Management Summary "Hydrogen blending with Natural Gas on Ameland"

The project "Hydrogen in natural gas on Ameland" demonstrated blending of up to 20% green hydrogen in the current existing Dutch natural gas distribution network. It serves as test case to further include green hydrogen as part of a successful energy transition.

Project approach

Fourteen homes, as part of apartment complex "Noorderlicht" were selected for this project. The residents were questioned 5 times about their domestic comfort in regular surveys, each time after an increase in the hydrogen percentage. Project partners were Joulz, GasTerra, Stedin and the municipality of Ameland. Kiwa Technology covered the blending installation, hydrogen production and testing of infrastructure and end user appliances.

This project investigated injection of hydrogen in the natural gas (Low Caloric) grid in a practical situation for the first time in the Netherlands. The field trial spanned 4 years and the effects on materials used in infrastructure and domestic installations were examined. This area was selected, because both the distribution network and indoor installations are representative of standard Dutch situations. This included materials for pipes, hoses, fittings, pressure regulators and gas meters.
During the project, new standard gas appliances (domestic boilers and stoves) were certified and installed in residents' homes. This was done with the support of appliance manufacturers (Nefit, Remeha, Vaillant, Atag, Etna & Pelgrim). The highly efficient boilers and stoves included were selected to represent various burner designs that are commonly used with natural gas in the Netherlands. Before actual installation in the residents' homes, the operation of all gas appliances was successfully tested under controlled lab conditions and all appliances were found to operate successfully when fuelled with a blend containing up to 30% hydrogen in natural gas.
Lastly, green hydrogen was produced by electrolysis powered by electricity from solar panels. Production characteristics were set up to enable fast response to the rapid variations in the gas demand.

Project progress

During phase 1 and after installation of the necessary equipment, bottled hydrogen was blended with natural gas from December 2007 onwards. During this winter period the blending installation proved reliable. Therefore, bottled hydrogen was replaced with green hydrogen produced by electrolysis powered by electricity from solar panels. The project finished in April 2011: all installations and infrastructure were removed or replaced and the gas supply at "Noorderlicht" was restored to its original state.

Results

The project showed that the blending of hydrogen up to 20% with natural gas had no impact on infrastructure materials or indoor installations, including domestic boilers and stoves. In more detail:

- Residential comfort: The residents were generally satisfied with their domestic comfort: none of the complaints could be related to the blending of hydrogen with natural gas.
- Infrastructure: No hydrogen-blend leaks occurred during the project. The infrastructure pipelines include a mixture of PVC, PE, POM and rubber connecting pipe. No visible or measurable degradation of materials has been found after exposure to the hydrogen mixture for 4 years. It must be kept in mind that this infrastructure has a general lifespan of 50 years.
- Gas meters and appendages: No visible effects from the hydrogen were found upon visual inspection of the gas meters and associated regulators. This includes the housing, metering parts and membranes. No measurable effect on control range or shut-off closing pressure from the regulators was found.
- Boilers and stoves: Both heating and cooking appliances functioned properly and to specification. No damage occurred as a result of operating appliances with the hydrogen-natural gas blend. Testing showed reduction of CO_2, CO and NOx as result of adding hydrogen. The boilers and stoves fired up normally and did not suffer from flame damage. During maximum operation with 20% hydrogen, the normally blue flame, acquired a red glow. This is a result of flames being closer to the burner and less well mixed with air prior to ignition. No internal components of the boilers or stoves were affected adversely by the hydrogen blend

Recommendations

- Infrastructure components: The test period for this project was over 4 years, however lifespans of these components are up to 50 years. No definitive conclusions on the effect of hydrogen can be drawn over this longer time period. However, the 4-year test implies that degradation of the mentioned materials because of a 20% hydrogen blend with natural gas is unlikely.
- Gas meters and appendages: Again, the lifespan of these components is much longer than duration of this project. Therefore, repetition of these tests is recommended over a longer period of time. Also, the ability of bellows gas meters to accurately measure hydrogen volumes was not tested in this project. This should be investigated, as part of a wider review on metering size and functionality.