



H₂

EC - FP6
DG - TREN
Integrated Project

Zero Regio

By-product Hydrogen and HP pipeline distribution

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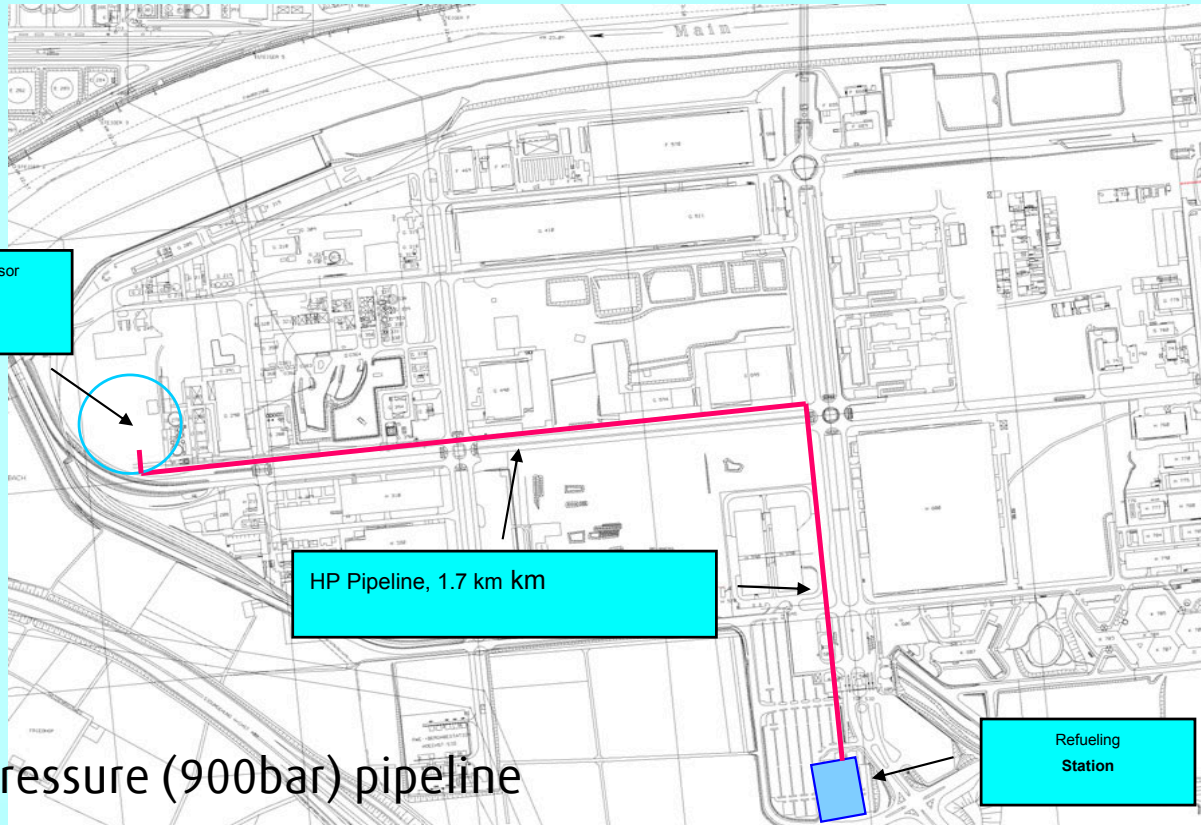
Zero Regio and impressions

- EU Funded under FP6
- 5 year demonstration project
- Refueling Infrastructure and fuel cell vehicles
- By-product hydrogen, liquid hydrogen delivery, on-site CH₄ Reformer
- 2 European countries
- 16 Partners from 4 member states
- Coordination: Infracore Hoechst (D)



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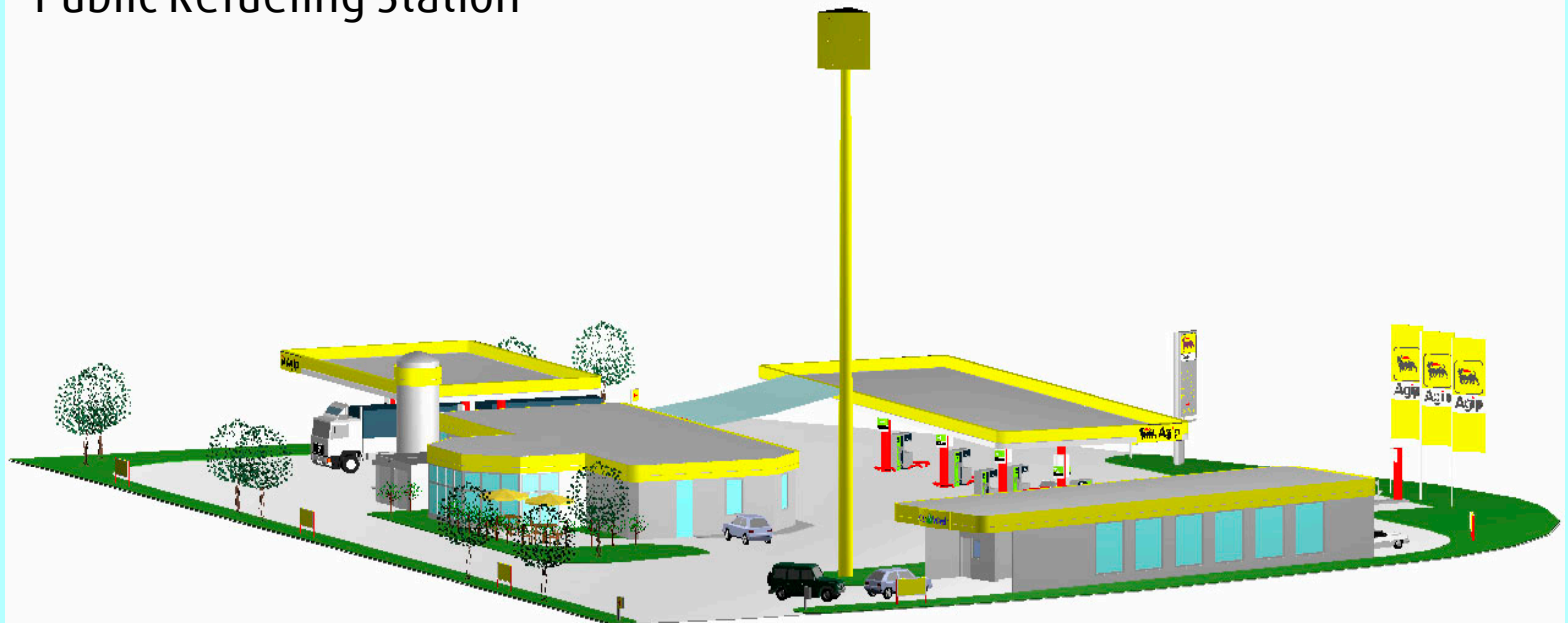
High pressure (900bar) pipeline



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Public Refueling Station





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What are the questions that the project should and will answer?

- Develop and test **refueling infrastructure** in two European countries.
- Develop and test emission free **transport systems** (FC cars) for every day use in European urban areas
- Gain experience in the use of **industrial surplus hydrogen** and high pressure (900 bar) pipeline system
- Gain experience in **multiple supply modes** (pipeline, liquid, on-site)
- Develop and test technology for production/purification, refueling, and application
- Detailed **analysis** of the every day use of the infrastructure and cars, regarding: consumption, operation, environmental impact, economics, socio-economics.



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Present state-of-the-art technology that is being or going to be demonstrated, and the prospects of future developments

Ingredients:

Supply modes:

- Pipeline (Industrial surplus Hydrogen)
- Liquid supply
- On-site methane reformer

Fuel Cell cars



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Industrial surplus Hydrogen

Available resources:

Germany* ~ 950 Mm³/a
(ISH* ~ 30 Mm³/a

Europe** ~ 1.8 Bm³/a**

Adds up to:***

~315.000 cars
~10.000 cars)

~600.000 cars

Synthesis gas:

Bandwidth between Hydrogen with impurities and Hydrogen-rich waste gas.

* Source Infracore Hoechst

** Source: E4Tech 2005

*** Own calculations: Gasoline equivalent 12.600km/a @ 8l/100km. Annual consumption of German passenger car [year 2000]



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Motivations

Linde is a Technology group with more than 125 years experience in the production and handling of industrial gases (among which H₂)

Total supply chain of hydrogen within one company

Committed to hydrogen as a fuel

Committed to deliver the tools for a wide automotive H₂ refueling infrastructure

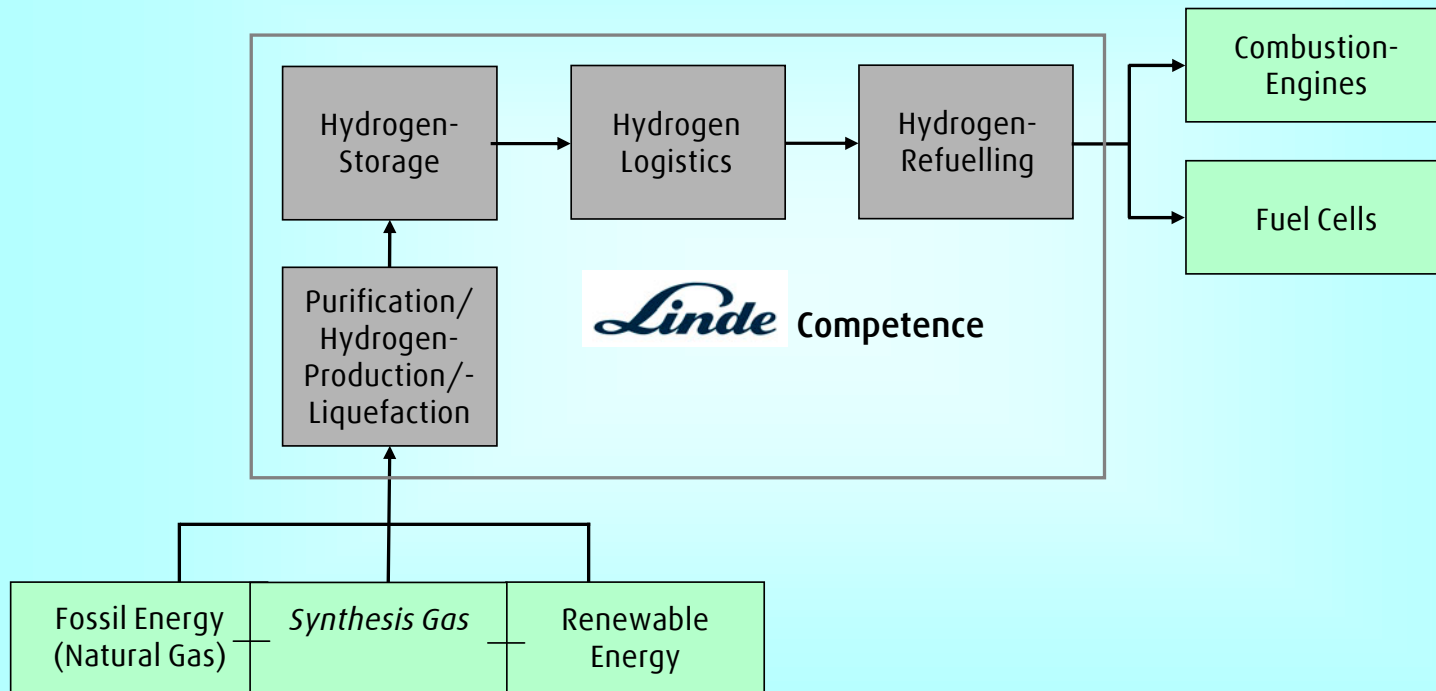
Aware that neither a single company nor an industry branch can do the task on its own



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Hydrogen Supply Chain





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Cross-project cooperation (Technological)

- Multiple **sources for energy** results in multiple energy supply paths
- Several **supply modes** exist to bring Hydrogen to refueling stations
- The best supply mode depends on several factors (application, timeframe, local situation,...)
- Regional characteristics along the hydrogen supply chain have to be taken into account (Zero Regio)
- Strategic approach for widespread use of hydrogen as fuel requires field experience (demonstrations)

Single projects are more effective if focused.
Results from demonstration projects have to be carefully examined (cross-project) before scaling up