

Self-regulated gas boilers able to cope with gas quality variation: State of the art and performances

Project Partners

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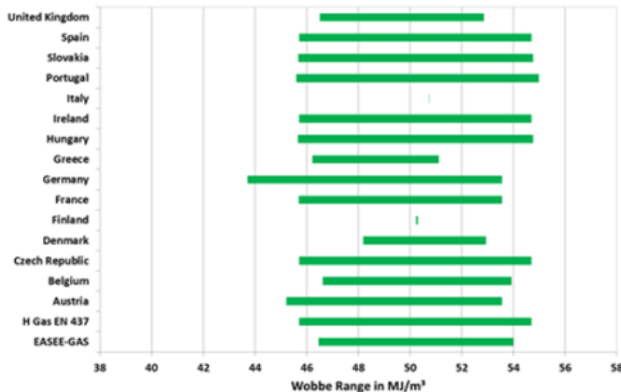
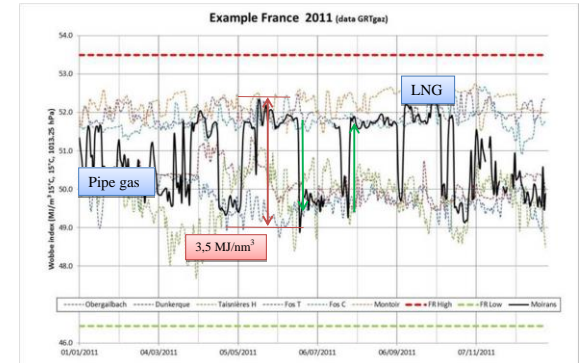
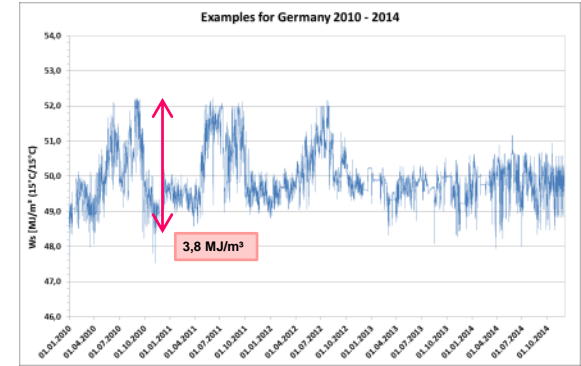
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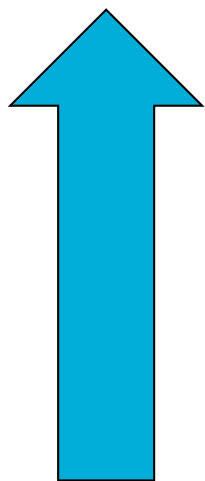
Technical background: Gas Quality

- Legal Wobbe limits in European countries ranges from 4 to 8.7 MJ/m³ (Max-Min) (largest value for NL, not on the slide below)
- European harmonization is still in work.
- Gases from different sources and renewable gases are increasingly supplied in the European Countries.
- The local Wobbe number fluctuated already in the past and will do in the future within the legal limits



Gas appliances technologies providing a high flexibility to natural and renewable gases become more and more important.

Gas quality in the EU



Wobbe

LNG's

Natural gases H

BIOMETHANE

Natural gases L

HYDROGEN

What quality can appliances cope with?

GASQUAL project



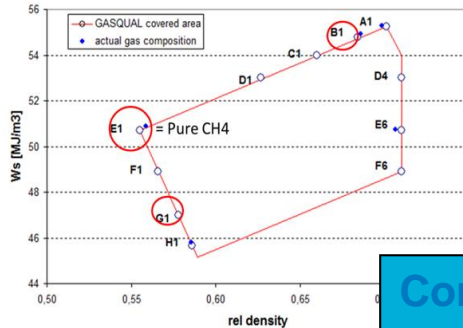
GASQUAL

- 100 domestic appliances' sensitivity to gas quality have been tested

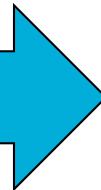


GASQUAL results = Sensitivity profile for 200 M. of EU gas appliances.

Some appliances can only accept a narrow band of variation.

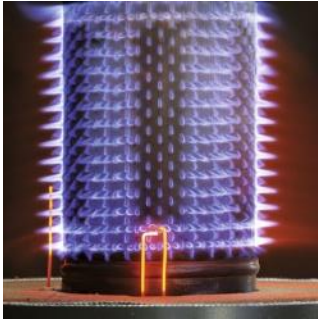


Conclusion



- Remove them from the market?
- Mitigate the effect of gas quality?

Project CCCB



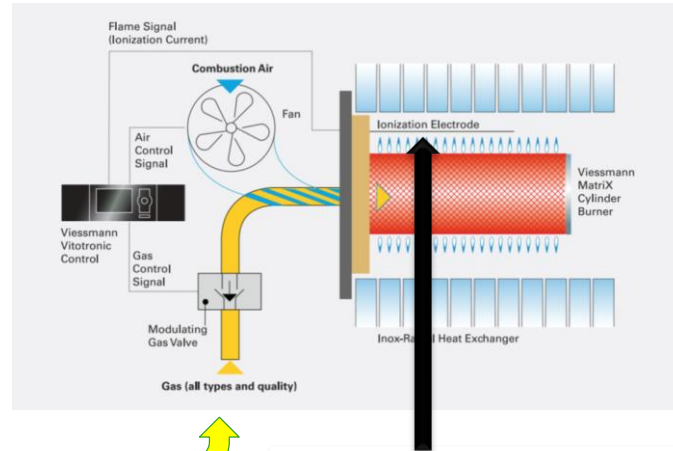
- To review the technology and market of combustion controlled condensing boilers in Europe
- To asses (incl. test) their ability to cope with the Wobbe range of natural gas due to (EN437) and to compare it to the functionality of conventional condensing boilers



Mitigations technologies

UPSTREAM COMBUSTION ZONE.

Corrective action based on the knowledge of gas quality entering the process (eg. GC)



IN THE COMBUSTION ZONE. Corrective action based on the analyse in the flame (ionisation etc..)

DOWNSTREAM THE COMBUSTION ZONE.

Corrective action based on the analyse of the combustion (O₂ etc..)

IONISATION

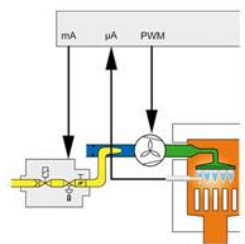
Advantages:

- Cheap and robust sensor
- Easy to integrate into the boiler

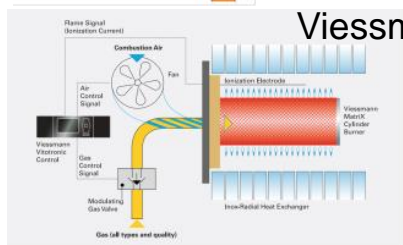
Disadvantages:

- Susceptible to deterioration
- No ionization signal from Hydrogen

Realized systems in CCCB based on Ionization Signal (Examples)



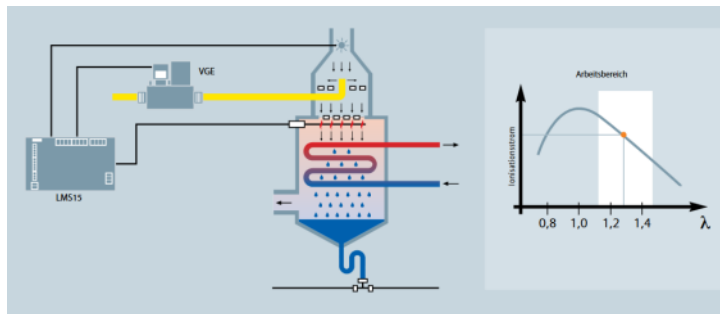
SCOT system
Kromschroeder



Lambda Pro system
Viessmann



VESTASIT
system
SIT

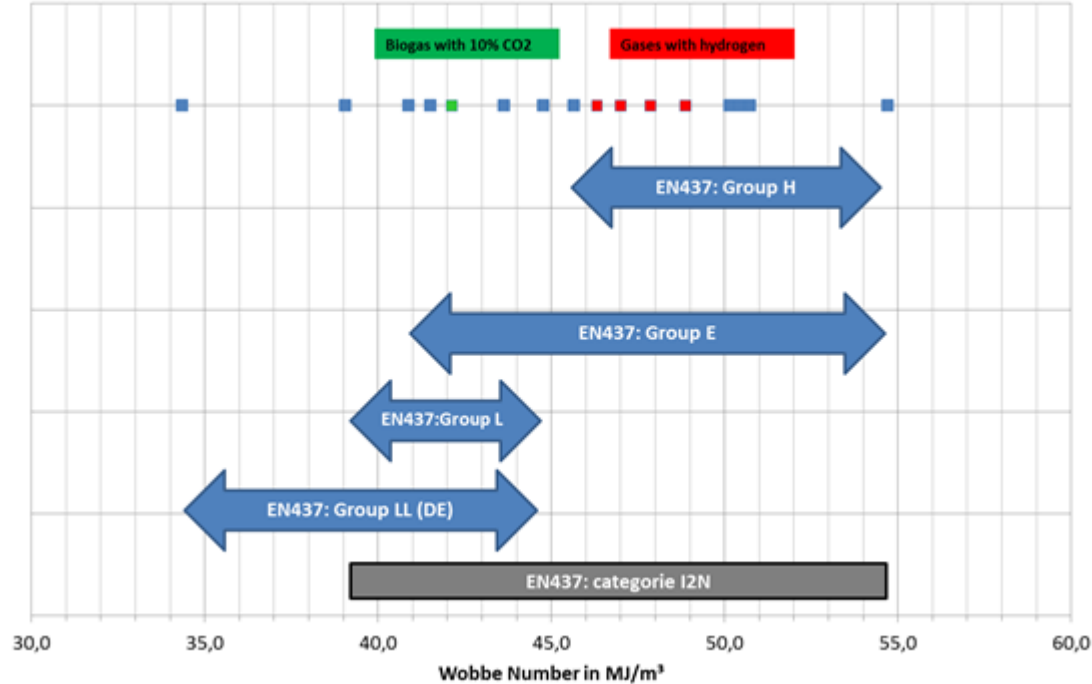


Sitherm Pro system
Siemens

Table made in 2017

Manufacturer	Load range	Year of market entry
Ariston	?	?
Bosch Thermotechnik Buderus	up to 20 kW	2017
Bosch Thermotechnik Junkers	up to 20 kW	2017
Brötje	15 kW-38 kW	2006
Chappee	12 kW	2016
Hansa	up to 36 kW	2018
Interdomo	15 kW-68 kW	2012
Rotex (Daikin)	15 kW – 28 kW	2017
Max Weishaupt	15 kW-60 kW	2001
Vaillant	up to 28 kW	2003
Viessmann	13 kW-150 kW	2005
Wolf	15 kW-30 kW	2013

Gases used in laboratory (Test of 6 boilers)



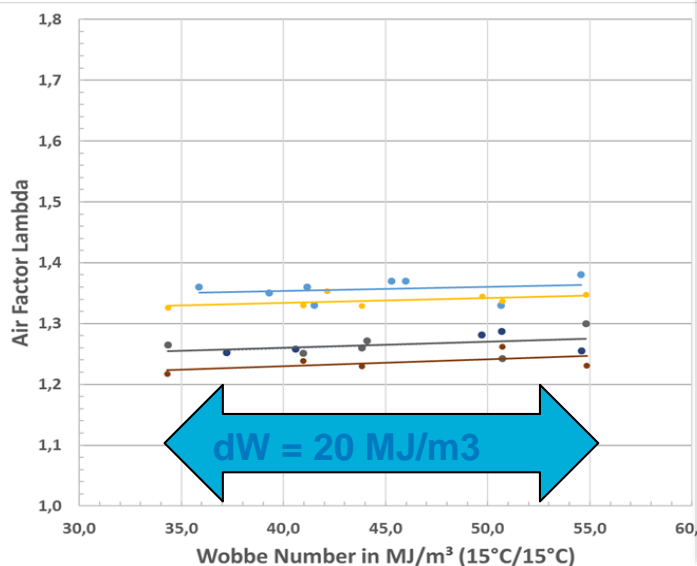
Test Gases over the whole range of natural gases.

Including the German group LL

Including hydrogen admixture up to 30%.

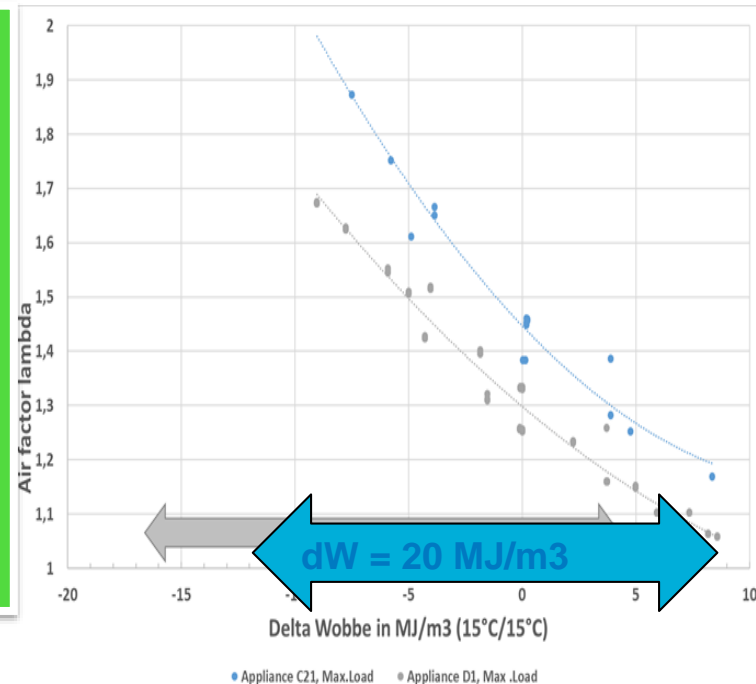
Including bio methane with 10% CO₂

Main Result: Air factor is maintained constant



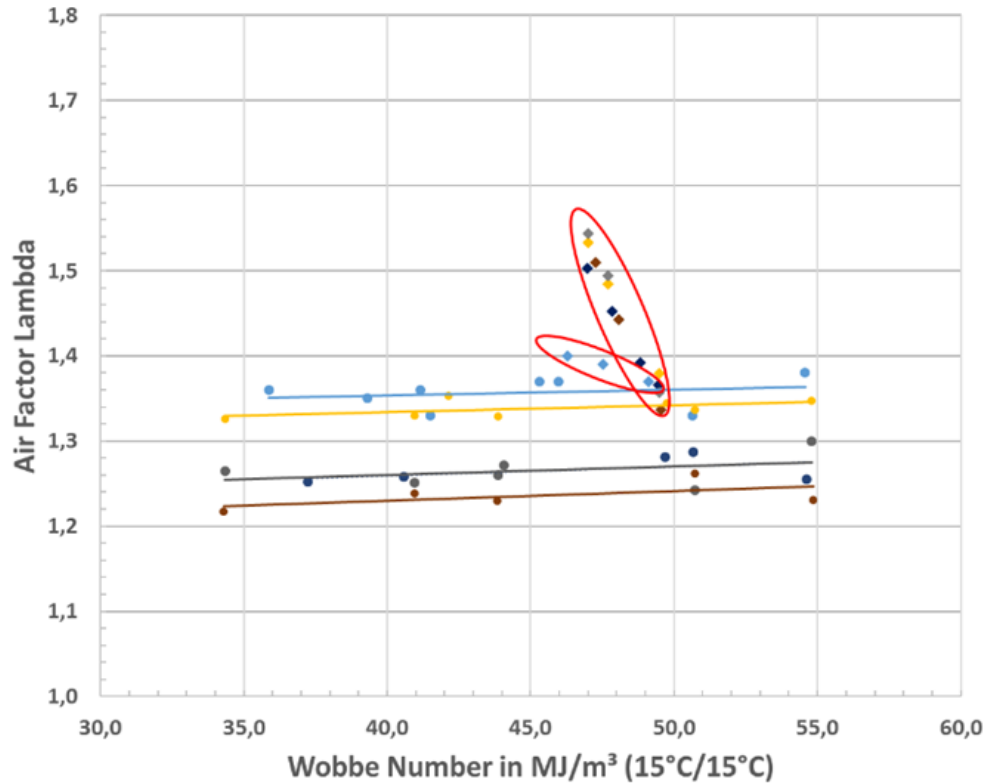
The combustion control system of all boilers keeps the air factor (e.g. O₂ and CO₂) quite constant over the whole range of Natural Gases with Ws from 34.3 MJ/m³ to 54.7 MJ/m³.

Boilers with Combustion control



Boilers without Combustion control

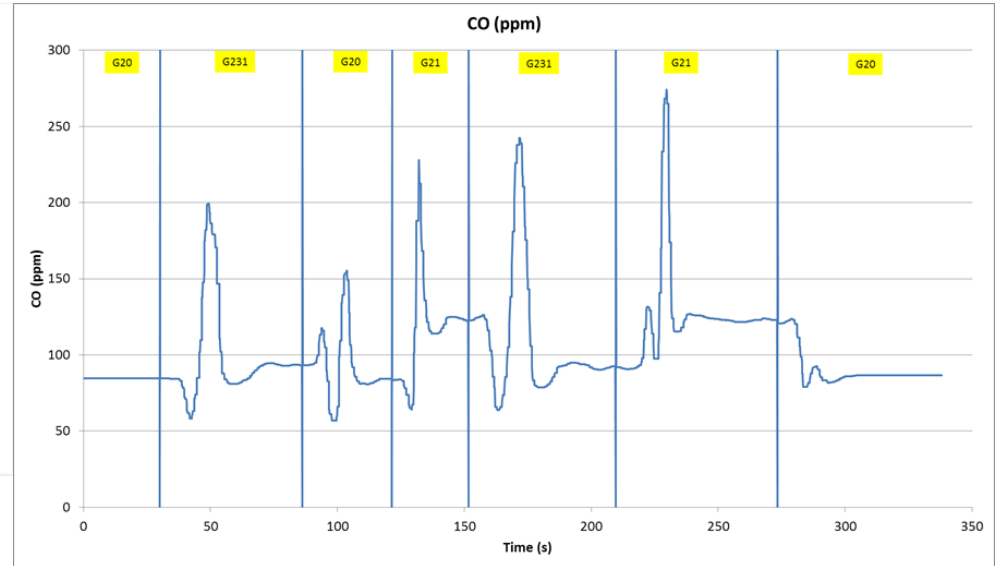
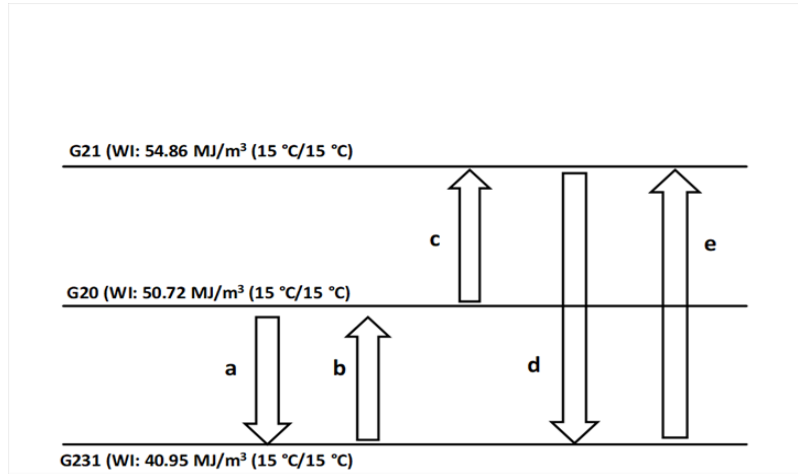
Air Factor change with H2 (but no safety issue encountered)



The boilers operate safely and with low emission with gases containing up to 30% hydrogen.

Emissions of CO and NOx are even reduced. However, the combustion control system does not work as for gases without hydrogen admixture.

Operation under rapid change



All boilers are able to cope with instantaneous jumps of gas quality from minimum to maximum and vice versa without any interruption of operation. The time to return to nominal operation (stabilization time) is less than 2 to 3 minutes.

Conclusion

As consequence of constant air excess:

- Stable **CO and NOx** over the whole range of Wobbe number.
- Stable **efficiency** over the whole range of Wobbe number ($< \mp$ ca. 2%)
- Because of the combustion control **no on site adjustment** is necessary (commissioning and maintenance or repair should be faster, cheaper and easier)

The development of market for boiler with combustion controls broaden considerably the range of Wobbe of that the gas appliance can burn and contribute positively in the harmonization of gas quality and **the integration of new gases in the net.**