

# PowerCell Sweden AB

When it burns, out comes only water

Dr. Thomas Tingelöf,

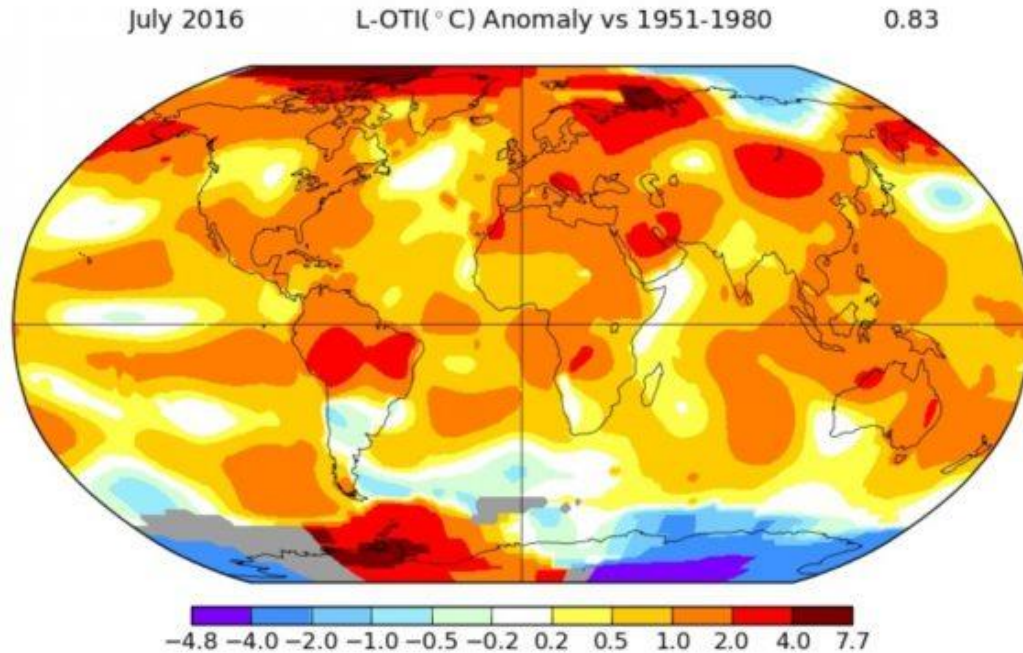
CTO

2019.06.13



# Ten years left (UN report)

2015, 2016, 2017 and 2018, The Highest Temperature Since 1880



# Bio-fuels add to the CO<sub>2</sub> problem



Bio-fuels (Methanol, Ethanol, Bio diesel etc) produces CO<sub>2</sub>.  
It takes 10-20 years until any carbon is back on earth.

The Carbon must be taken out of the Atmosphere!

Photo: Xenja Santarelli

# A Sense of Urgency

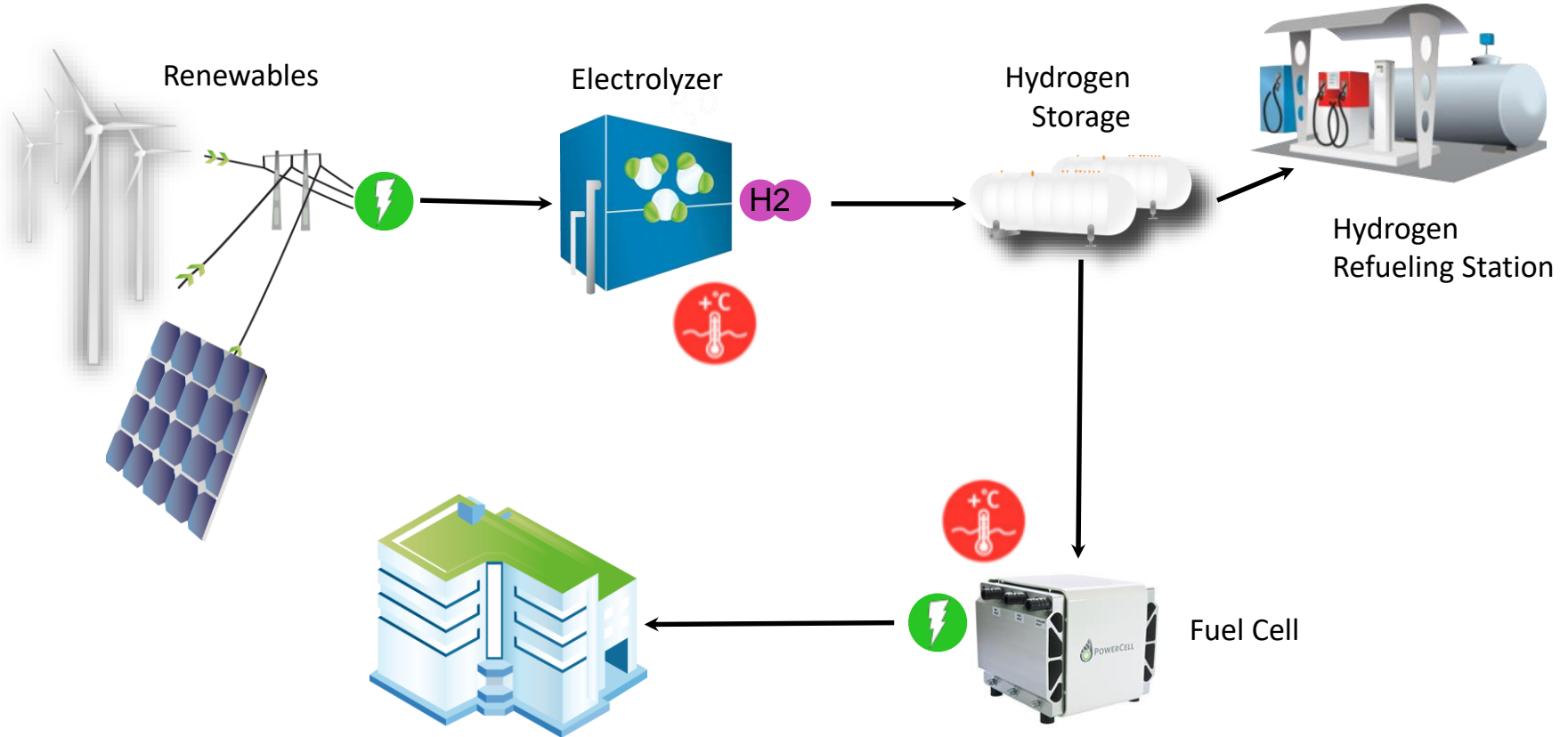


*“We observed associations between dementia incidence and local traffic pollution that remained after adjusting for known risk factors. The magnitude of the association was similar for Alzheimer’s disease and vascular dementia”  
Prof. Bertil Forsberg comments on study conducted over 15 years in Umeå Sweden*

# Electrification alone is not enough to solve our problems

- Electrification only solves the local emissions
- The power input into the energy system needs to change
- Massive investments in electrical grid transfer capacity is needed over the coming years to support increasing power need
- Lifecycle emissions of different drivetrains need to be minimized

# The Flexible Energy Society Based on Renewable Hydrogen



# Fuel cells in transport applications

- Fuel cells may be applied in a wide range of vehicles like forklifts, buses, trucks, cars, boats, motorcycles and trains
- In transport applications Polymer Electrolyte Membrane (PEM) fuel cell technology pushed to its limits:
  - Fast start up / shutdown (key on/off)
  - Low degradation under dynamic load cycling
  - Fast transient response
  - Freeze tolerance
  - Shock / vibration
  - Air / air starts
  - High volumetric power density
  - Low cost in mass production
- If they can make it here, they can make it anywhere...

# Automotive fuel cell system layout

## ○ Key components

- Fuel cell stack
- Air compressor
- Humidifier
- Hydrogen tank
- Hydrogen re-circulation system
- Power electronics
- Electric driveline

## ○ Hybridization

- Increases overall efficiency, supports durability and optimizes driving behavior

- Battery electric and hybrid combustion engine vehicles pave the way for fuel cells. The same or similar components are used.

Audi Q5 Hybrid Fuel Cell

04/11

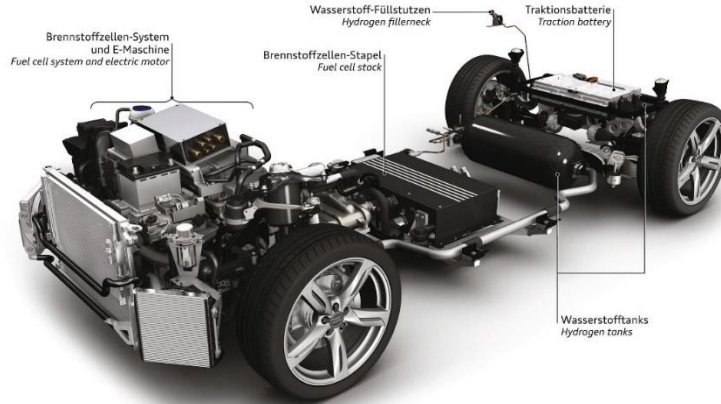


Illustration reproduced with permission from AUDI AG



# PowerCell

Company  
Customer Segments & Products



# An innovative pioneering tech company

- Founded in 2008, spin-off from Volvo Group
- Outstanding Fuel Cell Expertise
- Central functions located in Gothenburg
  - Subsidiary in Germany
  - Distributors in Japan, South Korea
  - JV in Norway for marine applications
- Extensive patent portfolio
- ISO Certified 9001 & 14001
- Listed on Nasdaq First North
  - Over 14 000 shareholders
- Three main industrial owners hold 30% of the shares – see below:



# PowerCell



1994



2008



autostack  
moves

2011



autostack  
core

2012



2014



2015



2017



2018



autostack  
industrie

2021



# Strong Industrial Partner Strategy

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VOLKSWAGEN  
GROUP



DAIMLER



3M



KALMAR

ABB



HEXAGON  
COMPOSITES

nel



Fraunhofer



SIEMENS



BOSCH

# Customer Segmentation

## Transportation



Cars



Buses



Trucks



Material  
Handling

## Stationary



Micro CHP



Power  
Container



Small Generators

## Marine



Cruise Ships



Ferries



Leisure marine

# PowerCell's Transport Product Strategy

- PEM fuel cell technology
- Metal plates, water-cooled
- Scalable fuel cell stacks & modular systems
- S2 fuel flexible - hydrogen or reformat
- Fuel cell stack designs for high volumes

PowerCell S3 (30-125 kW)



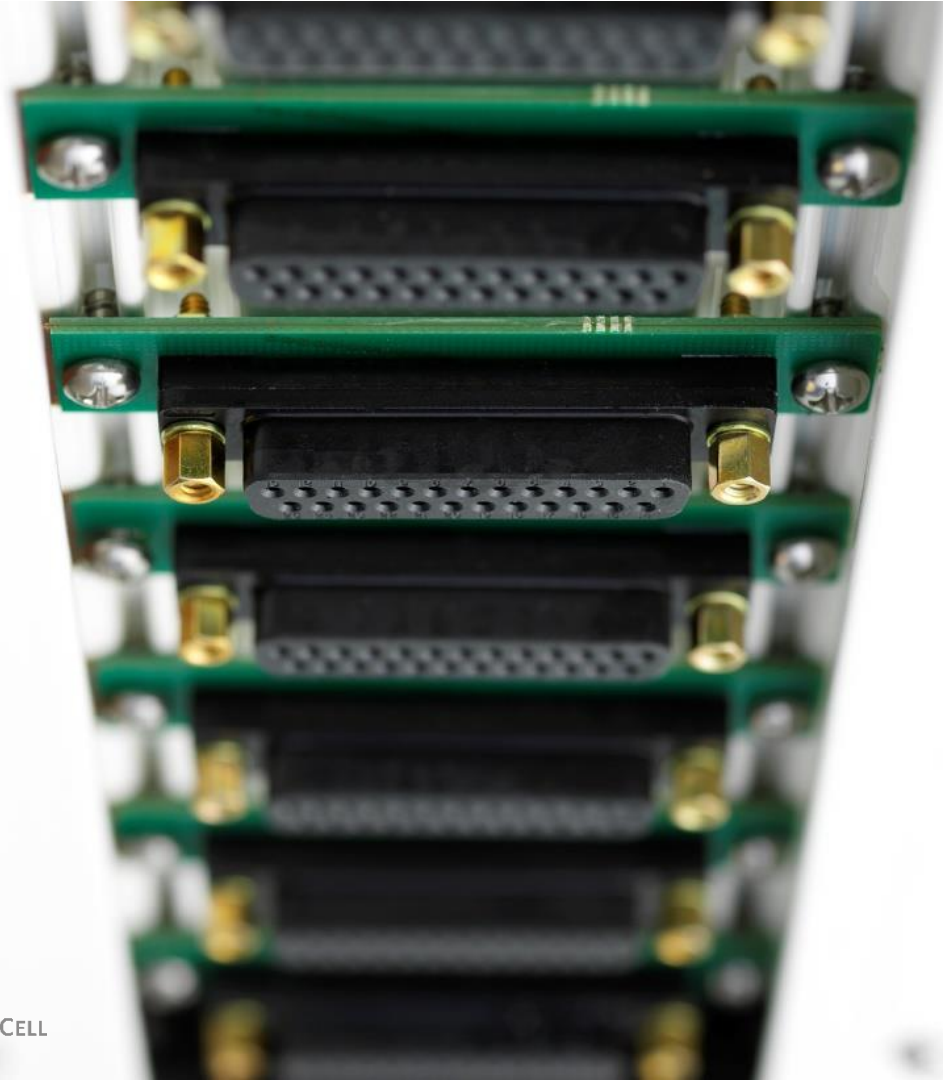
PowerCell S2 (5-35 kW)



# PowerCell

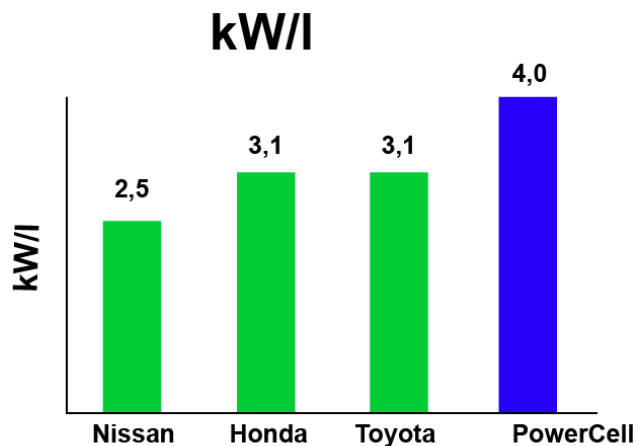
Fuel Cell Stack Platforms

Examples of customers cases



# S3 (30-125 kW): Cooperation with Bosch on world leading, high quality, fully validated fuel cell stack technology

- Joint fuel cell technology development on S3 platform
- Bosch will produce S3 technology under licensing agreement



S3 (30-125 kW)



## S2 (5-35 kW): Positioned to Benefit from Chinese Market Drivers

- Strong governmental support for transition
- S2 REX perfect fit for Chinese market
- Many ongoing customer tests
- New subsidies for hydrogen vehicles



50 000 Euro



80 000 Euro



130 000 Euro



PowerCell S2 as REX, Range Extender

# Publicly announced Fuel Cell Stack Prototype: “AutoStack-Industrie”

- Technical cooperation with German automotive industry:
  - BMW, Daimler, Ford, VW
- PowerCell’s responsibility:
  - design of the fuel cell stack
  - development of technology for mass volume production



# Example customer case: Material Handling for Kalmar and SSAB/Vattenfall

- 60 kW fuel cell system
- 18 ton forklift for SSAB steel mill
- Testing just concluded



*PowerCell MS-30*

## Example of customer case: Refuse truck for Renova

- ⇒ MS-100 FC system for heavy-duty applications
- ⇒ High system efficiency (62% peak / 48% at rated)
- ⇒ Plug-and-play solution





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