sunfire®

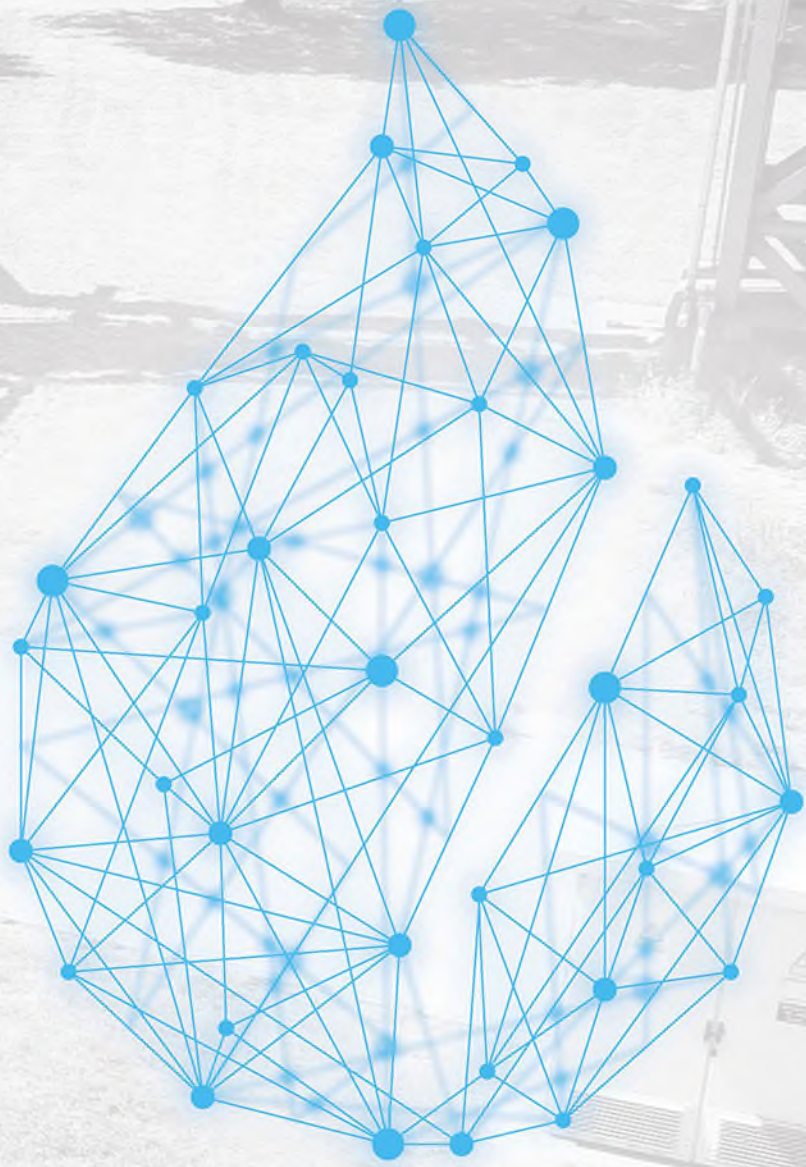
RENEWABLES EVERYWHERE

Mit grünem Wasserstoff zu grünem Stahl, Kraftstoffen und Chemie

Dr. Jens Baumgartner, Business Dev. Manager Electrolysis

Lausitzer Energiefachtagung, 27. Januar 2020

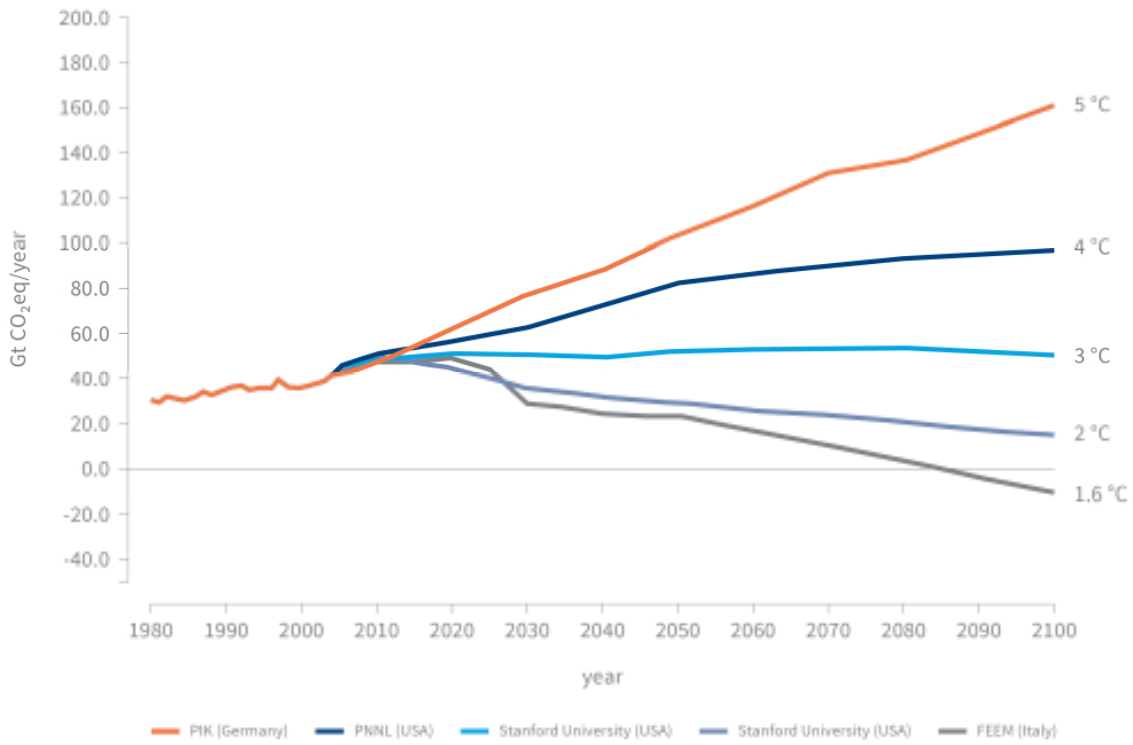
THE OBJECTIVE: MITIGATING CLIMATE CHANGE



PARIS CLIMATE AGREEMENT

THE FUTURE HAS TO BE RENEWABLE

- 85 - 100 % renewables needed to reach Paris Climate Target which still leads to significant negative impacts for human civilization



+ 5 °C: End of human civilization

+ 4 °C: Drought in Europe; China, India and Bangladesh mainly desert; Polynesia vanished; American Southwest largely uninhabitable

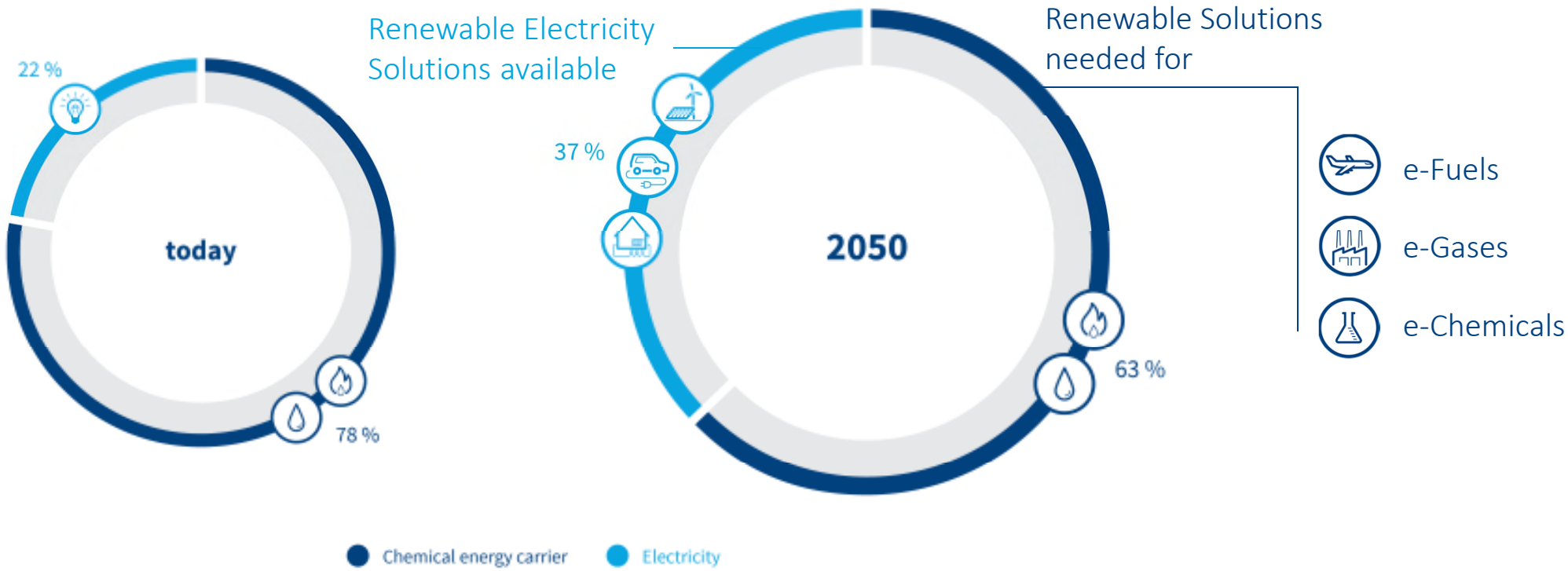
+ 3 °C: Forests in the Arctic and the loss of most coastal cities

+ 2 °C: Extinction of the world's tropical reefs, sea-level rise of several meters; abandonment of the Persian Gulf

Sources: https://www.pik-potsdam.de/paris-reality-check/
https://www.nytimes.com/interactive/2018/08/01/magazine/climate-change-losing-earth.html

THE NEXT LEVEL OF ENERGY TRANSITION

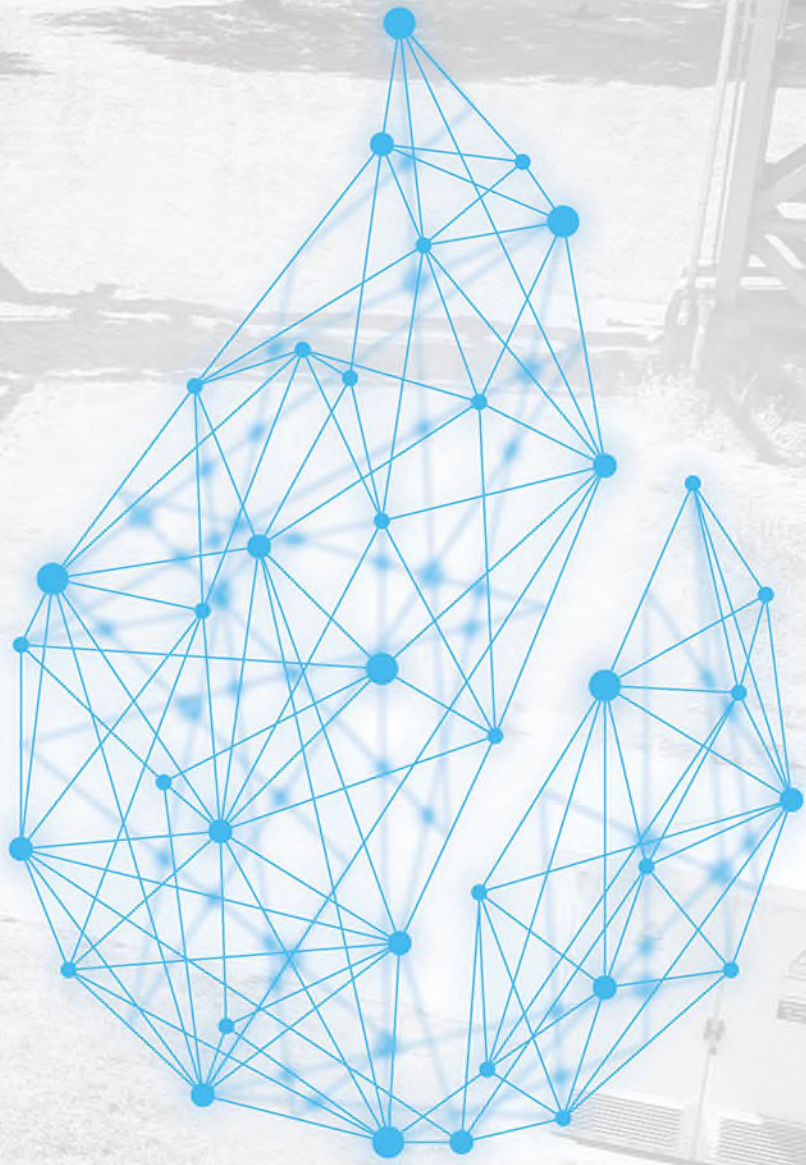
Even in scenarios with large increase of direct electrification liquid and gaseous energy carriers remain necessary to cover the global energy needs in 2050.

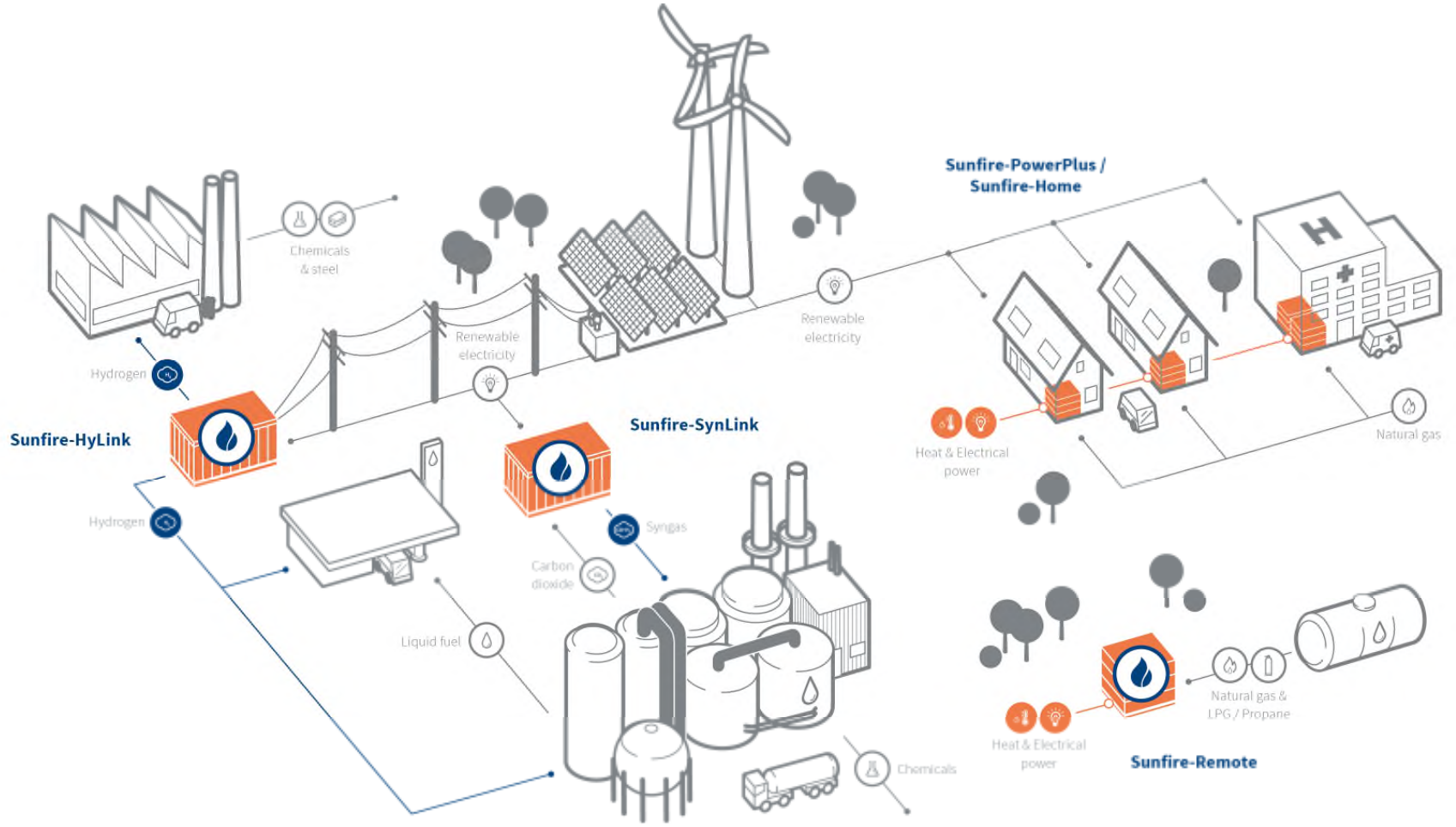


Sources: IEA, June 2017; World Energy 2014-2050, Political economist, 2014

THE SOLUTION: ELECTRICITY BASED LIQUIDS AND GASES

(e-Fuels and e-Gases)



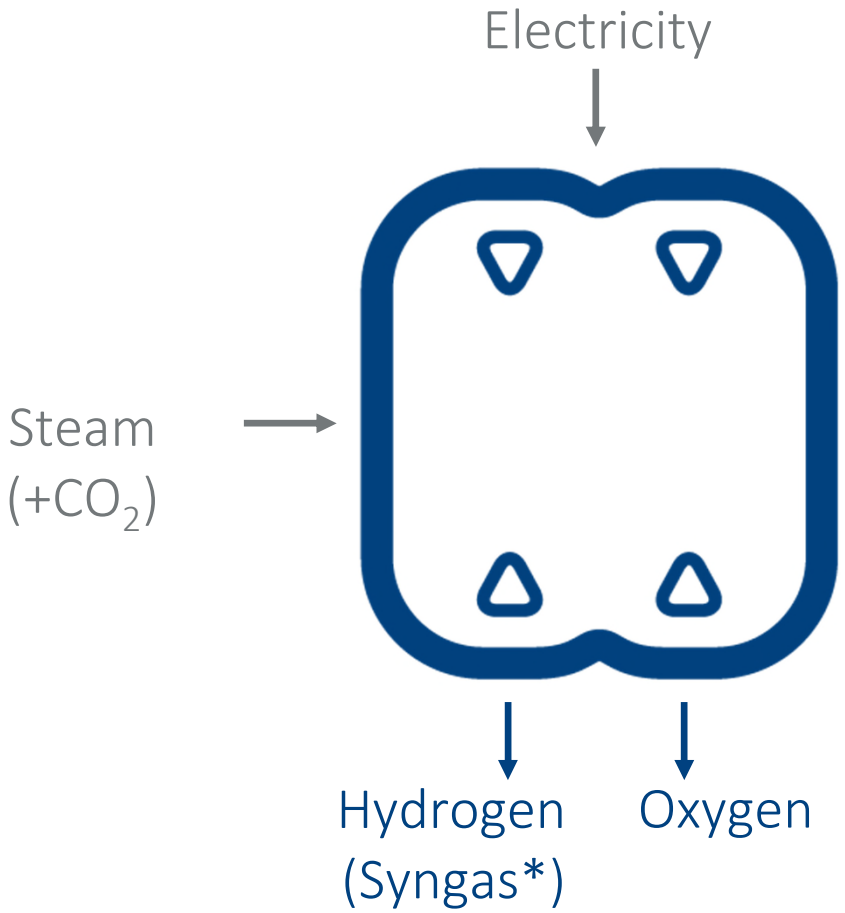


OUR VISION

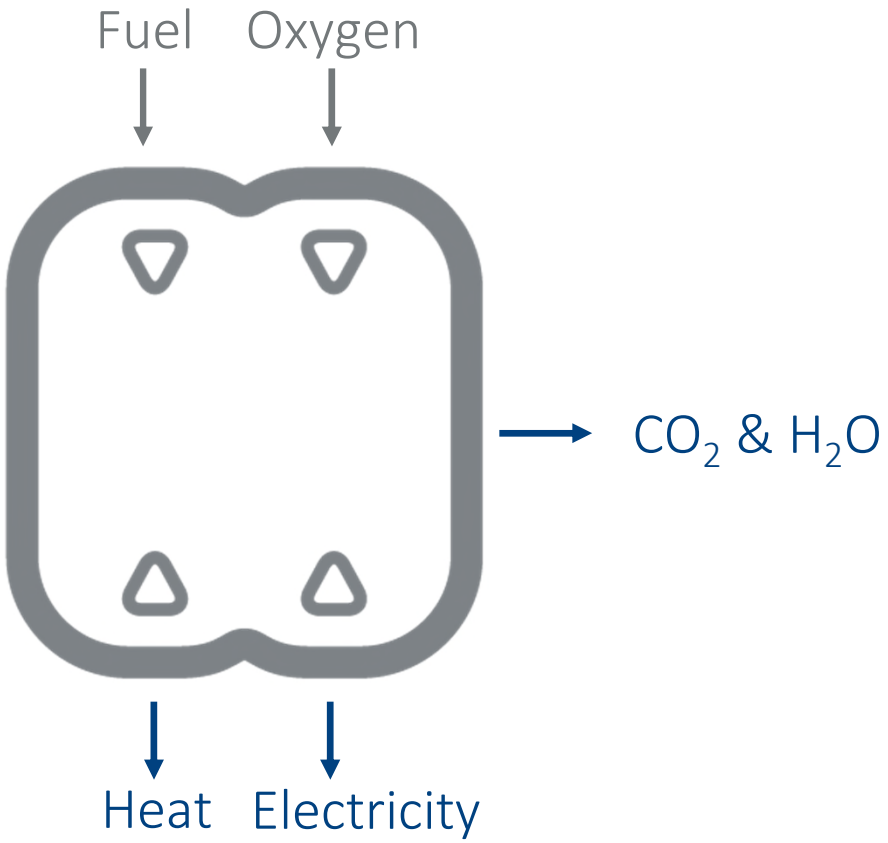
Achieve a zero emission society in transport, industry and energy sectors via electricity based liquids and gases, making renewable energy available wherever and whenever it is needed.

SOLID OXIDE CELLS CONVERT…

… Electricity into **Hydrogen (or Syngas)**



… Fuels and Gases into **Electricity and Heat**

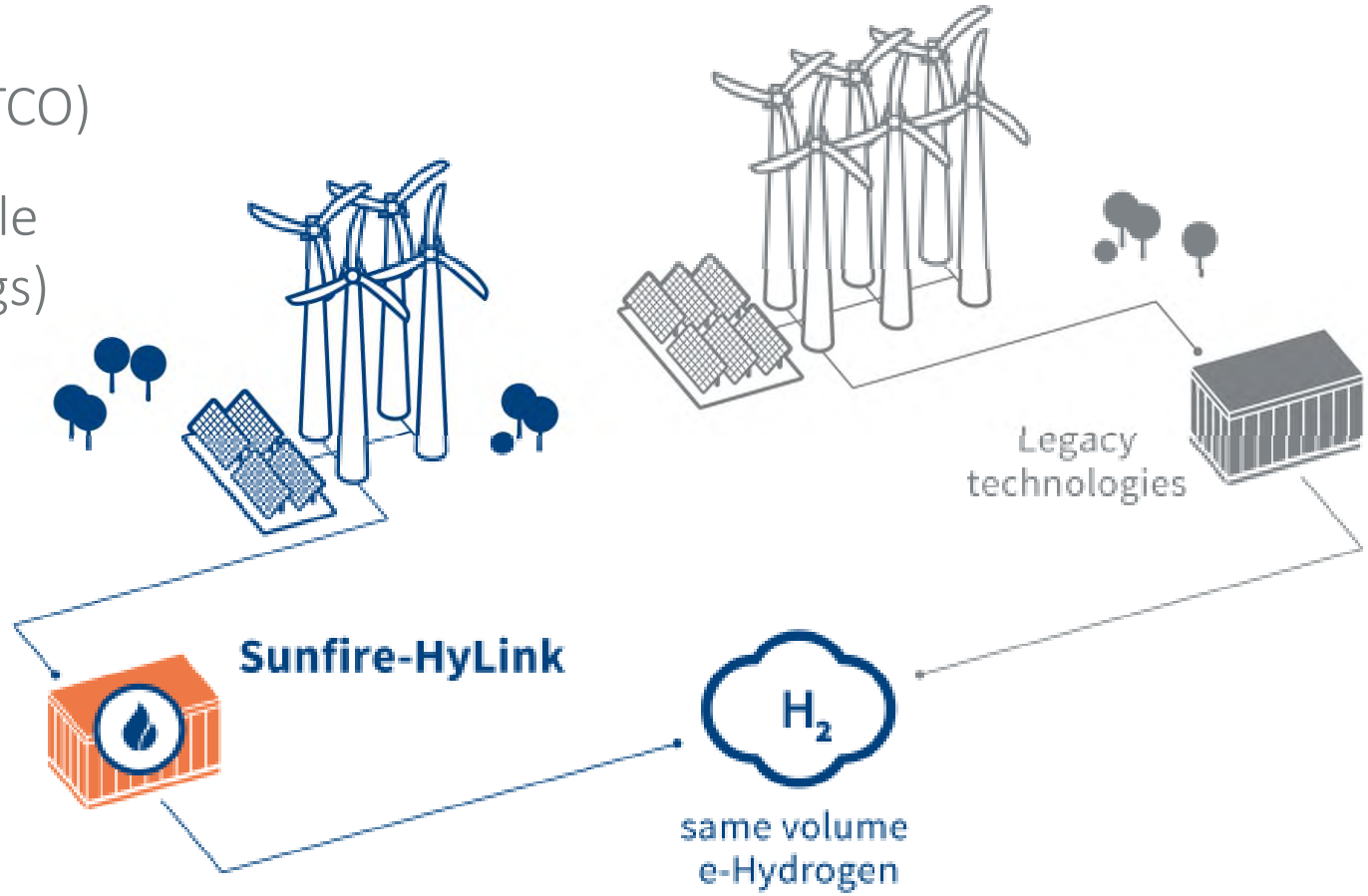


* Syngas (H_2 + CO) is the building block for e-Fuels

SOEC = MOST EFFICIENT ELECTROLYSIS

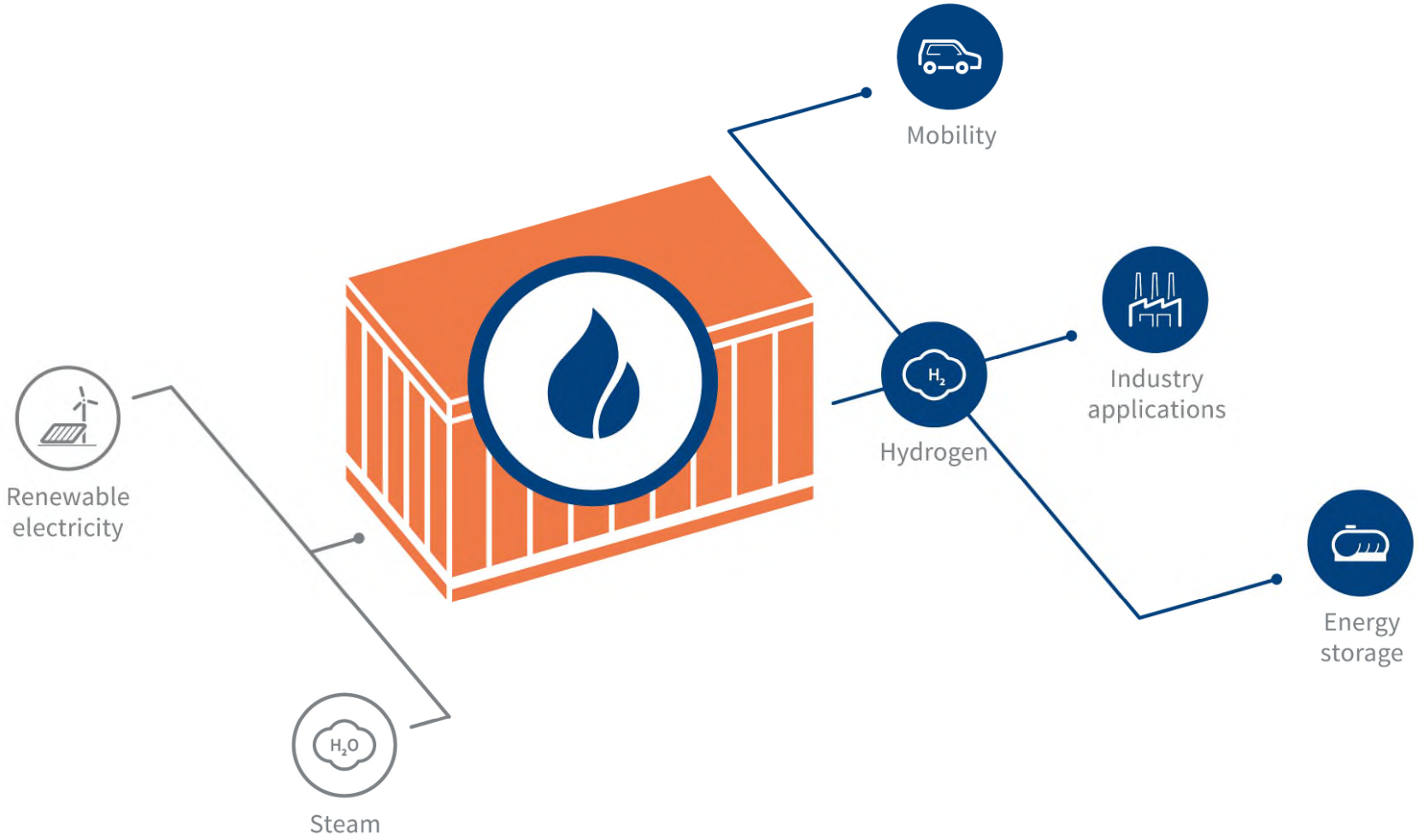
Based on Steam Utilisation

- Leading in total cost of ownership (TCO)
- Lower capacity of installed renewable energy is needed (investment savings)
- Grid capacity constraints reduced (investment savings)



RENEWABLE ELECTRICITY TO E-HYDROGEN

Sunfire-HyLink



RENEWABLE E-HYDROGEN

Sunfire-HyLink for e-Hydrogen production

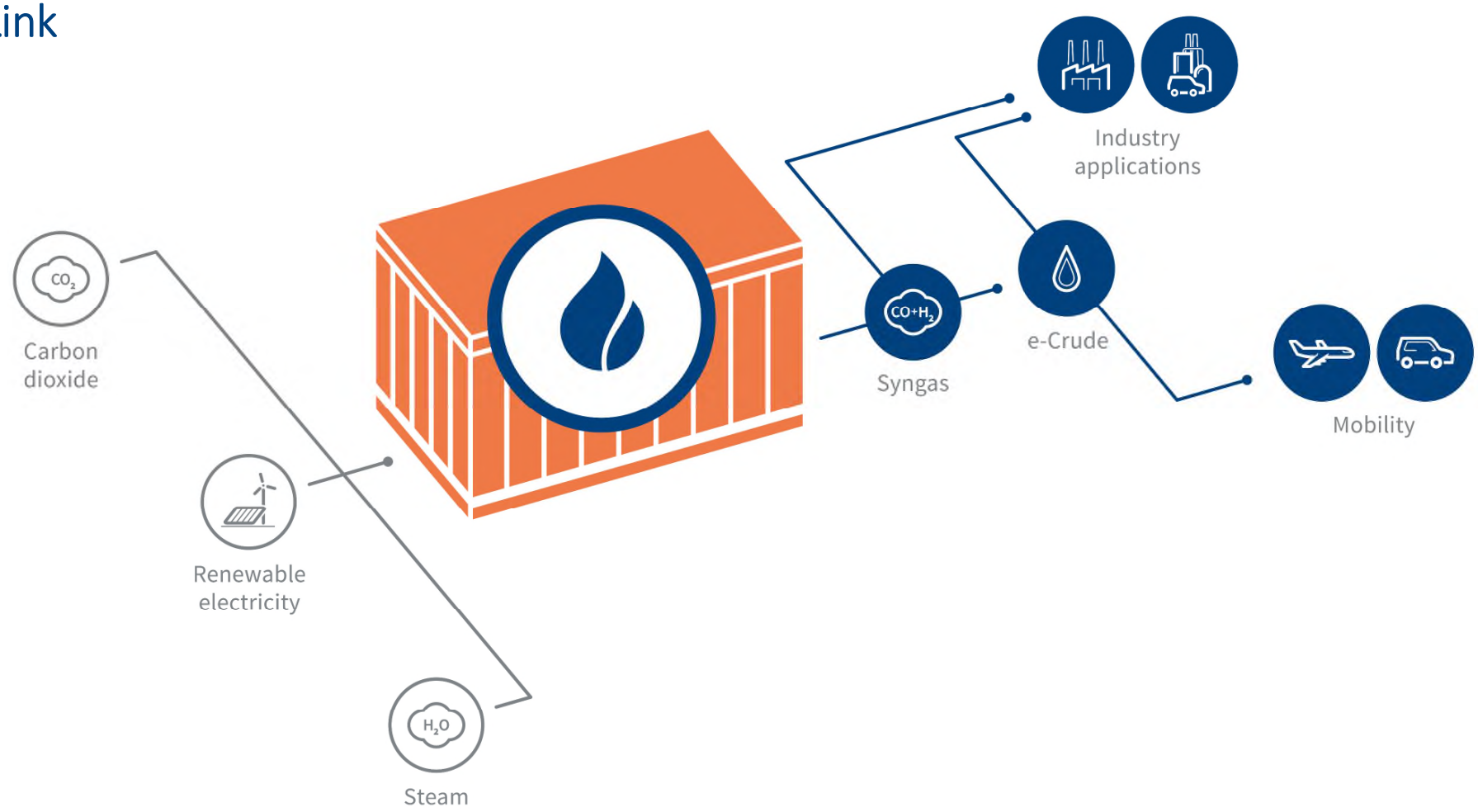
- Powered by renewable electricity and steam:
  - Production of hydrogen for annealing process of Stahlwerk Salzgitter AG for over 2 years
  - Industrial electrolysis concept for quick upscaling
- Upscaling to megawatt-scale currently ongoing
  - High efficiency proven
  - Full integration into integrated steel plant
- Hydrogen production according to technical gas supplier quality requirements

Installation Site

These projects have received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 700300 and No 826350.

RENEWABLE ELECTRICITY TO E-SYNGAS

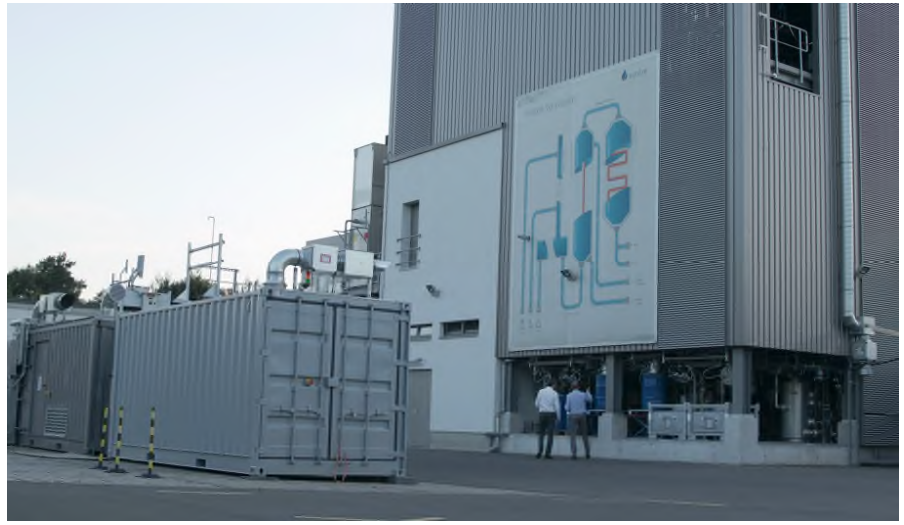
Sunfire-SynLink



RENEWABLE E-FUELS & E-CHEMICALS

Sunfire-SynLink for e-Crude production

- Powered by renewable electricity, CO_2 and steam:
  - Production of more than three tons of 100 % renewable e-Crude providing e-Fuels (Diesel, Gasoline) and e-Wax
  - Industrial reactor concept for quick upscaling
- Synthetic fuel with premium properties, verified by AUDI AG
  - High cetane value
  - Excellent combustion properties
- ASTM certified and drop-in capable (up to 50 %)
  - e-Jetfuel tested within Demo-SPK Project



Installation Site

SPONSORED BY THE
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RENEWABLE E-FUELS & E-CHEMICALS

Sunfire-SynLink for e-Crude production

- Sunfire will build the first commercial e-Fuels plant by 2022 in Herøya, Norway
- Multiple off-take agreements in place for 8,000 t/a
- Unique advantages through location
  - Low electricity prices (ca. 3 ct€/kWh)
  - Continuous supply (>7,000 h)
  - Distribution shipping terminal at site
- 10 potential sites for expansion identified

Business case repetitive in other European countries (e.g. Eastern Europe)!

Installation Site in Herøya, Norway

COMPANY FACTS

Knowhow

- ~ 130 Employees in Dresden and Neubrandenburg
- Full value chain from Ceramics, Engineering, Stack + System
  Production, up to Synthesis Processes, Service etc.

Patents

- More than 60 patent families (e.g. »process patent sunfire« WO/2008/014854)

Revenues

- Multi-million Euro Revenues in Global Markets since 2011

Investors

PAUL WURTH SMS group · idinvest PARTNERS · INVIEIN CAPITAL CEZ GROUP · KFW · TOTAL

Sunfire Headquarters

National and international awards
for innovative and pioneering technology

IMPRESSIONS

Sunfire Headquarter in Dresden

e-Fuels plant

Stack production

Test facilities

SUNFIRE PRODUCTS IN ACTION WORLDWIDE

Global industry leader in solid oxide technology

- Hundreds of systems installed
- Longest operation in customer applications
- Largest SOC electrolysis installer of the world

TOTAL · thyssenkrupp · SALZGITTER AG Stahl und Technologie · DLR

TermoKapital · GAZPROM · BOEING · CHINASTEEL · Vaillant

THANK YOU!

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