Hydrogen and other environment friendly buses at RET Rotterdam

UITP summit – Stockholm - June 11th 2019

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environmentally friendly, efficient, electric motion

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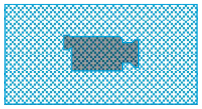
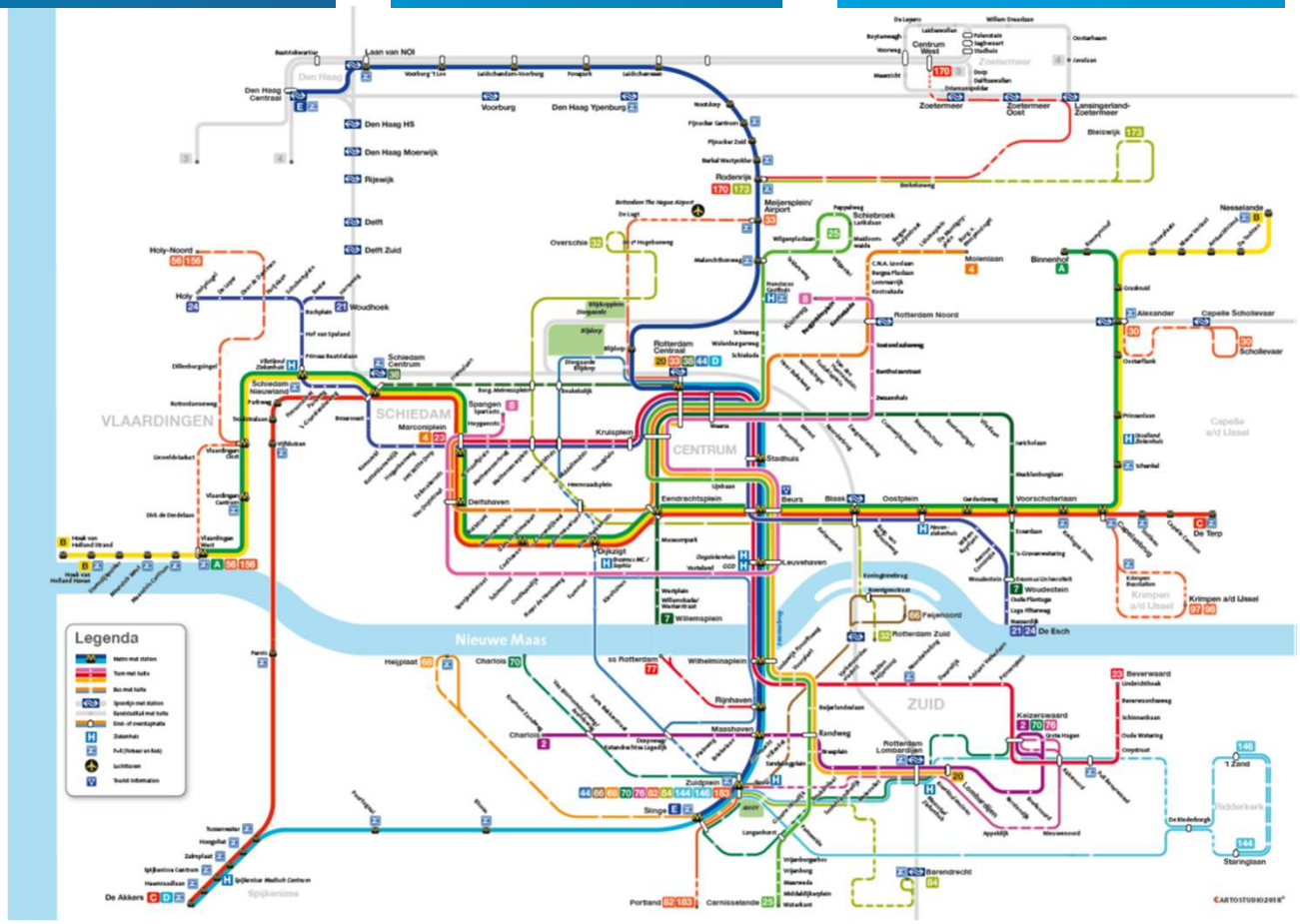
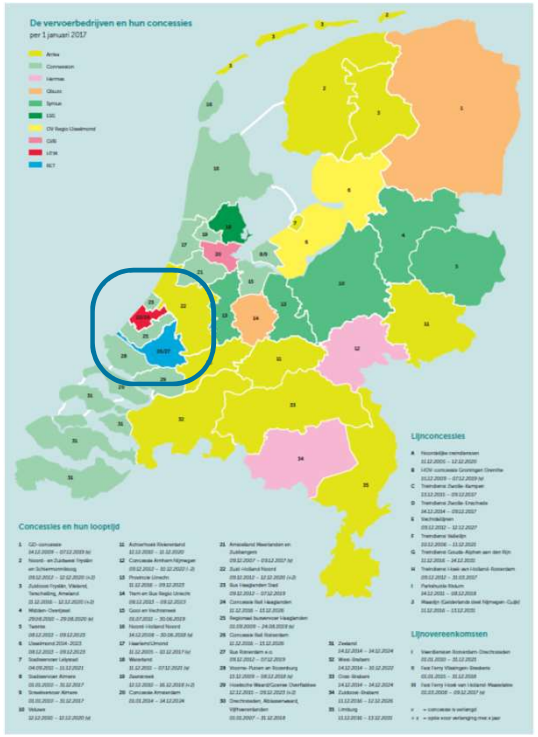
RET in brief

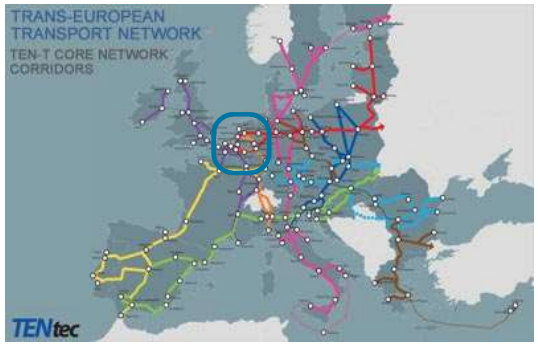
- 600.000 travelers per day
- Ca. 2.750 employees
- Fleet: 250 buses, 115 trams,160 metro, 1 ferry
- Annual turnover € 400 mio

- Company owned by Municipality of Rotterdam
  - > MRDH (Pta) owns one ‘golden share’
- Largest concessions
  - > Tram / Metro untill 2030
  - > Bus untill 2019 and 2019 - 2034
  - > Asset manager for rail assets (tracks, stations tram / metro)
  - > Owner of rolling stock
- Businessplan untill 2021 ("De Perfecte Reis")
- Travelers satisfaction 7,8 (scale to 10) in 2018
  - > 9 x increased by 0,1 p.y.

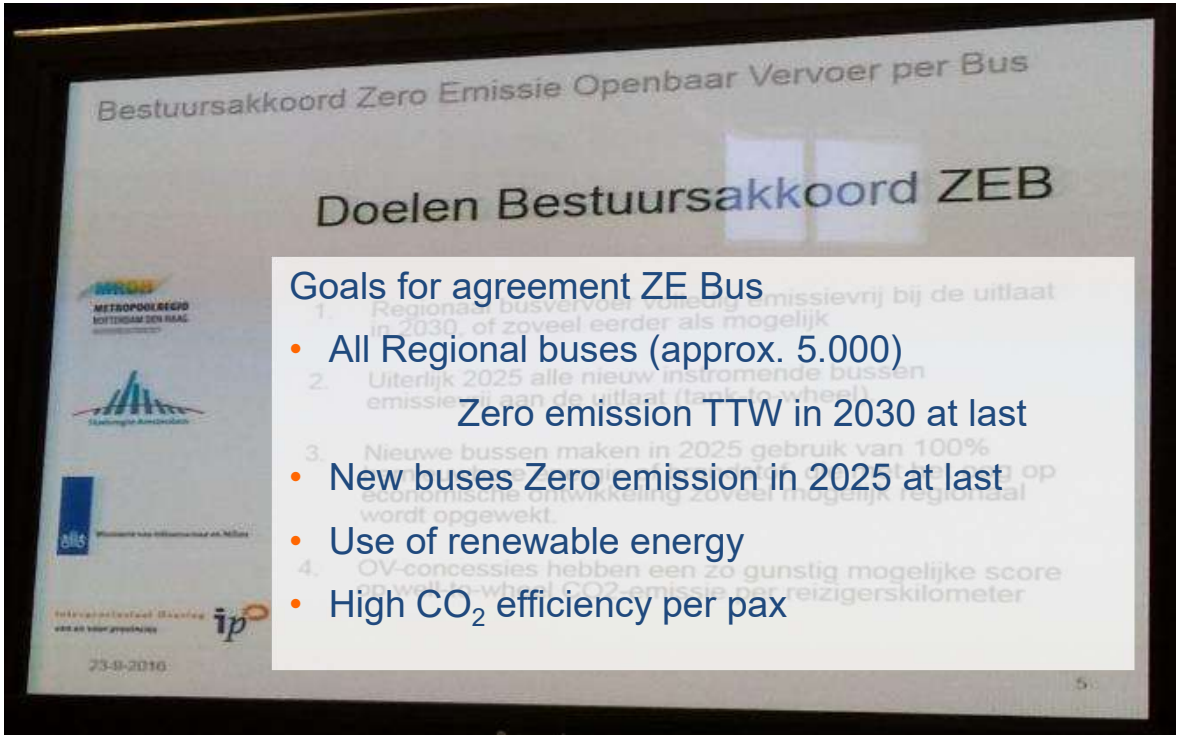








Context in The Netherlands



Grant of € 3,2 mio for
Action 2017-NL-TM-0060-W - REMETBUS2 Rotterdam

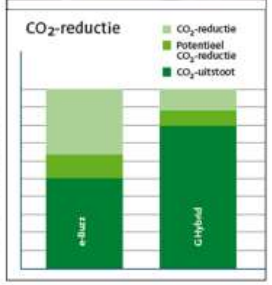
Medegefinancierd door de Europese Unie
Trans-Europees vervoersnetwerk (TEN-T)

Current bus fleet at RET

- 256 vehicles from 2006 and 2009

- 6 specials: electric hybrid and fuel cell vehicles

Gerealiseerd 2010 – 2014 *Hybride bussen*

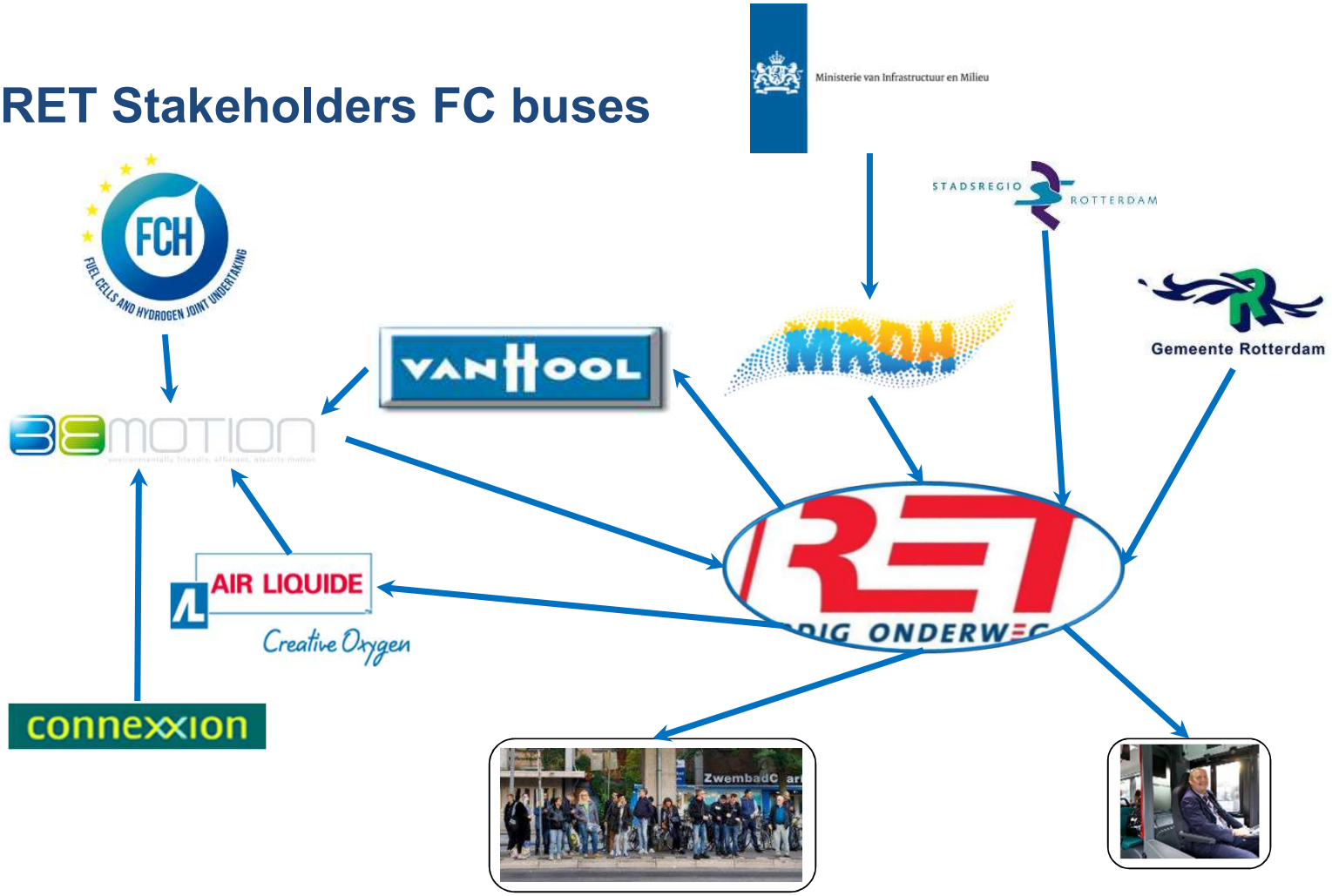


6 The start of operations

June 30: introduction of vehicle for stakeholders

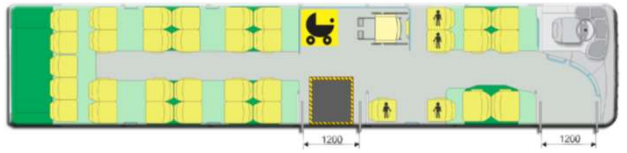
Including visit of fueling station

RET Stakeholders FC buses



Lay out of FC buses at RET Rotterdam

- 2 vehicles Van Hool A330FC
  - Siemens drive train and Ballard HD85 fuelcell
- Batteries 24 kWh
- 5 Tanks, 40 kg hydrogen
- 32 seats, 62 standing
- Electric heating interior
- Airco for driver and passengers



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Refuelling infrastructure

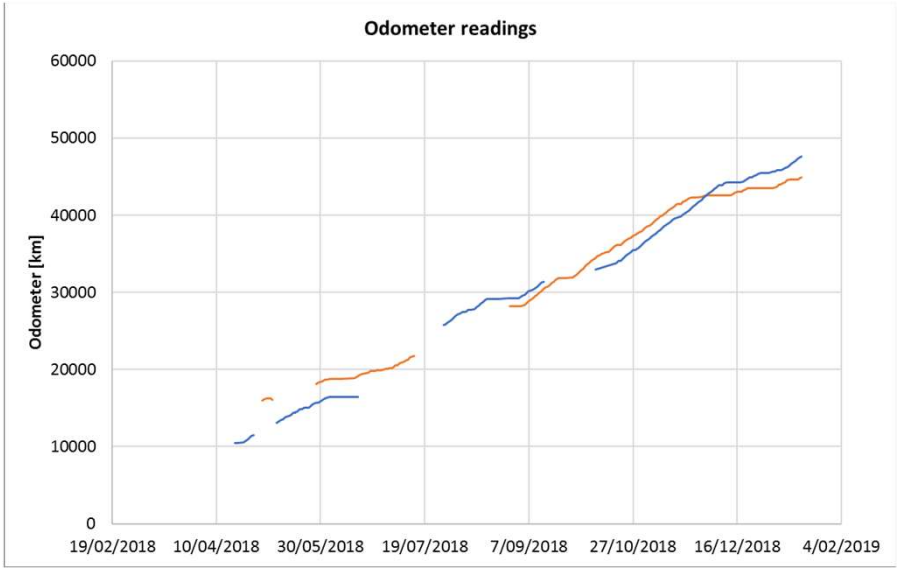
- Rhoon is a public refuelling station, for cars and heavy vehicles
  - •700 and 350 Bar
  - •Public accessible
  - •In 10 minutes drive from main plant RET Bus
- Deployment by AirLiquide
- Station realized with TEN-T subsidy.
  - •One of the requirements was neighbourhood of motorway A15, part of TEN-T network
- Hydrogen is available from the pipeline between Rotterdam and Antwerp
- Use and payment with Tokheim pillar and special card
- Safety check after connecting nozle, before fuelling
- Commercial price € 10,- per kg; RET pays € 8,50 (in first phase)
- For RET delivery of 45 kg/day guaranteed between 11 PM and 5 AM

•source: http://www.tankpro.nl/brandstof/2014/09/04/eerste-openbare-waterstof-station-in-nederland-van-start/

RET buses - distances

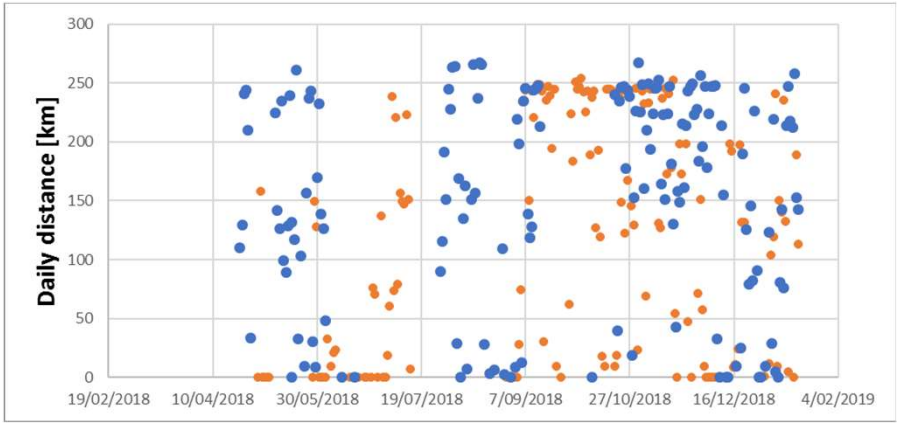
Set up of a data transfer system has been difficult at the start. Data transfer system is put in place and functions now without problems.

Both buses have travelled +50.000km since the start of the operations.

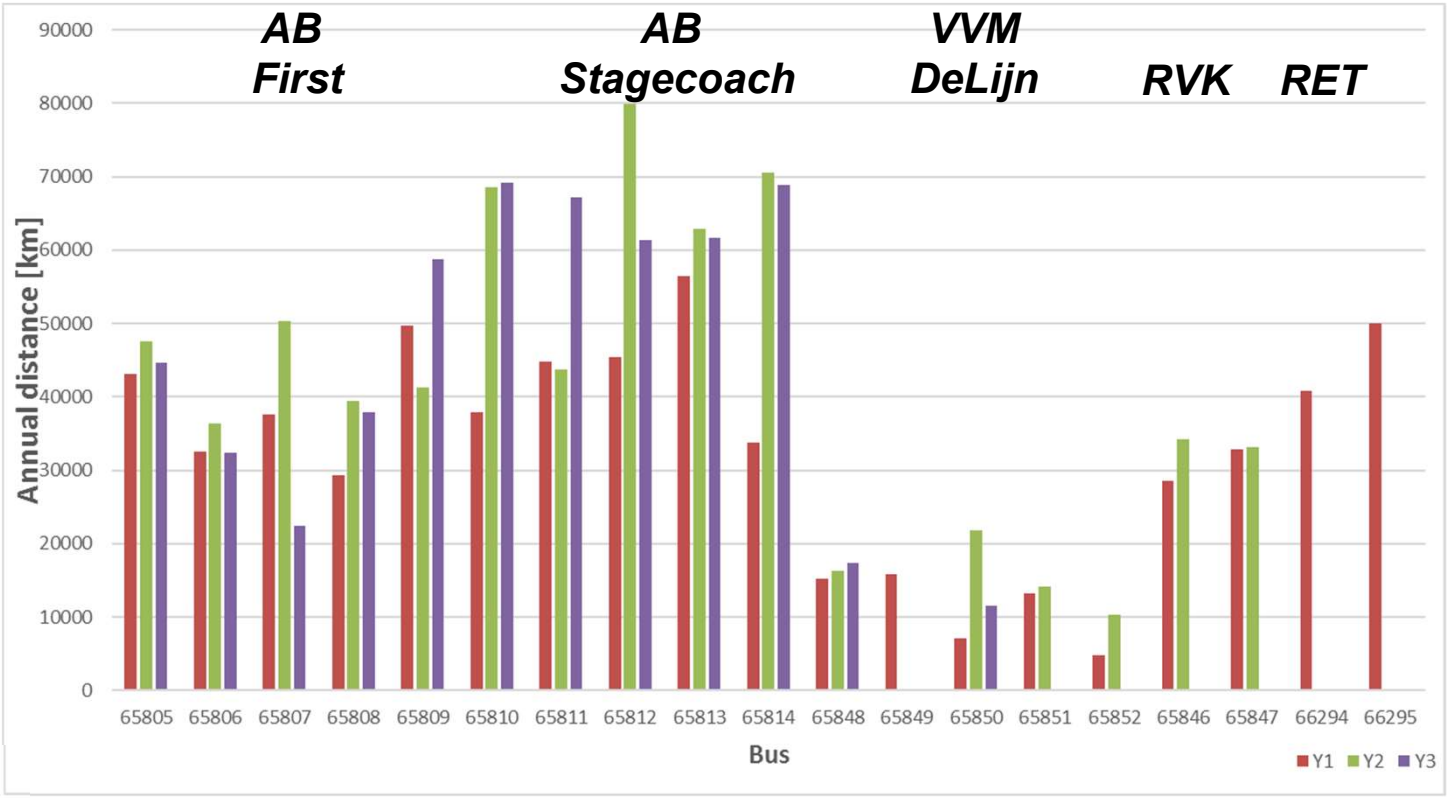


The daily distance travelled is rather variable.
The buses rub up to 250km daily.

Remark: in this graph, only data from ‘technical available days’ is given.



Annual distances of FC buses in projects



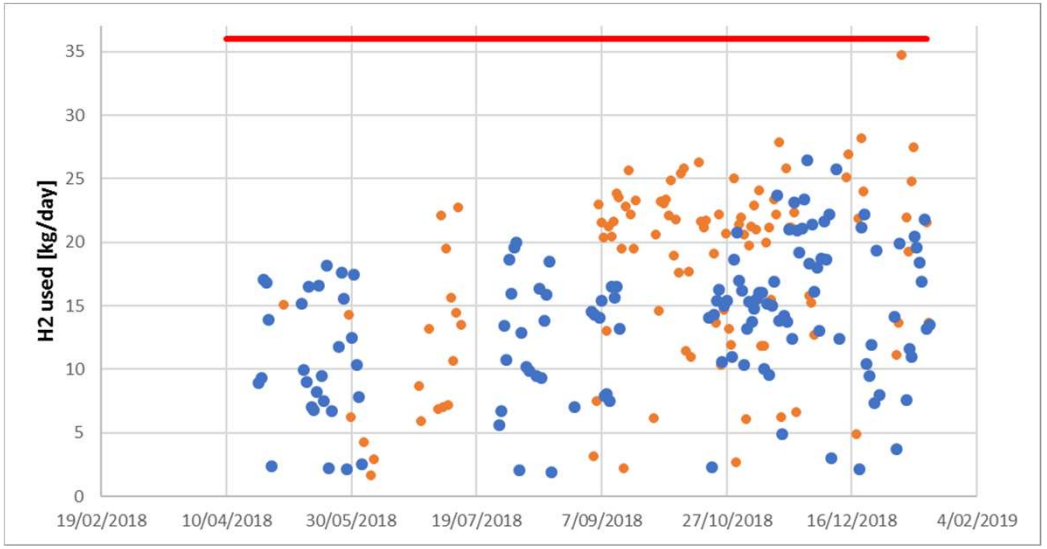
	Y1 av [km/bus]	
1	RET	45389
2	AB-Stagecoach	44640
3	AB-First	35647
4	RVK	30688
5	VVM DeLijn	11226

For information: RET has the fleet with highest first annual mileage of all monitored Van Hool FC buses.

RET – Hydrogen use

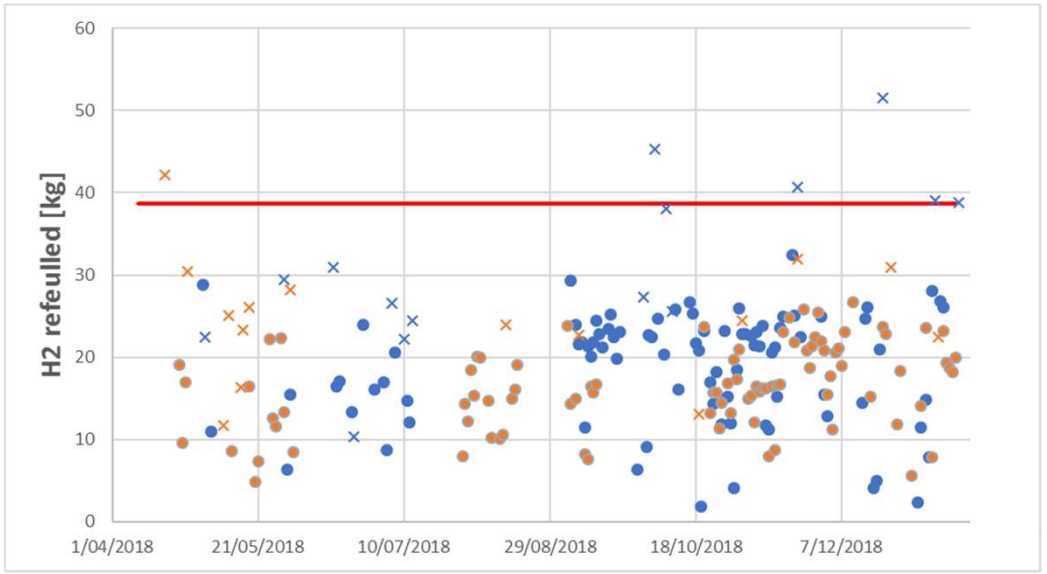
Buses consume up to 30kg/day, depending on the time of the year.
Hydrogen tanks are not full-used: ‘longer days’ can be made.

Red line: max available hydrogen in tanks



Amount of H_2 refeulled is variable: lot of refuels when tanks contain still a remarkable amount of hydrogen.
Some days 2 refuels in a bus.

Red line: max hydrogen mass in tanks
Crosses: second refuel for that day.

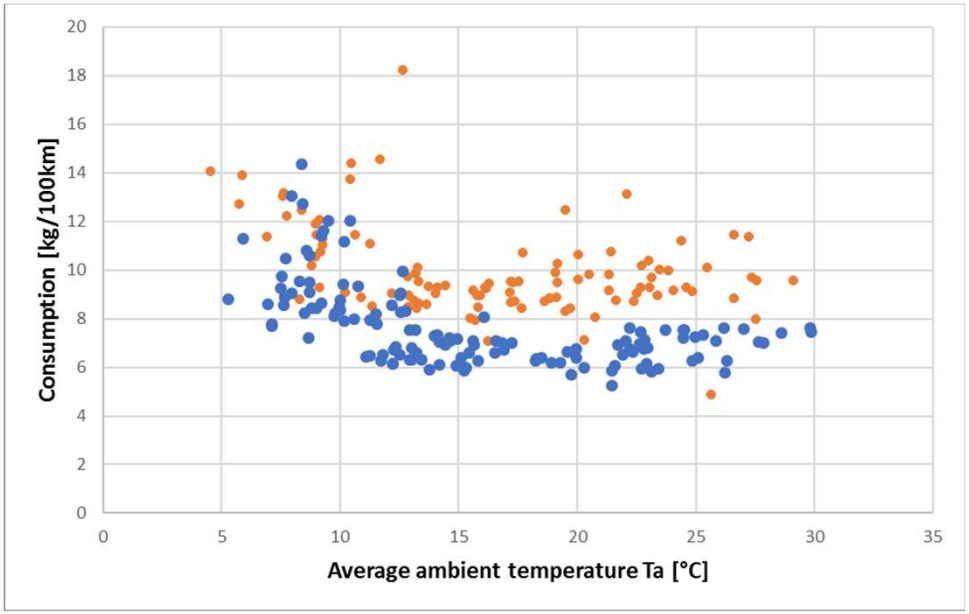


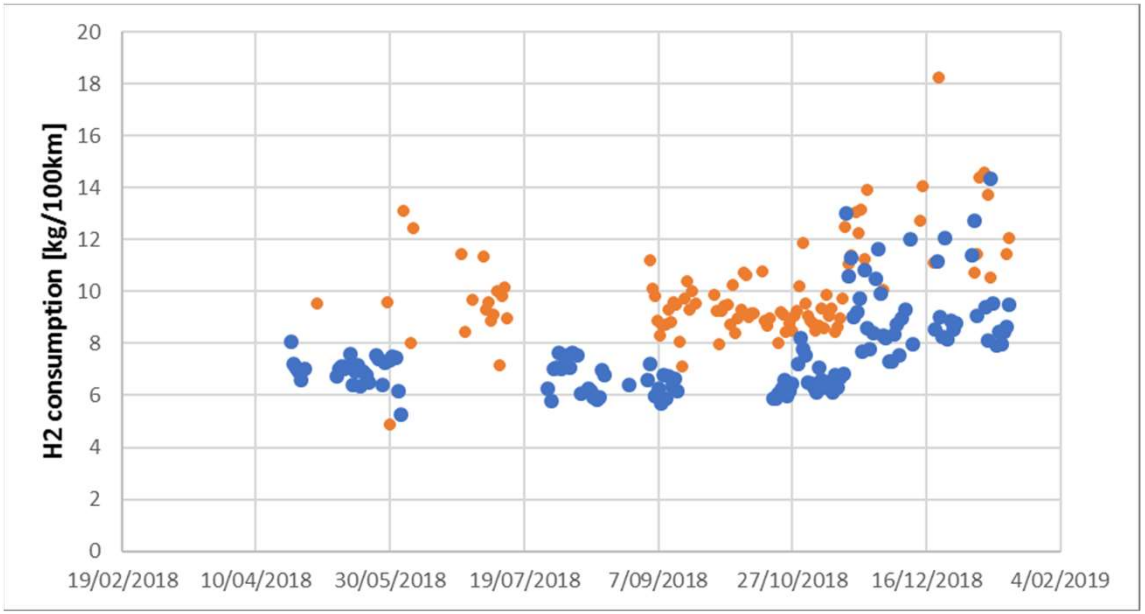
Remark: in these graphs, only data from ‘technical available days’ is given.

RET – Hydrogen consumption

At a given speed, H_2 consumption is dependent from ambient temperature (heating and airco consumption).

One bus consumes more than the other. That fuel cell is refurbished.





Where are we now?

Public Air Liquide station (h2 from h2 pipeline Antwerpen-Rotterdam)

2 Van Hool buses

- ✓ VHA330FC - 13m / Ballard FC
- ✓ In operation since october 2017

Km driven : **105 980 km**

- ✓ Bus 1: 52.573
- ✓ Bus 2: 53.409

First experiences of RET:

+ Passengers and drivers like the buses;

+ no investments in charging infrastructure/long distance lines (over 300 km/day)

- teething issues and TCO

Lessons learned

- ✓ The deployment of **vehicles needs to be aligned** with the **infrastructure** construction
- ✓ Consider new **safety** issues (optimize workshop)
- ✓ Expect Technology **'teething'** issues
- ✓ Make ure there is a good **supply chain** (f.e spare parts at the sites)
- ✓ Make sure **all stakeholders involved** support the project (good internal communication)
  - ✓ Operators have to work closely with manufacturers
- ✓ **Train**
  - ✓ The drivers (ambassadors!)
  - ✓ Technicians but also the management
- ✓ **Inform passengers**!

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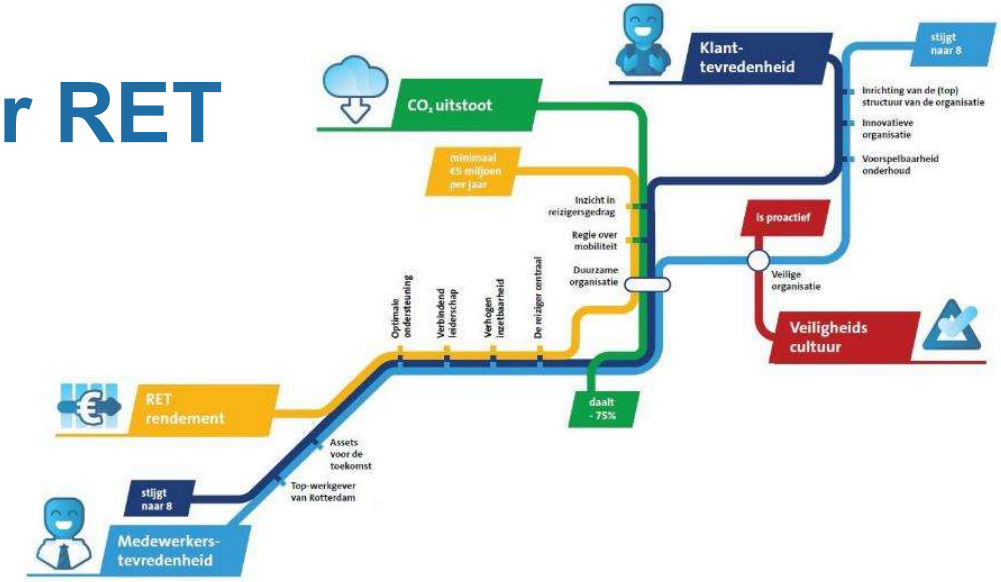
Future expectations for RET



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Huidig (Euro V)		250	50		5 a 10 reserve												
Extra ivm laden			+ 5		+10			+ 15					+ 15				
Minder ivm wijzigingen inzetmodel			-0		-0			-0					-0				
Totaal			255		260			265					265				
Zero 1			55														
Zero 2					50												
Zero 3								50									
Zero 4													110				
Euro VI (lease)			40														
Hybride			110										5 a10 reserve				
Totaal (incl TR)		250	255	255	260	260	260	265	265	265	265	265	265	265	265	265	265

PM – tranche 1 and 2 battery electric
PM – for tranche 3 and 4 all options open (including hydrogen)

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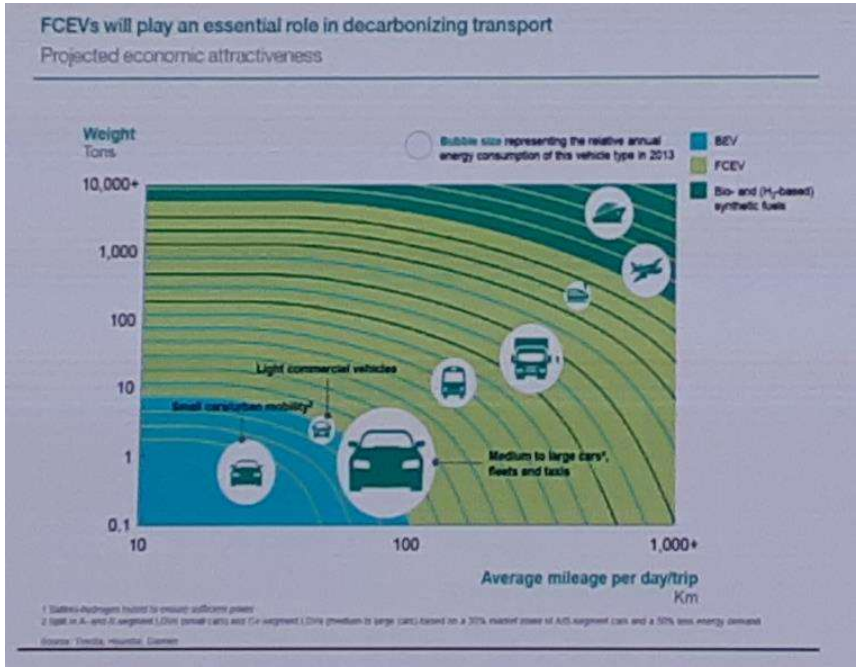
Future expectations for The Netherlands



2019:
3 public accessible HRS avialable
25 HRS stations planned / under construction
2025:
15.000 vehicles;
50 HRS
2030:
300.000 cars;
75.000 other vehicles
> 200 HRS

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Thank you for your kind attention!

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