Hitachi Zosen INOVA

Power to Gas

HZI-ETOGAS Introduction

Ricardo Hamdan, October, 2017

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Hitachi Zosen Corporation and Hitachi Zosen Inova
Global leader in Energy from Waste

Hitachi Zosen INOVA

- **Hitachi Zosen Corporation, Japan,** Revenue ~3.7 billion USD (3/16)
  - 9,500 employees, 87 subsidiaries
  - **Hitachi Zosen Inova AG based in Zurich, Switzerland (13 subsidiaries & locations)**
    - Hitachi Zosen Inova Kraftwerkstechnik GmbH, Germany
    - Hitachi Zosen Inova Etogas GmbH, Germany
    - Hitachi Zosen Inova BioMethan GmbH, Germany

Hitachi Zosen Inova
Global leader in Energy from Waste

Hitachi Zosen INOVA

Zurich-based Hitachi Zosen Inova is a global leader in energy and material from waste solutions (former Von Roll company founded in 1933)

- More than 600 employees in Switzerland, Germany, USA and the UK
- Global operation, maintenance & service businesses
- Over 500 reference projects worldwide
- Proprietary Energy from Waste (EfW) technology and complete turnkey plant and system solutions

- Continuous expansion and development of EfW technologies
  - 2014 Acquisition of Axpo and Kompogas
  - 2015 Acquisition of Biomethan GmbH
  - 2016 Acquisition of ETOGAS GmbH

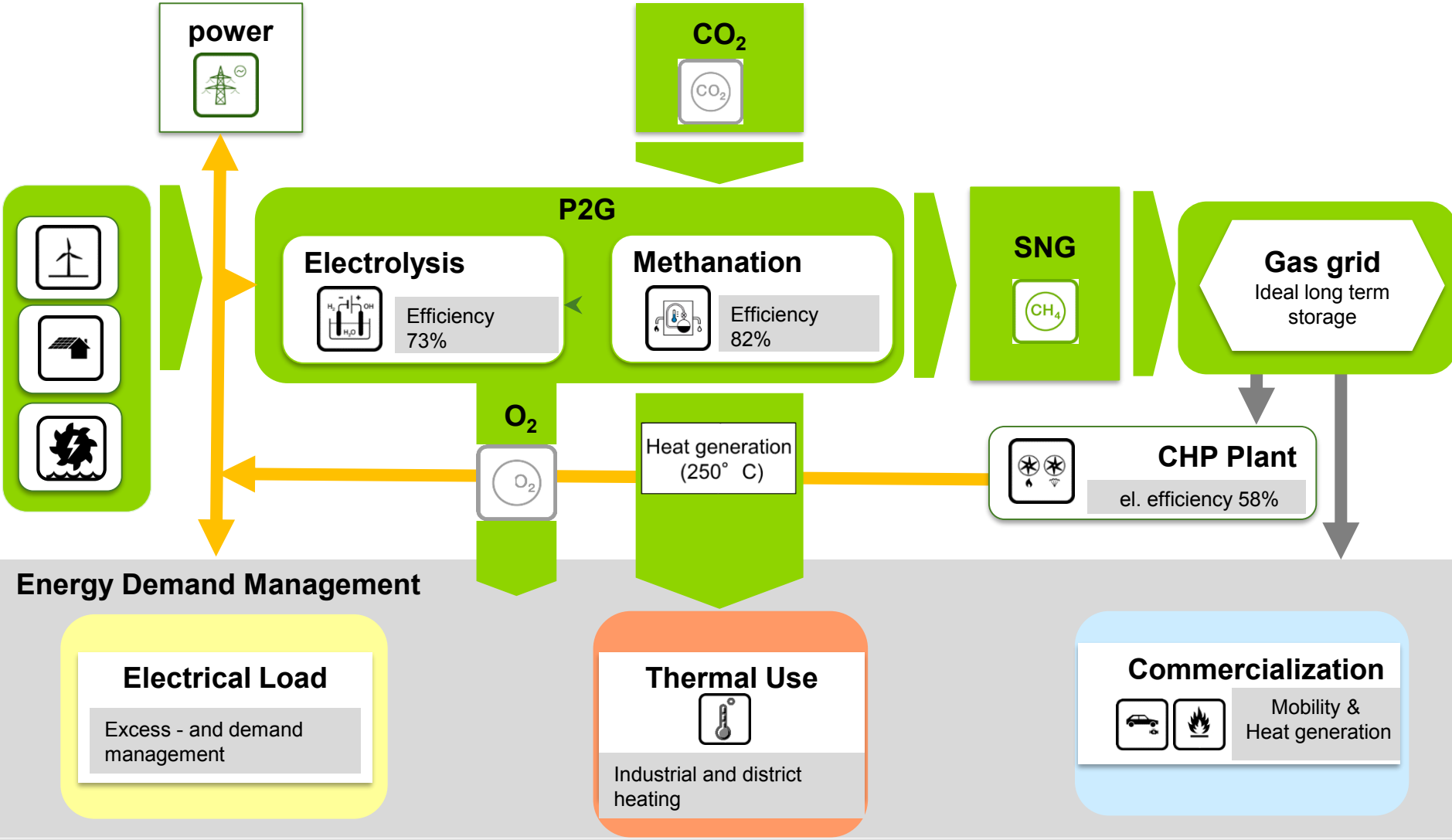
HZI ETOGAS
Power to Gas, Concept

Hitachi Zosen INOVA

- PtG allows the conversion of volatile **electricity** into **renewable, synthetic gases** (H_2 or SNG) **with unmatched low carbon footprint**, which
  - can be **stored, transported and commercialized**
  - for **mobility** (green synthetic fuels) and **industrial markets** (green chemistry)

- PtG adds **flexibility to energy systems** and thus enables efficient **integration of high shares of volatile renewables** into energy markets.
- PtG facilitates this by
  - creating a **connection between the power grid and the gas grid** with its **ample storage and transport capacity**;
  - recharging the gas grid without timing / technical restrictions and thus allows to generate electricity at some point of time somewhere and to **sell it in the form of synthetic fuel anywhere and anytime**.

Holistic Approach for PtG



HZI ETOGAS the Pioneer in PtG

Largest plant designed and built by HZI ETOGAS since 2013

Global Renewable and PtG Trends

- **USA/ Canada**
  - CEC and DOE are funding and pushing large scale PtH projects
  - California 50% renewable by 2030, AB 2514 and AB 2868 is a mandate for energy storage

Los Angeles Times

California invested heavily in solar power. Now there's so much that other states are sometimes paid to take it

By IVAN PENN
JUNE 22, 2017

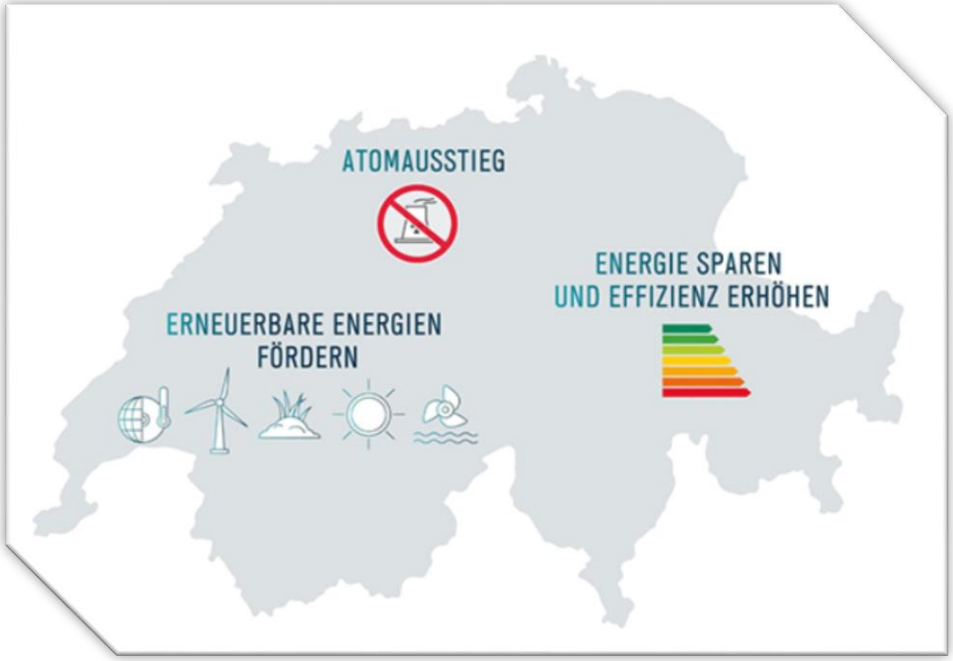
BBC NEWS

The growth of renewable energy has led to negative pricing in Texas, which has a lot of wind power, in the UK and other parts of Europe, including Germany.

  - Canada introduced a requirement for renewable natural gas (provincial requirements)
  - Canadian provinces push for Co2 neutrality and considering opportunities to convert CO2 into SNG by methanation

Global Renewable and PtG Trends

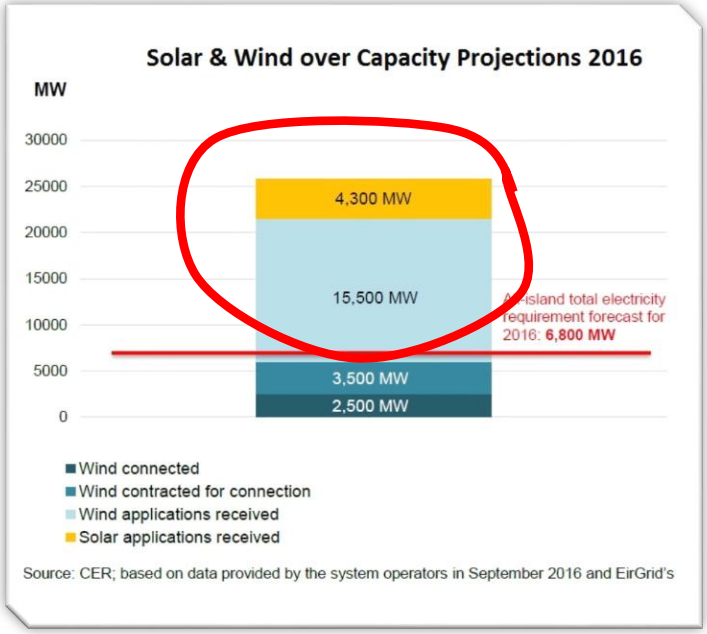
- **Switzerland**
  - Introduction of the Energy Strategy 2050 (exit nuclear power) and with renewable SNG requirement
  - Increase in PtG activities by major Swiss Gas and Power Utilities



Am 21. Mai 2017 hat das Stimmvolk das revidierte Energiegesetz angenommen. …….Die Schweiz kann so die Abhängigkeit von importierten fossilen Energien reduzieren und die einheimischen erneuerbaren Energien stärken. Das schafft Arbeitsplätze und Investitionen in der Schweiz.

Global Renewable and PtG Trends

- **Germany**
  - Retirement of nuclear power plants by 2022, increase in renewable intermittent power generation will lead to demand for long term energy storage
- **Ireland**
  - Continuous investment in renewable power generation especially in wind power generation increase in intermittent power generation
  - Renewables contribution to gross electricity consumption 40% by 2020
  - Renewables (biofuels & the renewable portion of electricity) contribution to transport energy 10% by 2020
  - Renewable contribution to heat (Thermal requirement - heating & cooling) 12% by 2020



HZI-ETOGAS Competencies

EPC PtG System integration

- 10+ years of experience and founder of industrial PtG concept
- 5+ years of EPC experience, built largest plant to date
- Developed sophisticated process knowledge in house
- AUDI 6,3 MW Plant -> PtG for grid balancing and e-gas production

Electrolyzer

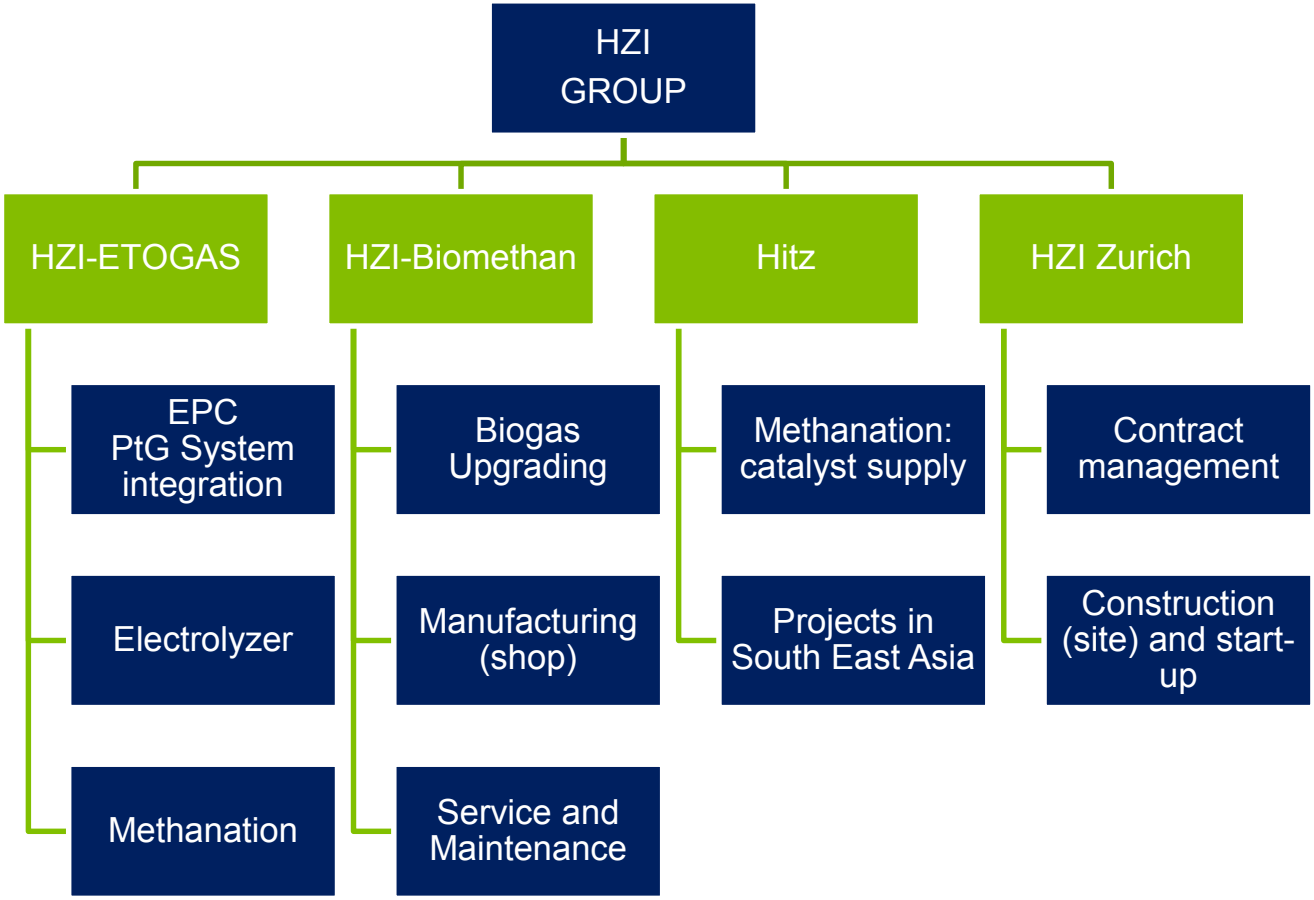
- Continuous development of electrolyzer stack technology to reduce CAPEX and OPEX for large scale plants
- RAG 600kW Plant -> Underground Sunstorage project

Methanation

- Implementation of most efficient technology for large scale production in terms of CAPEX and OPEX
- CVT Plant -> Upgrade of low-caloric waste gas
- 250kW Testplant, Comparison of two methanation reactor concepts

Source: ETOGAS

HZI Group Competencies



Examples of infrastructures with PtG plants to provide CO2 neutral SNG from Biogas

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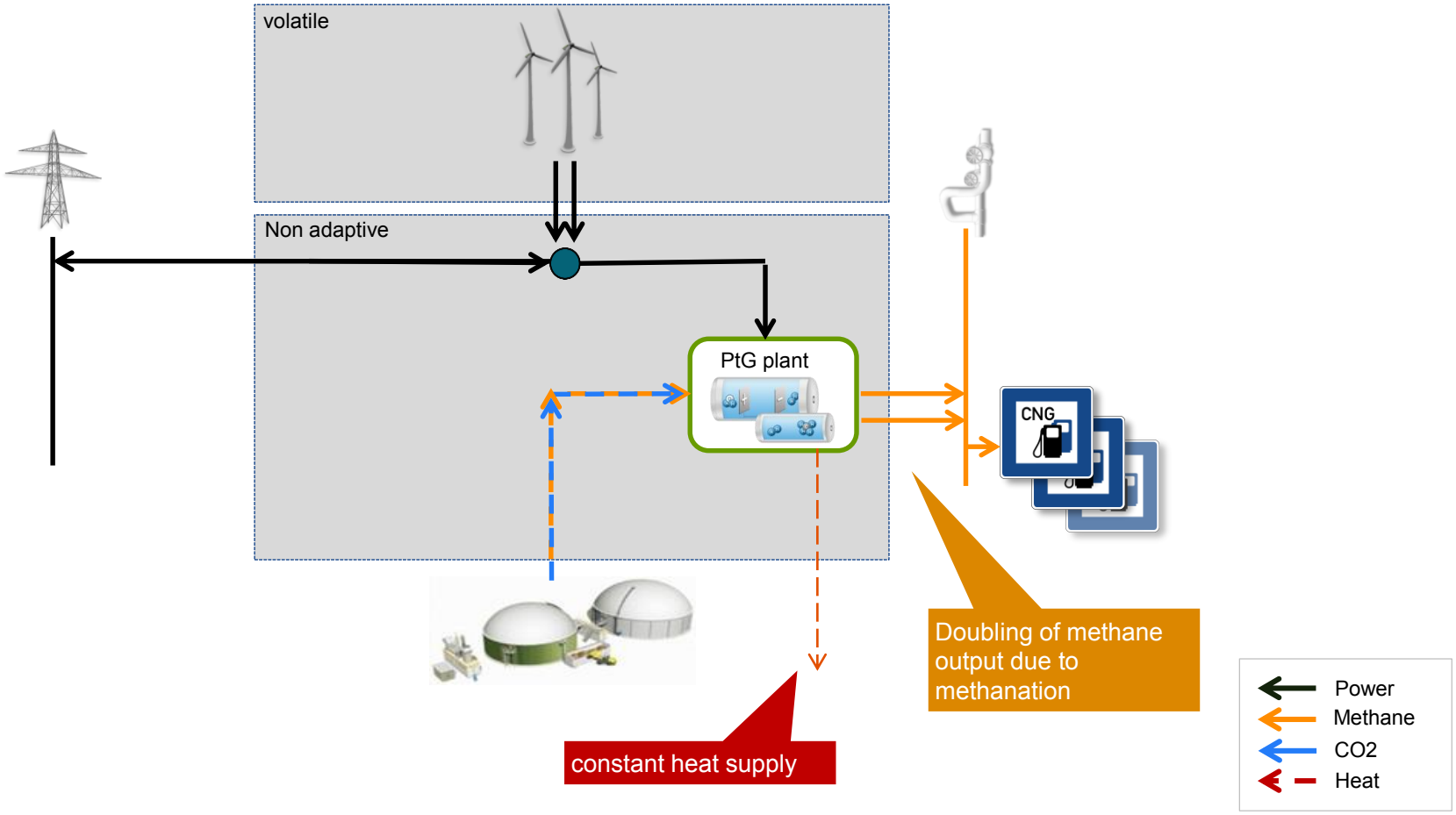

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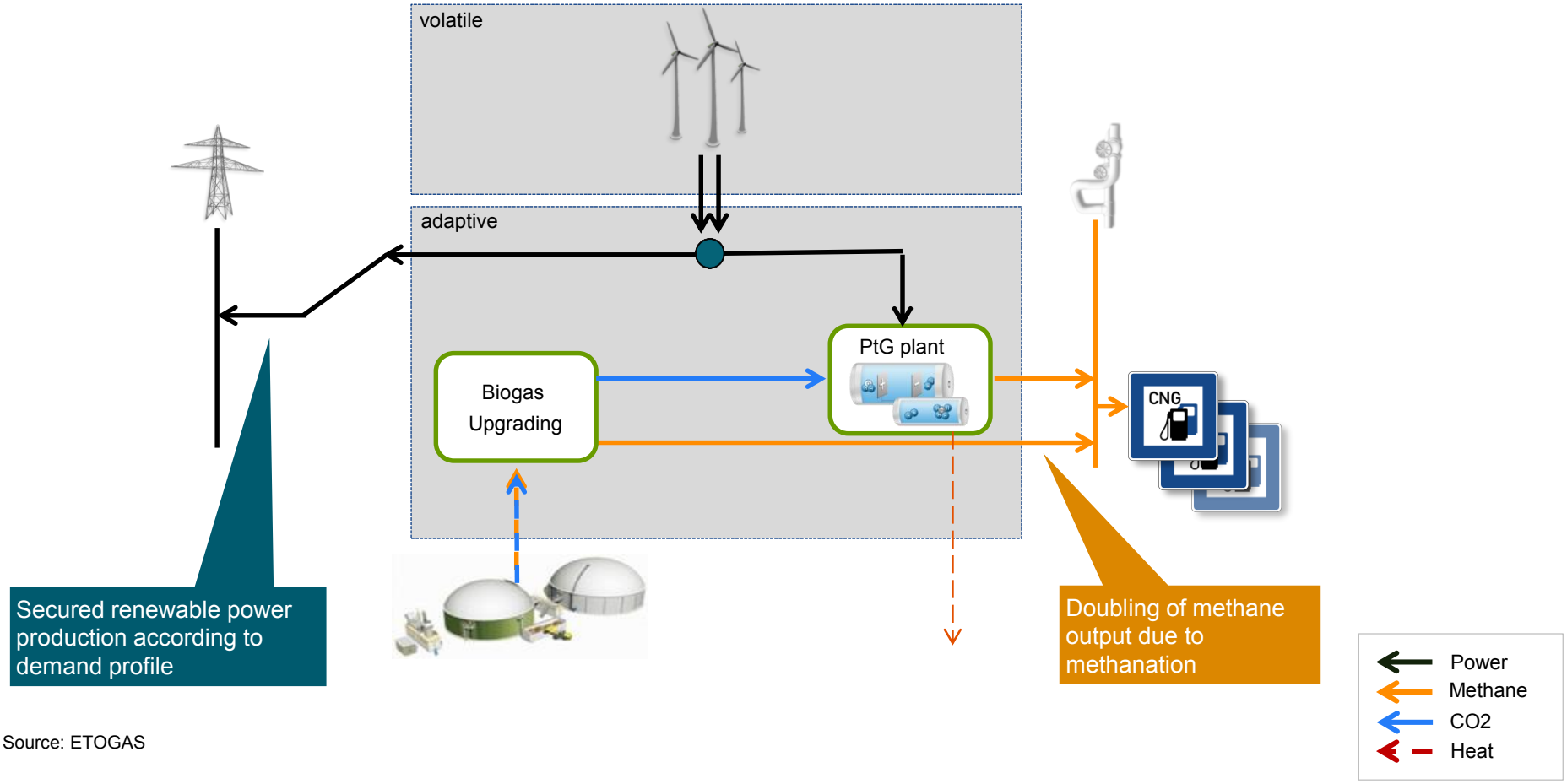

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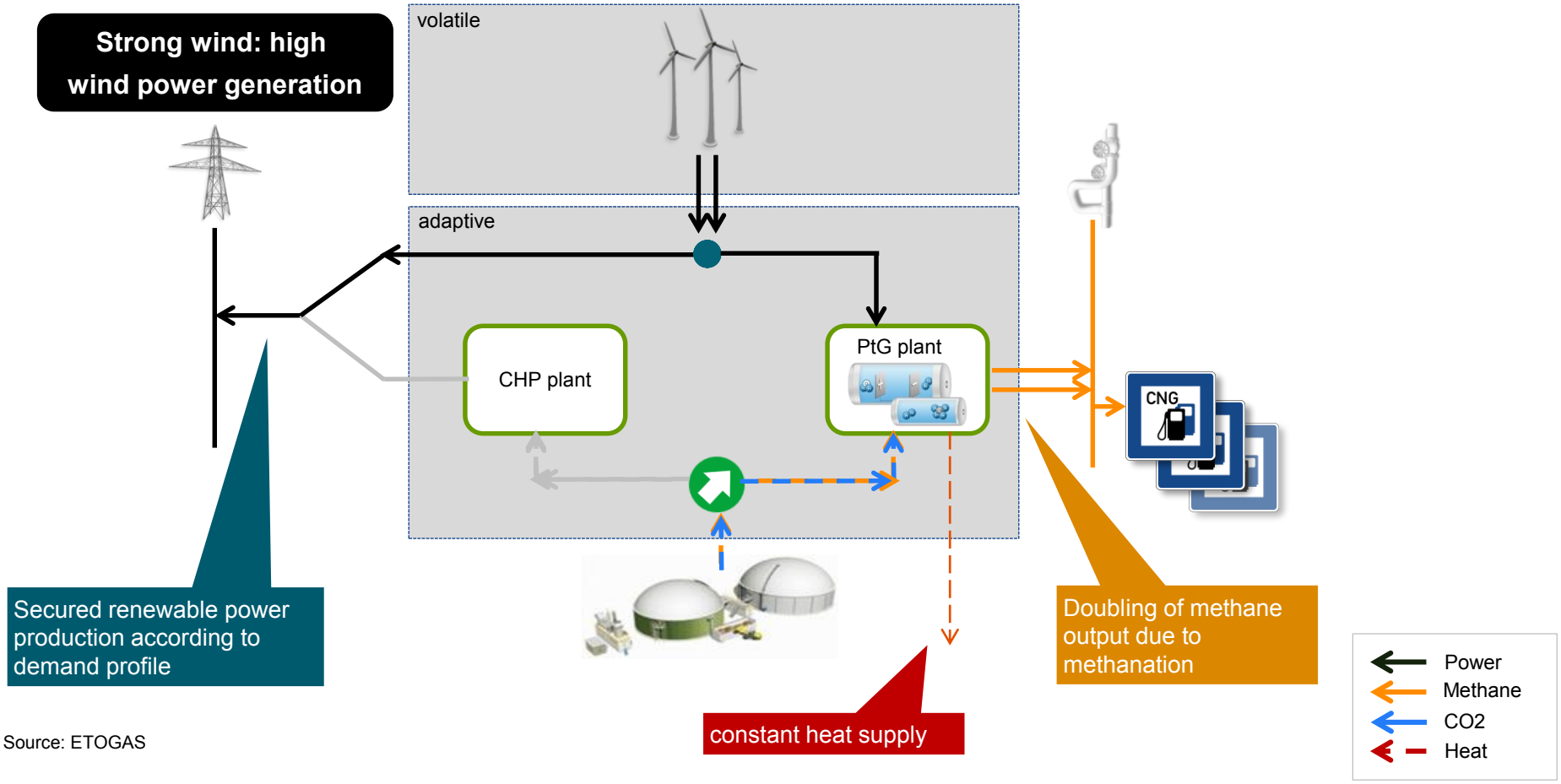

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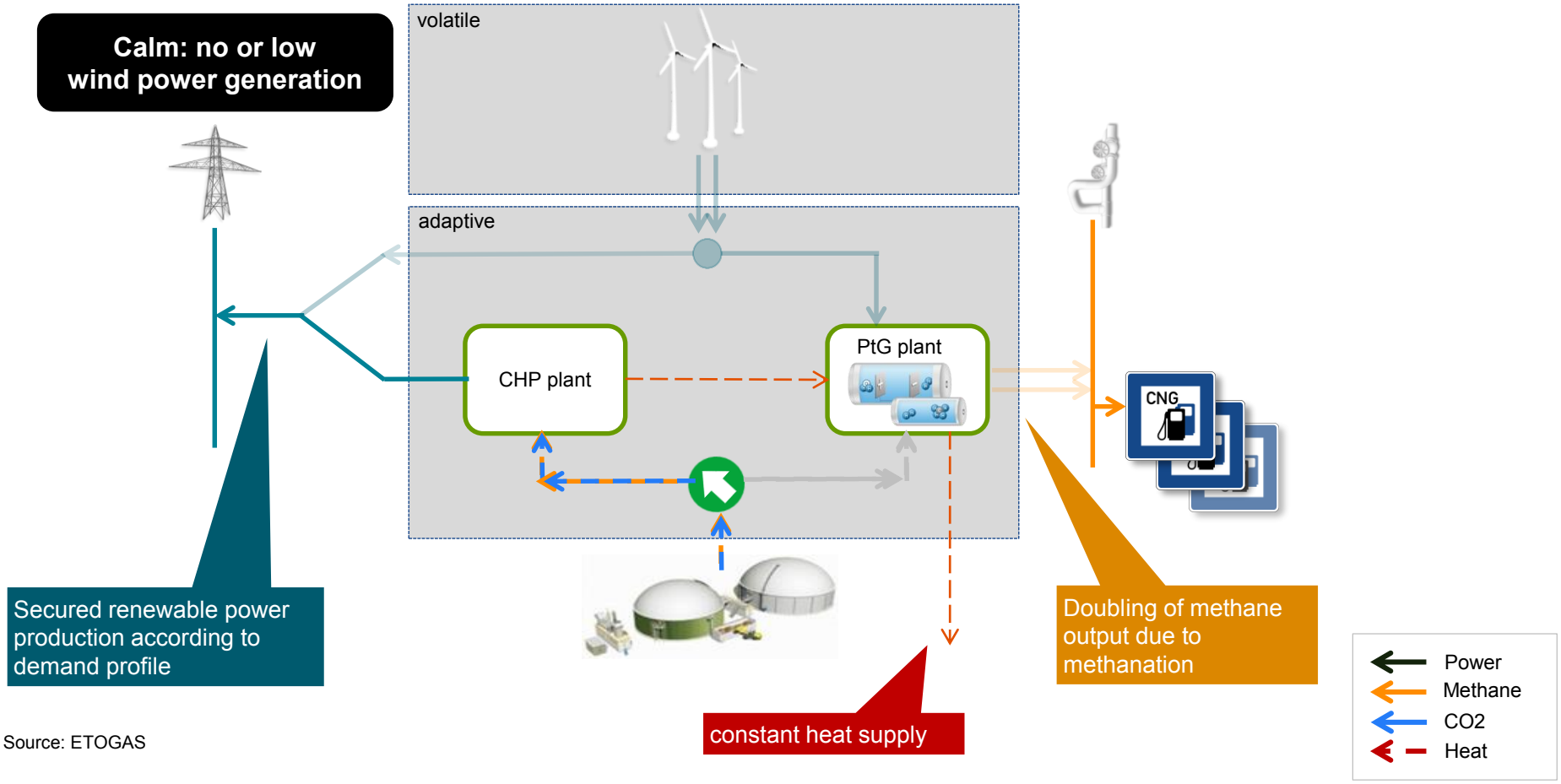


Source: ETOGAS

HZI-ETOGAS References

HZI-ETOGAS

Selected References

HZI-ETOGAS References

- **Power to Gas expertise since 2009**
- **PtG advanced plant concept & basic design**
- **References**
  - 25 kW_{el} alpha plant
    prove of concept
  - 6 MW_{el} Audi e-gas plant, EPC
    Largest PtG plant
  - 250 kW_{el} advanced methanation reactor plant (at ZSW)
  - H_2 to CH_4 industrial
    process gas recycling plant

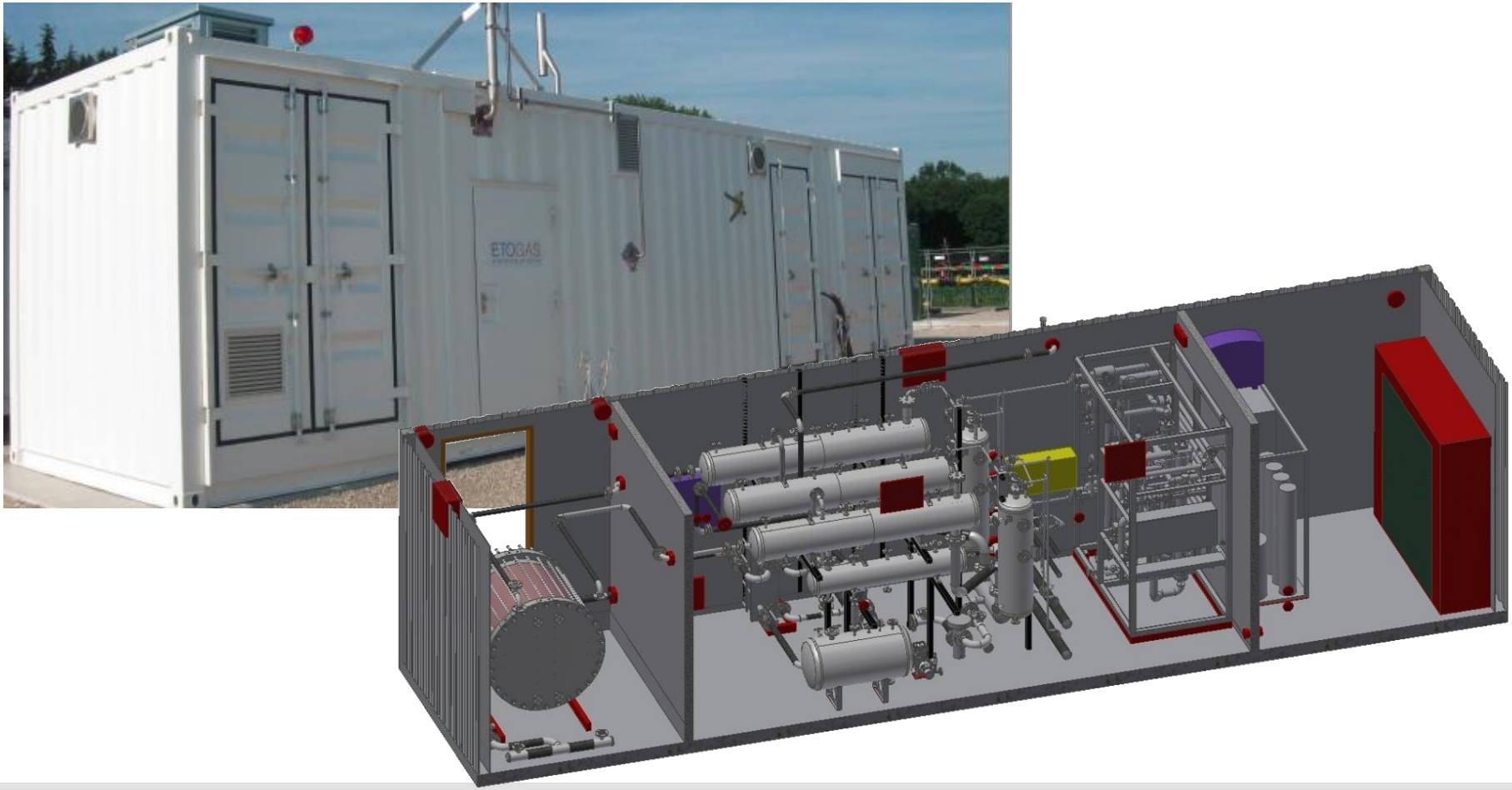
Power to SNG: AUDI e-GAS Plant / Werlte (6.3MW$_{el}$)

- Delivery: 2013/Q4
- Largest Plant in Germany

- Balance of System and EPC responsibility: ETOGAS
- Electrolysis
  - Alkaline Electrolyzer
  - Atmospheric operation with downstream compressor
  - 3rd party technology
- Methanation
  - Catalytic methanation
  - Salt cooled shell and tube reactor
  - 3rd party technology

PtH2 Plant: Alkaline Electrolyzer

- Turn Key Plant



Hydrogen to SNG: Methanation

- Hydrogen-to-SNG turnkey plants can be used to upgrade low-caloric waste-gases: First plant was successfully commissioned at a German carbon components manufacturer

Projects, Studies and Site Evaluations

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Projects, Studies and Site Evaluations:

- Wind generation sites
- Electric energy supplier / distributors
- Electric grid operators
- Gas supplier / distributors
- Mobility
- Chemical plants
- Integrated steel plants

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Thank you very much for your attention