HYDROGENICS

SHIFT **POWER** | **ENERGIZE** YOUR WORLD

THE ENERGY SHIFT IS UNDERWAY

H2@Port Workshop

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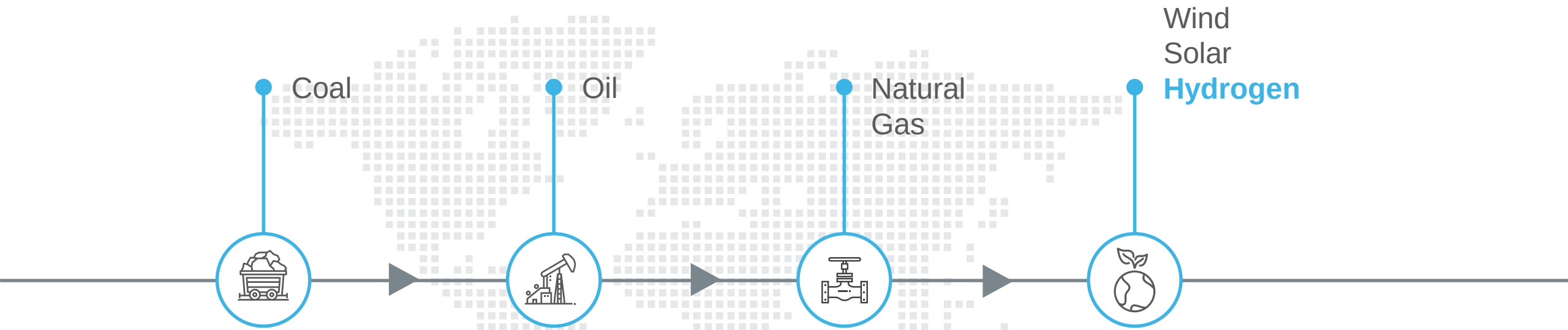
Director New Initiatives

Sept. 11, 2019

The world is changing, faster



CHANGE IS ACCELERATING

Public Interest (health/climate) = Political Will = Public $$ = Market Solutions

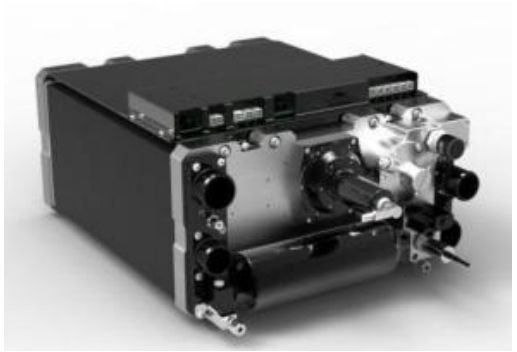
Electrolysers and Fuel Cells are Modular Electrochemical Energy Conversion Devices

Electrolysers

HyLYZER PEMWE Stack

Power Input: 2.5 MW
Hydrogen Output: 1080 kg/h
Output Pressure: 35 bar

Fuel Cells



HyPM HD30 Fuel Cell Power Module

Power Output: 30kW
Integrated Balance of Plant
Low Pressure Design
Cold Temperature Operation

WATER (H_2O) + **POWER** ⇄ **HYDROGEN (H_2)** + OXYGEN(O_2)

Electrolyser

Fuel Cell

Hydrogenics designs and builds Fuel Cell Power Modules and Electrolyser systems

Fuel Cells

Fuel Cell Bus Integrators, China

Alstom Coradia iLint, Germany

Truck, US

Electrolysers

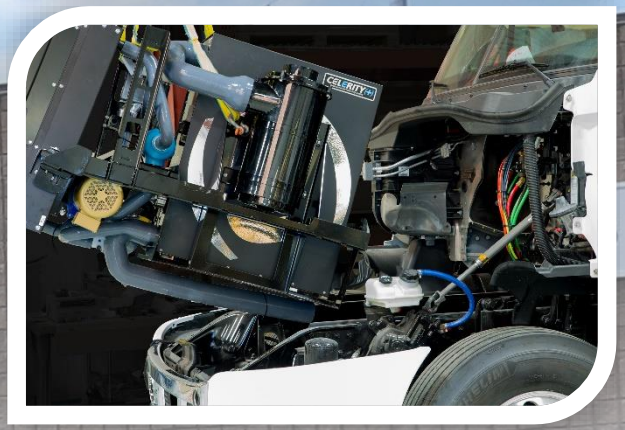
Uniper 2MW P2G, Germany

P2G H_2 Fueling, California

5MW Power-to-Gas, Ontario

Drayage Truck

- Class 8
- Integrated into the most popular Daimler Freightliner Chassis
- Ready for demonstration in Los Angeles, California



DAIMLER ACTIA TTSI

FUNDING PROVIDED BY THE CALIFORNIA ENERGY COMMISSION

SIEMENS

Hydrogen Marine

Zero/V

Feasibility of FC

Zero Emissions Research Oceanographic Vessel (ZERO/V) powered by hydrogen fuel cells

MarFC

Demonstrating in Maritime

Powering commercial units in demanding marine environment

SINTEF and ABB

Test & Model Main Propulsion

Model operation and control of marine power system for MW-scale propulsion plant

Water-Go-Round

Commercial adoption

First high-speed hydrogen powered fuel cell marine vessel in the U.S.

Zero/V

- Review design, identify potential barriers for technology adoption
- DNV-GL Conditional Approval
- Funded by the MARAD

MarFC

- Lower the technology risk
- Estimated Costs – CapEx, OpEx
- Permitting and acceptance
- Engage potential adopters/end users

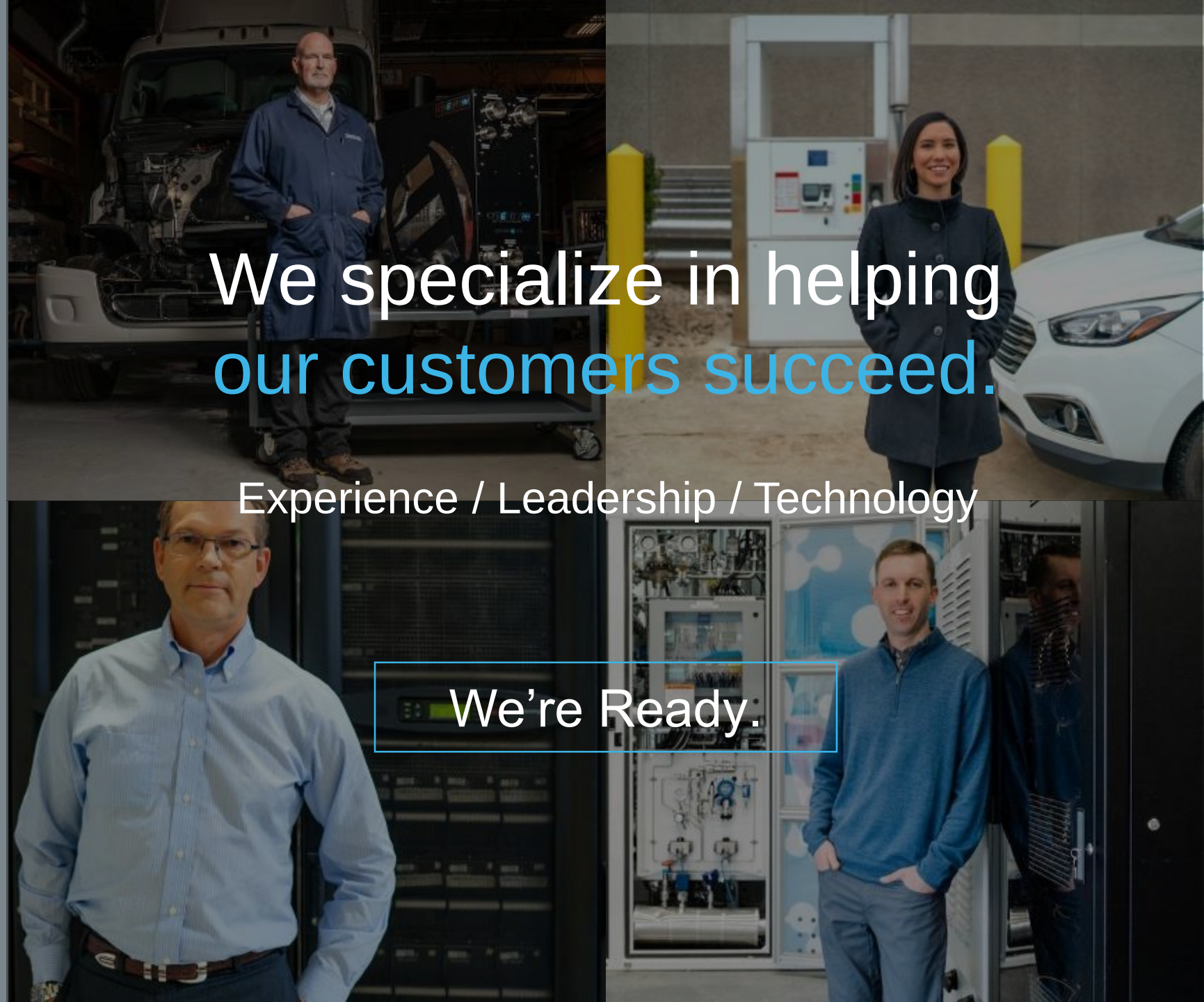
SINTEF and ABB

- Determine technicalities of scaling-up
- Control of fuel cell plant in combination with energy storage
- Optimize efficiency, reliability and the lifetime of fuel cell stacks

Water-Go-Round

- Commercial operation (2020), 84 passenger (reconfigurable), 22 knot top speed
- 2x 300 kW electric motors, 360 kW PEM fuel cell
- 100 kWh Li-ion battery, H2: 242 kg @ 250 bar

The human factor



We specialize in helping our customers succeed.

Experience / Leadership / Technology

We're Ready.

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