



**FUEL CELLS AND HYDROGEN**  
JOINT UNDERTAKING

# Building Innovative Green Hydrogen Systems in Isolated Territories: a Pilot for Europe – BIG HIT



**Dr Enrique Troncoso, Jesus Simon**

**Aragon Hydrogen Foundation**

[www.bighit.eu](http://www.bighit.eu)

Project coordinators:

[etroncoso@systemgconsulting.co.uk](mailto:etroncoso@systemgconsulting.co.uk)

[jsimon@hidrogenoaragon.org](mailto:jsimon@hidrogenoaragon.org)

**Programme Review Days 2018**

Brussels, 14-15 November 2018

# CONTENT



- Project Overview & Summary
- Project Status / Progress
- Communication & Dissemination





# PROJECT OVERVIEW



- Call year: [JTI-FCH-2015]
- Call topic: Hydrogen Territories, H2020-JTI-FCH-2015/H2020-JTI-FCH-2015-1
- Project dates: 2016-2021
- % stage of implementation 01/11/2018: [60%]
- Total project budget: [circa. 13m€]
- FCH JU max. contribution: [5m€]
- Other financial contribution: [circa. 8m€]
- Partners: [Aragon Hydrogen Foundation, ITM Power Ltd, Orkney Islands Council, Calvera SL, Community Energy Scotland, Shapinsay Development Trust, European Marine Energy Centre Ltd, Danmarks Tekniske Universitet, Symbio Fcell SA, Giacomini SPA, Scottish Hydrogen & Fuel Cell Association Ltd, Malta Ministry for Transport & Infrastructure]



# PROJECT OBJECTIVES

## BIG HIT - Building Innovative Green Hydrogen Systems in Isolated Territories: a Pilot for Europe

1. *The Demonstration of Orkney as a Hydrogen Territory*
2. *Contribution to FCH 2 JU MAWP (multi-annual work plan) targets*
3. *Demonstrating replicable hydrogen economy solutions*
  - Possibility to export results to other isolated locations (lessons learnt & best practices)
4. *Delivering the Local Authority's Orkney Hydrogen Economic Strategy*
  - Conversion of 2.7 GWh/year of curtailed RE (wind & tidal) to H<sub>2</sub>
  - Methodology to produce, store & transport hydrogen across islands (ferries)
5. *Environmental improvements*
  - Reduction of GHG emissions: 330 t pa CO<sub>2</sub> equivalent
6. *Bringing Economic Benefits to Island Communities (savings and new jobs)*
7. *Improve Local Knowledge & Public Acceptance of Hydrogen*

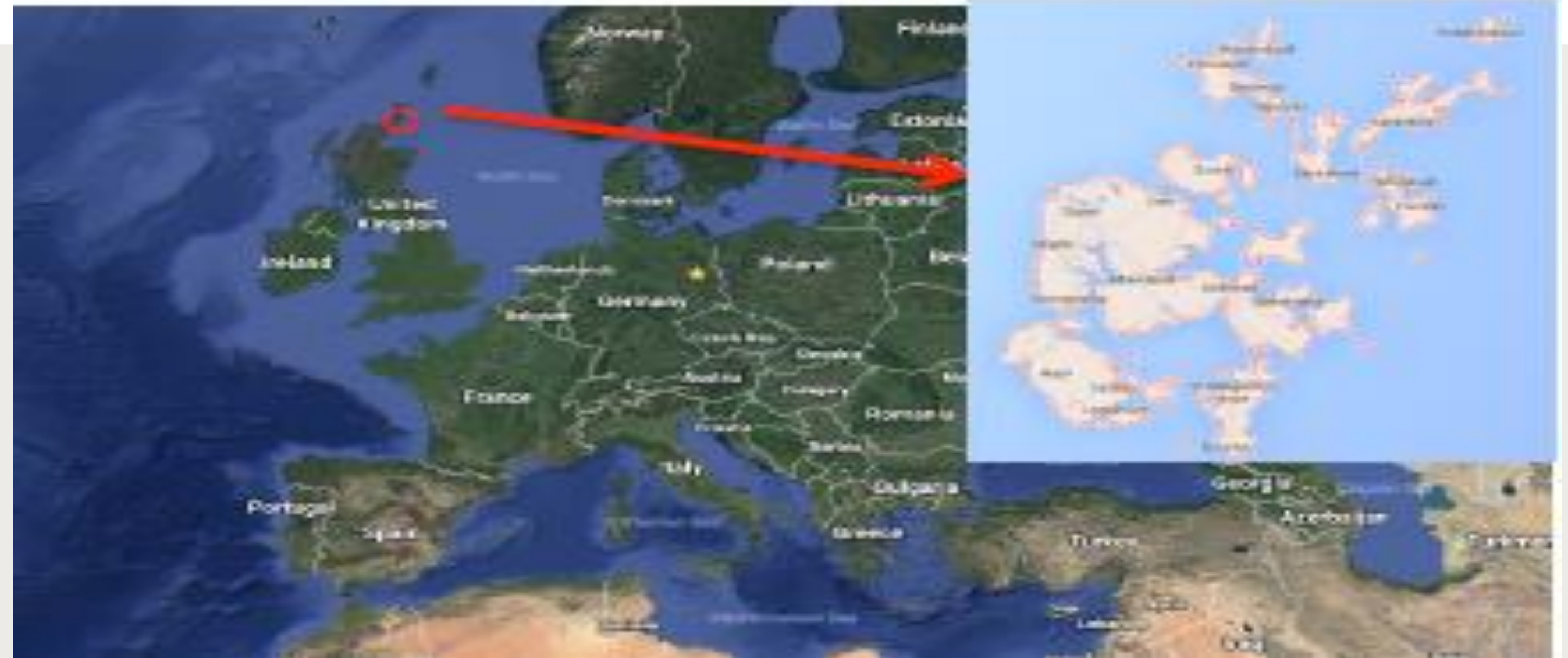


# PROJECT RATIONALE



## Orkney Islands:

- 20 inhabited islands. Population: circa. 21 000
- 58 MW of RES (11MW wave/tidal + 47MW wind)
- Orkney-UK interconnector 30MW capacity



Electricity grid overloaded (> 100% of demand from RES) = Significant curtailment



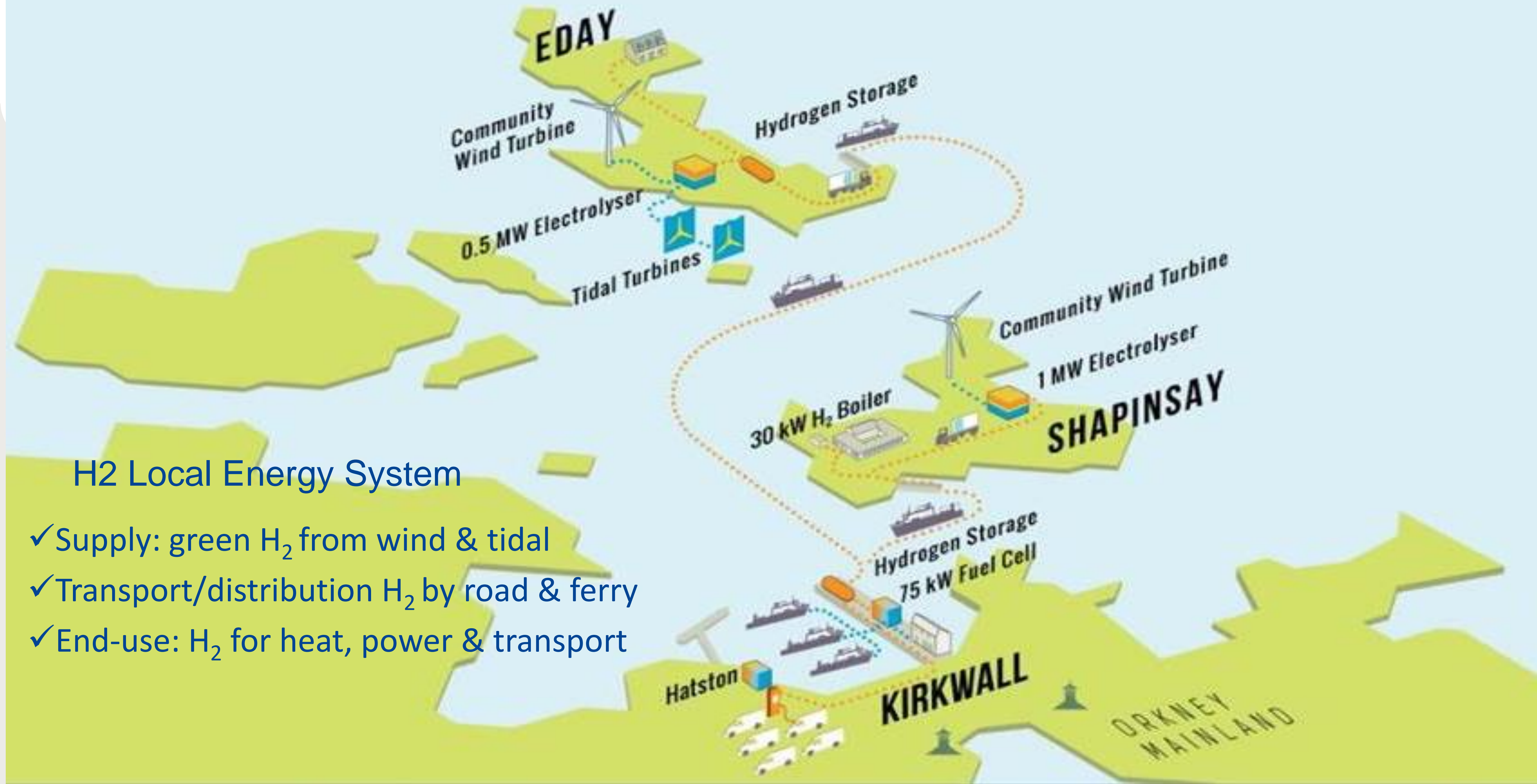
**Transition to low C economy, meeting electricity, transport and heat via hydrogen**





## H2 Local Energy System

- ✓ Supply: green H<sub>2</sub> from wind & tidal
- ✓ Transport/distribution H<sub>2</sub> by road & ferry
- ✓ End-use: H<sub>2</sub> for heat, power & transport



# IMPACTS & GLOBAL POSITIONING



- Pioneer pilot project – first in Europe as validated by EC (visibility, exposure & public awareness of potential of H2 as energy vector)
- Validates commercial/ownership models for integration of RES locally via local hydrogen (H2 Valleys case study)
- Delivery of local & national Low C Economic Strategy
- Boosts local economy including development of local skills & qualified jobs in emerging technologies
- Overcomes grid constraints and harness local (otherwise curtailed) renewable resources (wind & marine)
- Reduces (grid) investment & improves load management (optimizes use of electricity assets and local grid)

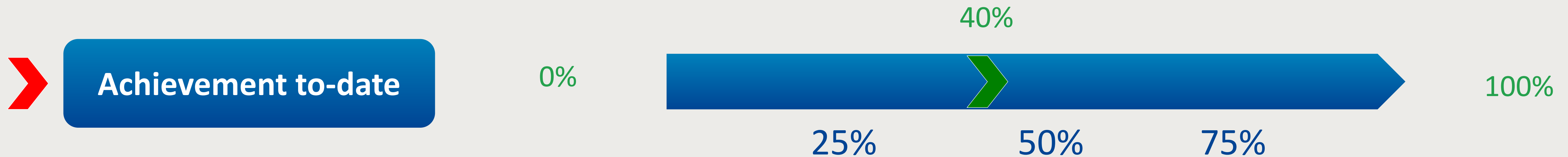




# PROJECT PROGRESS/ACTIONS – Orkney Islands as Hydrogen Territory



Status at month 28 of a 60 months project at date 01/11/2018



- Commissioned first H2 production site - Green H2 being produced from tidal & wind electricity locally
- Five FC-RE vehicles operating in Orkney – refilled with local green hydrogen
- CHP unit at the harbour commissioned and providing on-shore power to ferries (local green hydrogen)
- Logistics model (v1 completed) – transport & distribution of hydrogen across Orkney Islands
- Trials on ferries transporting H2 Trailers completed on one route (operational)
- ADR & Maritime certification of H2 trailers – new legislation/IMDG standards created!



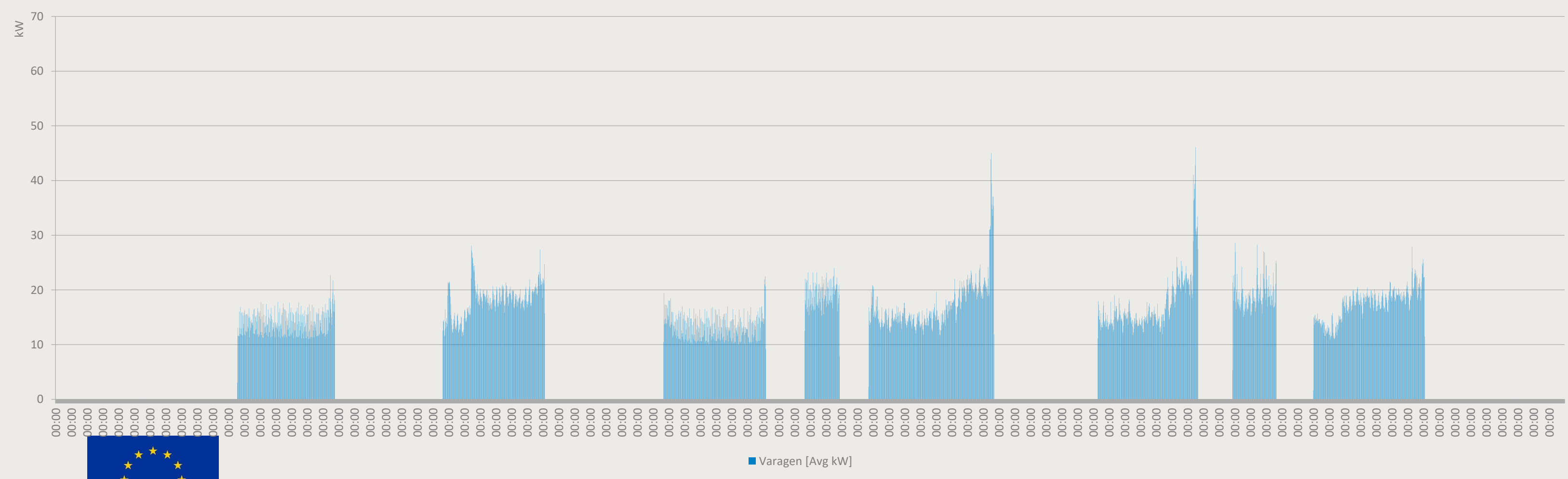
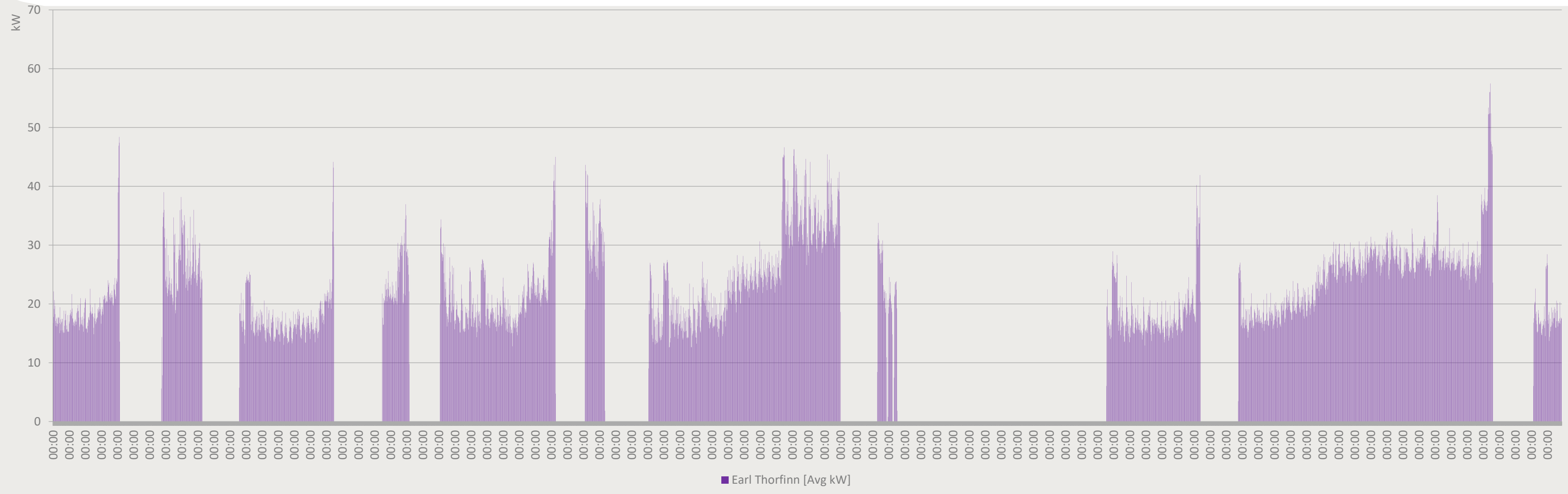


# PROJECT PROGRESS – Orkney Islands as Hydrogen Territory





# Deployment - On-shore power: 2 x 15-50kW to ferries when at pier (FC load)





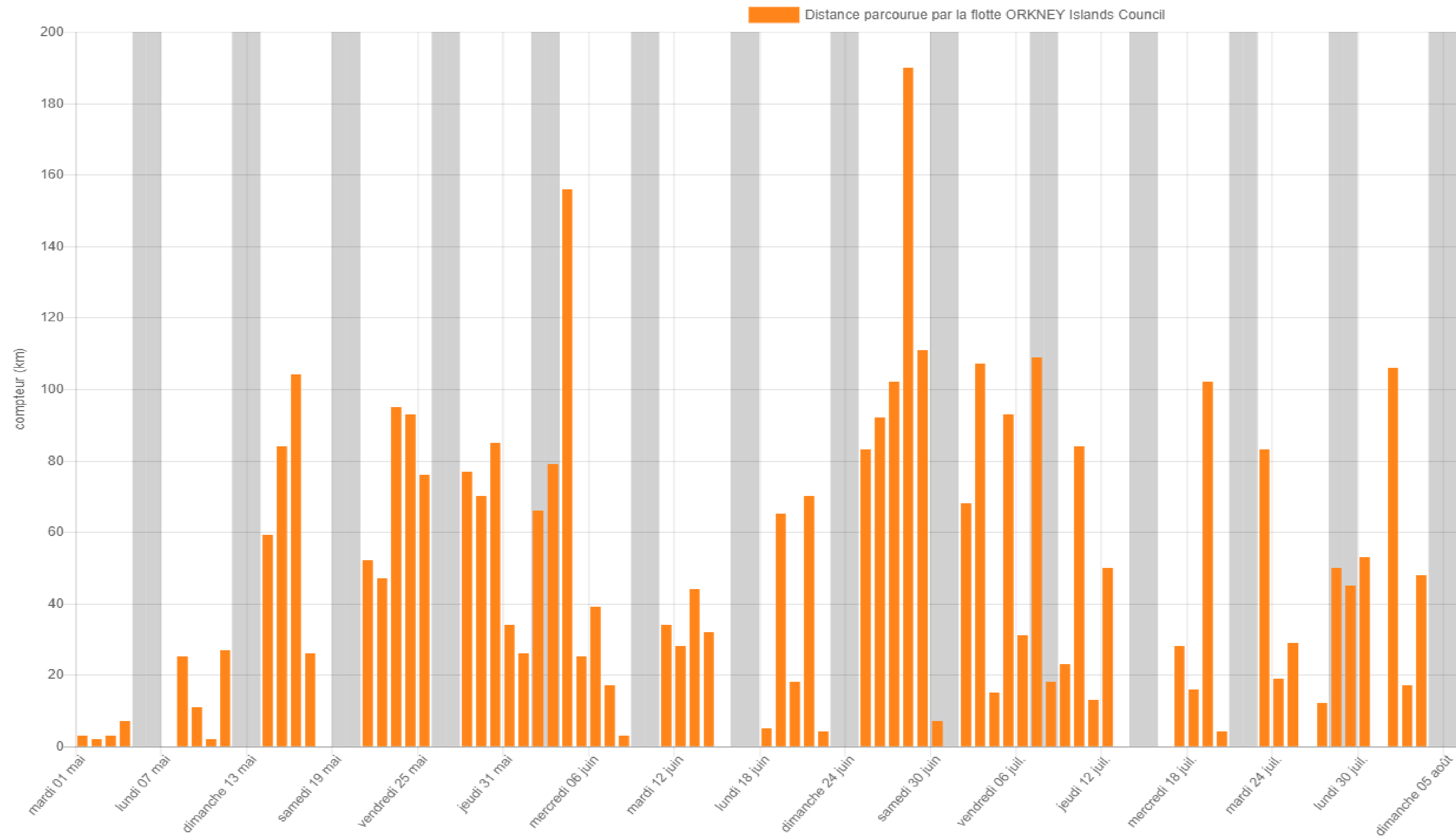
# Deployment - FC-RE vans mileage (3 months)



Distance (km) durant la période

Cumulée

Par jour



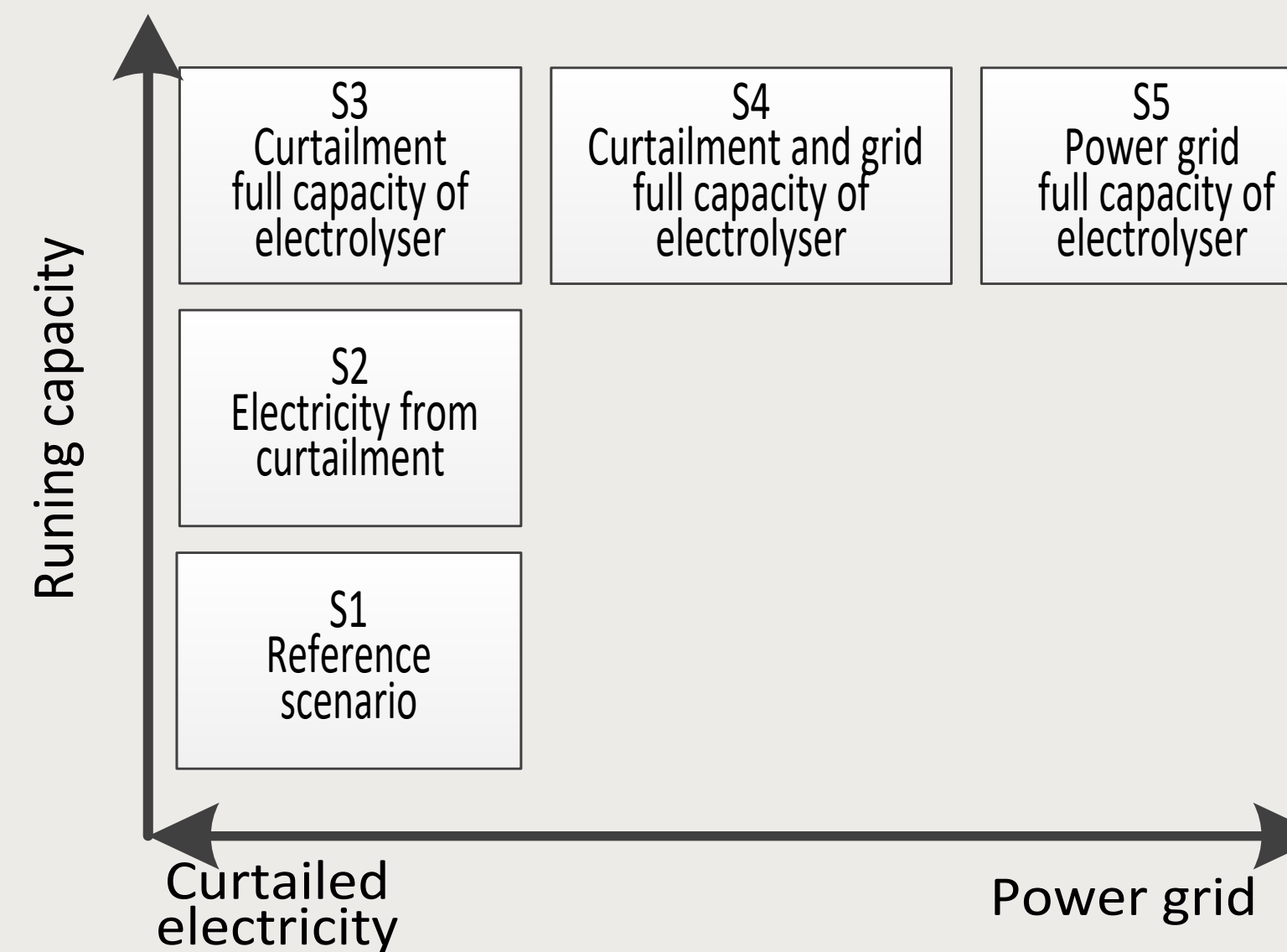
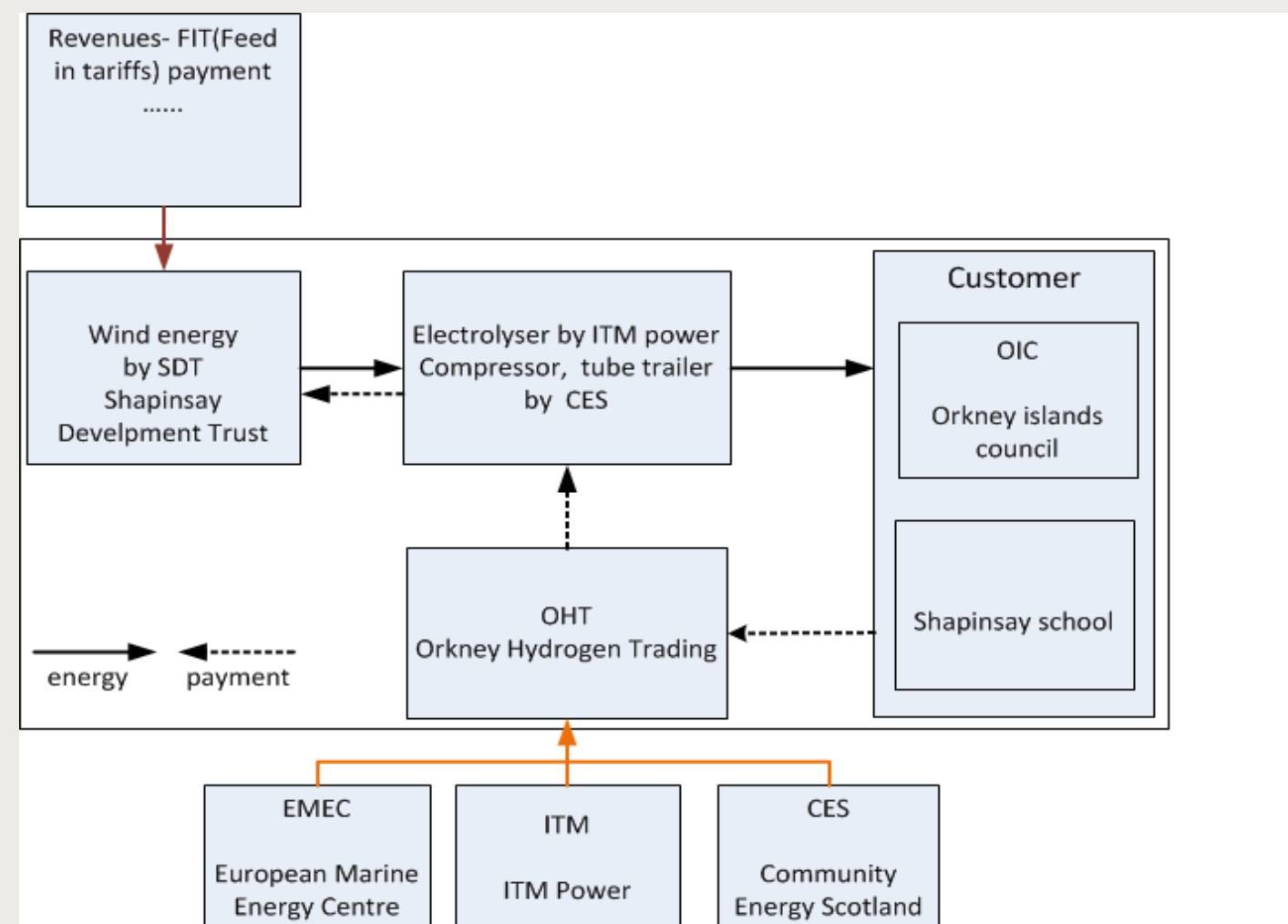
# PROJECT PROGRESS/ACTIONS – Impact: socio-economic & business models



Status at month 28 of a 60 months project at date 01/11/2018



## Commercial & business models (added value!)



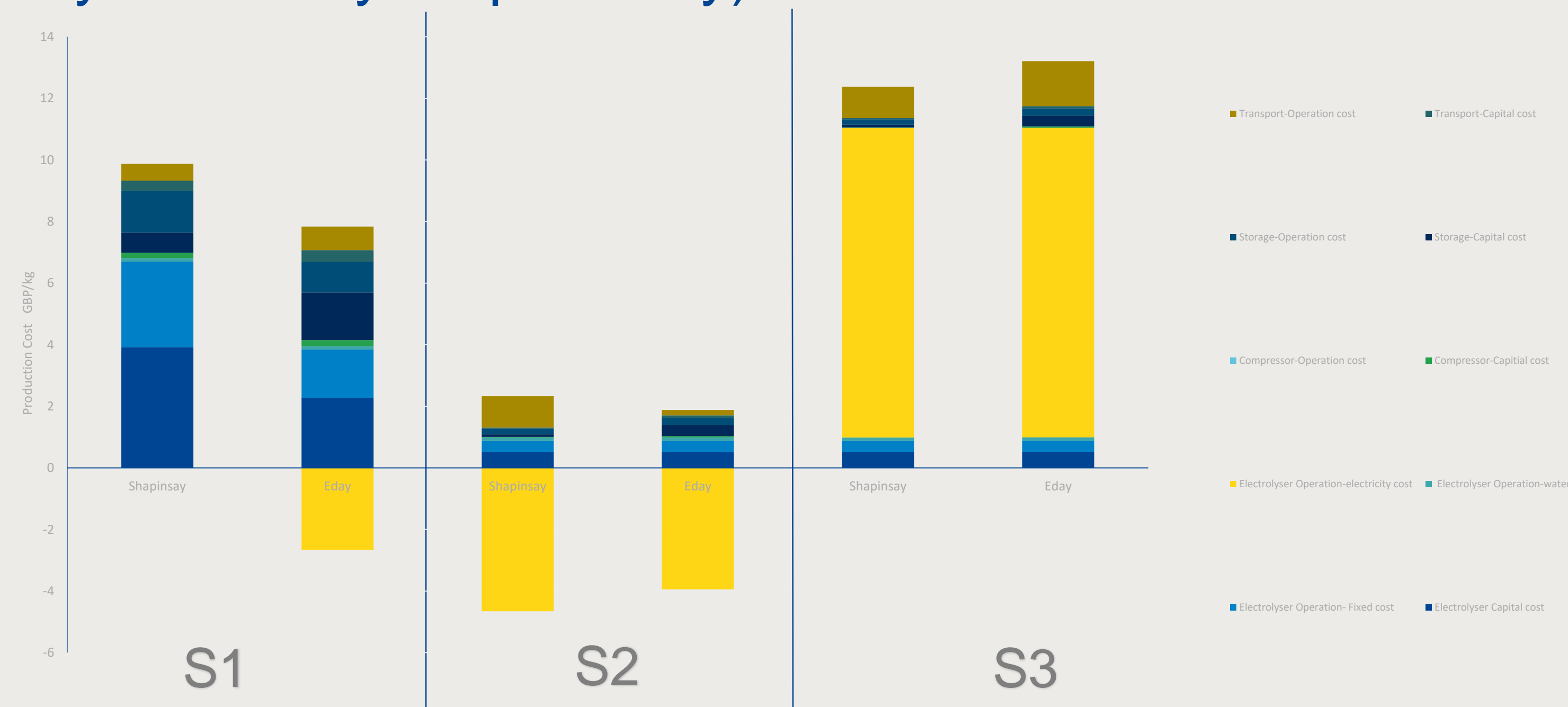
| Hydrogen production (ton/year) |      |
|--------------------------------|------|
| Shapinsay                      | Eday |
| 124                            | 62   |
| 26                             | 14   |
| 16                             | 14   |





- Electricity cost is the key parameter for hydrogen production costs
- The cost of producing 1 kg of green hydrogen in Orkney is currently estimated at between £5.17-9.87 £ (Isles Shapinsay and Eday respectively)

- Under S1 the largest cost of hydrogen production comes from electrolysis & storage CAPEX
- Possible to produce hydrogen at 2.5-3€ /kg under optimized conditions (S2)



# Risks and Challenges



- Financial (demo)– contingency needed
- Technical (demo): complex SE&I - contingency
- Complex operation & logistics (pioneer project)
- Management of stakeholder expectations
- Community perception (communication is key)

## Updated Risk Register

| 702092 (BIG HT) FCH-IA         |  |            |                |              |             |               |            |            |        |                |
|--------------------------------|--|------------|----------------|--------------|-------------|---------------|------------|------------|--------|----------------|
| HORIZON 2020                   |  |            |                |              |             |               |            |            |        |                |
| Call: H2020-JT-FCH-2015        |  |            |                |              |             |               |            |            |        |                |
| Topic: FCH-01.2-2015 Unit: FCH |  |            |                |              |             |               |            |            |        |                |
| Summary for publication        | Deliverables, Ethics, EMP, Other Reports | Milestones | Critical Risks | Publications | Disseminat. | Patents (IPR) | Innovation | SME Impact | Gender | ABS Regulation |
| ✓                              | i  | i          | ✓              | ✓            | ✓           | ✓             | ✓          | ✓          | ✓      | i              |

| Critical Risks           |  |                  |   |  |   |                                     |                            |         |  |
|--------------------------|--|------------------|---|--|---|-------------------------------------|----------------------------|---------|--|
| Foreseen Risks (Annex-I) |  |                  |   |  |   |                                     |                            |         |  |
| Number                   | Description  | Work Package No. | Risk Mitigation Measures  | State of the Play Reference Reporting Period | State of the Play Mitigation Measures Applied | State of the Play Risk Materialized | State of the Play Comments | Actions |  |
| 1                        | The catalytic boilers only output -50C heat, which is insufficient for space heating v   | 3                | The boilers will be used as a pre-heat, and the existing diesel boilers will be user to   | 1  | No  | Yes                                 |                            | X       |  |
| 2                        | Electrolyser unable to cope with direct connection to wind turbine                       | 3                | PEM technology is more suited to time varying input than alkaline. A grid connection      | 1  | No  | No                                  |                            | X       |  |
| 3                        | A failure of the hydrogen supply chain will result in a lack of heating in 2 schools, ha | 4                | The schools will retain their existing diesel boilers and the harbour will keep its exist | 1  | No  | No                                  |                            | X       |  |
| 4                        | Hydrogen production varies seasonally in response to the availability of curtailed win   | 4                | The inclusion of the tidal turbines helps smooth the seasonal wind variability The des    | 1  | No  | No                                  |                            | X       |  |



| Unforeseen Risks |                         |  |                  |  |  |   |                                     |                            |         |
|------------------|-------------------------|--|------------------|--|--|---|-------------------------------------|----------------------------|---------|
| Number           | Date the Risk was added | Description  | Work Package No. | Risk Mitigation Measures   | State of the Play Reference Reporting Period | State of the Play Mitigation Measures Applied | State of the Play Risk Materialized | State of the Play Comments | Actions |
| U1               | 29 Jun 2017             | High cost of the civil works in an isolated territory like the Orkney islands  | 3                | FHA as coordinator, with the support of the UK partners, is seeking for additio    | 2  | Yes   | Yes                                 |                            | X       |
| U2               | 29 Jun 2017             | 5 units of the RE-FCEV (H2 vans from SymbioFC) already in Orkney but without 1 | 3                | The FC can be damaged if the H2 tank is empty for months, not being able to s      | 2  | Yes   | Yes                                 |                            | X       |
| U3               | 03 Sep 2018             | Water connection in the hydrogen production site in Shapinsay not available in |                  | Use water bring to the place using different sources to maintain the electrolyz    | 2  | Yes   | Yes                                 |                            | X       |
| U4               | 03 Sep 2018             | Safety Review of the Shapinsay school takes longer than planned adding delay   |                  | Safety will be the first priority always in the project. To avoid delays or safety | 2  | Yes   | Yes                                 |                            | X       |
| U5               | 03 Sep 2018             | Inclusion of contingency plan and updated risk register                        |                  | The project Management/Implementation Risk Analysis & Contingency Plan ha          | 2  | No  | No                                  |                            | X       |





# Communications Activities



- Website operational – regularly updated as project progresses ([www.bighit.eu](http://www.bighit.eu))
- Presence on LinkedIn, Twitter  
- Two press releases in 2018
- [Video](#) & project schematic - key communication tools
- Active communication with EC/FCH JU, Scottish Government and key EU stakeholders

## Orkney Islands selected for €10.9 million EU 'BIG HIT' project

Building Innovative Green Hydrogen systems in an Isolated Territory: a pilot for Europe (BIG HIT)

11<sup>th</sup> May 2016

The Orkney Islands of Scotland have been chosen for the development of a new European-wide hydrogen project, building on the existing Orkney Surf 'n' Turf initiative. This wider European project is called BIG HIT (Building Innovative Green Hydrogen systems in an Isolated Territory: a pilot for Europe). BIG HIT is a five-year project, involving 12 participants based across six EU countries, and starts in May 2016.

The local authority partner in BIG HIT is Orkney Islands Council, providing local input together with the Shapinsay Development Trust (SDT), Community Energy Scotland (CES), and the European Marine Energy Centre (EMEC). Calvera, Giacomini, ITM Power, and Symbio FCell are the industry partners providing equipment and technical expertise. Technical University of Denmark (DTU) is the technical partner and the Scottish Hydrogen & Fuel Cell Association (SHFCA) is dissemination partner. The Ministry for Transport and Infrastructure (MTI) represents Malta as the lead follower territory for project replication. The overall BIG HIT project coordinator is Fundación Hidrógeno Aragón (FHA, The Foundation for the Development of New Hydrogen Technologies in Aragón).

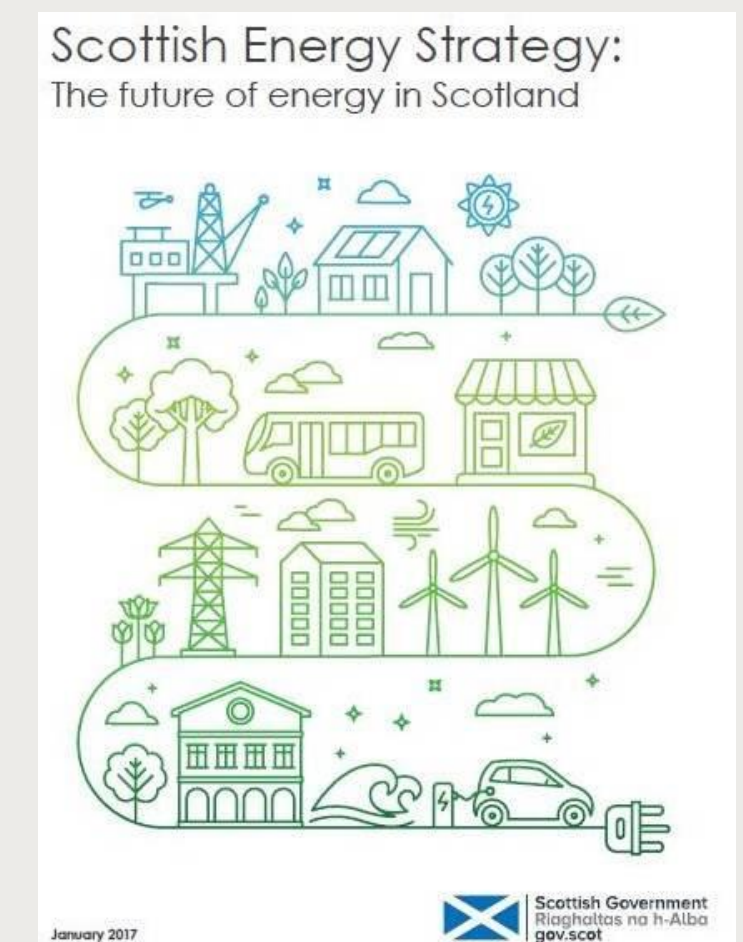




# Dissemination Activities



- Three workshops organized by the project and project presentations at >20 events so far (EU High-Level Energy Conference, Linz, 17/09/18)
- 3 scientific papers and 1 MSc dissertation (Heriot-Watt University)
- Public deliverables – (available on the website)
- Collaboration through DTU (as part of WP5) with University of Groningen and Heriot-Watt University
- Hydrogen Territories Platform (HTP)





# Dissemination Activities – Hydrogen Territories Platform (HTP)



- Scope: exchange of information to exploit replication possibilities of the BIG HIT platform to other remote regions/territories
- Members' benefits – access to:
  - Key project deliverables, key conclusions & best practices
  - Methodology & recommendations for project replication
- Members' role: feedback on replication methodology (data for development/validation)
- First results:
  - Outreach dissemination and engagement with interested regions: Malta (BIG HIT follower partner), Norway, Quebec, Northern NL, Germany-HYPHOS,
  - Preliminary business models and S-LCA socio-economic assessments completed
  - Development of HTP online structure and replication methodology ongoing







Contact:

Project coordination:  
Dr Enrique Troncoso  
[etroncoso@systemconsulting.co.](mailto:etroncoso@systemconsulting.co.uk)

uk

Jesus Simon  
[jsimon@hidrogenoaragon.org](mailto:jsimon@hidrogenoaragon.org)

Dissemination & communication:

Dr Nigel Holmes  
[Nigel.holmes@shfca.org.uk](mailto:Nigel.holmes@shfca.org.uk)



# OPTIONAL SLIDES



You can use any of the following slides and insert them inside the presentation, otherwise please delete them.



# Deployment - Ferries & H2 transport logistics

- Weather in Orkney
- Ferry timetables
- Potential disruptions
- Other passengers and bookings (life line service for islanders)
- Other vehicles (including dangerous goods)
- Ferry refit period (Jan-Mar)
- Charter mode for crew familiarisation, training and safe operations
- 3m exclusion zones?



|   |
|---|
| <b>Wednesday 1st of May - Sparsay-Eday Disruption</b> 14:00:00 - 17:00:00<br>Due to weather conditions the ferry service between Sparsay and Eday will be suspended on Wednesday 1st May. All bookings for this date will be cancelled. We apologise for any inconvenience caused.<br>Read More |
| <b>Fritha Loch - Sunday 20 May 2016</b> 15:00:00 - 16:30:00<br>The ferry to Fritha Loch will be suspended on Sunday 20 May. All bookings for this date will be cancelled. We apologise for any inconvenience caused.<br>Read More   |
| <b>May Half Marathon - Saturday 17 June 2016</b> 15:00:00 - 16:30:00<br>The ferry to Orkney will be suspended on Saturday 17 June. All bookings for this date will be cancelled. We apologise for any inconvenience caused.<br>Read More  |
| <b>Inter-Islands Sports - Saturday 18 June 2016 - in Orkney</b> 15:00:00 - 16:30:00<br>The ferry to Orkney will be suspended on Saturday 18 June. All bookings for this date will be cancelled. We apologise for any inconvenience caused.<br>Read More   |

| Route       | Day       | Time  | Status | Notes |
|-------------|-----------|-------|--------|-------|
| Orkney Main | Monday    | 07:00 | Active |       |
| Orkney Main | Tuesday   | 07:00 | Active |       |
| Orkney Main | Wednesday | 07:00 | Active |       |
| Orkney Main | Thursday  | 07:00 | Active |       |
| Orkney Main | Friday    | 07:00 | Active |       |
| Orkney Main | Saturday  | 07:00 | Active |       |
| Orkney Main | Sunday    | 07:00 | Active |       |
| Orkney Main | Monday    | 14:00 | Active |       |
| Orkney Main | Tuesday   | 14:00 | Active |       |
| Orkney Main | Wednesday | 14:00 | Active |       |
| Orkney Main | Thursday  | 14:00 | Active |       |
| Orkney Main | Friday    | 14:00 | Active |       |
| Orkney Main | Saturday  | 14:00 | Active |       |
| Orkney Main | Sunday    | 14:00 | Active |       |



# Ferries & H2 transport logistics – Training & crew familiarization





- Project development
- Co-funding complexity
- Adequate budget & contingency
- Management of community expectations (don't overpromise!)
- Consider local & national strategy/policy background



- Project delivery
- Financial flexibility (prioritize)
- Technical complexity (flexible timescales)
- Account for complexity of logistics & impact on local community
- Management of stakeholders & public perception

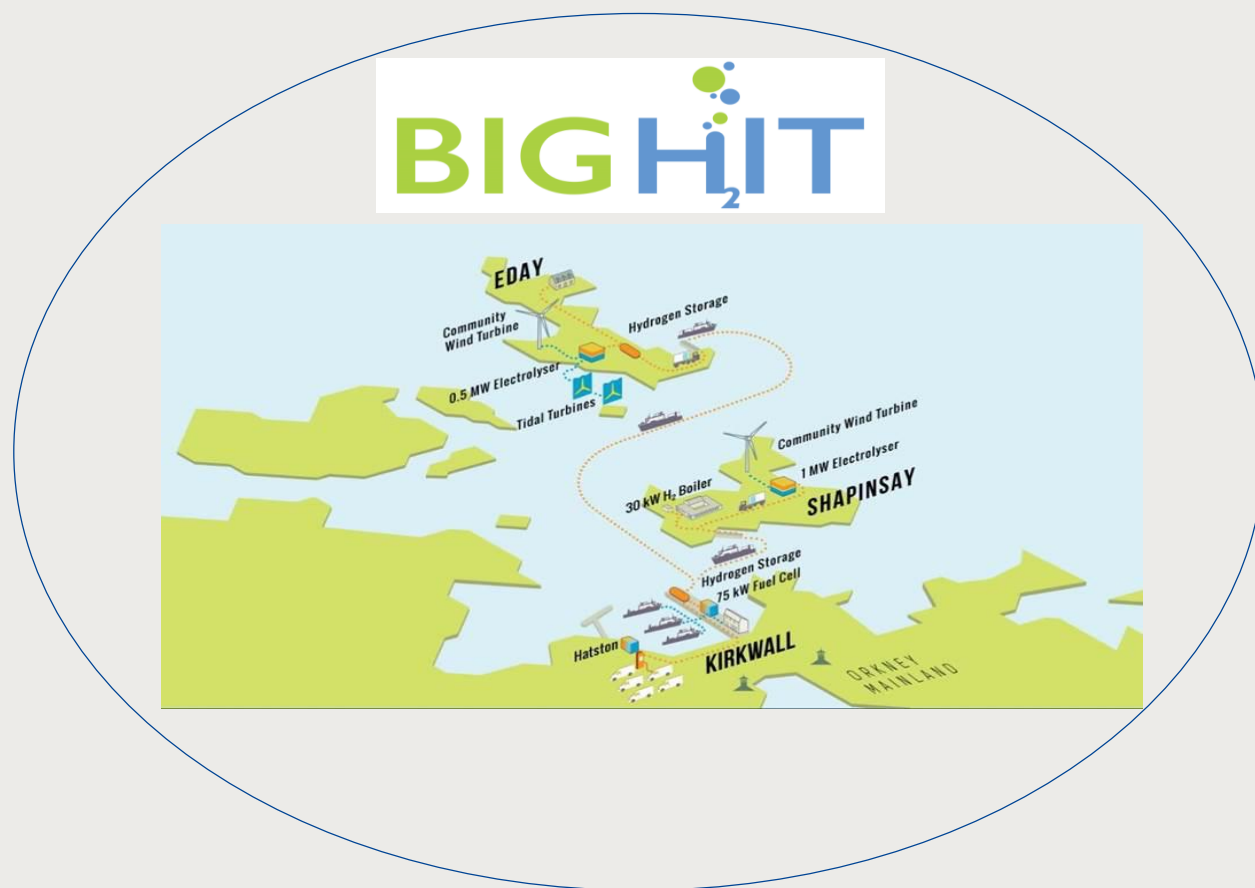
**CHALLENGING BUT**

**POSSIBLE, HAPPENING AND REPLICABLE!**



- 2018: > 40m€ investment in place for hydrogen deployment in Orkney
- Next: replication/co-operation with other EU regions

## H2 Local Energy System



H2 Ferries (H2020 co-funded HYSEAS III Project)

Grid load management (Interreg ITEG Project)

FCH deployment at port/harbour (port equipment, onshore power)

Industrial H2/O2 applications (ammonia, fish farm)

Mobility: HDVs, mini-buses and agricultural vehicles

Commercial & domestic/community heating