Life 'N Grab Hy
clean cities, clean air with hydrogen

Experiences and results LIFE demonstration @Cure in Eindhoven

Frans van Strijp, Cure Afvalbeheer

Life N' Grab Hy

clean cities, clean air

Cure afvalbeheer

Frans van Strijp

Director

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Cure Waste management

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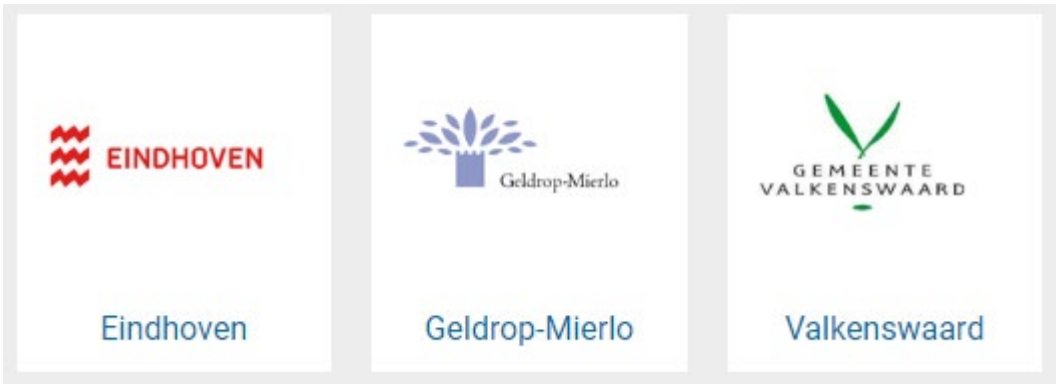
- Total waste management for the cities Eindhoven, Geldrop-Mierlo and Valkenswaard. Together about 300.000 inhabitants.
  - Separate waste collection
  - City Dumps
  - Waste treatment and trade of all the waste
- Location in Eindhoven
- 110 employees
- 35 specialized vehicles
- among which 2 full electric trucks 1 site loader and 1 crane-truck
- Since 1992 Cure is a well known name in the region



Main goals

zero emission

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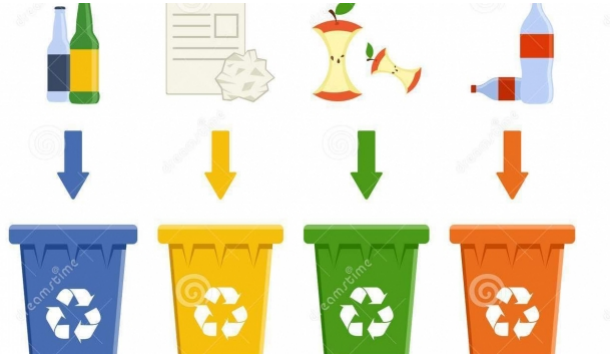
- Implement the policy goals of the cities in the future programs of Cure
  - Zero emission in the inner city 2025
  - Connecting technology in the region
  - Stimulate electric cars in the cities
- 100% waste separation and gaining raw materials out of the waste.
- High service level for all the inhabitants.
- Make circularity possible in our waste business
  - Urban mining
  - Employing programs for unemployed people



- lowest costs for citizens
- When the branch embraces the use of electric vehicles on a large scale, they will be faced with the choice to accelerate depreciation. Reason for Cure to investigate whether existing conventional vehicles can be converted to electric vehicles

Cure in the Life project! Why the LIFE project?

- Implement the policy goals of the cities in the future programs of Cure
  - Zero emission in the inner city 2025
  - Connecting technology in the region
  - Stimulate electric cars in the cities

- The policy goals of the inner City of Eindhoven pushes Cure to think beyond our normal way of working. **NO** emission in 2025 in the inner city, is a serious challenge.
- Because our way of working "small action radius in a densely populated area". Electric powered vehicles is possebly the solution.
- For Cure to achive this kind of developments on our own is not possible. So we are very pleased with the Life project. Now we can test and experience the advantages and perhaps also get to know the disadvantages.
- In this process we want to stimulate the market to switch to the production of electric trucks on a large scale

Experiment with the LIFE truck with hydrogen range extender.

The side loader has been deployed in various areas of Eindhoven

Collection of containers is going as we can expect from these vehicles. Emptying speed is fine.

Advantages of the vehicle are obvious. in addition to the significant improvement in sustainability, there is the clear improvement in the noise level

<u>Downsides we experience are:</u>

- The operating radius is too small, so that a total collection day is not yet possible.
- The speed of the vehicle, this is significantly lower than a conventional vehicle
- The weight of the vehicle is still very high, which means that less waste can be collected.

Lessons learned

1. The goal was to experience, in the field, that collecting waste in our complex logistic way without emission is possible.
2. The goal was to see if a used vehicle could be converted to a hydrogen-electric powered vehicle

- Emission-free collection of waste has turned out to be possible. Battery packs are and will be in future so large in capacity supported by hydrogen that they can carry out a day's work.
- Transforming a used and outdated diesel vehicle to an electrically powered vehicle with hydrogen support has proven to be a challenge. For the future it is better to choose a vehicle of much younger age.
- The market must be challenged to develop electrically powered hook vehicles with a large operating radius. Hydrogen will play an important role in this issue.

Plan of Action Cure phasing out non-emission-free vehicles

	Type of Vehicle	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
1	Side loader														
2	Side loader														
3	Side loader														
4	Side loader														
5	Side loader														
6	Side loader														
7	Side loader														
8	Side loader														
9	Side loader														
10	Side loader														
11	Side loader														
12	Side loader														
13	Side loader														
14	Side loader														
15	Rear loader														
16	Rear loader														
17	Rear loader														
18	Rear loader														
19	Rear loader														
20	Rear loader														
21	Rear loader														
22	Rear loader														
23	Rear loader														
24	Rear loader														
25	Hook Vehicle														
26	Hook Vehicle														
27	Hook Vehicle														
28	Crane vehicle														
29	Crane vehicle														
30	Crane vehicle														
31	Crane vehicle														
32	Crane vehicle														
33	Crane vehicle														
34	Cargo Vehicle														
35	Cargo Vehicle														
36	Cargo Vehicle														

Replacement schedule

Fuel

- Fossil diesel
- Bio diesel
- CNG/LNG
- 100% electric
- Electric / hydrogen

End of Fossil Fuel!

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The test and feedback

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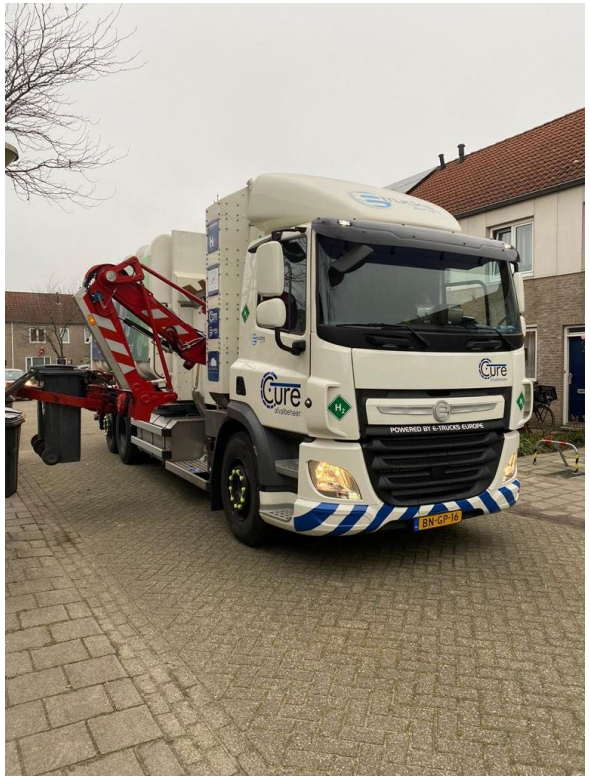
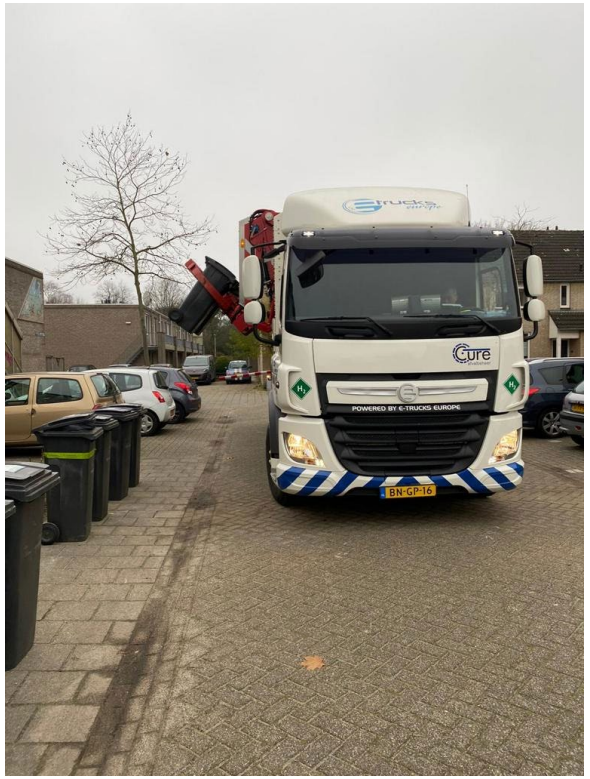




Demonstration movie on: www.lifeandgrabhy.eu/demonstartions

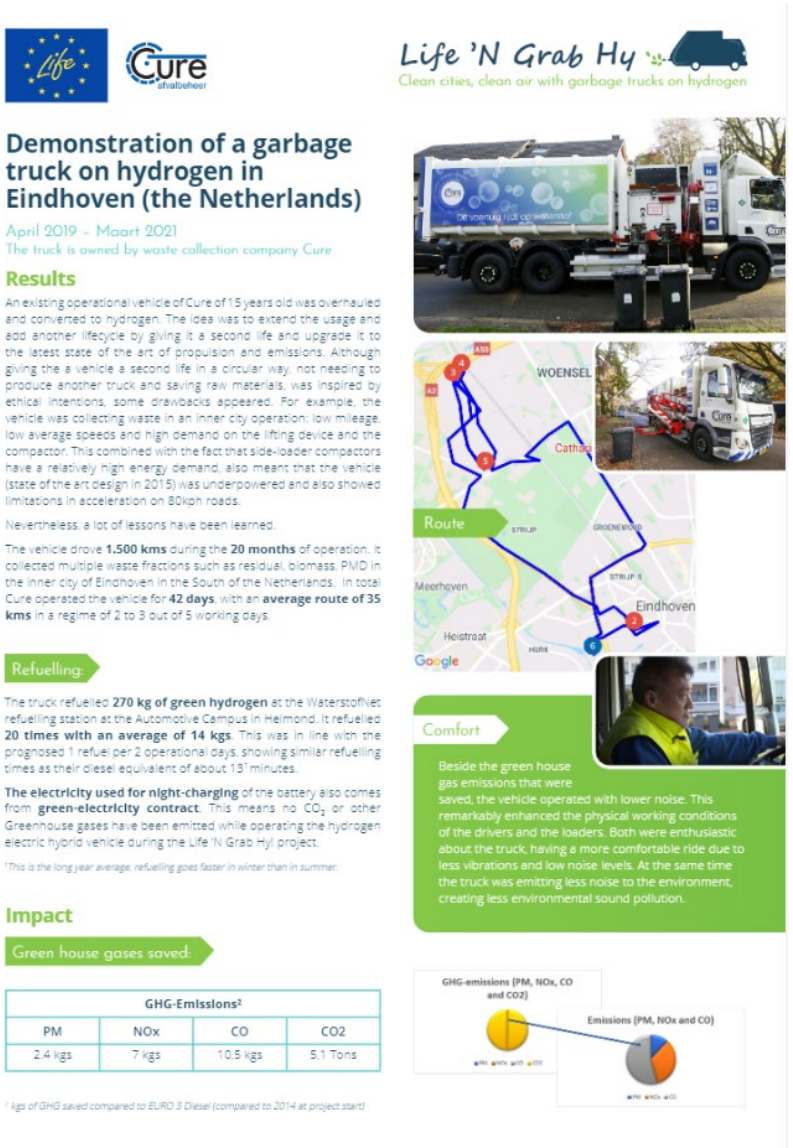
The local results (flyer)

- 20 months operational
- Distance covered 1.500 kms
- Average working day of 35 kms (inner-city)
- Refueling on average 14 kgs of hydrogen
- Saving in total 1.400 ltrs of Diesel

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)



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Clean cities, clean air with garbage trucks on hydrogen

Demonstration of a 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 13' minutes.

The electricity used for night-charging of the battery also comes from **green-electricity contract**. This means no CO_2 or other Greenhouse gases have been emitted while operating the hydrogen electric hybrid vehicle during the Life 'N Grab Hy! project.

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

Impact

Green house gases saved:

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

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WaterstofNet

Cure afvalbeheer

Etrucks europe

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

BAETSEN

These activities have received funding from the European Union's LIFE Programme under the Grant Agreement nr. **LIFE14 ENV/BE/000415**