



Life 'N Grab Hy 

AfterLIFE Plan

March 2021



Introduction, objectives and results

Garbage trucks are mainly operational in densely populated urban areas, in which there are strict criteria concerning emissions and environmental standards. There is an **increasing need for zero emission solutions** to comply with this upcoming access restrictions imposed by cities as part of air pollution reduction strategies.

Garbage trucks on hydrogen are a promising solution to meet this challenge. The trucks are zero emission, almost silent and the performances/flexibility are like diesel fuelled vehicles, as battery vehicles struggle to meet the range requirements. So garbage trucks on hydrogen can meet the requirements of as well municipalities, waste collection institutions as the local residents.

That's why WaterstofNet, E-Trucks Europe, Baetsen Groep, Cure Afvalbeheer and Hydrogenics initiated the **Life 'N Grab Hy! project**. Life 'N Grab Hy!, short for 'Liquidation of Full Emission and Noise by GARBage trucks with HYdrogen' is a by Life funded European demonstration project.

Two garbage trucks were converted to hydrogen and were demonstrated in different cities in the Netherlands and Germany (Eindhoven, Velhoven and Hürth, near Cologne).

E-trucks Europe built both hydrogen hybrid electric garbage trucks. The trucks are owned by waste collection companies **Baetsen** and **Cure. Hydrogenics GmbH** provided the integration and services for the fuel cell. WaterstofNet coordinated the project and the demonstrations and was responsible for communication and dissemination.

The Life 'N Grab Hy! project was very useful for the **project partners, as well as the partners involved** in the demonstrations. They all **gained a lot of experience and practical knowledge. All are taking the next steps in their contribution to a zero emission garbage collection in the future.**

Lessons learned:

- Users of the trucks on hydrogen (driver as well as the people behind the truck) were very enthusiastic about the better environment to work
- Starting with a new truck chassis and compactor works best
- Second LIFE investment in a truck + compactor gives additional issues due to age
- Larger FC needed, to recharge batteries
- Higher power output driveline / Electric motor needed, especially in hilly environments

Life 'N Grab Hy! was **"the crucial step for upscaling"** and evolving **from Prototype to Commercialisation**. The project also had a large reach-out. Over 50 cities and regions showed direct interest in the Life 'N Grab Hy! results.

The project achieved a total of **24.000 kms driven**, while GHG emissions saved and air quality improved by:



45 Tons of CO₂



20 kgs of
Particulate Matter



60 kgs of NOx



93 kgs of CO



Noise emissions were reduced
in operation with - 4Db (A)

Overview of the project

The companies Baetsen and Cure purchased zero-emission trucks from E-Trucks Europe at the beginning of the last decade. For Baetsen it concerned an electric portal arm truck. For Cure the proof of concept was an hydrogen-electric garbage truck. Both trucks were built in 2013. The two hydrogen refuse trucks used within this Life 'N Grab Hy! project were a further development of those proof of concepts. In order to demonstrate various types of collection systems, the Baetsen vehicle, was equipped with a rear loader system and the Cure garbage truck, with a side loader system. These are the two most used waste collection systems in Europe.



Baetsen rearloader



Cure sideloader



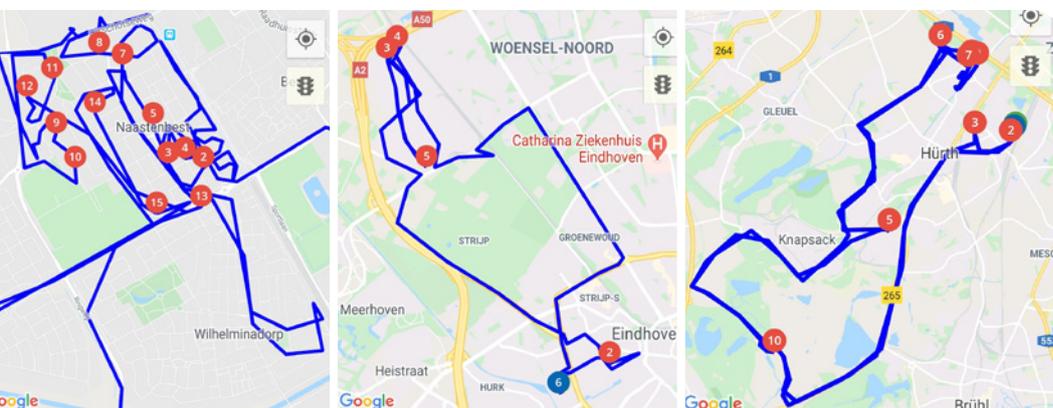
Official presentation of the two vehicles from Life 'N Grab Hy

The basis for the Baetsen vehicle was a new DAF chassis with a new body from the company Zoeller. An older vehicle was used for the Cure vehicle, which was renovated. After that, the hydrogen electric system was integrated on both vehicles. The integration took more than a year. On April 11, 2019, the two vehicles were officially presented during a meeting of the board of the 21 municipalities of the Eindhoven Metropolitan Area to ample media attention.

After the homologation and obtaining the first license plates for hydrogen trucks on the European market (unique milestone realized within Life&GrabHy), the two vehicles were used for the project time at Baetsen and Cure. The Baetsen vehicle has been tested for more than 20 months in the town of Best, Veldhoven and Son near the city of Eindhoven. In addition, it was deployed for a demonstration for two weeks in the town of Hürth, near the city of Cologne. The Cure vehicle has been deployed in the city of Eindhoven. The intention was to use both vehicles for several demonstrations at interested municipalities, but due to the measures against the spread of COVID-19, this was unfortunately not possible.

However, there is still a demand for short term demonstrations In Europe.

The plans for the After-LIFE period differ from each other for these two trucks. The future path and background are further described for each vehicle.



Examples of waste collection routes in Best, Eindhoven and Hürth vehicles from Life 'N Grab Hy

Situation at the end of the project

At the end of the project we can conclude that unique and crucial steps in the development and deployment of garbage trucks on hydrogen have been set.

The development of two garbage trucks, passing successfully the complete homologation trajectory, was 'first of a kind in Europe'. It was not only a 'primeur', but 'being homologated' is also a prerequisite for real implementation of garbage trucks on hydrogen.

Based upon the experiences with Life 'N Grab Hy!, 25 additional garbage trucks on hydrogen are currently under development in about 10 cities.

The LIFE project was a stepping stone to commercialization for E-Trucks which is now building more than 25 trucks at their new manufacturing facilities, where all the experiences, lessons learned and new developments of the LIFE'N Gab HY!-project are implemented to grow even further as an SME and sell these trucks throughout Europe.

Despite successful development and especially demonstration of the trucks on hydrogen, the 2 'Life' trucks are currently not in operation anymore.

Since January 2021, the Baetsen vehicle could no longer be used for the waste collection at Baetsen. From that date onwards regulations stated that waste collection vehicles are to be equipped with a weighing and registration system. Beside the fact that this would have its impact on the homologation/ type-approval, a new system integrated on the truck meant new testing, certificates and approval by the RDW, as well as a new investment for the remaining three months of the project at the customer's request. Also the lead time for this implementation as well as the adjustments, mandatory re-inspection and approval from the authorities would be too long. Baetsen, now part of the Remondis group, has decided to stop investing in this first vehicle and choose to transfer it to E-Trucks Europe by the end of the project for a new chapter, as will be described below.

Since March 2021, the Cure vehicle was also no longer in use due to major technical problems. A large oil leak in the gearbox occurred, which is a conventional and still and old original part of the base vehicle. That base vehicle was in fact already technically depreciated. Re-investing in this vehicle, also looking back to the experiences and learnings from the project, was therefore not worthwhile. Cure has also decided to transfer their vehicle to E-Trucks Europe at the end of the project period.

Recording agreements

The partners Baetsen-Remondis, Cure and E-Trucks Europe have agreed on a hand over of the vehicles to E-Trucks Europe for the above mentioned stated purpose.



Our Partners



Assessment of the situation

The demonstrations performed under the Life 'N Grab Hy!-project by these vehicles were new and unique in Europe. They provided a lot of data, experiences and good insights in order to be able to further develop the product on a technical level. Both vehicles have also meant a lot for the development of the market and gathering support for hydrogen heavy duty transport applications, such as waste collection vehicles. In the course of the project it has certainly become apparent, that there is still a large need among interested waste collectors to temporarily try out a hydrogen refuse truck in their operation. The project team and especially E-Trucks Europe want to respond to this. A precondition for these short term demonstration and use of the vehicle however, is that the vehicle to be deployed must make a good performance and have a positive contribution to its own product range. This means that the vehicle must be and perform at its best on a technical level but mostly on the drive-ability. Unfortunately, both vehicles, as experienced in the Life 'N Grab Hy!-project, in their current set-up, do not comply with these terms.

Reinvestment in the Baetsen vehicle seems worthwhile for E-Trucks Europe. There is a demand for demonstrations, tests and driving experiences with a hydrogen garbage truck. Due to the high cost of such vehicles, only customer order vehicles are being built. As a result, a ready-to-use vehicle cannot be used for other demonstrations. With the transfer and reinvestment in the Baetsen vehicle, a demo vehicle is now within reach. The vehicle thus retains its original function from the Life 'N Grab Hy! project.

Reinvestment in the Cure vehicle is not worthwhile, due to its design, age and numerous problems encountered within the Life 'N Grab Hy!-project.

After-Life objectives and methodology



Baetsen vehicle

After the Life-project, the Baetsen vehicle could, with a number of modifications, be well used and perform short-term demonstrations throughout Europe in order to serve the market. The base vehicle is now 5 years old. Major maintenance is necessary to get the base vehicle back to a reliable level for the next 5 years. As experienced in the demonstration at Stadtwerke Hürth, the 150 kW electric propulsion motor is too weak, especially because of the hilly environment. The more powerful 300 kW motor, which is new on the market will therefore be installed as standard. In practice, this is not inferior to a diesel engine and is even more attractive to drive. In view of the extra power required, a larger 45 kW fuel cell is required to recharge the battery pack during operation. The hydrogen electrical system will also have to be adapted accordingly in terms of peripheral equipment. The truck will keep its license plate, but has to be re-certified and furthermore be designed in the corporate style of E-Trucks Europe.

Cure vehicle

The base vehicle is worn out. Renovation of the vehicle is not an option anymore. However, the base vehicle does contain a number of components, that can be used as spare parts on other vehicles, but have expired warranty and is known as aged technology already. This applies especially to the more expensive components, such as the hydrogen tanks, the 30 kW Fuel Cell, the electric motor and the battery pack.

For the latter, the battery pack, which may no longer be usable in a mobile application, but it can still be used in a stationary application for energy storage.

Re-use of battery packs is preferred compared to recycling and also fully fits the Green company policy and ambitions of E-Trucks Europe, following Lansink's Ladder and try to re-use as much as possible before recycling. The factory of E-Trucks Europe is using solar panels to provide their electrical power needs. This power generated during the day is generally also used during the day. However, there are general exceptions and it concerns for example a restaurant combined with a care home (apartment building). These mainly consume electricity in the evening and not during the day. The battery pack coming from the garbage truck, could be used in a trial to test whether the electricity generated during the day can be stored and then used in the evening as power supply in the restaurant and care home. This smart-grid application of the former mobility battery pack, requires some development work and an inverter to supply 220V AC power from the battery pack. It will be examined whether this can be a way to give the battery packs of E-Trucks Europe a second life and deliver a technical solution with a potential profitable business case in the long term.



WASTE HIERARCHY - LANSINK'S LADDER



Powered by Recycling.com

Funding

Reinvestment Baetsen

The aim is to upgrade the Baetsen vehicle, so that it meets the current requirements. The estimated posts for the reinvestment in the vehicle are included as follows in Table 2.

Table 2. Reinvestment costs Baetsen

Cost structure
Base vehicle: major maintenance, renovation, painting, stickers
Installation of new electric engine 300 kW minus value free-falling reserve 150 kW motor
Battery pack: major maintenance
Installation of new 45 kW Fuel Cell minus value free-falling reserve Fuel Cell 30 kW
Small material

Three scenarios are reviewed for feasibility for a business case. It is assumed that the vehicle will last for an additional 5 years (60 months) in this configuration and that regular monthly maintenance is carried out. Calculations are based on an interest of 3.5% and a financial lease of the vehicle. Insurance is for the customer. In this calculation, VAT and other taxes are not included.

Looking at the market prices for garbage truck rental, we can say - after calculations - that the prices for a zero-emission vehicle are certainly reasonable. No profit mark-up has been calculated in this. This is not necessary for E-Trucks Europe, because it involves paving the way for the market for hydrogen refuse trucks. Reinvestment is therefore well worth it.

Reinvestment Cure

The aim is to dismantle the vehicle Cure. The estimated costs for the reinvestment in the buffering system are included in Table 3.

Table 2. Reinvestment costs Cure

Cost structure
Dismantle costs minus value iron and other materials
Battery pack: maintenance
Installation of a converter system
Small material

The development of the Care Home Electricity Storage System (CHESS) will be subsidized by the Metropolitan Region of Eindhoven. This project will be carried out by E-Trucks Europe as lead partner in collaboration with two partners: Alius Energy and Ben Cornelis.

Dissemination and communication of the results

All of the project's documents, pictures and movies are available on the project website. The Layman's Report was not physically distributed among the different stakeholders, due to Corona Covid-19, but is also available on the project website. The same applies for the After-LIFE plan as well as the demonstration leaflets/brochures.

The scientific results of the project will be available for at least 5 years after the project and will be presented on different stakeholder fora. e.g. presentation at Urban cleaning expo, Braga Portugal on 29/6/2021

The follow up projects REVIVE of the FCH-JU, Hector in the Interreg North West Europe programme and H2Rent in the Dutch National DKT1 programme are linked to the Life 'N Grab Hy! project via the signed cooperation on joined communication. This collaboration and cooperation also ensures a replication of the first vehicles and the much needed improvements for the next generation vehicles that are going to be operated in the different (new) European cities and regions.

The results and data gathered in the demonstrations are also used in the Dutch National Covenant for waste collection vehicles and its policy implementation by 2025.

Furthermore the re-use of the Baetsen vehicle (with a Life sticker and the QR-Code), its appearance in public and digital link to the project website and the monitoring tab, will keep the Life 'N Grab Hy! project disseminated also after the projects end.

Life 'N Grab Hy

Clean cities, clean air with garbage trucks on hydrogen

Stefan Neis

Project coordinator
stefan.neis@waterstofnet.eu
+32 499 73 83 60

WaterstofNet

Slachthuisstraat 112 bus 1
2300 Turnhout
Belgium

www.lifeandgrabhy.eu



HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

Pantone 420C, 429U
CMYK: C5 M0 Y0 K45
RGB: R147 G155 B161

Pantone 298C, 298U
CMYK: C69 M7 Y0 K0
RGB: R19 G181 B234



The Life 'N Grab Hy! activities have received funding from the European Union's Life Programme under the Grant Agreement nr. LIFE14 ENV/BE/000415"