

Newsletter

Testing Hydrogen admixture for Gas Applications

- All deliverables published for WP2: Status of gas utilisation technologies
- Experimental work, testing protocol
- Impact on certification and standardization
- Industry news

Foreword

One of the successes of THyGA is based on its capacity to communicate and disseminate about the acquired knowledge and potential exploitation of the results now and in the years to come. To do that, THyGA has shown to the stakeholders its willingness to share as much information as possible (80% of our deliverables are public). We involve specialists and the wider public in thematic workshops aiming at informing and getting feedback, to make sure that the approach we consider relevant is useful for a large audience. In that regard, 2020 has been successful with 3 main workshops: generic overview of the objectives in May 2020, and in October, results about the impact of blending hydrogen and natural gas (combustion theory and non-combustion aspects, hydrogen embrittlement and tightness issues) from WP2.

As detailed in this newsletter, Work Package 2 published 3 additional reports on the specificities of the different segments of appliances available in Europe, their main characteristics and expected behaviour when provided with H2NG admixture. The basis of the reports was an extensive meta-analysis of past experimentations and tests. Moreover, a consequent part of the WP2 and WP3 activities dealt with the development of a test protocol suitable for the selected appliances through a very iterative process involving taking into account a lot of feedback from manufacturers, associations and Technical Committees.

Good transition to the test activities under WP3 that started in May 2020, and directly contributed to the improvement of the test protocol: indeed,

each test brings its own specificities and leads us to improve our protocol and ways to analyse results. As of the publication of this newsletter, around 15% of appliances have been tested. Unfortunately, the pandemic situation took its toll on our test planning with to-be-expected delays, but we remain confident in our capacity to keep up and bring consolidated information starting with the next newsletter.

WP4 also delivered its first report, clearly describing the current framework of regulation and standardization in Europe, as well as the main impacts that need to be assessed to go further on the issue of standardization with H2NG blends. This topic is widely researched in Europe and discussed within WP4 with partners from standardization Technical Committees, experts, notified bodies and also International support through advisory panel members from USA, Japan, Canada and Australia that help bring other points of view to our European initiatives.

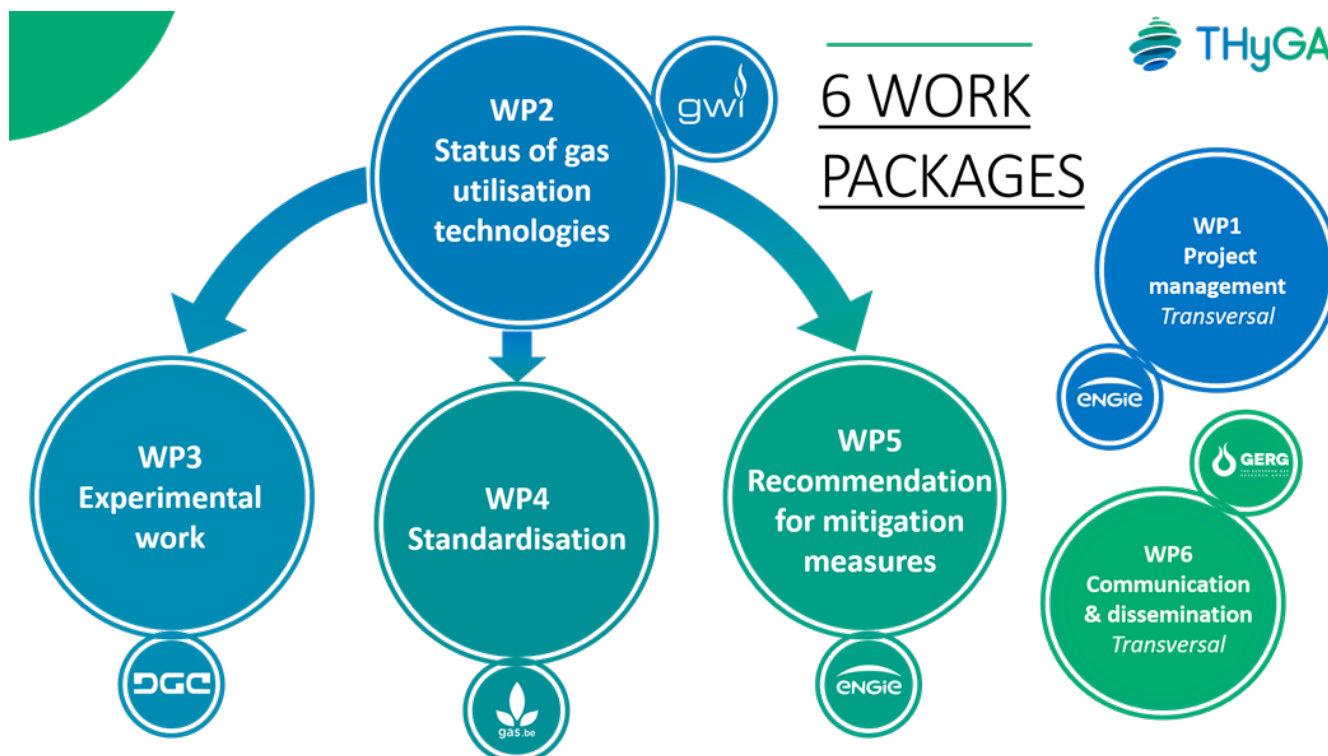
WP2 has now been completed and its results are already used within the project. Hopefully they help to convey knowledge on H2NG blends to specialists within our network and further. Good reading.

Patrick Milin, Project Manager

Finalisation of WP2:

Status of gas utilisation technologies – impact of hydrogen admixture and design of testing programme for devices

In the organisation of the THyGA project, Work Package 2 (WP2) occupies a central position. Led by GWI, the WP2 team was tasked with assessing the current status of gas utilisation technologies and the potential impact of hydrogen admixture. This is where the basics of the following work were set, appliances selected, and test programmes developed. All the public deliverables for WP2 have now been finalised and are accessible on the THyGA website – let's review what you can find there!



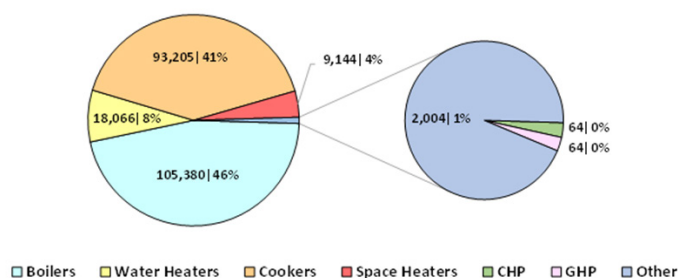
The reports produced by WP2 aimed at answering the following questions:

- What are the end-use gas appliances in the field today?
- What are the implications on combustion technologies when hydrogen is admixed into the natural gas?
- In practice, how does hydrogen admixture impact the combustion in existing appliances?
- Apart from combustion processes, what changes for an appliance when it runs on an H2NG blend?
- What are the conclusions for THyGA's testing program?

What are the end-use gas appliances in the field today?

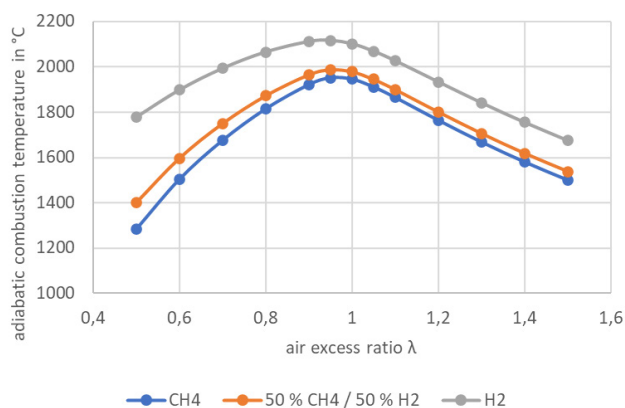
First, the project team produced a quantitative segmentation of the gas appliance market in terms of appliance population numbers. Based on statistics, calculation methods and estimations, the report [D2.1: «Market segmentation of domestic and commercial natural gas appliances»](#) provides a state-of-the-art inventory of the installed end-use appliances in the EU in 2020. This dataset allowed THyGA project partners to select a representative selection of burners, boilers and other appliances for various H2NG blends.

Market Segmentation of gas-fired appliances in EU 2020 (x1,000)



What are the implications on combustion technologies when hydrogen is admixed into the natural gas?

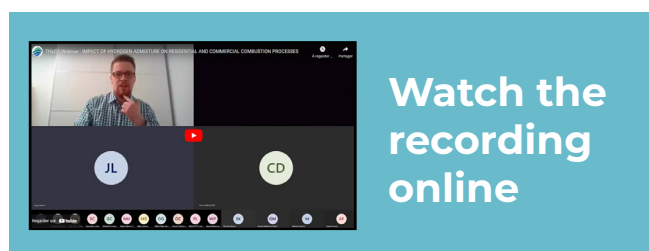
To provide a high-level insight of the impact on combustion processes, the project team produced an analysis based on combustion theory and literature review.



Adiabatic combustion temperatures of CH₄, 50 % CH₄ / 50 % H₂ and H₂ as functions of the air excess ratio, with air as oxidizer.

The report [D2.2: “Impact of hydrogen admixture on combustion processes – Part I: Theory”](#) addresses the effects of hydrogen admixture on the main gas quality properties, combustion temperatures, laminar combustion velocities, pollutant formation (CO, NO_x), safety-related aspects, and the role of combustion control.

A successful webinar was organised around the results of this report: you can [download the slides](#) and watch the recording on the THyGA website !



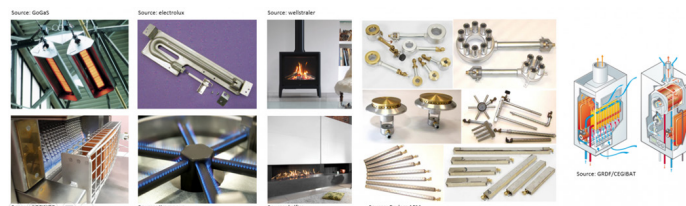
In practice, how does hydrogen admixture impact the combustion in existing appliances?

Following the theoretical analysis of the previous task, the report [D2.3: “Impact of hydrogen admixture on combustion processes – Part II: Practice”](#) focused on the implications of H₂NG combustion for gas appliances on the market.

The first part considers the important functional principles for hydrogen admixture, technology by technology.

In the second part, a literature review presents the available knowledge on the impact of hydrogen for various appliance types, including CO and NO_x formation, overheating, flame temperature, flashback, H₂ leakage, operational implications and efficiency.

Download the webinar presentations [here](#).



Examples of appliances found in the review.

Apart from combustion processes, what changes for an appliance when it runs on an H₂NG blend?

When injecting hydrogen in natural gas, non-combustion related impacts must also be considered: the hydrogen content in the gas mixture is likely to reduce the mechanical properties of metallic elements.

The bibliographic report [D2.4: “Non-combustion related impact of hydrogen admixture – material compatibility”](#) tackles hydrogen embrittlement of metallic components, chemical compatibility with other materials, and leakage concerns for end-use applications and the gas line inside the building.

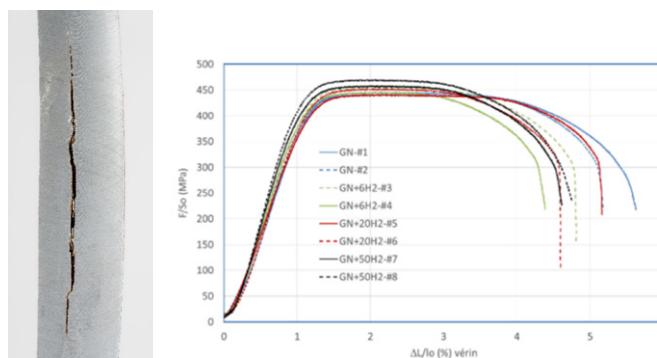


Illustration of hydrogen embrittlement (left); Tensile curves results for pure copper alloy on smooth specimens

What are the conclusions for THyGA's testing program?

Based on the previous results, the report [D2.5: “Testing programme for hydrogen tolerance tests of domestic and commercial natural gas appliances”](#), details the development steps of the test programme of the THyGA project.

It describes the exchange between the THyGA partners and the external stakeholders, as well as the process of acquisition and method for selecting test appliances.

THyGA testing news

Although the Covid-19 has created some challenges to the laboratories, testing has started and is developing well. 15% of appliances have been tested for the so called "short term" campaign where the safety, emissions and efficiency of the appliances are tested in laboratory with hydrogen- natural gas blends under different configurations in order to cover real situations of appliances operations:

- Different natural gas qualities
- Variation of gas pressure
- Cold and hot start
- Fast variations of H2 concentration
- Etc.

Some appliances will also be tested under so called "long term" campaign where the appliances will be running with H2NG blends over several weeks to identify possible long-term impacts of blending on appliances and components.

The collaboration with manufacturer is a key element of the testing in THyGA

Appliances manufacturers are involved in the discussions before, during and after the test. All appliances are tested with at least 40% (vol) H₂, a fraction that can be increased up to 60% (vol) H₂ with the manufacturer's approval. During the pre-test discussion, the manufacturers enabled us to fine tune the test programme to get the most out of the trials. Input from the manufacturers is also provided after the tests, when the results for each appliance are presented: THyGA benefits from a first-hand expertise to interpret and analyse the obtained results. Additionally, the long term testing protocol was discussed and defined with our manufacturer partners in THyGA in order to benefit from the already existing experience.

Next steps

All laboratories are now testing appliances. After a slow start having allowed to fine tune the test protocol, the test activity will now accelerate including the long term testing, planned to start in the summer 2021. Some "External labs", not directly partners of the project, showed interest to test appliances on their own, on the basis of the THyGA protocol. This dissemination activity will also bring additional value to the project since this win-win collaboration will increase the pool of available test results and each stakeholder will benefit from the increase of knowledge on the topic.



DGC's long term test rig is especially designed to monitor gas appliances performances over testing periods of several weeks or months.

The test rig will be used to test 5 appliances, some operating night and day, with hydrogen/ natural gas blends. Long term tests will also start soon at GWI premises.

**Follow
the THyGA team
on social media**



[GERG Twitter](#)



[GERG LinkedIn](#)

Impact on the current certification and standardization framework

An analysis of the European current certification and standardisation frameworks and the way they are impacted by hydrogen admixtures is available [on the project website](#). This report defines how the existing methodology can be adapted to account for the changing context. A benchmark of the framework in non-European countries is being finalized to understand how the other countries consider this issue.

A technical workshop “H2NG supply to residential and commercial appliances – standardization and certification” was organised by the project team at the end of March. The presentations and the recording of the workshop are available [here](#) on the THyGA website. The goal was to gather on a same stage a panel of international experts (manufacturers, standardization specialists) to share their views on on-going standardization work and their views of the evolutions to come.



Next steps

The project will dive into the possibilities of improvement of the existing framework, in link with standardization Technical Committees to identify any additional tests that may be required and thoughts about appropriate (additional) limit gases, or eventually an additional or revised reference gas.

Collaboration: ENTSOG



Together with DSO organisations (Eurogas, Geode, CEDEC, GD4S), ENTSOG has established a [Prime Movers Group on Gas Quality and Hydrogen handling](#).

This group will discuss the development of innovative and feasible ways to handle gas quality in fluctuating blends, as well as pure hydrogen grids in our future gas system, and the main technical challenges foreseen. Patrick Milin made a presentation to the group on the objectives and results of THyGA, and further exchange of information is expected.

Industry News

Hydrogen remains at the forefront of energy policy, in Europe and in the world. New players continue to join the hydrogen momentum, with plans emerging from [India](#), or [Turkey](#), to start blending hydrogen in the gas networks this year.

A few interesting initiatives to follow:

- **The European Hydrogen Backbone**

The [2021 report](#) updates the plans of this major work by 23 TSOs: a vision for a 39,700 km hydrogen pipeline infrastructure, almost 70% of which is based on repurposed existing natural gas pipelines.

- **The Hydrogen Europe Roadmaps**

Annual Work Programmes (AWP21 and AWP 22) are being negotiated with the European Commission, on the basis of 22 roadmaps, including the topic “Hydrogen in gas infrastructure”. The publication of the Annual Work Programmes is expected for the end of 2021.

- In the **United States**, [HyBlend](#), a U.S. Department of Energy Research Project, was launched last year to work on technical barriers to blending.

- **Hy4Heat**

The [‘Hydrogen for Heat’ programme](#) aims to support the UK Government by evaluating the feasibility of the natural gas to hydrogen network conversion option. Their scope includes domestic (WP4) and commercial (WP5) appliances.

- **HyNTS Future Grid**

This [programme](#), building on a portfolio of projects, will create a representative UK Hydrogen Testing and Training Facility.

- In **Germany**, DVGW and 33 partner companies developed a transformation path for regional and safe supply of climate-neutral gases in the [H2vorOrt](#) project.

- In **Spain**, the 3-year [H2SAREA](#) project will test hydrogen injection up to 20%, gradually increased in a second phase up to 100% hydrogen.

Feedback Survey

Thank you for reading!

We value your feedback! To help us improve our THyGA communication, to make a suggestion, or to ask a question to the project team, please follow this link:

[Feedback Survey](#)

Visit the THyGA website to browse all the project documents, and follow the GERG LinkedIn page to receive and share THyGA news!



If this newsletter was forwarded to you, and you would like to stay informed about the activities of the THyGA project, please email contact_thyga@engie.com

THyGA Members

BDR THERMEA GROUP



DGC
Danish Gas Technology Centre



ebi



Electrolux

ENGIE



“The THyGA project has received funding from the Fuel Cells and Hydrogen Joint Undertaking under grant agreement No. 874983. This Joint Undertaking receives support from the European Union’s Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe research.”

