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Scaling up green Hydrogen

Jon Andre Løkke

Chief Executive Officer

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from 4:45 – 5:00 a.m. CDT

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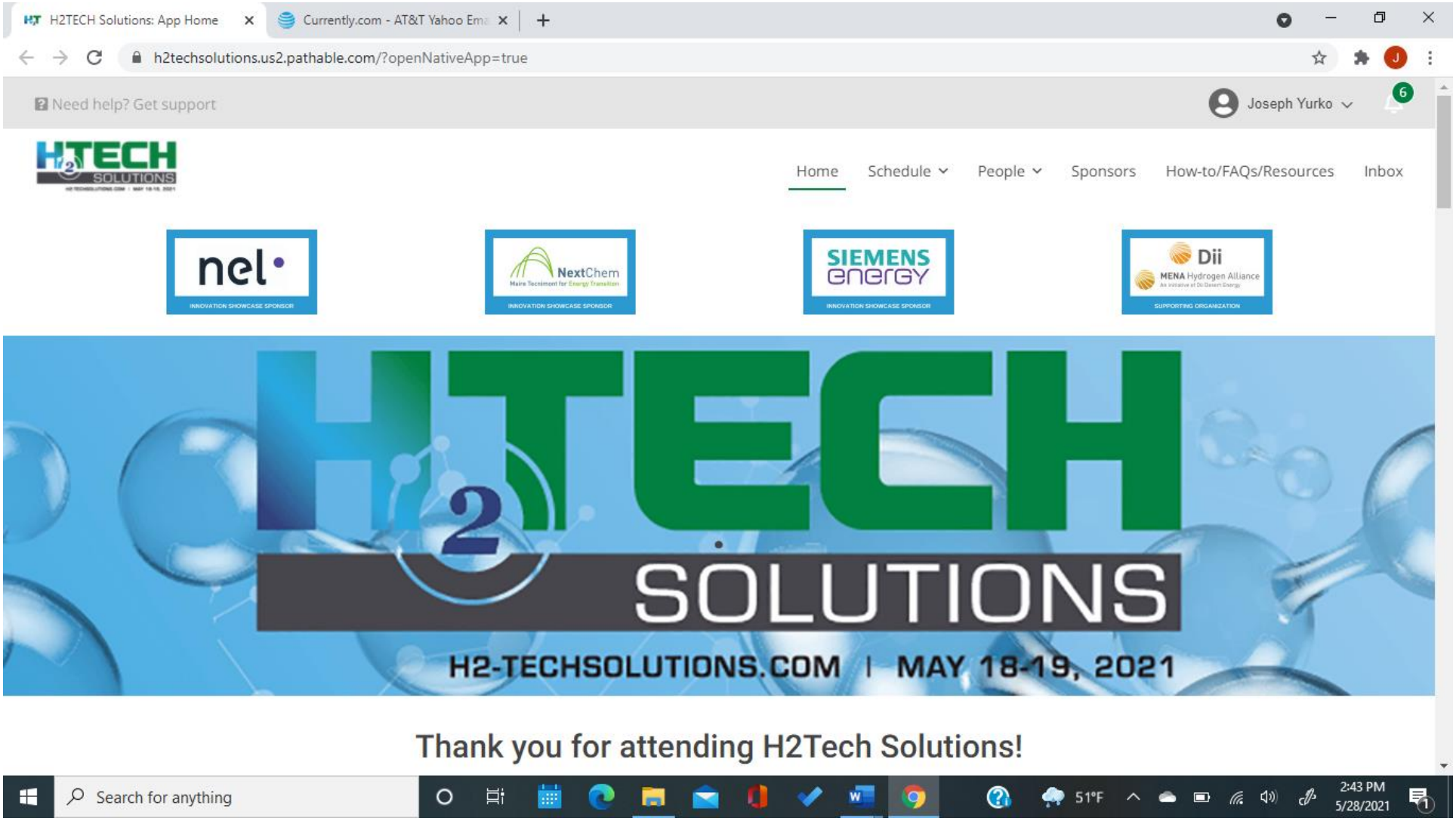
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Graham Bennett

Vice President and Head of Energy Transition

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KEYNOTE - 19 MAY

Jon André Løkke

Chief Executive Officer

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KEYNOTE 2 - 19 MAY

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FCHEA Fuel Cell & Hydrogen Energy Association

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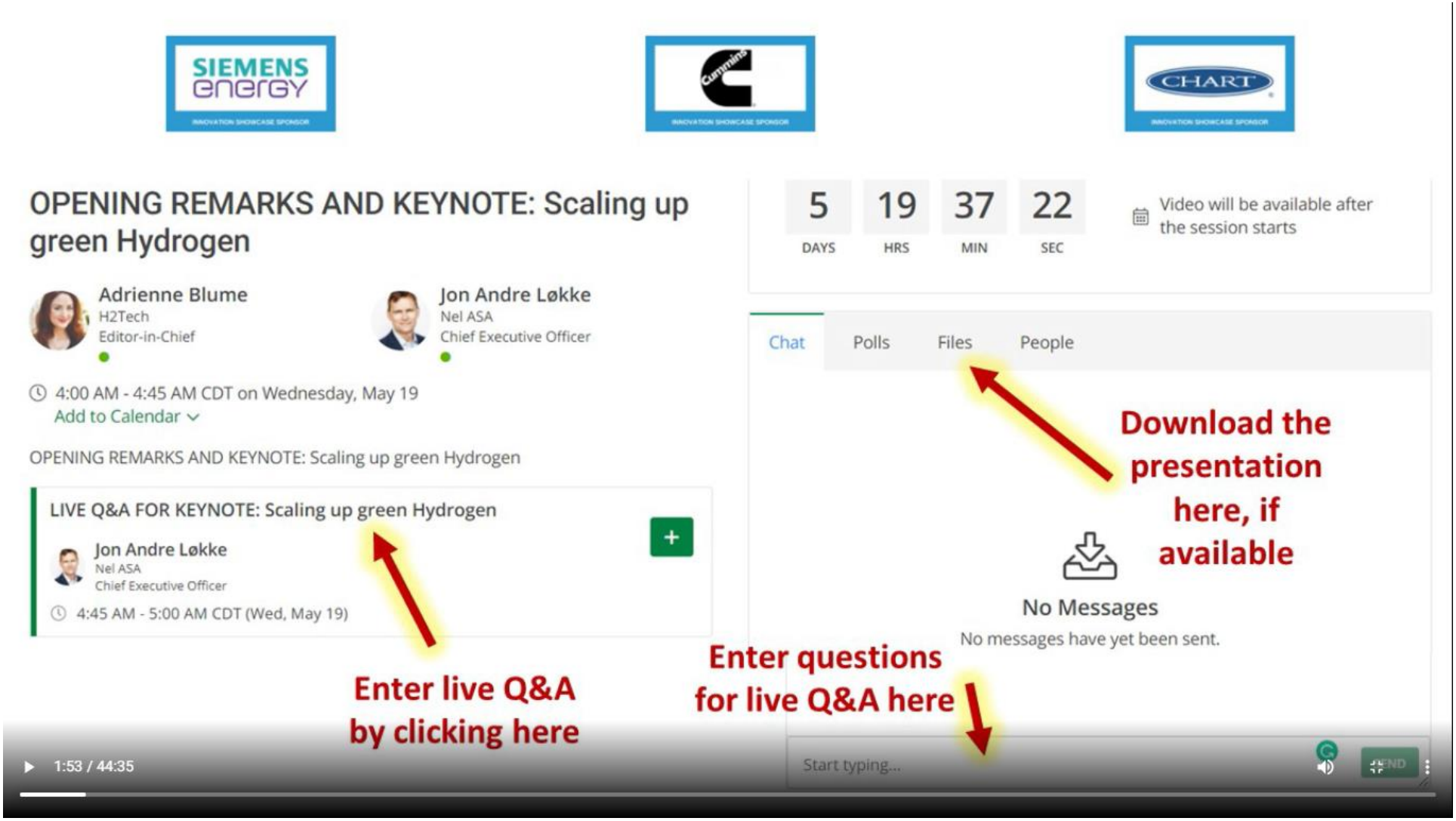
OPENING REMARKS AND KEYNOTE: Scaling up green Hydrogen
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H2Tech
Editor-in-Chief
Jon Andre Løkke
Nel ASA
Chief Executive Officer
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LIVE Q&A FOR KEYNOTE: Scaling up green Hydrogen
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Scaling up green Hydrogen

Jon Andre Løkke

Chief Executive Officer

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Scaling up green hydrogen
Jon André Løkke, CEO
19 May, 2021

THIS IS NEL

Leading pure play hydrogen technology company with a global footprint

Pure play hydrogen technology company listed on Oslo Stock Exchange (NEL.OSE)

Manufacturing facilities in Norway, Denmark, and U.S., and a global sales network

World's largest electrolyser manufacturer, with >3,500 units delivered in 80+ countries since 1927

Leading manufacturer of hydrogen fueling stations, with 110+ H2Station™ solutions delivered/in progress to 13 countries

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THE HYDROGEN OPPORTUNITY

Green hydrogen approaching fossil parity – game-changer across applications and markets

Electricity production	Hydrogen production	H2Station™	Fuel Cell Electric Vehicle
		Hydrogen is compressed and cooled in the H2Station™ ready for fueling through the dispenser	Hydrogen fueling is relevant for both light duty vehicles (LDV) and heavy-duty vehicles (HDV)
Solar, Wind	Electrolysers	Industrial applications	Power-to-X
Electricity is generated from wind or solar	Electricity is used to split water (H_2O) into hydrogen and oxygen	Green hydrogen has a massive potential to decarbonise industries, i.e. ammonia and steel	Hydrogen is expected to become relevant within all forms of industry, energy storage, heating, energy export and new applications

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MISSION
We deliver optimal solutions to produce, store, and distribute hydrogen from renewable energy
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THIS IS NEL

Strong field know-how and manufacturing capacity

PEM electrolysers

Wallingford, USA

Systems delivered: **2,700+**

Production capacity: **>50 MW/year**

History: **23 years**

Alkaline electrolysers

Notodden/Herøya, Norway

Systems delivered: **800+**

Production capacity:
40 MW/year → 500 MW/year (~2 GW/year)

History: **90 years**

Hydrogen refueling stations

Herning, Denmark

Stations delivered: **110+**

Production capacity: **300 HRS/year**

History: **16 years**

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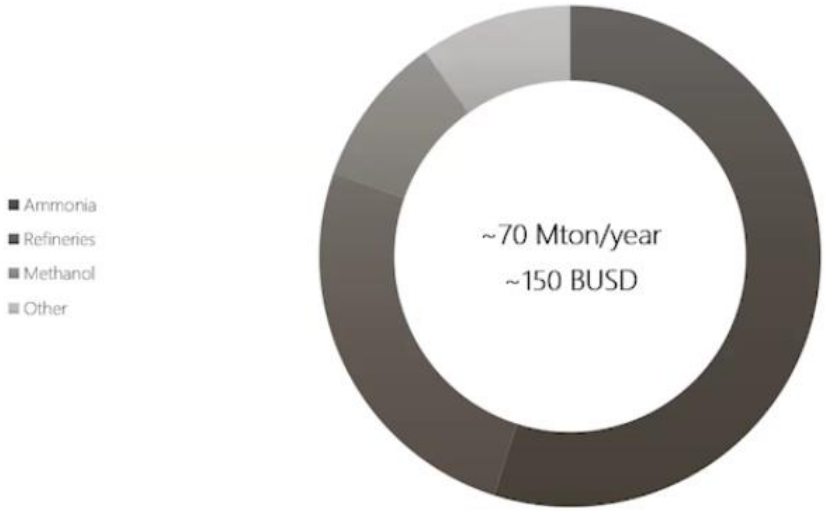
THE HYDROGEN OPPORTUNITY

Large opportunities for electrolysis within existing hydrogen market

Global hydrogen market by end use



- Currently only 1% from water electrolysis
- Large growth potential driven by increasing focus on climate and renewable energy, decreasing both electricity prices and electrolyser capex
- Focus on renewable hydrogen for refineries and ammonia, accounting for ~80% of market
- Electrolysis set to take larger share of overall hydrogen market. Annual electrolyser market potential of >$20 billion/year within existing hydrogen market alone

Source: 2020 estimates by Hydrogen Council (2017)

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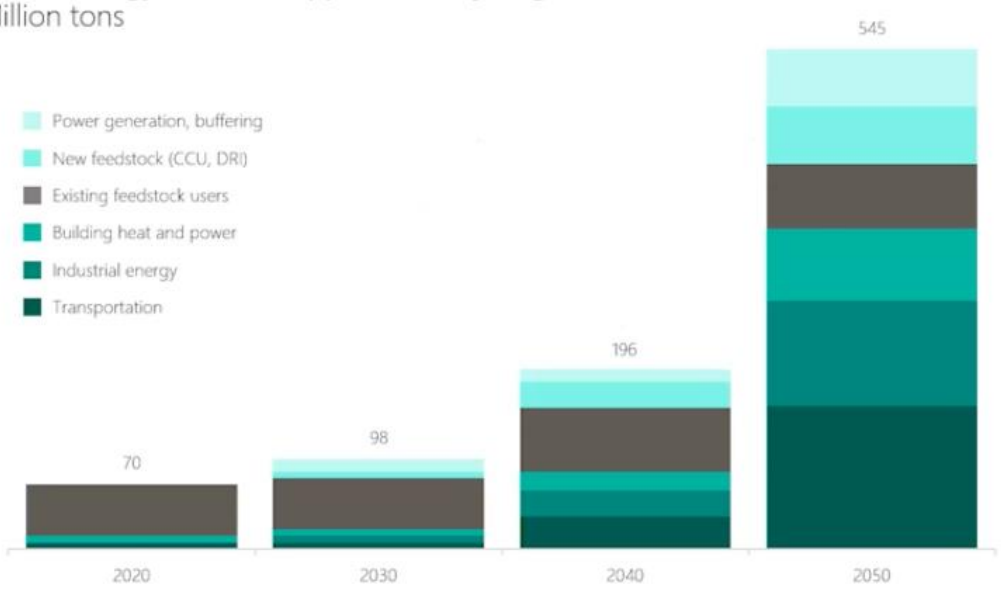
THE HYDROGEN OPPORTUNITY

Overall hydrogen market set to grow by 8x

Global energy demand supplied with hydrogen
Million tons



Growing hydrogen demand primarily driven by:

- Regulations to lower surplus demand for fuel
- Decreased crude quality – requires more hydrogen for processing
- Electrification of transport sector
- Move from coal to hydrogen for various industries
- As electrolysers start from a small base, this market potential will grow by >800x

Source: Hydrogen Council

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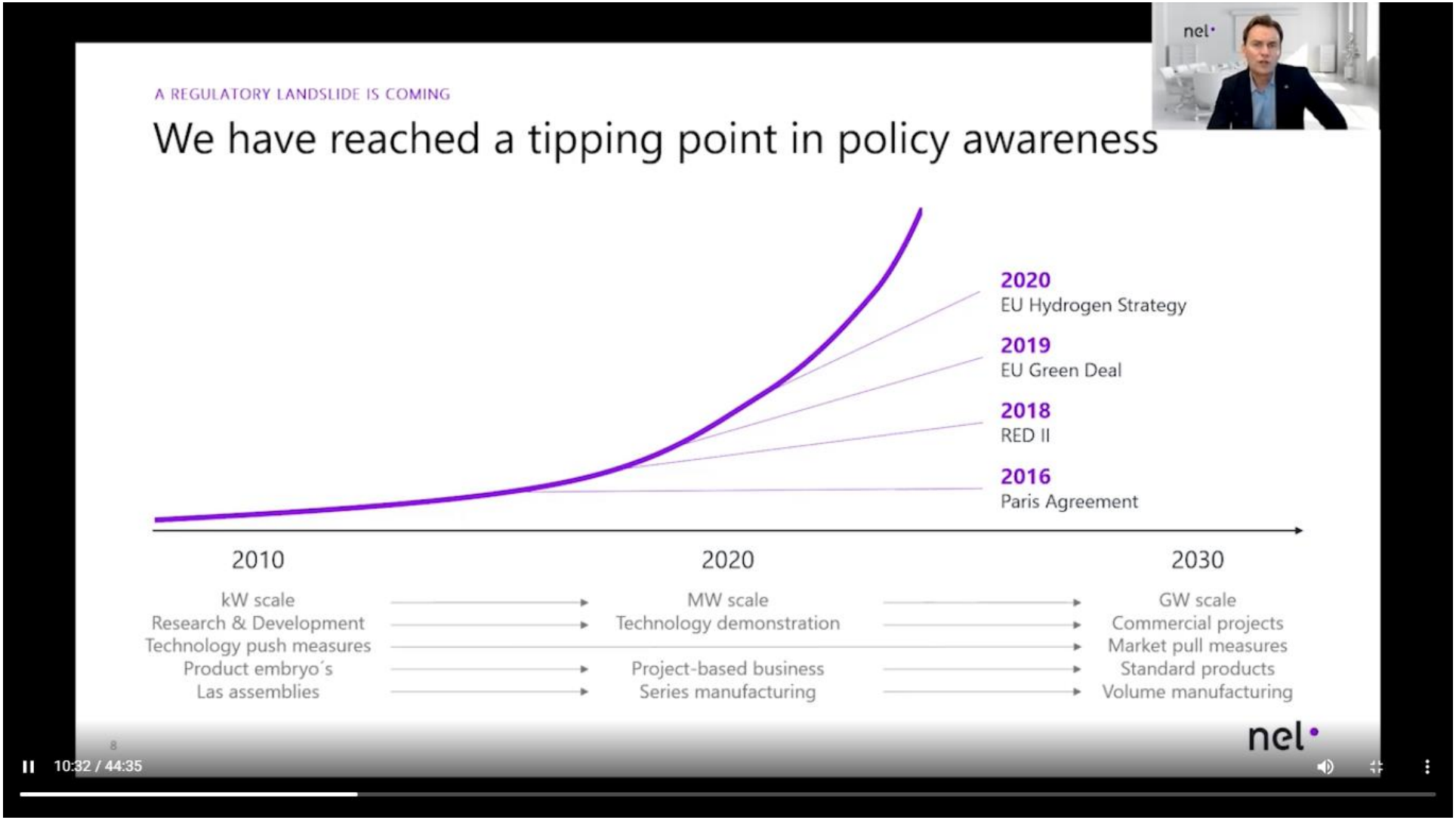
A REGULATORY LANDSLIDE IS COMING
We have reached a tipping point in policy awareness
2020
EU Hydrogen Strategy
2019
EU Green Deal
2018
RED II
2016
Paris Agreement
2010
2020
2030
kW scale
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Product embryo´s
Las assemblies
MW scale
Technology demonstration
Project-based business
Series manufacturing
GW scale
Commercial projects
Market pull measures
Standard products
Volume manufacturing
8
10:32 / 44:35

THE HYDROGEN OPPORTUNITY

Hydrogen is expanding its areas of application

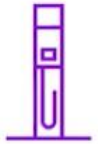
Industrial applications

- Niche industrial applications represents "traditional" hydrogen markets
- Steady demand for hydrogen

Power-to-X

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

Mobility



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

Steady growing market

Markets expected to see fast growth going forward

THE HYDROGEN OPPORTUNITY

Strong tailwind for hydrogen solutions

1

Strong momentum within mobility, especially within HDV

>2,000 GW electrolysis potential*

IVECO & Nikola partnering in European fuel cell HDV market

Anglo American/ENGIE to develop fuel cell electric mining trucks

Hyundai reveals HDV concept – plan to deliver 1,600 trucks to Switzerland

2

Accelerated focus on industrial hydrogen applications

>2,000 GW electrolysis potential

Ammonia

Refinery

Steel

* At 50% market share. Image credits: Nikola Corporation, Anglo American, Hyundai

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MARKET DEVELOPMENTS

Electrolyser market going forward

Ammonia

Refinery

Methanol/
Synthetic fuel

Cement

Steel/Metals

Remote power

Gas pipelines

Energy export

Fish farming

Electrolysis potential >2,000 GW

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Dramatically cutting cost on electrolysers, will enable green renewable hydrogen on par with fossil hydrogen!

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NEL CUTTING COST FASTER THAN COMPETITION

$1.50/kg

Nel green hydrogen cost target by 2025

Assumptions: Nel analysis based on electricity of $20/MWh, >8% cost of capital, cost of land, civil works, installation, commissioning, building water etc., lifetime 20 years incl. O&M cost, at 30 bar

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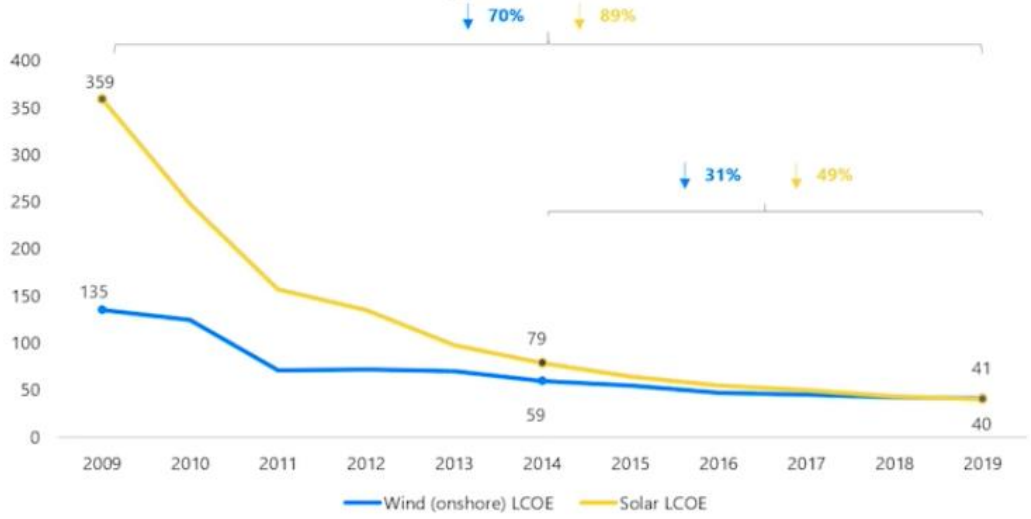
NEL CUTTING COST FASTER THAN COMPETITION

Cost of wind and solar dropping significantly – green hydrogen to follow

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



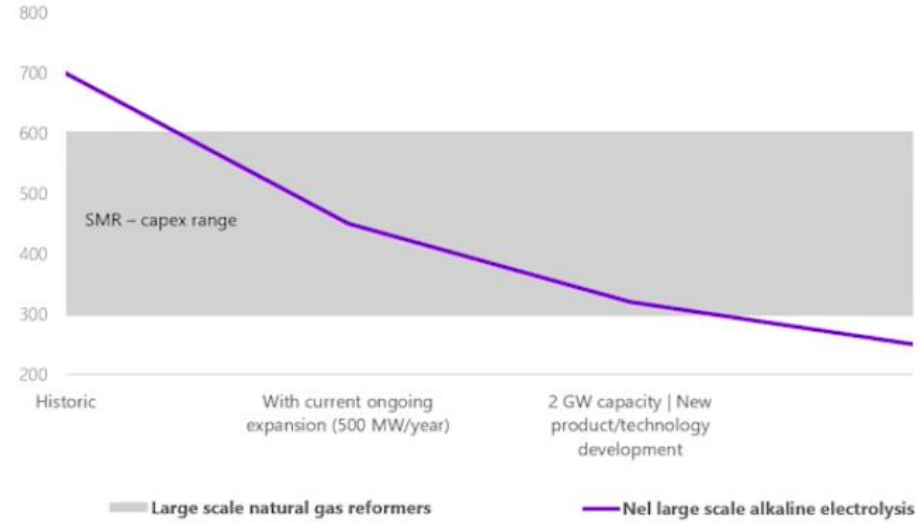
- With falling LCOE[1] of wind and solar prices, renewable hydrogen follows the same path, as electrical power constitutes 70-80% of hydrogen's total cost
- Record low auction prices for solar PV and wind – prices as low as $13.5/MWh and $17.86/MWh respectively [3,4]
- Prices expected to drop further, LCOE of solar PV and onshore wind expected to fall by 71% and 58% respectively[5]
- Renewable hydrogen competitive with fossil fuels at $50/MWh – competitive in most markets at $30/MWh

Sources: [1] LCOE = Levelised cost of energy (total production cost of building and operating electricity-generating plant, [2] Lazard; Renewables Now, [3] PV magazine, [4] IRENA (International Renewable Energy Agency, [5] BloombergNEF New Energy Outlook 2018

NEL CUTTING COST FASTER THAN COMPETITION

Growth in renewable hydrogen will accelerate with reduced capex for electrolysers

Capex of steam methane reformers (SMR) vs. Nel's alkaline electrolysers
$/kW



- Steam methane reforming (SMR) dominates hydrogen production using natural gas and steam
- Nel establishing new manufacturing plant targeting >40% cost reduction – further capex reduction expected due to increased production volume and further size scaling
- Nel targets capex to drop below SMR over time
- Electrolysis expected to be preferred production method if opex (i.e. power prices) is low enough, or at parity, with alternative production methods

Source: Company analysis and projections, hydrogen production plant excluding installation, civil works and building.

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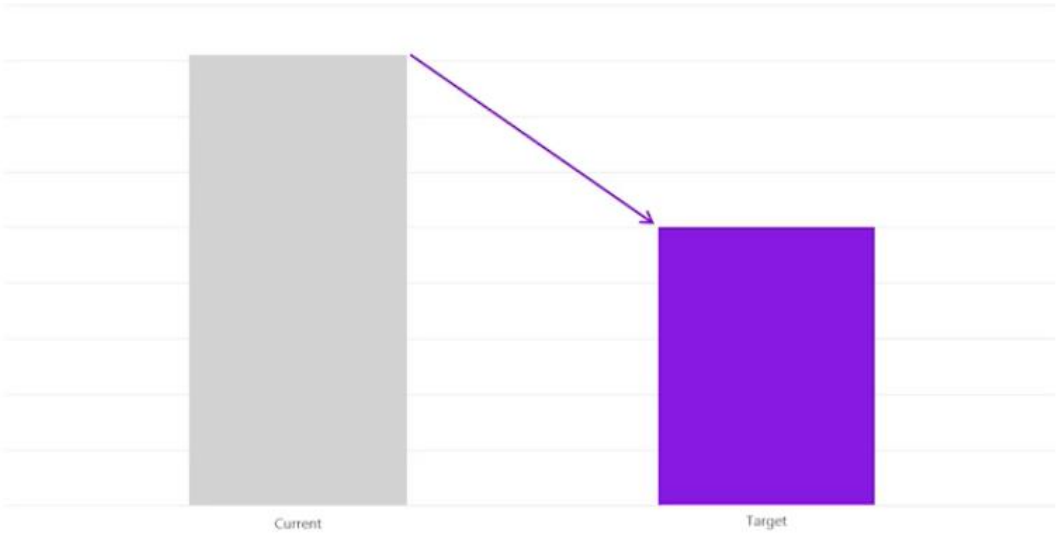
NEL CUTTING COST FASTER THAN COMPETITION

The world's most efficient electrolyser becoming even more efficient

Roadmap to reduce energy consumption towards theoretical minimum

Energy consumption (kWh/Nm^3 H_2)



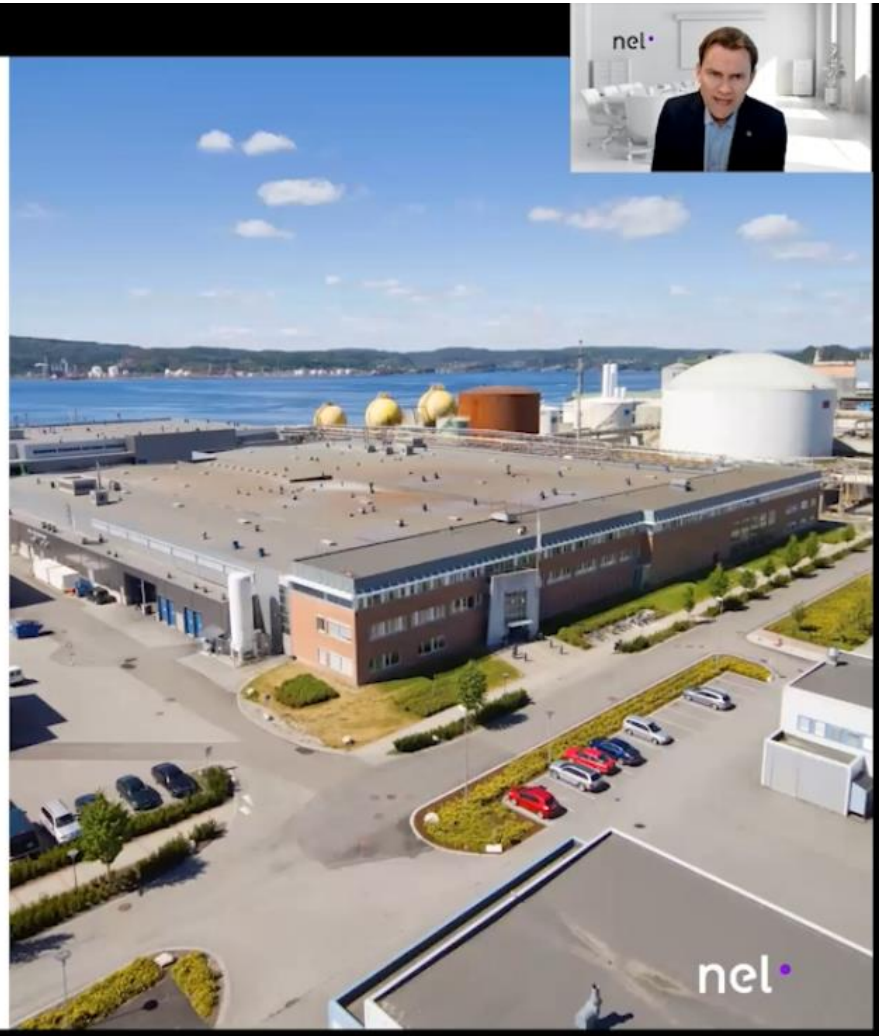
Main enablers in product and manufacturing process will reduce specific energy consumption with 5 to 10 pct.

- Zero gap electrodes
- Surface treatment / texturing
- Reduced production variation

NEL CUTTING COST FASTER THAN COMPETITION

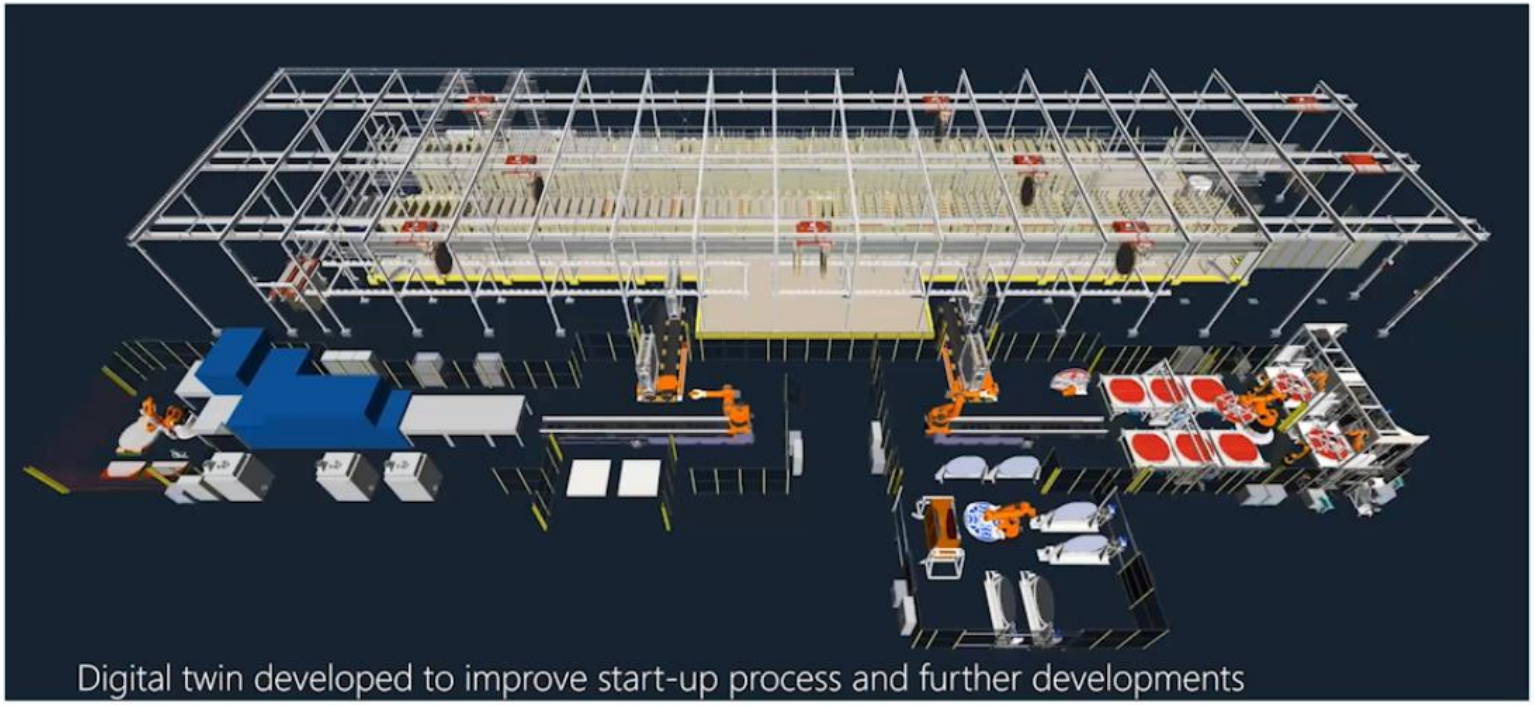
Capacity expansion at Herøya

- Fully automated and designed according to **lean manufacturing and industry 4.0 principles**
- Industrial scale production of most efficient electrolysers in the market, at a **game-changing cost**
- Large scale production line improvements identified, name plate capacity of **~500 MW** for initial line
- Room to expand to **~2 GW** annually (space for 4 lines)
- CO_2 reduction potential in line 1 (pilot) of **1.000,000 ton** – with 2 GW, **4-5 million ton**
- Test production in new line **Q2'21**, start of ramp-up Q3'21



NEL CUTTING COST FASTER THAN COMPETITION

Production line 1 – fully automated



Digital twin developed to improve start-up process and further developments

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Standardization to improve cost and reduce delivery-time

Building independent

All main components as skids

All hydrogen safety standards imbedded

Safe work zones and walkways

Pre-fabricated pipe rack

Stacks arriving on skids preassembled

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Other important developments

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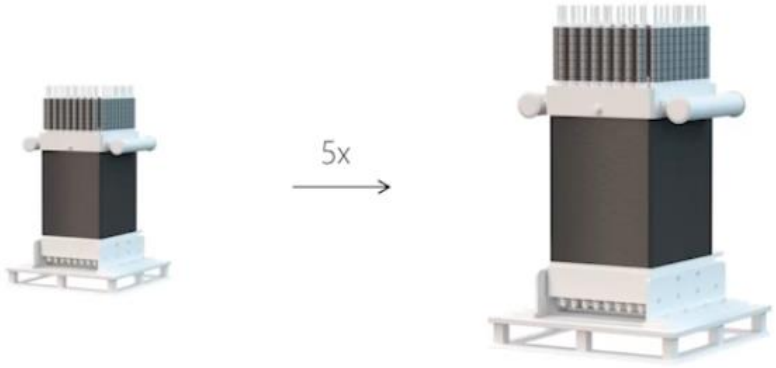
NEL CUTTING COST FASTER THAN COMPETITION

Scaling up for future large-capacity opportunities



- 5 times scale-up of advanced, patented electrolyser cell stack design
- 1.25 MW input power
- Capacity to make more than 500 kg H2 per day
- Based on Nel's unique competence and experience to design and manufacture durable cell stack products
- Size is maximized on current supplier capabilities

From LDV to HDV, improving performance, robustness & reliability

Press Esc to exit full screen

HYDROGEN FUELING IN BRIEF

Hydrogen is becoming relevant in all forms of mobility

Forklift

Bus

Delivery truck

Truck

Construction equipment

Passenger car

Train

Fast ferry

Car ferry

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27:47 / 44:35

HYDROGEN FUELING IN BRIEF

Fast fueling LDVs with 600 km in 3-5 minutes is a must

5 kg dispensed in <5 minutes
requires >600 km driving range

Charging BEV w/ >600 km range (100 kWh) in 5 minutes would require 1,200 kW grid connection

HYDROGEN FUELING IN BRIEF

Fast fueling HDVs with 1,000 km range in 10-15 minutes is a must

Battery charging would require a **8,000** kW grid connection – hydrogen fueling only **300** kW

100 kg dispensed in 10-15 minutes, equal to 1,000 km driving range, only requires a 300 kW grid connection

Charging a Battery Truck with 1,000 km range (1,000 kWh) in 10 minutes would require an 8,000 kW grid connection

Image credits (clockwise from top left): ASKO, Toyota, Nikola Motor Company, Hyundai.

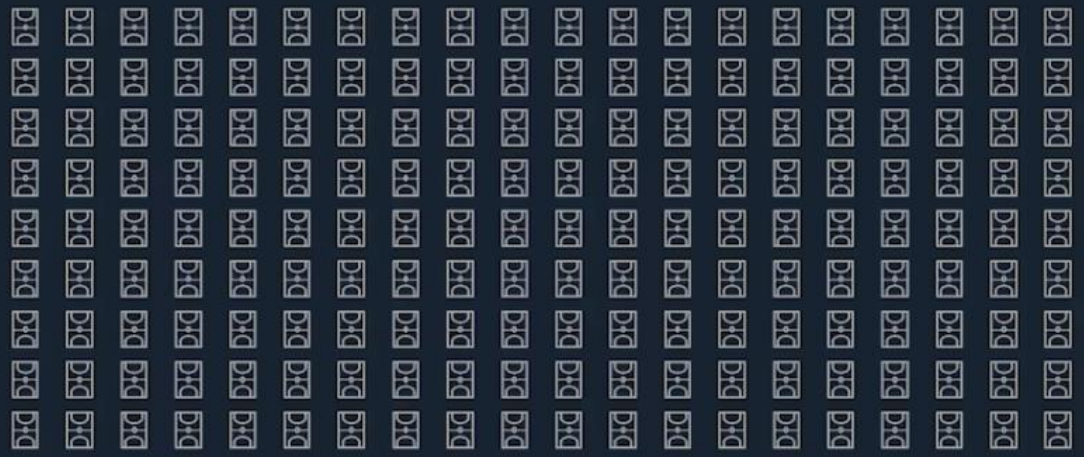
HYDROGEN FUELING IN BRIEF

Hyper-fast-fueling is key to serve many customers quickly

Land requirements for charging stations for all New York City taxis would be equal to...

Battery

180
NBA courts



Example from "Hydrogen meets digital", Hydrogen Council discussion paper, September 2018

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HYDROGEN FUELING IN BRIEF

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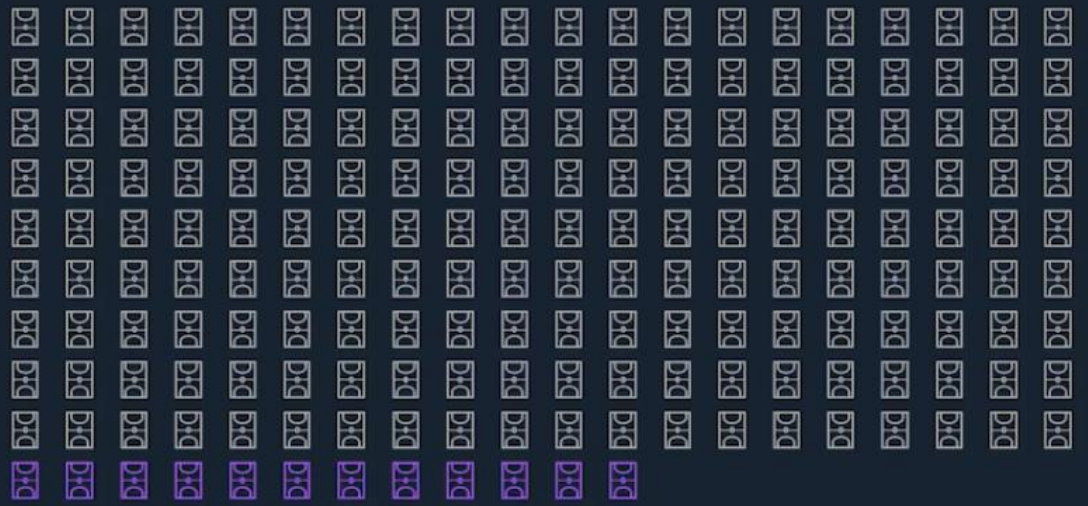
Battery

180
NBA courts



Hydrogen

12
NBA courts

Example from "Hydrogen meets digital", Hydrogen Council discussion paper, September 2018

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THIS IS NEL FUELING

Type approved standardized hydrogen fueling products

Supply Cabinet | Supply & Fueling Storage | Station Module | Dispenser

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SCALING TECHNOLOGY FOR A 10X MARKET

Hydrogen fueling, as fast as diesel, is a must – an industry-wide challenge

Hydrogen and energy transfer during fueling

- End-users expect same performance as today
- Today, cars and busses are fueled with 1-2 kg H_2/min
- Heavy duty vehicles will require 10 kg /min – x10 today
- A very large amount of energy transferred to the vehicle
- Industry group working on new HDV nozzle

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Project examples

nel

PROJECT EXAMPLES

Signed contract with Iberdrola to supply a 20 MW green fertilizer project in Spain

To deliver 20 MW PEM electrolyser solution to Iberdrola

- Iberdrola, one of the largest electricity utilities in the world, has together with world-leading fertilizer manufacturer Fertiberia launched a project to establish the largest green hydrogen plant in Europe
  - Project includes 100 MW photovoltaic plant, a 20 MWh battery and a 20 MW electrolyser
  - Will use hydrogen to produce green fertilizer commencing in 2021

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PROJECT EXAMPLES

Signed letter of intent (LoI) with Statkraft for green hydrogen project in Norway

Up to 50 MW electrolysis to support fossil free recycling steel production

- Statkraft, the largest renewable energy company in Europe partnered up with Celsa Armeringsstål (Celsa), a leading steel producer
- Facility in Mo i Rana which produces reinforced steel from recycling of scrap metal
  - Current production: 700,000 tons/year (equal to two Eiffel towers per week)
  - By exchanging natural gas with hydrogen, CO2-emissions can be reduced by >60%
- Nel and Statkraft has entered into a LoI for 40 – 50 MW of electrolyser capacity

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PROJECT EXAMPLES

Supplying electrolysers to HYBRIT, the fossil-free steel project in Sweden

Photo: Vattenfall

Supplying electrolysers to the currently most advanced fossil-free steel project

- Nel has received a purchase order for a 4.5 MW alkaline electrolyser which will be used in a pilot plant for fossil free steel production
- Hybrit Development AB (HYBRIT) is a joint venture owned equally by SSAB, LKAB and Vattenfall
- The steel industry accounts for 7% of global and 10% of Swedish CO2-emissions
- Pilot plant will operate in Luleå, Sweden from 2021 – 2024, with target of full-scale implementation by 2035

PROJECT EXAMPLES

Delivering electrolysers for life-support oxygen production

Received purchase orders of USD >9 million for life-support stacks in 2020

- Ongoing contract with United Technologies' Collins Aerospace Division for supply of PEM electrolyser stacks for critical life support oxygen
  - Used on-board U.S. and U.K. Navy submarines
  - Delivered under an exclusive contract
- Delivered life-support electrolyser stacks for more than a decade

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PROJECT EXAMPLES

Electrolysers for hydrogen fuel production

Delivering electrolysers for green hydrogen fuel production

- 3.5 MW electrolyser to Engie for a hydrogen mining haul truck project in South Africa
- 2 MW electrolyser for Hydrospider, a H2 Energy affiliate in Switzerland for Hyundai fuel cell electric trucks
  - 30 MW framework agreement
- 2 MW electrolyser for Sunline Transit Agency for hydrogen buses
- ~1 MW electrolyser for Lhyfe for bus fueling
  - 60 MW frame contract

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PROJECT EXAMPLES

24 H2Station™ modules sold to California

California one of the most important markets for fueling stations

- Nel has received purchase orders for a total of 24 H2Station™ modules for 12 sites in California
- Fueling passenger vehicles, buses and trucks
- Key customers: Shell, Sunline Transit Agency
- Containerized 2 MW PEM electrolyser delivered to support bus fueling
- State of California continues to support deployment of hydrogen infrastructure

PROJECT EXAMPLES

Supporting hydrogen production and fueling technology for Nikola

Received biggest purchase order for electrolysers in 2020

- Partnership with Nikola, global leader in zero-emission transportation and infrastructure solutions
- Received purchase order of USD 30 million for >85 MW alkaline electrolysers related to development of world's first 8 ton/day hydrogen fueling stations
  - Electrolysers will primarily be delivered from new electrolyser mega-factory currently under development in Norway
- Purchase order for associated station equipment expected when Nikola has firmed up exact station locations

Photo: Nikola Motor Company

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PROJECT EXAMPLES

Korea showing highest current momentum for establishing LDV hydrogen infrastructure

Hydrogen fueling stations roll-out in Korea

- Nel Korea has received purchase orders for a total of 16 H2Station™ units in Korea
- Korea has ambitions of >300 hydrogen stations by 2022
- Nel Korea is part of HyNet, a special purpose company for expanding the country's hydrogen infrastructure is under development
- Korea has adopted international standards for hydrogen fueling stations
- The compact design of the Nel H2Station™ enables time- and cost-efficient infrastructure build-up

Photo: Team in South Korea celebrating the opening of the first Nel station

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PROJECT EXAMPLES

Various other fueling projects

Transport for London

Everfuel

PAK Energia dla Ciebie

HTEC Hydrogen Technology & Energy Corporation

H2Station™ modules for buses and passenger vehicles

- Bus fueling station for Transport for London in the UK
- Stations for passenger vehicles in Denmaek and buses in the Netherlands for Everfuel
- Combined passenger vehicle/truck stations for ZE PAK in Poland
- Station for passenger vehicles for HTEC in Canada

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SUMMARY

Hydrogen markets accelerating faster than anticipated... We are ready!

- Pure play, independent hydrogen technology company
- Decades of experience on both PEM and alkaline electrolyser platforms, especially large-scale
  - A billion++ of operating hours in the field; bankable, with performance guarantees
- Scaling up mature, large-scale platforms, enabling cost leadership position
  → accelerating *fossil parity*
- Partnerships are key; engaged in projects for the most important future large markets
- Gigawatt market coming sooner than anticipated
  - Cost development of renewables and global politics accelerating the development

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number one by nature

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SESSION HOST:

Adrienne Blume

Editor-in-Chief/Executive Editor

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4:00 AM - 4:45 AM CDT on Wednesday, May 19
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LIVE Q&A FOR KEYNOTE: Scaling up green Hydrogen

Jon Andre Løkke
Nel ASA
Chief Executive Officer

4:45 AM - 5:00 AM CDT (Wed, May 19)

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