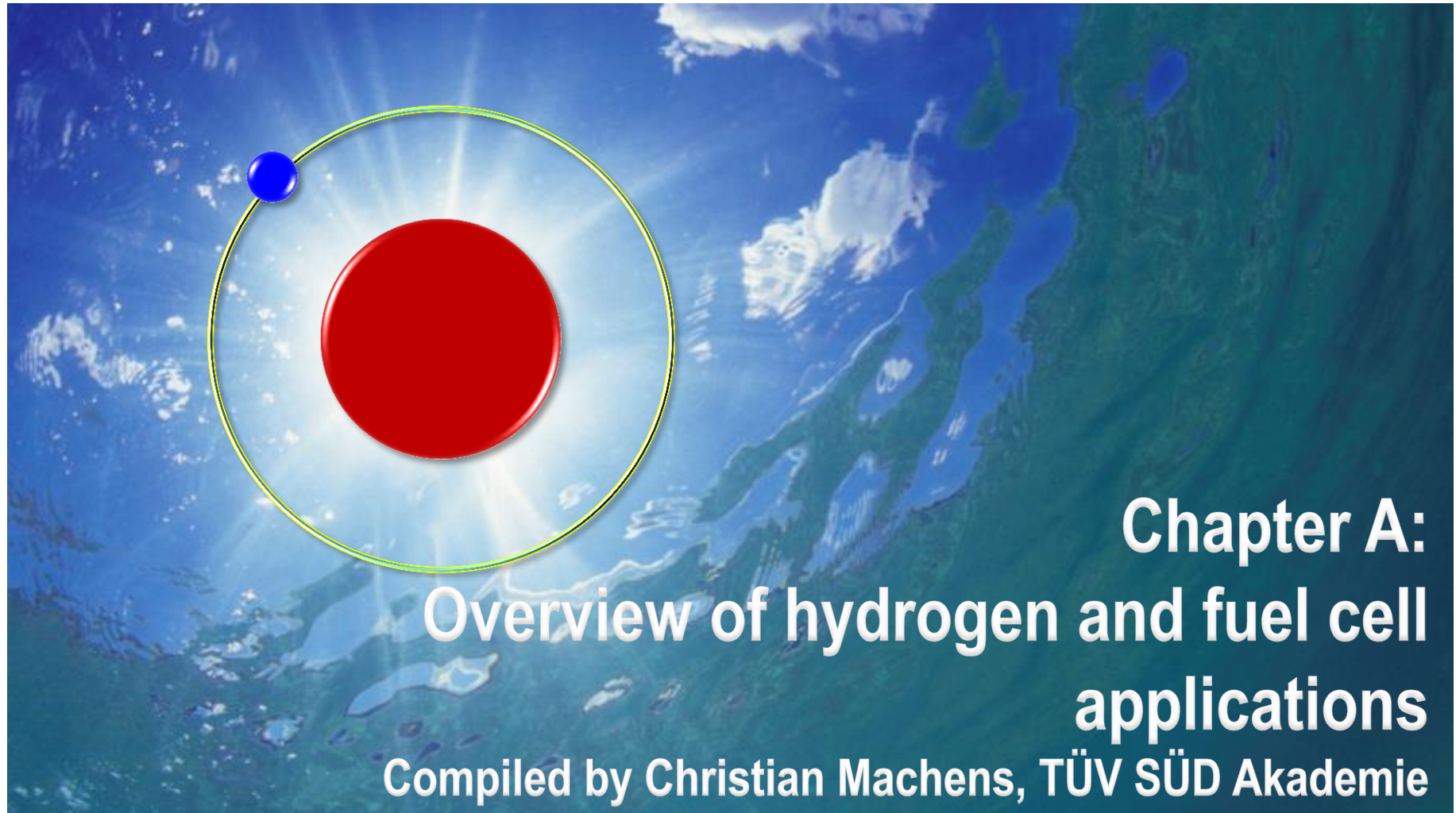


Welcome to the HyFacts Short Course



Stationary H₂ storage

3D-representation of the system Container NRJ™ (Reference: Axane)

Note 1: dimension of the Container NRJ™: L 5,9 m • W 2,35 m • H 2,39 m
(up to 5 hydrogen bundles can be stored in the system).

Note 2: the top face or one side face of the container is opened, to ensure the appropriate ventilation of the container.

2

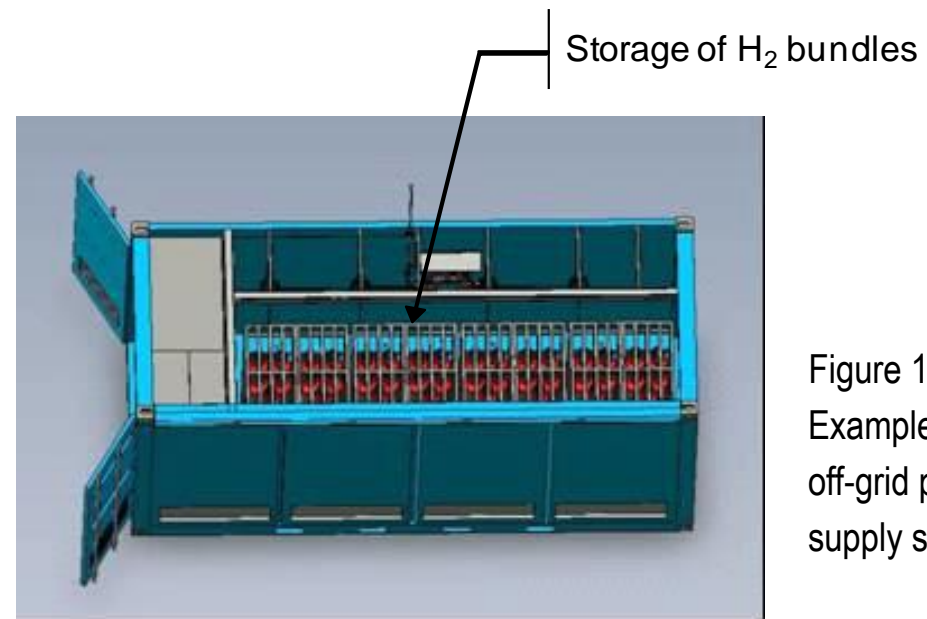
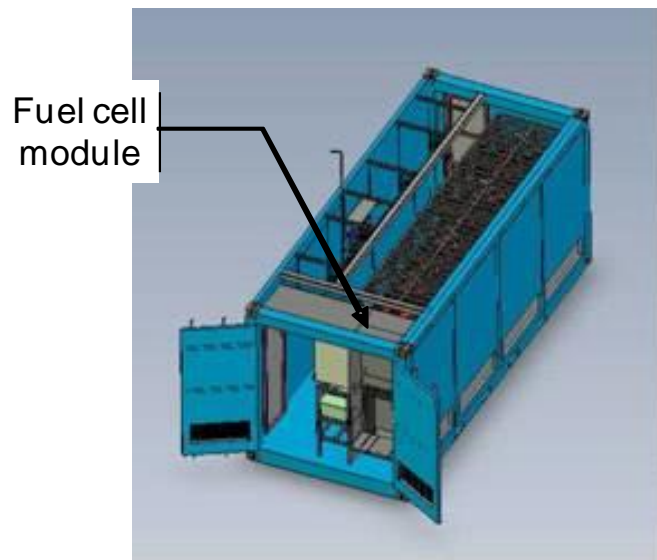


Figure 1:
Example of
off-grid power
supply system

Stationary fuel cells

The Comm Pac™ system for outdoor use, developed by Axane

- Note 1: pressure of the gas feeding the fuel cell: 10 bars (reduced to 250 mbar upstream the fuel cell)
- Note 2: ventilation grilles (close to the fuel cells) and a ventilation opening (above the hydrogen storage) have been included in the system design for safety reasons.

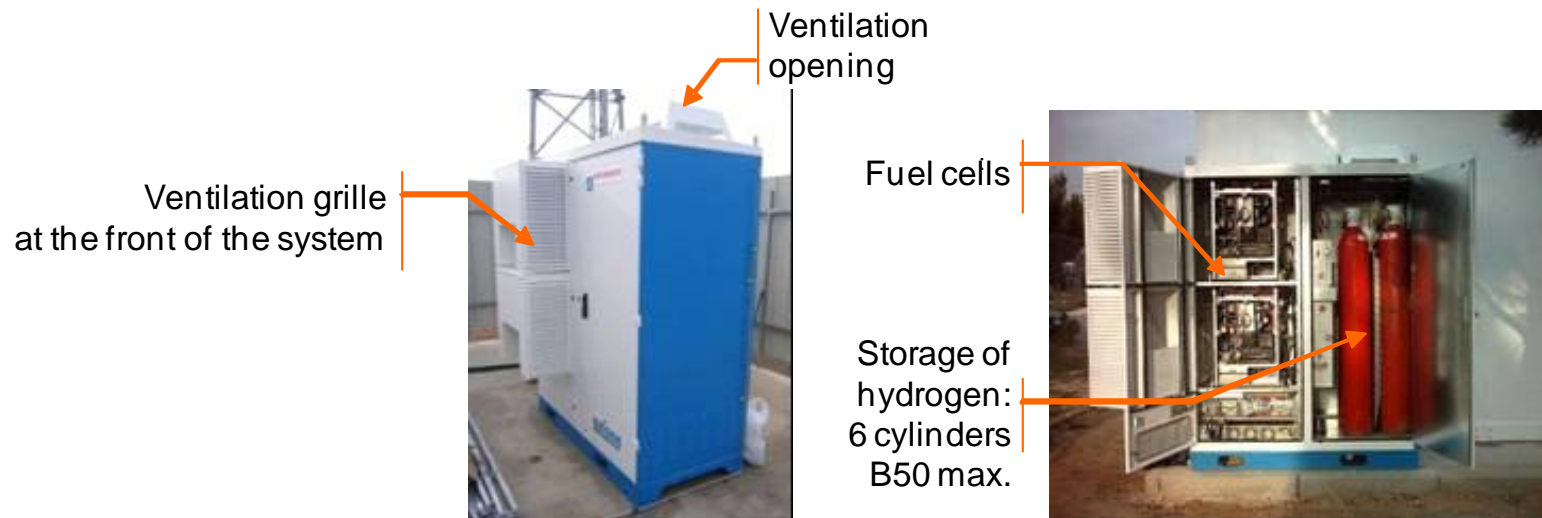


Figure 2:
Example of
off-grid
power supply
system

Material Handling applications with fuel cells

- Early market: Material handling vehicles or municipal vehicles
- Advantage: Short refuelling time
 Constant operating speed (As batteries get „weaker“, working speed decreases)
 No exchange of batteries necessary
 Less space required for refuelling (3 minutes consecutively)
- Power requirement: 1.5 – 10 kW_{el}
- In operation: 2,300 pcs. in North America (2011)
- Refuelling: Either by hydrogen dispenser or exchange of bottles

4



Picture 3: Forklifts with fuel cell

Municipal vehicle with Fuel Cell



Technical Data

Max. Speed: 50 km/h

FC: PEM
48V, 2.5 kW_{el}

Additional advantages of FC operated vehicles:

- Emission free
- Silent operation
- Auxiliary power supply possible (for tools, pumps, ...)

Picture 4: VEM H2 Fuel Cell utility vehicle (HyChain Project)



Picture 5: H2 Pressure cylinders in the vehicle

Fuel cell vehicles



Figure 6: Example of a hydrogen-powered passenger car developed by Honda, whose commercialization is planned for 2015

Figure 7: EC Type Approved Suzuki Burgman Fuel Cell Scooter



Figure 8: One of the 8 H₂ busses in regular service on London RV1 (Source: National Associations Meeting 25 April 2012, Munich, WG 11 “Hydrogen Energy”)



H₂ in the new energy system

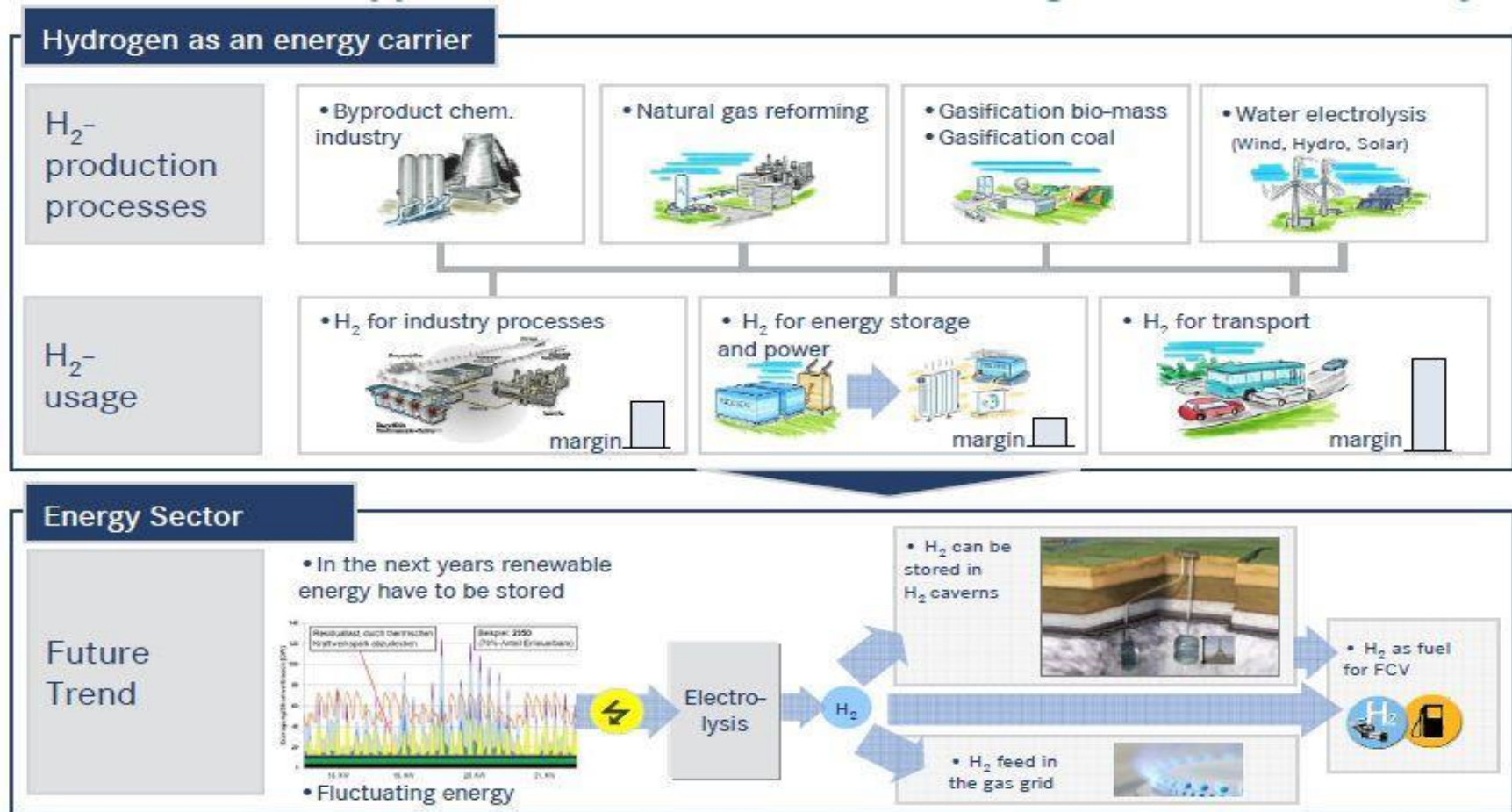
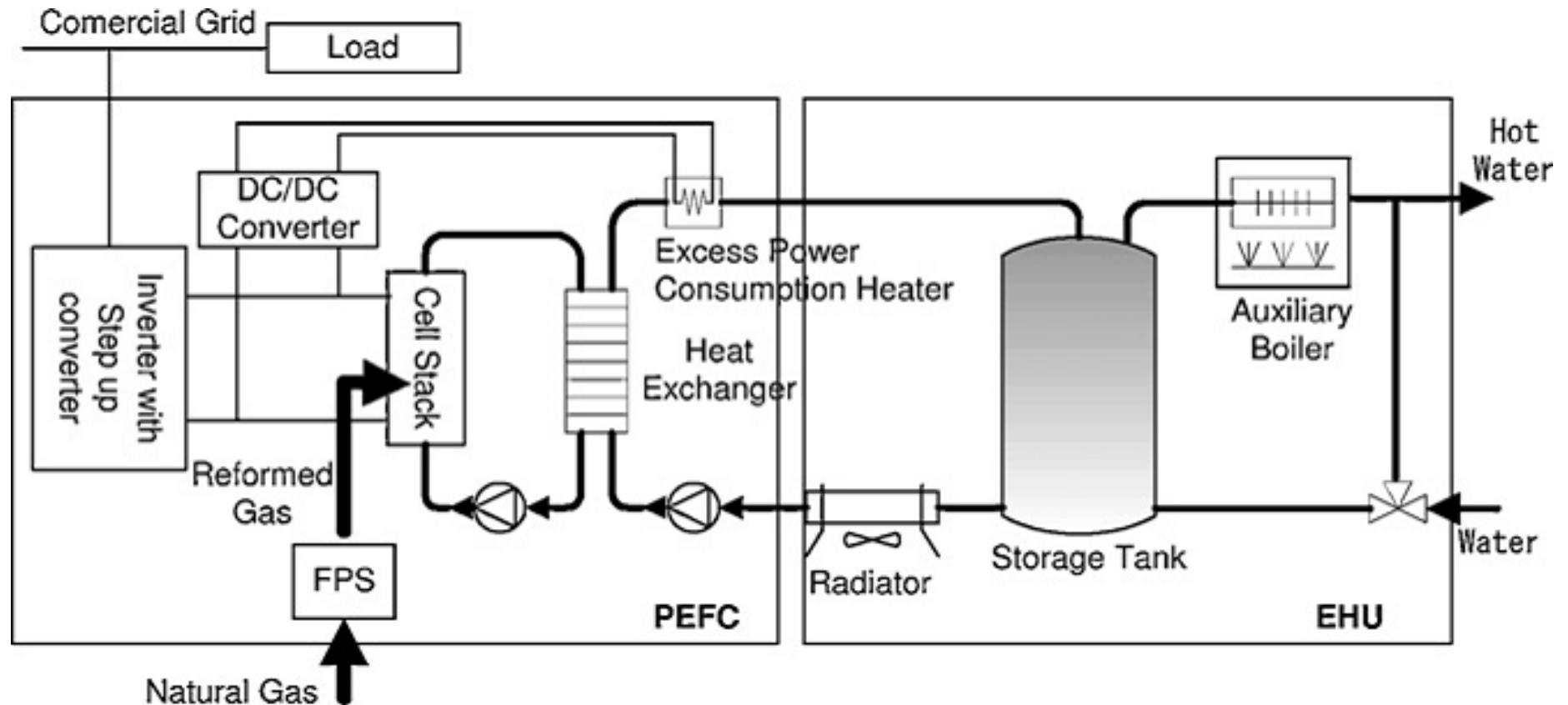


Figure 10: Hydrogen as an energy carrier

Source: "Hydrogen production, usage and storage in the future energy sector", Dr. J. Wind and D. Kreyenberg, Daimler, April 19th, 2012

Fuel cell as CHP (combined heat and power)

Figure 12: Configuration of polymer PEM/PEFC (Proton Exchange Membrane) Fuel Cell



Source: A study on energy saving in residential PEFC cogeneration systems, Kazushige Maeda, Kouji Masumotoa, Akihito Hayano, Osaka Gas. Co. Ltd, Journal of Power Sources, September 2008

FPS: Feedgas Purification System; EHU: External heating unit