//EU HYDROGEN RESEARCH DAYS 15-16 NOVEMBER

THyGA
Testing Hydrogen admixture for Gas Applications

Patrick Milin

ENGIE

https://thyga-project.eu

patrick.milin@engie.com

Clean Hydrogen Partnership

European Hydrogen Week

Co-funded by the European Union

//EU HYDROGEN RESEARCH DAYS 15-16 NOVEMBER

Project Overview

- Call year: 2019
- Call topic: FCH-04-3-2019 - Hydrogen admixtures in natural gas domestic and commercial end uses
- Project dates: January 2020 – March 2023
- % stage of implementation 01/11/2023: 100%
- Total project budget: 4M€
- Clean Hydrogen Partnership max. contribution: 2.5M€
- Other financial contribution: /
- Partners: BDR Thermea, CEA, DGC, DVGW-EBI, ELECTROLUX, ENGIE, Gas.be, GERG, GWI

Clean Hydrogen Partnership

European Hydrogen Week

Co-funded by the European Union

Project Summary

Context: Hydrogen, along with green electricity from wind and solar power, provides a pathway to decarbonise the European energy systems. Hydrogen blending in the gas grid would reduce the carbon footprint of gas utilisation, contributing to an overall reduction of greenhouse gas emissions.

Hydrogen injection in the gas grid

New challenge for end-use equipment…

…in particular for higher % of H_2 in blends

>200 million residential and commercial gas appliances in Europe!

Project Summary

Objectives and expected results

CLOSE KNOWLEDGE GAPS

related to technical impacts on residential and commercial gas appliances.

SUPPORT STANDARDIZATION ACTIVITIES

to answer the needs for new appliance operation, test gases, etc.

CLARIFY THE ACCEPTABLE HYDROGEN PERCENTAGE

that would not compromise safety and performance.

//EU HYDROGEN RESEARCH DAYS 15-16 NOVEMBER

Project Progress/Actions

Testing H2NG blends on 100 appliances

Achievement to-date

Theoretical data → 100% → ~100 appliances testes

~50 manufacturers involved

The analysis covers

- Safety (synthesis on the right)
- But also: efficiency, emissions, comfort….

Overall Impact of H2 on					
SEGMENT		Efficiency	NOX	CO	CH4
100a	Boiler premix	+	-	-	
100b	Boiler NOT premix	0	-	-	
200	Water heater	0	-	-	
300	Cooker dom	0	- (*)	-	
400a	Catering premix	NM	-	-	
400b	Catering NOT premix	unclear	-	-	
500	Space heaters	0	-	unclear	
600	CHP	0	unclear	unclear	
700	GHP	0	-	-	
800	Radiant heater & commercial air heaters	-	unclear	-	

(*) can suddenly increase for H2 >40%

NOT INCLUDING DELAYED IGNITION POTENTIAL ISSUES OR OTHER POSSIBLE NOT IDENTIFIED ISSUES

		H2 % Tested							
		0	0-10	10-20	20-23	23-30	30-40	40-50	50-60
100a Boilers fully premix	Safety			simple mitigation (3)	mitigation to be defined		4	7	10
	Safety with mitigation			Dedicated adjustment methodology			1	4	7
	Operational								
100b Boilers Not premix	Safety								3
	Operational								
200 Water heaters	Safety						1	1	1
	Operational								
300 Cookers domestic	Safety					2	8	8	10
	Operational								
400a Catering equipment – Premix	Safety			simple mitigation (1)	mitigation to be defined (2)				
	Safety with mitigation			Dedicated adjustment methodology					
	Operational								
400b Catering equipment – Not premix	Safety					1	1	1	1
	Operational								
500 Space Heaters	Safety								1
	Operational						flame aspect		
600 Combined Heat and Power (CHP)	Safety					1	1	1	1
	Operational								
700 Gas Heat Pumps (GHP)	Safety								
	Operational								
800 Radiant heater & commercial air heaters	Safety								
	Operational								

//EU HYDROGEN RESEARCH DAYS 15-16 NOVEMBER

Project Progress/Actions

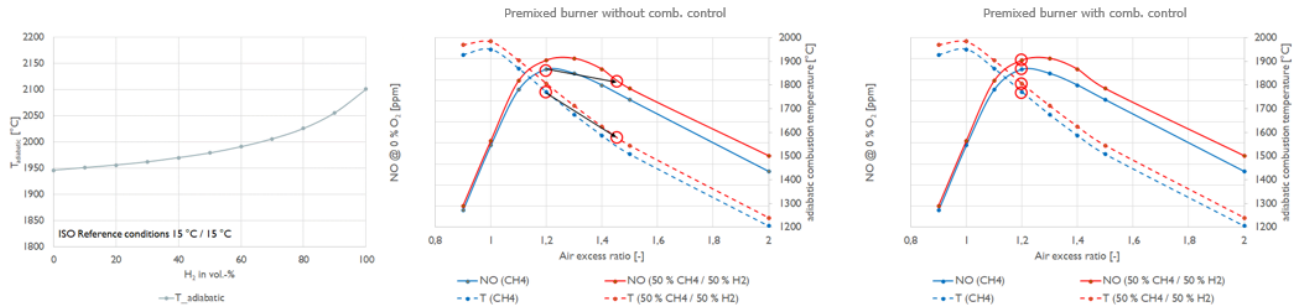
Support standardization activities

Achievement to-date → Current standardization framework → 100% Description and identification of issues

Studying test gases for H2NG in link with notified bodies and CEN Technical committees' initiatives

Limit gas purpose	Natural gas (2nd family – group H)	H_2NG (with 20% H_2)	Comment
incomplete combustion and sooting	G21 (87% CH_4 + 13% C_3H_8)	G21	as H_2 concentration may vary between 0 and 20%)
flame lift (flame instability)	G23 (92,5% CH_4 + 7,5% N_2)	G23 or Gxx	H_2 lowers WI, but flame speed increase compensates⇒ to be calculated
light-back (flashback)	G222 (77% CH_4 + 23% H_2)	G22 (65% CH_4 + 35% H_2)	only for partial premixed burners + fully premixed burners equipped with combustion control
		Gyy (G21 and/or G24 proposed)	for fully premixed burners
overheating	G24 (68% CH_4 + 12% C_3H_8 + 20% H_2)	G24 ?	overload + increased flame speed

Identification of risks linked to table of **Gas Appliance Regulation essential requirements** and the **findings of WP3** testing **for 20% H_2NG**



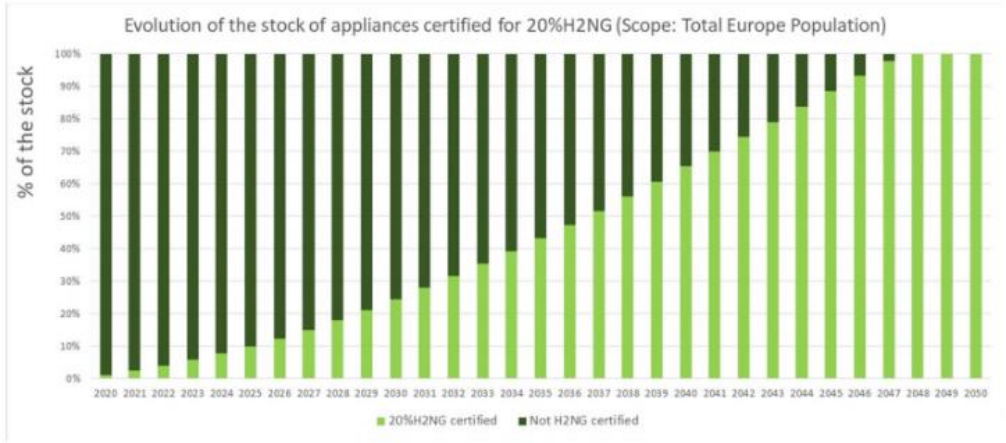
H_2 property	Risk	Cause	Comments + evaluation for 20% H_2NG
Higher flame temperature	Higher NO_x emissions	Thermal NO_x formation	Impact may be (partially) compensated by air excess increase 20% H_2NG: NOx emissions decreasing apart from some exceptions
	Material/product deterioration	Material does not resist the higher temperature	Impact increased by the higher flame speed, but (partially) compensated by air excess increase 20% H_2NG: no issues detected, but case by case evaluation required

Project Progress/Actions

Recommendation for large scale implementation

Achievement to-date → Unknown on existing stock → 100% Quantification of H2NG blends on the stock

Working on standardization for new appliances must be coupled with work on existing stock



3 topics should be adressed by all stakeholders: delayed ignition on some appliances, liability and adjustment ! Many leads provided in THyGA reports

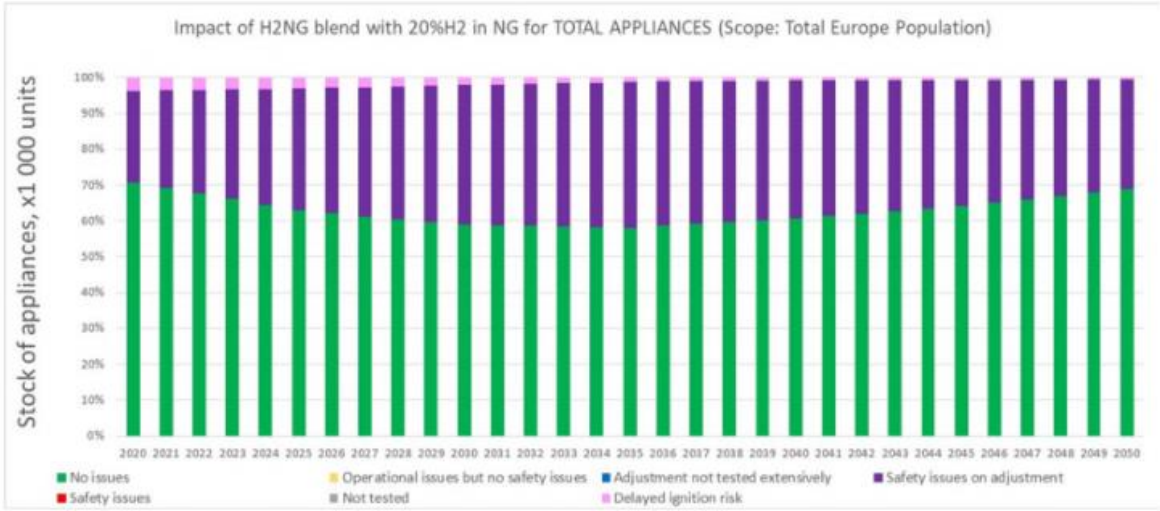


Figure 16: ThyGA results projected on the evolution of the stock of appliances

//EU HYDROGEN RESEARCH DAYS 15-16 NOVEMBER

Risks, Challenges and Lessons Learned

Helping standardization bodies on PNR activities requires a lot of flexibility

- CEN TCs starting to work on "H_2 ready" certification, some going faster than others
- "H_2 ready" concept discussed in regulation for Energy-related Products (ErP): Ecodesign & Labelling
- Manufacturers H_2 roadmaps pushed by the "Primemovers" initiative
- DSO / TSO clearer about possible H_2% in the gas grid (up to 20 %)

Consequences for the project

READJUSTING THyGA testing to give the best value to the industry (focus on 0 to 30% H_2)

ADAPTATION of the content and objective of the WP4 to best suit the needs of the stakeholders

RESULTS ALREADY KNOWN by some actors beforehand BUT TOTALLY NEW FOR OTHERS = finding the good balance

Clean Hydrogen Partnership

European Hydrogen Week

Co-funded by the European Union

//EU HYDROGEN RESEARCH DAYS 15-16 NOVEMBER

Exploitation Plan/Expected Impact

Exploitation

80% of the deliverables are public + ~12 workshops

Presence in ~30 conferences and 2 technical papers

Wide advisory panel group to ensure maximized exploitation of the project's results

Associations, manufacturers, research centers, notified body, DSO (Europe and International)

AFECOR, APPLIA, CEFACD, CogenEurope, EFCEM, EHI, ELVHYS, Eurogas, Marcogaz

Assotermica (IT), BDH (Germany), HHIC (UK), ICOM (UK), SYNEG (FR), UNICLIMA (FR), APPLUS (SP), Cadent (UK), Enagas (SP), GRDF (FR)

AGA (USA), CGA (Canada), JPA (Japan), ARPA-E (USA), GTI (USA), Tokyo gas (Japan)

AGA Rangemaster, AO Smith, AristonThermo, ATAG, Bosch, Broetje, BSH, Carlieuklima, Carrier, Ebmp-papst, EC Power, Electrolux professional, Gogas, Groupe Atlantic, GWM, Immergas, Kalfire, Lacanche, MEMS, MKN, MTT, Nortek, Qtec, Percy Doughty, Rational, Remeha, Schwank, Senertec, SolidPower, Systema, Vaillant, Viessmann, Weishaupt, Wolf

But also Standardization Committees

CEN TC 49, CEN TC 58, CEN TC 62, CEN TC 106, CEN TC109, CEN TC 131, CEN TC 180, CEN TC 238 – Liaison, Sector Forum Gas – Utilisation - Liaison

And strong links with other European projects

GERG

Removing the technical barriers to use of hydrogen in natural gas networks and for (natural) gas end users.

HIGGS Hydrogen in Gas Grids

SUPER P2G

HyDelta

HyDeploy

Impacts

Impact 1: Establishing what %H2 can be implemented in domestic and commercial sector

Impact 2: Establishing how the existing certification shall be modified to allow higher concentrations

Impact 3: Recommendations for revision of EN or ISO standards or drafting of new standards based on PNR results and a review of the existing testing methods

Impact 4: Improved knowledge on the effect of H2NG on common burner types including necessary adjustments and design changes.

Clean Hydrogen Partnership

European Hydrogen Week

Co-funded by the European Union

//EU HYDROGEN RESEARCH DAYS 15-16 NOVEMBER

Communications Activities

VISIT THE THyGA WEBSITE

All public presentations and deliverables of the project will be available on the project website

thyga-project.eu

GERG LINKEDIN & WEBSITE

For regular updates, you can also follow the GERG LinkedIn page and website

GERG THE EUROPEAN GAS RESEARCH GROUP

CONTACT EMAIL

Do not hesitate to contact us by email at contact_thyga@engie.com

Clean Hydrogen Partnership

European Hydrogen Week

Co-funded by the European Union

//EU HYDROGEN
RESEARCH DAYS
15-16 NOVEMBER

Thank you

Clean Hydrogen Partnership

European Hydrogen Week

Co-funded by the European Union