HYDROGENICS

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

Hydrogenics Selected References

Grid Balancing, Power to Gas (PtG)

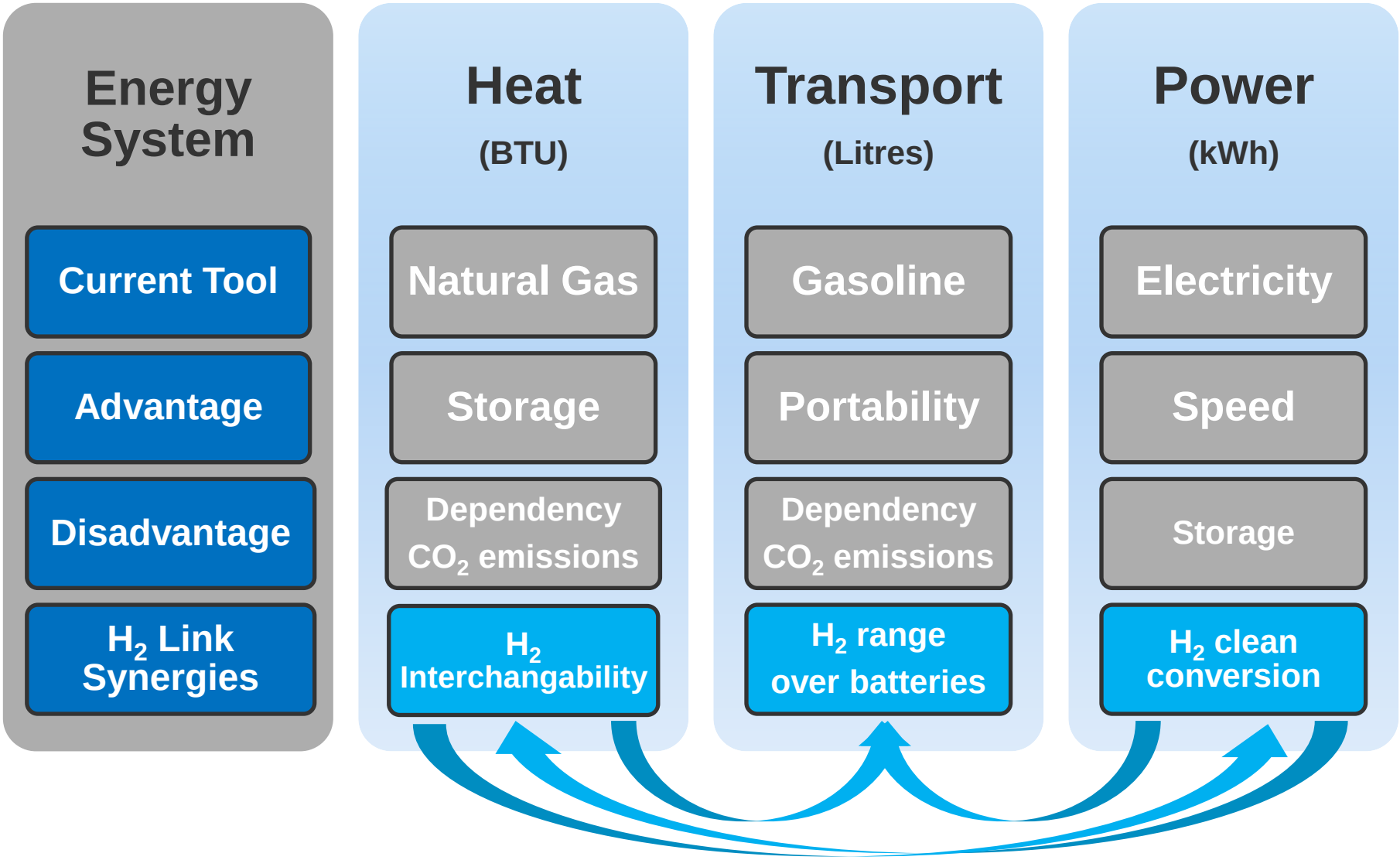
2013

In a nutshell

- Global provider of
  - On-site hydrogen water electrolysers
  - Energy Storage systems
  - H_2 fueling stations
  - Fuel cells systems
- Since over **60 years**
- 125 employees
- Listed on NASDAQ (HYGS) and TSX (HYG)
- **Own R&D and product development**
- Over 1,800 projects deployed in >100 countries

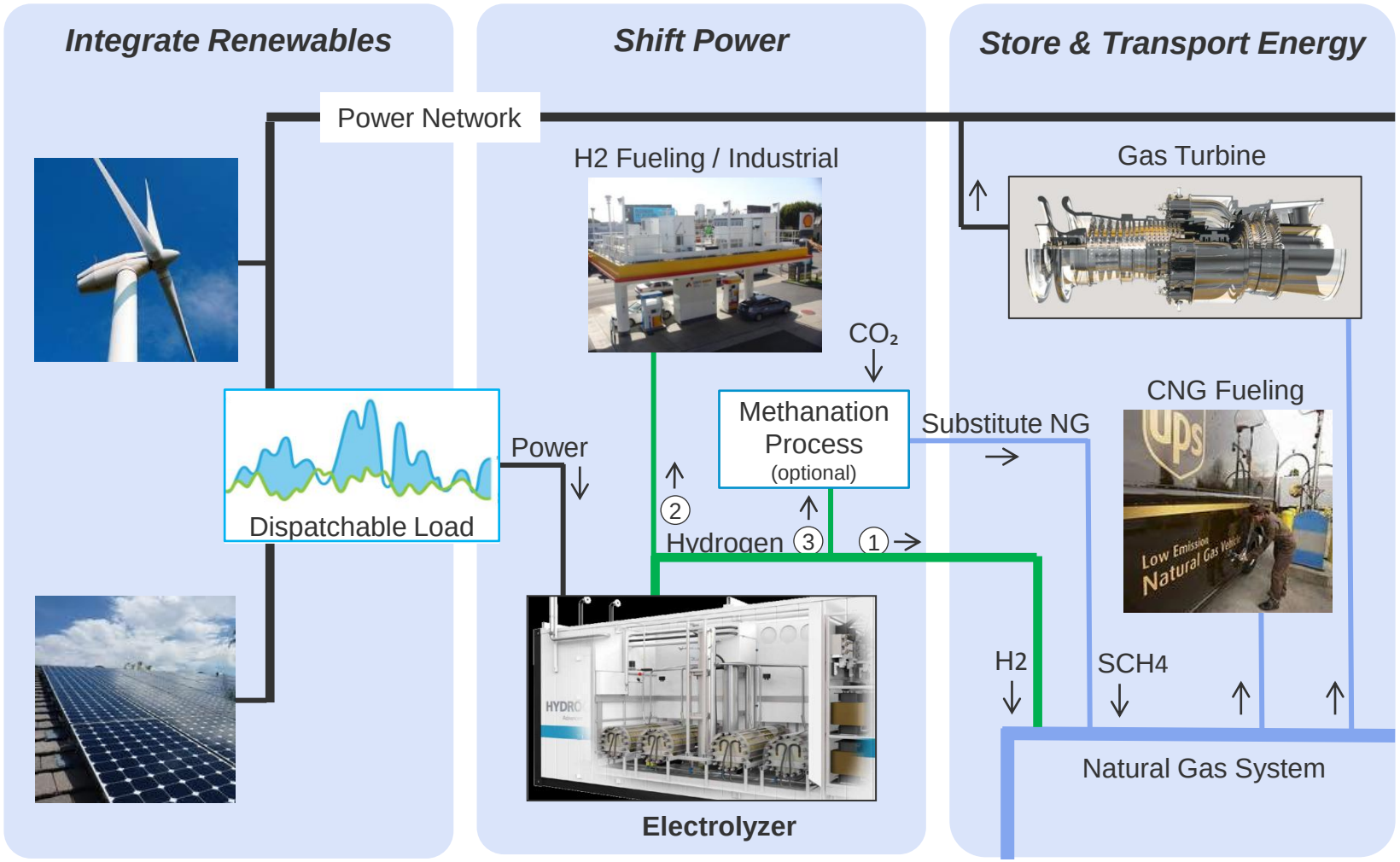

Production Hall
Oxygen cleaning
Final Skid & Container Integration
Welding area (certified)
Skid/System Assembly

The Smart Energy Grid – Hydrogen to build bridges




Hydrogenics’ PtG & Grid Balancing Expertise

Power-to-Gas bridges the power, gas and transport networks to unlock new options for energy storage



Ontario, Canada

Ontario Grid Frequency Regulation

OBJECTIVES

- Investigate the reactivity of a HySTAT® hydrogen generator.
- Provided frequency regulation by responding to real-time frequency regulation signals from the IESO on a second-by-second basis using an electrolyser.

SOLUTION:

- HySTAT® S4000 Indoor solution producing 100Nm³/h H_2.
- Perfect ability to capture the overload and cope with the volatility of frequency regulation signals.

ieso

HYDROGENICS

SHIFT POWER | ENERGIZE YOUR WORLD

Galicia, Spain

Sotavento Grid Stabilisation

OBJECTIVES

- Research and technological demo centre aimed at improving the implementation of renewable energetic systems.
- Production of hydrogen from a wind farm that features 24 wind turbines of 5 different technologies.
- Use the H_2 in an internal combustion engine to produce electricity.

SOLUTION:

- HySTAT® 60 Outdoor with all peripherals to produce 60Nm³/h H_2.
- H_2 compression and storage system to store H_2 and one HICE.

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

gasNatural fenosa

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

AIR LIQUIDE

Port Talbot, Wales

Glamorgan Smart Grid project

OBJECTIVES

- Improve interaction between renewable electricity, electrolytic hydrogen production and fuel cells at Baglan Energy Park
- Use of the 20 kW solar panels and a wind turbine to produce H_2.

SOLUTION:

- HySTAT® 10/10 Indoor electrolyser to produce 10Nm³/h H_2.
- Compression, storage and dispensing system
- HyPM 12 kW Fuel cell.
- 2 HyPM12 Kw (Integrated in a shuttle bus and an electric delivery vehicle)

Meckl.-Vorpommern, Germany

RH_2 - WKA Grid Stabilisation

OBJECTIVES

- Provide electricity from a 140MW onshore wind farm at any time and when needed using hydrogen as energy storage. Some turbine are rated at 7.5 MW and CO_2 savings are estimated at +- 250.000 t//year.
- Use the H_2 in an internal combustion engine to produce electricity and retrieve the heat from the system for the building.
- In a next stage, use H_2 for transport and demonstrate the PtG (Power to Gas) solution by injecting the produced H_2 in the nearby pipeline.

SOLUTION:

- 1MW HySTAT® indoor solution with all peripherals to produce 210Nm³/h H_2.
- H_2 compression and storage system to store 27MWh (+-810kg) H_2 at 310bar
- One HICE.

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

WIND-projekt

Stuttgart, Germany

Methanation process

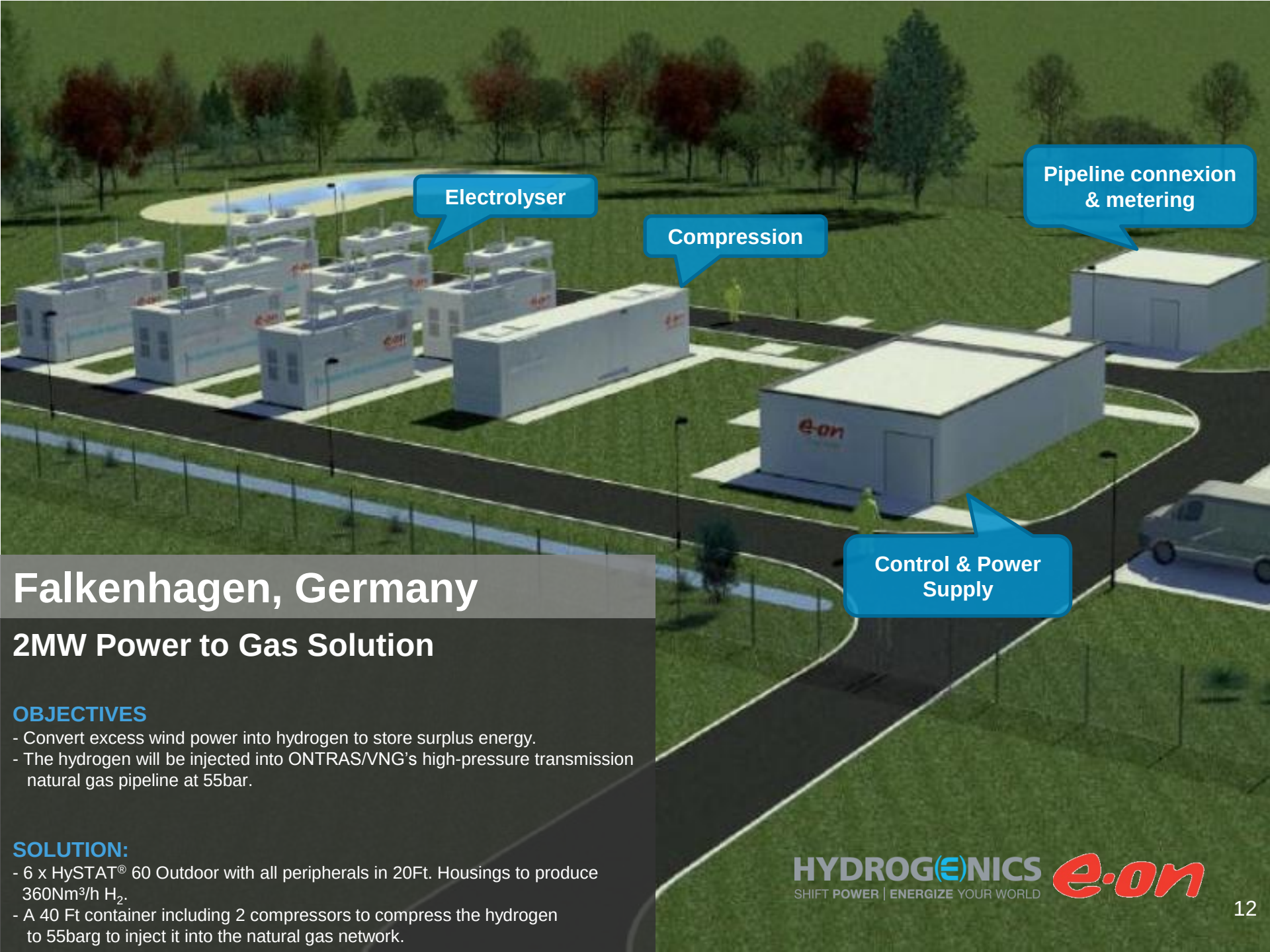
OBJECTIVES

- Demonstrate the PtG (Power to Gas) solution using methane.
- Produce H_2 from the surplus of electricity and combine it with CO_2 from a biogas plant to produce methane → 4H2 + CO2 → CH4 + H2O.

SOLUTION:

- HySTAT® 60 Outdoor with all peripherals to produce 60Nm³/h H_2.
- The electrolyser combined with a methanation process produces bio -methane.
- Bio-methane is injected in the gas grid, leading to a carbon neutral process.

HYDROGENICS ZSW
SHIFT POWER | ENERGIZE YOUR WORLD



Falkenhagen, Germany

2MW Power to Gas Solution

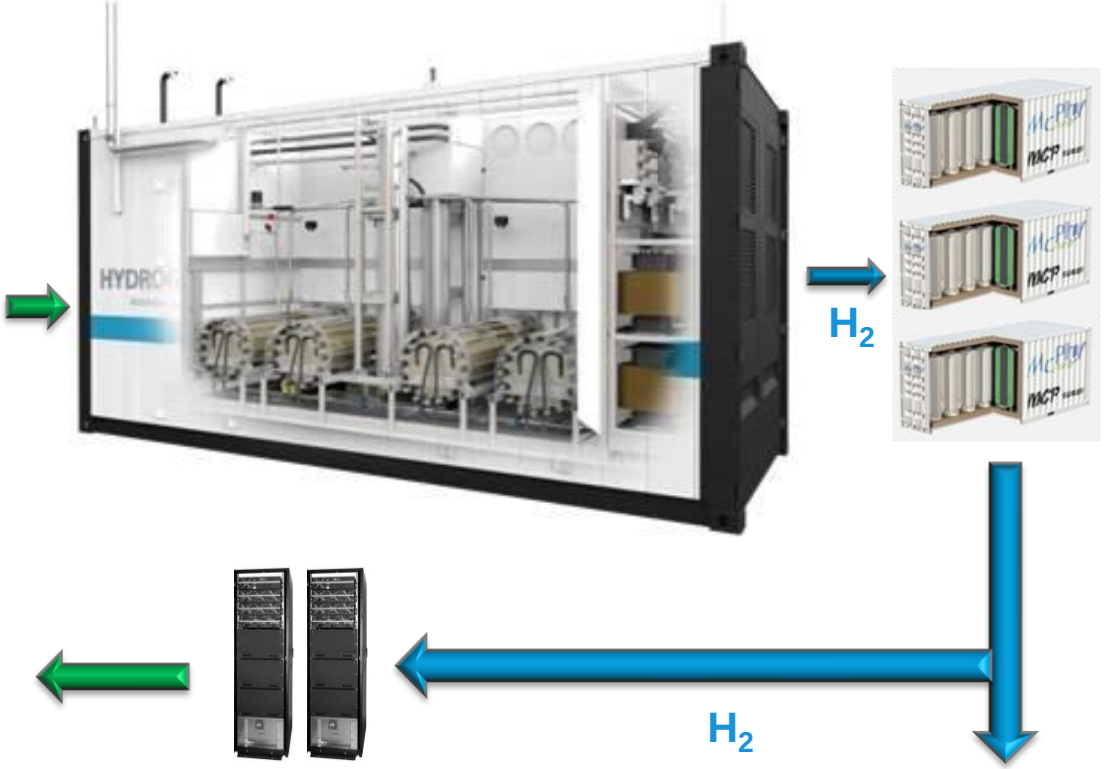
OBJECTIVES

- Convert excess wind power into hydrogen to store surplus energy.
- The hydrogen will be injected into ONTRAS/VNG's high-pressure transmission natural gas pipeline at 55bar.

SOLUTION:

- 6 x HySTAT® 60 Outdoor with all peripherals in 20Ft. Housings to produce 360Nm³/h H_2.
- A 40 Ft container including 2 compressors to compress the hydrogen to 55barg to inject it into the natural gas network.

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD
e·on



Puglia, Italy

INGRID (24Mio€ FCH JU project, 7 partners)

OBJECTIVES

- Allow increased penetration of highly fluctuating RE into the grid using electrolysis and supply-demand balancing.
- Improvement of distribution operation through active/reactive power control for optimal voltage regulation and power quality.
- Use H_2 for transport, industry, grid balancing and injection into the gas network.

SOLUTION:

- 1MW HySTAT® electrolyser 40Ft. outdoor solution with all peripherals to produce 200Nm³/h H_2.
- 60kW Fuel Cell backup system.
- 39 MWh, 1'000kg solid hydrogen storage system.

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

Enel

Canada

Embridge invests 5Mio. CAD in Hygs

OBJECTIVES

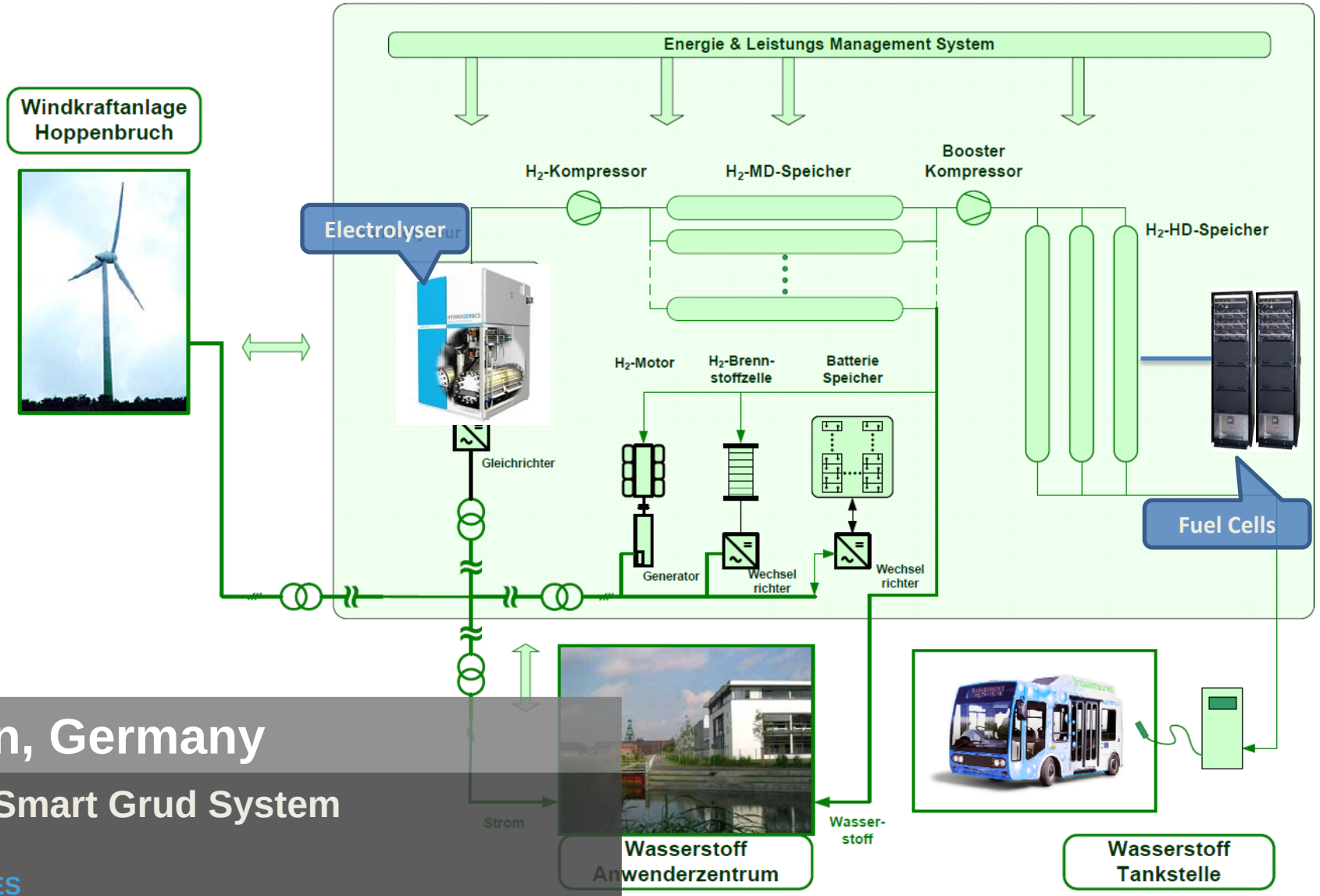
Develop utility scale energy storage in North America to:

- **Bridge the electricity and natural gas networks**
- **Bring seasonal storage capabilities to electricity networks**

ENBRIDGE

HYDROGENICS

SHIFT POWER | ENERGIZE YOUR WORLD



Herten, Germany

Herten Smart Grud System

OBJECTIVES

- Convert excess wind power into hydrogen to store surplus energy.
- The hydrogen will be used for different application, like providing backup power or refueling

SOLUTION:

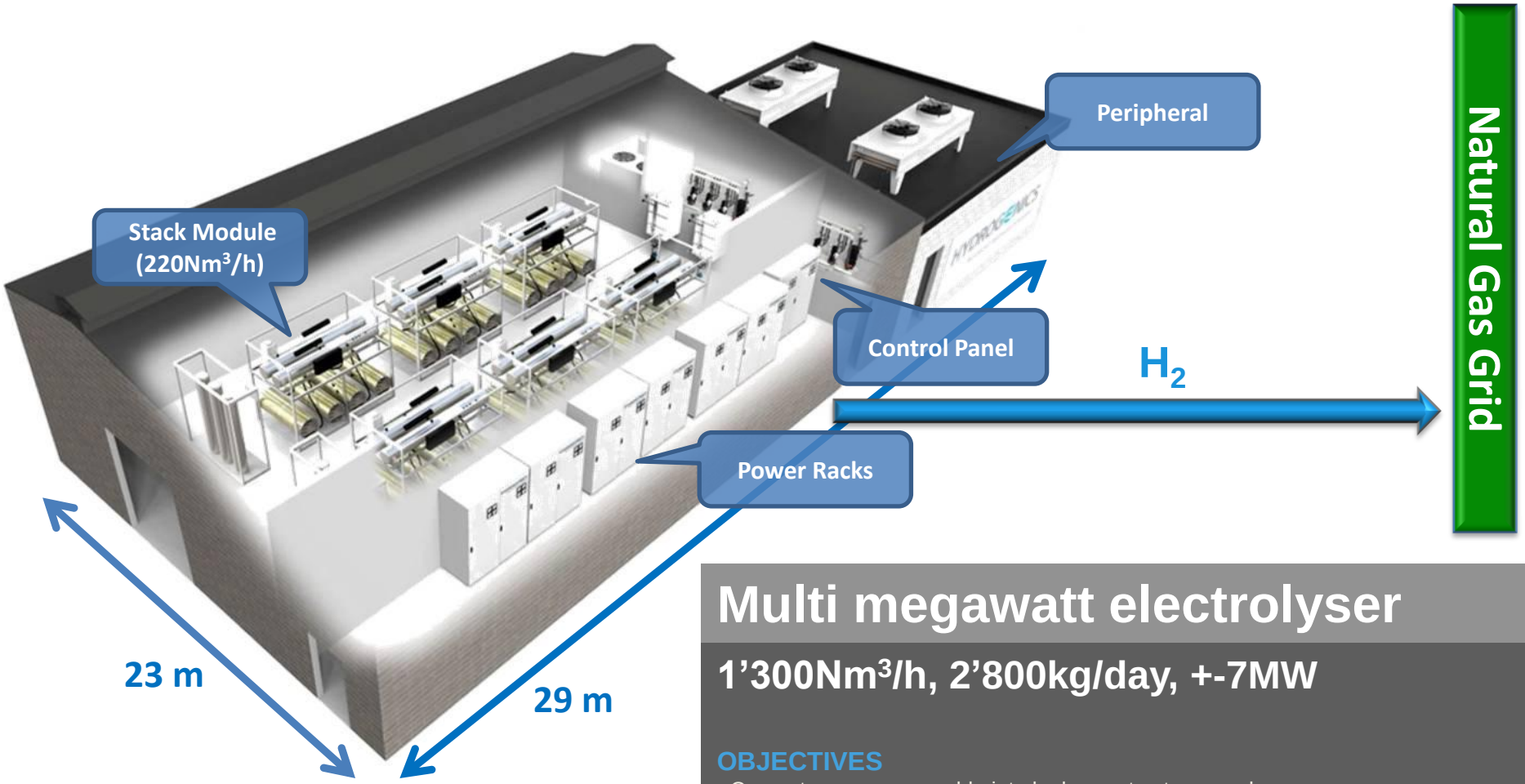
- HyPM-R®, 50kW Fuel Cell System
- HySTAT® 30 Indoor electrolyser with all peripherals to produce 30Nm³/h H_2.

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

h2herten

Multi megawatt electrolyser

1’300Nm³/h, 2’800kg/day, +-7MW



HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

Multi megawatt electrolyser

1’300Nm³/h, 2’800kg/day, +-7MW

OBJECTIVES

- Convert excess renewable into hydrogen to store surplus energy.
- The hydrogen can be used for different application, like direct injection into the natural gas grid, vehicles refueling or for industrial applications.

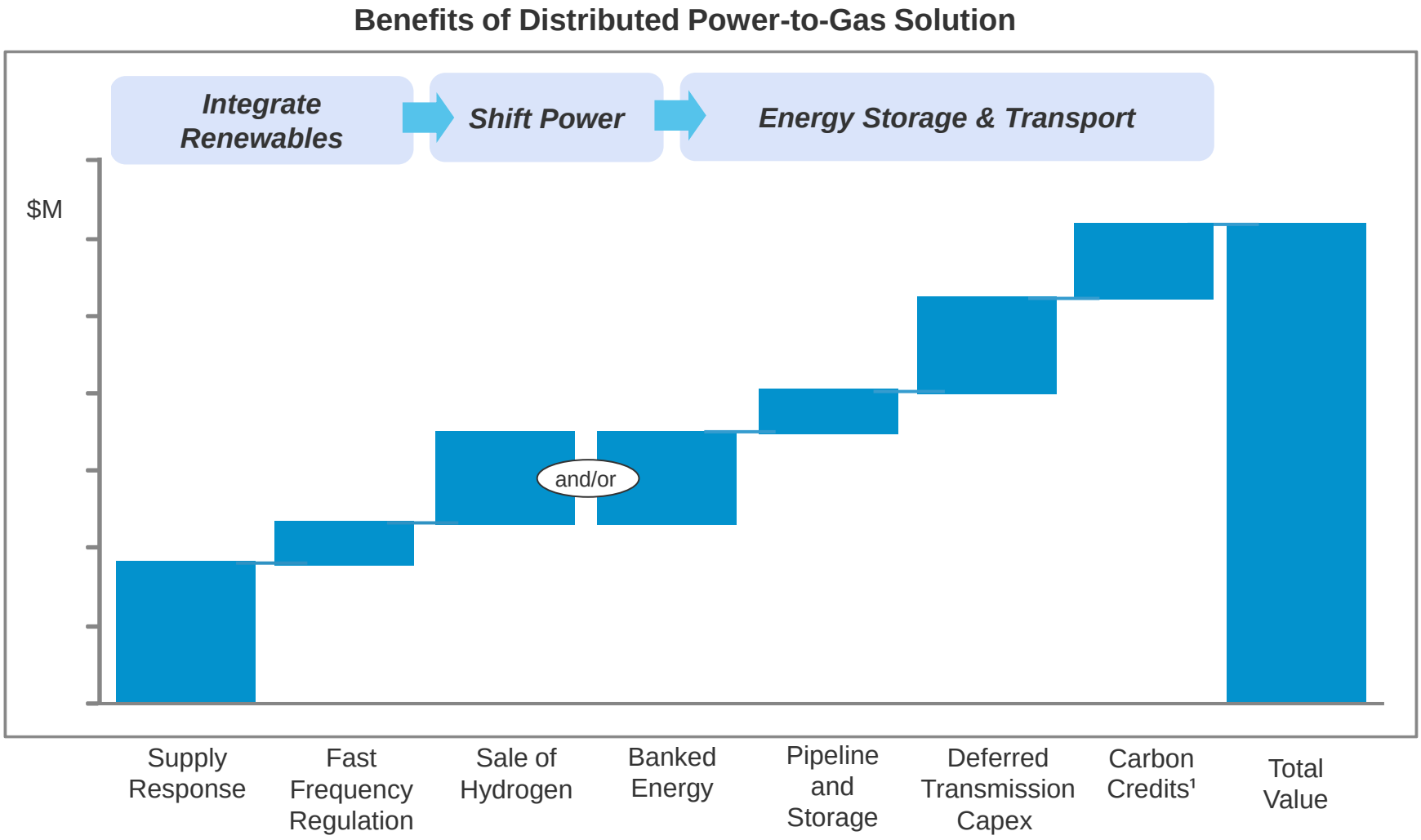
SOLUTION:

- HySTAT® 1300 Indoor electrolyser with all peripherals to produce 1300Nm³/h H_2.

Rich and Diverse Business Models

- Marketing of “Green Gas”
- Electricity transport when and wherever you want
- Energy Arbitrage up to seasonal and “unconstrained”
- Power to Hydrogen Fuel – zero emission transit
- Grid stabilization services

Mutiple Revenue Streams



[1]A 10MW Power-to-Gas plant running 2000 hours a year would reduce carbon emissions by 3225 tonnes CO2 equivalent by displacing natural gas

Hydrogenics' Value Proposition

HYDROGENICS

Shift **Power** | **Energize** your world.

Hydrogenics' product added value

- Flexible production (10-100%)
- Fully-automated production
- 10barg (25barg) pressure without compressor
- Compact and highly efficient solution
- Adapted power management
- Robust design and high reliability (many units in operation)
- Reduced and simple maintenance (limited moving parts)
- Hydrogen purity according to requirements (up to 99.999%)
- Compliant to all major international standards

Hydrogenics' team added value

- Direct contact with the manufacturer
- Dedicated Technology and R&D team
- 60 years of experience and professionalism
- Over 45 fueling stations delivered worldwide
- Safety and reliability is our main concern
- Design, production and startup by Hydrogenics
- Worldwide start-up and After-sales service
- Full maintenance contract possibility
- Recognized by major companies