Towards LARGE SCALE hydrogen projects

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VICE PRESIDENT, TECHNOLOGY

Nel Hydrogen today

- Hydrogen technology company listed on the Oslo Stock Exchange (NEL.OSE | >18,000 shareholders)
- Manufacturing facilities in Norway, Denmark and U.S. & global sales network
- Revenue of 489 MNOK in 2018 (302 MNOK in 2017)
- World's largest electrolyser manufacturer, with >3500 units delivered in 80+ countries since 1927
- World leading manufacturer of hydrogen fueling stations, with ~60 H2Station® solutions delivered to 10 countries

Alkaline and PEM electrolysers
Converting water and electricity to hydrogen and oxygen – for industry and energy purposes

Compact hydrogen fueling stations
Hydrogen fueling stations capable of fueling any kind of vehicle. World's most compact – simple to integrate with other fuels & standardized

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Strong field know-how & manufacturing capacity

Wallingford, USA

PEM electrolyzers

2,700+ systems delivered

Production capacity:

30MW/year

Notodden, Norway

Alkaline electrolyzers

800+ systems delivered

Production capacity:

40MW → 360MW/year (2020)

Herning, Denmark

Hydrogen Refueling Stations

60+ stations delivered

Production capacity:

300 HRS/year

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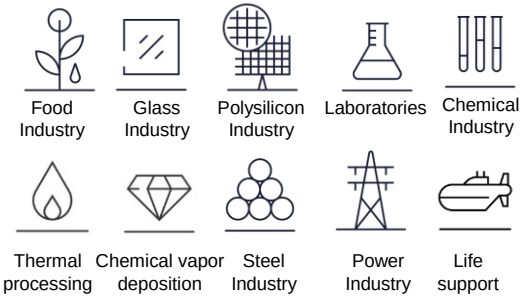
Hydrogen is expanding its areas of application

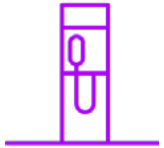
CONVENTIONAL INDUSTRY



- Conventional industries represents “traditional” hydrogen markets
- Steady demand for hydrogen

Steady growing market

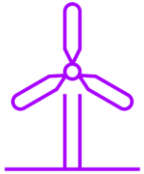
MOBILITY



Mobility
(transportation)

- Key market going forward – both withi hydrogen production and fueling
- Heavy duty sector developing faster than anticipated – hydrogen now relevant fuel for all forms of mobility

POWER-TO-X



Power-To-X
(renewable hydrogen)

- Decreasing cost of renewables & electrolyzers is accelerating market
- Vast opportunities within existing & new sectors

Markets expected to see fast growth going forward

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Across USA, 2020-2028

HDV:
3 Gigatons of
CO_2 per year

Electrolyzer capacity for
the first 50 Nikola stations: 1000


1 Gigaton of CO_2 per year
Electrolyzer capacity needed for one fertilizer/Ammonia plant:
>1000
MW
Convert the industry back to renewable electricity / Green
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3 Gigaton of
CO_2 per year
Electrolyzer capacity needed
for one steel plant:
>1000
MW
Use green Hydrogen for
reduction of Iron Ore
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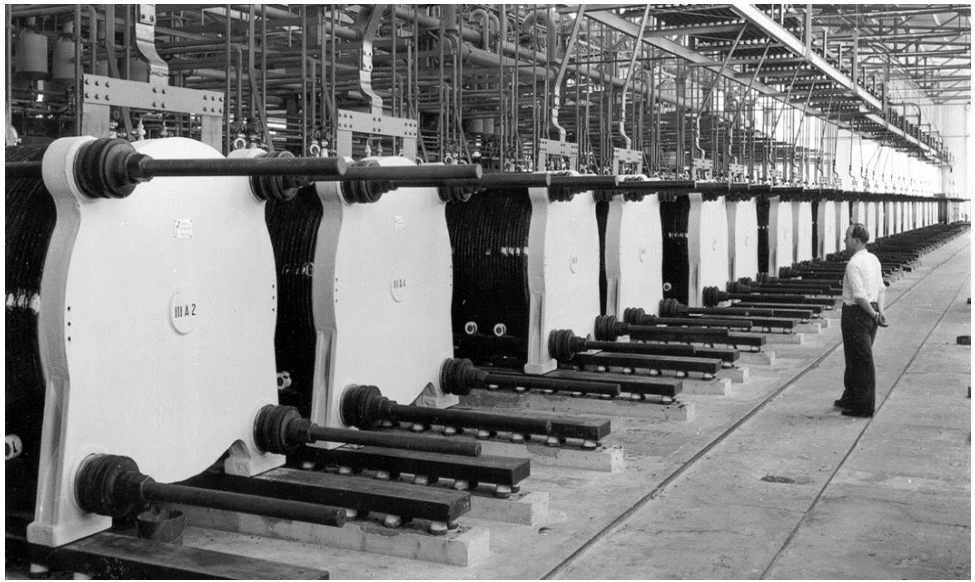
Large scale electrolysis isn’t new

Green Ammonia

Rjukan & Glomfjord, Norway (1927 – 1993)

Nel has built some of the largest electrolyzer plants in history

- 3 x ~135MW (each ~65 t/day) in Norway
- 100% green electricity from hydro power
- Hydrogen used for large scale ammonia production
- Developed proprietary active layer for the electrodes, increasing efficiency - still an industry secret today
- Other significant improvements on efficiency, output and life time



Chemicals

Rjukan, Norway (2006)

Hydrogen peroxide from green electricity

- 9.2 MW electrolyzer plant (4.2 t/day)
- 100% green electricity from hydro power
- Hydrogen and oxygen used for hydrogen peroxide (H_2O_2)
- 24/7 industrial operation

Polysilicon (solar PV)

Sarawak, Malaysia (2013)

The world’s largest electrolyzer plant in operation

- 25 MW electrolyzer plant (12 t/day)
- 100% green electricity from hydro power
- Hydrogen used for polysilicon production
- 24/7 industrial operation where reliable hydrogen supply is c

Scaling up Hydrogen Mobility

Opened the world's biggest hydrogen station manufacturing plant in Herning, DK

Annual nameplate production capacity of up to 300 H2Station®

- Serial production according to lean principles
  - Hydrogen compression, cooling and gas control assembled onto one skid
  - Allows both CE- and UL-certified stations off the line
- H2Stations for Europe, US and Asia running on same production line. 70MPa and 35MPa fueling option
- Production-line in action can be seen via link to the right

https://www.youtube.com/watch?v=7YxjytkkNi4

Hydrogen fueling stations coming online

Newly opened hydrogen at Citrus Heights, California

Newly opened energy station at Hvam, Norway (Photo: Uno-X)

Source: www.greencarcongress.com (Dec. 25, 2018)

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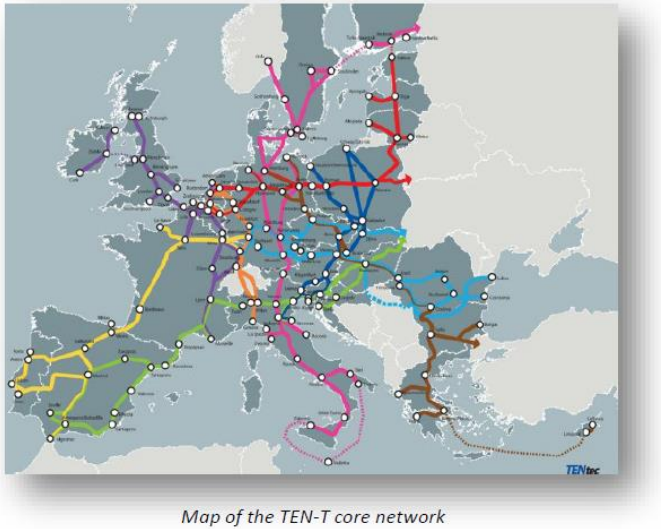
H2BusEurope: Deploying hydrogen buses and fueling infrastructure across Europe

Nel & partners awarded EUR 40 million in project support for 600 FC buses & infrastructure in EU

- EU-funding (CEF) for large-scale rollout of Fuel Cell buses and infrastructure to reach commercial hydrogen deployment

Current zero emission legislation in EU require 15 000 buses/year
Total number of city buses operating in Europe: ~350 000



Map of the TEN-T core network

Hydrogen infrastructure Oslo/Akershus

Akershus Energi

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- Grid balancing
- Excess power
- District heating

Glomma, river power

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8 ton/day electrolyser

Trucked-in in pressurized tanks (500 bar)

HEXAGON

UMOE

- 1,000-1,500 kg H2 per trailer

Potential Funding partners:

ENOVA

Innovation Norway

AKERSHUS fylkeskommune

HDV/Nikola demo

1 000 km in 10 min

posten bring TINE Felleskjøpet

Ruter

10+++ busses at Bekkestua, other

Ruter

HDV – Hyundai/SCANIA

Trucks, forklifts, cars

ASKO

H2 Train

Kongsvinger-Elverum-Koppang

ALSTOM

LDV fueling station

700 bar, 5 kg in 3 min

Kjørebo, Hvam, Ås, etc.

Uno X

Norled / Ruter

Fast ferry (Oslo/Drøbak)

NORLED

OSL Gardermoen

Electrification airport internal traffic

AVINOR

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Hydrogen supply from semi-centralized production

Central large scale production (H2Hub), distribution and fueling

Green hydrogen Production:

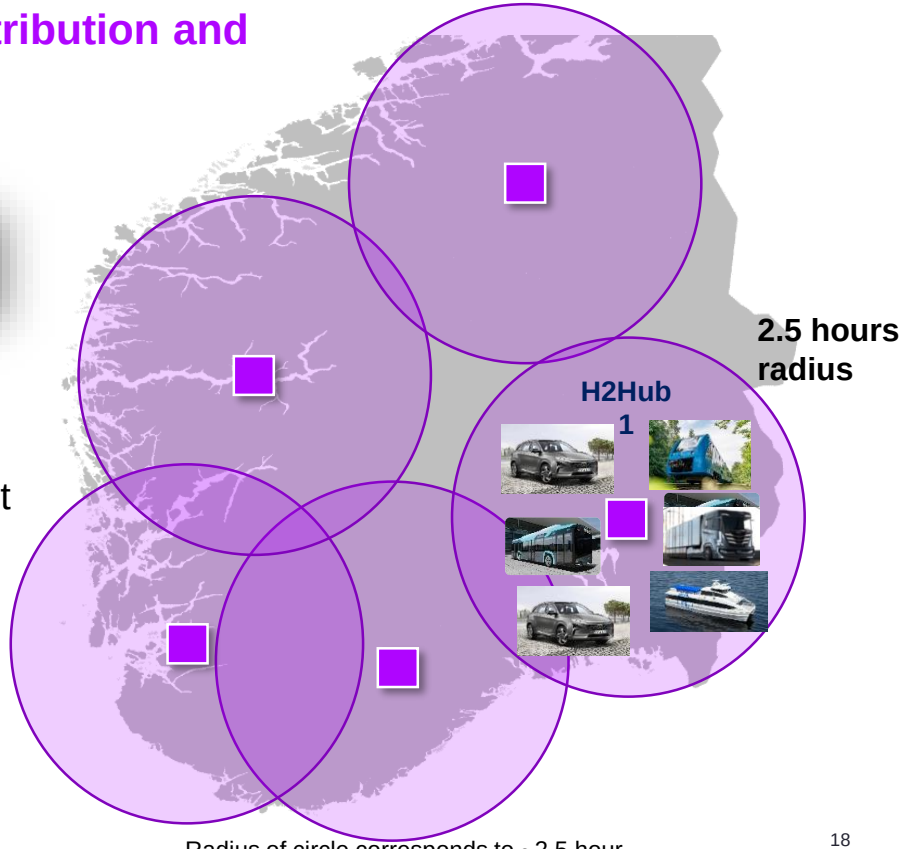
- 8 – 24 tons / day from Hydro/Wind

Efficient hydrogen distribution:

- 1,000-1,500 kg H2 pr. truckload

Efficient hydrogen distribution:

- 2.5 hour travel distance for optimal distribution cost
- H2Station capacity can easily be added or expanded
- Fuel with 100% renewable hydrogen at attractive price



Radius of circle corresponds to ~2.5 hour driving

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Number one by nature