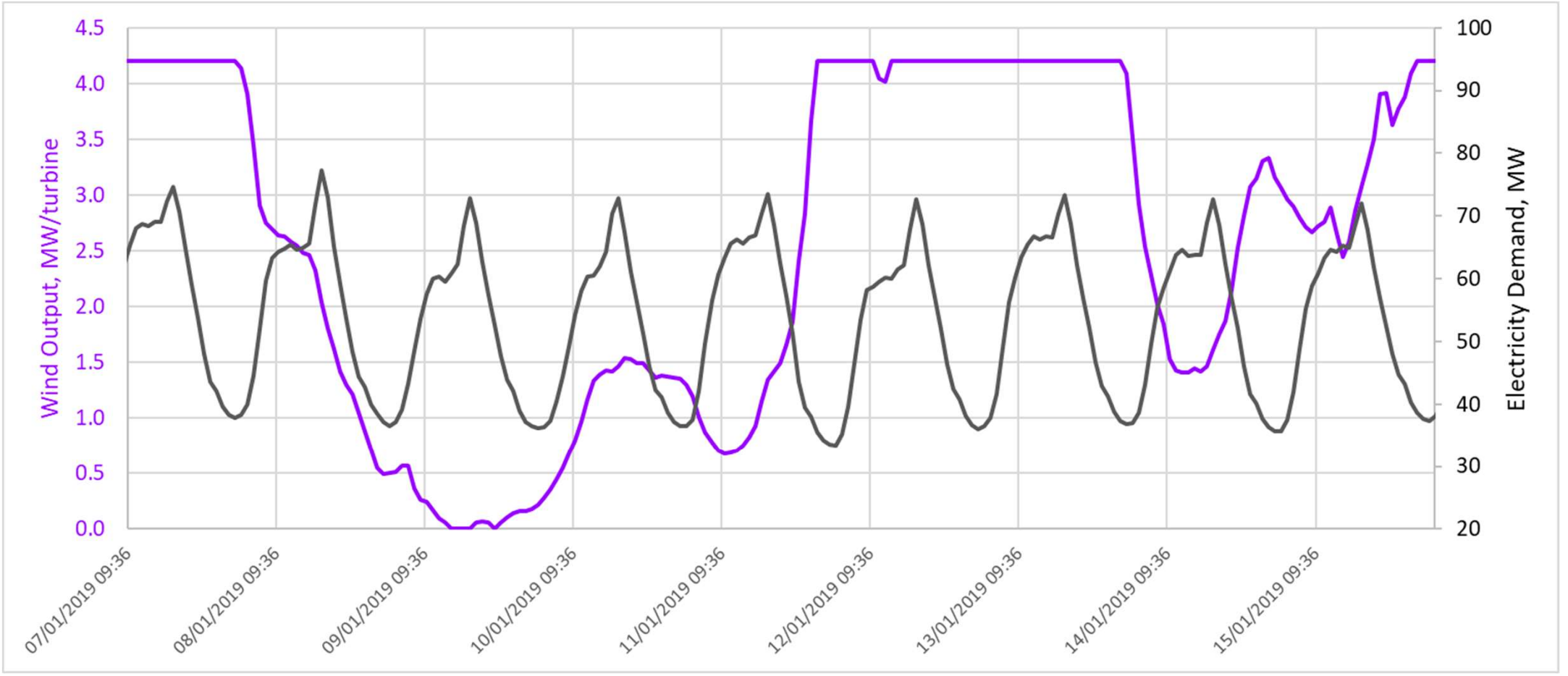
Variation electricity demand over 8 days in January

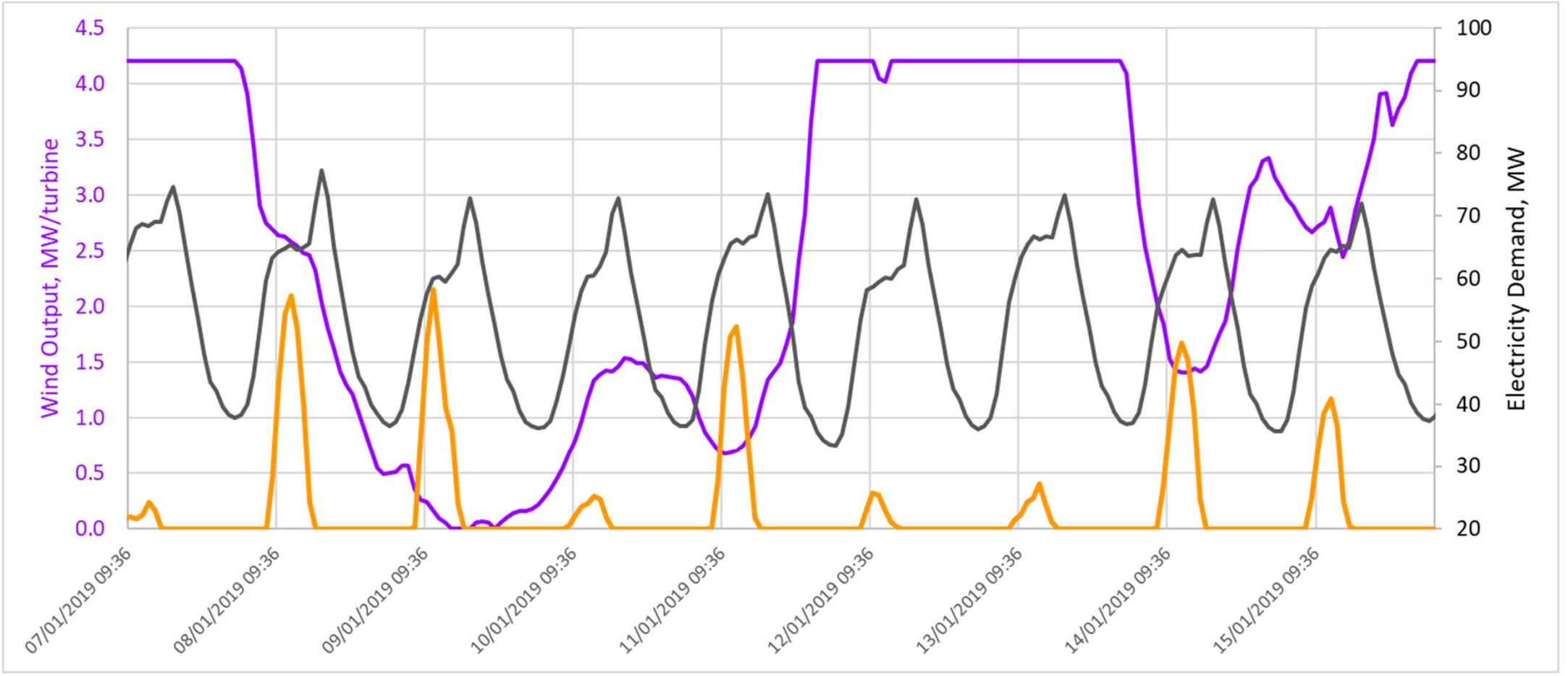


Data courtesy of MUA

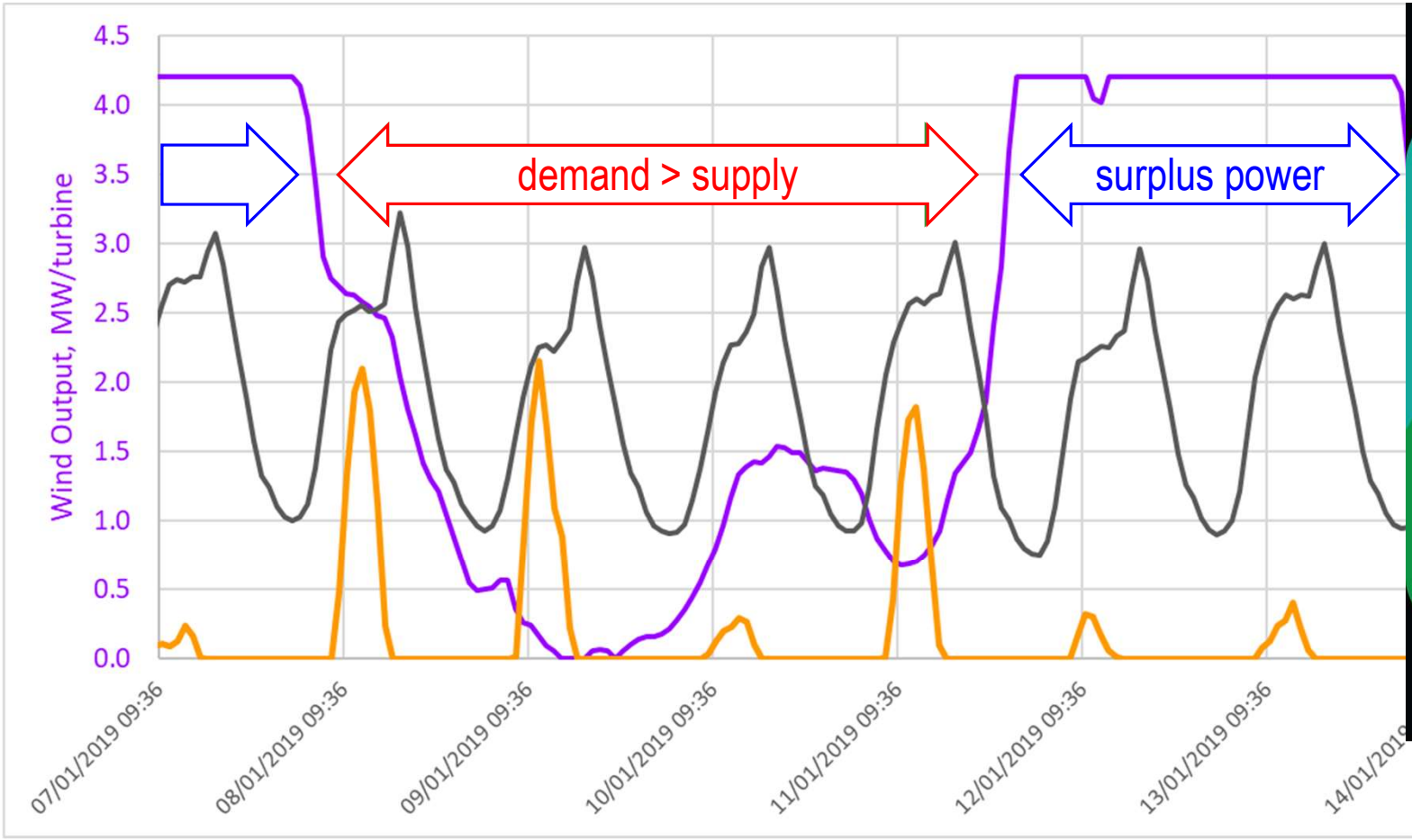
Variation in wind power over 8 days in January



Variation in solar power over 9 days in January

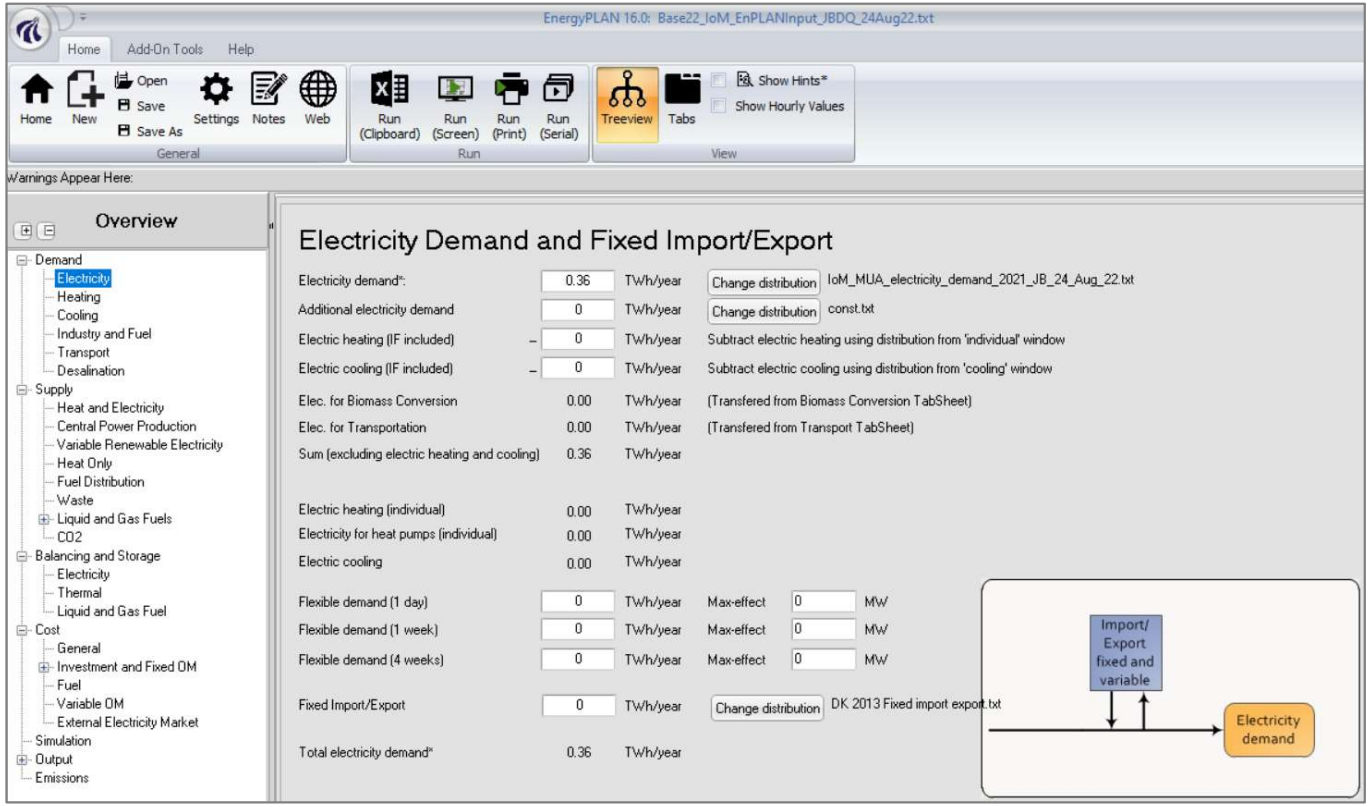


Turn on power plant, import electricity or build energy storage?



What we did

- Compiled data* on all energy transition options
  - generation, storage, costs
- Built digital models using state of the art software
  - EnergyPlan & PowerFactory
- Simulated & optimised paths to future energy systems
  - roadmap to low-carbon IoM



* Including generation, transmission, demand & cost data from MUA

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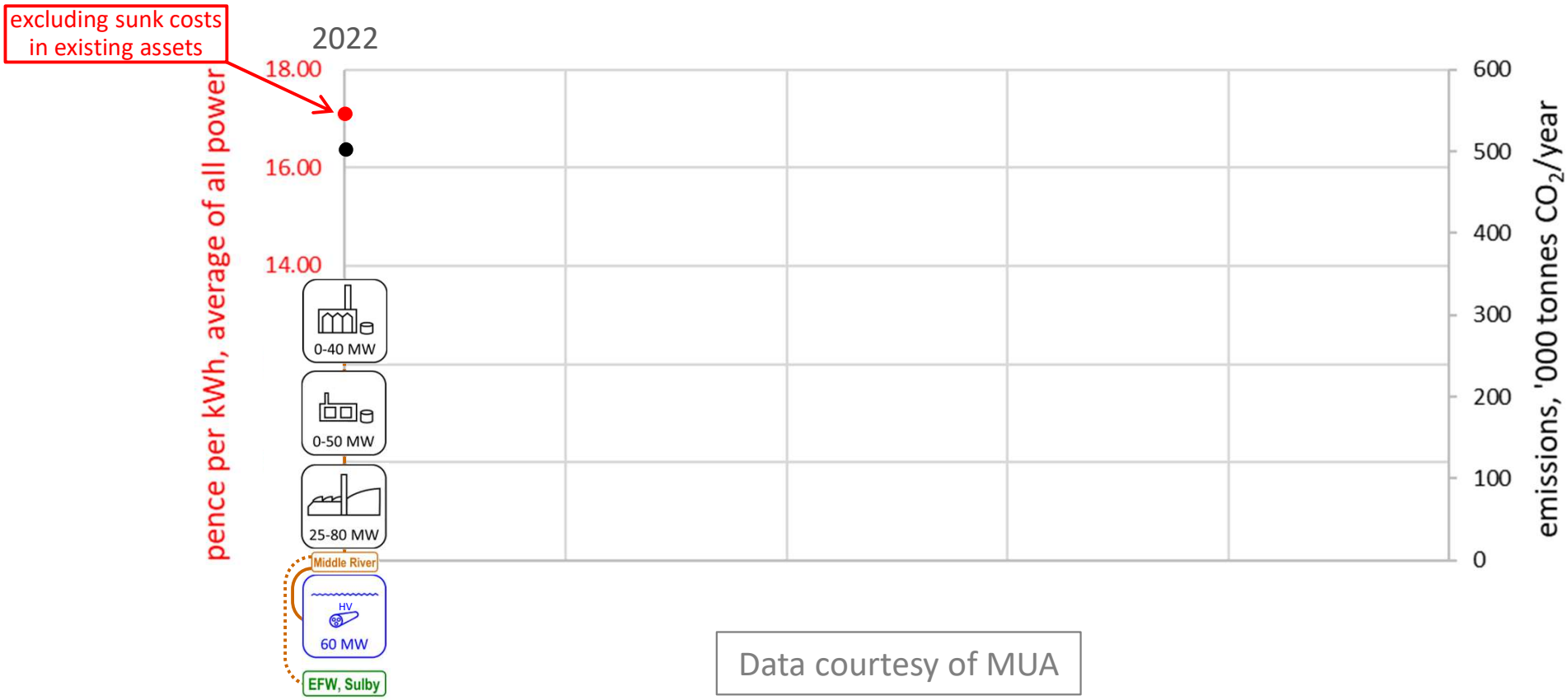
Stepwise pathway to Manx self-sufficiency in renewable energy



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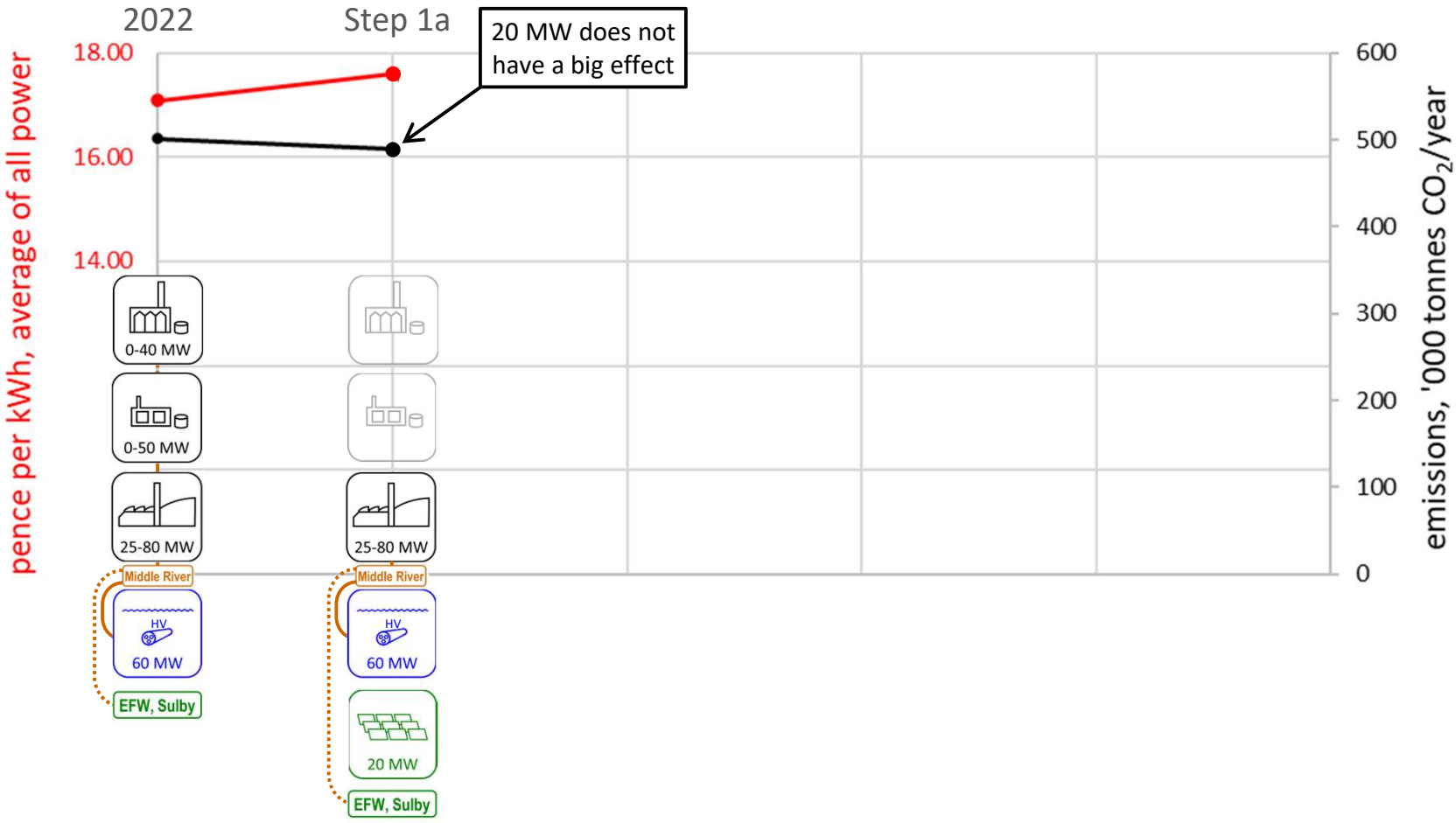

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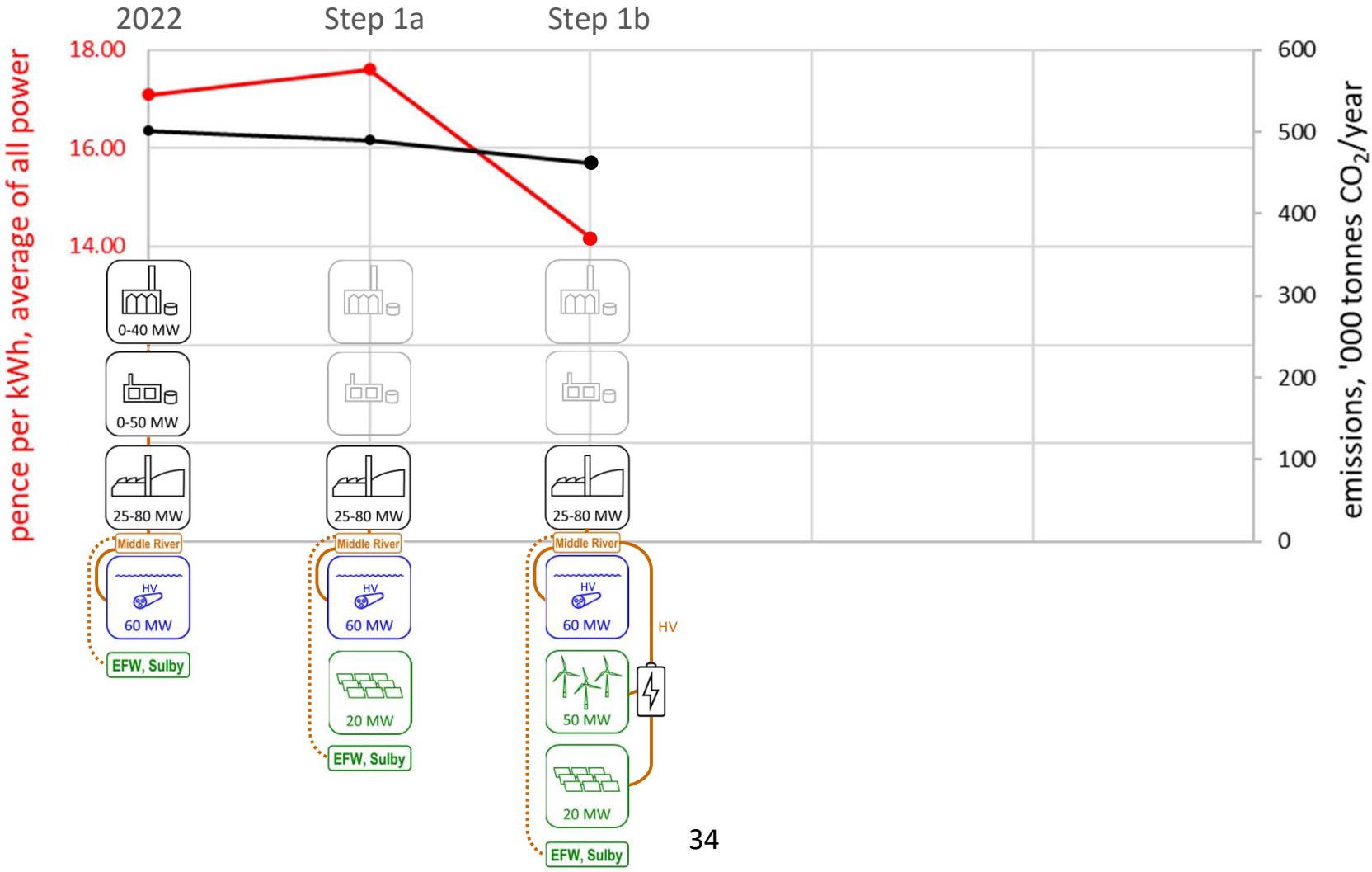

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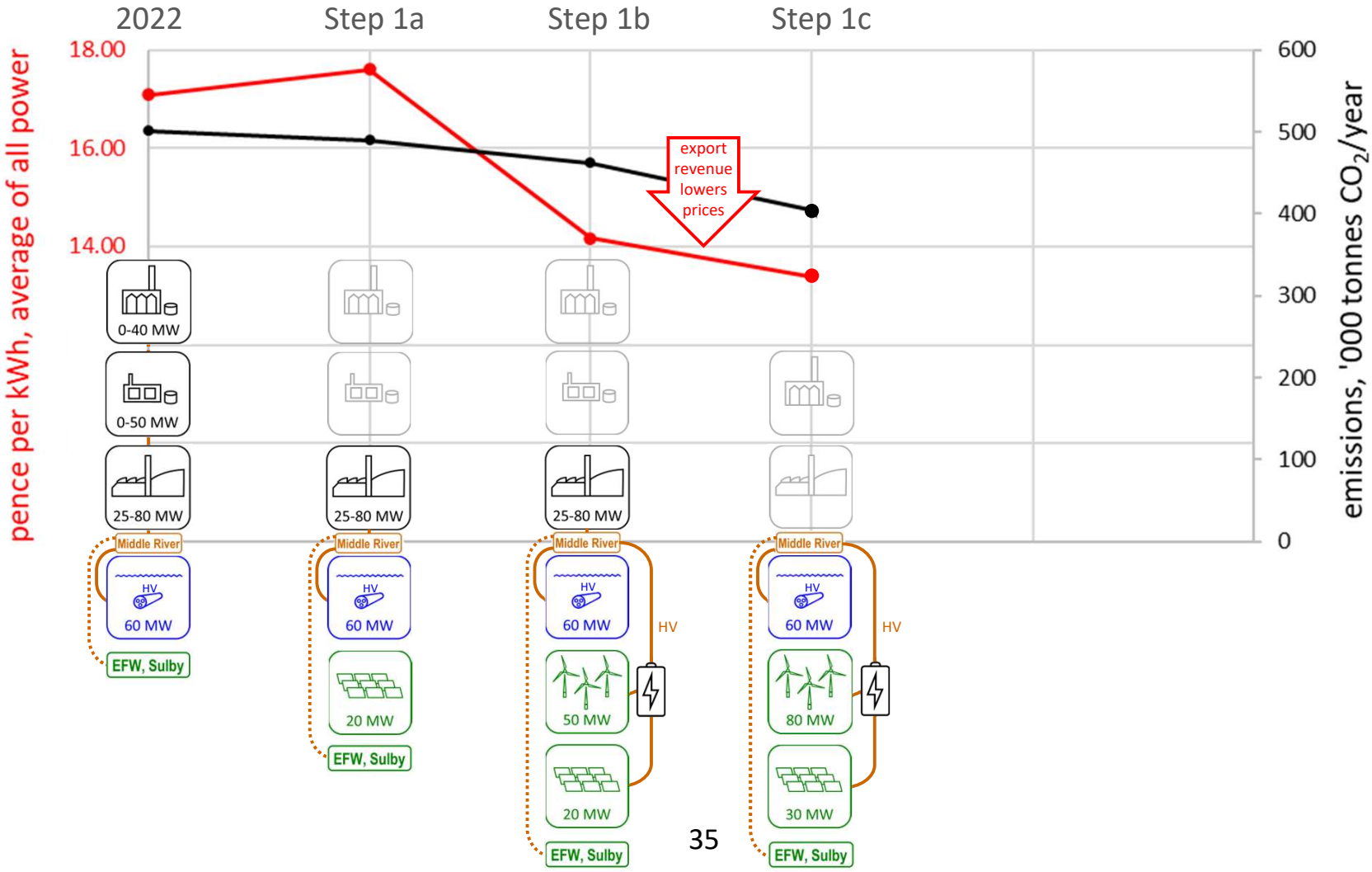

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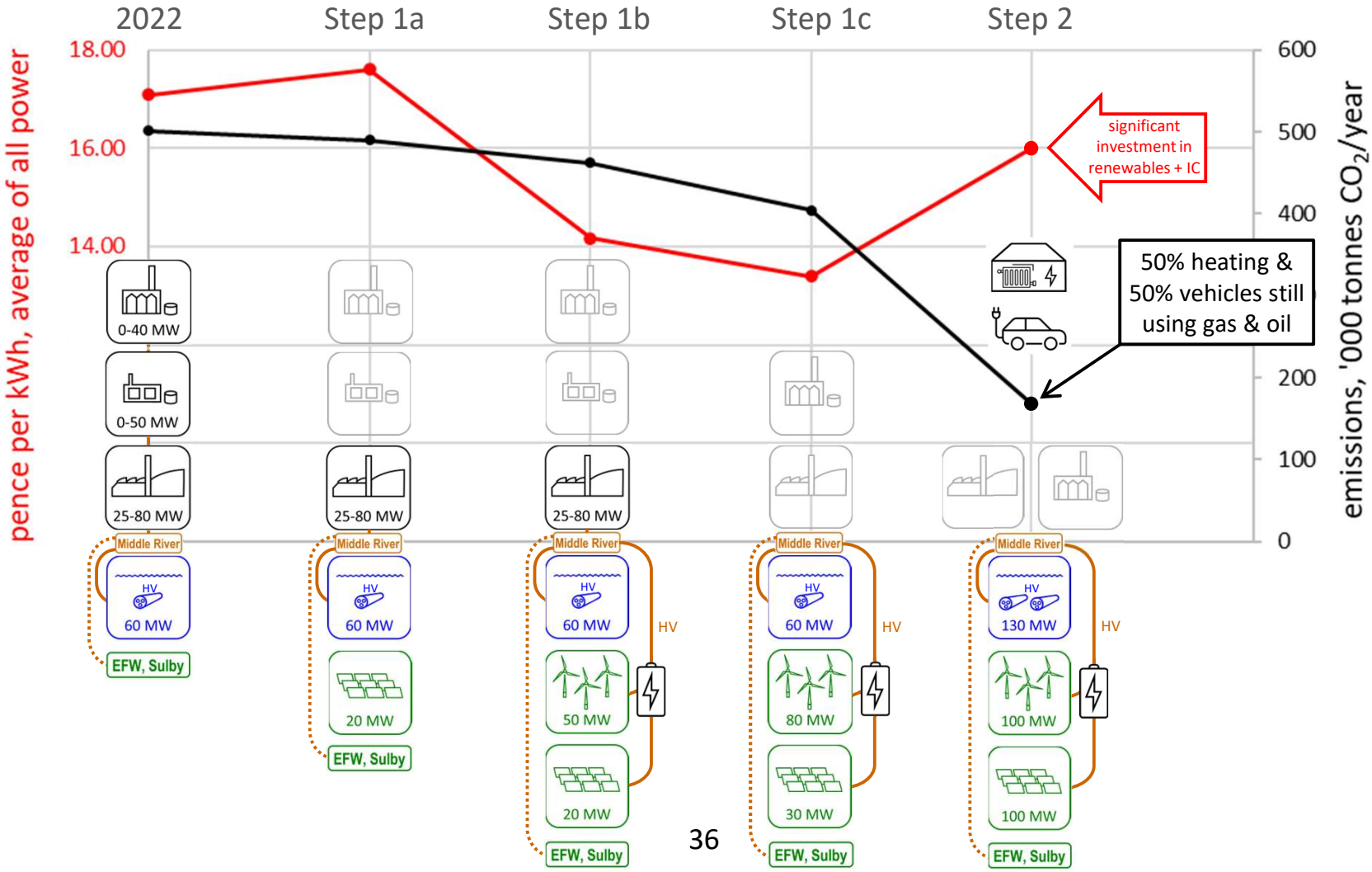

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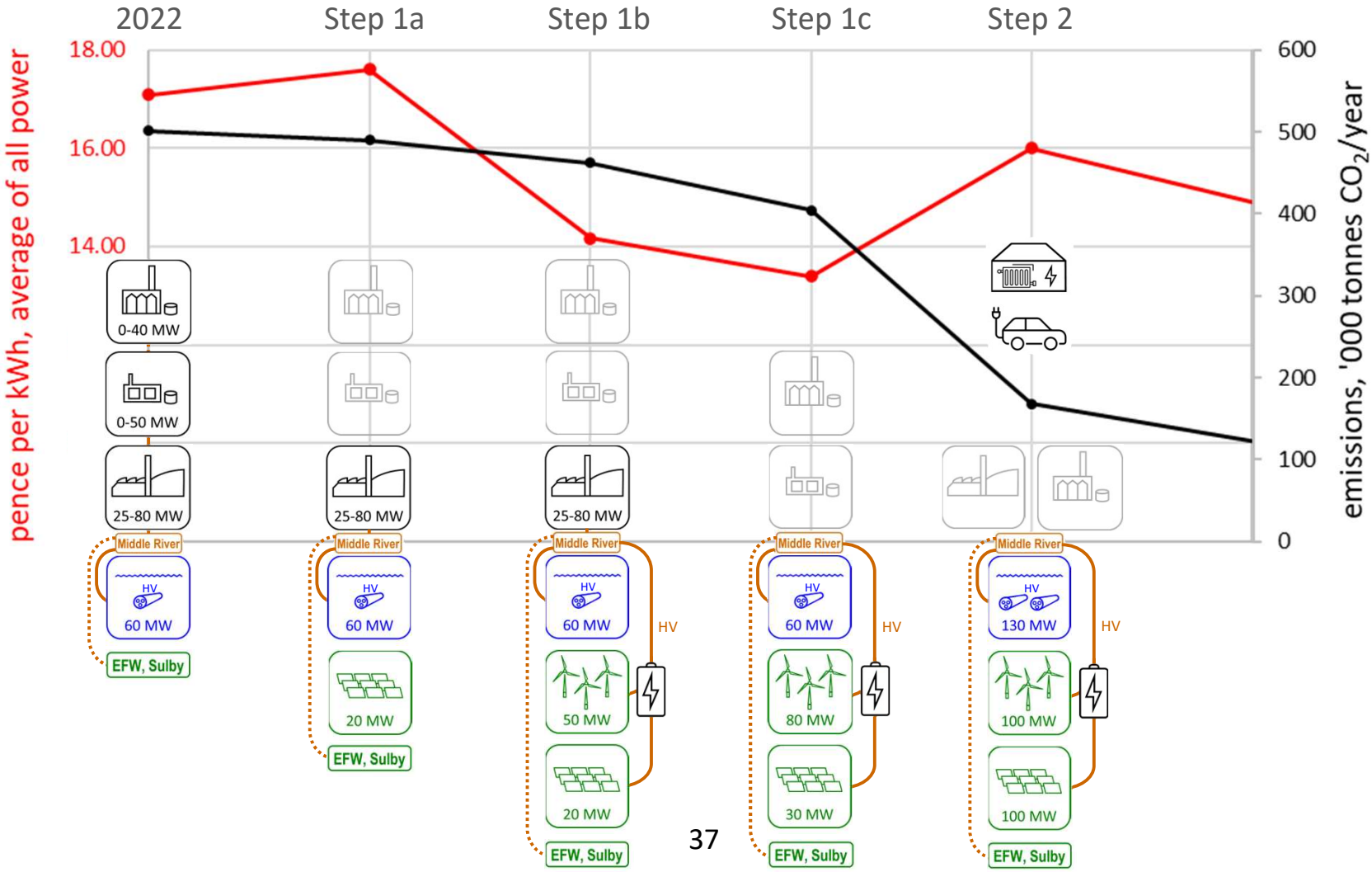

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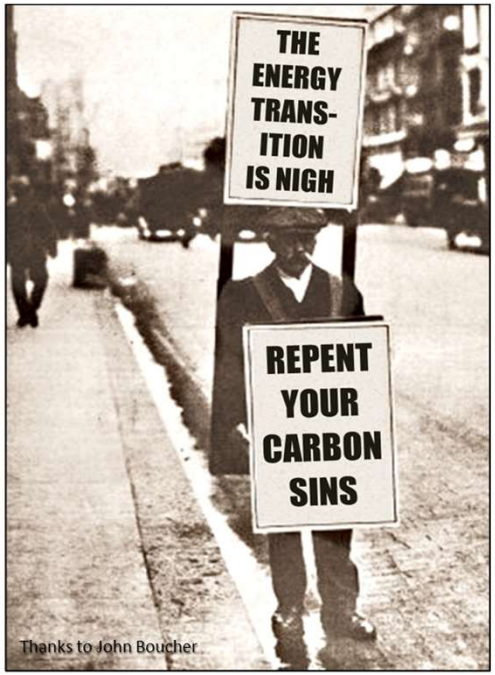
Conclusions I

- Isle of Man committed to net zero emissions – most benefit in doing it now
- What fantastic assets we have
  - Just a question of choosing, facilitating & accommodating an optimum path
  - Need to move quickly to secure 1) affordable energy and 2) private funding
- Yes it is doable… even with a 33 kV grid at current demand
- Gas prices are unpredictable, unlike renewables
- At grid scale, renewable energy is economic
- A larger interconnector adds more value
- Energy storage improves value & export sales



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Conclusions II

- Risk of avoiding losing revenue & business
- All the technology is available & companies are ready to invest
- Permitting needs to be streamlined
- The grid will need to be reinforced, flexible & smart
- District heating, biofuels & H_2 should be added to our options
- Alignment is critical – time to collaborate
- Let's work this out this afternoon
- Please join us at the Energy Transition workshop on Friday
  www.greenfutureisland.im

15 years since first iPhone

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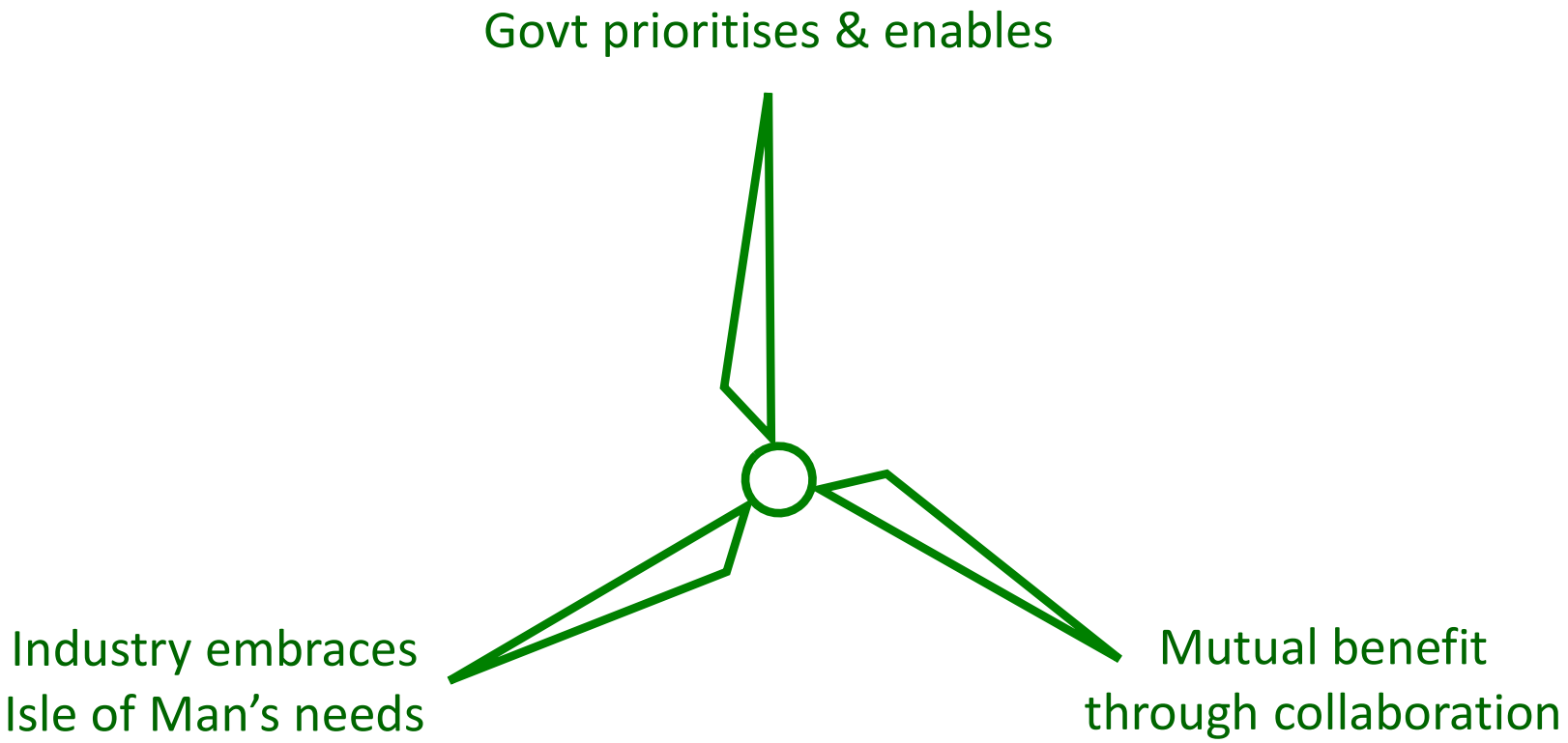
Conclusions - IoM can have global impact by example



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