GREEN HYDROGEN

OPPORTUNITIES IN THE ENERGY SYSTEM

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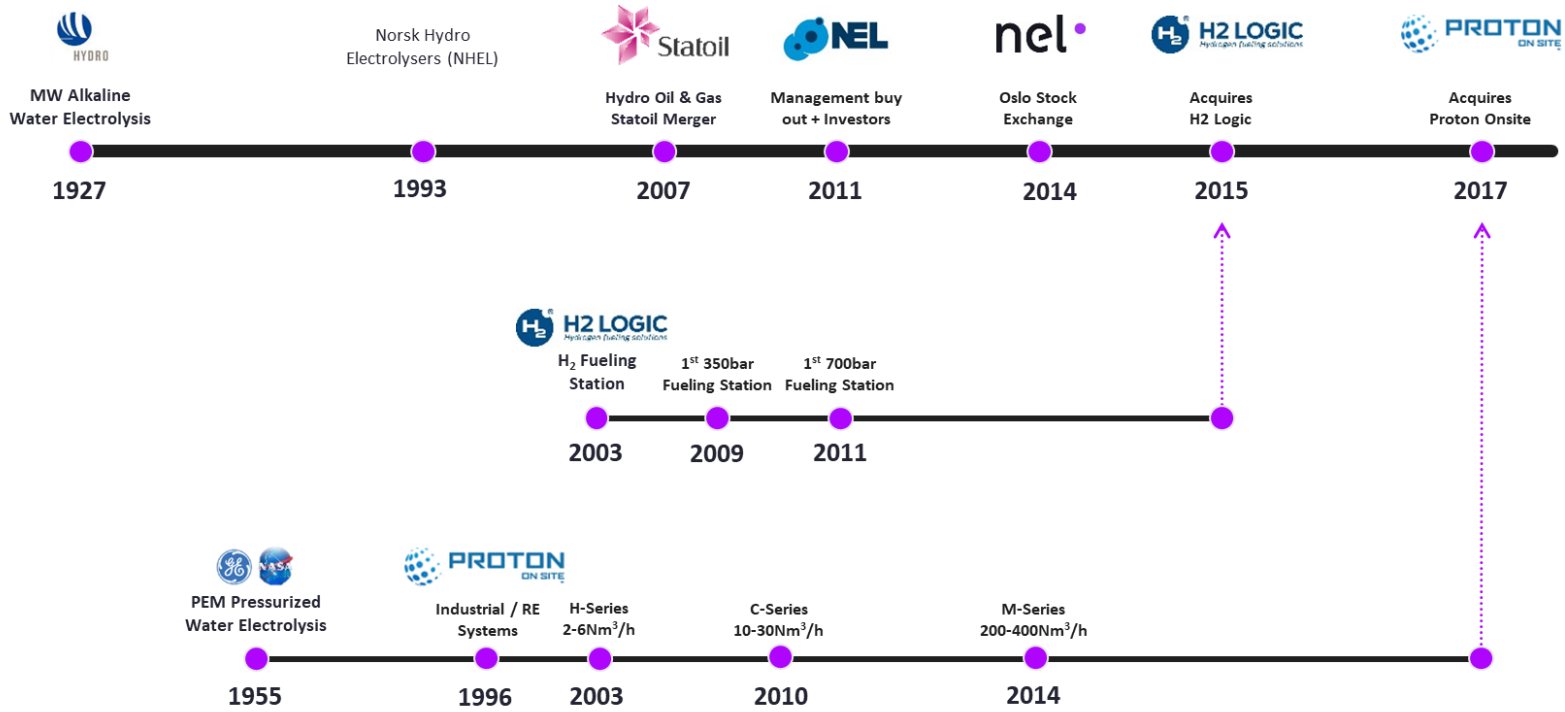
Early Pioneers in Each Technology Field



Hydrogen is key to electrify the transport sector

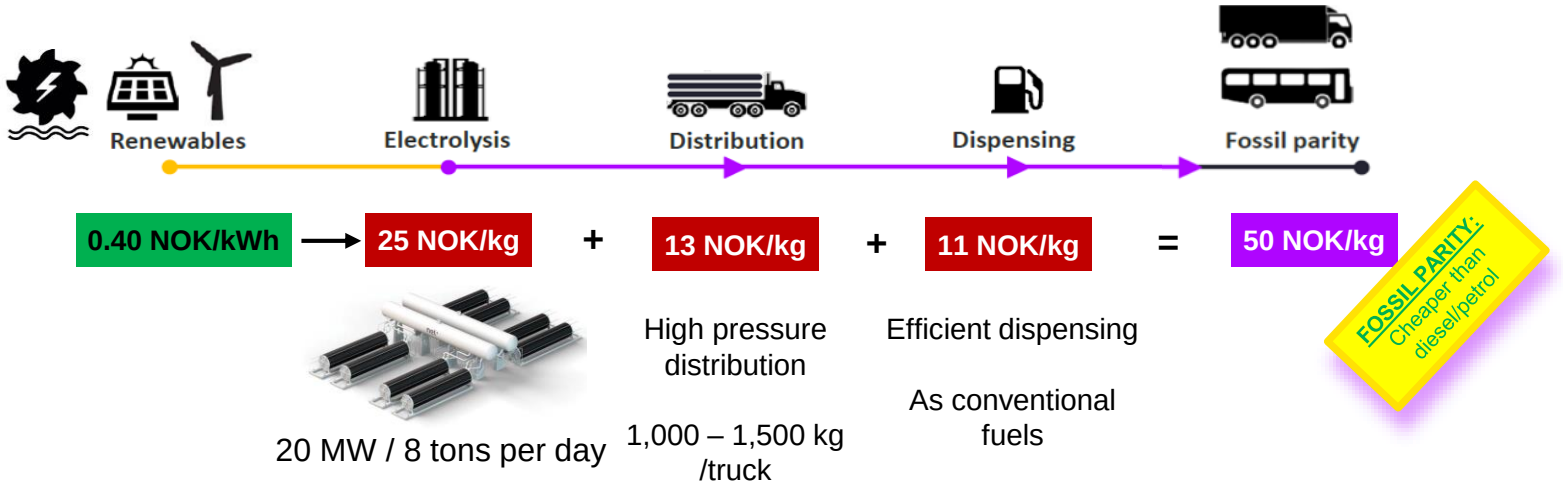
Hydrogen as preferred future fuel alternative:

- True zero emission from production to use
- Can beat fossil fuel applications on a TCO-basis
- Low weight (compared to e.g. batteries), especially relevant in the heavy duty segment
- Fast recharging (fueling) time
- Long driving range
- Low/no need for electric grid upgrades
- Not dependent on rare earth metals (e.g. cobalt, lithium)
- Global standards for fueling established
- Same quality fuel used for small to large applications
- Cleans the surrounding air

Fossil parity for mobility sector achievable in Norway today

Centralized production close to power or heat source enables business case

- Regional hydrogen production, use of low cost renewable energy
- Possible to integrate with central heating grid
- Parity with taxed diesel possible already from 4-8 ton per day

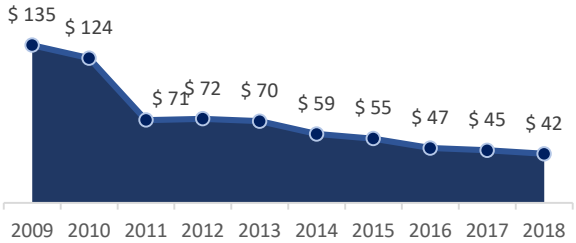


Cost of wind and solar has dropped by 69% and 88% during the last decade – renewable hydrogen following on the same path

Wind and solar is on a trajectory to become the cheapest form of electricity

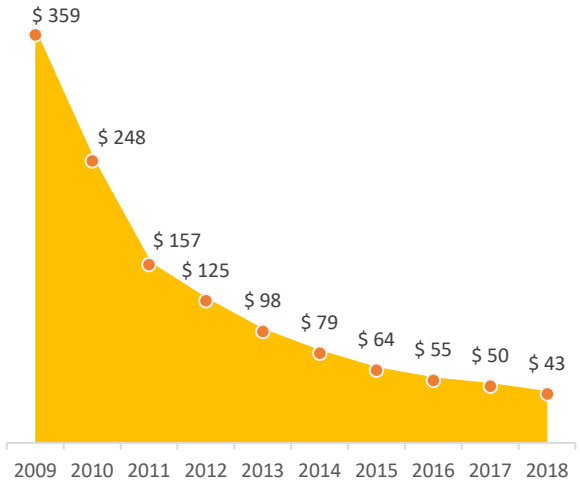
Wind LCOE

Unsubsidised levelized cost of energy ($/MWh) [2)]



Solar PV LCOE

Unsubsidised levelized cost of energy ($/MWh)[2)]



- With falling LCOE[1)] of wind and solar prices, renewable hydrogen follows the same path, as electrical power constitute 70-80% of the total cost of hydrogen
- Record low auction prices for solar PV and wind has seen prices as low as $17.7/MWh and $17.86/MWh respectively (as of 2017) [3)]
- Prices are expected to drop further, LCOE of solar PV and onshore wind are expected to fall by 71% and 58% respectively by 2050[4)]
- At $50/MWh renewable hydrogen is becoming competitive with fossil fuels and at $30/MWh renewable hydrogen is becoming competitive in most markets

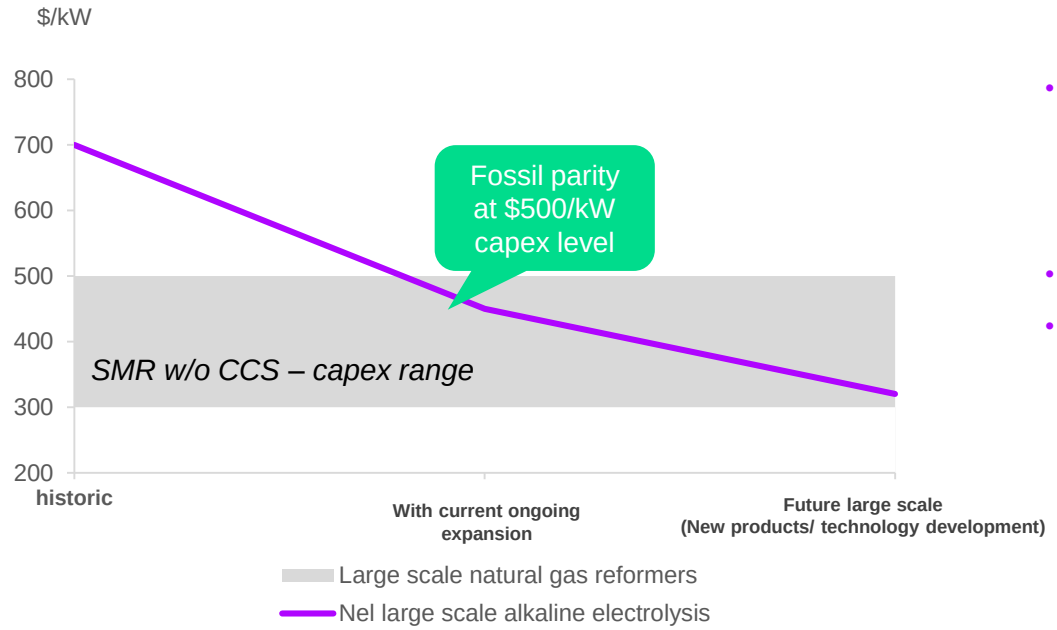
Note: 1) LCOE = Levelised cost of energy, which is a way of calculating the total production cost of building and operating an electricity generating plant
Source: 2) Lazard; Renewables Now, 3) IRENA (International Renewable Energy Agency); 4) BloombergNEF New Energy Outlook 2018

Decreasing cost of renewable hydrogen (and oxygen) opening up new business areas

- Wide variety of existing and new markets where electrolysis can play a major role
  - Exchanging fossil hydrogen with renewable hydrogen (f.ex fertilizer)
  - Exchanging coal with renewable hydrogen (f.ex steel manufacturing)
  - Oxygen & heat adds value
- Electrolysis “bridges the gap” between the power and industry sector, increasing the value of electrons
- Ability to adapt to diverse and intermittent renewable energy sources becoming increasingly important

Growth in renewable hydrogen will accelerate with reduced capex for electrolysers

Hydrogen production - capex price

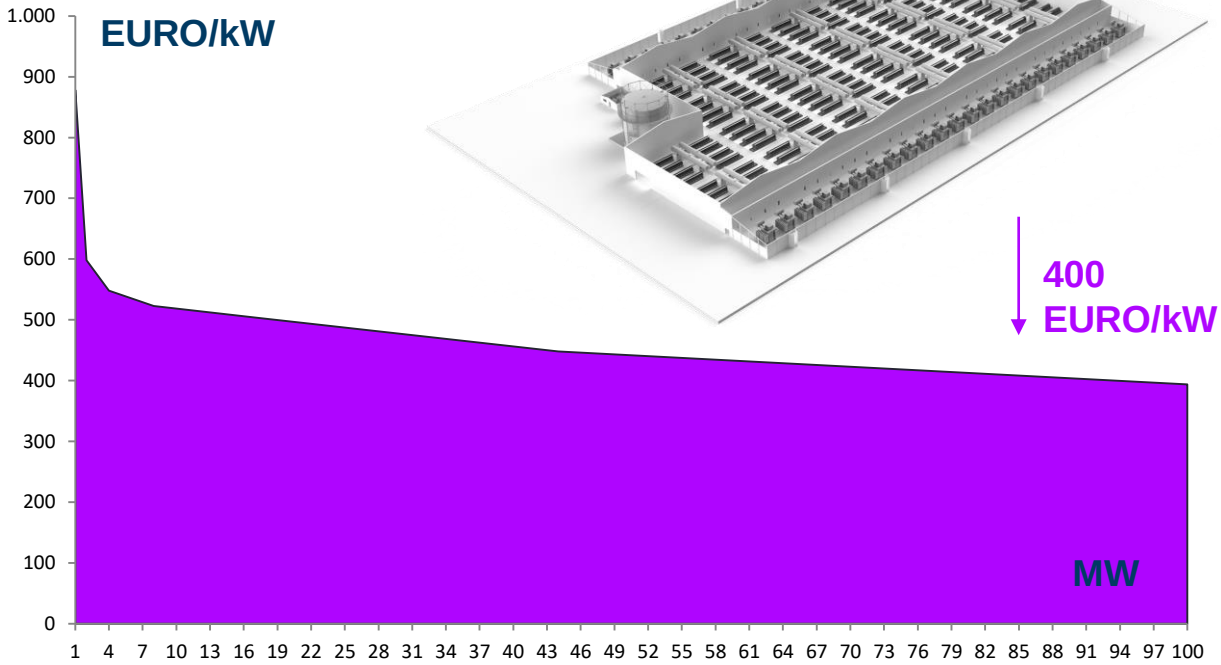


- SMR – “steam methane reforming” is dominating hydrogen production today, using natural gas and steam
- Nel is establishing a new manufacturing plant targeting a >40% cost reduction
  - Expect to see further reduction in capex with increase production volume, and further size scaling of products
- Nel targets capex to drop below SMR over time
- Electrolysis expected to be the preferred production method if **opex (i.e. power prices) are low enough (or at parity) with the alternative production methods**

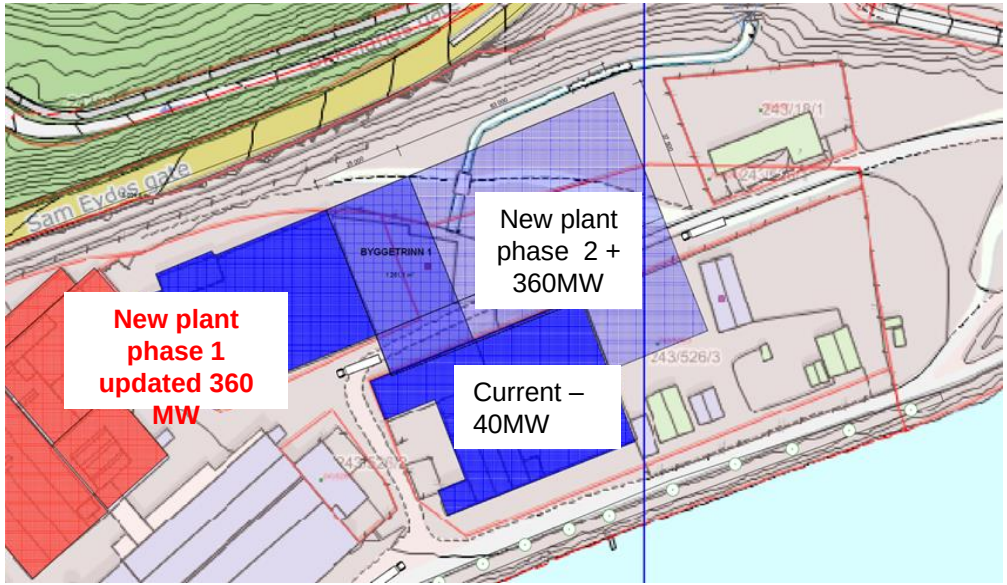
Source: Nel

Nel Electrolysers

CAPEX - Significant economy of scale

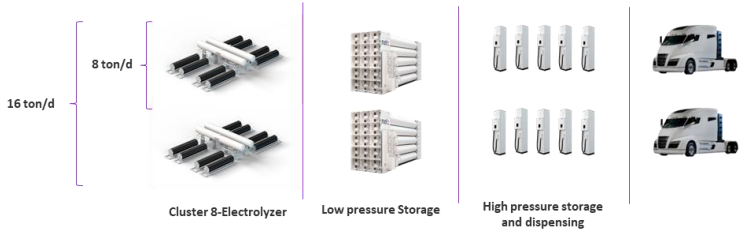


Factory expansion will drive down Capex



Total Notoden site – Capacity 760MW

NIKOLA MOTOR COMPANY



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Thanks for the ride, dinosaurs!
We'll take it from here.
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