

# REVIVE



For clean  
and silent  
waste  
collection

***Refuse Vehicle Innovation  
and Validation in Europe***

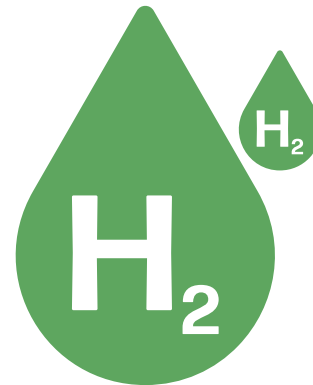


Co-funded by  
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# ACHIEVEMENTS

REVIVE's overall achievements to date, being the largest demonstration of fuel cell-range extender trucks.

- ▶ Developing a high-performance fuel cell refuse truck
- ▶ Deployment of 11 trucks in Europe
- ▶ Extensive demonstration in daily operations for up to 3 years
- ▶ Raised the profile of the FC technology as a viable option for waste collection
- ▶ Analysed future business models for zero emission waste collection using hydrogen produced from waste sources through a dedicated 'Waste-to-Wheel' study



# INTRODUCTION TO TECHNOLOGY

## Why Hydrogen and fuel cells

Hydrogen and fuel cells enable viable zero-emission alternatives that offer environmental benefits, such as air quality improvements, reductions in greenhouse gas emissions, and noise reduction. This can significantly improve the operational flexibility of vehicles for waste collection and other uses.

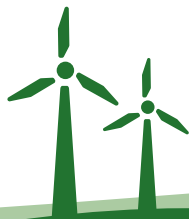
## Fuel Cell Refuse Trucks

Heavy-duty vehicles (such as buses and trucks) account for roughly 20% of Europe's road transport CO<sub>2</sub> emissions. Hydrogen and fuel cell platforms are one of the very few options that can plausibly offer a zero-emission heavy-duty vehicle. Refuse trucks are a particularly attractive application for heavy-duty hydrogen fuel cell platforms.



# DEMONSTRATIONS

11 trucks



# OPERATIONAL HIGHLIGHTS

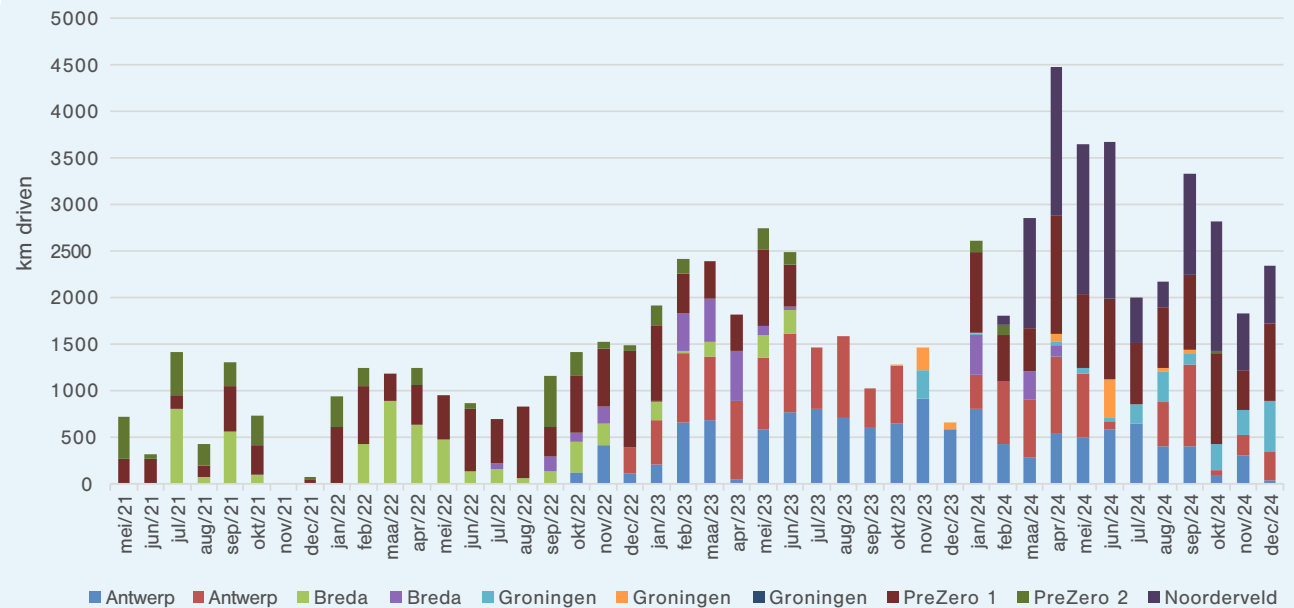


## REVIVE data by the project closure (December 2024)

- ▶ > 72,000 km driven
- ▶ 8,100 kg H2 used
- ▶ Number of refills: 1,100
- ▶ 68 tonnes of CO2 emissions avoided
- ▶ Improvements to air quality and noise pollution
- ▶ 13,140 tonnes of waste collected
- ▶ 7 European cities impacted
- ▶ Average refill time: 15 minutes
- ▶ FC hours: 5,200



## Distance travelled in service





**Antwerp**

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**Noordenveld**



**Groningen**



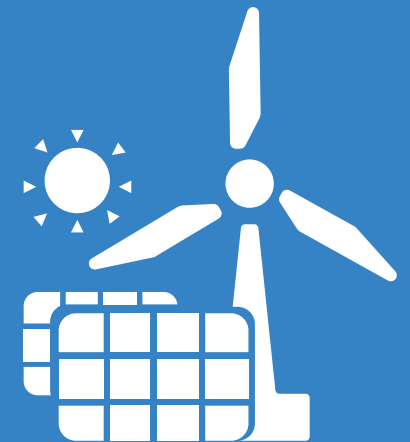
**Breda**



**Arnhem & Veldhoven**



**Gothenburg**



# LEARNINGS

## Challenges & recommendations for the sector

Challenges →→→→	Learnings
<b>High Costs:</b> Fuel cell trucks are 3x more expensive than diesel trucks and 50% costlier than BEVs.	Scaling up production will narrow this gap. In the short term, subsidies and financial incentives are critical.
<b>Hydrogen Fuel Costs:</b> Hydrogen fuel constitutes a significant portion of FCHV operational costs.	Reducing green hydrogen production costs is key to improving cost efficiency.
<b>Limited Availability of FCHVs:</b> Few models are available, especially in the heavy-duty segment, leading to retrofitting which is very expensive.	Increased OEM involvement will expand FCHV models and reduce reliance on costly retrofits.
<b>Lack of Refueling Infrastructure:</b> Uncertainty around reliable and accessible refuelling networks.	Localised stations for captive fleets and synergies between vehicle types (cars, buses, trucks) can strengthen infrastructure.
<b>Non-Standardised Hydrogen Storage &amp; Refueling Protocols:</b> Lack of unified industry standards.	Industry-wide standardisation is needed for future-proof investments and seamless system integration.
<b>Certification &amp; Registration Delays:</b> Lengthy processes due to novel technology and non-harmonised regulations.	Streamlining European certification for vehicles and fuel will enable faster adoption and market entry.
<b>Limited Dissemination of Emergency Response Guidance:</b> The Emergency Response guide for hydrogen applications is not widely accessible across Europe.	Enhancing accessibility and distribution of the guide will ensure emergency responders are well-equipped to handle hydrogen-related incidents, improving safety and preparedness.

## Recommendations to swiftly address technological barriers in the short / medium term

- 1 **Further standardisation of H2 storage systems and development of refuelling protocols**
- 
- 2 **Further development of FC truck and powertrain prototypes and standardisation of FCH technology**
- 
- 3 **Large scale demonstration of FCH Heavy-Duty Fleets (including refuse trucks)**
- 
- 4 **Continued deployment of hydrogen refuelling stations**

# THE IMPACTS OF THESE H2 REFUSE TRUCKS

## CASE STUDY NOORDENVELD

## CASE STUDY ANTWERP

- ▶ On the 1<sup>st</sup> March 2024, one refuse truck was deployed and is to be in operation for 12 years.
- ▶ The truck refuels in Groningen.
- ▶ The truck operates in the top part of the province of Drenthe.
- ▶ The municipality of Noordenveld has the ambition to become the most durable municipality in Drenthe in 2030.

More details can be found within the [press release](#)



ESA Trucks director, Wim van Nispen, hands over the key to the heavy-duty hydrogen refuse truck to alderman of Noordenveld, Alex Wekema.

### Noordenveld takes hydrogen-powered refuse truck into service

“

*This new refuse truck not only looks clean, it is really clean. It does not emit any CO2 and also moves through the streets almost silently. The green colour of the add-on container ensures that the truck does stand out and fits in nicely with its green character.* — Alderman Wekema

- ▶ Two refuse trucks are in operation, the first refuse truck was deployed on the 7th December 2023.
- ▶ The trucks are running in the southern part of Antwerp and refuel at DATS24 hydrogen refuelling station.

More details can be found within the first [press release](#) in December 2023.

Followed by the projects first [video](#), where you will be able to follow the path of a refuse truck through the city and harbour of Antwerp, highlighting several hydrogen refueling stops.



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### City of Antwerp operating 2 hydrogen refuse trucks

“

*Antwerp is always at the forefront of innovation. Once again, because we are the first city in Flanders to put hydrogen-powered garbage trucks into service. These clean garbage trucks are a win-win-win; they emit no CO2, no particulate matter and they hardly make any noise. In this way, we ensure clean household waste collection in the city.”* — Els van Doesburg

# REVIVE



 Gemeente Breda



[h2revive.eu](https://h2revive.eu)



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