



Hydrogen-Powered Waste Collection: Fuel-Cell Refuse Trucks in Europe REVIVE Project Overview

26/01/2024



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



Co-funded by
the European Union

Sustainability is our Business

We are the world's largest pure play sustainability consultancy

Founded in 1971, we are the largest advisory firm in the world focusing solely on sustainability, offering unparalleled depth and breadth of expertise.

We shape a sustainable future with the world's leading organizations

Our purpose guides everything we do. We create a better future by helping the world's biggest brands address today's sustainability imperatives.

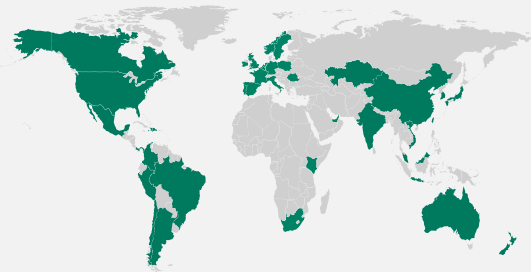
We are the recognised market leader in sustainability services

Numerous industry benchmarks attest to our market leadership and the majority of our work is sole-sourced, reflecting trusted partnerships we build with our clients.

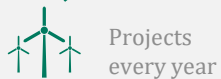
7,000+
professionals

170
Offices

40
Countries &
territories



20,000+



50+

Years of experience

We partner with...



#1 Sustainability
service provider
- HFS 2022

**“The end-to-end provider
of ESG and sustainability
consulting services”**
- Verdantix Green Quadrant 2022

ERM's Sustainable Energy Solutions team combines technical knowledge with strategic insight to address low carbon energy innovation topics



SES provides technically informed sustainable energy strategy consulting services across innovative areas of energy transition



Buildings



Transport
(including batteries)



Industry; Carbon capture
usage & storage;
Greenhouse gas removal



Fuels
& Chemicals



Hydrogen
& fuel cells



Energy
networks



Smart energy
systems



Policy input
& evaluation










Sustainability &
resource assessment



Funded project
management

ERM has initiated most of the major hydrogen transport projects in Europe and is coordinating many of these initiatives

Sector	Projects ERM initiated and is supporting	Key features
Cars / vans	 	<p>H2ME: c.1,400 FC cars / vans, 50 hydrogen refuelling stations across Europe</p> <p>ZEFER: 180 taxis and refuelling stations in three cities</p>
Buses	 	<p>JIVE: c.290 FC buses + new HRS in 20 cities across Europe, deployment from early 2020s</p> <p>H2Bus Europe: 600 FC buses and refuelling infrastructure in three clusters</p>
Trucks	  	<p>H2Haul: 16 heavy-duty FC trucks from two manufacturers (IVECO & VDL), deployment from 2023</p> <p>H2Accelerate: 150 hydrogen trucks and 8 heavy-duty hydrogen refuelling stations, deployment from mid-late 2020s</p> <p>REVIVE: 11 hydrogen refuse collection trucks in Belgium, Netherlands and Sweden</p>

We also started and are coordinating the national hydrogen mobility initiatives in the UK, France, and Ireland



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

Key objectives:



Develop a high-performance fuel cell refuse truck



Deployment of 11 trucks in Europe



Target 24 months of demonstration in daily operations



Raise the profile of the FC technology as a viable option for waste collection






Analyze future business models for zero emission waste collection using hydrogen produced from waste sources through a dedicated 'Waste-to-Wheel' study

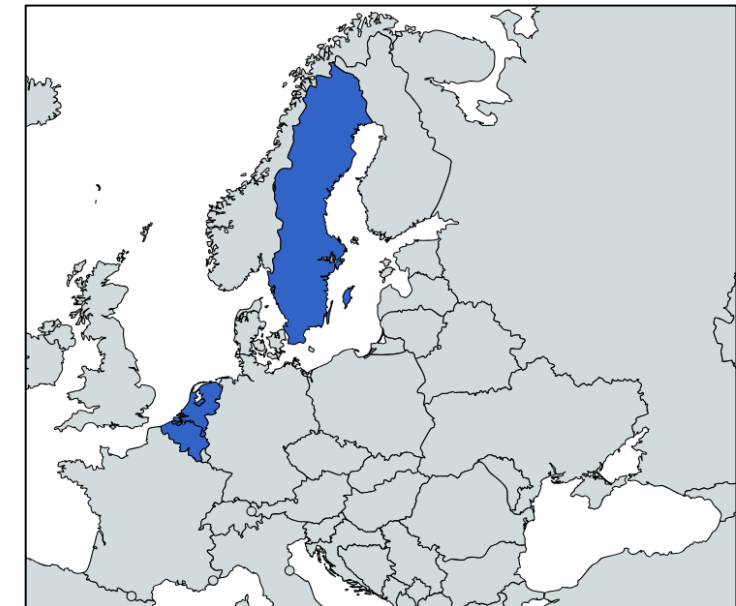


REVIVE brings together a strong consortium of equipment manufacturers, waste truck operators and hydrogen experts

Members of the REVIVE Consortium

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

Deployment sites

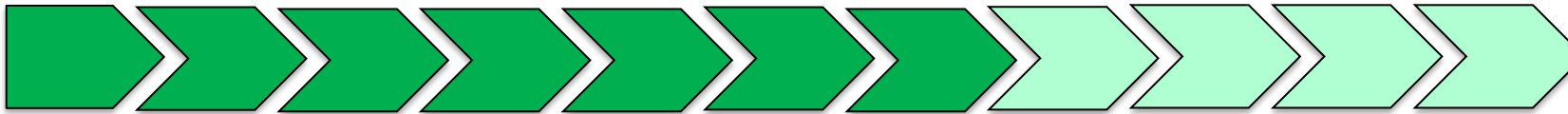


REVIVE is into the operational phase of the project

1st deployment:
May 2021

7 of 11 trucks deployed:
Dec 2023

4 trucks in final
commissioning



All 11 trucks completed the construction phase, are certified and registered

- Breda (2)
- PreZero (2)
- Renova (1)
- Antwerpen (2)
- Groningen (3)
- Noordenveld (1)

7 trucks delivered to customers

4 trucks are in the final stages before deployment to customer



Groningen truck under construction
at E-trucks Europe Lommel →

Real-world data is being collected from daily waste collection operations

Operational data from 6 REVIVE trucks to Sept 2023



40,000 km driven



4250 kg H2 used



Number of refills: 550

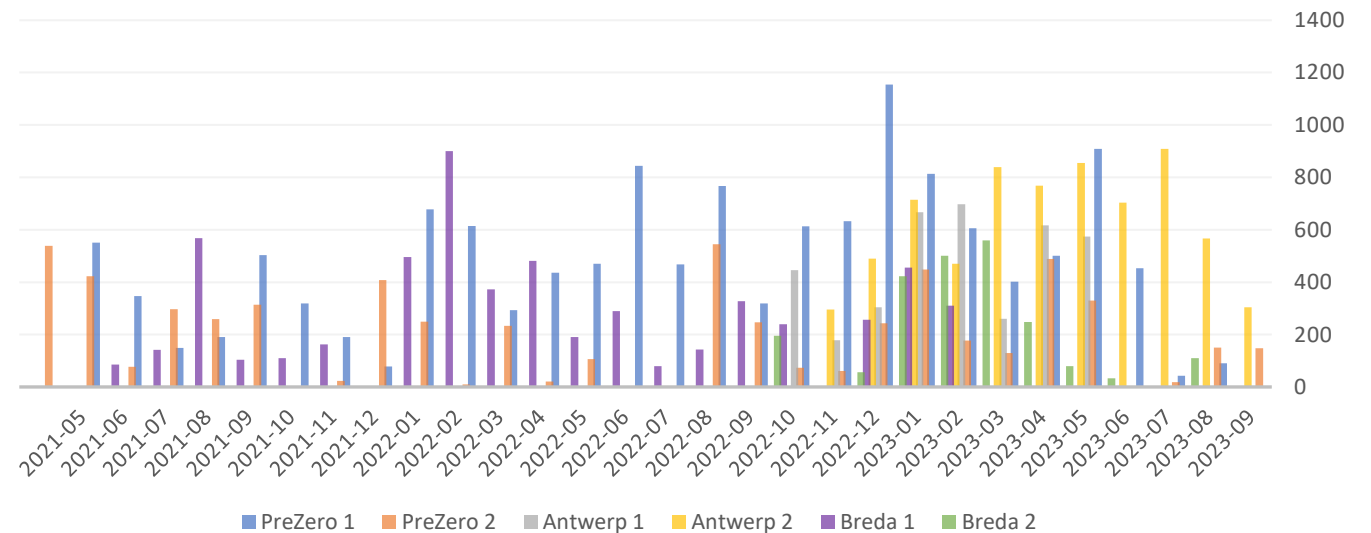


Average refill time: 17 minutes



FC hours: 2500

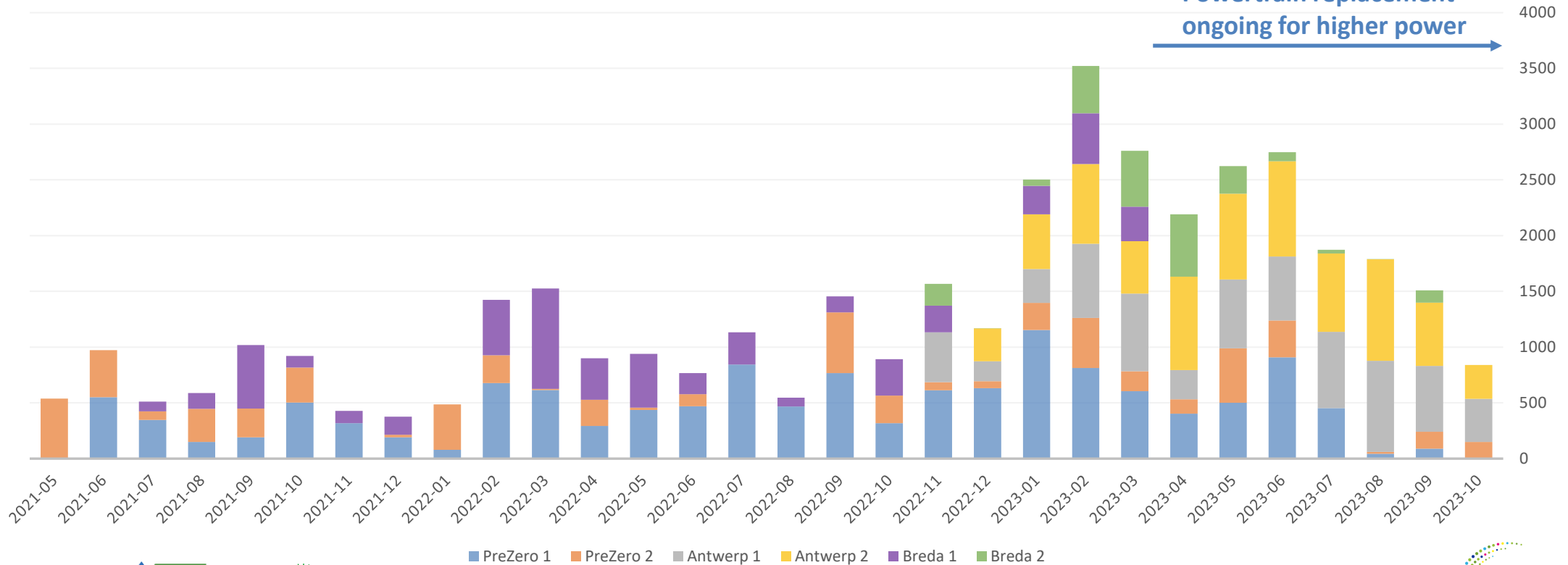
Monthly Distance Driven



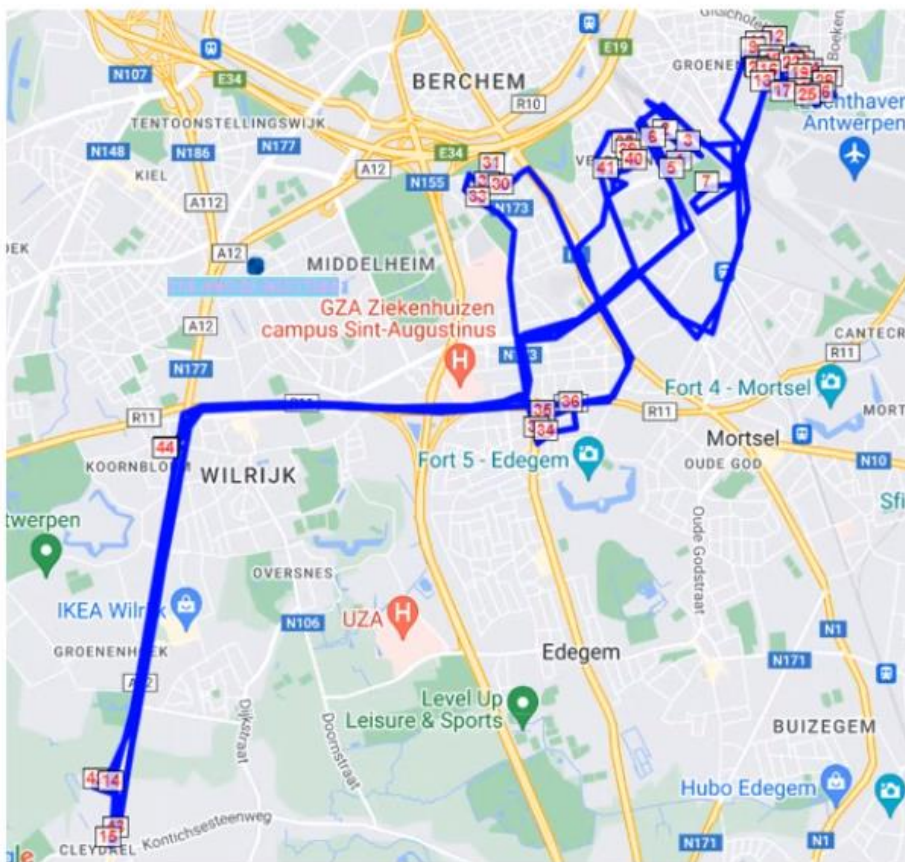
Data will be used for analysis, including a detailed 'waste-to-wheels' study

Monthly Distance Driven (km)

Powertrain replacement
ongoing for higher power



Two trucks in Antwerp, Belgium, have driven over 17,000km and have collected 4,000 tonnes of waste



REVIVE has faced several challenges as an early technology demonstration project

Availability of HRS infrastructure:

Critical for project timing & truck operations

Low Technology Readiness Level:

Relative to other h2 vehicle types and to non-EU suppliers

Lack of regulation:

EU/National directives to deploy, maintain and repair H2 vehicles

Covid-19 & global supply chain issues:

Persistent sector issue that has extended project timelines

Stakeholder Expectation Management is key

No standard truck configuration:

Different cities needing unique specifications requires additional testing, homologation & registration



Common themes have emerged across EU hydrogen mobility projects led by ERM

Hydrogen Refuelling Stations



- Build in redundancy to improve availability
- High utilisation key for business case
- Permitting/planning procedures can differ between regions and countries

Expectation Management



- Establish and communicate realistic project expectations -> challenges will be faced
- Pick up learnings from earlier and ongoing FC Bus activities
- Have the 'right' people – champions for the technology, expert planners etc.

Vehicles



- H2 is beneficial for maintaining stable operations through longer range and shorter refuelling
- With early deployments differing vehicle specifications create complexity
- Global supply chain is still maturing, including for spare parts

Sector Advancement



- Commercialization of h2 mobility relies on scaling up demand, including heavy-duty
- Success stories for zero-emission vehicles are linked to financial incentives and support from local authorities
- Form part of a plan for a broader 'clean' energy system involving hydrogen

Collaboration with similar projects and programmes is a key tool to share learnings and overcome challenges

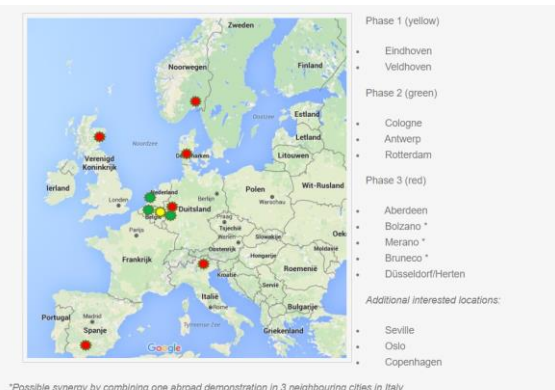
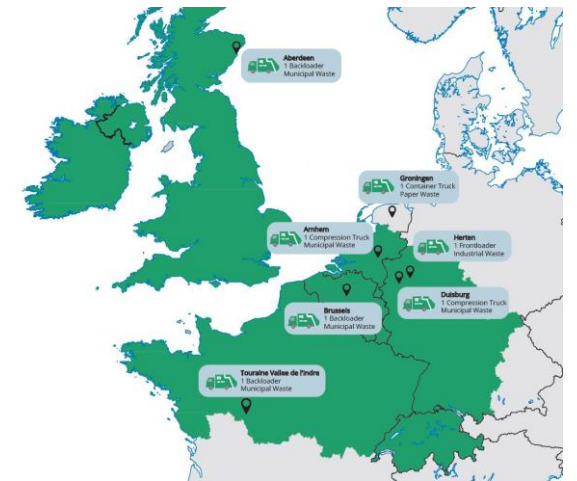


Letter of Cooperation
for the

Life 'N Grab HY!, REVIVE & Hector - projects

Topics:

- Coordinate dissemination activities
- Common definition of policy recommendations
- Co-organisation of events





This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 779589. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation programme, Hydrogen Europe and Hydrogen Europe Research.

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