

# Zero-emission bus reference

Qbuzz - Gerrit Spijksma





## Zero-emission bus reference projects: Groningen and Drenthe



# Introduction Qbuzz

## Groningen Drenthe region:

- 100.000 commuters per day
- 3.700 rides per day
- 333 buses



## Utrecht region:

- 175.000 commuters per day
- 5.000 rides per day
- 350 buses
- 24 trams



## DAV region:

- 2.300 bus rides per day
- 180 buses
- 140 train rides per day
- 10 trains



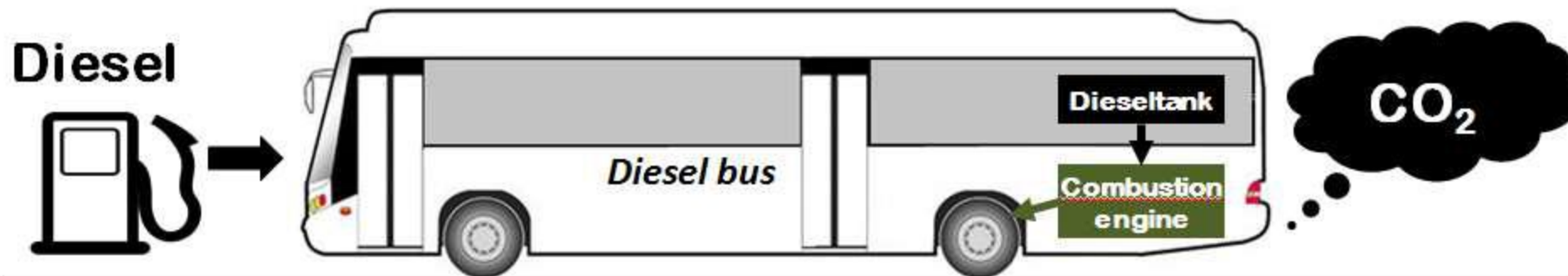
# National Policy and Developments

- From 2025, all new public transport buses will be zero-emissions vehicles based on a covenant between Dutch government and public transport authorities. It is not a law.
- By 2030, the entire Dutch bus fleet of approximately 5,300 buses has to be turned into a zero-emission bus fleet.
- In the near future more electric and hydrogen-powered buses will be used in public transport. At present, buses with both drive lines are in operation in Groningen Drenthe and electric in Utrecht and DAV

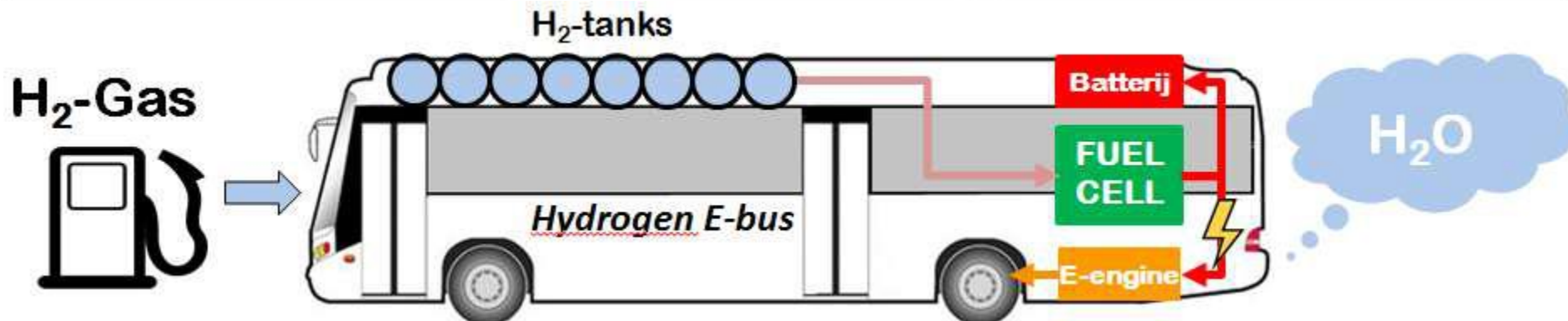
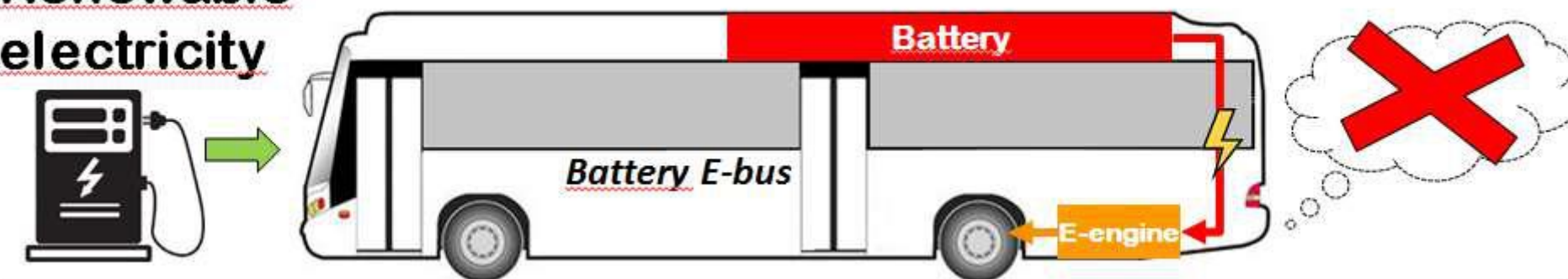




## Diesel and ZERO-EMISSION Buses



**Renewable  
electricity**



# Why is E technology complex

- Diesel bus can store energy for 800 km vs 100 km to 300 km for an electric bus
- Shrinking energy storage overtime – with diesel this stayed the same
- Time required for energy loading/fueling is much longer
- Fast charging reduces the lifetime of the battery – charging strategy required
- New technology for drivers, technicians and (operational) management
- Significant loading infrastructure required (and accordingly permits)



# Overview of Introduction E Technology

- First three electric busses in Utrecht in 2014 – Optare and induction charging
- Two electric busses introduced in Q1 2017 in Groningen-Drenthe based on overnight charging - Ebusco
- Ten electric busses introduced in Utrecht in Q3 2017 based on opportunity charging - Ebusco
- Ten electric buses introduced in Groningen-Drenthe in Q4 2017 based on opportunity charging – VDL
- In Q1 2018 two hydrogen busses introduced in Groningen-Drenthe – Van Hool
- In Q4 2018 over 40 electric buses in DAV region with opportunity charging

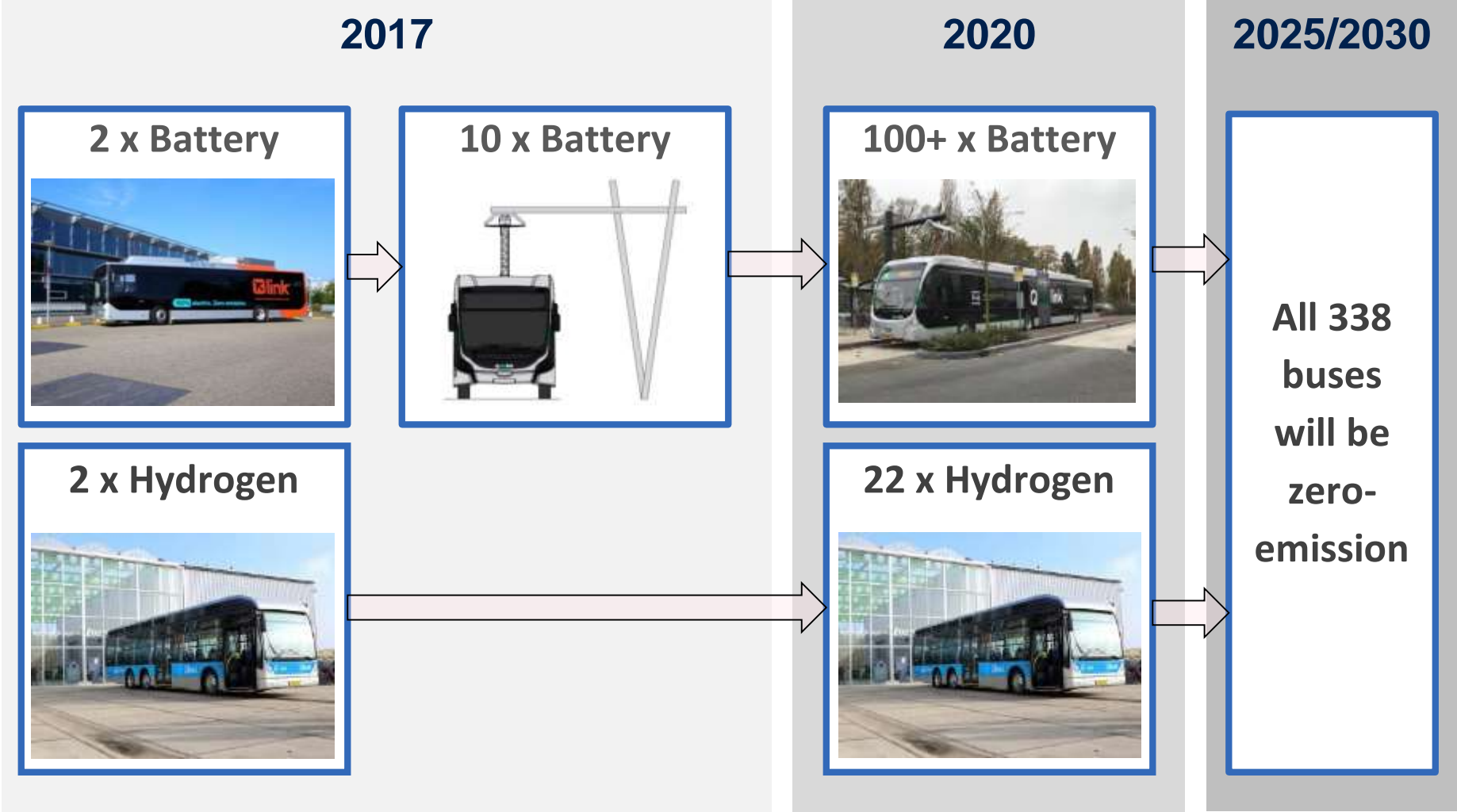


## Experiences to Date

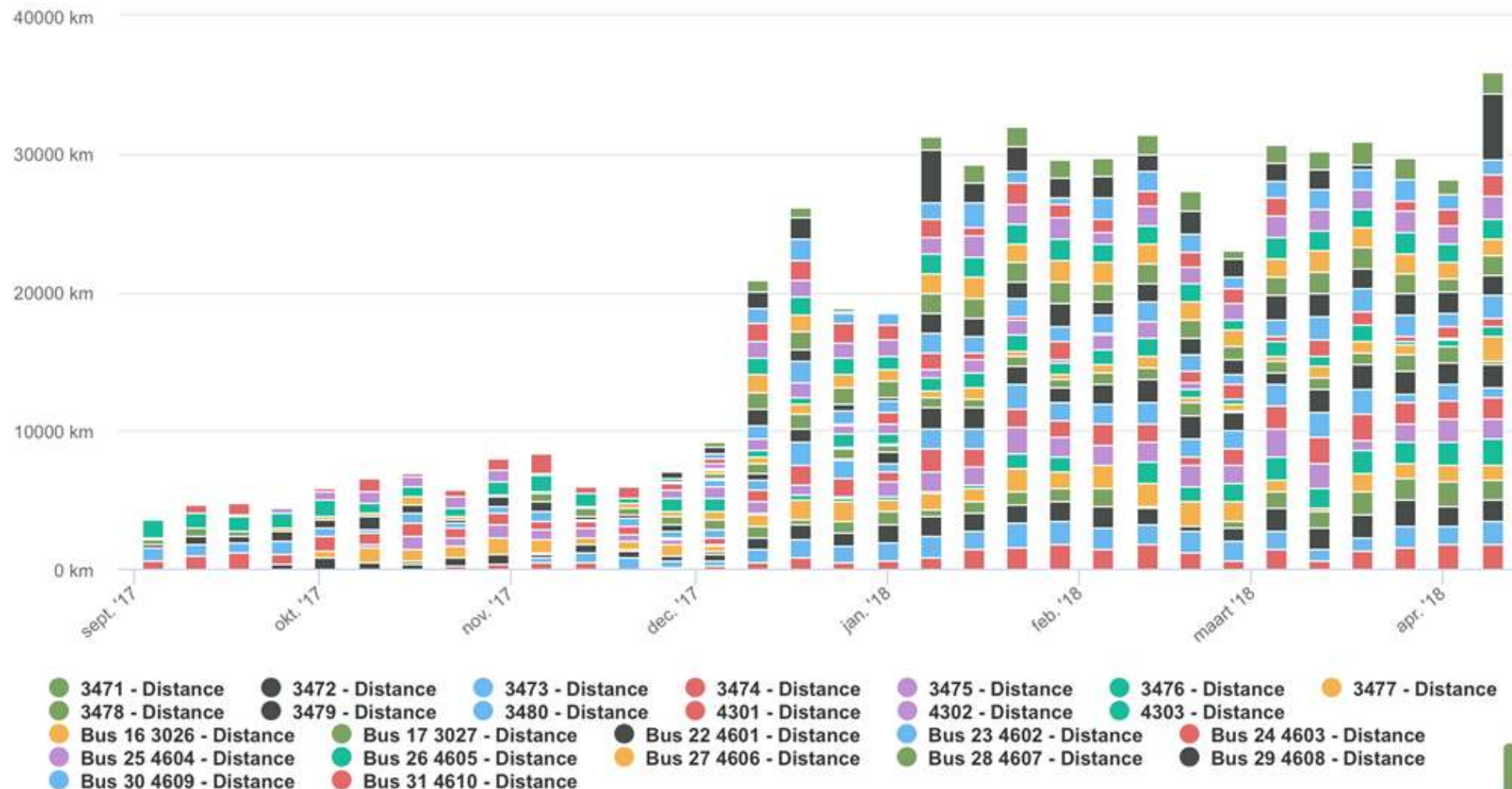
- Everything that is new will go wrong
- But failure is not an option
- Top management involvement
- Knowledge of the lines and calculation methods to determine number of buses required
- Battery knowledge needs to be develop
- Plan introduction of the new buses with dedicated drivers
- Implement monitoring systems
- Do not give up, when the first results are disappointing
- Suppliers claim experience and knowledge; do not trust them, they only want to sell their product
- Be careful with contract management, late deliveries or substandard quality can be expected. Monitor progress in factories yourself.



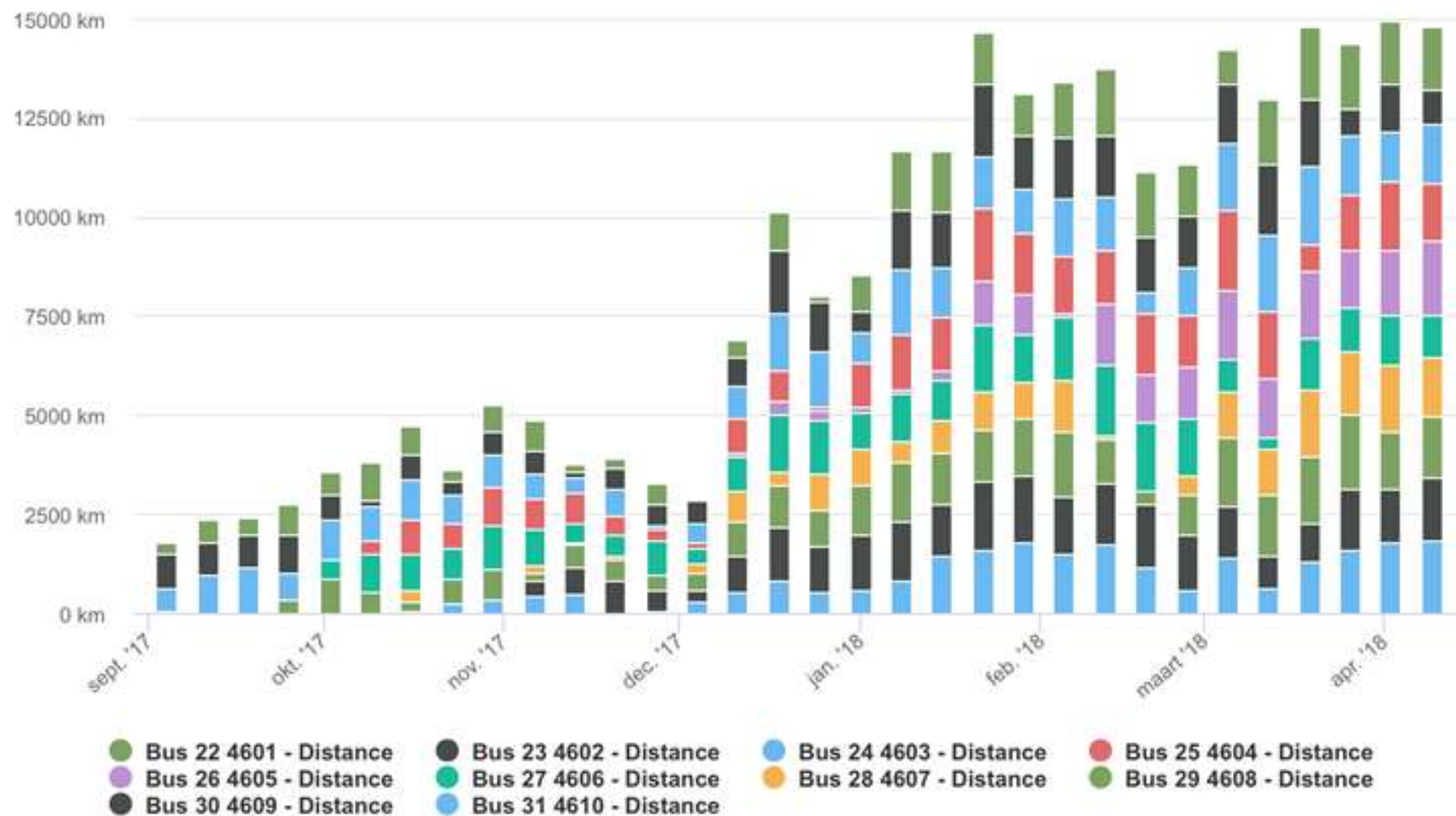
# Development Strategy Groningen Drenthe



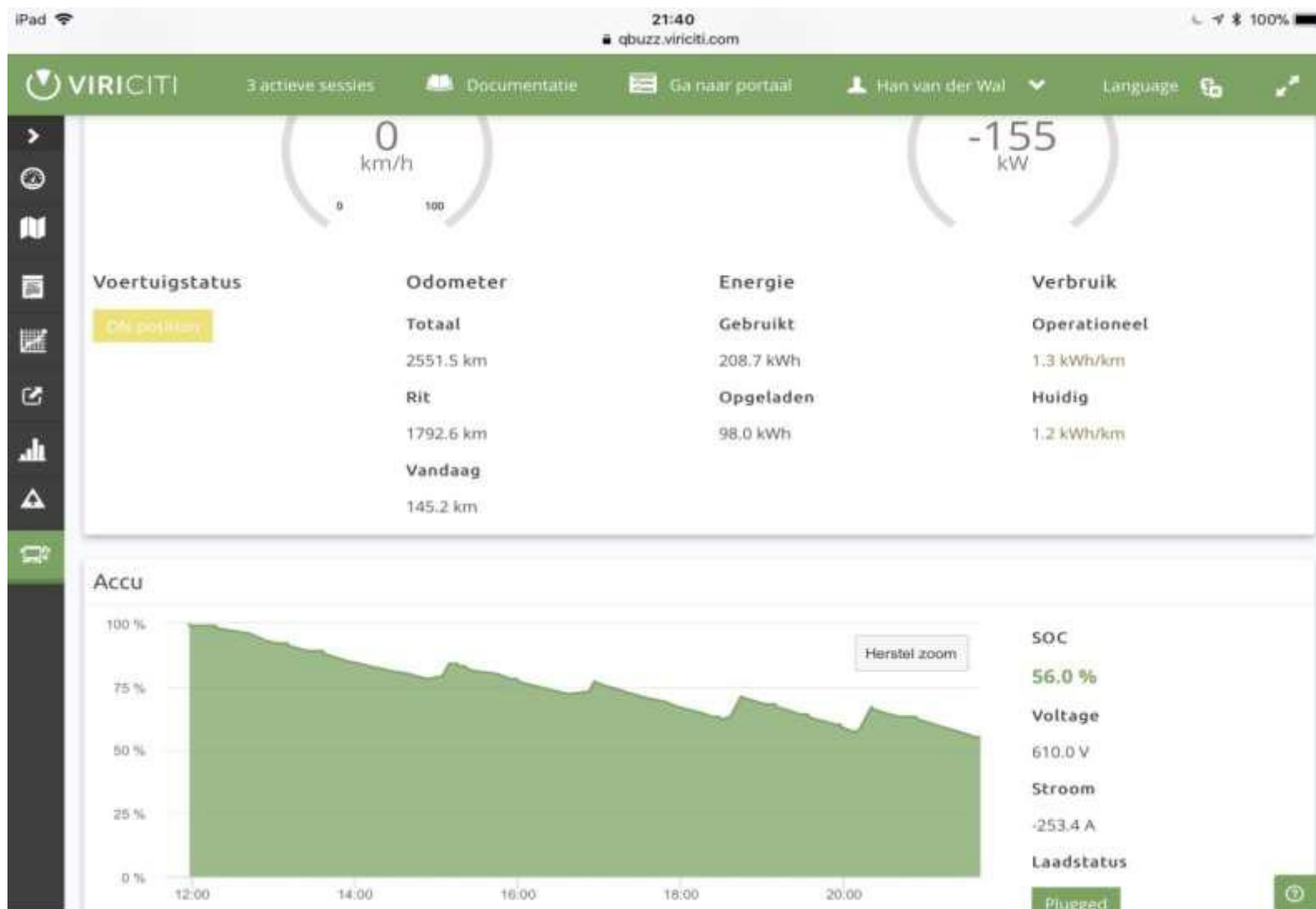
# Total Zero Emission weekly mileage at Qbuzz NL



# Project e-bus line 1 Utrecht



# Per vehicle – brand: Ebusco





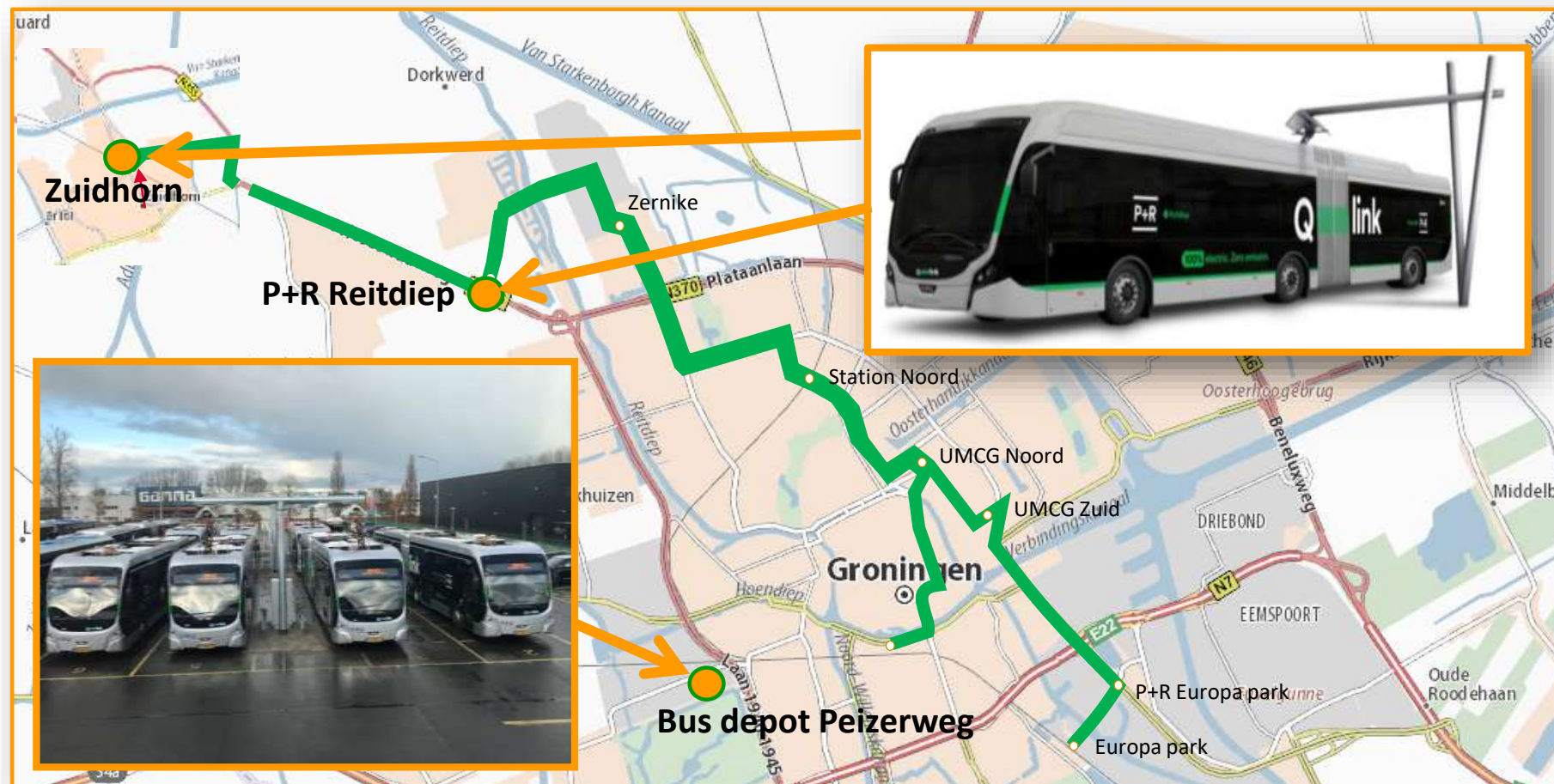
# GD - Electrification Q-LINK GREEN

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Groningen Drenthe



- Ten electric articulated buses: VDL Citea
- Two opportunity (fast) charge stations: Zuidhorn and P+R Reitdiep
- Overnight charging at bus depot Peizerweg, City of Groningen
- Operation: 7 days a week, average daily distance: 265 kilometre per bus



# Fast Charge Station P+R REITDIEP

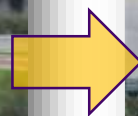
Transformer substation 1750KVA



Heliox charger unit 1 and 2 (2x 300kW)



Charge pole 1



Charge pole 2

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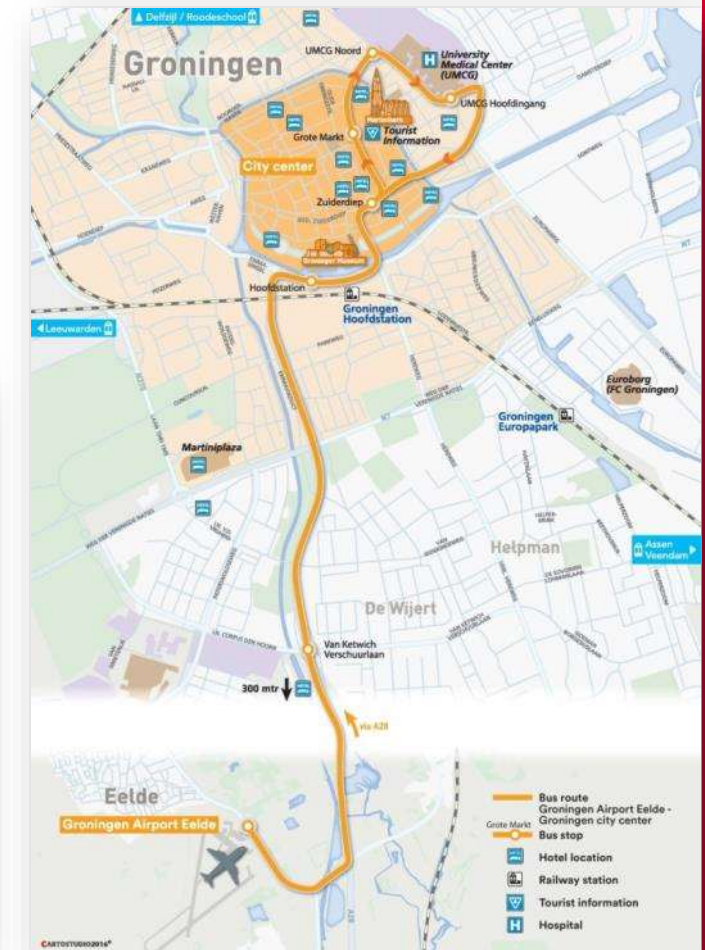
Groningen Drenthe





# GD – Electrification AIRPORTLINER

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# GD – Pilot Two Hydrogen Buses

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Groningen Drenthe



- Two Van Hool A330 Fuel cell buses
- Hydrogen refuelling station located at AkzoNobel site, Delftzijl
- Operation: 6 days a week, from Appingendam tot the City of Groningen and the City of Assen
- Average daily distance :250 kilometre per bus (on week days)



# Hydrogen Chain: Production, Distribution and Refuelling Station

Energy source:  
Offshore wind  
farm



Green Hydrogen as  
by-product  
from chlorine  
production plant



Hydrogen  
distribution by  
pipe line



Hydrogen  
refuelling  
station



Two van Hool  
Fuel cell buses



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Groningen Drenthe



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Ministerie van Infrastructuur en Milieu



provincie  
groningen

OV-bureau Groningen Drenthe



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# Artist Impression Refuelling Station

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Groningen Drenthe

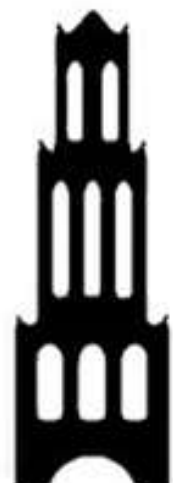


# Utrecht – Opportunity Charging





# Utrecht - Induction Charging





# Energy Consumption

- Consumption / kilometer

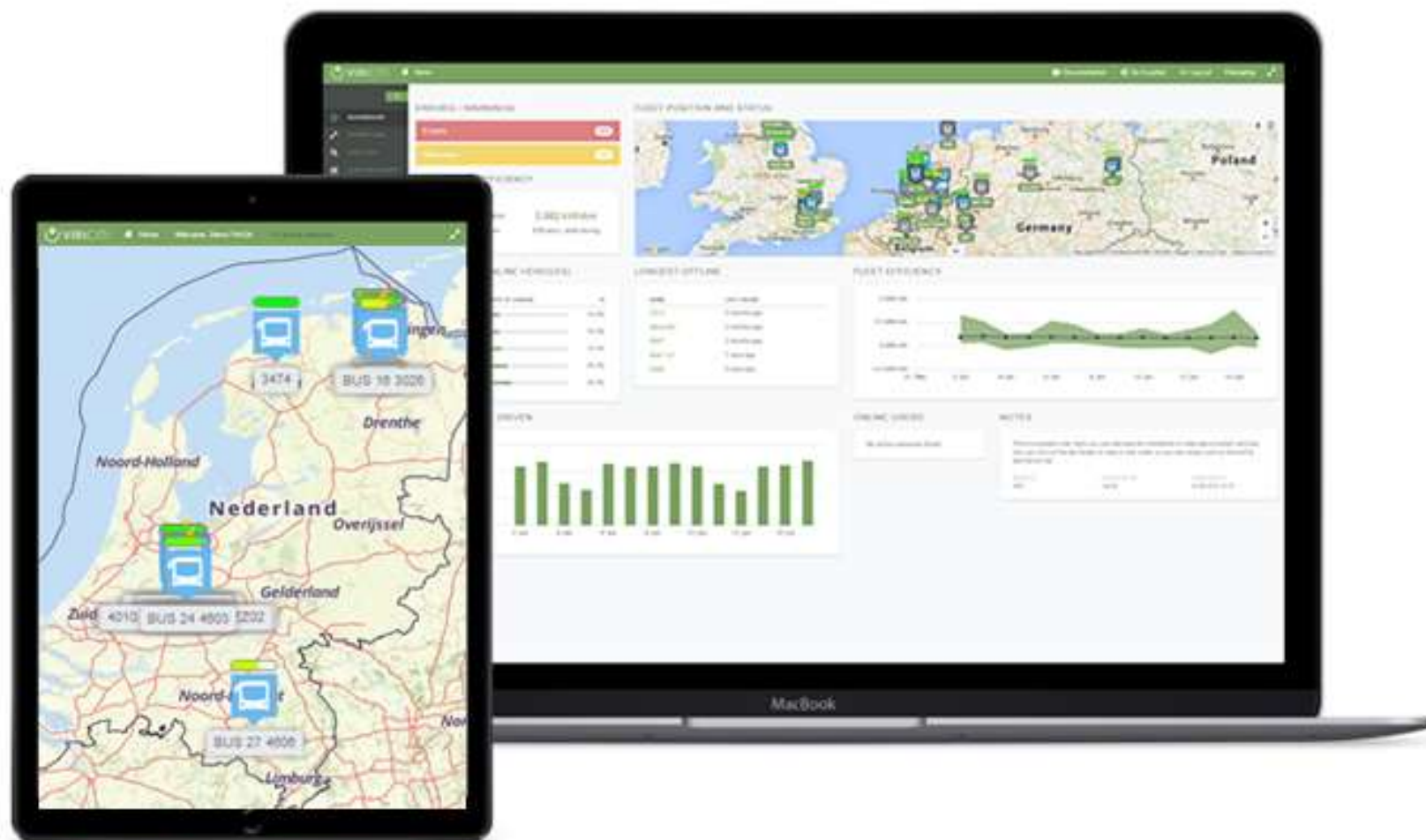
- **12 meter bus**

•	Winter :	Summer:
• Driving	1,0 kWh / Km	0,9 kWh / km
• Heating	<u>0,5</u> kWh / Km	<u>0,2</u> kWh / km
•	1,5 kWh / Km	1,1 kWh / km

- **10 meter bus**

•	Winter :	Summer:
• Driving	0,8 kWh / Km	0,7 kWh / km
• Heating	<u>0,4</u> kWh / Km	<u>0,2</u> kWh / km
•	1,2 kWh / Km	0,9 kWh / km

# Monitoring buses – real time



# Importance of Online Monitoring

- Dispatcher can see online the condition of vehicles.
- With battery state of charge we can predict the daily reliability of the bus-service.
- Individual drivers can see their performance and educate themselves in better driving.
- Lifetime of battery will be longer with online technical checks.

# Future technology Electric bus testing

- **Rampini 9 meter Bus**
- Imported from city of Vienna for testing the ability of charging on the overhead wiring of tramlines.
- **Alstom 12 meter Aptis**
- Tested in Utrecht, Groningen, Rotterdam for more passenger space and better curve fitting in narrow infrastructure



## Rampini from Vienna



# Alstom Aptis

