



Life 'N Grab Hy 

Clean cities, clean air
with garbage trucks
on hydrogen!

Layman Report 2021



Life 'N Grab Hy! What and why?



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.

They are zero emission, largely silent and and at the same time they provide the equivalent flexibility of diesel fuelled vehicles, as battery vehicles struggle to meet the range requirements. So garbage trucks on hydrogen are meeting 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 are 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 en Cure. Hydrogenics GmbH provided the integration of 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.

Our Partners

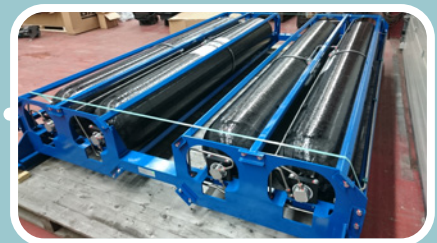
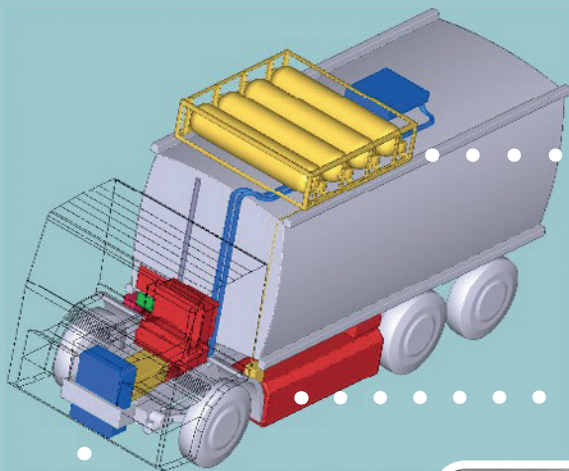
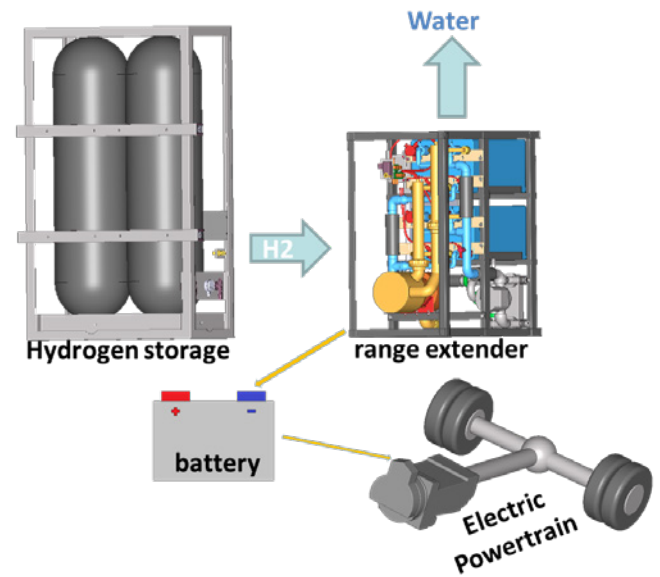


A garbage truck on hydrogen: how does it work?

Fuel cells convert hydrogen and oxygen from the atmosphere, into electricity, heat and water vapour. The electricity is used to recharge the vehicles' onboard batteries, which provide the electric motor with energy to drive and the compactor to compact waste.

The concept 'fuel cell as recharger of the batteries' is defined as a 'range extender'. Thanks to the compressed hydrogen, stored in the tanks, the trucks are fuelled within a few minutes.

Advantages of a truck with hydrogen are a large driving range and large flexibility regarding operation. So, hydrogen fuelled trucks have comparable performances as a standard diesel truck. They only emit water vapour.



Hydrogen storage tanks



Fuel cell



Battery pack

The garbage trucks on hydrogen: developed and built



During the course of the project two waste collection vehicles were built by E-Trucks Europe: one for waste company Baetsen and one for waste company Cure.

Truck Specifications

Vehicle	Baetsen	Cure
Max. Gross Vehicle Weight	26 Ton	26 Ton
Battery capacity	154 kWh	154 kWh
Range (depending on operation mode)	400 km	400 km
Power Fuelcell	40 kW	40 kW
Power electric motor	150 kW – 210 hp	150 kW – 210 hp
Torque	2000 Nm	2000 Nm
Hydrogen tank content	30 kgs	20 kgs
Chassis	DAF CF 6x2	DAF CF 6x2
Compactor	Haller-Zöller	Translift
Type of pick-up system	Backloader	Sideloader



The first homologated garbage trucks in Europe!

The Life 'N Grab Hy! trucks were the first fully homologated hydrogen garbage trucks in Europe that received a license plate. Therefore they could operate in a normal operating scheme for garbage collection.



Crucial to large scale implementation of the technology, is to fulfill a complete homologation process. Only homologated vehicles are allowed to operate throughout in Europe.

This process required quite a lot of time, but resulted in two homologated trucks on hydrogen, including the conformity to all specific European directives for waste collection vehicles. The homologation process of the trucks has several steps. First the complete vehicle assembly (chassis, compactor and driveline) was inspected visually, investigating the conformity and the use of only certified components. Secondly, the vehicle was subjected to an extensive road testing campaign on the Dutch Road Administration agencies test centre (RDW) in Lelystad, performing successful brake-testing, including automatic braking, evasive manoeuvring and functionality testing. Finally, EMC (Electro Magnetic Compatibility) performances have been tested.





Demonstration of the garbage truck on hydrogen in Eindhoven, Best and Son (the Netherlands)

April 2019 - December 2020

The truck is owned by waste collection company Baetsen

Results

The vehicle drove more than **23.000 kms** during the **20 months** of operation. It collected multiple waste fractions such as residual, biomass and PMD in the municipalities of Veldhoven, Best and Son in the South of the Netherlands.

In total Baetsen operated the vehicle **213 days**, in a regime of 4 out of 5 working days. Occasionally the trucks was also used for paper collection during weekends.



Refuelling:

Throughout its lifetime in the project the vehicle refuelled **142 times**. On average it refuelled **17 kilograms** of hydrogen and this within **17 minutes**¹. The refuelling time of a hydrogen truck is therefore comparable to a conventional Diesel truck. The truck refuelled a total of **2434 kgs of hydrogen**.

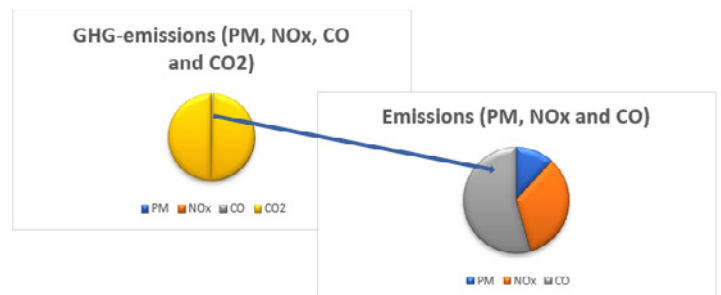
¹This is the long year average, refuelling goes faster in winter than in summer.

Impact

Green house gases:

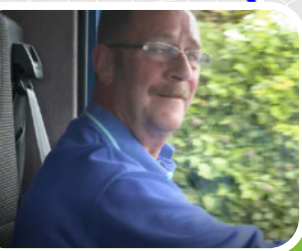
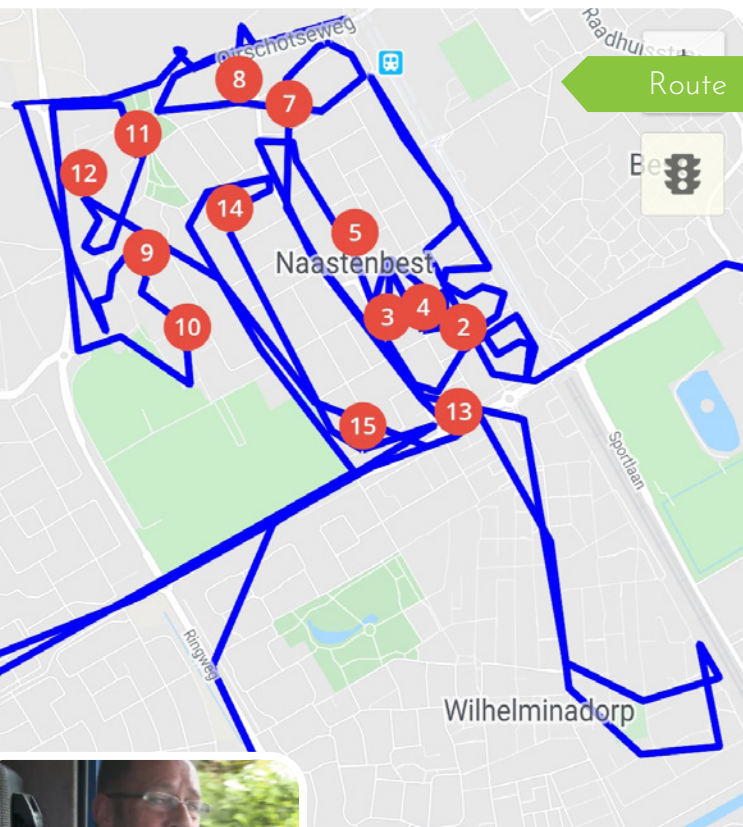
During its operation the truck saved 9500 liters of Diesel (equivalent of the hydrogen refuelled) and 1535 liters of Diesel (equivalent of the electricity of the night charging), significantly reducing the Green House Gas-Emissions².

GHG-Emissions ³			
PM	NOx	CO	CO2
17.4 kgs	50.1 kgs	79,7 kgs	38,7 Tons



²Tank to wheel emissions have been taken into account.

³ kgs of GHG saved compared to EURO 3 Diesel (compared to 2014 at project start)



Comfort

Beside the green house gas emissions that were saved, the vehicle operated with lower noise. This remarkably bettered the working conditions of the drivers and the loaders. Both were really enthusiastic about the trucks. In the meanwhile the trucks also emitting less noise to the environment.



Demonstration of the garbage truck on hydrogen in Eindhoven (the Netherlands)

April 2019 - Maart 2021

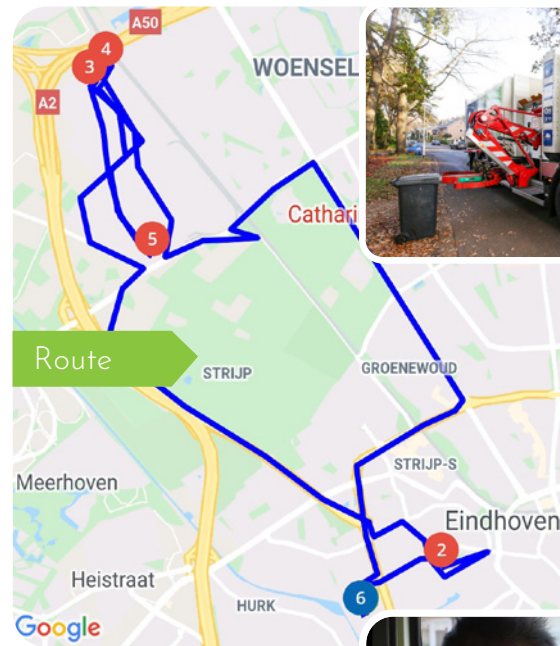
The truck is owned by waste collection company Cure

Results

An existing operational vehicle of Cure of 15 years old was overhauled and converted to hydrogen. The idea was to extend the usage and add another lifecycle by giving it a second life and upgrade it to the latest state of the art of propulsion and emissions. Although giving the a vehicle a second life in a circular way, not needing to produce another truck and saving raw materials, was inspired by ethical intentions, some drawbacks appeared. For example, the vehicle was collecting waste in an inner city operation: low mileage, low average speeds and high demand on the lifting device and the compactor. This combined with the fact that side-loader compactors have a relatively high energy demand, also meant that the vehicle (state of the art design in 2015) was underpowered and also showed limitations in acceleration on 80kph roads.

Nevertheless, a lot of lessons have been learned.

The vehicle drove **1.500 kms** during the **20 months** of operation. It collected multiple waste fractions such as residual, biomass, PMD in the inner city of Eindhoven in the South of the Netherlands. In total Cure operated the vehicle for **42 days**, with an **average route of 35 kms** in a regime of 2 to 3 out of 5 working days.



Refuelling:

The truck refuelled **270 kg of green hydrogen** at the WaterstofNet refuelling station at the Automotive Campus in Helmond. It refuelled **20 times with an average of 14 kgs**. This was in line with the prognosed 1 refuel per 2 operational days, showing similar refuelling times as their diesel equivalent of about 13¹ minutes.

The electricity used for night-charging of the battery also comes from **green-electricity contract**. This means no CO₂ or other Greenhouse gases have been emitted while operating the hydrogen electric hybrid vehicle during the Life 'N Grab Hy! project.

¹This is the long year average, refuelling goes faster in winter than in summer.

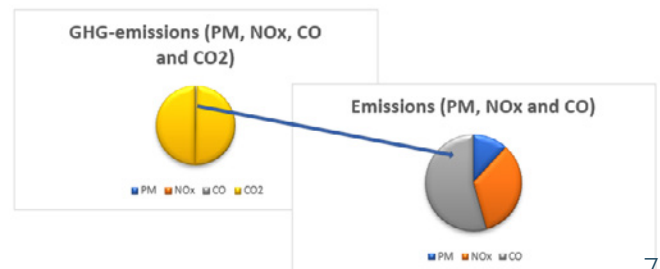
Comfort

Beside the green house gas emissions that were saved, the vehicle operated with lower noise. This remarkably enhanced the physical working conditions of the drivers and the loaders. Both were enthusiastic about the truck, having a more comfortable ride due to less vibrations and low noise levels. At the same time the truck was emitting less noise to the environment, creating less environmental sound pollution.

Impact

Green house gases saved:

GHG-Emissions ²			
PM	NOx	CO	CO2
2.4 kgs	7 kgs	10,5 kgs	5,1 Tons



² kgs of GHG saved compared to EURO 3 Diesel (compared to 2014 at project start)



Demonstration of the garbage truck on hydrogen at the Stadtwerke in Hürth (Germany)

January 2020

The truck is owned by waste collection company Baetsen

In January 2020 a 2 weeks demonstration of the garbage truck on hydrogen, owned by Baetsen, took place in the city of Hürth, a municipality south of Cologne. The Stadtwerke Hürth, that co-owns the hydrogen refuelling station on the Knapsack Industrial plant for buses, was very interested in starting a demonstration with a hydrogen garbage truck. After their experience with buses, they wanted to experience the potential of these trucks, because they are also responsible for the municipality's waste collection. They want to contribute to a more environmentally friendly waste collection in the future.



Refuelling:

During the demonstration period the vehicle refueled a total of **98,19 kgs** of hydrogen in **6 refuelling events**.

Results

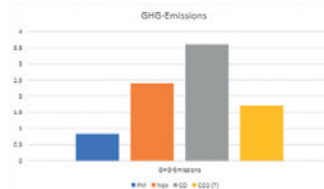
During its 2 weeks operation of the hydrogen garbage truck covered **431 kms in the daily operation**. It collected residual waste in mini containers, operating in a period of **8 operational days** within the 14 days timeframe.

Impact

Green house gases saved:

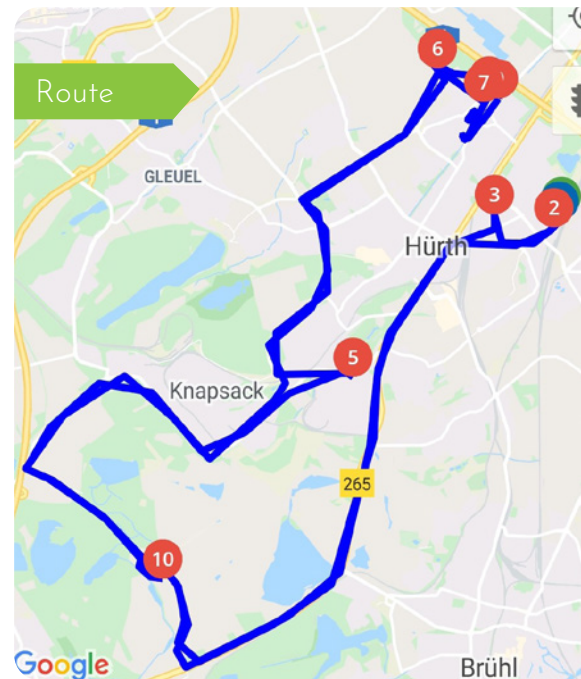
During this short demonstration in the municipality of Hürth, the truck was able to reduce Green House Gas-Emissions¹.

GHG-Emissions ²			
PM	NOx	CO	CO2
0,83 kgs	2,4 kgs	3,6 kgs	1,7 Tons



¹ Tank to wheel emissions have been taken into account.

² kgs of GHG saved compared to EURO 3 Diesel (compared to 2014 at project start)



Comfort

Beside the reduction of green house gas emissions, the vehicle operated with lower noise emissions (-4Db in comparison to a standard diesel operated vehicle), leading to better working conditions.

The most noticeable and positive effect for the drivers and loaders working on the back of the waste collection vehicle, resulting from the interviews held with the people that operated the vehicle, was the lower noise level of the truck. They were more relax and less tired after a day's work.

Driver: "It's more relax to drive this truck during a full day of operation, although it is not a low-entry cabine"

Loader: "You really notice the difference in noise emissions and the tailpipe emissions compared to our diesel operated truck, which are load and smell".

The general public also noticed and mentioned, that less noise was emitted to the surrounding environment by the truck passing by in the streets.

Conclusion

Although the truck is not designed for the specific local conditions in Hurth (f.e. hills), it was a great opportunity for the organisation to learn more about hydrogen technology and to gain experience in driving this hydrogen garbage truck with low noise and zero-emissions.

Stadtwerke Hürth sees a future for hydrogen in their fleet, especially when the truck (originally designed for flat area's) will be adapted to the hilly local situation.

Monitoring results and impact

Results

- **2 trucks developed and built**
- **Full homologation** received
- **26 months** of operation (2 trucks)
- **2 workshops for maintenance** of the hydrogen garbage trucks realised. This were the first workshops for hydrogen garbage trucks in Europe.
- Substantial growth of demand and **multiplied production** for E-Trucks Europe (to some 50 units per year)
- **New construction facility** at E-trucks Europe (to be able to realise the increased demand)
- **Increase of employment**
- **Significant** GHG emission and noise **emission savings** (see impact below)
- **Worldwide attention**, information requests and demonstration visits
- **Cooperation** with 3 other EU and national hydrogen refuse collection truck projects, inspired by the Life 'N Grab Hy! project (H2RenT, Revice and Hector)



Learnings

- Start with new trucks or trucks not older than 5 years
- Need for larger fuel cell & larger electric motor for more demanding operational schemes (eg hills and slopes)
- The end users are in favour of the technology, but the costs of the vehicles and hydrogen have to be reduced
- Drivers, loaders and public are very enthusiastic about the trucks. They offer better working conditions, because of the lower GHG and noise emissions they produce

Impact

- **255 days** of operation in **5 cities** (Veldhoven, Best and Son, Eindhoven, Hürth) in 2 member states (the Netherlands and Germany)
- More than **24.000 kms** driven
- **Reduction of 12 500 litres of Diesel**
- Reduction of **45 ton CO₂, 20 kgs of hazardous Particulate Matter, 60 kgs of NO_x and 93 kgs of CO**
- a reduction of operational noise level with **-4 Db(A)**
- **Positive impact** on the **working conditions** of the operators of the garbage truck
- **Better air quality** ensuring the public health in urban areas, when deployed at larger scale



Experiences



Adwin Martens

Managing Director WaterstofNet

“The project Life 'N Grab Hy! was the crucial chain in the introduction of garbage trucks on hydrogen in Europe. Especially the homologation and the test drives in real operation were key in the further roll out of this clean technology resulting in a better air quality in the cities. After the 2 Life 'N Grab Hy! vehicles, now already more than 20 garbage trucks will start working in different European cities.”



Cor van Ostade

Driver at Baetsen

“If it was up to me I would like to drive this truck until I retire, it's so comfortable and silent! It was also really impressive that people from Japan are visiting Baetsen to see me driving a garbage truck, it make me realise how special it is of what we are doing in this project.”



Wei Hong Ding

Driver at Cure

“I'm really happy that I am one of the first drivers that can test this new technology. It works well!”



Stefan Neis

Project coordinator
Life 'N Grab Hy!

“We met a lot of technical, legislative and operational challenges. I am convinced that solving these issues was a necessary step in the futher roll out of this technology.”



Flip Bamelis

Head of engineering
E-trucks Europe

“In the beginning I was the only one responsible for all technical developments at E-trucks Europe. At the moment I already have 5 colleague engineers, supporting the roll out of this clean technology.”

The future

More garbage trucks

Thanks to the experiences of the Life 'N Grab Hy! project, more garbage trucks will be operated and tested in Europe in the large scale demonstration projects Hector, Revive and H2RenT.

More than 20 trucks are planned for the coming years, as you can see on this map.



New construction facility

E-trucks built a new construction facility with the capacity to build 50 trucks on hydrogen a year.

Next steps

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.

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
2300 Turnhout
Belgium

www.lifeandgrabhy.eu



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