

# International Workshop on Hydrogen Infrastructure and Transportation

September 11<sup>th</sup> 2018



## Scandinavian Update

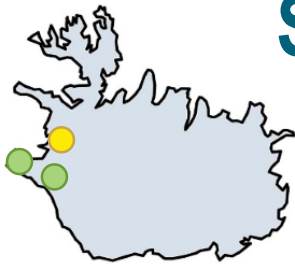
Presented by:  
Vegard Frihammer, CEO, Greenstat AS

# Status of fueling stations and future plans





# Scandinavian Hydrogen Highway Partnership



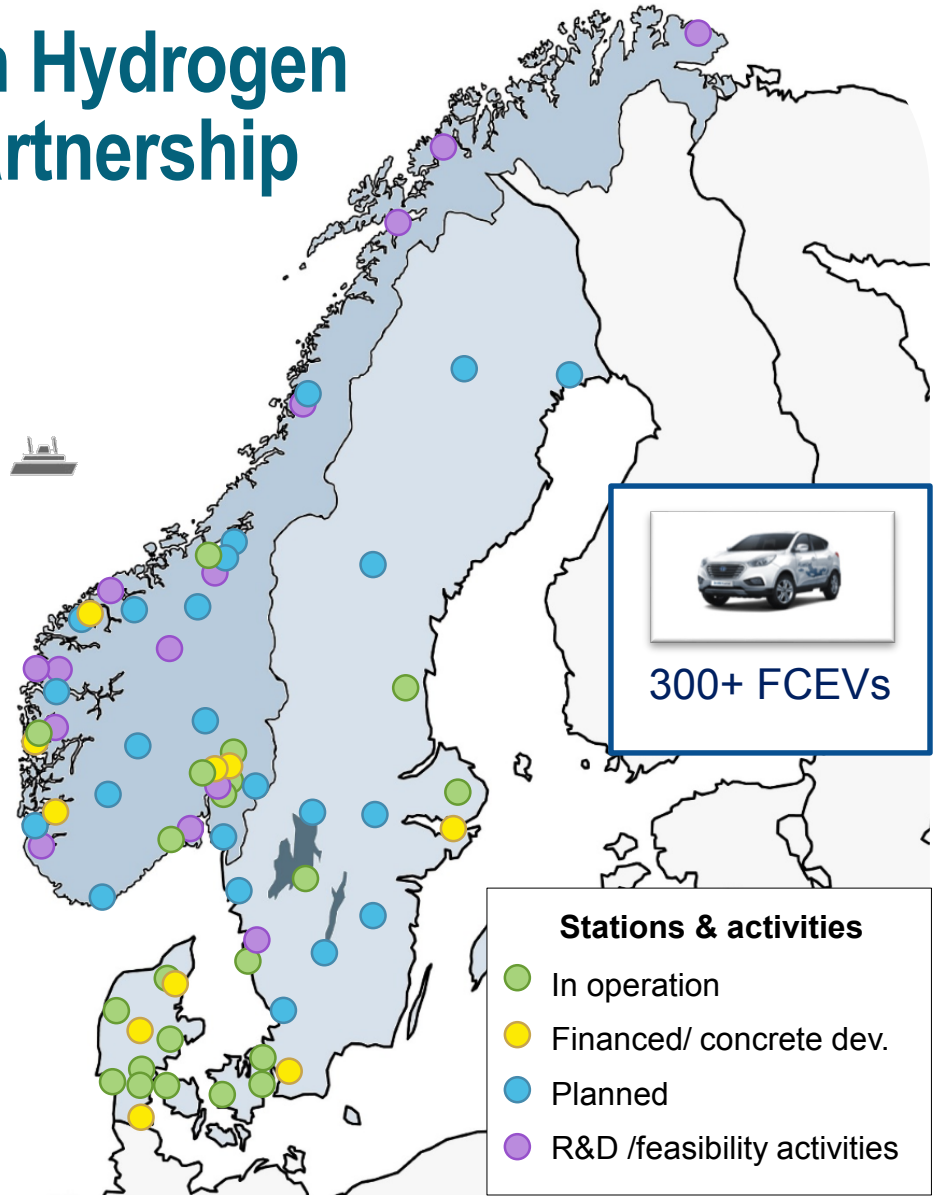
22 stations in operation (10 DK 4 NO 5 SE 2 ICE)

- 11 Danish H2 Fuel (Denmark)
- 4 HYOP (temp. closed) (Norway)
- 2 Uno-X Hydrogen (Norway)
- 1 Air Liquide (Norway, for buses)
- 1 ASKO, 2017 (Norway, for trucks)
- 2 Icelandic Hydrogen, 2018 (Iceland)
- 4 AGA Linde (Sweden)
- 1 Väner Energi (Sweden)

20 concrete stations under dev. 2018-21

- 6 Uno-X ++, 2018-20 (Norway)
- 9 No. H2 Corridor, 2019-20 (Sweden)
- 1 Icelandic Hydrogen, 2019 (Iceland)
- 2 Bus projects, 2019-20 (Denmark - Norway)
- 1 Ro-Pax Ferry demo, 2021 (Norway)

40+ stations within 2020



**Stations & activities**

- In operation
- Financed/ concrete dev.
- Planned
- R&D /feasibility activities

# NORWAY (1 of 2)



## FCEV/HRS update Norway

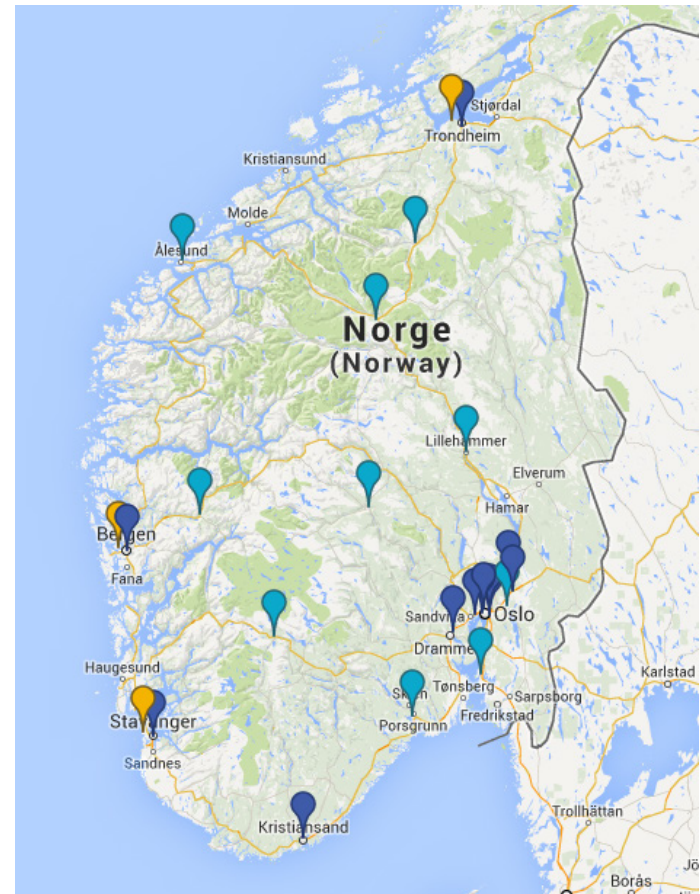
- 126 FCEVs
- 5 FCEV buses/ 10 new buses from 2019-2020
- 4 HRS's in operation (2 for cars, 2 for buses & trucks)
- 4-6 new HRS's by 2018-20
- A national Hydrogen Strategy for Norway will be launched in 2019



# NORWAY (2 of 2)



- **Uno-X Hydrogen**, owned by Uno-X, NEL and Praxair 2 stations / 20 by 2020
- **Air Liquide** 1 station (bus)
- **ASKO** 1 station (truck)
- **HYOP** (4 temporarily closed)
  - Need funding to reopen stations



# DENMARK



## The world's first country wide network in daily operation

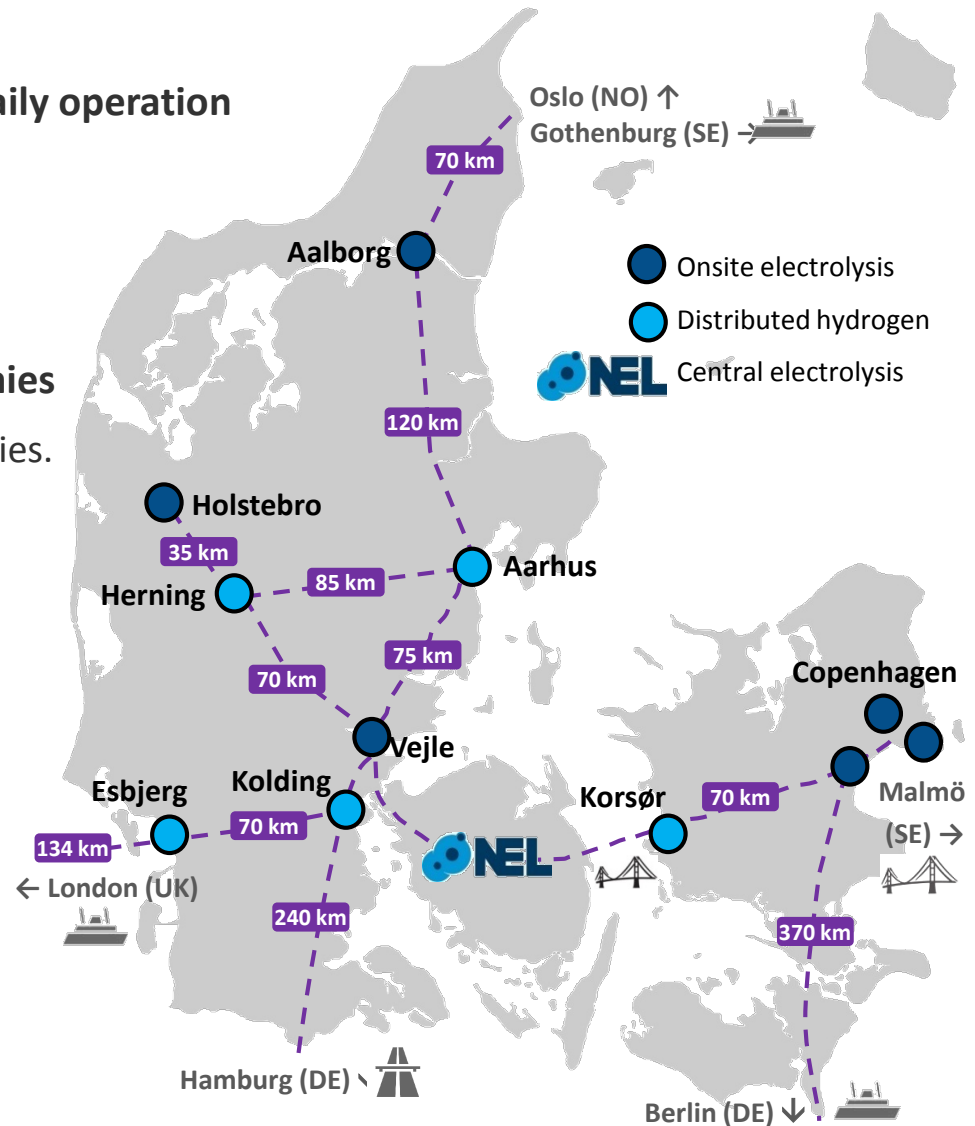
- 9 stations.
- 50% of population within 15 km

## Collaboration with leading oil & gas companies

- Joint venture investments in operation entities.

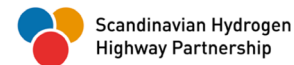
## 100% green hydrogen supply in Denmark

- 6 stations – onsite electrolysis production.
- 3 stations – central NEL electrolyser.



**H<sub>2</sub>** Copenhagen Hydrogen Network A/S

**H<sub>2</sub>** Danish Hydrogen Fuel A/S



# SWEDEN

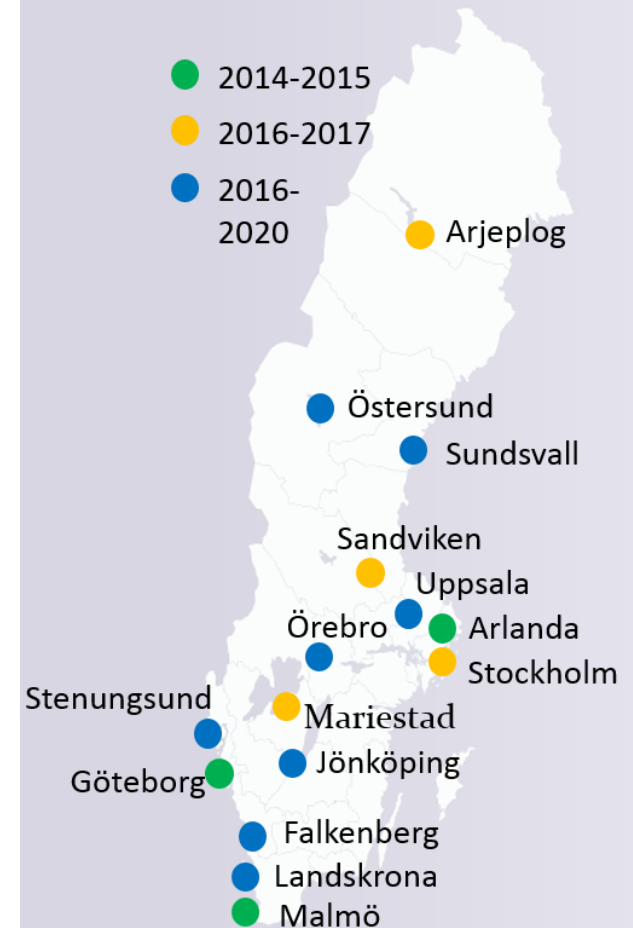


## STATUS

- 32 FCEVs currently on the road – and 15 more ordered
- First taxi fleet in Scandinavia in operation
- 5 HRS stations
- All hydrogen is 100% renewable



## Initial plan for HRS in Sweden



# Iceland

- 2 HRS in operation





# Vehicle types, Norway

- Total 126, per august 2018
  - Hyundai Ix35 Fuel Cell, 90
  - Toyota Mirai, 36
  - Hyundai Nexo (coming now)

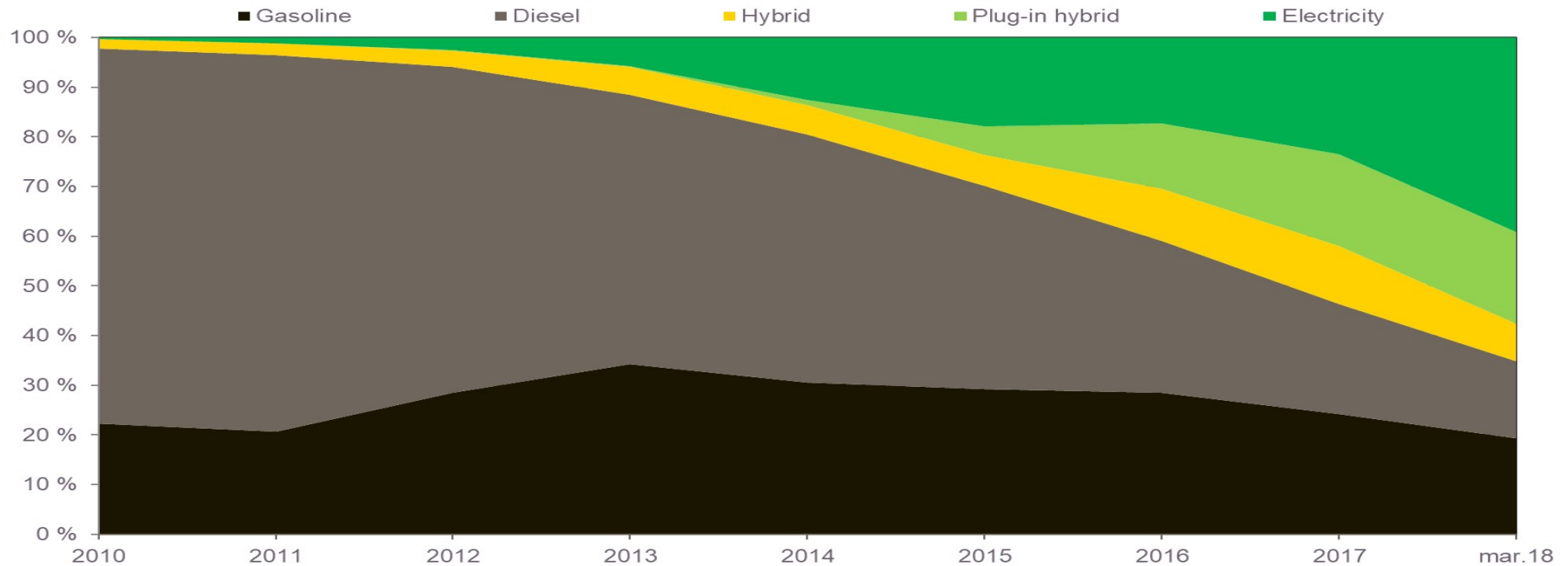


# NORWAY – Policy works!



BEV introduction a huge success, FCEV could follow same path

## Light vehicle sales in Norway 2010 - March 2018



Source: OFV - Opplysningsrådet for vegetrafikken

# Capacity, Norway

- Oslo, combination of onsite and trucked hydrogen
  - UNO X, 250 kg per day at Sandvika
  - HYOP,
    - 200 kg per day at most stations
    - Two stations can be scaled up to 1000 kg per day
  - Ruter/Air Liquide, 250 kg per day
- Trondheim, onsite production
  - Asko, trucks 300 kg per day
- Bergen, trucked hydrogen from Rjukan
  - UNO X, 200 kg per day,

# Integration with gasoline infrastructure

- Norway
  - HYOP, dedicated stations
  - UNO X, integrated

Protocol:

70MPa SAE J2601

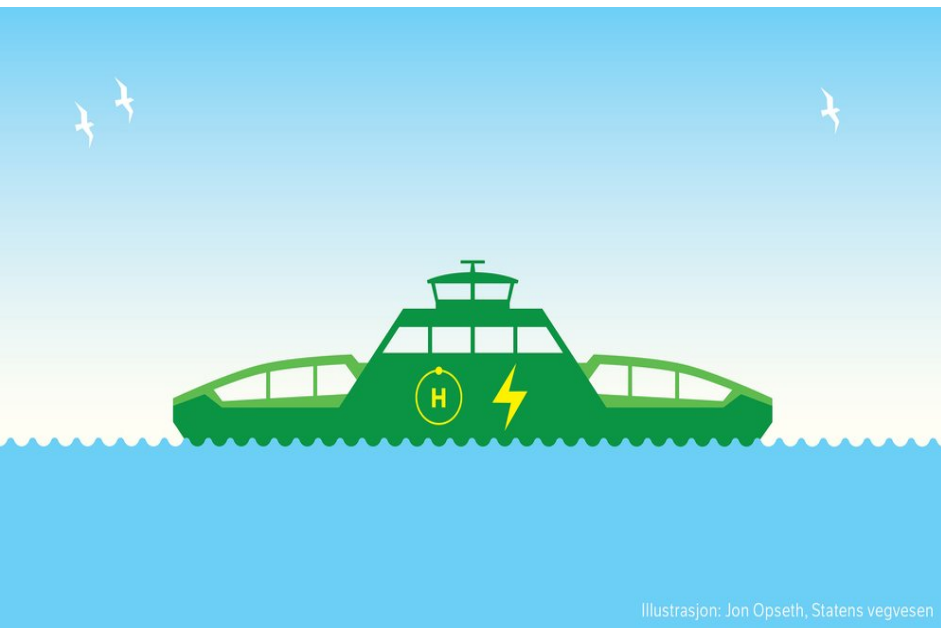


# Maritime H2 revolution

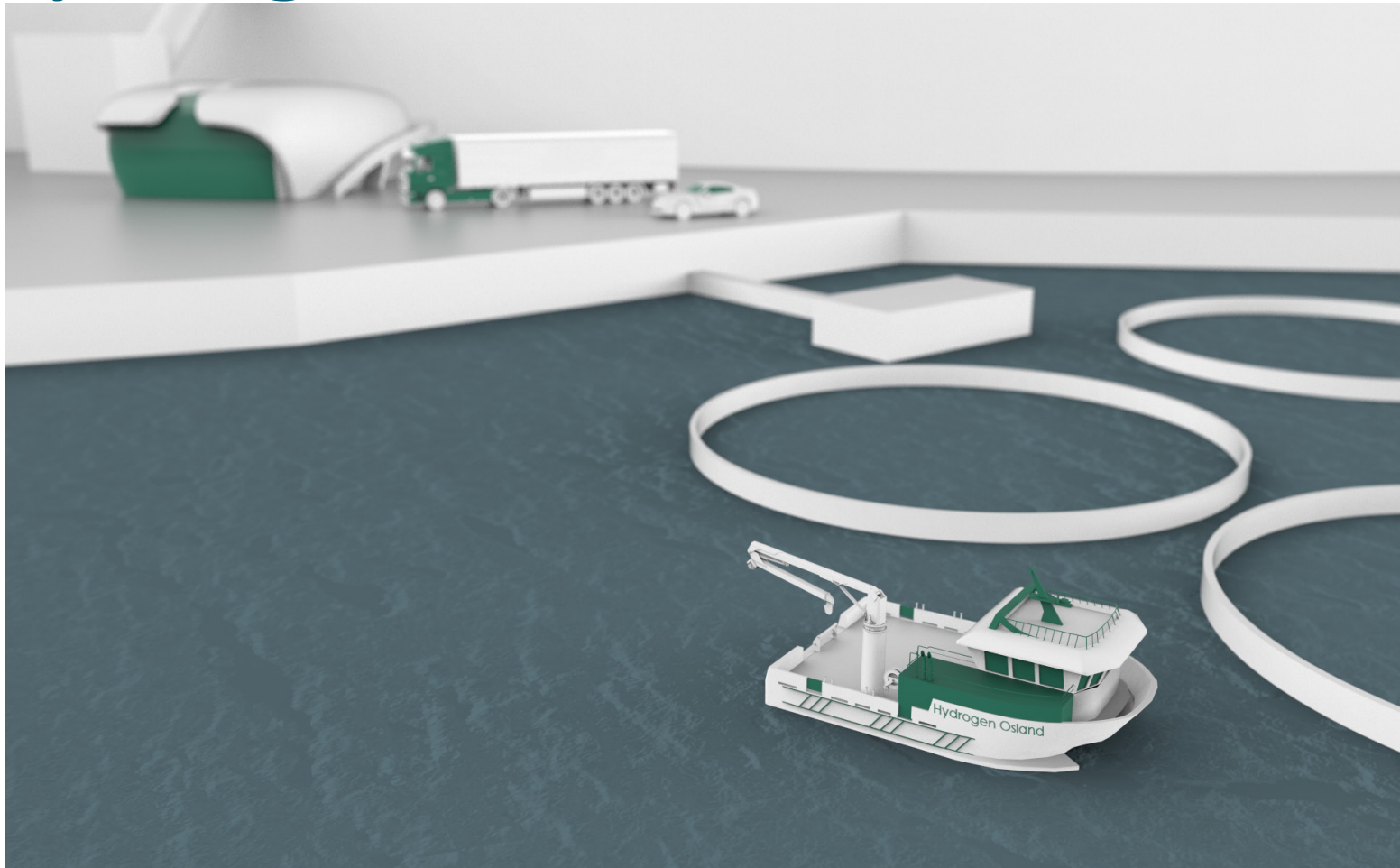
- From one electric ferry in 2016, two 70 in just a few years.
- Same pattern expected for hydrogen ferries, express boats and other vessels



# Hydrogen ferry (2021)



# Hydrogen work boat



# Hydrogen express boat





# Hydrogen Cruise ship



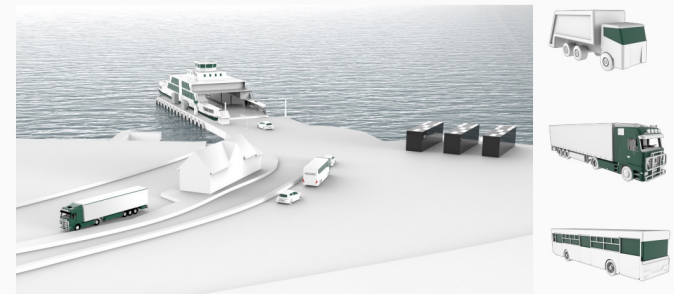
# Hydrogen Yacht



# 1000 truck initiative launched

- Aiming for 1000 trucks by 2023

## 1000 hydrogenlastebiler i Norge innen 2023



# Key challenges Norway

- Political roadmap at a national level
- Availability of cars at reasonable prices
- Volume production of station solutions
- Availability of hydrogen at a reasonable price
- Transport costs

# Thank you!

## Questions?