



WHEN TRUST MATTERS

# Hydrogen blending

Introduction to our Hydrogen Services

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# We provide assurance - through domain and industry expertise

## **Certify, verify and test**

against regulatory requirements, standards and specifications

## **Co-develop and share**

new rules, standards and recommended practices

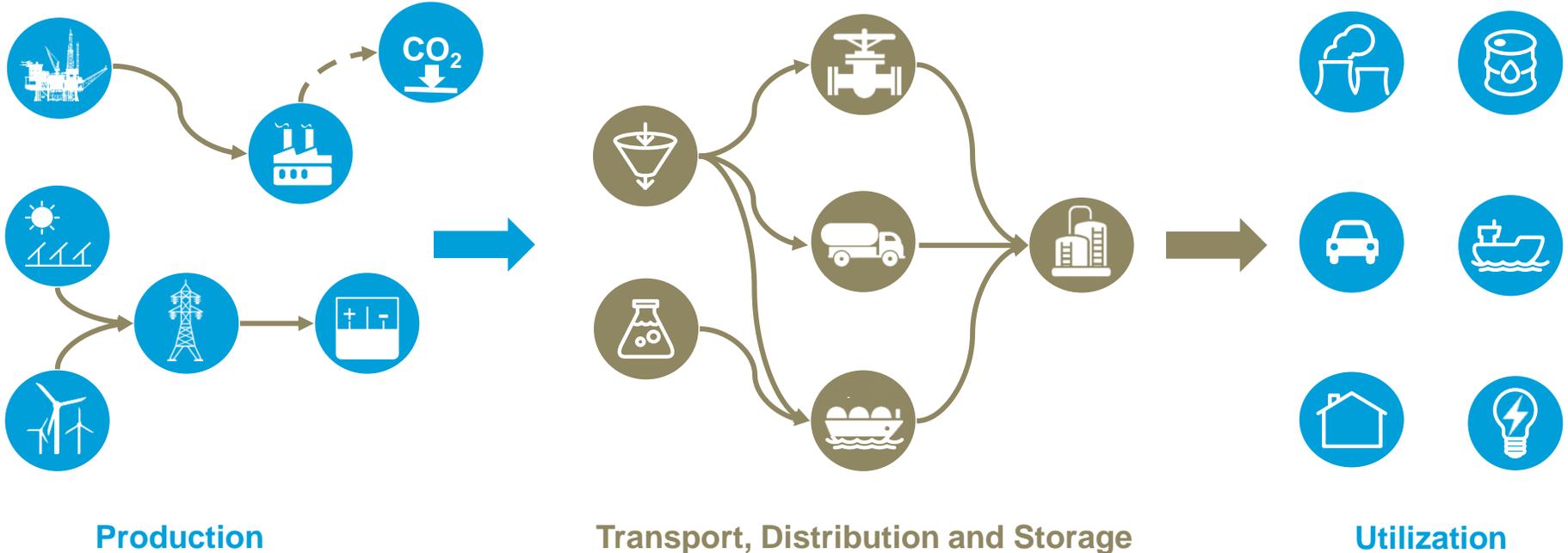
## **Qualify and assure**

new technologies, data, operational concepts

## **Give expert advice**

on safety, technology, risk efficiency, and performance,

# Unique position to cover the whole hydrogen value chain



DNV offers a wide range of both **technical and business advisory** services and, with broad expertise across the energy and maritime industries, we are in a **unique position** to cover the **whole hydrogen value chain**.

# NaturalHy

In this research project the preconditions of hydrogen addition to the existing natural gas system have been investigated. The focus was on potential barriers (show stoppers), such as gas exchangeability, safety, pipeline integrity (management). The project was carried out together with 40 European partners in a period of 5.5 years and with a budget of 17 M €, partly financed from the EC FP6 program.



## DNV's role

- Program management
- Practical experiments
- Impact studies
- Assessing the impact of hydrogen blending on the natural gas infrastructure in the field

## Project details

<b>Customer</b>	40 EU partners
<b>Country</b>	EU
<b>Date</b>	2004-2010

# Blending Hydrogen in existing natural gas networks

Pipeline material

Pipeline risk

End user appliances

Up to 50%

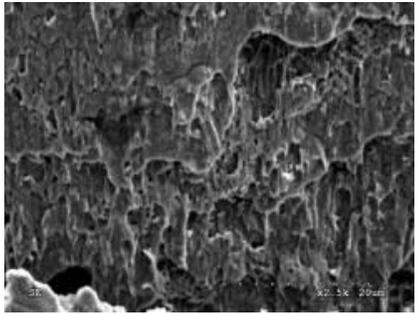
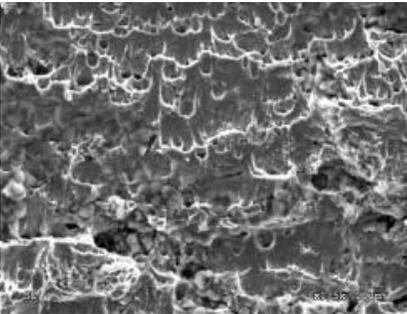
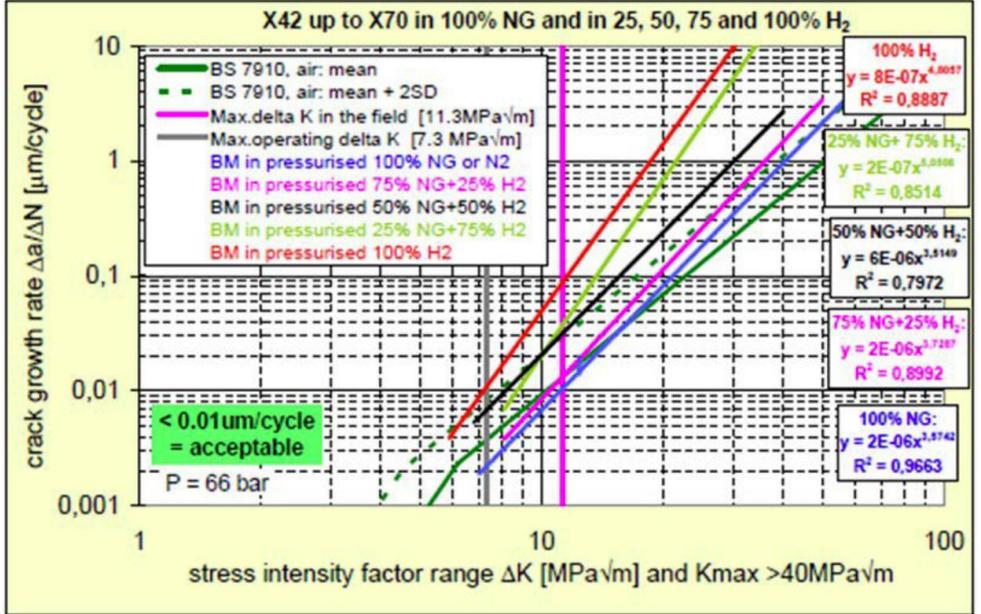
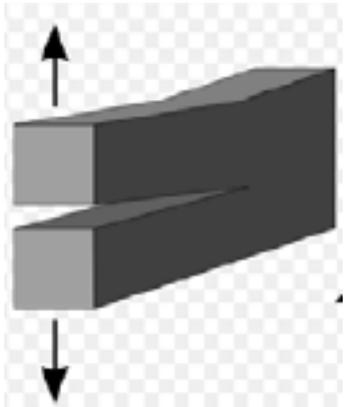
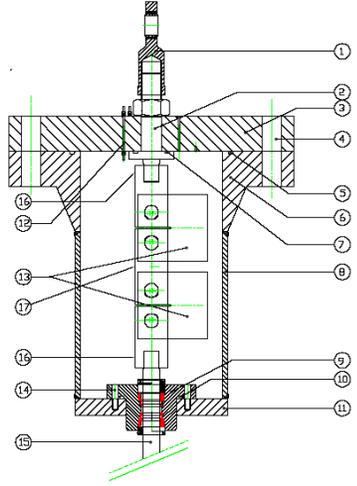
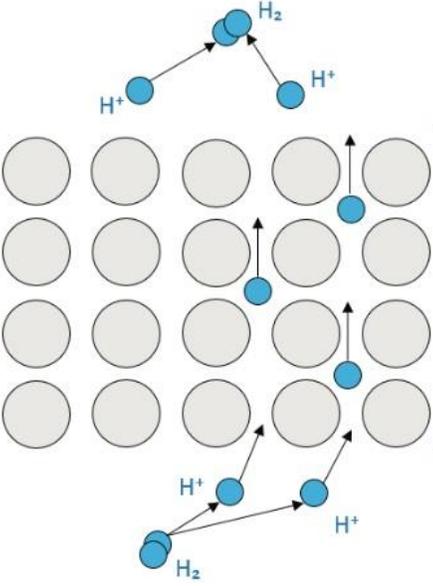
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0-20%

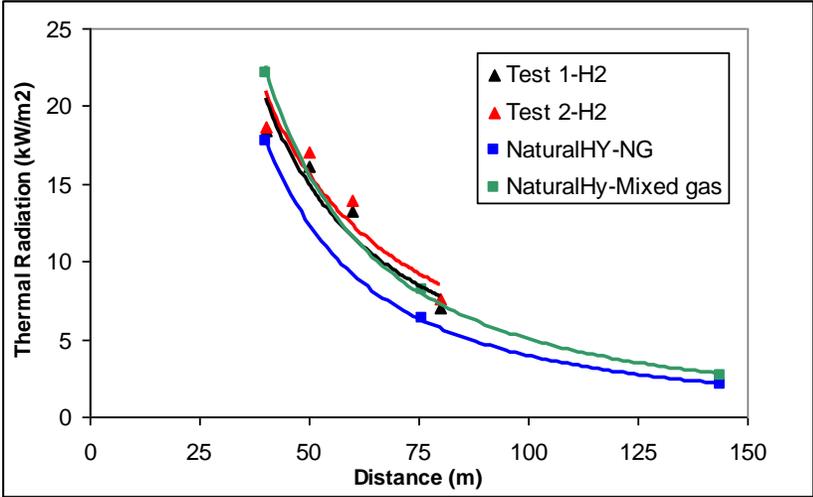
20-50%

No show stoppers

# Material research: embrittlement



# Risk: Hydrogen pipeline fires



# Risks for adding hydrogen to natural gas to end use equipment

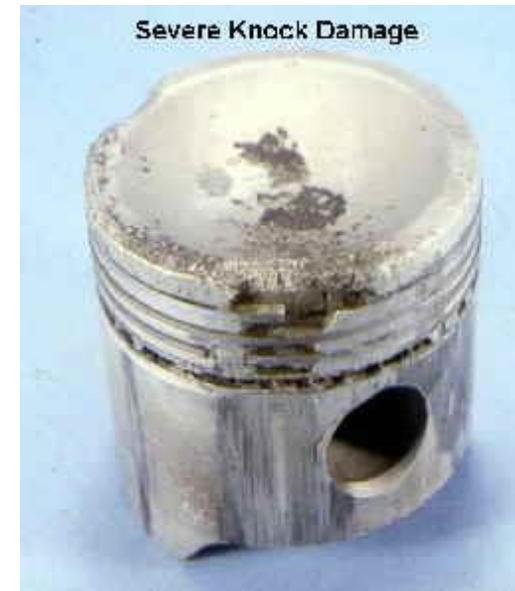
- Flame stability
- Engine knock, pre-ignition turbines
- Pollutant emission, NO<sub>x</sub>, ...etc.



Dutch natural gas

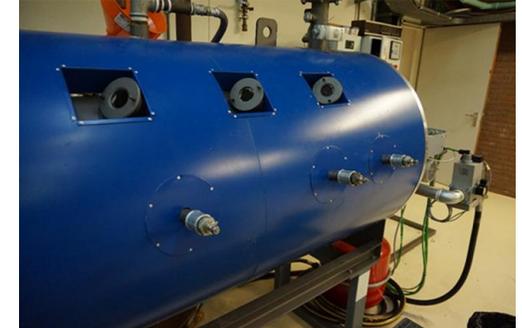


Addition of 5% H<sub>2</sub> to Dutch natural gas

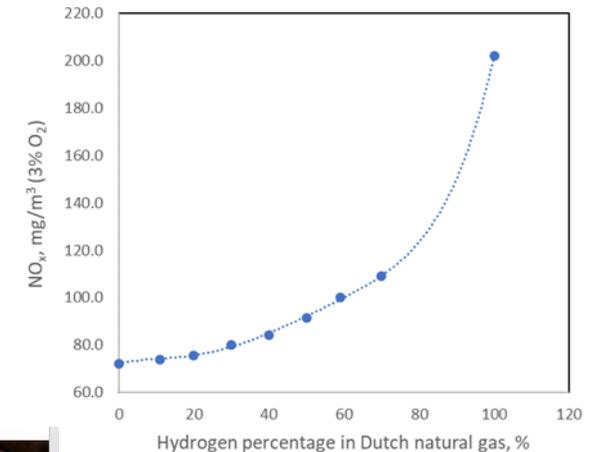
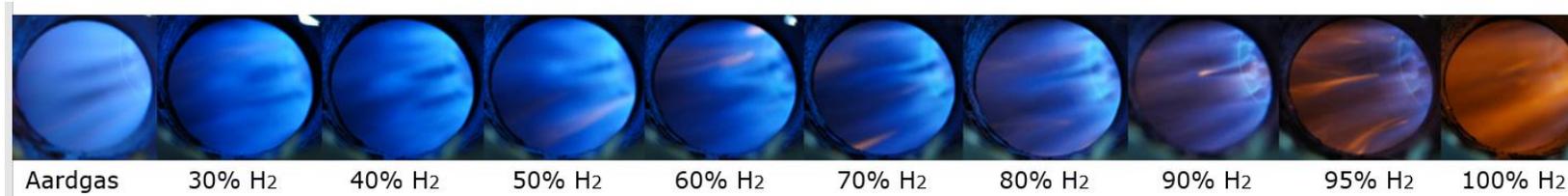


# End user: Fuel flexible burner system for indirect heating

- When adding hydrogen to natural gas the fuel adaptive control system keeps:
  - Fuel-to-air ratio constant
  - Thermal input (load) is constant
- Flame color changes from the typical blue color of natural gas flames to orange (hydrogen)
- No over heating of the burner is observed
- Hydrogen addition to NG results in an increase in the NO<sub>x</sub> emission

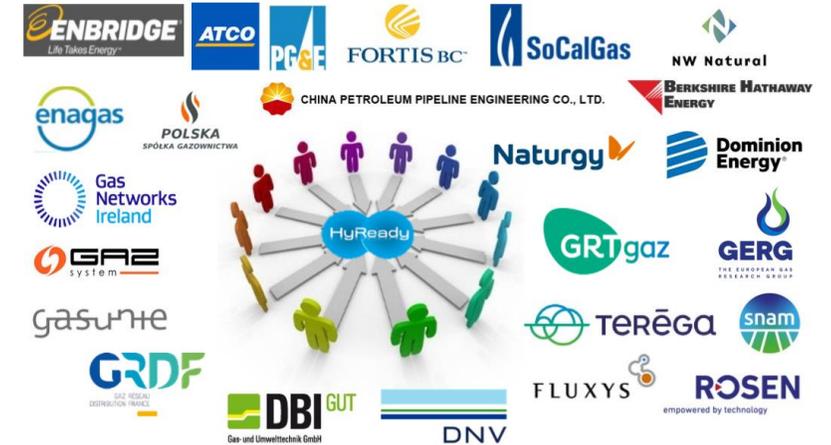


NO<sub>x</sub> emission should be decreased by applying NO<sub>x</sub> mitigating strategies



# Develop guidelines: HYREADY

To support the decarbonization of the energy system, stakeholders consider the accommodation of hydrogen (e.g. from Power-to-Gas) in the natural gas grid. There are no existing guidelines for TSOs and DSOs to prepare their natural gas networks and operations for the injection of hydrogen with acceptable consequences. The overall goal is to formulate a set of practical guidelines that enable grid managers to assess the consequences of and mitigating measures for adding hydrogen up to a 30% blend. In the first phase, the project focuses on both high-pressure gas networks and low-pressure distribution networks. The second phase deals with end user equipment and compressors. The consortium consists of 18 international partners from both Europe, Asia, Canada and the US.



## DNV's role

- DNV performed:
  - The program coordination and implementation of the guidelines, in collaboration with DBI-GUT.
  - Literature research, interviews with suppliers and knowledge from the partners to give input to the document.
  - Building on earlier work performed in the NaturalHy and HIPS project.

## Project details

<b>Customer</b>	Multiclient (TSO)
<b>Country</b>	US/Canada – EU
<b>Date</b>	2017 – ongoing

# Thank you

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