REVIVE

REVIVE Project Overview

HECTOR Final Event

31/10/2023

A project co-funded by
under the Grant Agreement n.779589

Clean Hydrogen Partnership

Co-funded by the European Union

Project Summary

Revive will accelerate the development of hydrogen fueled refuse trucks in Europe

Key objectives:

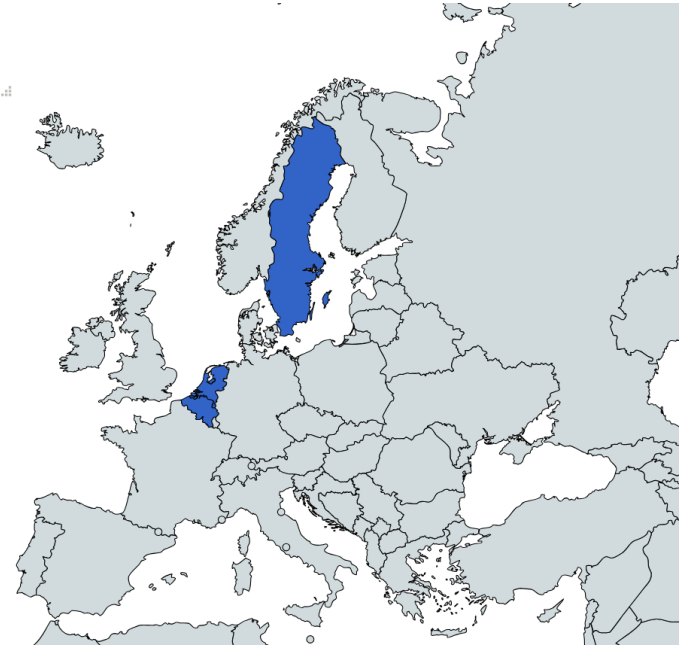
- Develop a high-performance fuel cell refuse truck
- Deployment of 15 trucks
- At least 24 months of demonstration in their operating environment
- Raise the profile of the FC technology as a viable option for waste collection
- Analyze the future business models for zero emission waste collection using hydrogen produced from waste sources through a dedicated ‘Waste-to-Wheel’ study

Project Summary

Members of the REVIVE Consortium

Vehicle operator	Manufacturers	Experts
Prezero Netherlands City of Groningen City of Noordenveld City of Breda City of Antwerp Renova (Götenburg)	E-trucks Europe Proton Motor PowerCell	Tractebel Engie CEA WaterstofNet ERM/Element Energy

Deployment sites



Progress/Actions – Truck Construction

Construction phase

7 → 11

100%

- 11 trucks completed the construction phase
  - Breda (2)
  - PreZero (2)
  - Renova (1)
  - Antwerpen (2)
  - Groningen (3)
  - Noordenveld (1)
- 4 trucks are in the final stages of certification

- Delays in construction due to:
  - Delayed ordering
  - Supply chain issues (covid-19, current geopolitical situation)
  - Ongoing technological development
  - Additional scrutiny for certification



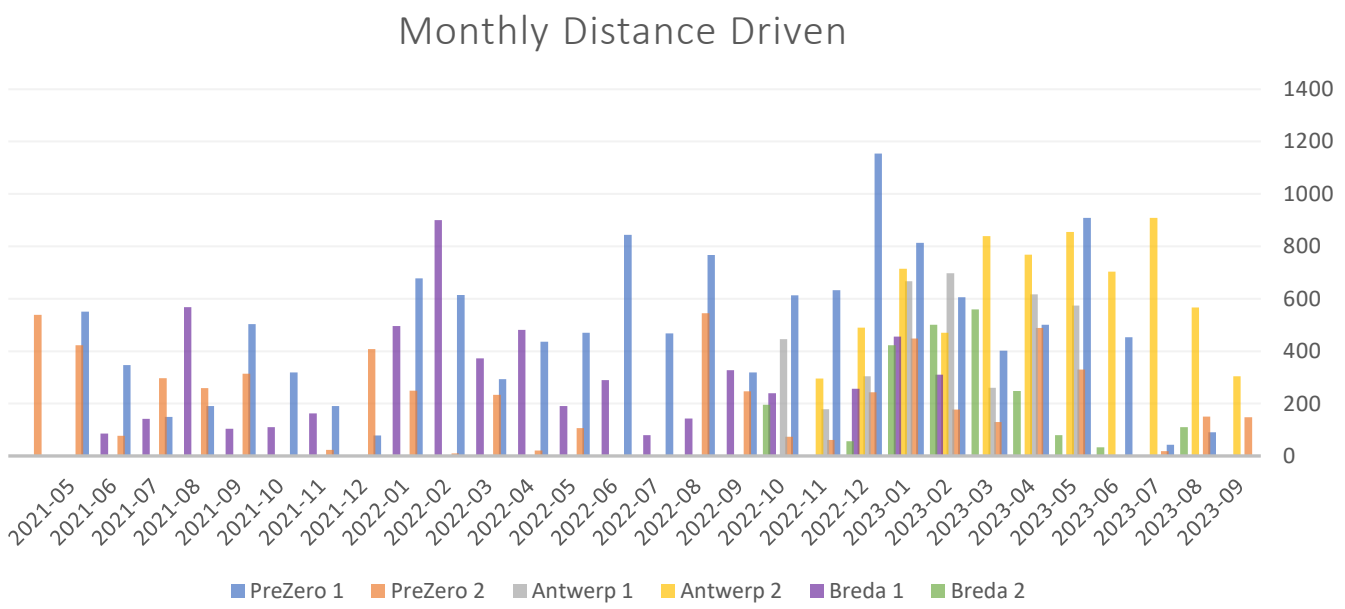



Groningen truck under construction at E-trucks Europe Lommel

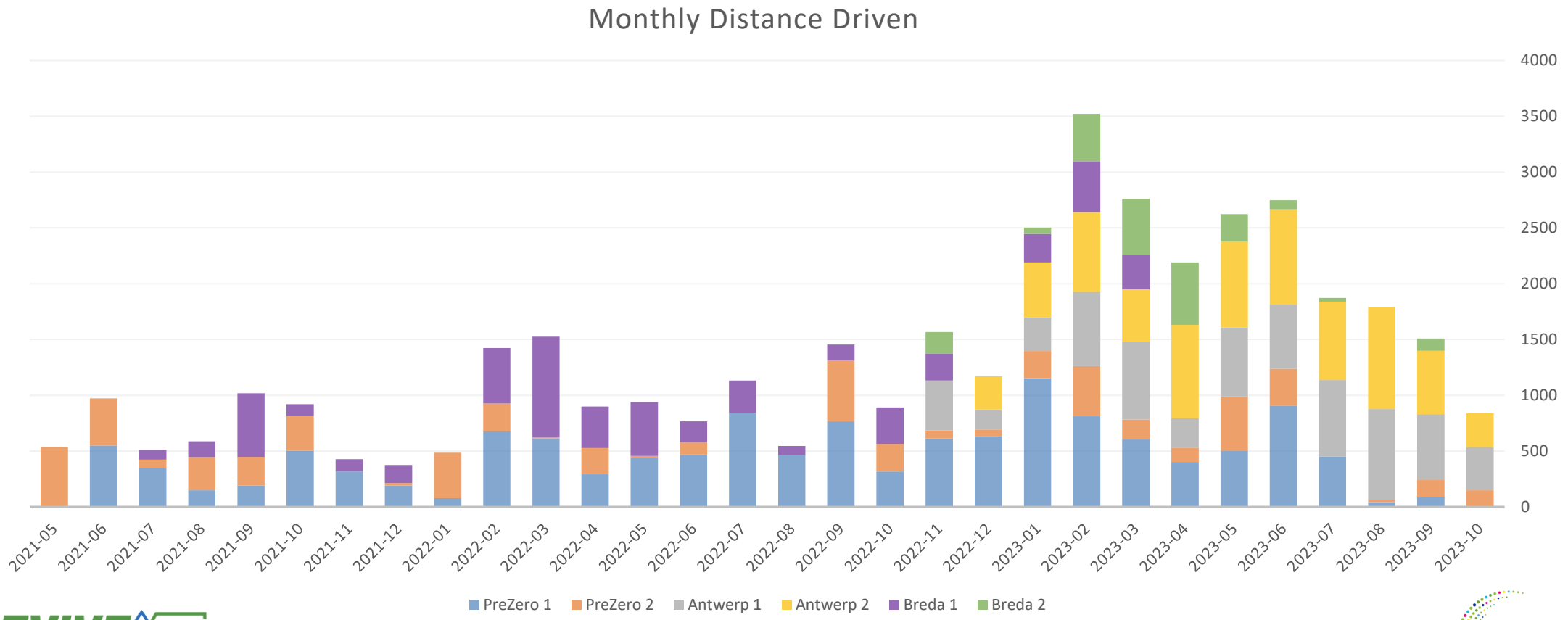
Operational Data from REVIVE (1/2)

- Operational data from 6 trucks
  - Breda 1 (since July 2021)
  - Prezero 1 & 2 (since May 2021)
  - Breda 2 (since November 2022)
  - Antwerp 1 (since November 2022)
  - Antwerp 2 (since December 2022)

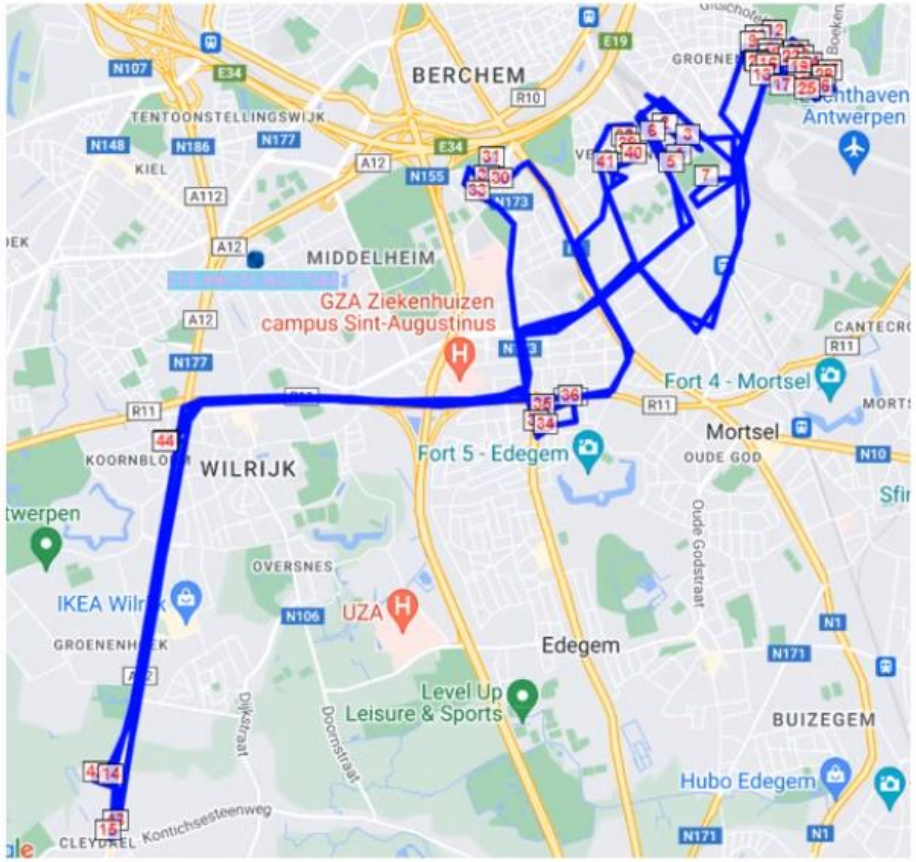
- Operational data REVIVE trucks
  - +/- 40.000 km driven
  - +/- 4250 kg H2 used
  - Number of refills +/- 550
  - Average refill time 17 minutes
  - FC hours +/- 2500



Operational Data from REVIVE (2/2)

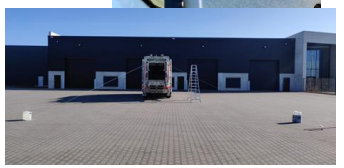


Antwerp data



Risks, Challenges and Lessons Learned

- Availability of HRS infrastructure -critical for project timing & truck operations
- TRL of European FC suppliers - TRL of selected suppliers lower than non-EU suppliers
- Covid-19 & general supply chain issues
- No standard truck configuration
  - Every unique truck configuration needs to go through the homologation process and requires new testing
  - Additional delay for exporting vehicles (outside of the Netherlands)
  - “Keep it simple”
- Lack of regulation – No EU/National directives to stall, maintain and repair H2 vehicles
- Stakeholder Expectation Management

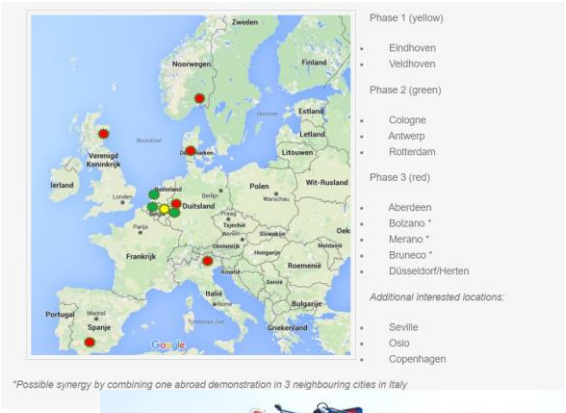


REVIVE H2

Clean Hydrogen Partnership

Synergies With Other Projects And Programmes

Life N' Grab Hy
clean cities, clean air



Life N' Grab Hy clean cities, clean air | REVIVE H_2 | Interreg North-West Europe HECTOR

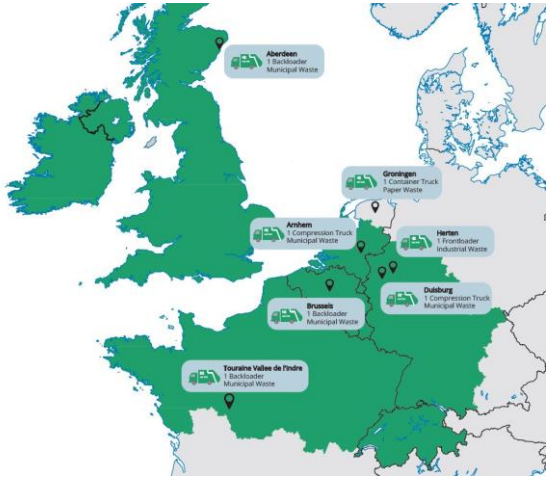
Letter of Cooperation
for the
Life 'N Grab HY!, REVIVE & Hector - projects

Topics:

Coordinate dissemination activities

- Common definition of policy recommendations
- Co-organisation of events

Interreg North-West Europe HECTOR
European Regional Development Fund



Aberdeen City Council · Gemeente Groningen · Touraine Vallée de l'Indre · Metropole Ruhr AGR Gruppe · Wirtschaftsbetriebe Duisburg · preZero · HAN University of Applied Sciences, HAN Automotive Research · Bruxelles Propreté / propreté.brussels

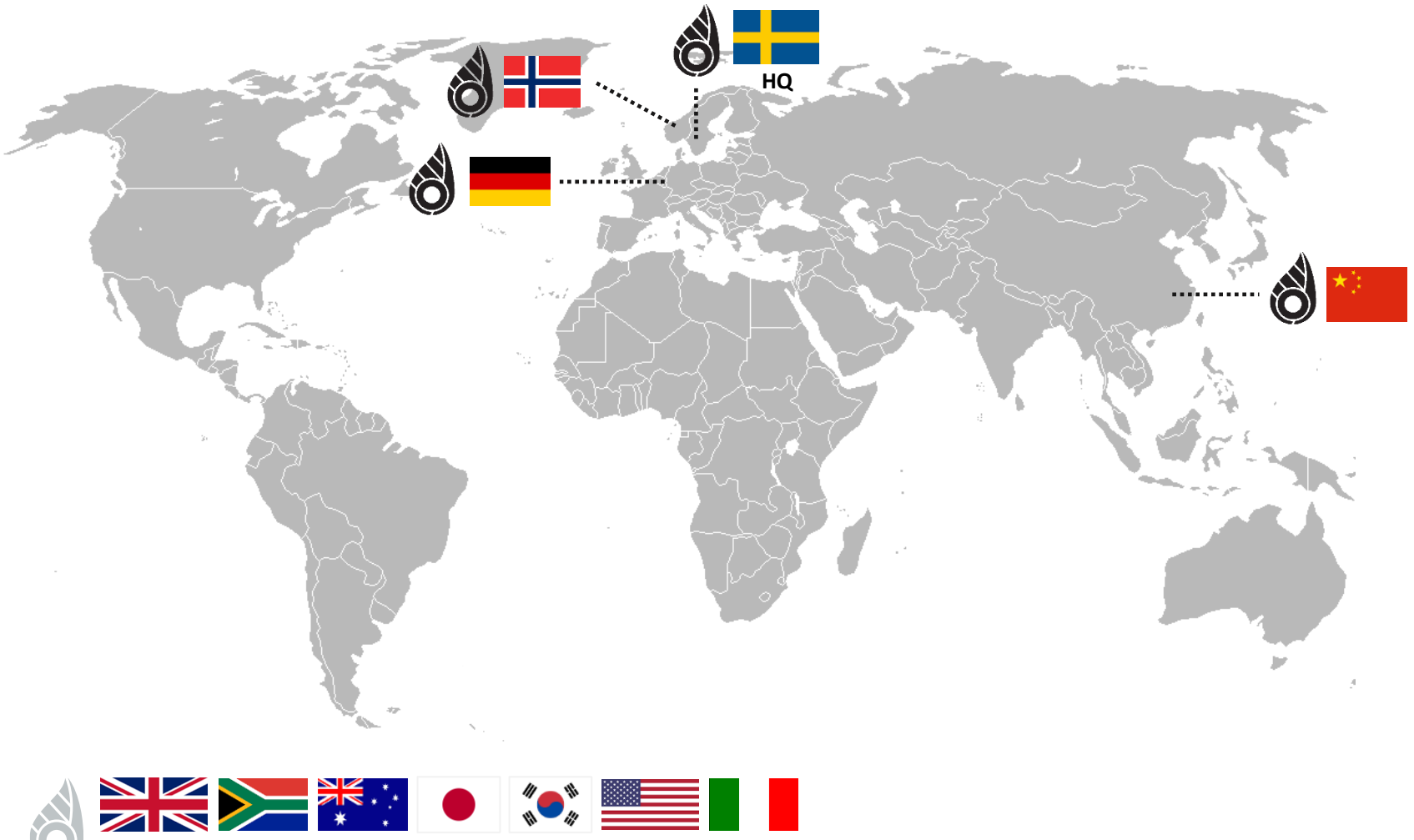
Life

REVIVE H_2

Clean Hydrogen Partnership

PowerCell Group

PowerCell Group



Leading Fuel Cell technology built on
25 years of R&D & IP

Spin-out from the Volvo Group in 2009

Listed on NASDAQ since 2014

HQ in Sweden with global presence

Strategic partners & customers
to drive business

Marine

- Passenger
- Fast Ferries
- Cargo Vessels
- Large Yachts

Power Generation

- Prime Power
- Back-up Power
- Peak Shaving
- Shore Power

Off-Road

- Material Handling
- Mining Equipment
- Agricultural
- Construction

Aviation

- Passenger planes
- Drones
- eVTOL

On-road

BOSCH
Invented for life

Funded by:

Project: 779589 – REVIVE

Refuse trucks: Albert & Herbert

- Collaboration between Renova, PowerCell, Scania and Joab
- PS100 fuel cell system
- 28 kg of Hydrogen(350 bar), battery 56 kWh
- Peak effect 280 kW (Battery and Fuel Cell)
- Range ~260 km
- Delivery 2021

PS100 system

- 100 kW net power
- Robust and compact design
- High energy density
- Proven in every segment *PowerCell operates within*
- Configurable
- *Can be installed with additional heater for cold climate operation*

Lessons learned

- Great synergy between battery and fuel cell
- Easy refueling – 10 minutes max
- Operates like a normal electric truck
- Might be better with 700 bar tanks?
- Retrofit works well
- When space is a limitation, choose a fuel cell system with highest possible power density

Thank you for listening!

For further information please contact:

Mårten Bengtsson
marten.bengtsson@powercellgroup.com

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Clean Hydrogen Partnership

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