



**NAP**  
PROCESS INDUSTRY  
NETWORK

# TOWARDS AN ALL-ELECTRIC INDUSTRY

NAP STUDIUM GENERALE

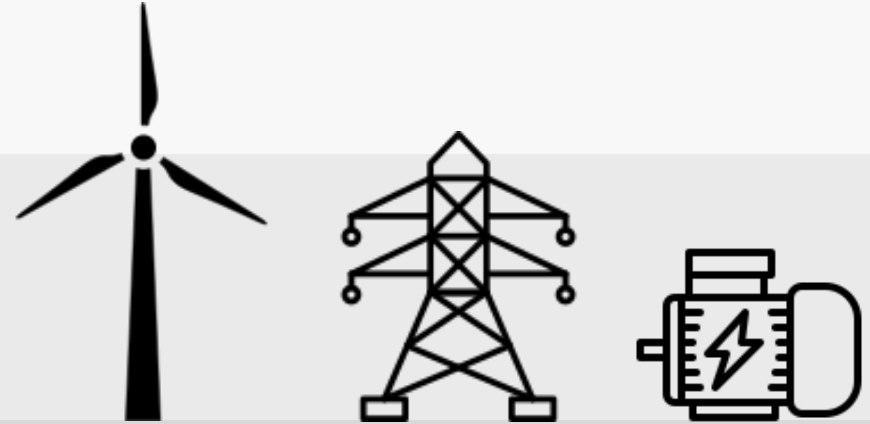
Accelerating the electrification in the process industry.  
Energy Transition Campus, Amsterdam, 24 March 2022

**avans**  
university  
of applied sciences

**STORK**  
A Fluor Company

# AGENDA

1. The decarbonisation challenge
2. Possible solutions
3. The road to all-electric



A blue-tinted photograph of an industrial facility, likely a refinery or chemical plant, featuring tall distillation columns, storage tanks, and complex piping. The image is used as a background for the title slide.

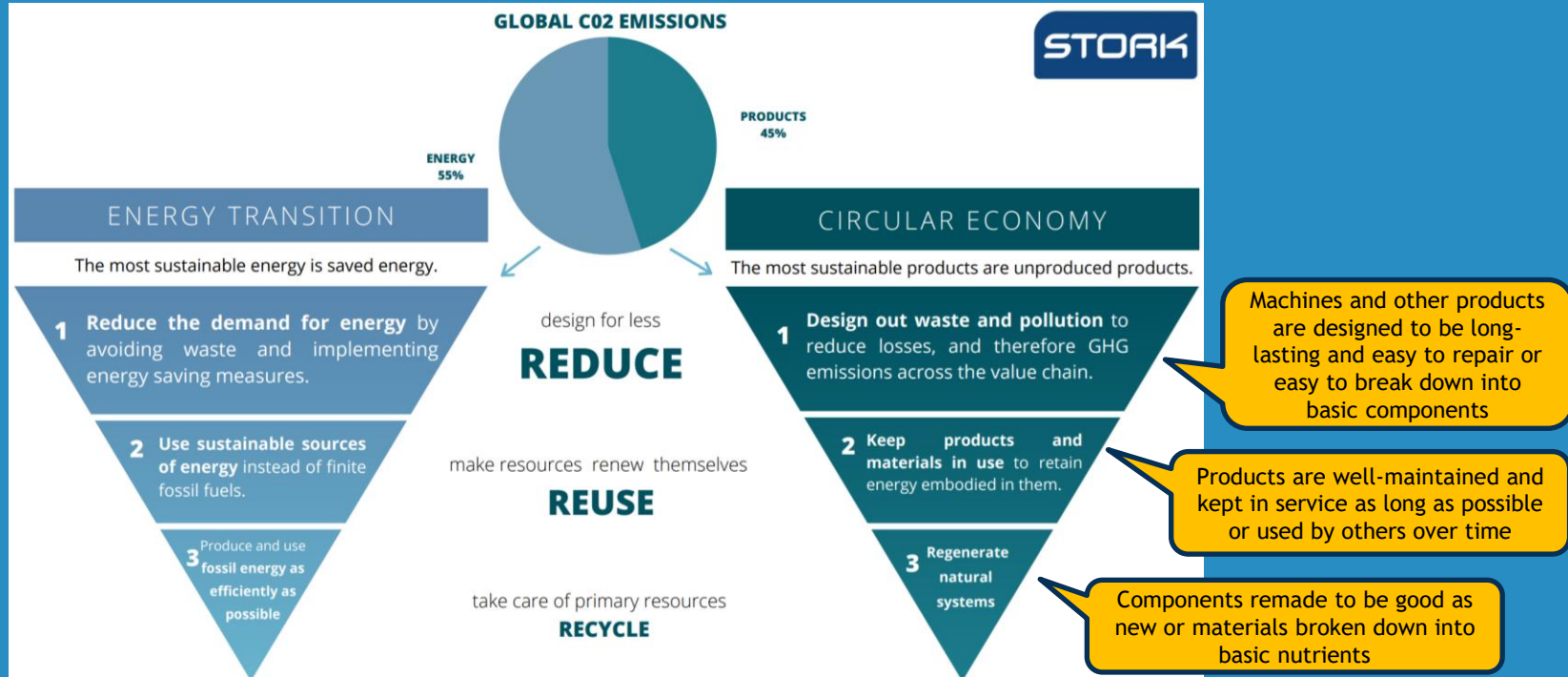
# THE DECARBONISATION CHALLENGE

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# MANAGING DECARBONIZATION

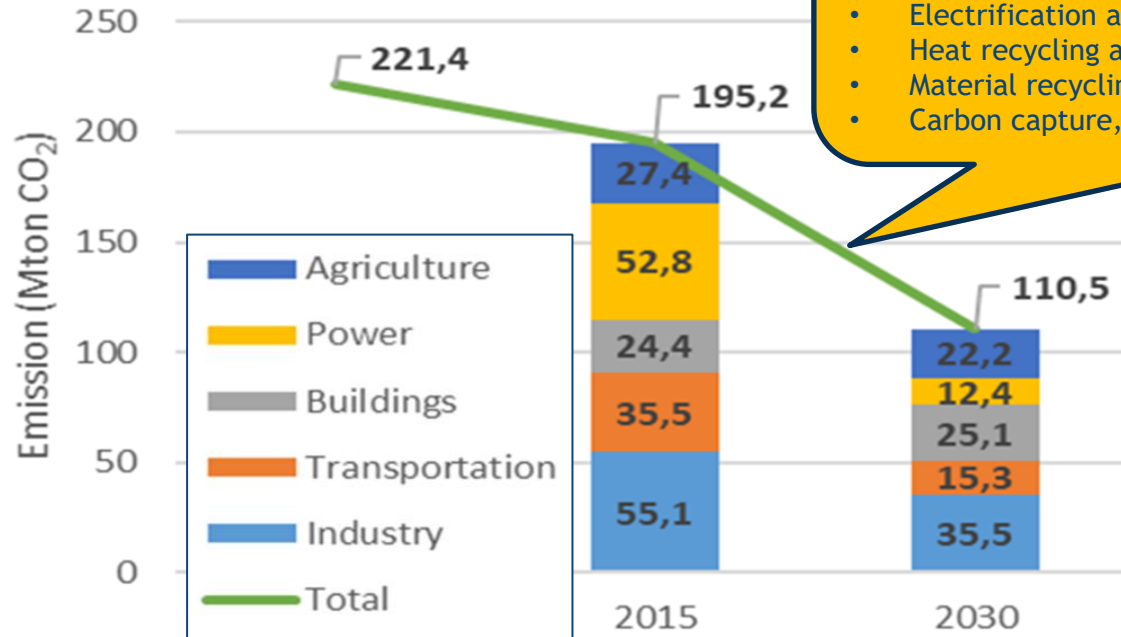
Not only energy, but also the circularity of feedstock and materials



# DUTCH CLIMATE AGREEMENT

## 19.4 Mton less CO<sub>2</sub> in 2030

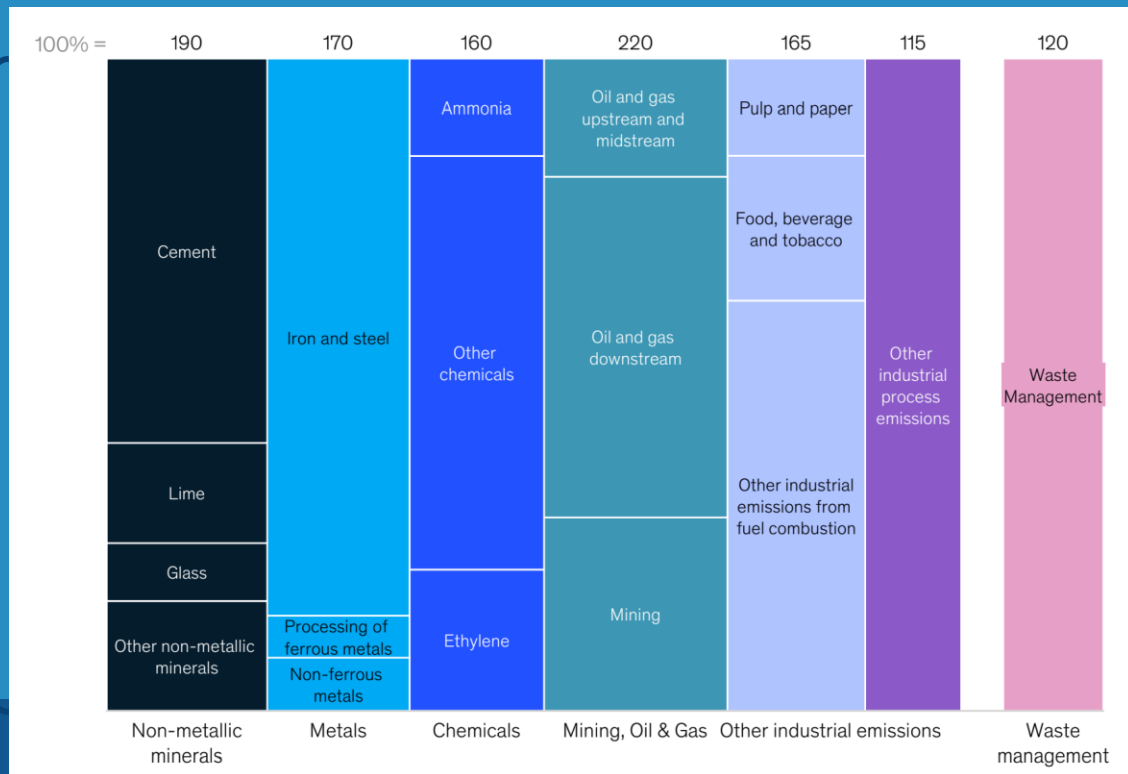
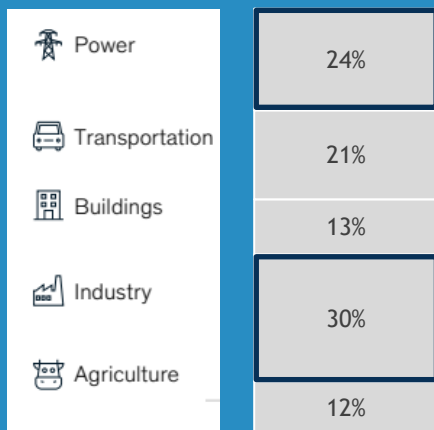
- Production stop of Groningen gas field
- Improvement of the Emissions Trading Scheme (ETS)
- Cleaner and more efficient production
- More renewable energy (biomass, green gas, geothermal heat)
- Electrification and hydrogen
- Heat recycling and reuse
- Material recycling and sustainable feedstock
- Carbon capture, storage and usage (CCSU)



# EMITTING INDUSTRIES

## INDUSTRY ACCOUNTS FOR ALMOST ONE-THIRD OF EU-27 GHG EMISSIONS

Emissions by sub-sector for EU-27, 2017, MtCO<sub>2</sub>e



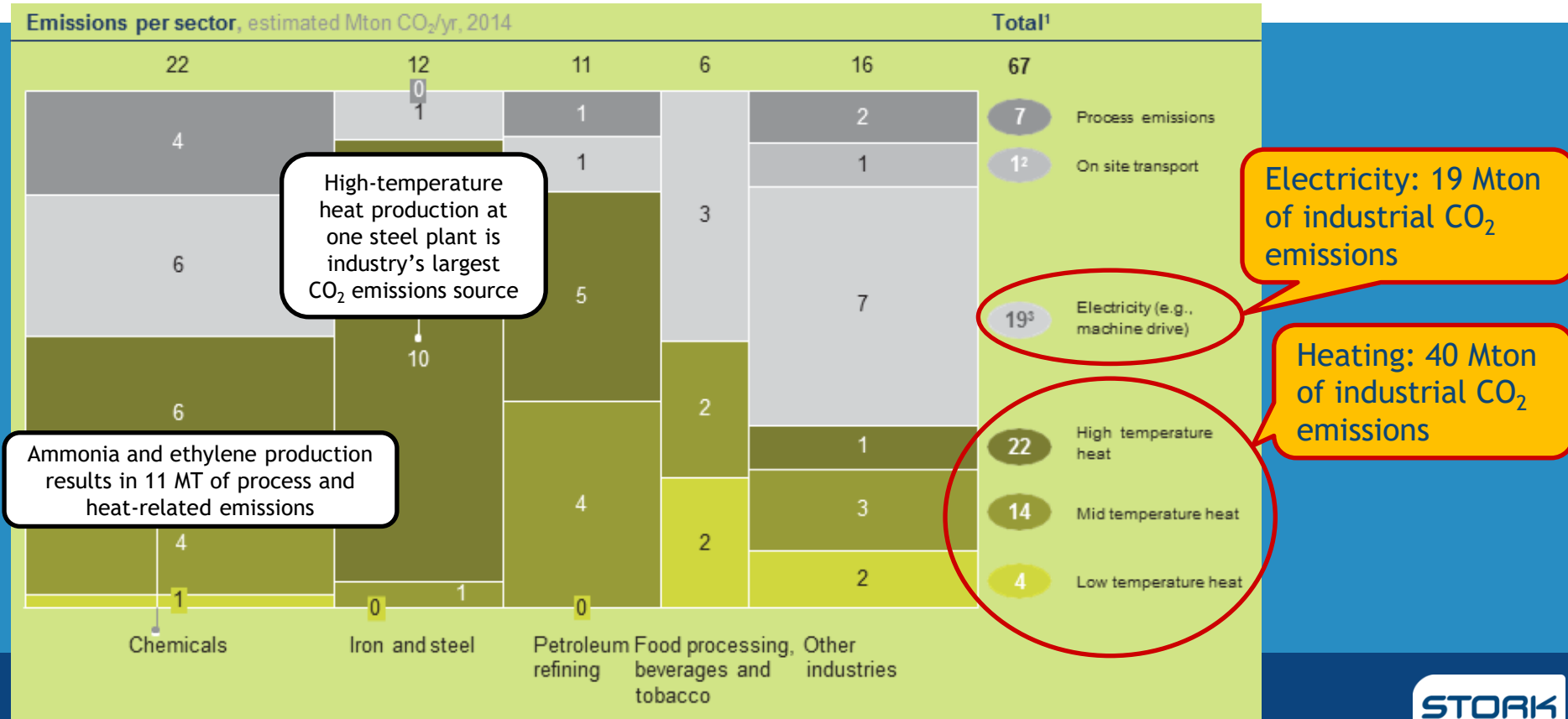
Source: Net-Zero Europe, Decarbonization pathways and socioeconomic implications, McKinsey&Company, November 2020

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# MAJOR CO2 SOURCES

## Heating and Electricity



Source: Energy transition: mission (im)possible for the industry?, A Dutch example for decarbonization, McKinsey&Company, October 2017

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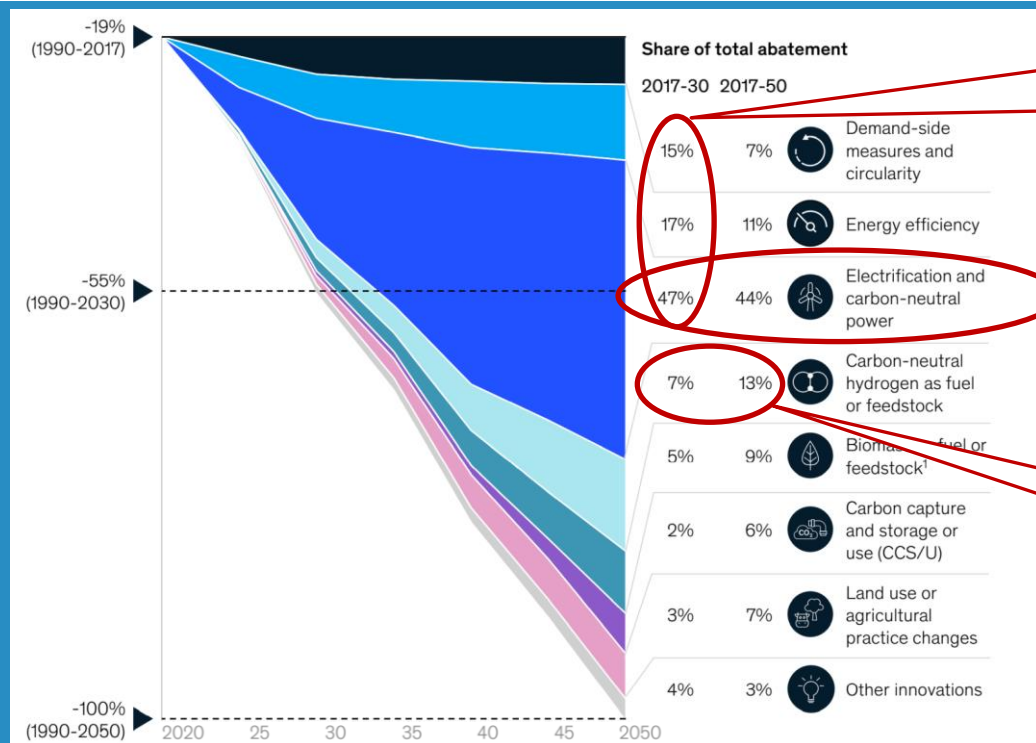
The background of the slide is a photograph of an industrial facility, likely a refinery or chemical plant. It features various structures including tall distillation columns, storage tanks, and complex piping systems. The entire image is covered with a semi-transparent blue filter. In the center, there is a white rounded rectangular box containing the text 'POSSIBLE SOLUTIONS'.

# POSSIBLE SOLUTIONS



# POSSIBLE SOLUTIONS

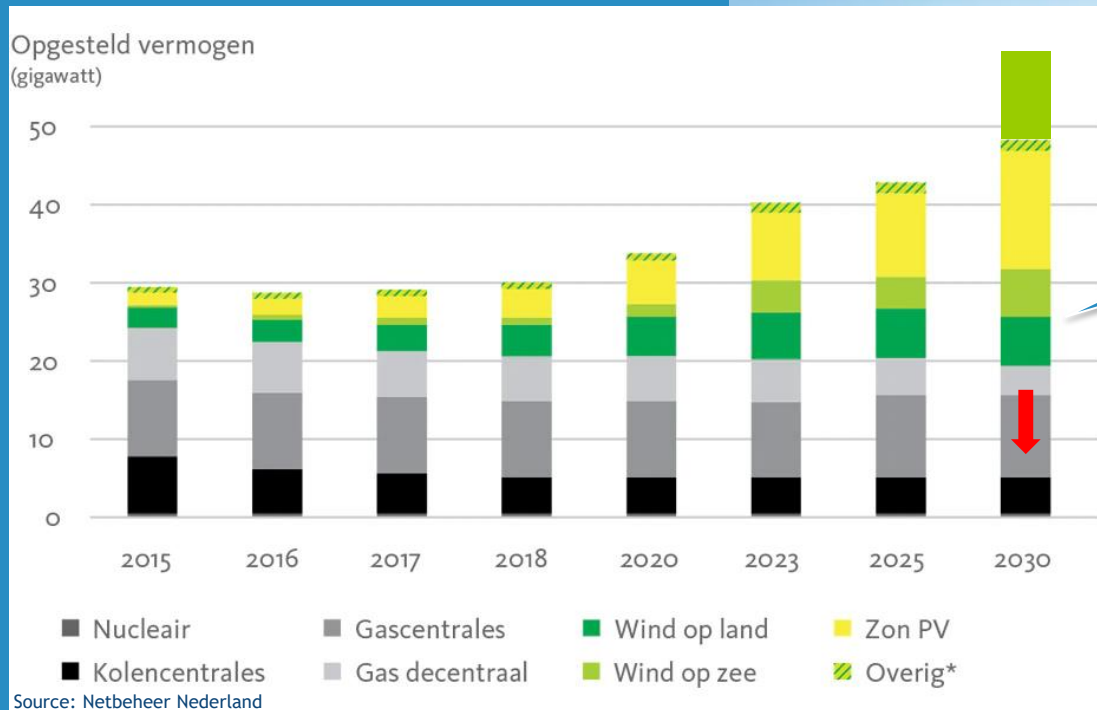
## Decarbonization levers to reach net-zero emissions by 2050



Source: Net-Zero Europe, Decarbonization pathways and socioeconomic implications, McKinsey&Company, November 2020

# CARBON NEUTRAL POWER

## Dutch government doubles offshore wind energy production



Shifting the energy mix by 10.7 GW extra wind capacity by 2030



# ELECTRIFICATION IN INDUSTRY

## Challenges ... and opportunities

### Fossil to Electricity

Motors & Drives



Heat integration



### Smart control



### Grid connection & Storage



# POSSIBLE SOLUTIONS

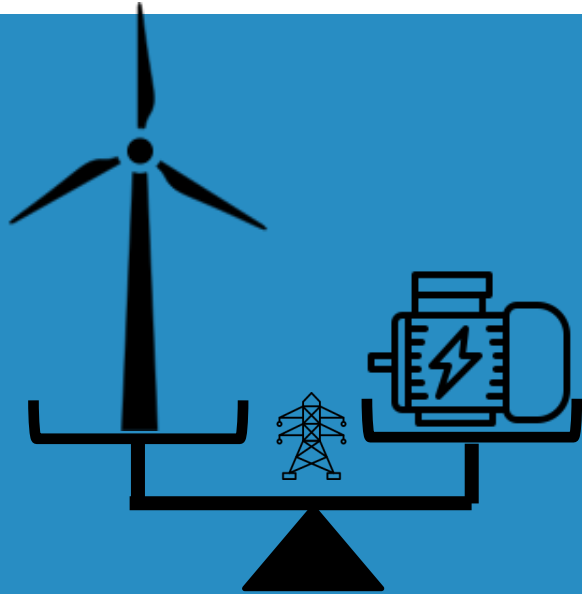
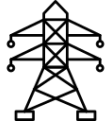
## Feasible economical reduction potential

Technology groups	Motors & Drives		Heat Integration					Smart Control			
Industry sectors	High efficiency electro motors	Electro-mechanical system optimization	Flue gas recuperation	HT heat pumps	Mechanical vapor re-compression	Heat transformer	Hybrid boilers	Advanced process control	Energy management analytics	Asset management analytics	Totals
Industrial gasses	0	11	5	0	0	0	90	26	14	16	162
Steam crackers	0	29	55	4	15	29	0	74	36	39	281
Ammonia and N-fertilizer	0	5	10	1	2	0	10	49	21	19	117
Wider chemical industry	1	32	59	52	127	86	90	58	25	57	557
Refineries	0	20	85	6	23	76	0	65	31	29	335
Iron and steel	2	47	49	2	8	0	0	46	23	17	194
Food	5	49	67	165	165	16	130	106	63	62	828
Paper & Board	1	39	20	38	88	0	50	23	14	14	287
<b>Totals</b>	<b>9</b>	<b>232</b>	<b>350</b>	<b>268</b>	<b>428</b>	<b>207</b>	<b>370</b>	<b>447</b>	<b>227</b>	<b>253</b>	<b>2761</b>

Source: Project 6-25 Technology Validation, RHDHV, July 2020

Reduction potential in Kton CO2/yr

# GRID CONNECTION & STORAGE



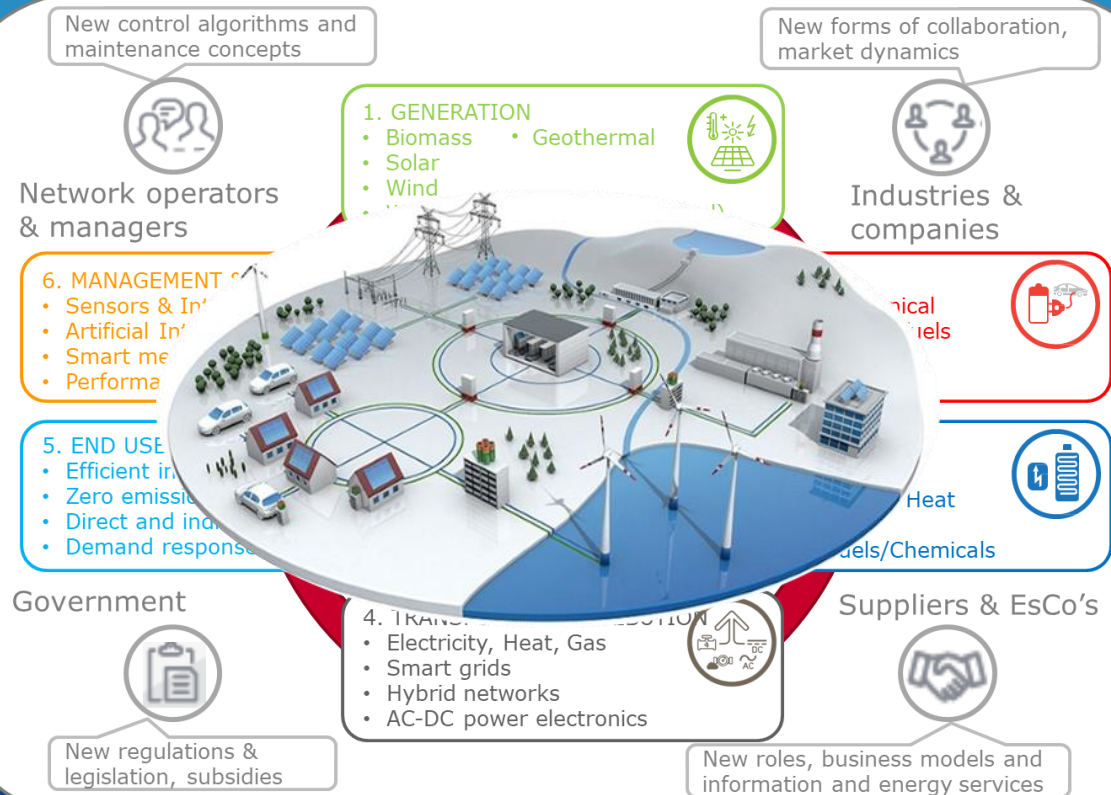
Smart grids

Energy storage solutions



# SMART GRIDS

## Systems integration & balancing demand and supply



- Better grid utilization
- Prevention of grid congestion and expansion
- Enables more local production
- Flexibility for end-users
- Dynamic load control
- Multi-vector solutions
- Supports direct and indirect electrification
- Integration of storage and back-up solutions



# “WATER WILL BE THE COAL AND THE OIL OF THE FUTURE”

“Yes, my friends, I believe that water will one day be employed as fuel, that hydrogen and oxygen which constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable”

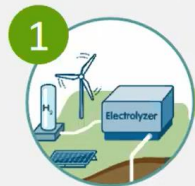
Jules Verne, *The mysterious island*, 1874-5



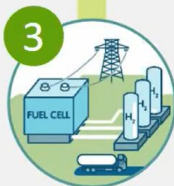
# HYDROGEN CAN PLAY 7 ROLES IN THE ENERGY TRANSITION

Enable the renewable energy system → Decarbonize end uses

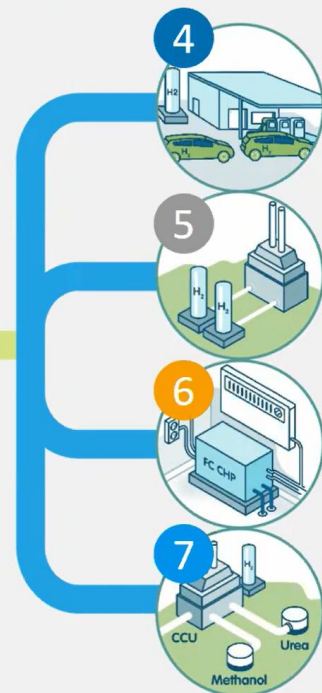
Enable large-scale renewables integration and power generation



Distribute energy across sectors and regions



Act as a buffer to increase system resilience



Help decarbonize transportation

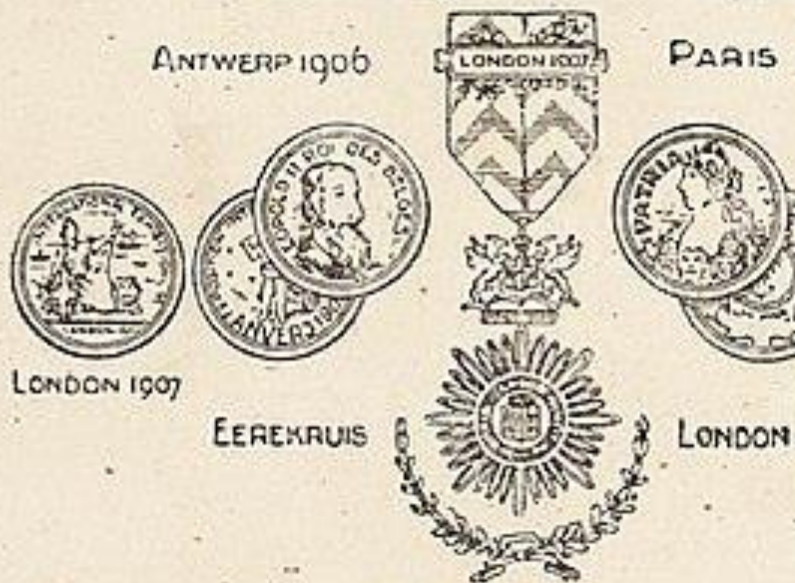
Help decarbonize industrial energy use

Help decarbonize building heat and power

Serve as renewable feedstock

6-  
De Eenige Oprechte Haarlemmerolie  
in FLESCHJES en CAPSULES

575



N.V. Oprechte Haarlemmerolie Fabriek  
ACHTERSTRAAT 8 - 8a - 8b  
HAARLEM





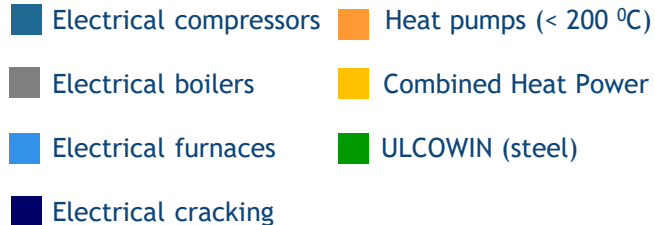
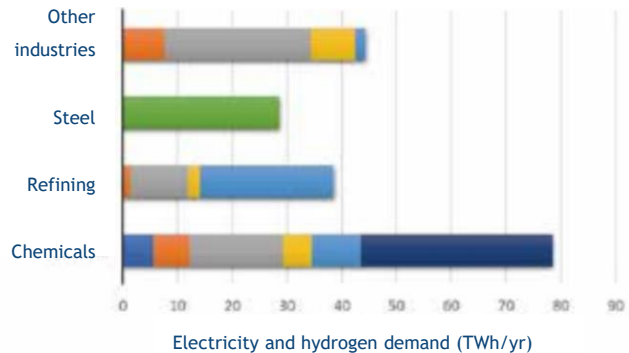
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# THE ROAD TO ALL-ELECTRIC

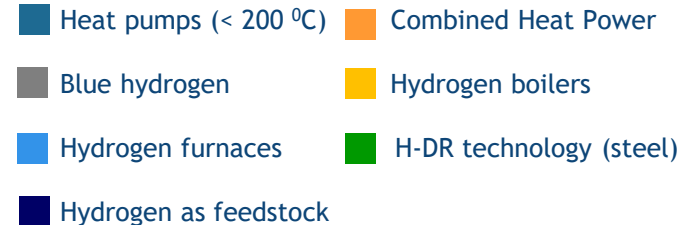
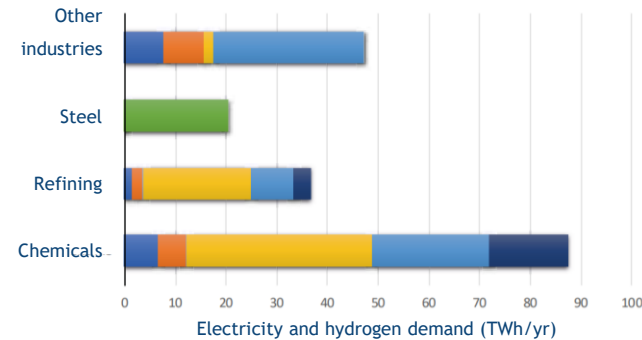
# THE ROAD TO ALL-ELECTRIC

## Direct and indirect electrification solutions

Potential direct electrification per sector



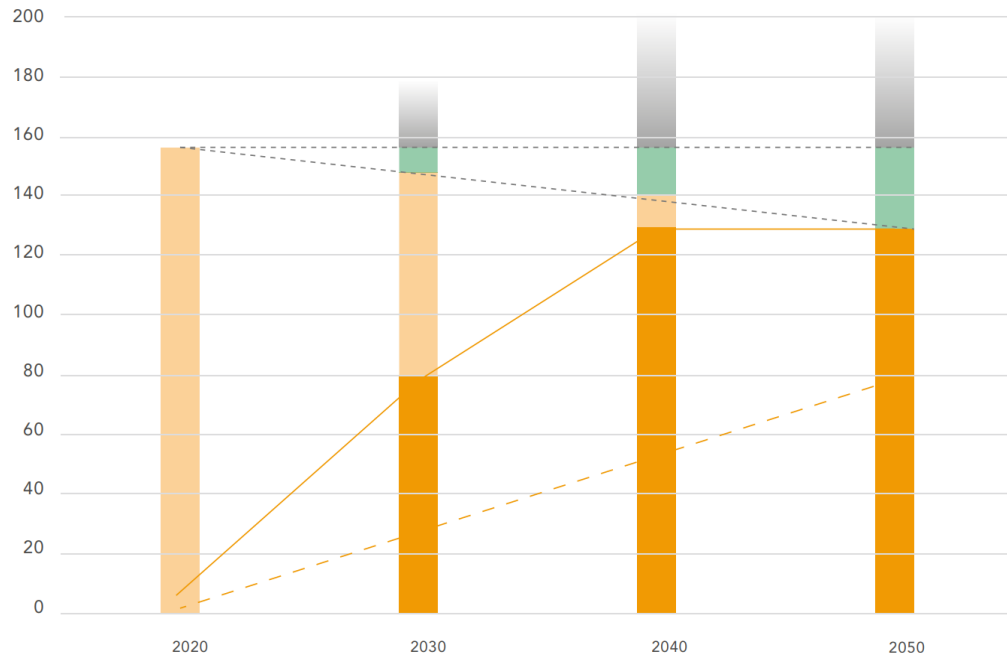
Potential indirect electrification per sector



# THE ROAD TO ALL-ELECTRIC

## Electrification potential

Fossil fuel energy demand in industry (TWh)



- Growth potential
- Energy savings (efficiency increase)
- Fossil fuel consumption
- Electrification potential

- 80 to 130 TWh electrical energy demand in 2050
- 60 to 80% of the total energy demand in 2050 delivered by electricity
- 30 to 80 TWh of industrial electrification is already possible in 2030
- In 2050, industry needs 3 to 4 times more electricity than the current demand
- 26 to 46 GW extra offshore wind is needed to supply the electricity demand

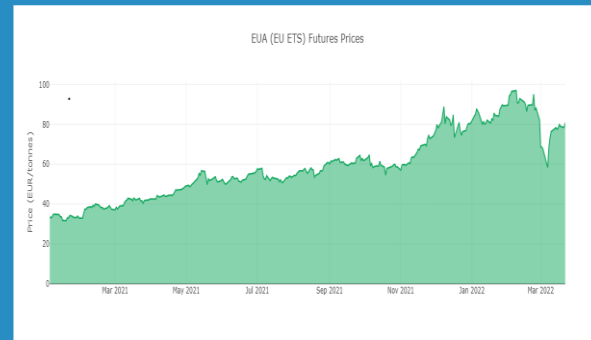
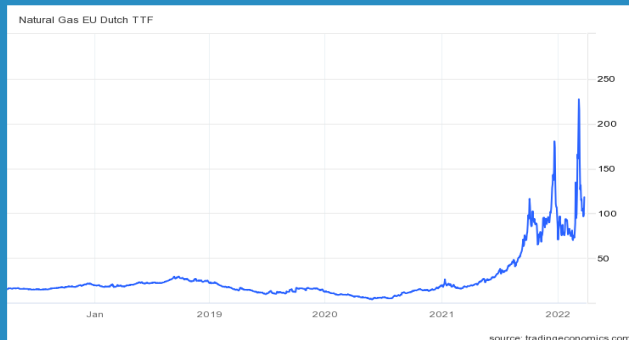
Source: "Routekaart Elektrificatie in de Industrie" (Roadmap Electrification in the industry)



# THE ROAD TO ALL-ELECTRIC

## Rising prices for fossil fuels and CO<sub>2</sub>

- “The Brent crude oil price is thus likely to be driven back up again in the coming weeks as the war in Ukraine continues.” (Oilprice.com)
- “EU natural gas futures spiked to €130 per MWh, the highest since March 11<sup>th</sup>” (tradingeconomics.com)
- “The price of carbon permits in Europe has crashed dramatically following Russian’s invasion of Ukraine, lowering the cost of emitting carbon for the EU’s most polluting companies. (theguardian.com)



# TO SUMMARIZE

- Industry is accountable for one-third of Europe's CO2 emissions
- The decarbonization challenge is not only about energy
- It's not up to one industry to solve; many industries have impact
- Heating and electricity (eg for machine drives) are major CO2 sources
- Half of industrial CO2 reduction is linked to electrification, using carbon-neutral power
- Lots of high impact solutions are already available
- The Dutch industry has a high potential for both direct and indirect electrification
- We have to deal with the current geopolitical situation giving a paradigm shift in the energy markets

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# THANK YOU FOR ATTENDING!

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> **QUESTIONS?**