ACTION OVERVIEW

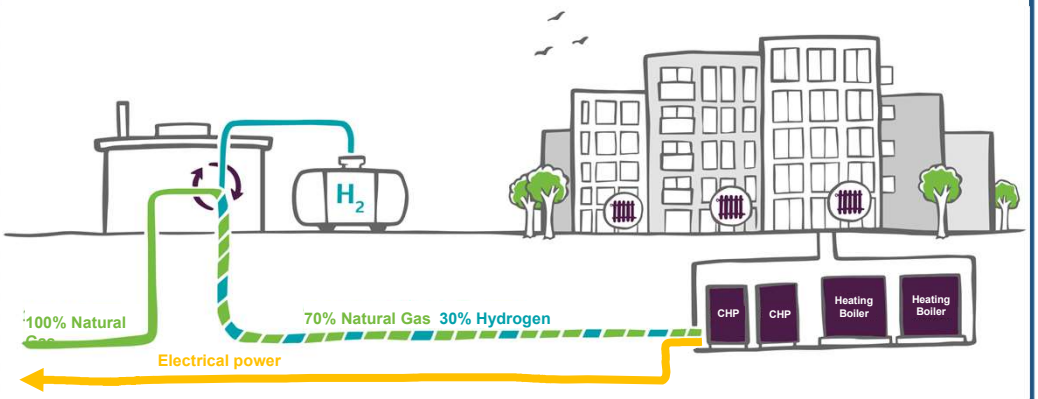
Renewable Hydrogen in CHP

This action was implemented by the University of Applied Science in Hamburg in collaboration with Gasnetz Hamburg and enercity Contracting Nord. A full report (D 3.3), written in English in November 2019, is available at https://mysmartlife.eu/publications-media/public-deliverables/

OBJECTIVES

- Convert hydrogen back into electricity and heat
- Gain knowledge on the operation of Combined heat and power (CHP) with a share of hydrogen and natural gas
- Research in system integration

IMPLEMENTATION



CHALLENGE

Hydrogen is becoming increasingly important in the energy transition as an alternative fuel and energy carrier. Through the well-known and understood electrolysis, hydrogen can be produced with the help of electrical energy from wind power, solar or water. It can also be used as a storage medium. When consumers need electricity, it is converted back by conventional combustion engines or fuel cells.
In the transformation process from fossil fuels to renewable hydrogen, the blending of hydrogen into the existing natural gas infrastructure is a key issue. For such an approach, however, there is still a need for adaptation and research on various parts of the infrastructure. In a first step towards implementation, gas mixtures of different proportions of natural gas and hydrogen are therefore inevitable.
The subject of this action is the effect of a variable hydrogen share in the gas grid on the operation of a CHP unit including a peak load boiler for the heat supply of a residential area. The converted CHP plants at the consumer's site are the first link in a hydrogen chain from green electricity to reverse generation in times of need. Therefore, an initial assessment of the system efficiency of hydrogen use is also necessary.

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An European urban transition project towards more sustainable cities through innovative solutions, in the fields of mobility, energy and digital.

Smart City

Global project

Coordination: Cartif
European grant: 18 M€
30 partners, 6 countries
Period: Dec. 2016 - Sept. 2022
Demonstrators: Nantes, Hamburg, Helsinki

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"Am Schilfpark" Hamburg

Coordination: Borough of Hamburg-Bergedorf
European grant: 5,25 M€
14 partners

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Energy

Involved Partners:

University of Applied Science Hamburg,
Gasnetz Hamburg,
enercity Contracting Nord

PROGRESS

The heat supply concept is based on a central heat production with a local district heating network. The heat supply consists of two CHPs with a capacity of 50 kWel / 100 kWth and two gas boilers with a capacity of 500 KWth. Boilers as well as CHPs can be operated with natural gas and a high share of hydrogen content of up to 30%. The local district heating network, which is mainly laid in the basement and underground car park, is over 460 metres long and distributes the heat to residential buildings in the development area and is operated by enercity Contracting Nord.

The technical implementation of the hydrogen injection and special mixing system to allow an energy mix with a hydrogen share of up to 30% was successfully completed by Gasnetz Hamburg as the local gas grid operator in 2020. Based on the existing infrastructure for a scalable hydrogen share, a test series programme was started to test and prove the technical concept as well as the interaction of the gas / hydrogen infrastructure and its corresponding operation of the CHPs with different proportions of hydrogen.

Within the test scheme, different hydrogen contents from 5 % up to 30 % will be evaluated. The University of Applied Science Hamburg developed a measurement concept and supervises the test series as well as the analysis of the generated data and its impact on reducing greenhouse gas emissions.

LESSONS LEARNT

- In light of the climate challenges, energy management and the development of renewable energy sources are becoming two important levers for reducing greenhouse gas emissions, notably in the residential field.
- First results of the technical infrastructure testing allowed the partners to identify required fine-tuning processes to cope with divergent reaction cycles as well as pressure and timing requirements for the hydrogen injection based on different heat demand.
- When heat demand is low, CHP units tend to serve the system in terms of their electricity feed-in behaviour. In winter, however, they tend to behave contrary to the system.

Additions from enercity Contracting Nord:

- The importance of the use of hydrogen and other renewable gases in the heat sector will also increase in the future.
- The technical requirements of the individual components must be adapted to be hydrogen-compatible in order to meet the individual requirements of a secure heat supply.
- The test programme, which is still ongoing, should lead to a clear understanding of the technical requirements and the specific processes to control the complex system of hydrogen mixing under flexible heating demand scenarios.

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