

I&C Challenges related to Gas Quality Limits and Fluctuations

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Flexibility – a future requirement for gas users

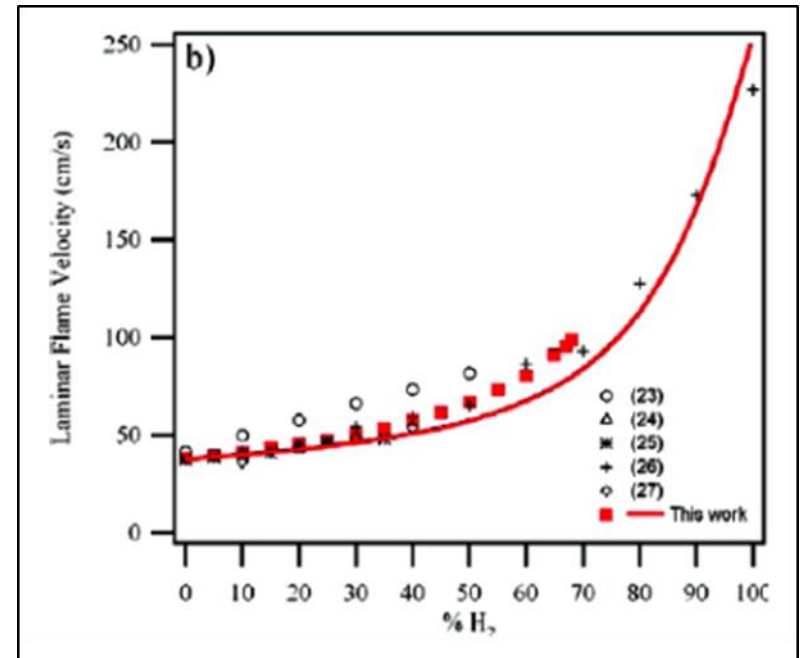
- To meet the challenges of accepting a wider range of gas types/sources:
 - Network operators have to be more flexible
 - But this must be tempered by the ability of the end-use equipment to be flexible also
- Any changes must not impact on the safety and integrity of using gas
 - But we need to explore if the existing ranges for gas quality can be extended to the benefit of all across the “Gas Chain”
- For this project we’re focusing on I&C industry impacts including:
 - Increasing the Wobbe Index limit
 - Enabling the quantity of hydrogen that’s acceptable to increase.

Gas Safety (Management) Regulations

Content or Characteristic	Value	
Hydrogen sulphide content	$\leq 5 \text{ mg/m}^3$	
Total sulphur including H ₂ S	$\leq 50 \text{ mg/m}^3$	
Hydrogen content	$\leq 0.1\% \text{ molar}$	Hydrogen blend up to 20%
Oxygen content	$\leq 0.2\% \text{ molar}$	
Impurities	No liquids or solids that interfere with consumer appliances	
Hydrocarbon and water dewpoint	No interference with consumer appliances	
Wobbe Index	47.2 to 51.41 MJ/m ³	53.25 MJ/m ³
Incomplete combustion factor	≤ 0.48	Update interchangeability parameters?
Sooting index	≤ 0.60	

Fundamental impacts of gas quality on combustion

- Compositional change can lead to:
 - Potential changes to Flame temperature
 - Potential changes in flammability limits
 - Burning Velocity
 - Autoignition temperatures (and ignition delay times)
- If the gas composition changes then this can impact on the air:fuel ratio and impact on:
 - Heat release profiles
 - Flame length and stability
 - Emissions (NO_x, CO, and more)

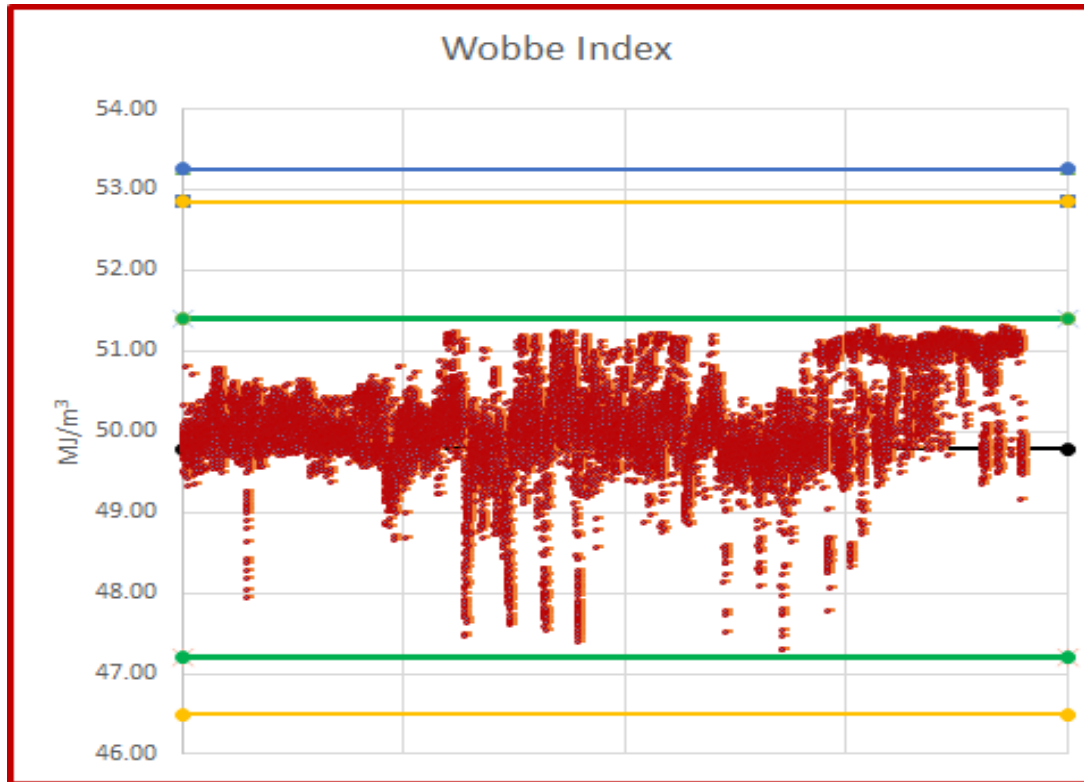


Dirrenberger et al (2011)

Possible impacts of wider gas quality range on I&C equipment

- Knock in gas engines
- Autoignition in premixed sections prior to burner in GT DLE (DLN)
- Heat release profiles change – overheating surfaces
- Existing control systems may struggle if outside of their design range
- Emissions may change
 - NO_x may increase, could be an issue for permit levels for power generators (IED – LCPD, MCPD)
 - EU ETS plant – CO₂ emission may vary as this is linked to gas composition (Hydrogen would help here).
- Measurement equipment may be compromised with wider fuel quality ranges and variability in gas composition

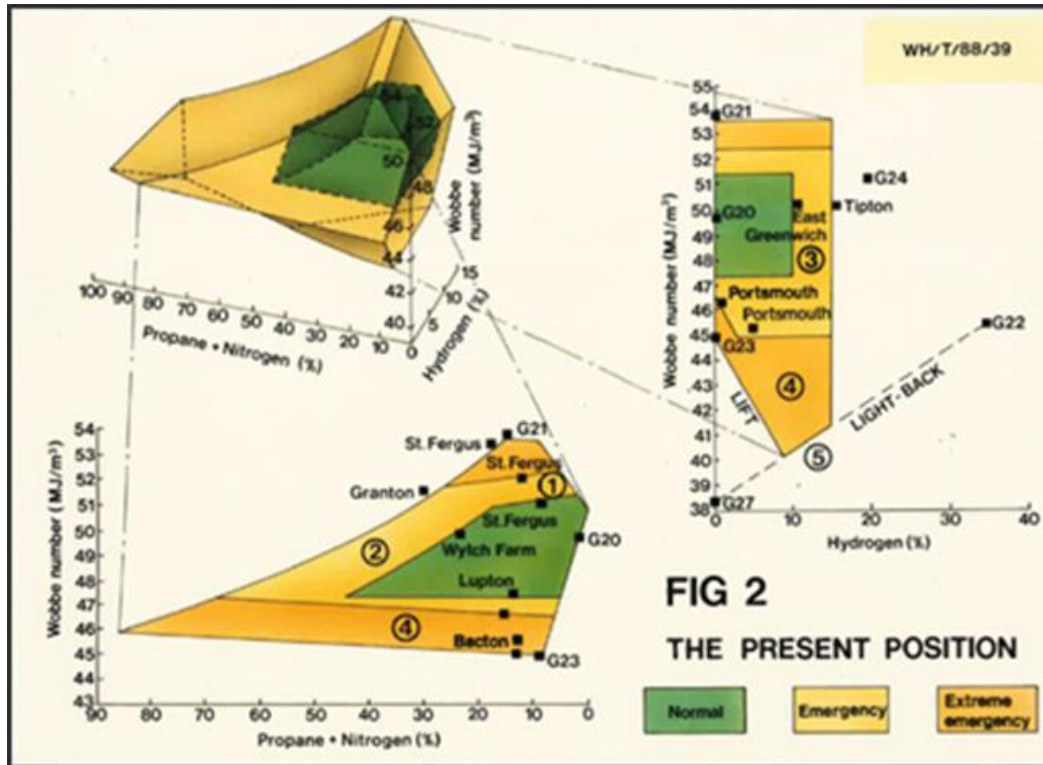
Possible ranges to consider for new Wobbe Index limits



— Current limits — Current emergency limit — Proposed change to upper limit

For Hydrogen in natural gas – historical information

- For the original gas interchangeability work
 - Older style partially premixed burners:



Impacts of hydrogen in gas on selected combustion equipment

- Effect on burners
 - Generally OK for relatively modest hydrogen addition (up to 10%)
 - Appliance type and make specific (may be an issue with the age of some appliances)
 - Influence of burner type
 - Possible loss of performance – may be an important consideration if any boilers are slightly undersized for the properties
- Effect on gas turbines
 - Siemens GT gas specification for newer installations – up to 10% H₂ acceptable
 - GE still recommend their published gas specification – which mentions “Trace” hydrogen content (although they are reviewing their recommended guidelines)
- Effect on gas engines
 - Conflicting information – it appears that there is a consensus that 5% H₂ will be OK but higher hydrogen content may result in operational difficulties

I&C – gas quality impacts

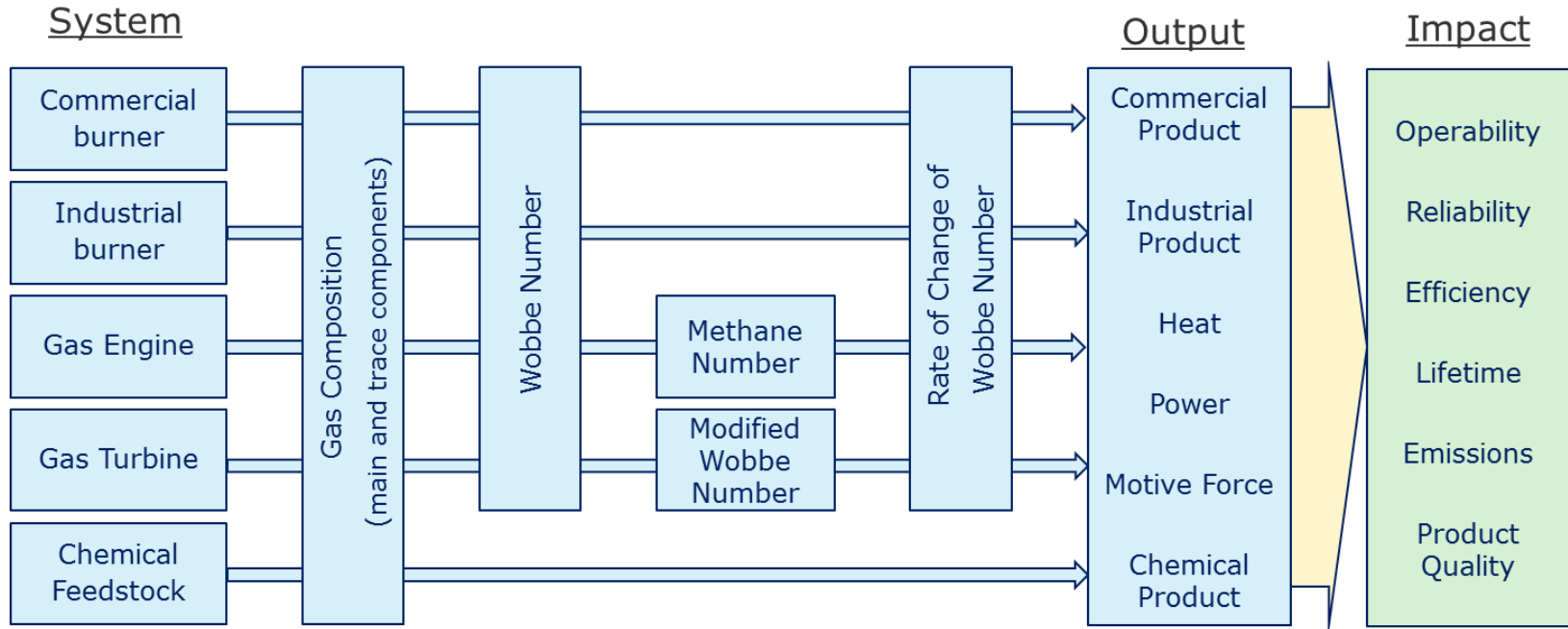
Project Overview – Impact on Industrial and Commercial Gas Users

Overview

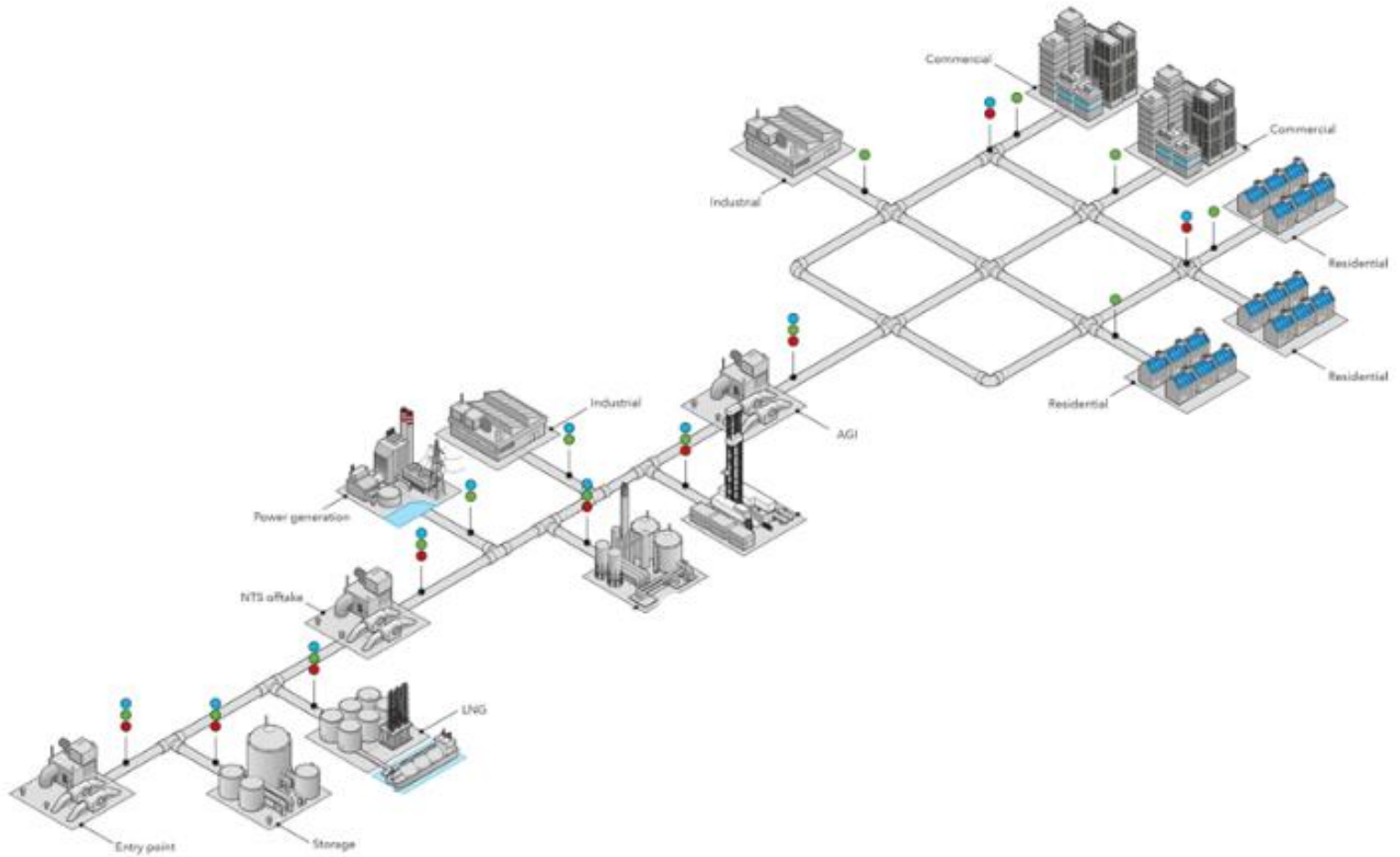
- Gas quality issues
 - Burner/system operability
 - Burner/system controls
 - Process/product quality impacts
 - Emissions (NO_x, CO, HAPs, VOCs)
- Control systems
 - Gas quality or the process?
 - Sensors (oxygen/hydrogen)
- Collate information from end-users
 - Stakeholder Workshop
- Report on findings



Concept– Impact on Industrial and Commercial Gas Users



Stakeholders and concerns



I&C Questionnaire and Information received so far

Industry engagement

- Literature review
- One-to-one meetings
- Questionnaire
- Stakeholder Workshop
(this event)

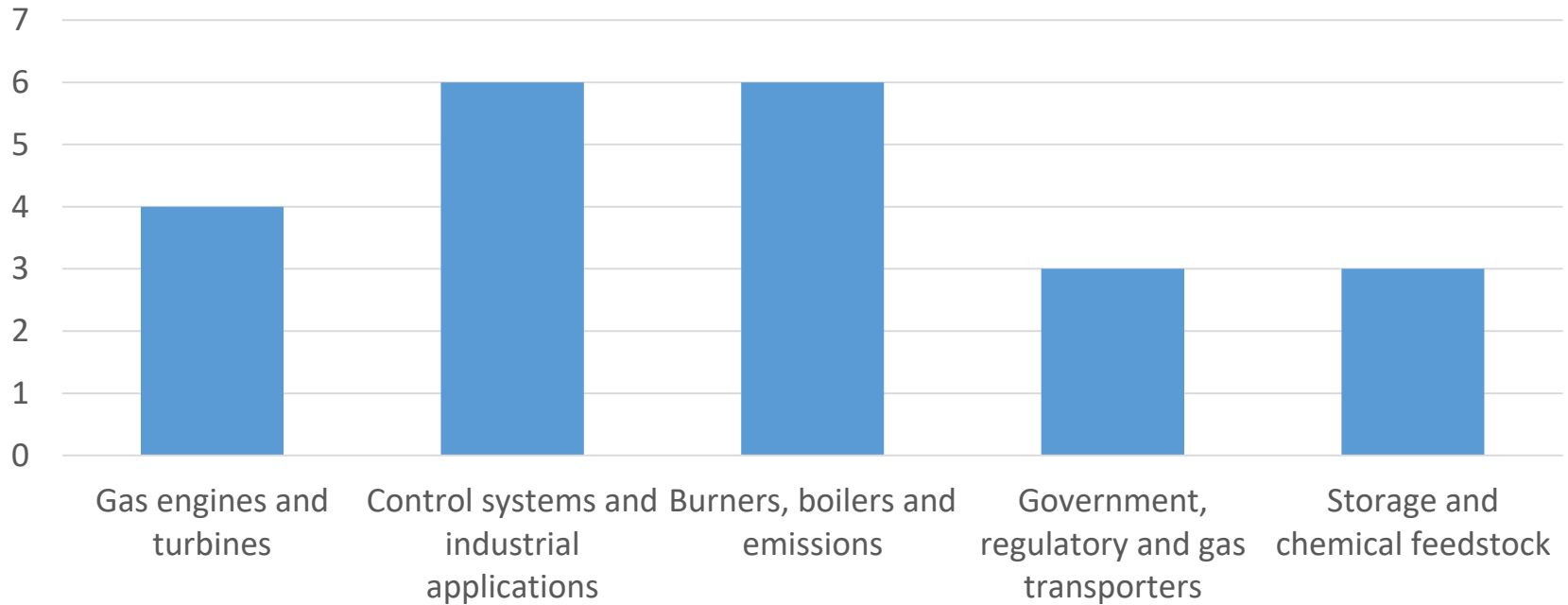
#	Category	Question
1	Combustion Plant Details	A brief overview of your combustion equipment/controls and how gas quality impacts your business
2	Current Gas Characteristics	Is your company aware of the gas quality characteristics of your natural gas supply (Composition, Wobbe Index, CV, etc)?
3		Do you experience operational and/or commercial issues with the current variation of gas composition/quality?
4	Current Gas Quality Measurement	Do you measure (or use data provided on) the current variation of gas composition/quality?
4a		Do you take any action when gas quality changes are measured or indicated by a third party?
4b		Can your plant accommodate current variations in gas quality (see illustration in introduction)?
5	Possible Future Gas Characteristics	If the gas quality limits were widened, would this impact on the performance and operability of your equipment for combustion, measurement or control?
5a		If you use gas as a feedstock for a chemical process would the wider range impact on your process?
6		If widening the limits also increased the frequency and magnitude of gas quality changes, would this impact on your combustion equipment, measurement equipment or control equipment?
7		If hydrogen were added to the natural gas supply at amounts of up to 20 mol%, would this impact on your combustion equipment, measurement equipment or control equipment?
8	Remedial actions and research	If the gas quality limits (Wobbe Index and hydrogen content) are amended, can existing systems and equipment be adapted or upgraded to ensure continued operation?
9	Additional information	Any further details which may be relevant

Information received so far

- Questionnaire sent to around 80 contacts
 - Major industrial users / equipment suppliers
 - Industry bodies / trade associations
 - Several consultants
- Coverage from gas entry to emissions measurement
- 22 questionnaires returned:
 - Highlighted that some industries are aware of gas quality impacts (eg. Power generation)
 - Some are not overly concerned (as long as the CV is within a typical range)

Questionnaire Responses

Number of Responses



The convenors for the workshop:

- The convenors are:
 - Gas engines / Gas turbines (Howard Levinsky)
 - Control systems / Industrial applications (Terry Williams)
 - Burners / Boilers / Emissions (Martin Brown)
 - Government, Regulatory / Gas transporters (Dave Lander)
 - Storage / Chemical feedstock (Richard Whitehead)

Group Leader	Morning	Afternoon
Howard Levinsky	Red	1
Terry Williams	Black	2
Martin Brown	Blue	3
Dave Lander	Green	4
Richard Whitehead	Orange	5

Thank you and we hope you enjoy the workshop

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