The future is green

Moving towards a zero-emission bus fleet



Qbuzz

ov bureau groningen drenthe

OV-bureau = Public Transport Authority Groningen Drenthe

5.600 km2
1,1 mln inhabitants
(Groningen 220.000)

PT contracts
€ 114,5 mln
Per year

Passenger revenue
€ 57 mln
Per year
(50%)

PTO
Qbuzz



Passengers
27 mln
per year (2019)

Passenger-km
290 mln
per year (2019)

Busses
400+

Algemene klanttevredenheid
GD-concessie
7,7

CO2 emission (2020)
20 gram
per passengerkm

Busdrivers
900+

ov bureau groningen drenthe

Qbuzz = Public Transport Operator

Groningen Drenthe region:
- 100.000 commuters per day
- 1.000 employees
- 436 buses

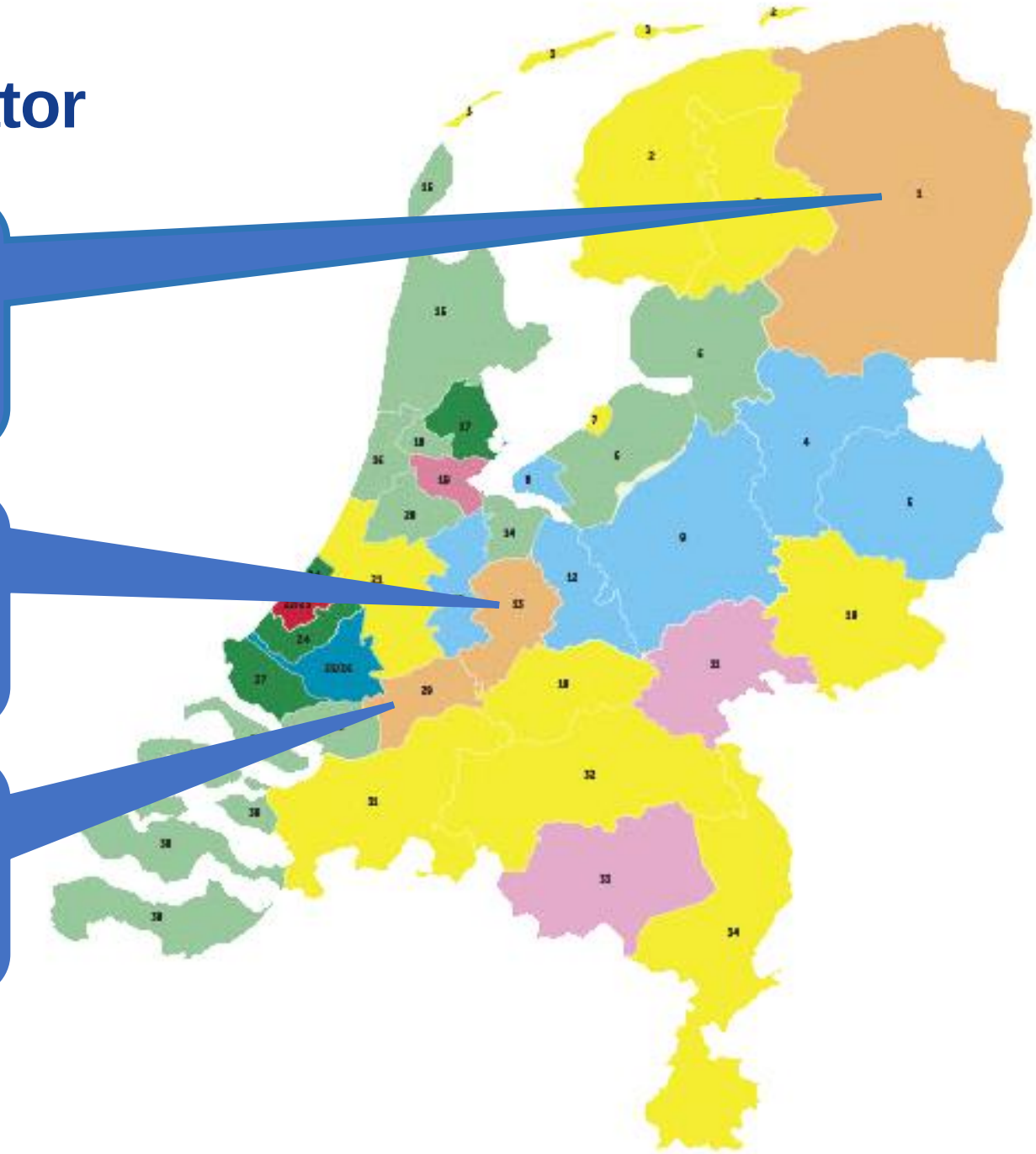


Utrecht region (U-OV):
- 200.000 commuters per day
- 1.200 employees
- 335 buses
- 49 trams



DMG region:
- 50.000 commuters per day
- 450 employees
- 166 buses
- 10 trains





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FERROVIE DELLO STATO ITALIANE

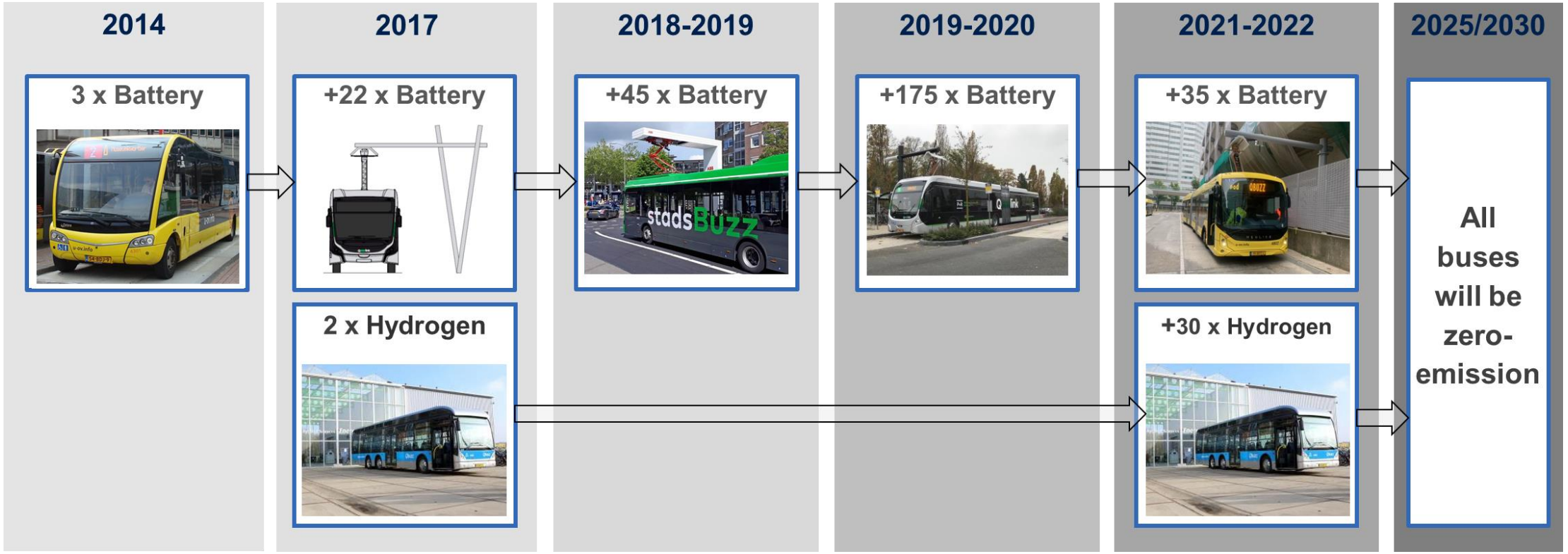
2015: Nationaal Bestuursakkoord Zero Emissie bus

All new buses must be ZE from 2025
All buses must be ZE from 2030



ov bureau groningen drenthe

Qbuzz zero emission roadmap

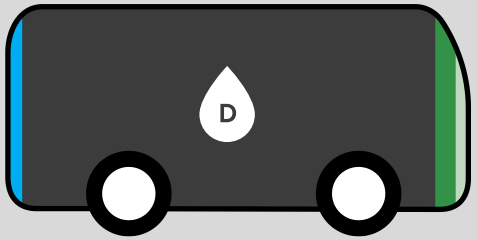


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Zero emission roadmap Groningen Drenthe 2018 - 2030

2018

GD concession
dec 2009-dec 2019
Qbuzz

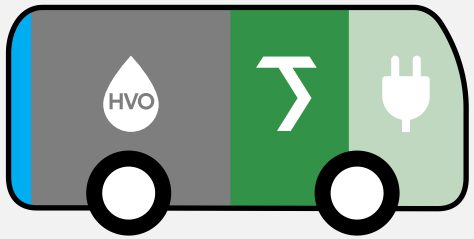


14 Zero emission buses
(of 360+)

10 Q-link
2 citybuses
2 regional buses

2020

GD concession
dec 2019-dec 2029
Qbuzz

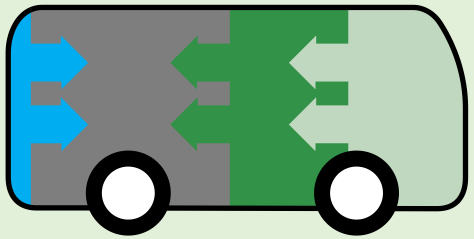


186 Zero emission buses
(of 360+)

59 Q-link
45 (all) citybus
60 regional buses
22 regional buses
HVO in the rest of the buses

CO_2 -90%

2022



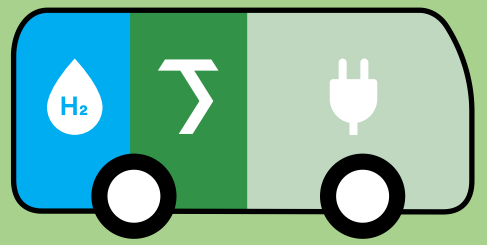
2022 business cases:

10 regional buses
2 retrofit Qliner coaches
1 eight person bus

Next steps tender

3 Q-link Dec 2023
9 Q-link Dec 2027

2030



CO_2 0%

Green Hydrogen

Opportunity charging

Overnight charging

Qbuzz

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Zero emission vehicles

Profit

- Clean: less or no emission of harmful substances
- Sustainable: less or no CO_2 emission
- Quiet: less noise production inside and outside the vehicle

Challenges

- Sufficient energy on board
- Energy management
- Energy infrastructure

Battery-electric vehicles

Profit

- Reduced maintenance costs
- Lower mileage costs
- Reliability
- Battery life

Challenges

- Depot space
- Peak power
- Grid stabilisation
- Investments
- Power grid capacity

H_2 vehicles

Profit

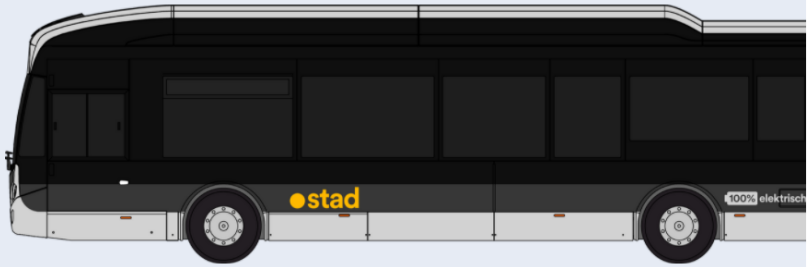
- Short filling time
- No charging infrastructure on the go
- Quiet and clean
- OV as launching customer

Challenges

- Increase in scale and price reduction needed
- Offer bus suppliers

Citybus

- ✓ Heavy-duty use in the city
- ✓ Up to 250 km/day
- ✓ Smaller battery + quick recharging on the go



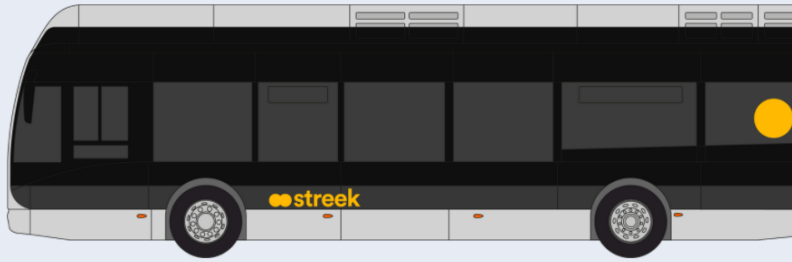
Regional bus

- ✓ Short to medium daily distances in the region
- ✓ Up to 300 km/day
- ✓ Large battery + charging at depot



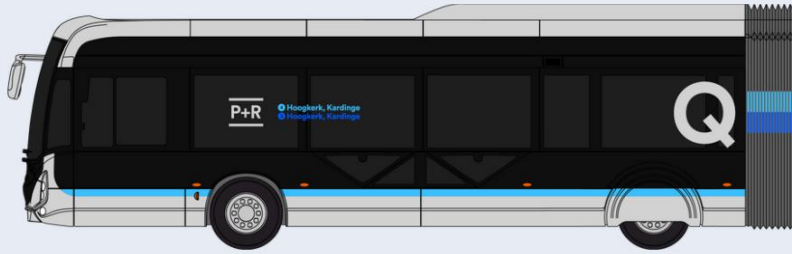
Regional bus

- ✓ Long daily distances in the region
- ✓ > 300 km/day
- ✓ H_2 is already a reality for 32 buses



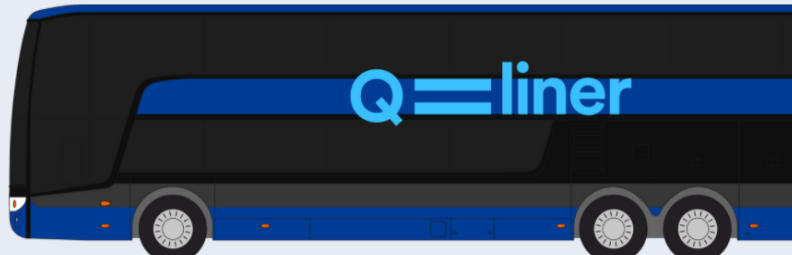
Q-link

- ✓ Zware toepassingen in en om de stad
- ✓ Heavy duty applications in and around the city
- ✓ 300-600 km/day



Qliner

- ✓ Motorway buses (Qliner)
- ✓ 750-1000 km/day
- ✓ Euro VI-HVO - Hydrogen in development

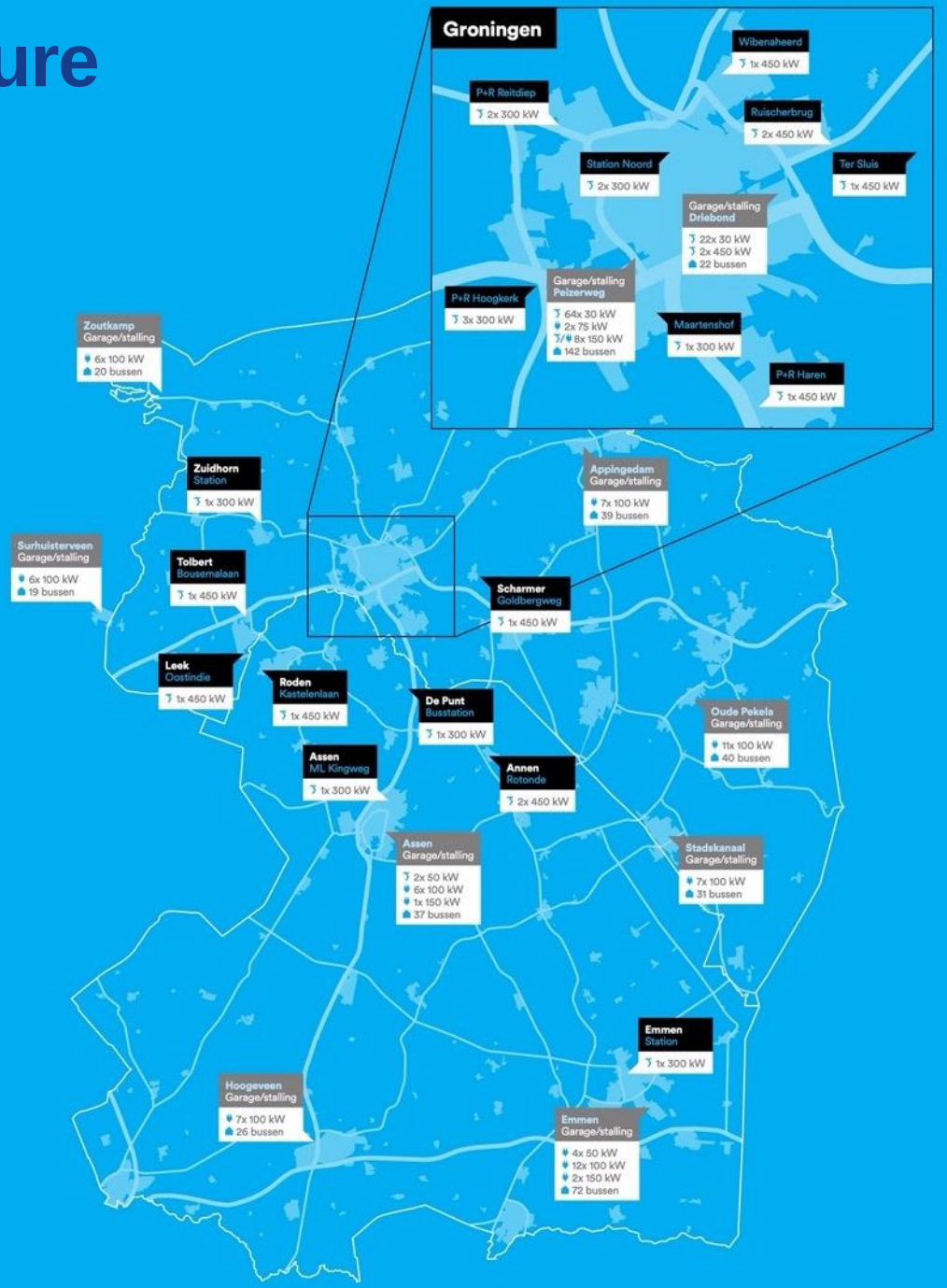


Charge infrastructure



25 ‘end of line’ opportunity chargers (fast, 300-450 kW)







100 depot overhead chargers (50-150kW)



65 depot plug-in chargers (slow)

Hydrogen Refuelling Stations

Delfzijl 2017

2-5 buses

Groningen 2021

20-30 buses

Emmen 2022

10+ buses







ZE buses battery electric

- **33 city and 10 Q-link buses VDL**
  - 10 VDL Citea's SLFA-181 Electric / 180 kWh (2018)
  - 11 VDL Citea's SLFA-180 Electric / 288 kWh (2020)
  - 32 VDL Citea's SLF-120 Electric / 216 kWh (2020)
  - Charging with a pantograph and charging station.
  - Fast recharging on the road, slower recharging at the depot and full recharging overnight.
  - Range between 120 and 170 kilometers.

- **62 region buses Ebusco**
- 12 meter
- 363kWh battery
- 105 kWh per 100 km
- Charging with a plug, at the depot.
- Range between 220 and 280 kilometers.

- **49 Heuliez GX 437 Q-link**
- 18 meter.
- Li-ion NMCG battery system
- Charging with a pantograph and charging station.
- Fast recharging on the road, slower recharging at the depot and full recharging overnight.
- Range between 105 and 125 kilometers.





ZE buses hydrogen

32 Van Hool A330 FC LE33 regional buses

- Ballard Fuel cell
- 38.5 kg H2, of which 36 kg is usable
- Range 400km
- Fast fill Hydrogen refueling station at depot (350bar)
- Takeoff 250.000 kg/year



