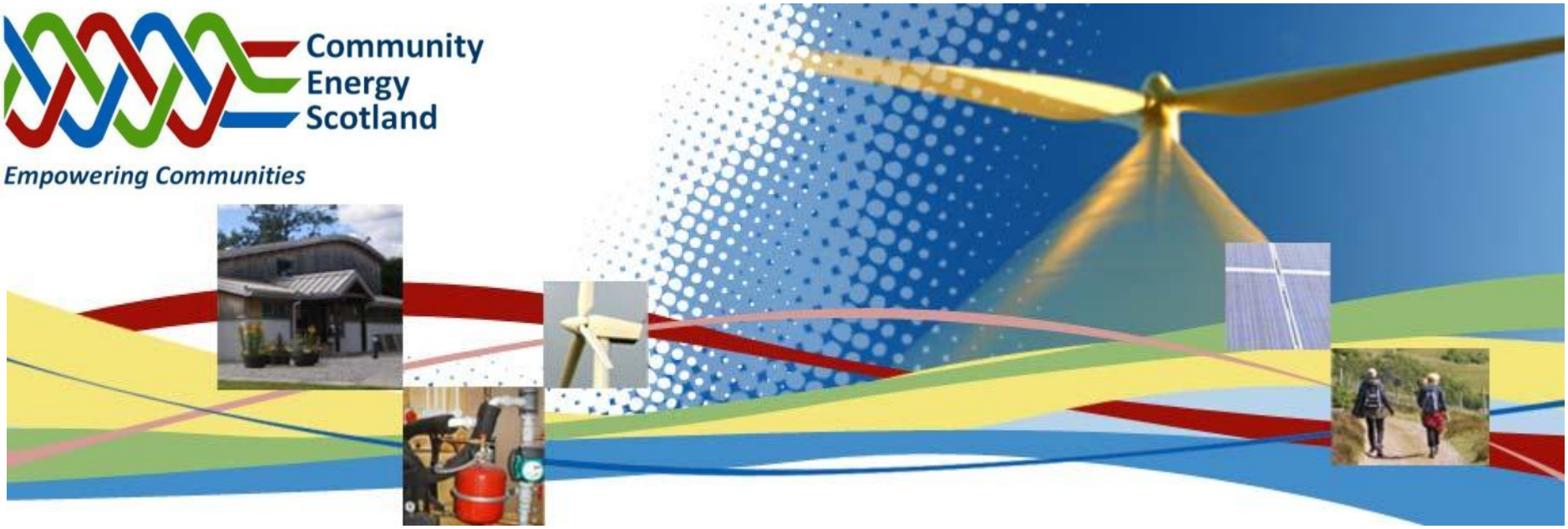
Community Energy Scotland

Empowering Communities



Orkney Hydrogen:

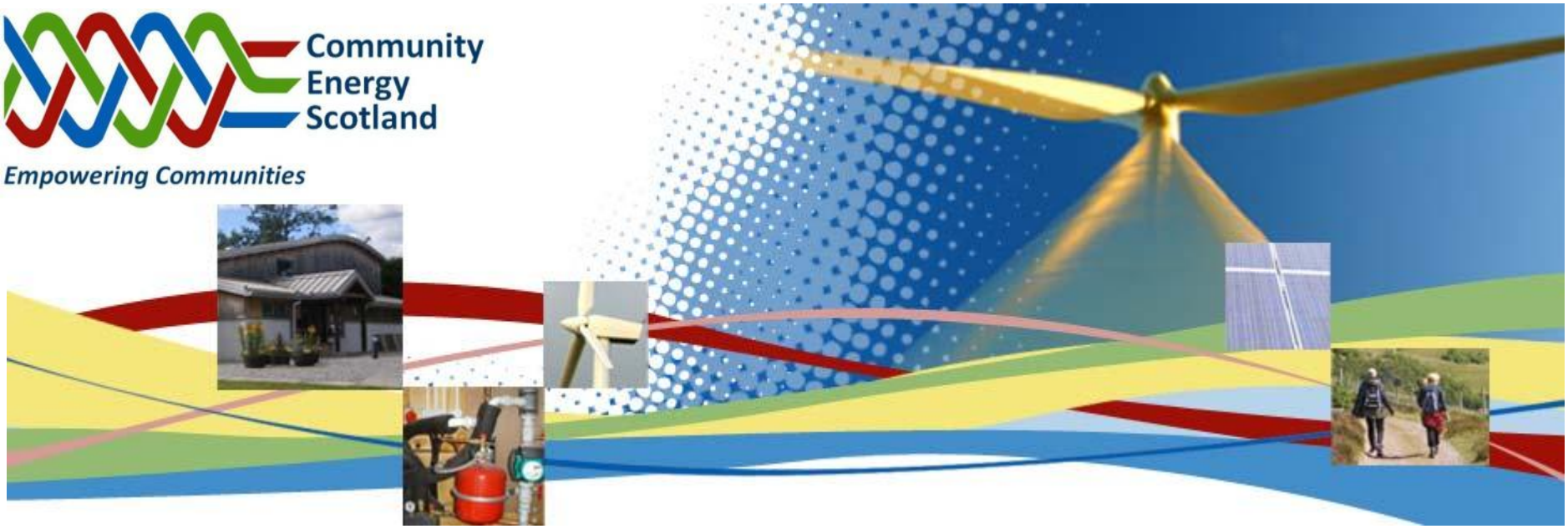
Making it work with renewable energy for a low carbon marine sector

International Conference: Ports, Maritime Transport & Insularity

Milos, 21-22 April 2017

Community Energy Scotland

Empowering Communities



Mark Hull – Head of Innovation

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Email: mark.hull@communityenergyscotland.org.uk
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Community Energy Scotland

Empowering Communities

Our Core purpose:

‘To build confidence, resilience and wealth at community level in Scotland through sustainable energy development’

Community Energy Scotland

Empowering Communities

- 25 staff spread across Scotland, including Orkney and Western Isles
- **Over 400 members**- mostly non-profit distributing community groups
- Supported **over 600 community energy installations** across Scotland
- Our projects provide income and affordable energy worth over **£5 million per year** to local people

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Empowering Communities

Why are island communities doing this? - Opportunity

- Resource
- Wind (Wave and Tide)
- Revenue
- Incentives - Was Grants + ROCs, then FiTs, now?
- Community Will

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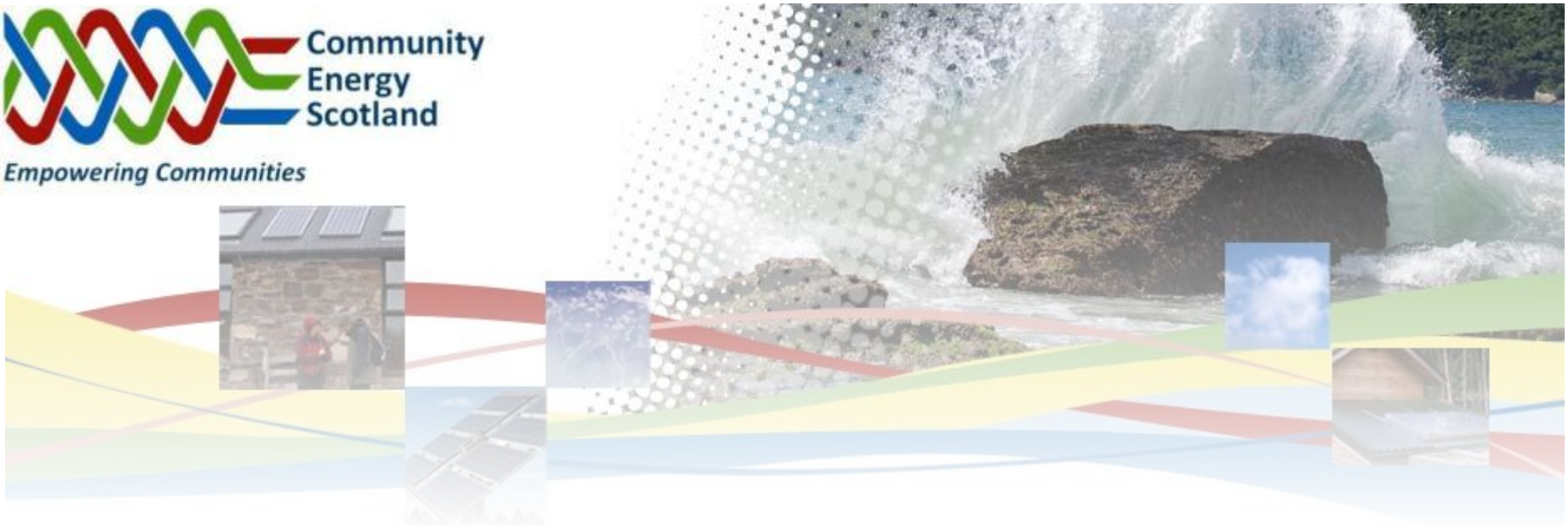
Empowering Communities



Why are island communities doing this? - Need

- Depopulation
- Fuel Poverty
  - Heating
  - Transport
- Skill shortage and under employment
- Resilience

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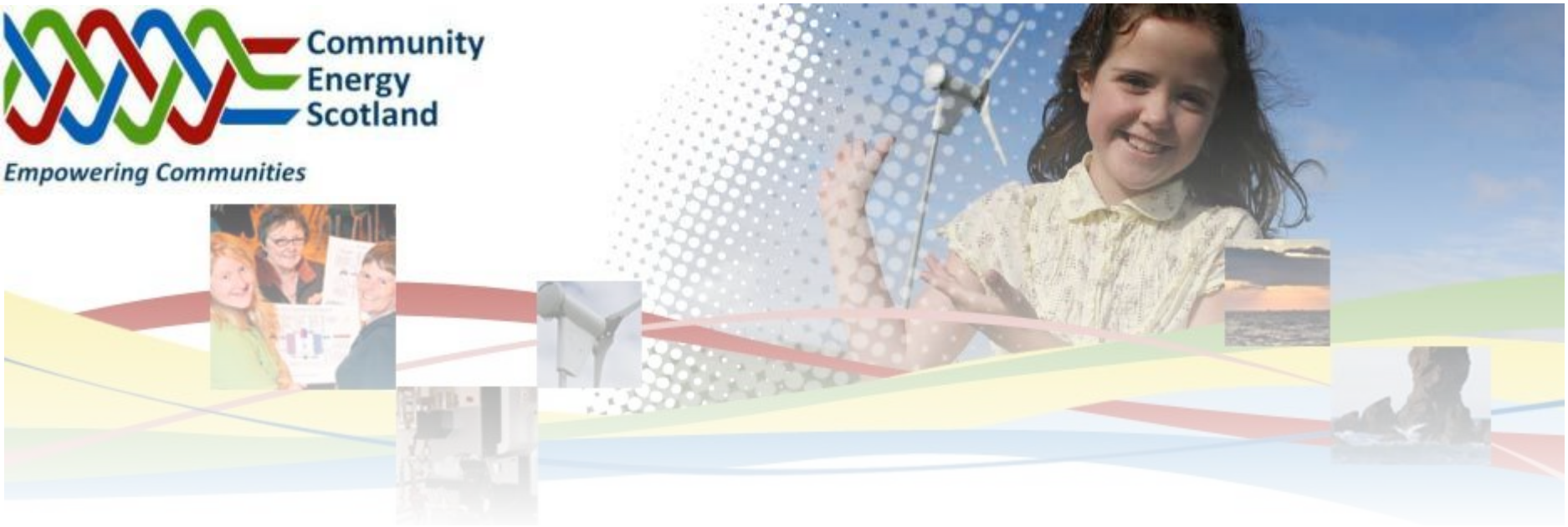
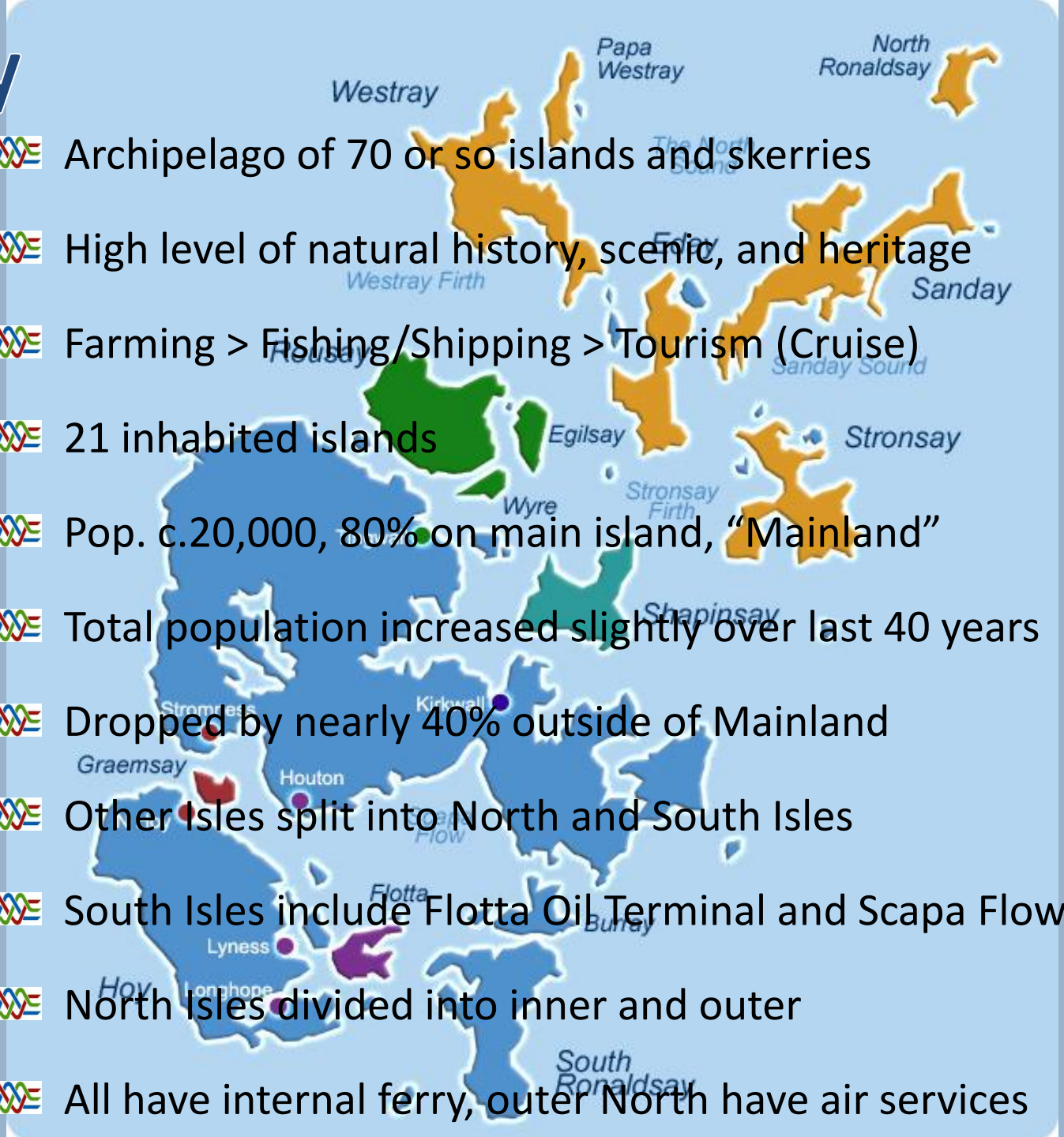


Why are island communities doing this? - Benefit

- Money
  - Independent Community Controlled Fund
  - Local Community Development Plans
  - Pump priming
- Enabling
  - Competence/Confidence
  - Self Determination


Orkney
Norway
Finland
Estonia
Baltic Sea
Latvia
Lithuania
North Sea
United Kingdom
Denmark
Belarus
Ireland
Poland
Netherlands
Germany
Ukraine
Belgium
Czechia
Slovakia
Moldova
Austria
Hungary
Romania
France
Black Sea
Croatia
Serbia
Bulgaria
Turkey
Italy
Portugal
Greece
Spain
Tyrrhenian Sea
Lebanon
Israel

Orkney



- Archipelago of 70 or so islands and skerries
- High level of natural history, scenic, and heritage
- Farming > Fishing/Shipping > Tourism (Cruise)
- 21 inhabited islands
- Pop. c.20,000, 80% on main island, “Mainland”
- Total population increased slightly over last 40 years
- Dropped by nearly 40% outside of Mainland
- Other Isles split into North and South Isles
- South Isles include Flotta Oil Terminal and Scapa Flow
- North Isles divided into inner and outer
- All have internal ferry, outer North have air services

Orkney Large-scale Community Owned Wind Turbines

Wholly owned

Joint venture

Total Installed: c. 7.3MW

All but Westray – ANM/New Non-firm Connections

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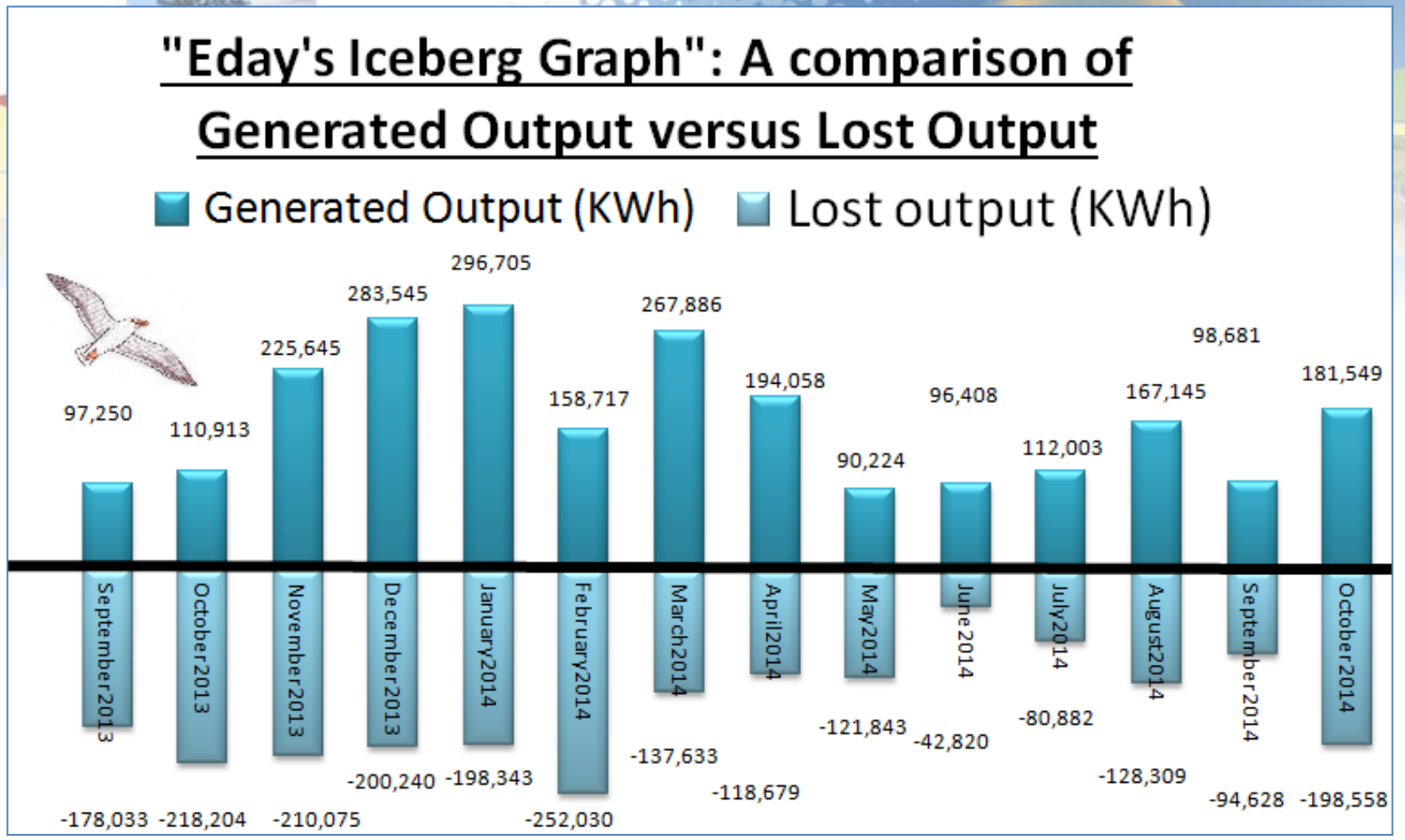
"Eday's Iceberg Graph": A comparison of Generated Output versus Lost Output



Courtesy Andrew Stennett, ERE

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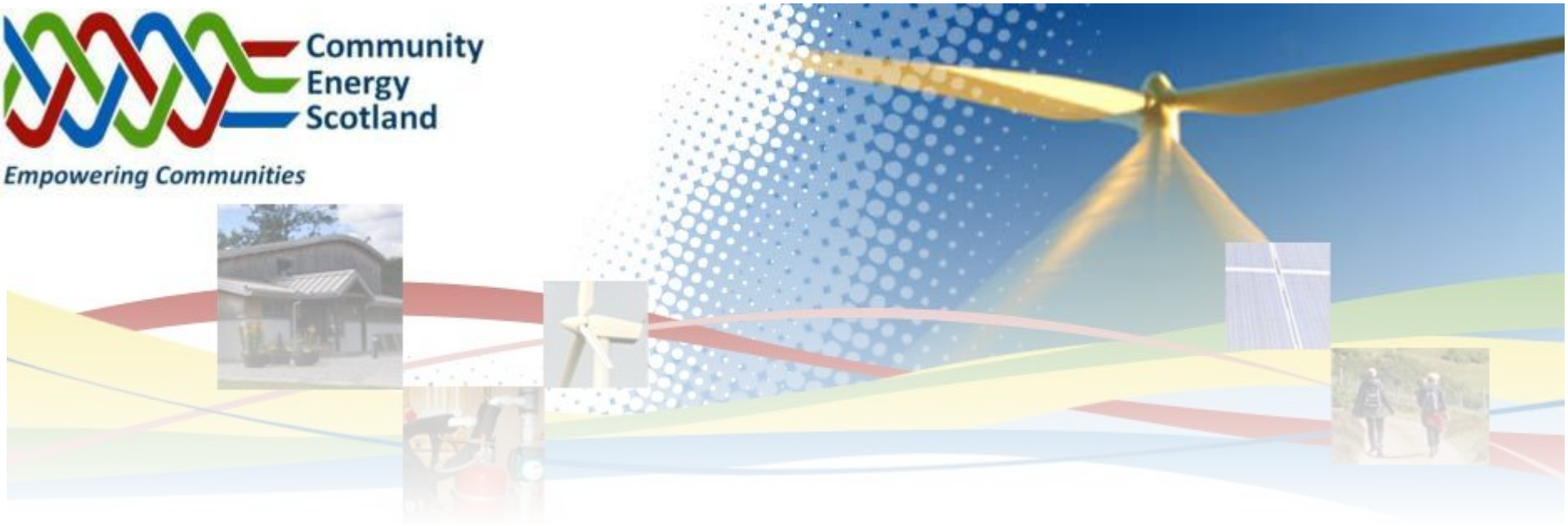

Improving our Electricity Grid Network?

- Work with Grid Operator to improve existing connection management
- Work with them, government & other users on local grid upgrades
  - *E.g. Seasonal line rating, local grid reinforcement etc.*
- Urge longer term investment in wider, transmission, reinforcement
- See what we can do ourselves!

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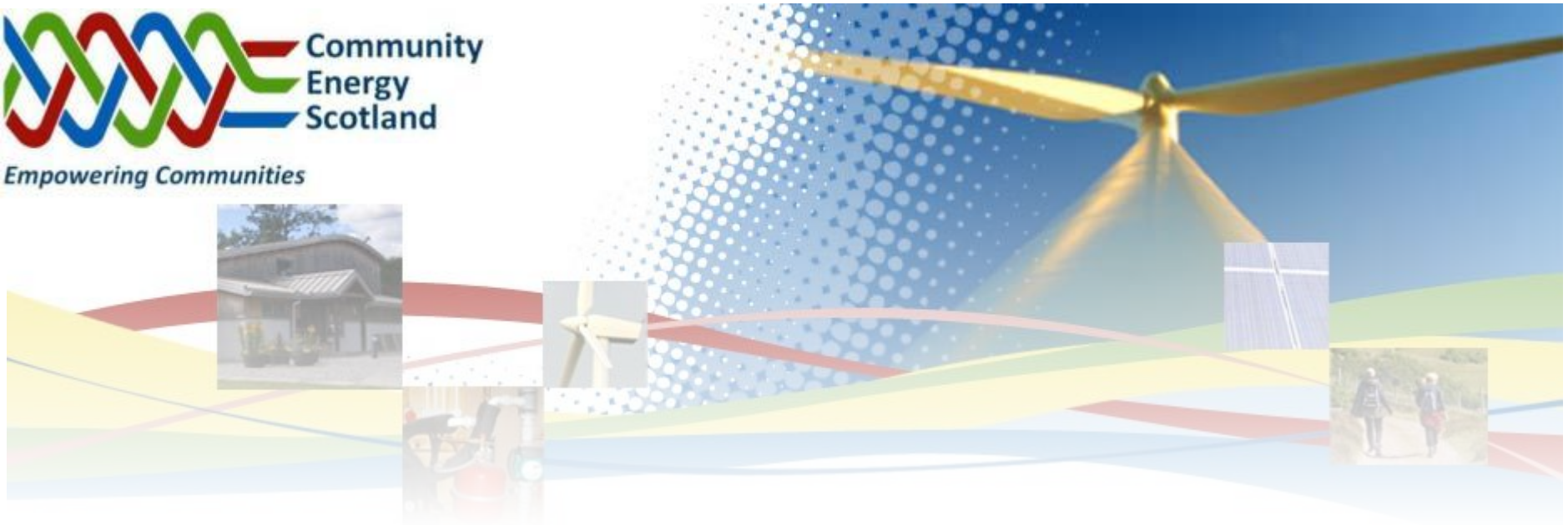

Can we make this a local opportunity?

- ✘ Can’t change the grid
- ✘ Can’t export out to the grid
- ✓ Est. >25GWh (£4M+) p.a. available if we can **use it locally**!
- ✓ Increase community fund revenue
- ✓ Increase local content, value and benefit

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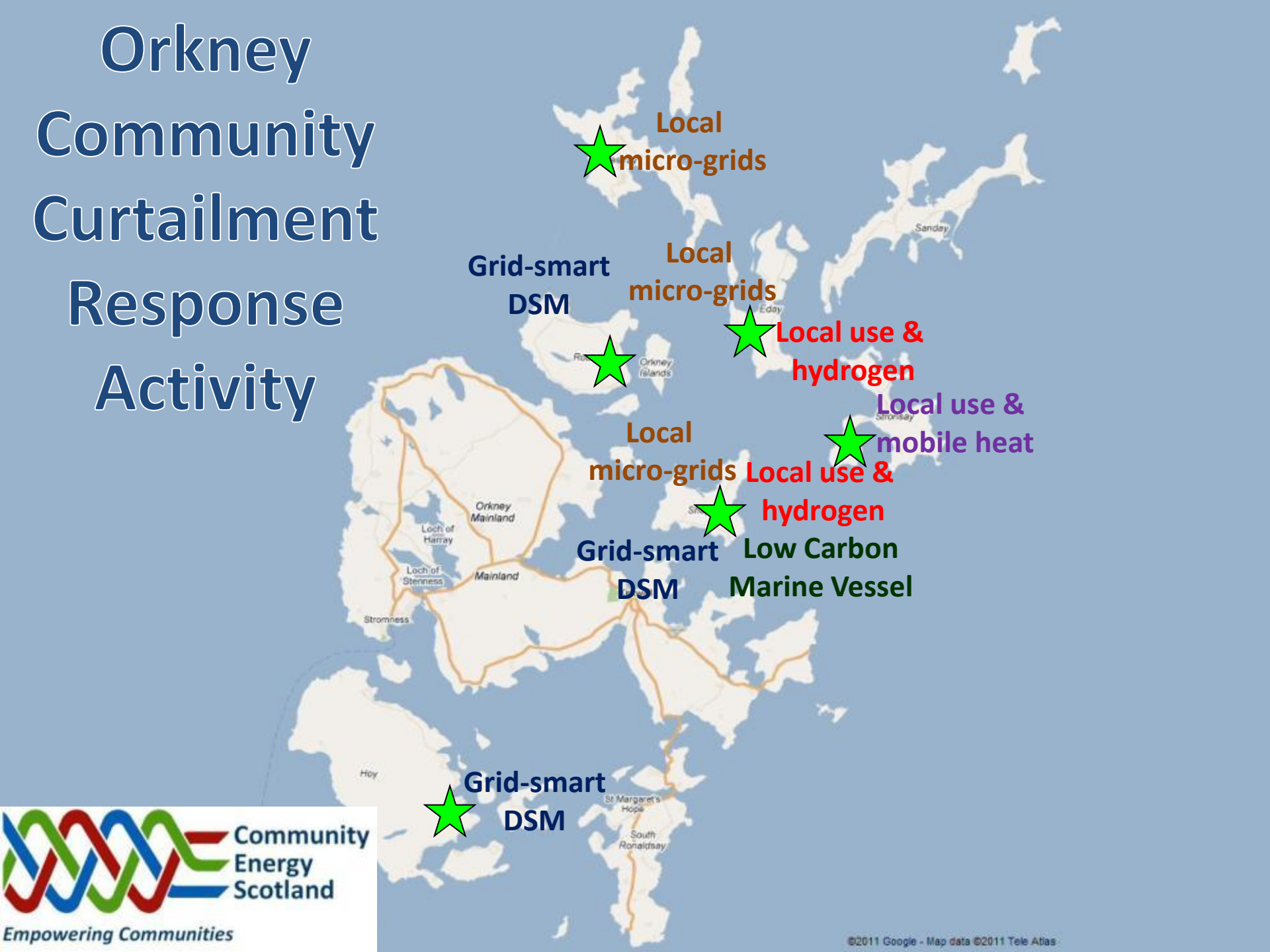
So what are Orkney communities doing?

- Encouraging and incentivising conversion to electricity use
- Linking demand on the grid to production and curtailment
  - Technology – tele-switching of domestic and public heating
  - Contractually – payment/rebate for “Grid Smart” demand
- Creating and encouraging, pre-grid, near site demand
- Researching replacement of transport fuels

Orkney Community Curtailment Response Activity



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Empowering Communities

Shapinsay Low Carbon Marine Transport Study

- Trust funding a highly successful “out of hours” passenger service
- They need to find a long term sustainable solution
- Analysing curtailment and existing marine fuel use patterns
- Looking at cost benefits and technological maturity of hydrogen and electric propulsion, marine vessel technology and design, along with onshore infrastructure for charging and vessel supply

SURF 'N' TURF

A project to integrate tidal & wind electricity,
To generate and transport hydrogen,
Bypass Orkney's grid pinch points, and
Smartly supply local energy demands.

THIS PROJECT HAS BEEN SUPPORTED BY THE SCOTTISH GOVERNMENT'S LOCAL ENERGY CHALLENGE FUND

LOCAL ENERGY SCOTLAND

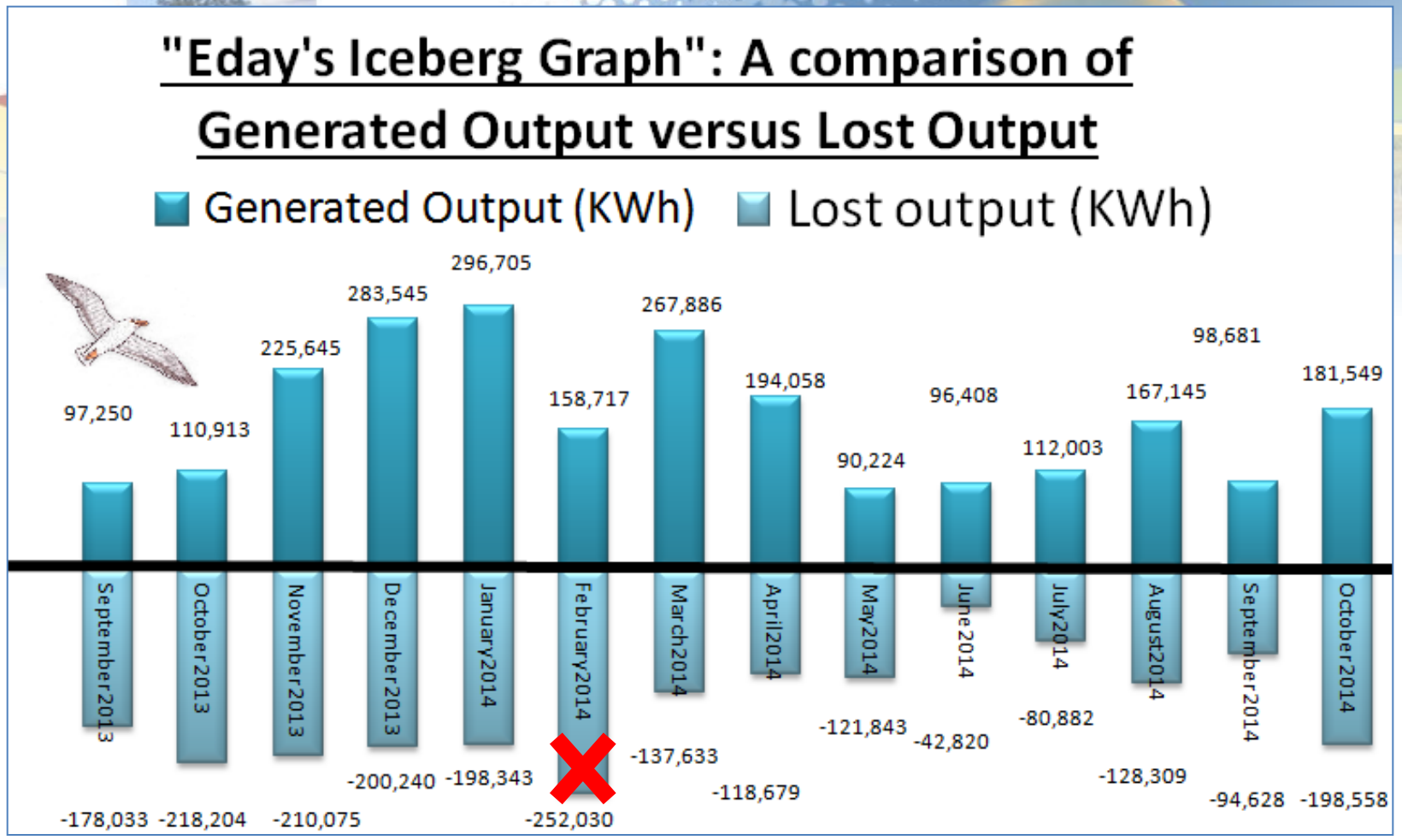
THE CHALLENGE FUND

Greener Scotland
Scottish Government

Community Energy Scotland

Empowering Communities

"Eday's Iceberg Graph": A comparison of Generated Output versus Lost Output



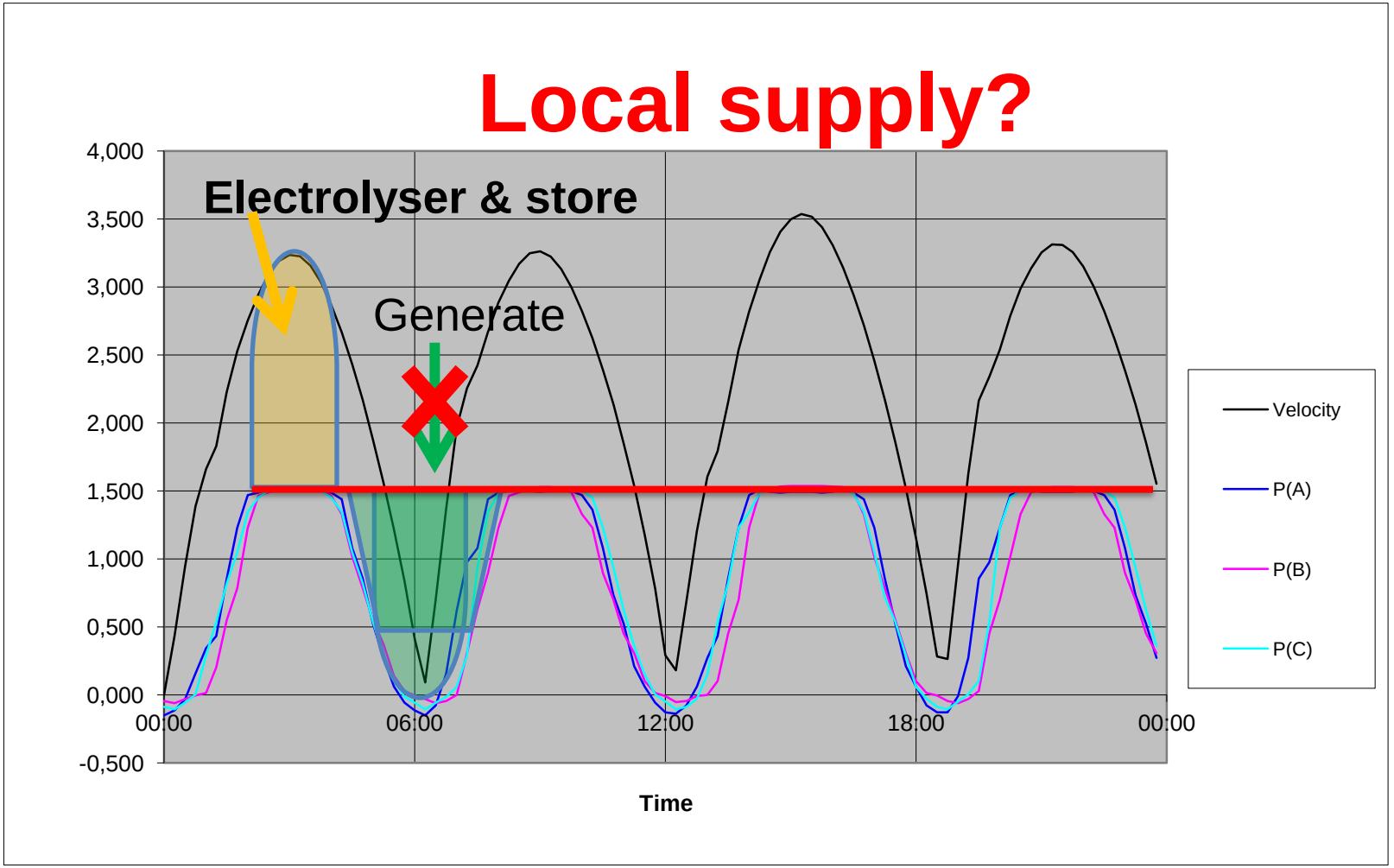
Local supply?

Courtesy Andrew Stennett, ERE

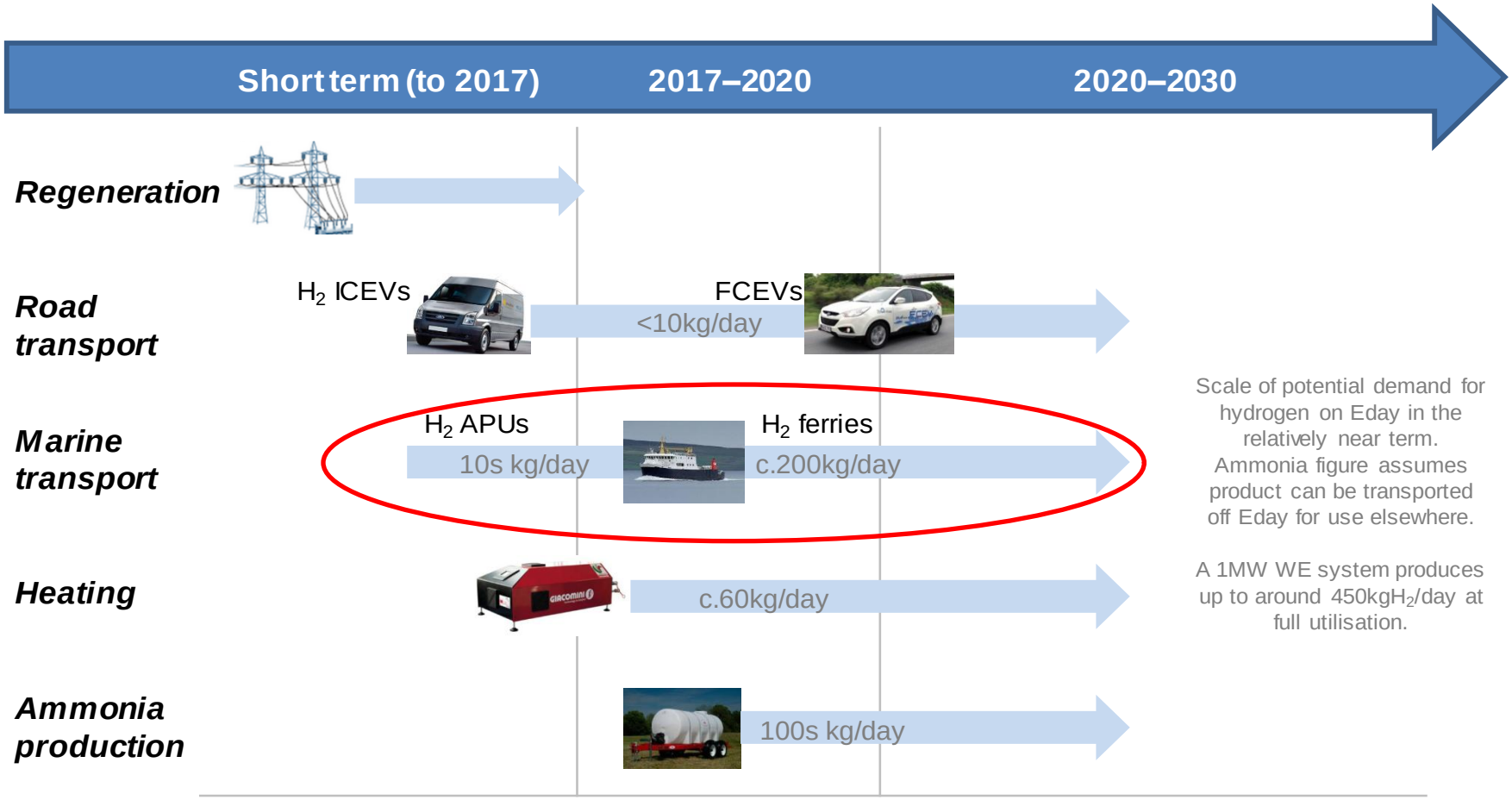
Developer timeline

- World leading wave and tidal energy test centre
- Steadily increased tidal activity
- Grid connection now limiting
- Need local solutions
- Options analysis
- Hydrogen storage

Tidal Characteristics



H_2 Supply Options study



Scale of potential demand for hydrogen on Eday in the relatively near term. Ammonia figure assumes product can be transported off Eday for use elsewhere.

A 1MW WE system produces up to around 450kgH_2/day at full utilisation.

ICEV = internal combustion engine vehicle, FCEV = fuel cell electric vehicle, APU = auxiliary power unit

Orkney Ferries

ORKNEY ISLANDS COUNCIL
Marine Services
HARBOUR AUTHORITY · TOWAGE SERVICES · FERRY SERVICES

ORKNEY
ISLANDS COUNCIL

- Orkney Islands Council reviewing energy use for ferries
- 9 vessels across Outer and Inner Isles routes

- 10s of MWh of diesel a day ‘each’
- Lack of mature low-carbon propulsion technology
- 50kW Auxiliary Power Units & cold iron overnight

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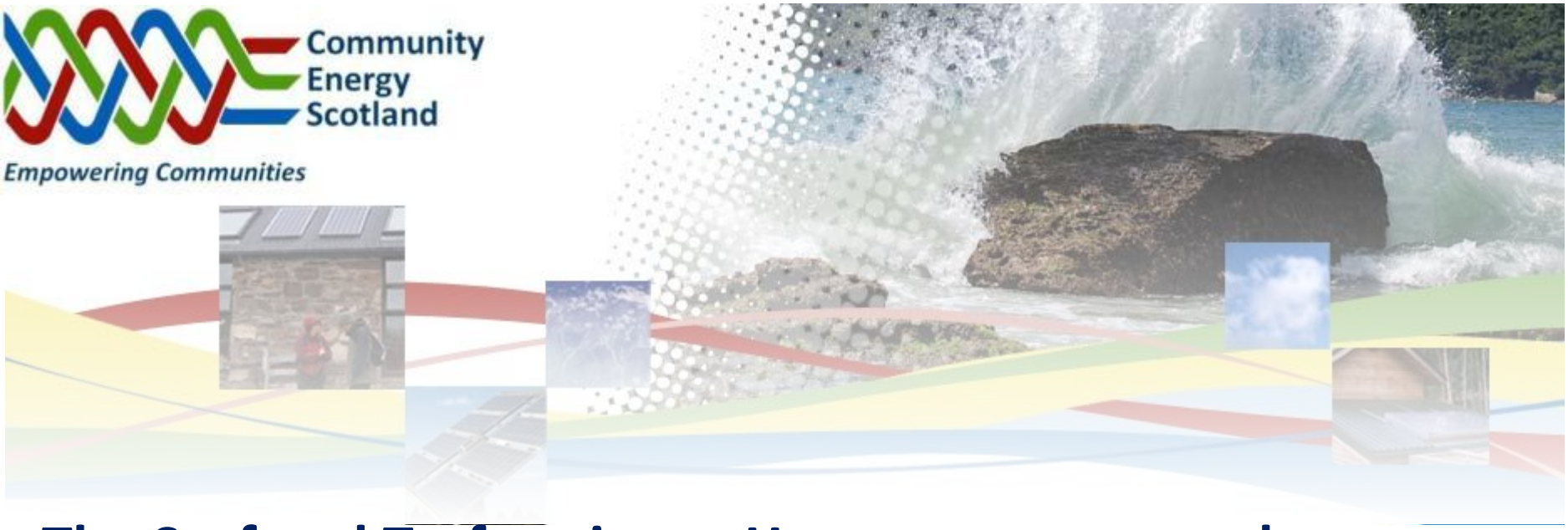
Empowering Communities



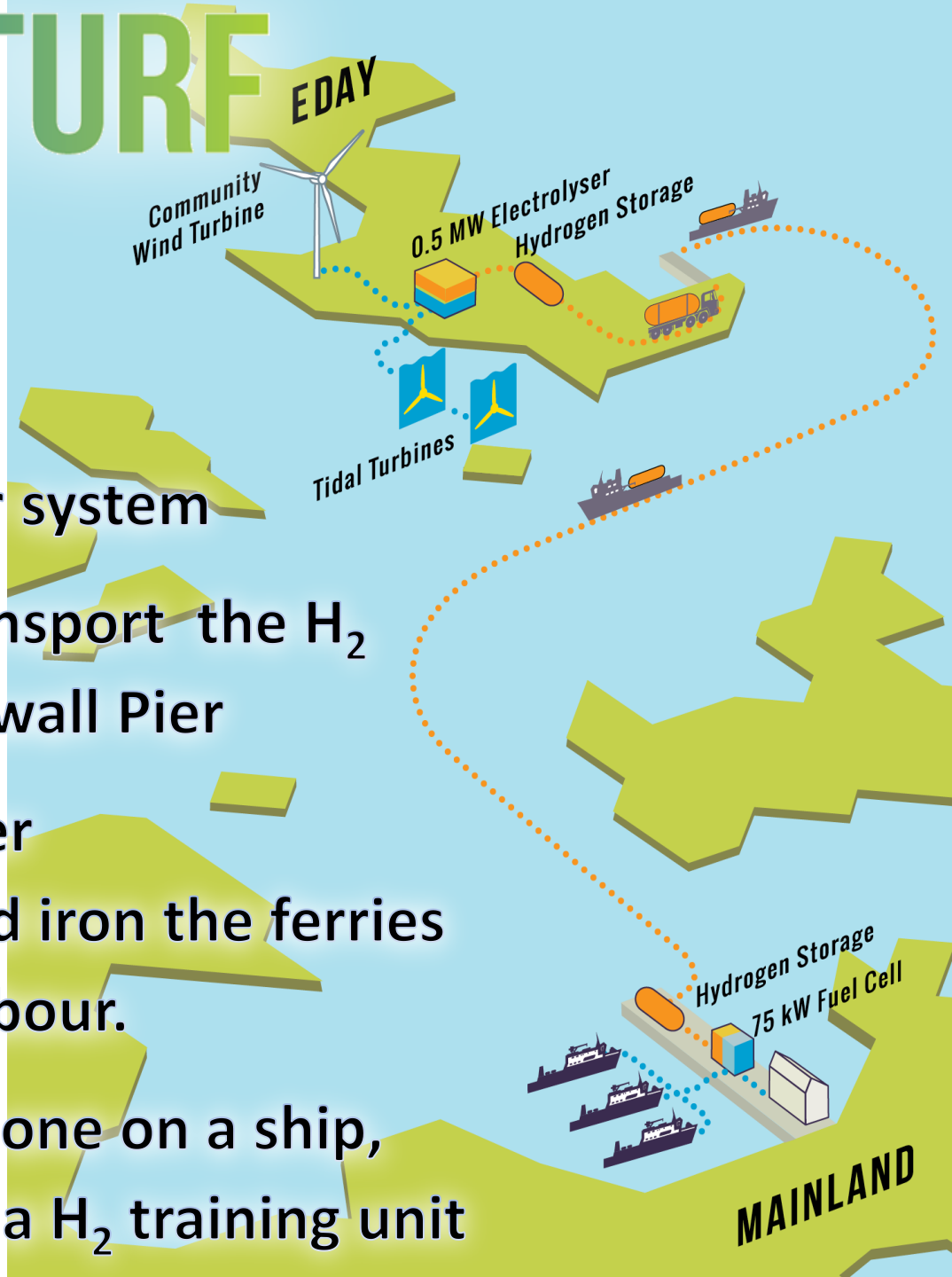
The Surf and Turf project – How we came together

- Eday's turbine is c.600m from EMEC
- Opportunity to combine Wind and Tide to supply the electrolyser
- EMEC need a clear practical demonstration of hydrogen use
- Council need to decarbonise their current and future ferry fleet
- Wish to lead the way for training for Marine H_2 handling
- Initially looked at auxiliary power and burning whilst underway
- Difficulties in maritime certification & approval in timescale

SURF 'N' TURF

What are we doing?

- Integrate the ERE wind to the EMEC electrolyser system
- Use mobile stores to transport the H_2 between EMEC and Kirkwall Pier
- Run a fuel cell on the Pier making electricity to cold iron the ferries and supply the local harbour.
- Adapt the FC so it is like one on a ship, then equip and run it as a H_2 training unit



SURF 'N' TURF

What will be its legacy?

- Put in place a self sustaining credible local H_2 supply chain/use
- A world first, integrating curtailed wind & tide for H_2 production
- Real relief from curtailment and extra funds for the community
- Strengthen EMEC's lead role in Eday, Scotland and worldwide
- Reduce local authority CO_2 emissions immediately
- Create a platform for increased local H_2 use and OIC investment
- A unique MCA backed UK facility for maritime H_2 training.
- BIG HIT/Dual Ports...

LOCAL ENERGY SCOTLAND

THE CHALLENGE FUND

Greener Scotland Scottish Government

LOCAL ENERGY SCOTLAND

THE CHALLENGE FUND

Greener Scotland
Scottish Government

BIG HIT: Underway

Objective:

- Expand the Surf n Turf model to include Shapinsay community turbine
- Use hydrogen for heating local public buildings
- Install a hydrogen refuelling station in Kirkwall
- 10 fuel cell vehicles

Partners

Participant organisation name	Country	Proposed Role
Fundacion Para El Desarrollo De Las Nuevas Tecnologias Del Hidrogeno En Aragon	Spain	Co-ordinator
ITM Power (Trading)	UK	Providing 1MW Electrolyser, refuelling station and system integration
Orkney Islands Council	UK	Land for refueller, vehicles for FC conversion, operating vehicles, schools for heating
Calvera Maquinaria E Instalaciones	Spain	Providing tube trailers
Shapinsay Development Trust	UK	Providing access to constrained wind energy and land for equipment
Community Energy Scotland	UK	Providing access to SnT equipment and organising H2 transportation
European Marine Energy Centre	UK	Providing access to 0.5MW electrolyser
Danmarks Tekniske Universitet	Denmark	Societal analysis
SYMBIO FCell	France	FC range extenders
Scottish Hydrogen and Fuel Cell Association	UK	Publicity, Dissemination and H2 Territories Platform
Giacomini S.p.A.	Italy	H2 boilers for 2x schools
Ministry for Transport and Infrastructure, Malta	Malta	Follower territory – observing what we do with a view to replicate

The BIG HIT Plan

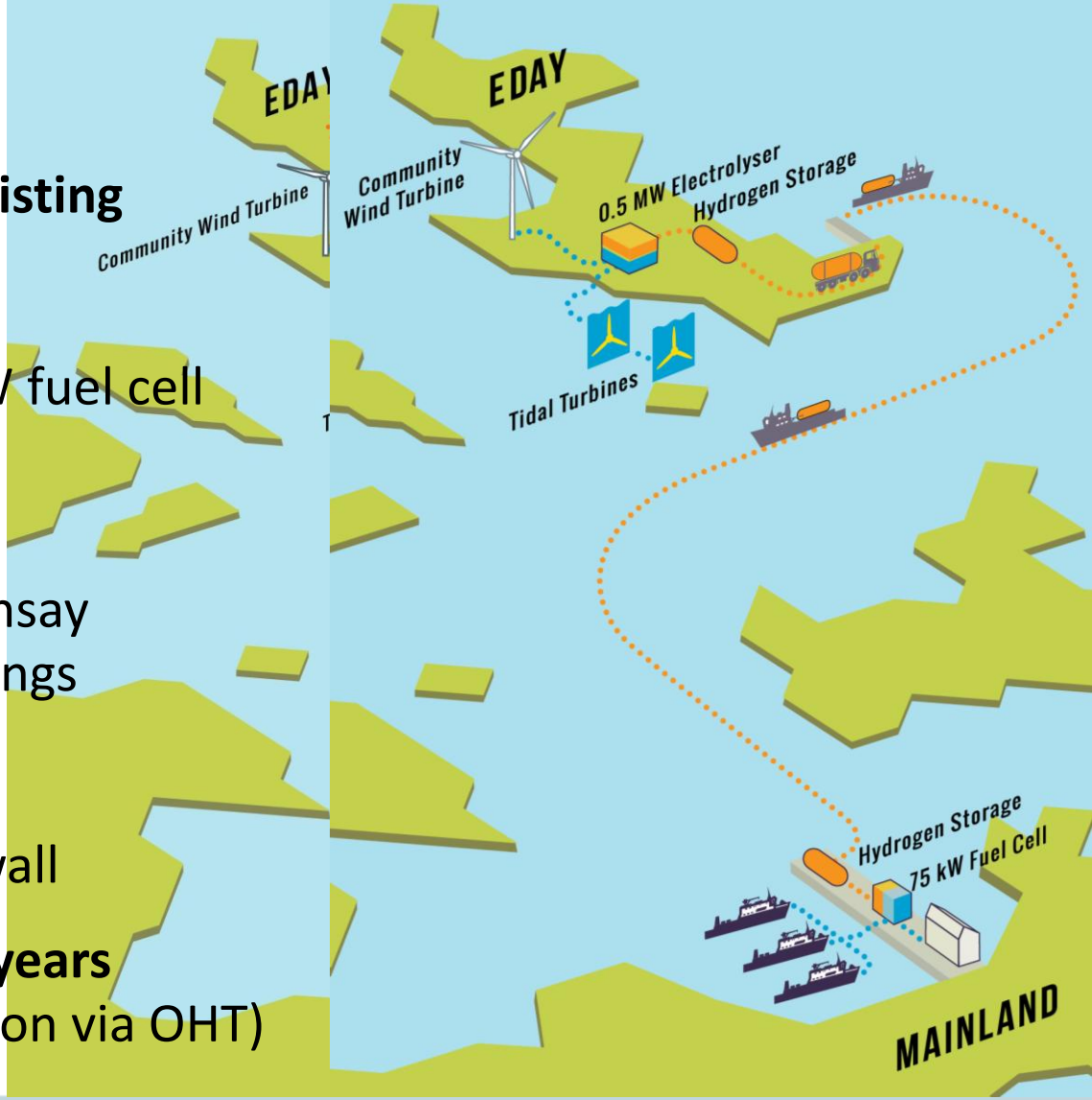
To include and expand upon existing H_2 infrastructure in Orkney

EMEC 0.5MW electrolyser,
CES's 3x tube trailers & 75kW fuel cell
powering Kirkwall harbour

To add:

1MW electrolyser on Shapinsay
H_2 heating for council buildings
2x tube trailers
H_2 refuelling station &
10 fuel cell vehicles in Kirkwall

EC-funded & operational for 4 years
(post-demo commercial operation via OHT)



Community Energy Scotland
Empowering Communities

ITM POWER
Energy Storage | Clean Fuel

Local Benefits

Funder	€ millions
Regional and National Funding	3.4
Partner funding	2.5
FCHJU	5.0
Total	**10.9**

- A flagship EU project with 12 partners from 6 countries bringing prestige to Orkney, and Scotland
- A €10.9m project, with €5m granted from the EU via FCH JU
- Bringing a projected €400k for FIT income to Shapinsay Development Trust
- Bringing €279k to partially offset the CES Surf n Turf loan
- Bringing resource to EMEC to help maintain their electrolyser, helping de-risk another flagship project
- Have large publicity benefits – Orkney will have more H_2 equipment than any other region in the UK
- Building an infrastructure (both physical and commercial) to allow smaller bolt-on projects in the future.

DUAL Ports: Underway

INTERREG Project

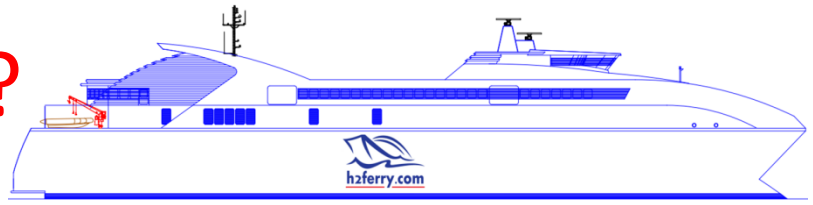
Objective:

- To allow the future refuelling of hydrogen ships

Achieved by:

- Designing the first hydrogen ‘bunkering’ facility (desktop based)
- Partnering with OIC and Orkney College
- Working with the Marine Coastguard Agency to ensure their new regulations are in line with design

HySeas Projects: Ongoing?



Objective:

- Two projects investigating the feasibility and design of an H_2 ferry complete
- Also the overall vessel design complete and two diesel-electric hybrid vessels now built and in service as ferries in Scotland
- Applied for funding for "string test" to test H_2 and propulsion systems together
- Will be seeking funding for including in new ferries
- We are keen to bring to Orkney – have infrastructure and suitable waters and routes

BAE SYSTEMS

Imtech

University of St Andrews

Logan Energy

BALLARD

PUTTING FUEL CELLS TO WORK

CMAL

Caledonian Maritime Assets Ltd

Stòras Mara Caileannach Eta

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ITM POWER

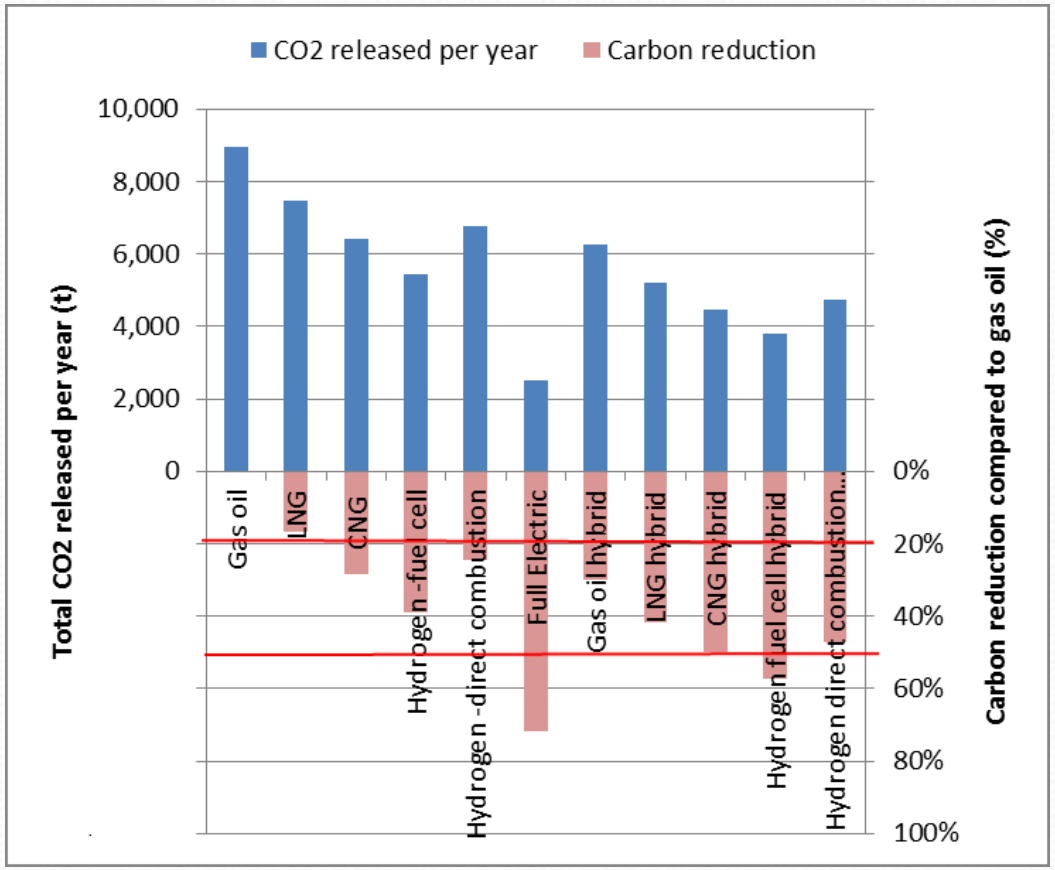
Energy Storage | Clean Fuel

LOW CARBON FERRIES FEASIBILITY STUDY
Part 2 Analysis
Report to Orkney Islands Council

LOCAL ENERGY SCOTLAND

ORKNEY ISLANDS COUNCIL

ORKNEY ISLANDS COUNCIL
Marine Services
HARBOUR AUTHORITY • TOWAGE SERVICES • FERRY SERVICES



PITCHES (Powering Isolated Territories with Hydrogen Energy Systems): Provisionally funded

- Innovate UK – Energy Catalyst funding
- Building on BIG HIT and ongoing Orkney Hydrogen activities
- Look to support additional activity, data gathering and analysis of operation of the funded Orkney Hydrogen systems to allow transfer of learning on the economic and practical realities of deploying such systems in remote or off-grid communities
- Proposing to partner with Community Energy Malawi
- Begins later this year

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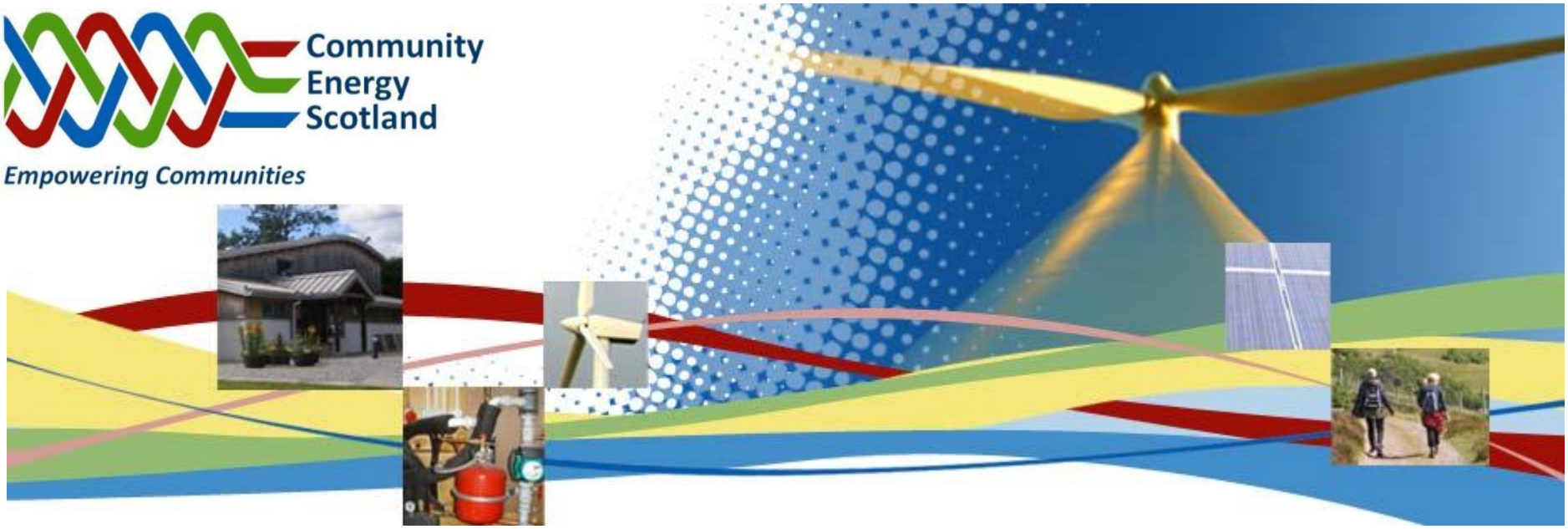

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SURF 'N' TURF

What will it achieve?

- Research integrating tidal & wind generation for H_2 production
- Optimise electricity inputs to match both curtailment patterns
- Develop production and transport to fit Pier use and infrastructure limits
- Optimise FC to increase electricity value
- UK certification/approval for H_2 training