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A graphic element for the NEMESIS logo, consisting of three stacked rectangular blocks: a yellow block on top, an orange block in the middle, and a red block on the bottom. The blocks are slightly offset to the right.

**NEMESIS**

# NEMESIS

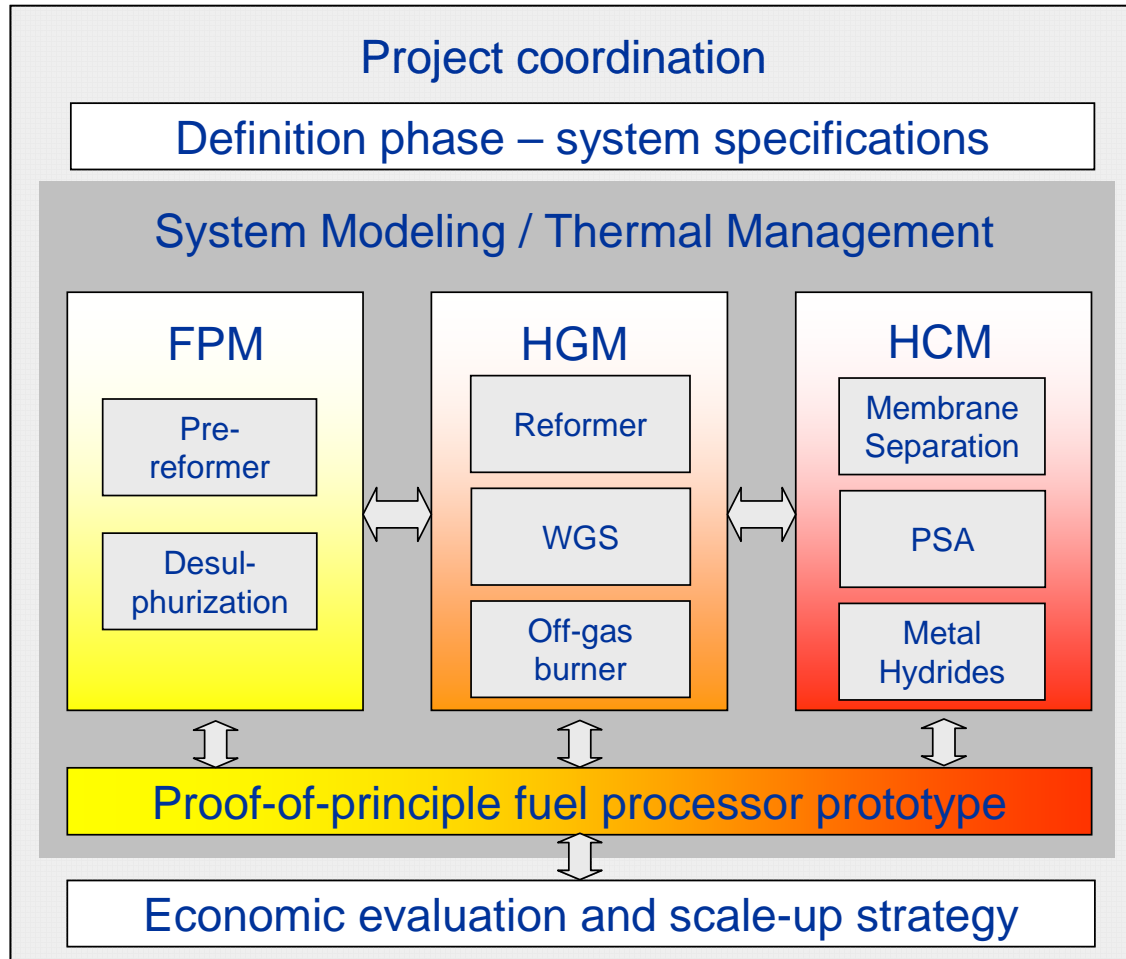
## New Method for Superior Integrated Hydrogen Generation System

(contract # 019827)  
12/2005 – 11/2008

***Antje Wörner***  
***DLR – German Aerospace Center***

# Project Achievements

## *Project and Partnership Description*





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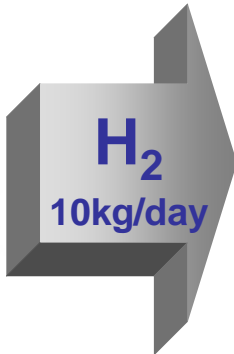
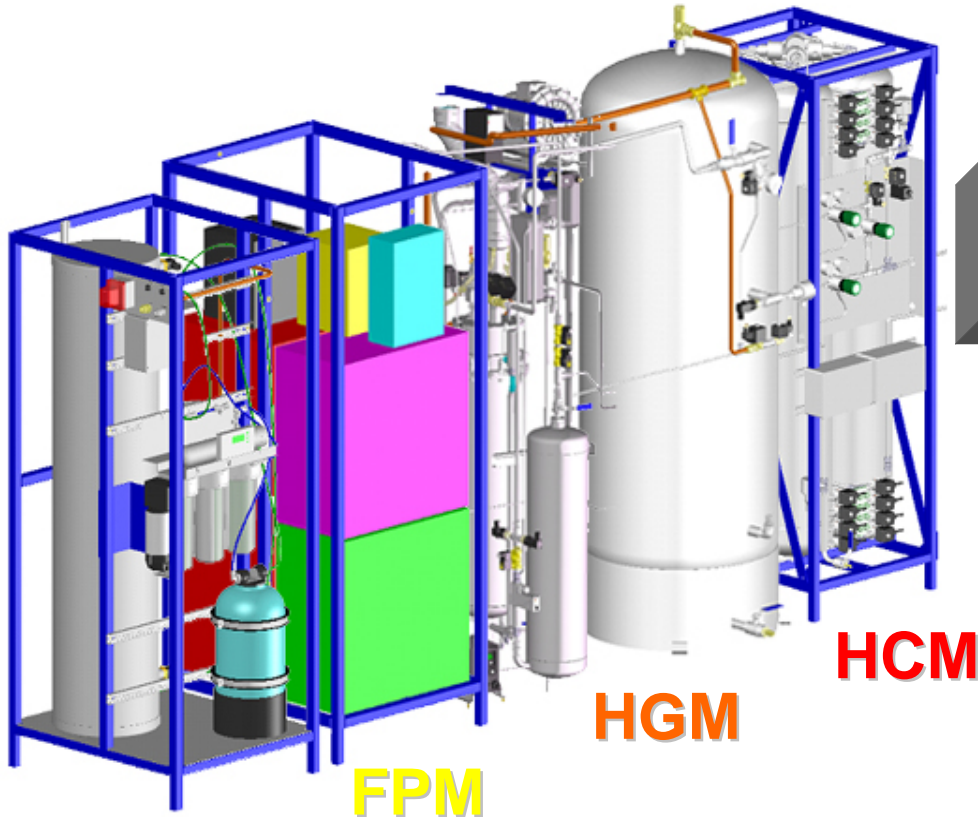
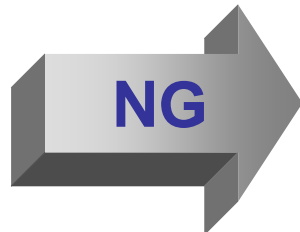
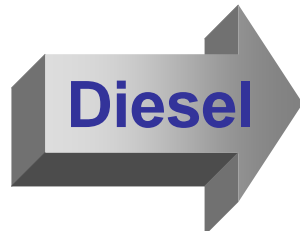
# Project Achievements

## *Project Starting Point and Goal*



**HYGEAR** 

Fuel Processor Technology for NG





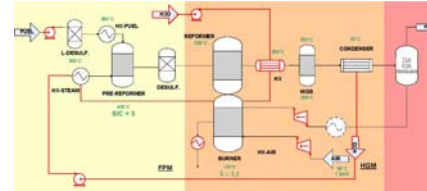
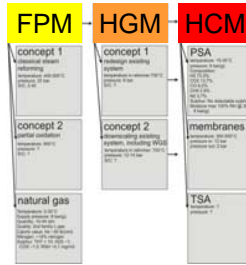
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# Project Achievements

## Approach for R&D

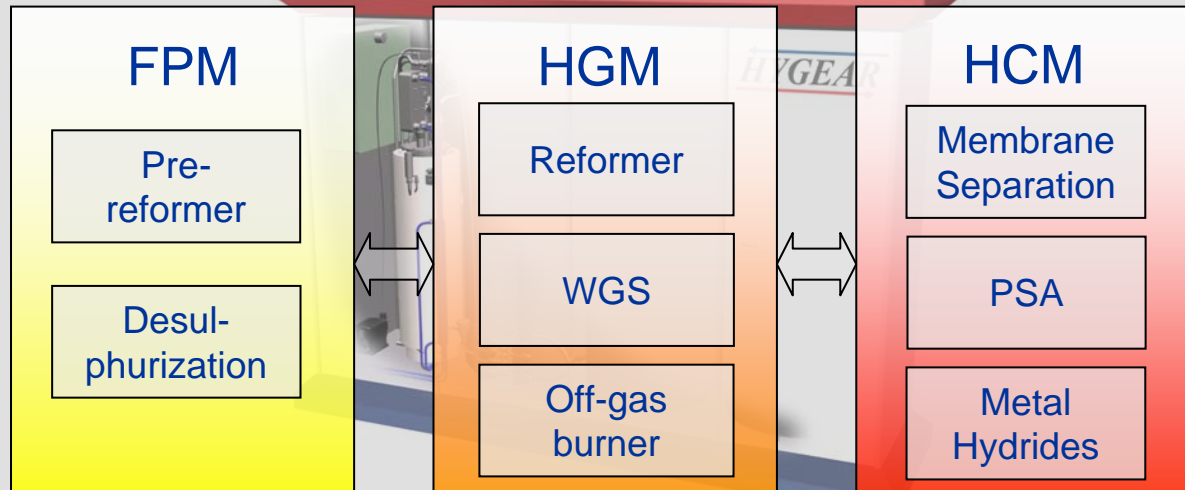
system specification



system simulation



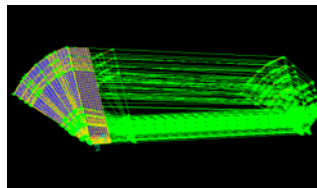
## System Modeling / Thermal Management



prereformer catalyst testing



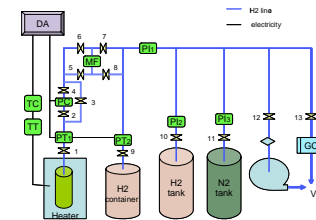
test setup for adsorbents for desulphurization



CFD simulation of burner and reformer



reformer testing



investigation of metal hydrides



membrane development



testing of advanced PSA

# Project Achievements

*Progress towards overall project goal*



**12/05**

**Project targets  
and goals**

**05/06**

**Functional  
requirements**  
↓  
**Process  
concepts**

**11/06**

**System  
simulation**  
↓  
**Decision for  
lead concept**

**08/07**

**Layout of  
prototype unit**

**06/08**

**Manufacturing  
of  
prototype unit**

**11/08**

**Testing**

**L- and G-Desulphurization**  
**Prereforming**  
**CFD-Simulation**  
**Reformer Testing**  
**Single Bed PSA**  
**Membrane Separation**  
**Metal Hydrides**

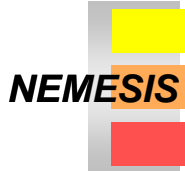
**Adsorbents**  
**Catalysts**  
**Membranes**  
**Material & Design**  
**Operating Conditions**





# Project Achievements

## *Technical Achievements*

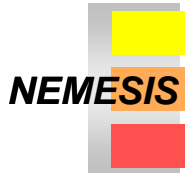


- fuel processor based on steam reforming  
→ improvement in efficiency
- liquid and gaseous fuel  
→ multi-fuel aspect  
→ desulphurization
- based on existing technology upgraded by innovative materials and components  
→ marketability

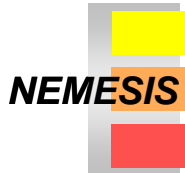


# Alignment to IP

## *Correlation with IDAs*



- ☛ **IDA 1: Hydrogen and Refueling Stations**
  - ☛ **develop and install distribution chains for hydrogen vehicles**
  - ☛ **Phase I 2010: demonstration at 13 sites with 9 refueling stations → onsite H<sub>2</sub> production**
  - ☛ **R&D: refuelling technologies**
    - ☛ reduce cost of technology
    - ☛ improve system reliability
    - ☛ regulation and safety issues
  - ☛ **strengthen SMEs → smaller production values and early markets**



### Phase I 2010: demonstration with 9 refueling stations



2008: proof-of-principle prototype 10kg H<sub>2</sub>/day  
→ upscaling by a factor of 10 to 50 for fueling  
20 to 100 vehicles/day

### 2020: cost of hydrogen at pump <2.5€/kg (centralized and decentralized, excl. taxes)



cost target can be reached with NEMESIS  
technology

### strengthening of the position of SMEs



HyGear as manufacturer of small fuel processors



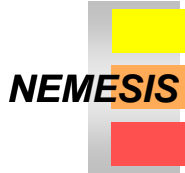


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# Enhancing cooperation

## *Technology transfer / Collaborations*

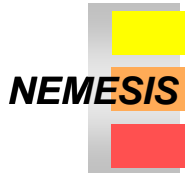


- **Results from FURIM have been considered as input for NEMESIS**
- **Co-operation contract of Air Products with HyGear on the sales and marketing of steam reforming technology into various application areas including refueling stations**



# Project future perspectives

## *Proposed future research approach*



- ☞ **end of the project: proof-of-principle prototype unit with 10kg H<sub>2</sub>/day, concept for upscaling and integration into the existing infrastructure**
- ☞ **starting point for next steps towards demonstration and commercial product**



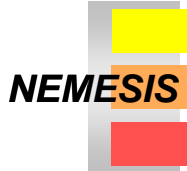
### ***NEMESIS II* project**

- ☞ **optimization of innovative materials**
- ☞ **testing of critical operating conditions**
- ☞ **expansion of fuel range (e.g. DME, biodiesel)**
- ☞ **system integration of fuel processor**
- ☞ **integration into refueling station**
- ☞ **upscaling to 100 to 500kg H<sub>2</sub>/day**



# Project future perspectives

## *Future Collaborations*



### cooperation on EU level



#### WP7 Economic Evaluation

- input from CUTE and HYWAYS (experiences and cost figures from technical side)
- input from HyApproval (codes and standards)

### contribution to future JTI Work Programme



demonstration of the technology developed within NEMESIS at refueling stations



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A vertical graphic element consisting of three stacked rectangular blocks: a yellow block at the top, an orange block in the middle, and a red block at the bottom. The word "NEMESIS" is written in bold, black, italicized capital letters across the orange block.

***NEMESIS***

# NEMESIS

Thank you for your attention!

***Antje Wörner***  
***DLR – German Aerospace Center***