Direct Steam Generation

A Hydrogen Based Solution

Customer Event Steam Turbine and Generators 2023



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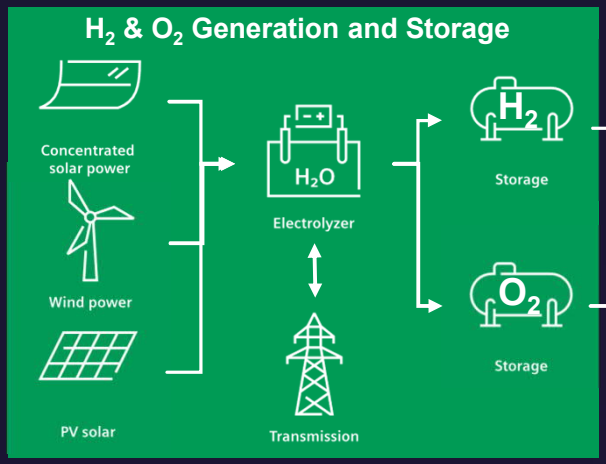
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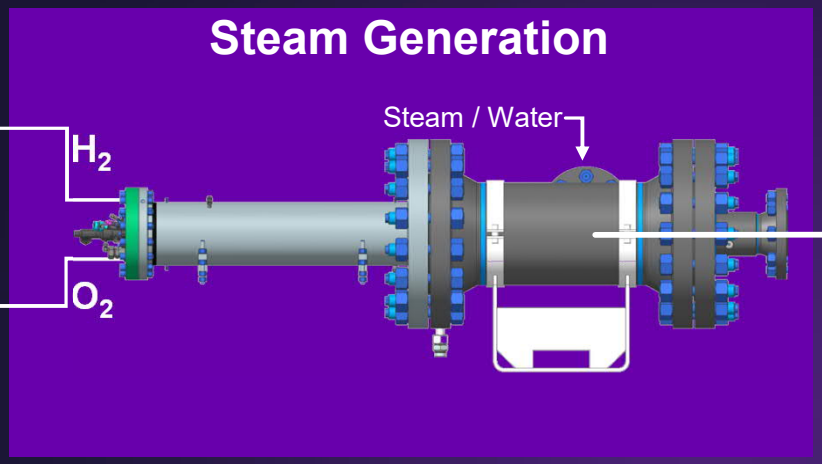
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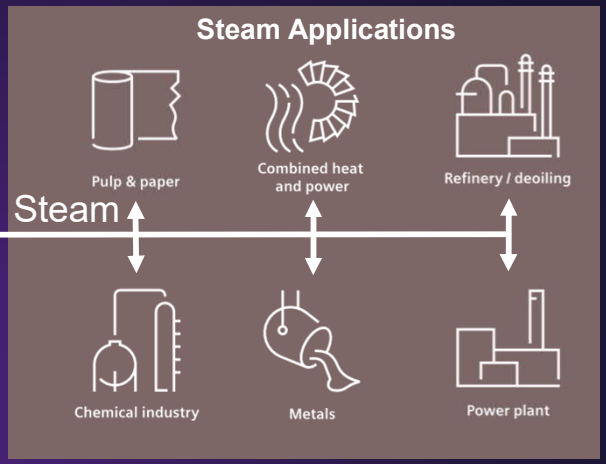
SIEMENS energy

Generating steam by H_2 & O_2 combustion in a pressurized steam atmosphere

- ✓ CO_2 & NO_x free
- ✓ Low CAPEX
- ✓ Flexible operation
- ✓ Green- & brownfield



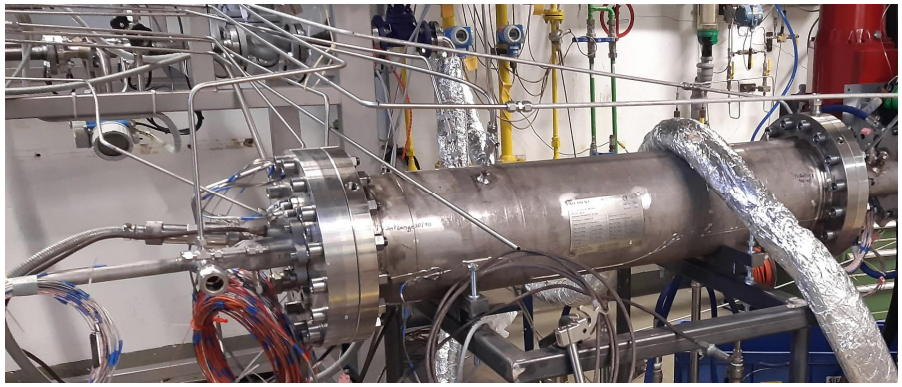


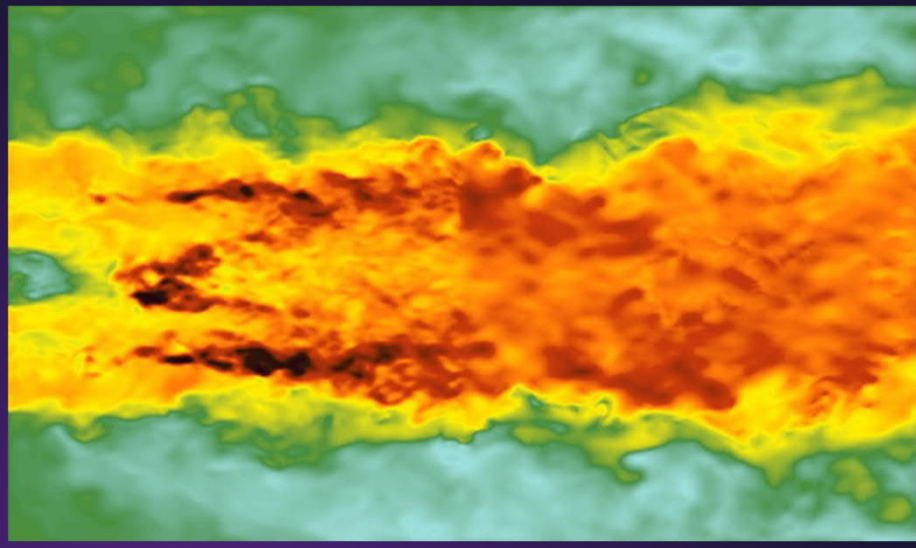


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Technology

- Combusting hydrogen and oxygen in a pressurized steam atmosphere
- Adjusting the outlet temperature by mixing with steam or water
- Advanced Manufacturing technologies such as 3D-printing of pressure parts





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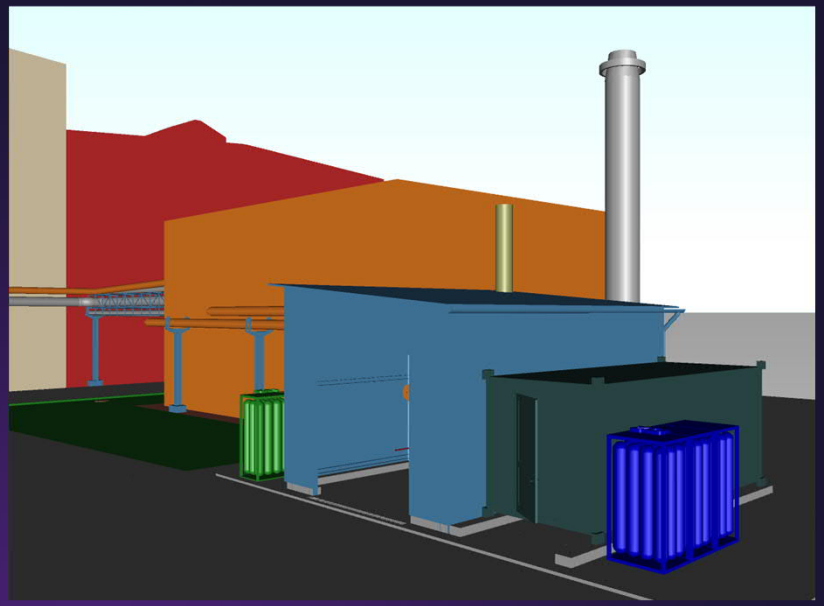
Development Timeline

Current Project: “Hydroxy” (2022-2025)

- Combustion design
  - based on SE’s reliable Gas Turbine knowledge
  - Cooperation with German Aerospace Center (DLR)
- System integration (closed water-steam cycle)
  - Using SE’s profound experience in industries and the power generation sectors
  - Addressing challenges of green / brownfield applications
- 2023: **TRL 3** for 15 bar (successful combustion tests)
- 2025: **TRL 6** for 15 bar (prototype in a steam plant)
- Funded by Federal Ministry for Economic Affairs and Climate Action

Next Step: Demonstrator with < 5 MW_{th}

We are open for potential partners



Demonstration Plant in Görlitz: reaching TRL 6

Deutsches Zentrum für Luft- und Raumfahrt

Federal Ministry for Economic Affairs and Climate Action

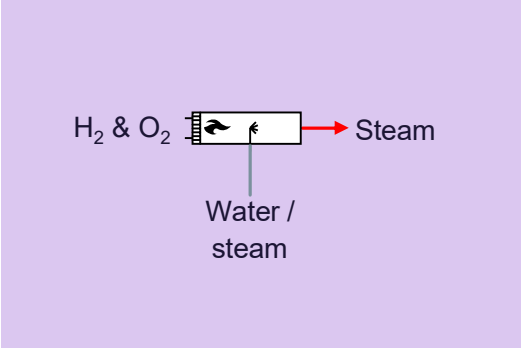
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Promising Applications

Process Steam

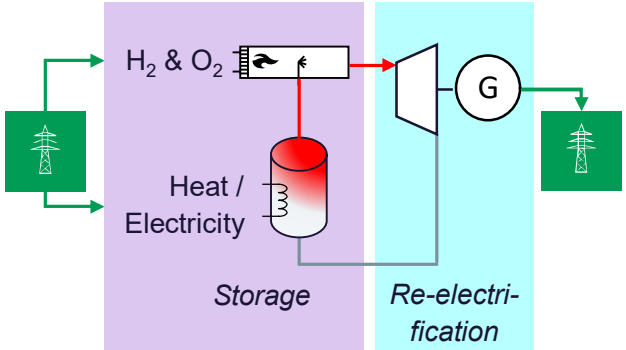
Demand-driven steam generation / superheating, e.g. for process steam



- ✓ Precise steam conditioning
- ✓ Low CAPEX, no CO_2, no NO_x
- ✓ Reduction of excess steam production by fast peak load supply

CHHS

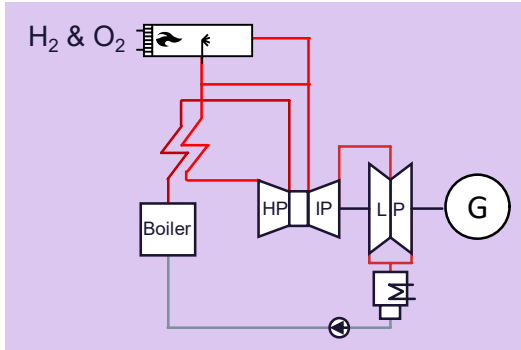
Combining the benefits of heat & hydrogen storage



- ✓ Low CAPEX / MWh
- ✓ Long-term storage possible
- ✓ Flexible design and power split

Steam Cycle Upgrade

Optimization of water steam cycles in combination with steam turbines



- ✓ Increase capacity, efficiency & flexibility of electricity generation
- ✓ Arbitrage earnings: produce H_2 & O_2 when electricity prices are low
- ✓ Operate only at times when needed, save costs during normal operation

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Key Take Away
Direct Steam Generation - A Hydrogen Based Solution

Low CAPEX for Green- & Brownfield-Transformation

Low space requirements and investment costs by avoiding heat exchangers and boilers.

Flexible Operation

Quick start-up and load changes for participating in storage or arbitrage market as well as fast supply for peak demand of process steam.

No CO_2, no NO_x

Reduced CO_2 footprint by replacing fossil-fired steam boilers with our emission-free hydrogen-based solution.

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Contact

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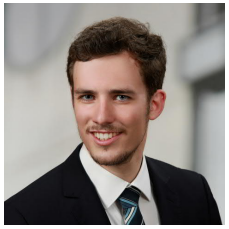
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