
The FEREDOX[®] Technology

Chemical Energy Storage

WOLF ENERGETIK – Technology Provider for the industry



DR. BODO WOLF

Expert in energy research and state energy supply systems

Since 1990 development of key technologies for the transition of energy supply to renewable energies

Founder of successful technology companies (Choren Industries, Sunfire, SunCoal Industries)



CLAUDIA HAIN

Managing Director

Founder of Wolf Energetik for the transition of storage technologies to industrial utilization



ENGINEERING TEAM

Engineers, economists and lawyers work on solutions in an interdisciplinary manner.



Dr. Klaus Lucka

Managing Partner of Tec4Fuels GmbH



Dr. Uta Weiß

Managing Director of the Gesellschaft für Mineralölanalytik und Qualitätsmanagement GMA



Olaf Schulze

Authorized signatory of DBI-Virtuhcon GmbH

TECHNICAL ADVISORY BOARD

Advises on technical and strategic issues

TRANSFORMATION – Climate friendly industry?

The CO₂ reduction policy is forcing industry to transform its current energy and raw material supply.

At the same time, industries face numerous challenges for the conversion of current production:

FLEXIBILITY – due to fluctuating electricity and hydrogen availability and prices on the market

AVAILABILITY – of carbon for certain processes and products

EFFICIENCY – of the new processes and process chains

RISING COSTS – for fossil raw materials and CO₂ certificates

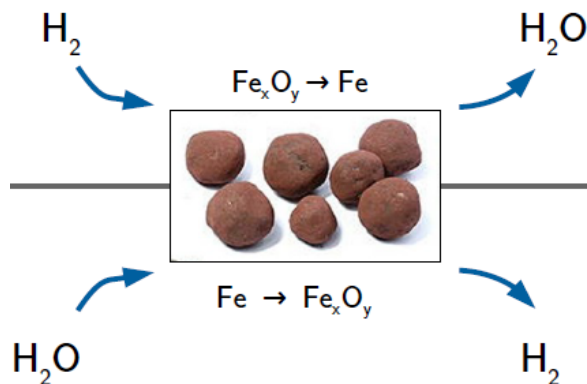




Storage material made of specially treated iron masses.



H₂ production plant for 20,000 m³/hour for the production of town gas, Magdeburg 1974



ADVANTAGES OF THE FEREDOX® TECHNOLOGY

- Patented process for the use of CO₂ for the production of synthesis gas
- Safe indirect hydrogen storage with high energy density
- Robust industrial process with high cycle stability and long service life
- Very good scalability for large applications

PROOF OF CONCEPT – Old industrial process, new tasks



FEREDOX® TEST PLANT in Freiberg (Saxony)

Material investigations and experimental testing
design, testing and scaling of efficient reactors

Digital twin methods, process simulation,
hardware-in-the-loop, software-in-the-loop

Process automation and monitoring

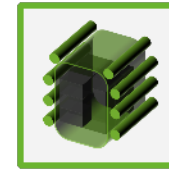
Interface engineering for integration into
complex systems

DIGITAL TWIN LIBRARY for model-based system development

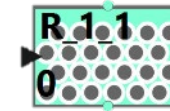
DIGITAL TWIN IN MODELICA

Dynamic simulation model of reactor and media interfaces

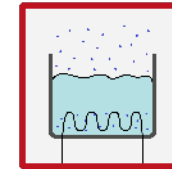
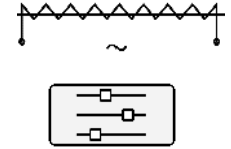
- Virtual experiments with dynamic curves of the input variables
- Reactor model validated with measurement data from experimental trials
- Model-based control strategies: Test of different control algorithms → Increase of flexibility & efficiency
- Coupling of reactor with fuel cell → Evaluation of control for stable fuel cell operation
- Test of operating strategies and their performance
- Different reactor designs can be modeled & investigated with the library



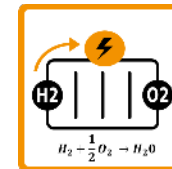
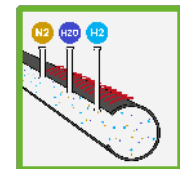
F10 reactor and reaction zones



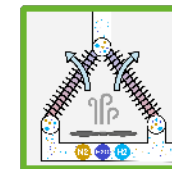
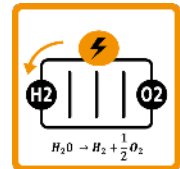
Media and controllers



Steam generation and conditioning



Fuel cell and electrolyzer



Gas cooling with air or water

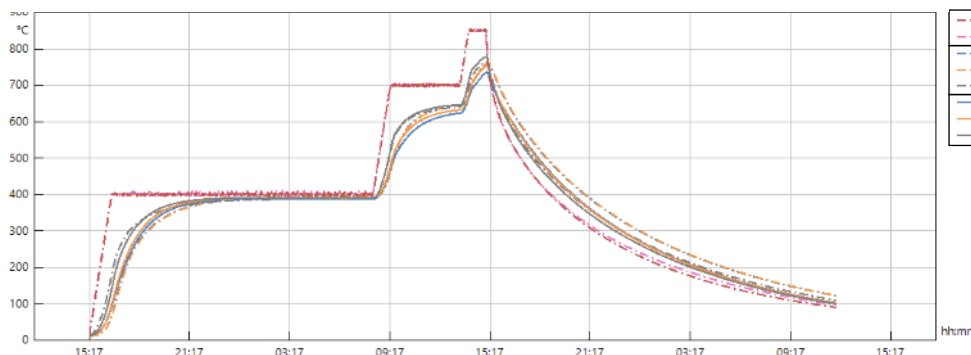


Gas handling



... further standard models

Temperatures of the heating elements and reactor zones



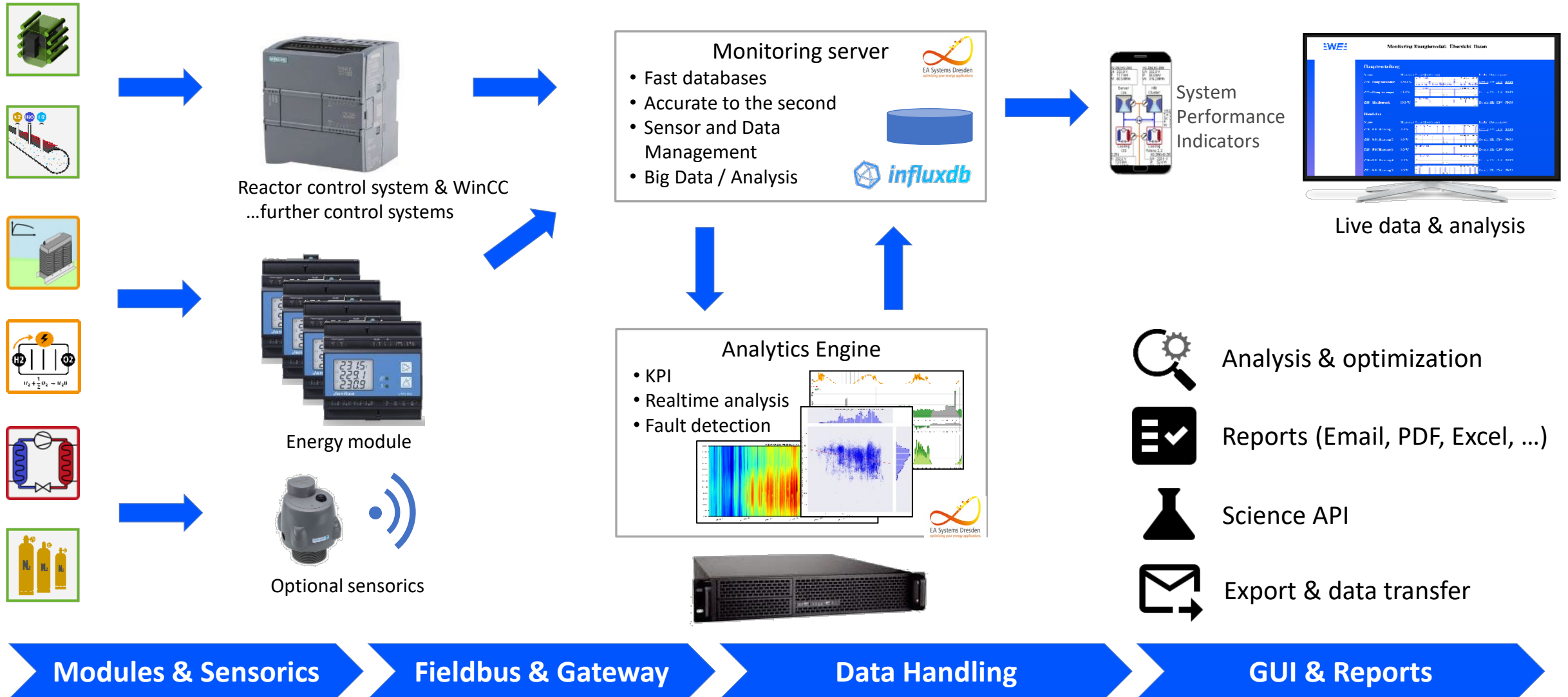
Heating elements, measured
reactor, measured
reactor, calculated

→ Good fit



PLANT-MONITORING

Live data and analyses

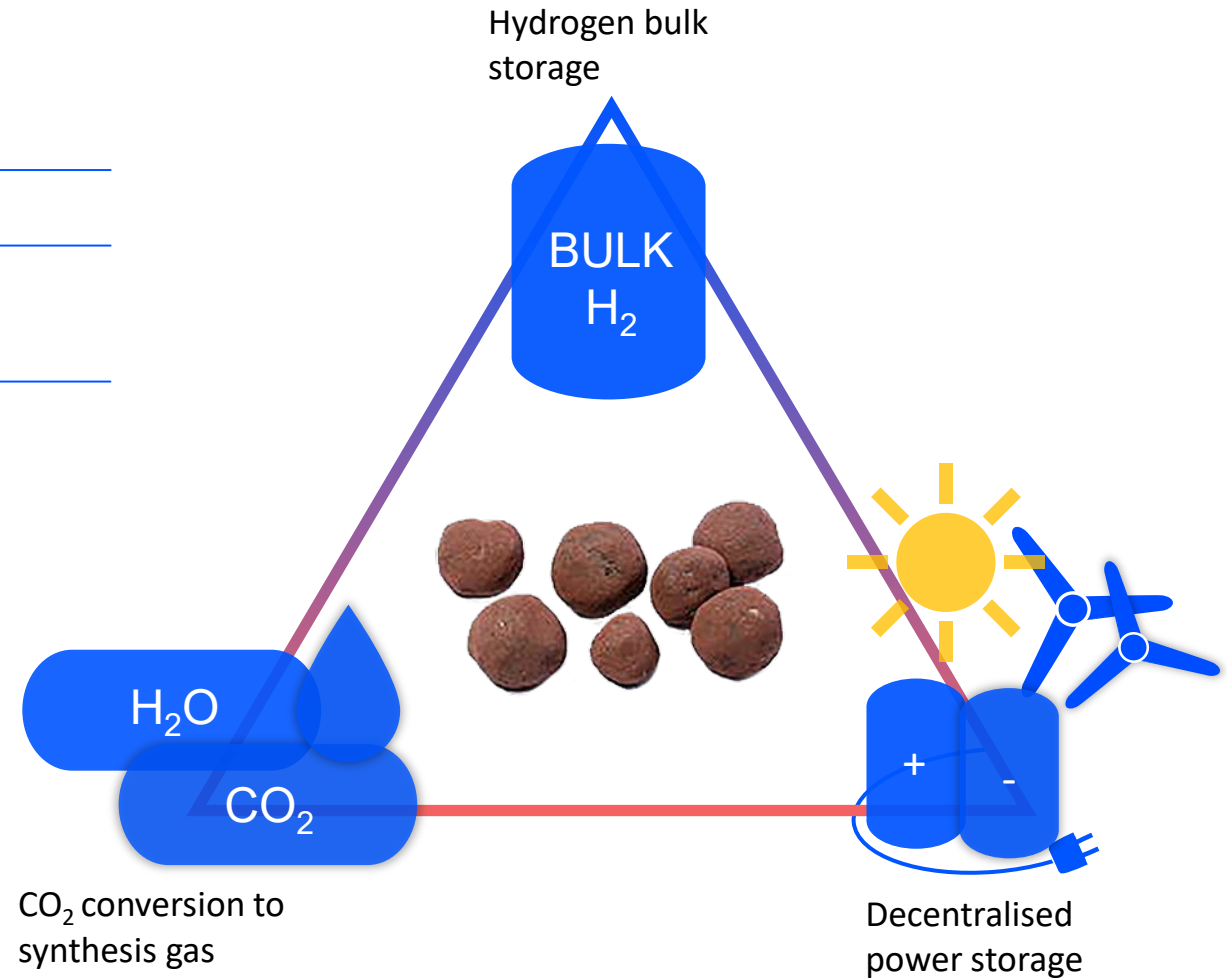


APPLICATIONS

Simple and safe hydrogen storage

Decentralised power storage as a system with electrolysis and fuel cell

CO₂ conversion to synthesis gas for the production of renewable hydrocarbons



FEREDOX® – Hydrogen storage for bulk and buffer tanks

Treated iron as energy carrier

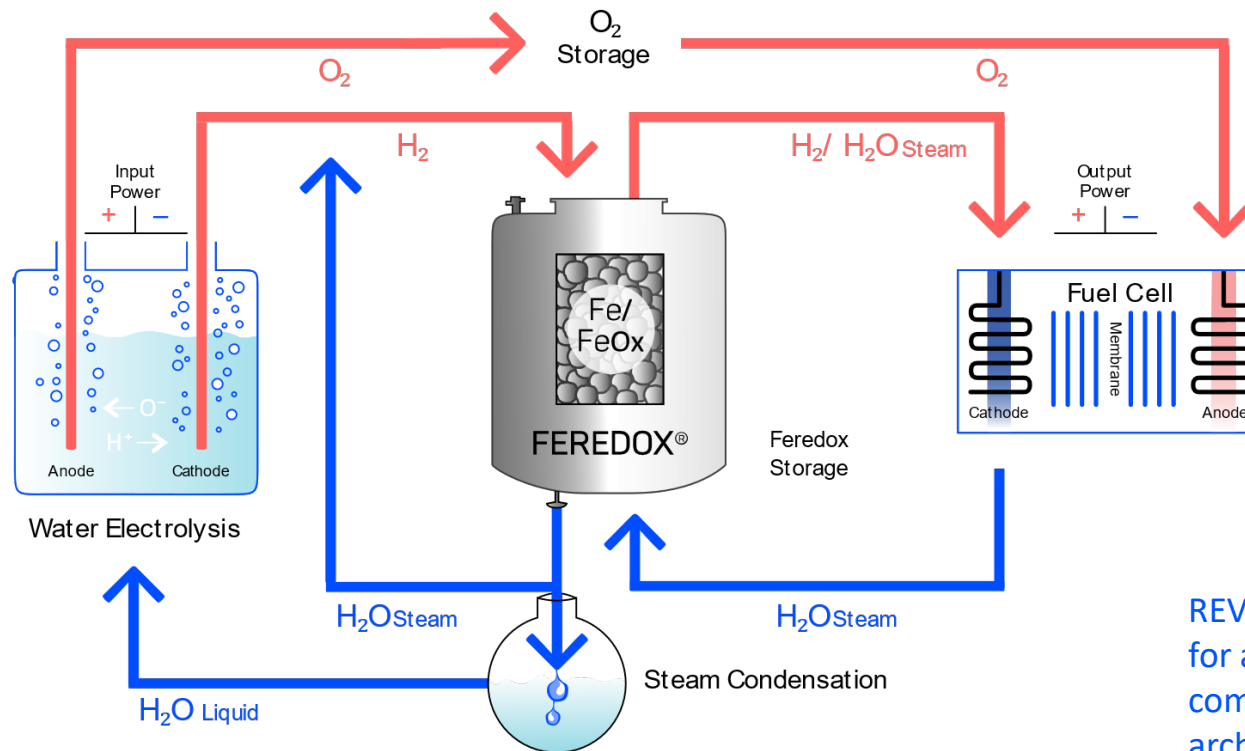
The hydrogen consumption of chemical industry and metallurgy needs hydrogen storages with high rated power and capacity, ready for transport over long distances.

The FEREDOX storage technology allows hydrogen supply in an industrial scale and independent from power or gas grids.

The energy density of FEREDOX storages is up to $3 \text{ MWh}_{\text{chem.}}/\text{m}^3$ iron storage material storing an equivalent of up to 72 kg hydrogen.



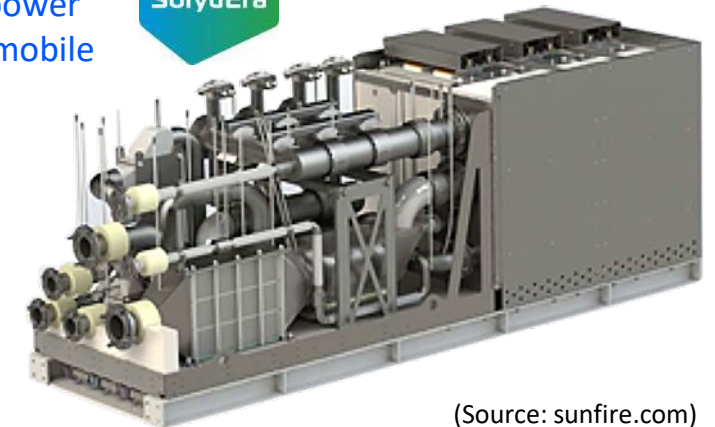
FEREDOX® – Power storage with electrolysis, fuel cell or circuit motor



FUTURE H DRIVE

Development of a power storage system for mobile application

TEC4
FUELS



(Source: sunfire.com)

REVERSIBLE FUEL CELLS allow for a very simple and compact power storage architecture.

EXERGY STORAGE
The materially closed loop operation is avoiding energy losses by emissions.

FEREDOX® – CO₂ conversion for synthetic hydrocarbons



P2X
Europe

STRATEGIC PARTNERS

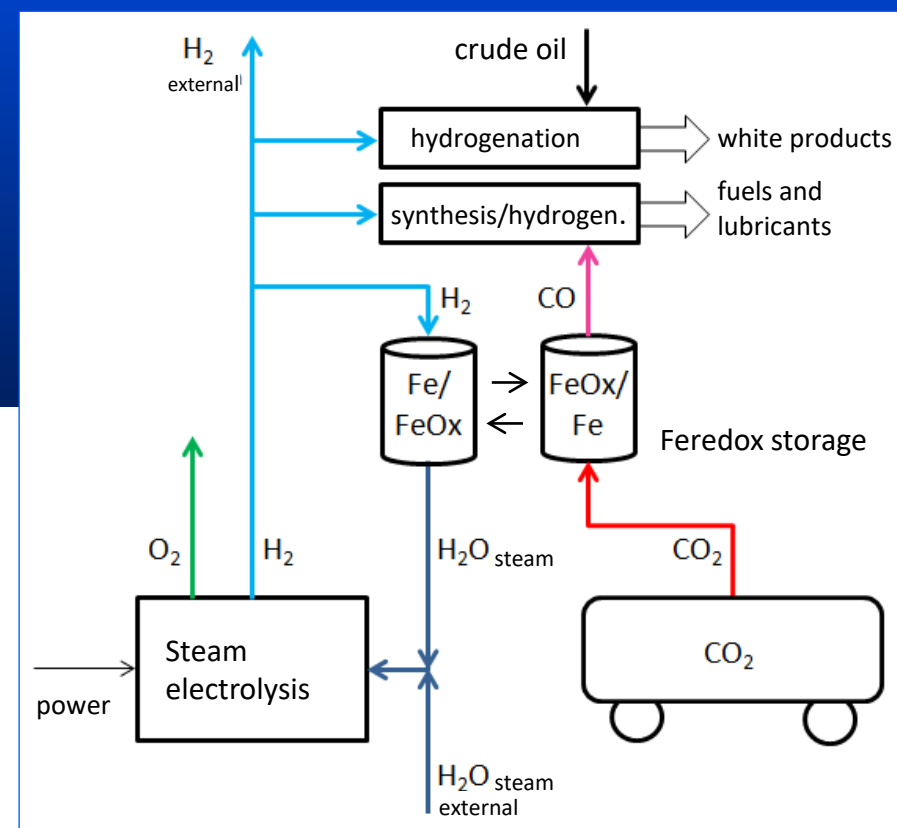
Power-to-liquid Joint
Venture for the marketing
of E-fuels and
petrochemical specialities

Synthesis gas is a hydrocarbon base material in the chemical and oil industry for the production of fuel, combustibles and lubricants (methane, gasoline, Diesel, kerosene, wax).

Production of synthetical hydrocarbons

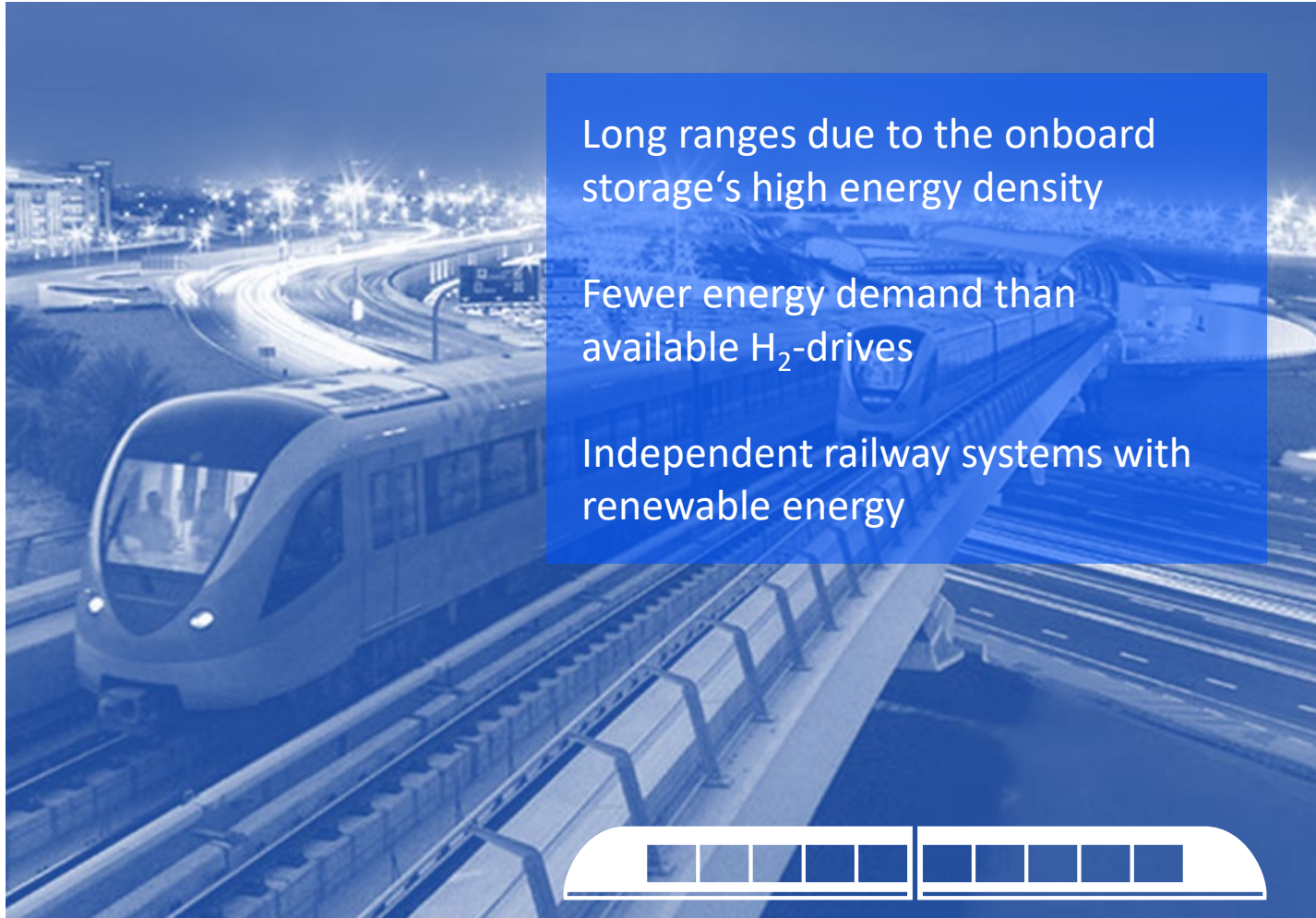
Heavy oil hydrogenation in the petroleum industry to make it more eco-friendly, thus insertion of renewable energy in heavy oils to reduce carbon dioxide emissions

FEREDOX® Application – CO₂ conversion of CO for the synthesis gas production



FEREDOX® – H2RAIL.PRIGNITZ emission-free railway

Electrification of railway without overhead contact line



FEREDOX® – The energy storage technology

OUR SERVICES

Conceptual storage integration _____

Basic Engineering and support for Front End
Engineering Design (FEED) _____

Licensing and know-how transfer _____

Commissioning support _____



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WE transform industries.

STORAGE IS KEY.
