

ENGINEERING  
TOMORROW



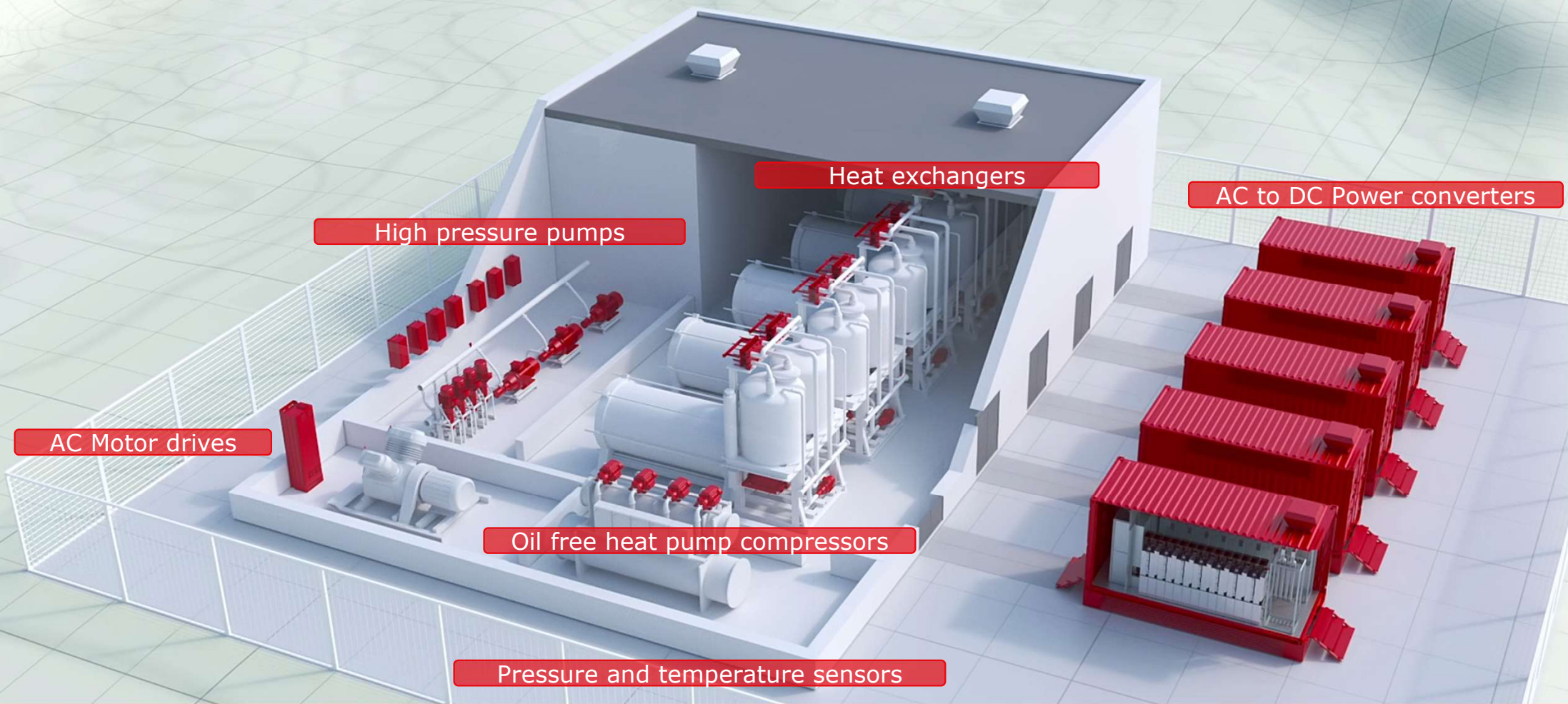
# Future Trends in Power Supply Units for Hydrogen Electrolyzers



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# Hydrogen Electrolysis – Powered by Danfoss

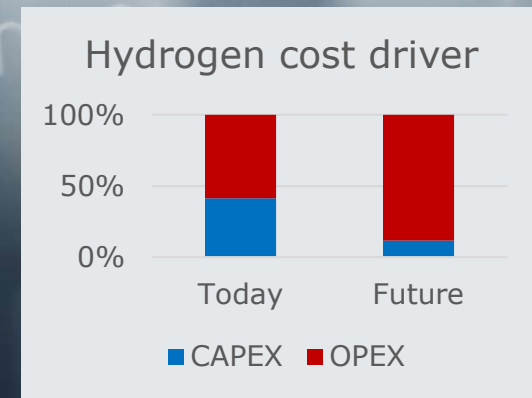


# “Companies should consider the total cost of owning an electrolyzer”

$$LCoH_2 = \frac{\text{Annual capital repayment} + \text{operational \& maintenance costs}}{\text{Annual production of H}_2}$$

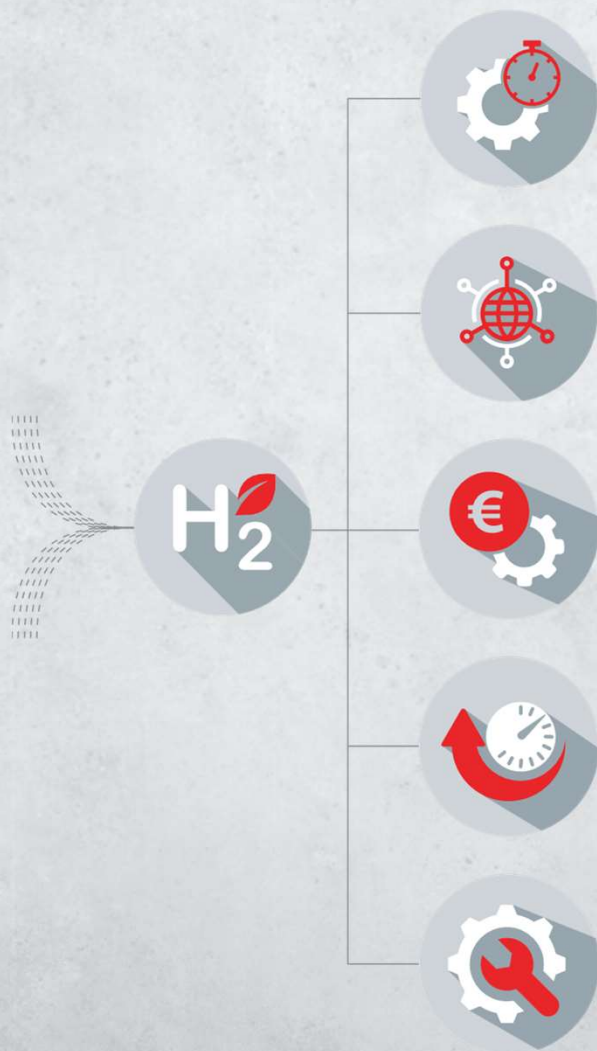
What you should consider:

- OPEX
- CAPEX
- Efficiency



Source: IRENA LCoH projections, 2020

# H<sub>2</sub> PRODUCTION COST



## EFFICIENCY

*(most important parameter – apart from the electricity cost)*

- DC quality (*Low ripple values, important for electrolyzer*)
- AC quality (*Low THD, less current in transformer and cables*)
- Part-load operation

## GRID CONNECTION

*(important for the future smart electrical grid)*

- Grid code compliance (*de-risk project*)
- Total Harmonic Distortion (*no extra filters*)
- Reactive power (*decreased need to install new grid, voltage control*)

## INSTALLATION COST & TIME

*(How the converter influences cost-drivers for the site)*

- Compact converter leaves small footprint (*no external filters*)
- Modular design (*ease of quick installation*)
- Liquid cooling (*revenue stream for district heating*)
- Back-channel cooling (*low cost, no air conditioning*)

## UPTIME & AVAILABILITY

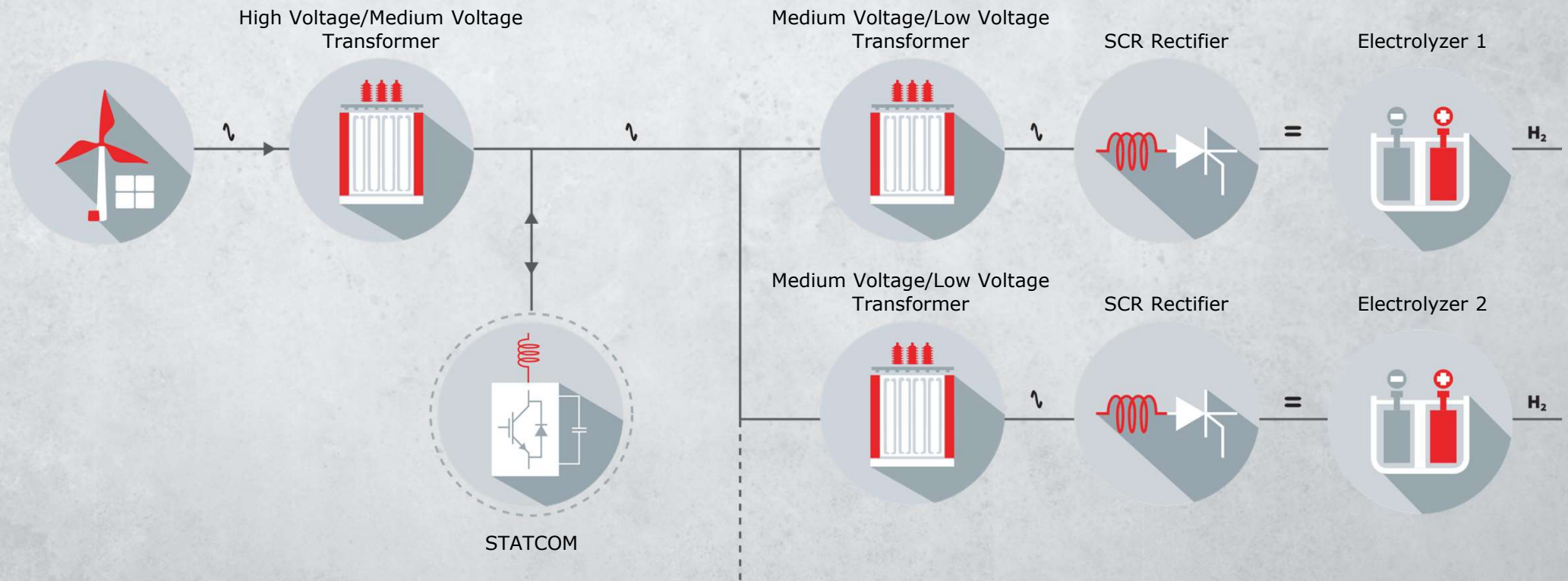
- Quality
- Robust
- Environment

## MAINTENANCE

- Spare parts
- Excludes one unit
- Easy replacement

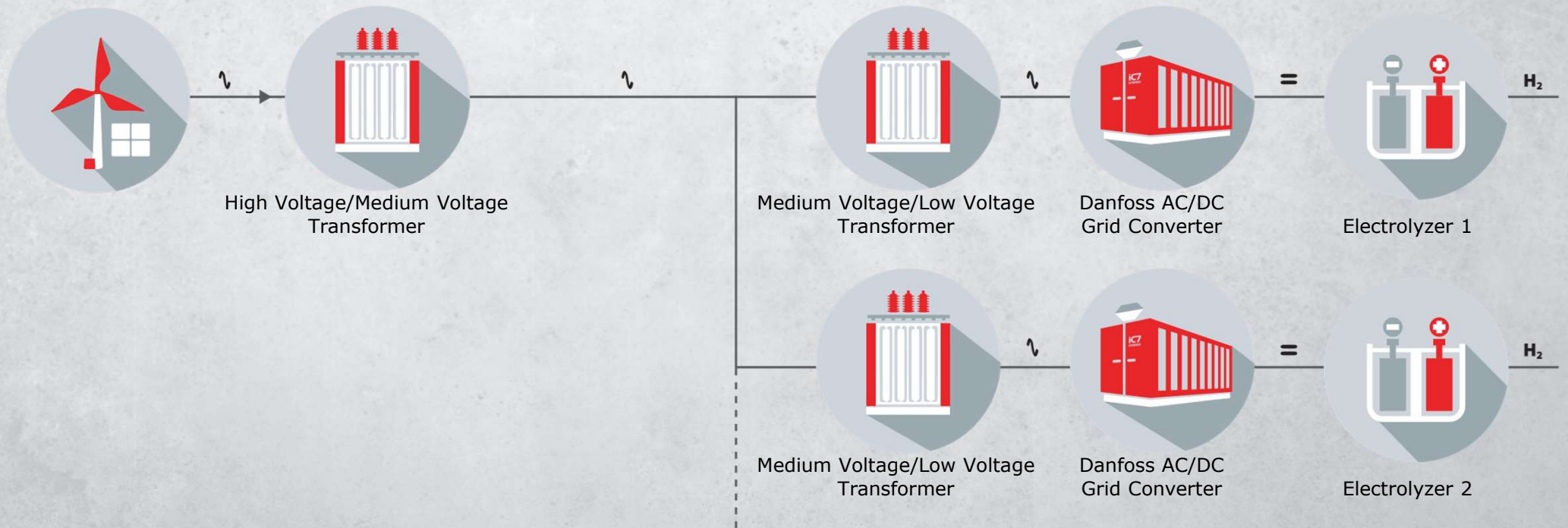
■ CAPEX  
■ OPEX

# Electrolyzer plant with SCR + STATCOM



## Electrolyzer plant with

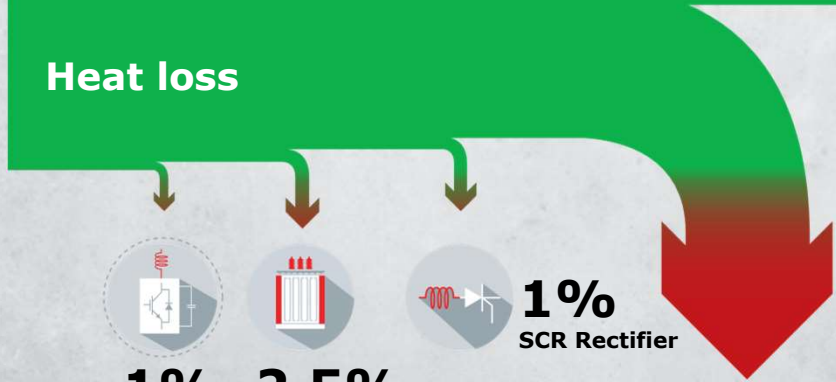
# Danfoss Grid Converter



# Energy Flow Diagramme SCR + STATCOM



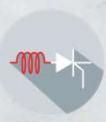
**69.8%**  
Hydrogen



**1%**  
STATCOM



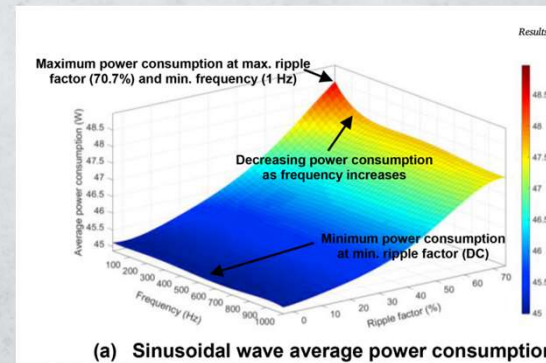
**2.5%**  
Medium Voltage  
to Low Voltage  
transformer +  
cables



**1%**  
SCR Rectifier



**27%**  
Electrolyzer



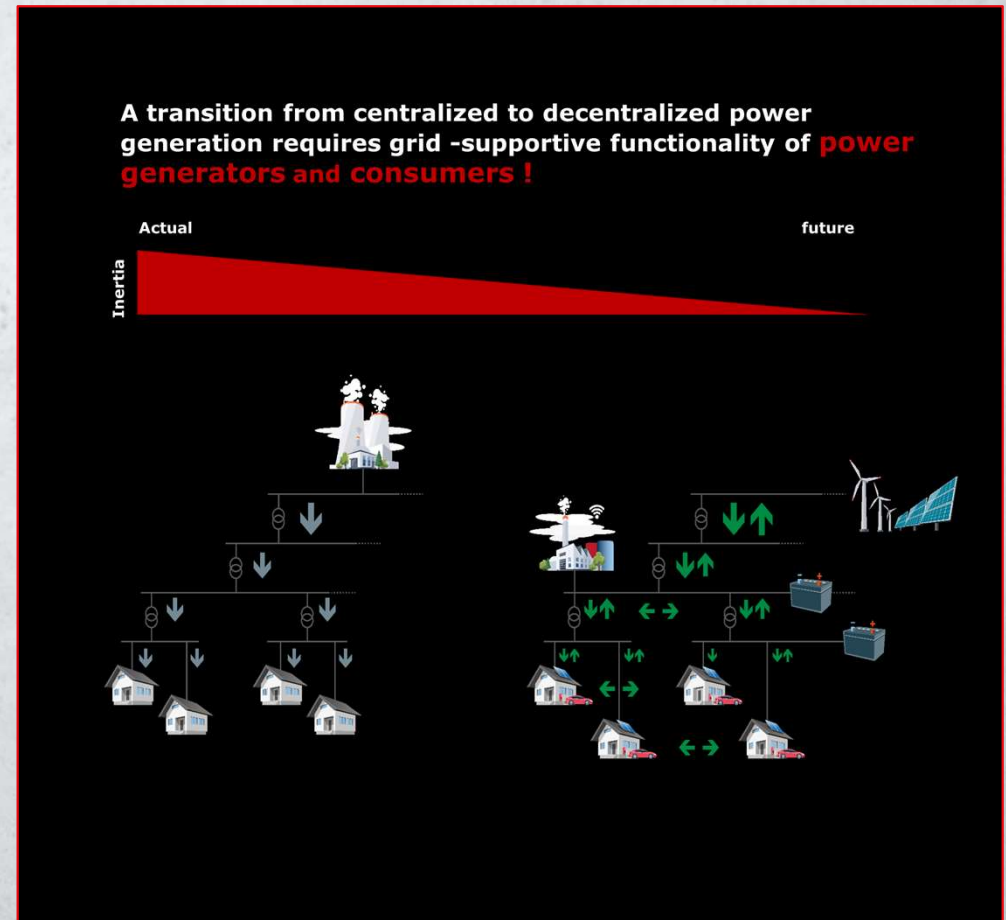
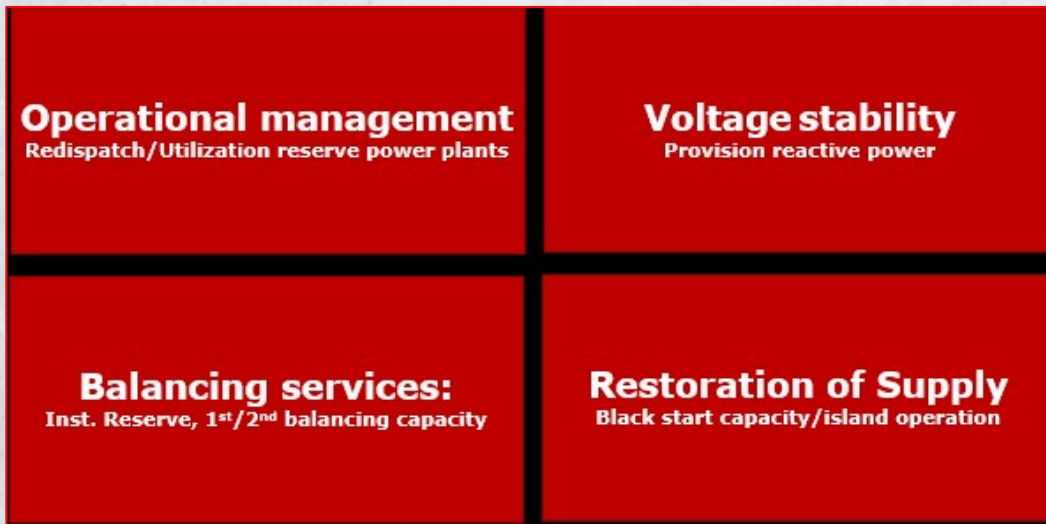
Source: North-West University, Potchefstroom, South Africa, 2021





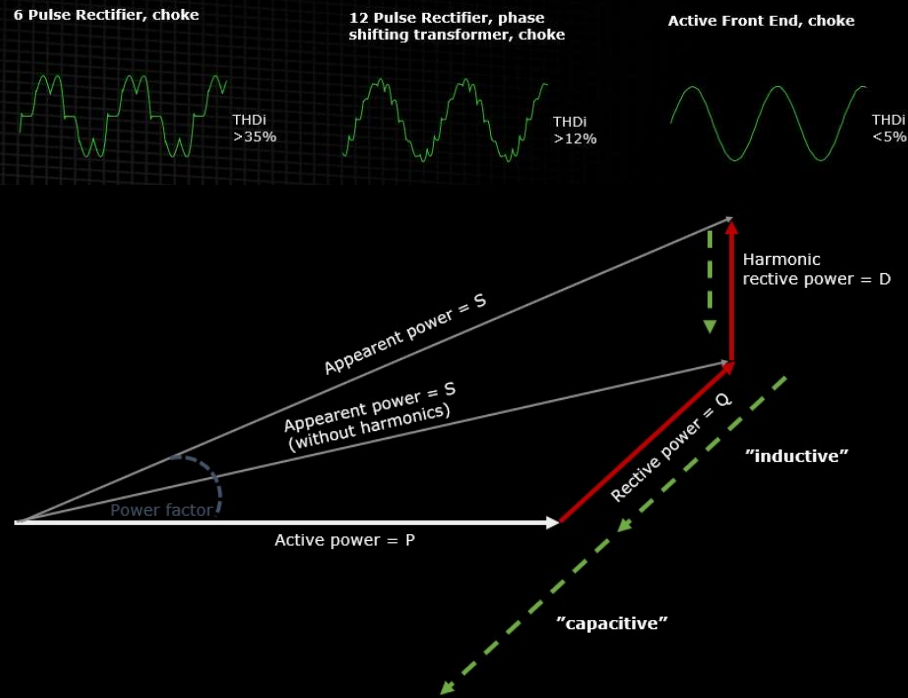
# Ancillary services and the role of future consumers

Transmission system operators are responsible for ancillary services:



# Grid Stability

## Functionality of voltage control



Balancing services

Voltage stability

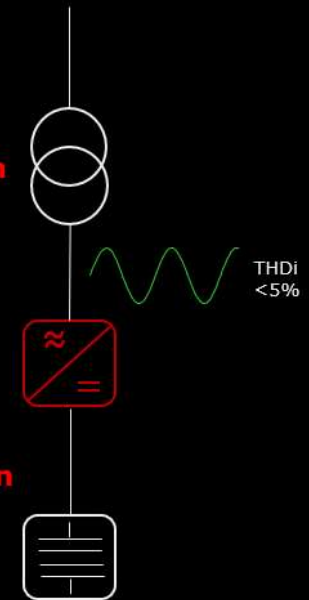
MV/LV Transformer

- Voltage transformation
- Galvanic isolation

Active Front End

- Convert AC to DC
- Harmonic mitigation
- Reactive power comp.
- Power factor correction

Electrolyzer



# Danfoss AC to DC converters

Danfoss Drives liquid cooled series

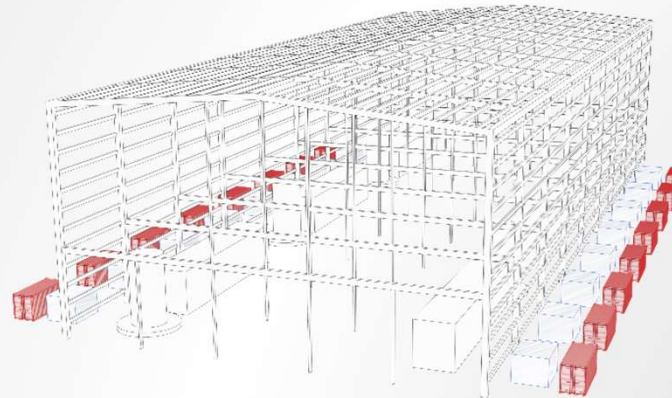


- Modularity increases system reliability
- Un-matched power density
- Full power at high ambient temperatures

Danfoss Drives air cooled series



- Modularity increases system reliability
- Self cooling increases reliability and efficiency
- Few auxiliary components



Electrolyzer plant

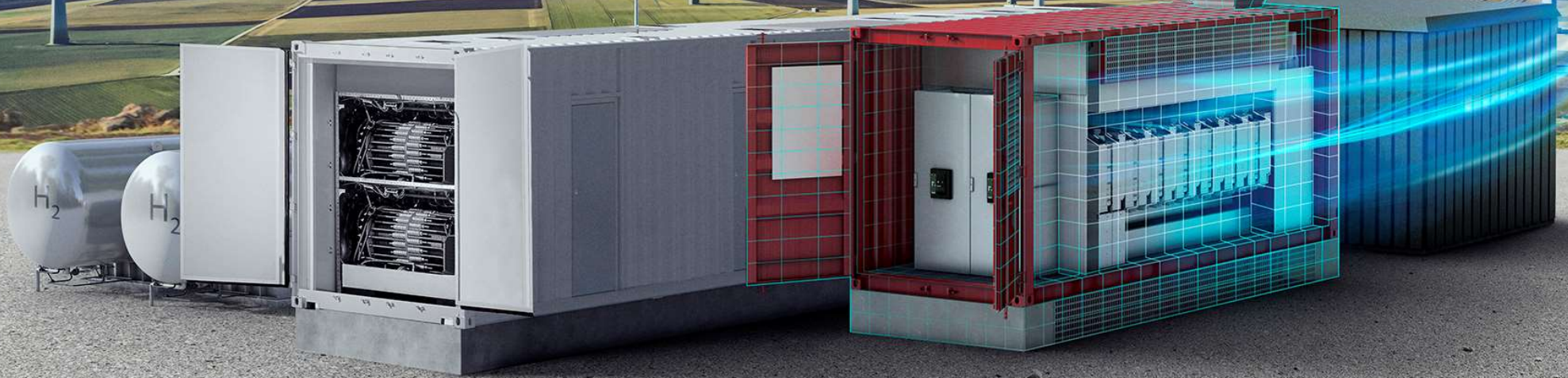
Further information:

<https://www.danfoss.com/en/markets/energy-and-natural-resources/dds/get-on-target-in-power-to-x/>

[https://www.youtube.com/watch?v=A\\_HFSYi6fZUM&t=52s](https://www.youtube.com/watch?v=A_HFSYi6fZUM&t=52s)

Sustainable  
**future**

**Grid**  
performance





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