

Webinar

ELECTRIFICATION

Transitioning to a lower-carbon production

- Thank you for joining.
- You can ask questions via the Q&A button in the zoom menu. During the webinar, all attendees are muted.

STORK PROVIDES OPERATIONS & MAINTENANCE SERVICES ACROSS MULTIPLE INDUSTRIES

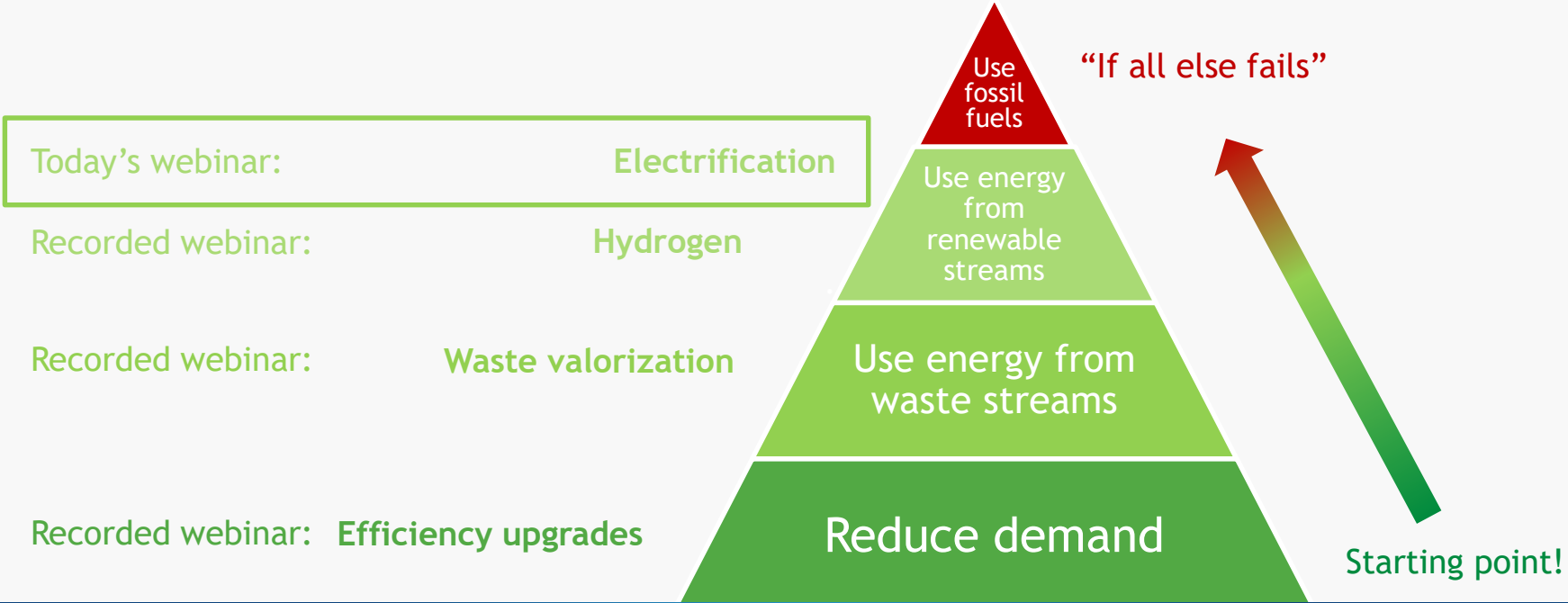


Decarbonize
existing assets

Support the
energy transition

FOCUS OF TODAY'S WEBINAR

HIERARCHY OF DECARBONIZATION MEASURES





ELECTRIFICATION

Transitioning to a lower-carbon production

PRESENTERS



Bart Desmet

Principal Consultant @ Stork Asset Management Technology



Geert Hoeflaak

Business Development @ Stork Pumps



Alex Heino

Sr. Energy Consultant @ Stork Thermeq

ELECTRIFICATION AGENDA

1. Introduction to electrification



2. Sustainable electricity production



3. Transmission and distribution



4. Electrification in industrial assets



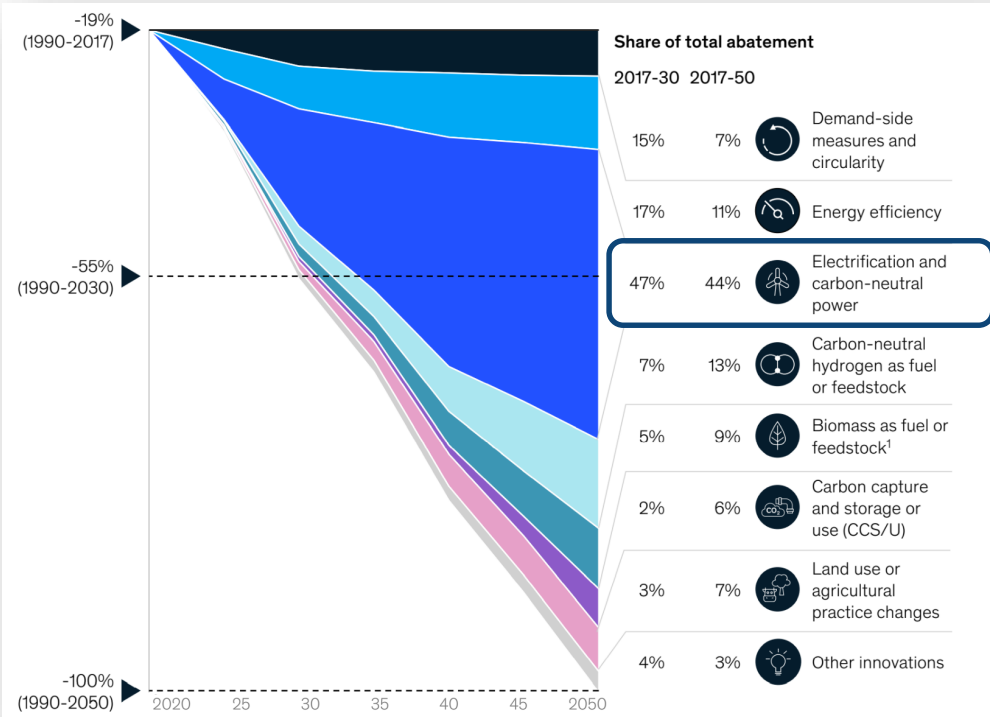
5. The electrification business case





INTRODUCTION TO ELECTRIFICATION

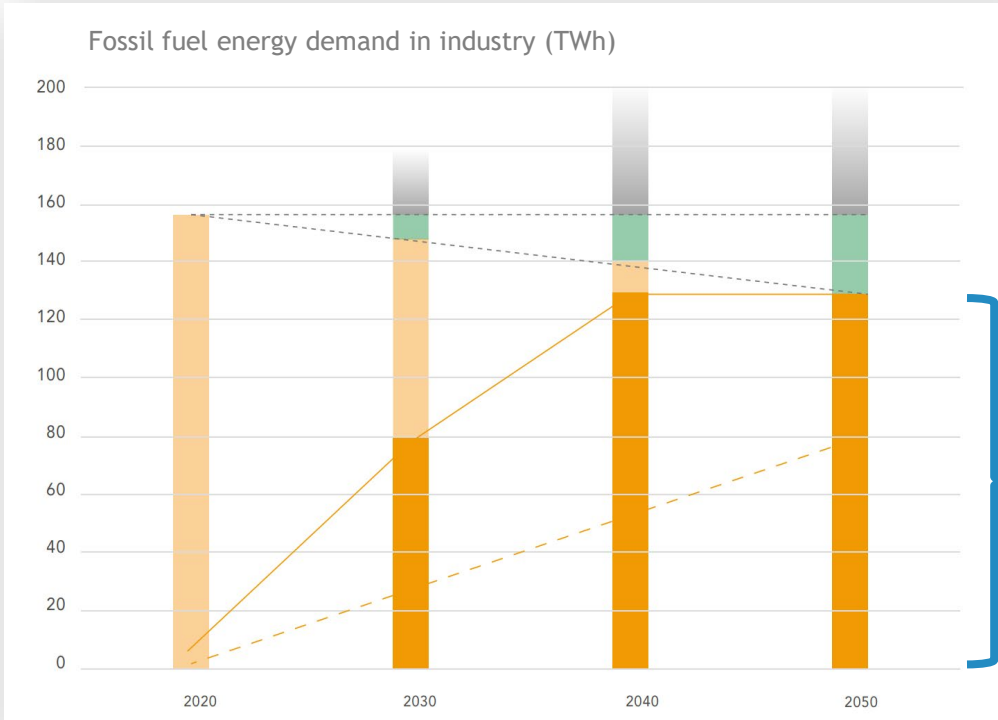
INTRODUCTION TO ELECTRIFICATION MAJOR CONTRIBUTION TO DECARBONIZATION



**ALMOST HALF OF CO2
REDUCTION TO COME
FROM ELECTRIFICATION:**

- Carbon-neutral power generation
- Use electricity instead of fossil fuels

INTRODUCTION TO ELECTRIFICATION DECARBONIZATION OF DUTCH INDUSTRY



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

80 %

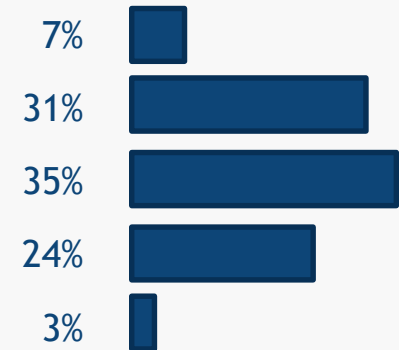
POLL

WE APPRECIATE YOUR INPUT!



To what degree is electrification a topic in your organization?

- No topic. We're not working on it yet.
- We are thinking about it. Nothing tangible yet.
- We are developing an electrification strategy.
- We have a strategy and are implementing electrification.
- We have no clear strategy but are electrifying individual equipment.



INTRODUCTION TO ELECTRIFICATION

WHAT THE DUTCH GOVERNMENT CONCLUDED



18th March, 2022, The Netherlands:

“The government wants to greatly expand offshore wind energy.

It plans to add 10,7 GW of capacity by 2030, more than double to what was planned.”



INTRODUCTION TO ELECTRIFICATION “ONE CHAIN”





SUSTAINABLE ELECTRICITY PRODUCTION

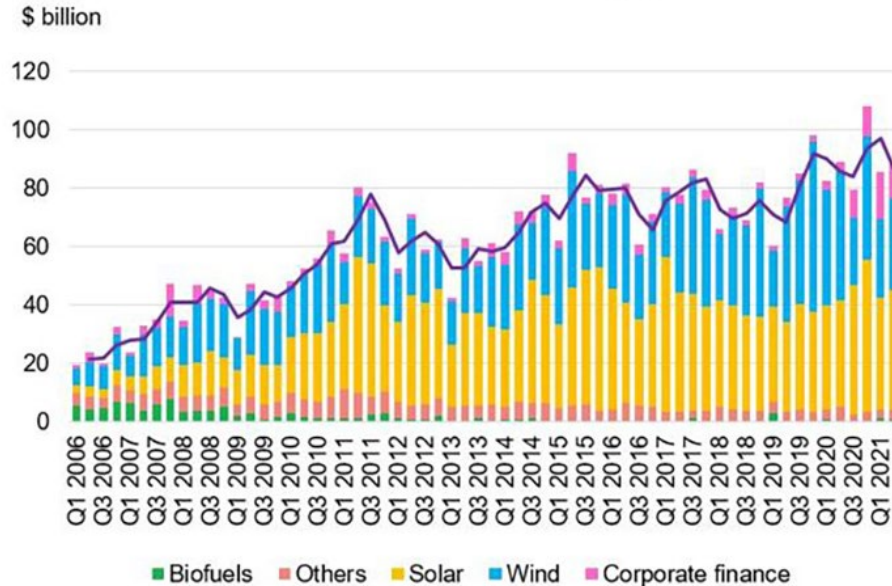
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SUSTAINABLE ELECTRICITY PRODUCTION INVESTMENTS GROWING FAST



Figure 1: Global new investment in renewable energy, 2006-1H 2021



- Investments in green electricity have been growing historically
- This growth is still going on.
- Growth acceleration expected from exploding fossil fuel prices

SUSTAINABLE ELECTRICITY PRODUCTION OFFSHORE AND ONSHORE WINDFARMS

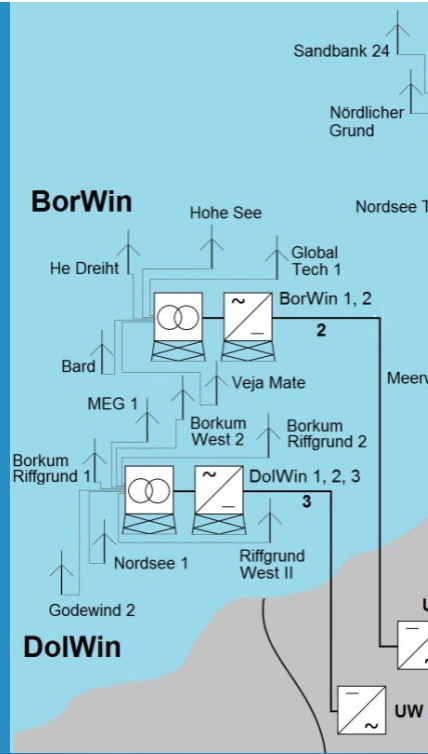


Global capacity added in 2020*:
- 113 GW

Global installed base 2020**:
- 733 GW

Showcased Stork project:

- 800 MW AC/DC converter station
- Dolwin Alpha; 60 km off German coast (Northsea)
- Scope: Construction of entire electrical system



* Source: IEA report "Renewables 2021"

** Source: International Renewable Energy Agency (IRENA)

SUSTAINABLE ELECTRICITY PRODUCTION

SOLAR PV (PHOTOVOLTAIC PANELS)



Global PV capacity added in 2020*:
- 134 GW

Global installed base 2020**:
- 713 GW

Showcased Stork project:

- 21MW Photovoltaic field
- Borsele, Netherlands
- Scope: Realisation of substation



* Source: IEA report “Renewables 2021”

** Source: *International Renewable Energy Agency (IRENA)*

SUSTAINABLE ELECTRICITY PRODUCTION CONCENTRATED SOLAR PLANTS (CSP)



Global CSP capacity added in 2020*:
- 101 MW

Total global installed base 2020*:
- 6 475 MW

Showcased Stork project:

- 50 MW CSP
- Palma del Rio, Spain
- Scope: Major overhaul steam turbine generator



* Source: *International Renewable Energy Agency (IRENA)*

SUSTAINABLE ELECTRICITY PRODUCTION

TIDAL POWER GENERATION



Global capacity added in 2020*:

- 20 GW

Total global installed base 2020**:

- 1 210 GW

Showcased Stork project:

- 1,25 MW Tidal power plant
- Oosterschelde storm surge barrier (NL)
- Scope: Construction of electrical system



* Global renewable hydropower capacity

** Source: *International Renewable Energy Agency (IRENA)*

SUSTAINABLE ELECTRICITY PRODUCTION GENERATOR-PUMPING STATION



Global capacity added in 2020*:

- 20 GW

Global capacity in 2020**:

- 1 210 GW

Showcased Stork project:

- New pump with turbine-generator
- 47 kW generator capacity (@ 3,4 m)
- Polder pumping station Krimpenerwaard (NL)
- Scope: Tailor-made design, construction and installation of pump/turbine combination



* Global renewable hydropower capacity

** Source: *International Renewable Energy Agency (IRENA)*

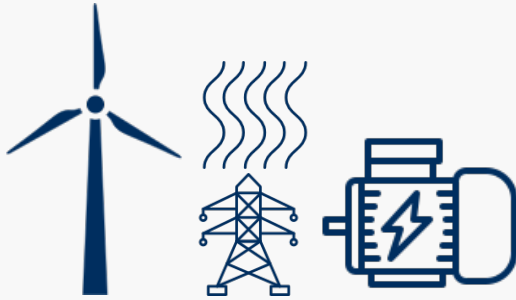


TRANSMISSION AND DISTRIBUTION

TRANSMISSION AND DISTRIBUTION CHALLENGES AND SOLUTIONS



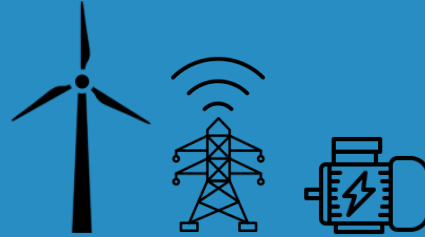
CHALLENGE



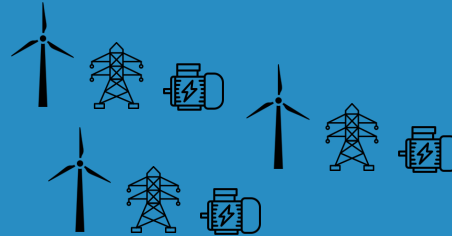
Congestion
of the grid



SOLUTIONS



Grid capacity
expansion

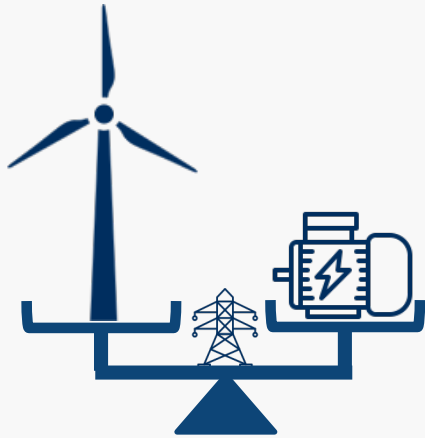


More local
production

TRANSMISSION AND DISTRIBUTION CHALLENGES AND SOLUTIONS



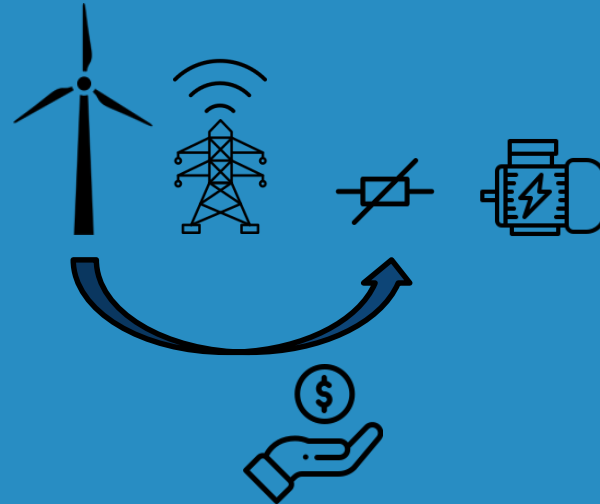
CHALLENGE



Balancing
the grid



SOLUTIONS

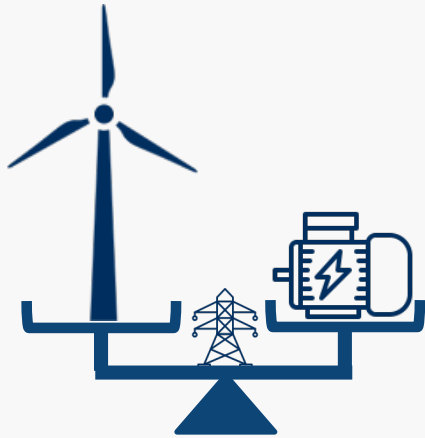


Smart grid
Dynamic load
control

TRANSMISSION AND DISTRIBUTION CHALLENGES AND SOLUTIONS

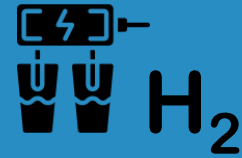
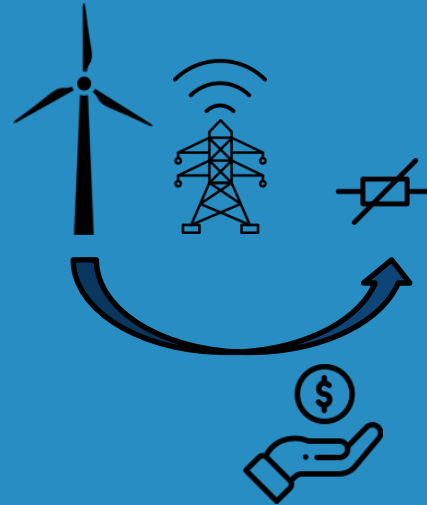


CHALLENGE



Balancing
the grid

SOLUTIONS

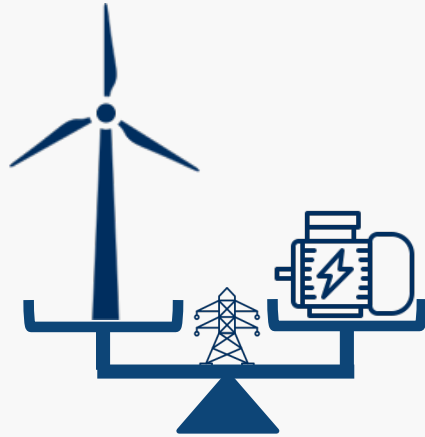


Electricity
to Hydrogen

TRANSMISSION AND DISTRIBUTION CHALLENGES AND SOLUTIONS

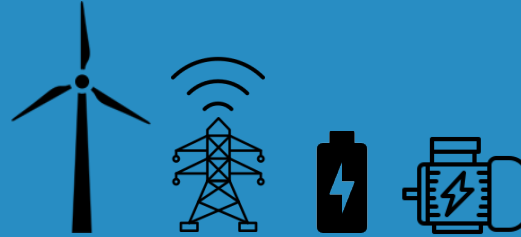


CHALLENGE

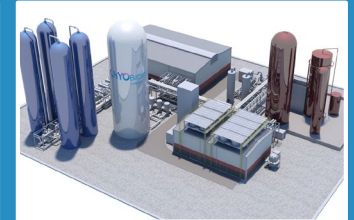


Balancing
the grid

SOLUTIONS



Energy storage
solutions



TRANSMISSION AND DISTRIBUTION PUMPED STORAGE HYDRO POWER



Global capacity added in 2020*:
- 445 MW

Global capacity in 2020**:
- 121 273 MW

Showcased Stork project:

- Pumped storage power plant
- Reisach (Germany)
- Generator power: 35 MVA
- Scope: refurbishment of +60 year old generator for increased efficiency and life-time extension



* Global pumped storage capacity
** Source: *International Renewable Energy Agency (IRENA)*



ELECTRIFICATION IN THE INDUSTRY

ELECTRIFICATION IN INDUSTRY CHALLENGES ... AND OPPORTUNITIES



Fossil to Electricity

Driving



Heating

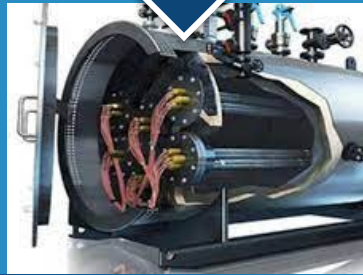


Connection

to the grid



Controls



ELECTRIFICATION IN INDUSTRY CHALLENGES ... AND OPPORTUNITIES

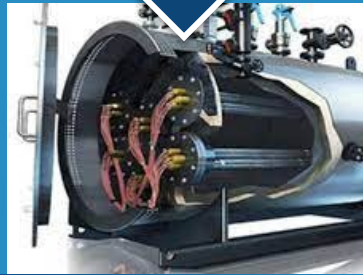


Fossil to Electricity

Driving



Heating



Connection

to the grid



Controls



DRIVING APPLICATIONS

PUMPING STATION OOSTERPOLDER



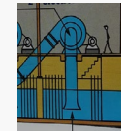
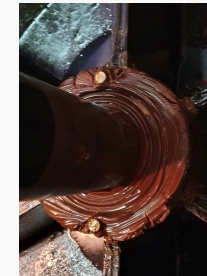
CUSTOMER CHALLENGE:

- Eliminate consumption of fossil fuels
- Outdated equipment (pump, gearbox, motor)
- Insufficient pump capacity and head for 100 year flood event

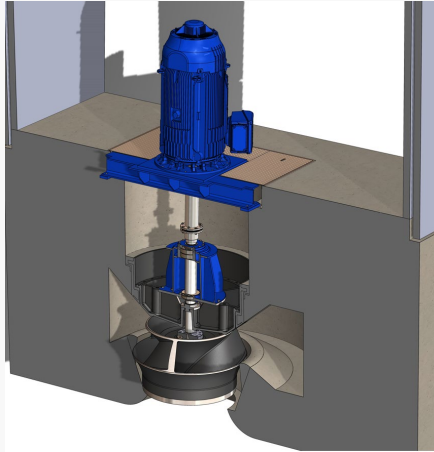


SOLUTION:

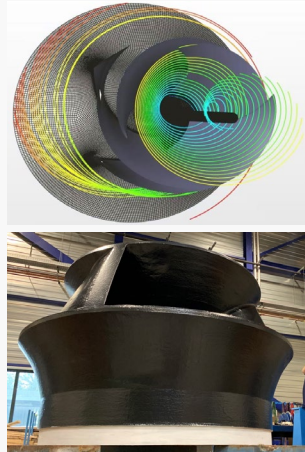
- 3D scanning of existing pump impeller
- Hydraulic engineering to re-use impeller and meet desired pump performance
- Remove diesel engine & gearbox
→ install permanent magnet E-motor & VFD
- Updated E&I system for remote control & optimal performance



DRIVING APPLICATIONS PUMPING STATION OOSTERPOLDER



3D design



CFD impeller



Pump assembly
& Pull Out Unit



PM-Motor,
Controls & VFD

DRIVING APPLICATIONS PUMPING STATION OOSTERPOLDER



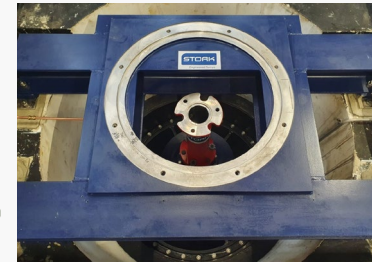
BENEFITS:

- No fossil fuels needed (green energy)
- Best efficiency of pump performance @ duty points
- PM motor → optimum efficiency within large pump operating window
- Utilized optimization of efficiency (+2%) by direct drive design; no gearbox
- Minimize electricity by efficient remote operation (per software)
- No physical presence (operator) needed
- Electrification enables possible update of entire installation



BENEFIT IN NUMBERS:

- 18.000 liter diesel per year
- 8.600 kWh saving per year
- 36.500 kg of CO2 per year (forest of 1.460 trees)



DRIVING APPLICATIONS

PUMPING STATION SCHAPHALSTERZIJL



CUSTOMER CHALLENGE:

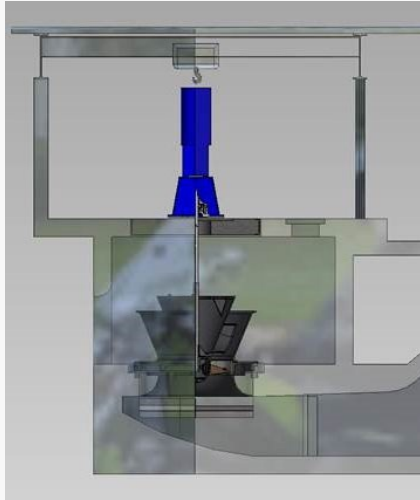
- Minimize electricity consumption
Task end user = energy neutral in 2025 & climate neutral in 2050
- Pump capacity & head - insufficient for 100 year flood event;
rising sea level, heavier and frequent rainfall
- 3 parallel pumps operating at fluctuating capacities

SOLUTION:

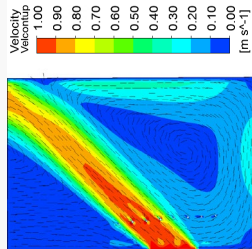
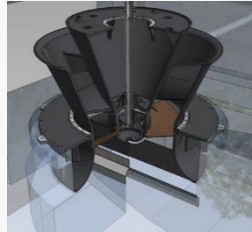
- Study of current water management and available pump capacity
- Identify improvement opportunities; pump, drive train, E&I,
fish friendly, sustainable energy generation, electricity usage
- Incorporate experts present at the end user; engineering and O&M



DRIVING APPLICATIONS PUMPING STATION SCHAPHALSTERZIJL



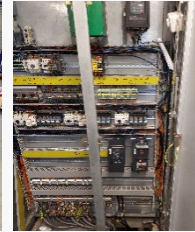
3D design



CFD
discharge



Pump Assembly



Drive Train



DRIVING APPLICATIONS

PUMPING STATION SCHAPHALSTERZIJL



SOLUTION:

- 3 x Stork OVOP-160, optimum hydraulic design
- 3 x 220 kW E-motor, gearbox, VFD
- Continuous monitoring; temperature & vibration
- Redundancy electro technical installation

BENEFITS:

- Up to 40% less energy (with identical pump capacity and head) due to running on its Best Efficiency Point (BEP);
 - Pump performance
 - Drive train performance
 - Computer controlled duty point & number of pumps
 - Water management, upfront pumping with sustainable energy
- 39,000 kWh saving per year // 166.000 kg of CO2 per year



ELECTRIFICATION IN INDUSTRY CHALLENGES ... AND OPPORTUNITIES

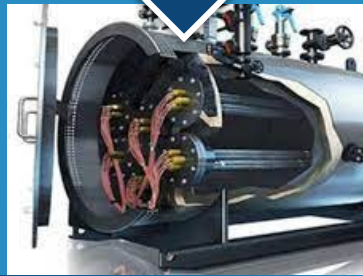


Fossil to Electricity

Driving



Heating



Connection to the grid



Controls



HEATING APPLICATIONS E-BOILER



- Electricity is ~4 times more expensive than fossil fuel (2021)
- However, Electricity price is fluctuating
- No CO2 emission
- No NOx emission
- Very quick response time
- Future ready
- Company image



HEATING APPLICATIONS E-BOILER FINANCIALS



Pricing of electricity is complicated:
Depends on contract and location



BID PRICE

Will be determined in short notice.
E.g.: Day-ahead price.
You can 'bid' on a time/price slot.

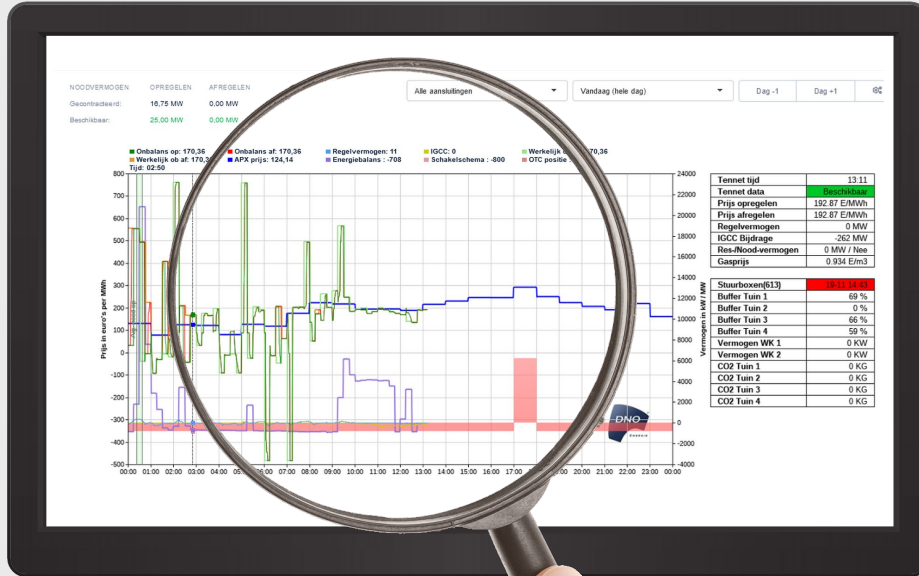


REAL-TIME PRICE

Current price. Most variabel!

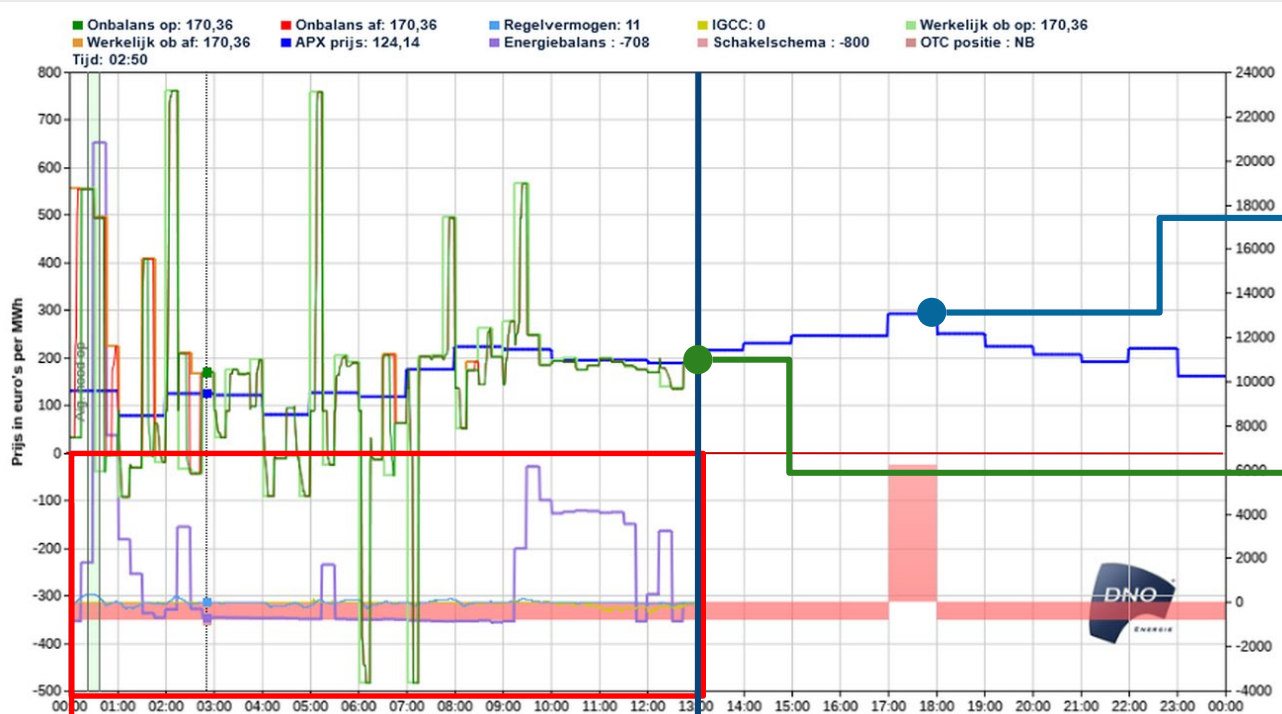


HEATING APPLICATIONS E-BOILER FINANCIALS



HOW DOES THIS
WORK FROM AN
END USER
PERSPECTIVE?

HEATING APPLICATIONS E-BOILER FINANCIALS



 **BID PRICE**

 **REAL-TIME PRICE**

Negative price

Time = now

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HEATING APPLICATIONS E-BOILER OPERATION



Electrical connections

- Up to 50 MW, Up to 22 KV

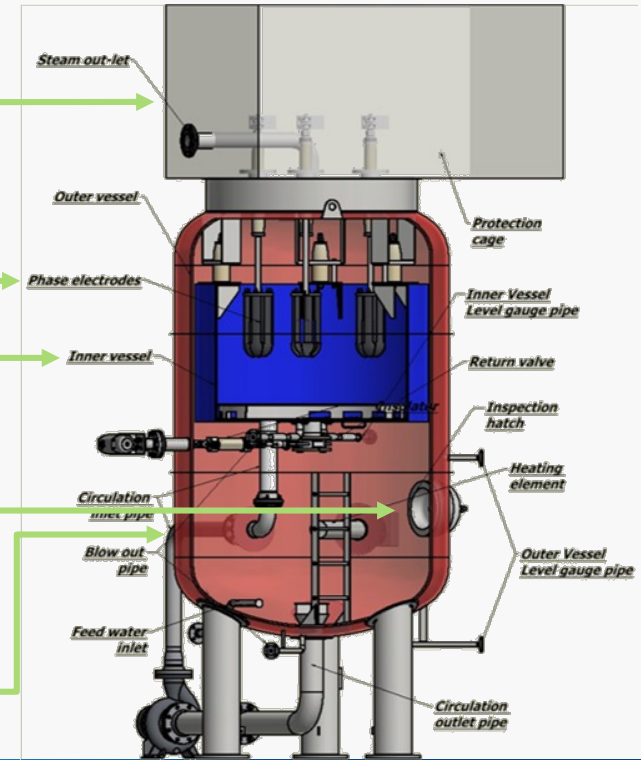
Electrodes

- Power control: contact surface with water
- Very quick response (3 to 1 minute from hot)
- No superheated steam (although it is possible)

Internal top vessel

Manhole

Buffer



HEATING APPLICATIONS E-BOILER SUMMARY



- Standard, reliable technology
 - Max 60 (80) Bar saturated steam (superheating is possible)
 - Power between 5 en 50 MWth (depends on conditions)
- Operation is comparable to conventional boiler
- Very dynamic (100% power in 3 (1) minute from hot)
- Good product for energy transition. Balance of power
- Boiler has no CO₂, NO_x emissions
- In general: as an extra steam (or hot water) supply





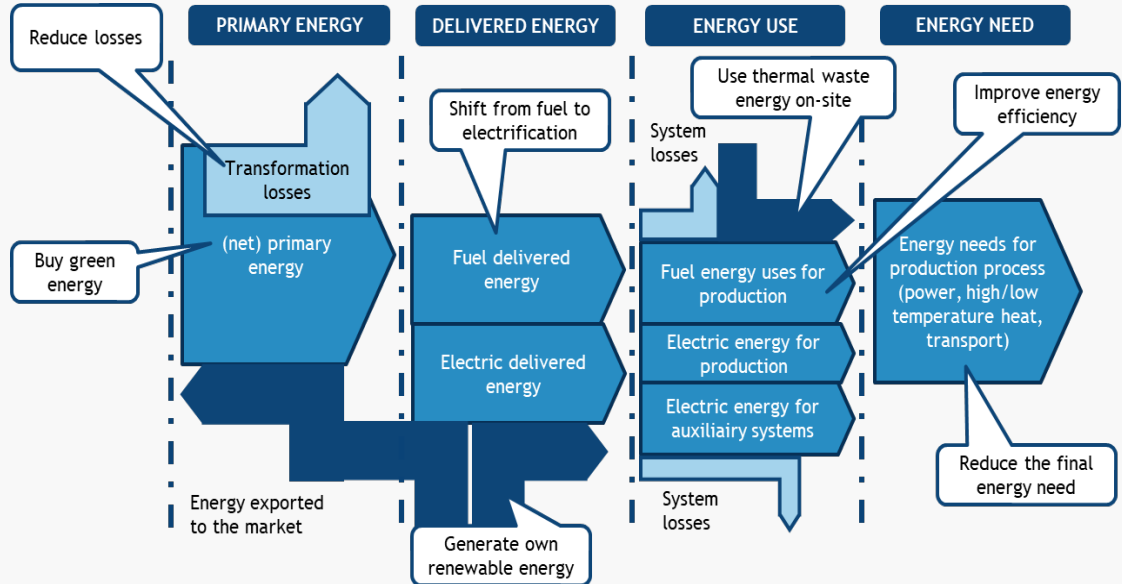
THE ELECTRIFICATION BUSINESS CASE

THE ELECTRIFICATION BUSINESS CASE

ENERGY VALUE STREAM MAPPING



- Energy performance baseline
- Energy conversion and efficiency analysis
- Evaluating and prioritizing opportunities
- Selecting effective measures



THE ELECTRIFICATION BUSINESS CASE VALUE BASED PORTFOLIO MANAGEMENT

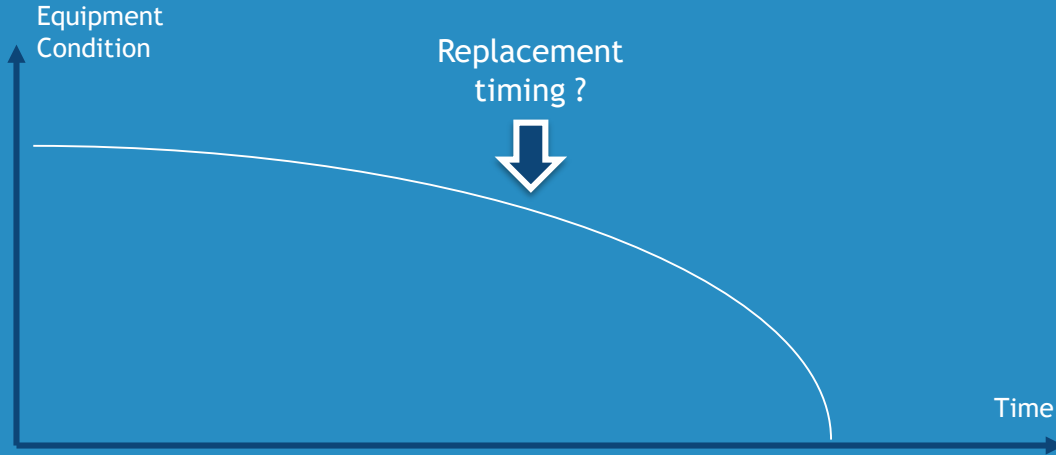


- Identify what brings value to the business (economic and other)
- Weigh project candidates against multiple criteria
- Result : transparant project prioritizing
- Applies to CAPEX and non-CAPEX improvement measures

Project candidates **Value criteria**

Project ID	Projects / Improvement proposal:	AM Goals:	IMPACT					
			Comply with legislation regarding installations	Control leakages	Occupational safety	Production Volumes and Quality	Technical Reliability	Operational Costs
1	Develop AM vision	Impact	1	2	3	2	2	
		Ease improvement action	2	2	2	2	2	
2	Set AM objectives & strategies	Impact	1	3	3	2	2	
		Ease improvement action	2	2	2	2	2	
3	Develop and implement standards	Impact	1	1	3	2	2	
		Ease improvement action	2	2	2	2	2	
4	Use best practices on group level	Impact	0	0	3	2	2	
		Ease improvement action	2	2	2	2	2	
5	Improve Plant breakdown structure	Impact	1	0	3	2	2	
		Ease improvement action	2	2	2	2	2	
6	Review criticality ranking	Impact	1	1	3	2	2	
		Ease improvement action	2	2	2	2	2	
7	Develop maintenance strategies	Impact	3	1	1	3	3	
		Ease improvement action	1	1	1	1	1	
8	Improve RBI on MVC plant	Impact	0	3	2	3	3	
		Ease improvement action	1	1	0	1	1	
9	Plan sufficing capacity for projects	Impact	2	3	0	3	3	
		Ease improvement action	2	2	2	2	2	
10	Improve Workflow management	Impact	4	6	2	6	6	
		Ease improvement action	2	2	3	2	2	

THE ELECTRIFICATION BUSINESS CASE LONG TERM ASSET REPLACEMENT PLAN



LTARP approach:

- Maintain OR replace & electrify ?
- Best replacement timing ?
- Depending on changing parameters

The background is a stylized illustration of an industrial landscape. It features several wind turbines in the upper half, power lines and pylons in the middle ground, and a large factory building with multiple chimneys in the lower right. The entire scene is rendered in various shades of blue and green, with a semi-transparent white rounded rectangle in the center containing the text.

WRAPPING UP

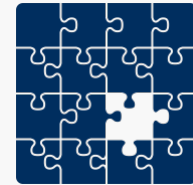
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RECAP - ELECTRIFICATION



- Pressure and momentum for electrification are increasing
- Electrification involves change on strategic, tactic and operational levels
- Electrification brings challenges and new opportunities



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> **QUESTIONS?**

THANK YOU FOR ATTENDING!

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