Hydrogen Blending Standards: UK-Canada-US knowledge sharing and collaboration building

Steffan Eldred, Knowledge Transfer Manager - Clean Energy & Infrastructure at Innovate UK KTN

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BACKGROUND

In March 2021, the British Consulate-General Vancouver and the UK Science and Innovation Network partnered with Innovate UK KTN to deliver two open-audience webinars and a virtual workshop. Those events demonstrated the opportunity for the UK, Canada and the US, three G7 countries, to work together and show leadership in key enabling regulation for the new hydrogen economy.

Since then, hydrogen's role in the net zero economy continues to develop at pace. Addressing gaps in codes, standards and regulation for hydrogen and natural gas blending remains an important key to unlocking the low carbon hydrogen opportunity and accelerating decarbonisation.

In February 2022, the British Consulate-General Vancouver and the UK Science and Innovation Network partnered again with Innovate UK KTN to bring leaders from the hydrogen standards community in the UK, Canada and the US together for another open audience webinar and two further virtual workshops.

The webinar on 15th February shared progress and action on hydrogen blending standards over the past year. The 210 plus attendees were also given the opportunity to network with other delegates via a meeting platform. You can access the webinar recording on the Innovate UK KTN Website here.

Two workshops on 16th and 17th February enabled industry, regulatory, policy and academic experts to meet through facilitated breakout sessions. Each workshop opened with a relevant industry talk highlighting case study activity and successes. The topics included:

- Developing technical standards models
- Standards and connections for centralised versus localised blending
- Developing materials and infrastructure standards for blending
- Developing materials and infrastructure standards for distribution

A summary of the workshops and these discussion topics is provided in this report. It was clear that significant progress has been made in the last year with practical examples being given at both the webinar and the workshops of projects that are in flight. The workshops highlighted continued interest in opportunities for UK-Canada-US collaboration.

WORKSHOPS: Knowledge sharing and collaboration building

On the 16th and 17th of February 2022, workshop discussion groups focussed on technical standards models, standards, and connections for centralised versus localised blending, and developing materials and infrastructure for blending and distribution.

Under each topic, participants worked through three key questions to share their organisation and country activity:

- What has happened in the past 12 months?
- What are the next steps collaboratively, what is the decision making process and who is responsible for this process?
- Who are the right people and organisations to take this action and collaboration forwards?

A summary of the discussion notes posted by the attendees is provided below. Please note that these points reflect the personal opinions and experiences of attendees and may not reflect the policies or views of all present or their organisations. A summary of the attendees' organisations is provided in the Annex. Not all attendees attended both workshops.

WORKSHOP 1 | 16th February 2022

Developing technical standards models

What has happened in the past 12 months?

UK

- HyStreet test facility with DNV at Spadeadam
- HyDeploy Winlaton site started blending onto public gas network
- East Coast Cluster and HyNet North West given the go ahead
- Future Billing Methodology consultation
- UK hydrogen strategy publication
- UK has consulted on low-carbon hydrogen standard (late 2021) following report produced on options – The UK's Department for Business, Energy & Industrial Strategy (BEIS) is due to finalise this in 2022
- Worked on the Gas Safety (Management) Regulations to make them hydrogen ready by removing some constraints such as Incomplete Combustion Factor (ICF) and Soot Index (SI) and replacing them with RD limits. Now being consulted on.

Canada

- Alberta has published a hydrogen strategy (Oct 2021) and consulted with local stakeholders on updating legislation to allow for hydrogen blending (expected early 2022). This involved BEIS and Northern Gas Networks (NGN) sharing their experiences
- BC Hydrogen Strategy released in July 2021.
- Establishment of codes and standards working group among other working groups supporting the Canadian hydrogen Strategy
- National Research Council (NRC) and The University of British Columbia (UBC) created a collaboration centre on Clean Energy Transition
- Natural Resources Canada started 4 projects related to codes and standards and a 4-year Clean Fuels Programme wrapped up. Selection in April 2022
- Enbridge Power to Gas (PtG) project started in Ontario
- Quebec is doing a consultation for a hydrogen strategy for 2030
- Énergir (network gas distributor) is testing Hydrogen in closed networks - gradually to a target of 20%
- Institute of gas engineers and managers are developing standards for blending and 100% hydrogen
- CSA Z662 Oil & Gas Pipeline Systems - added H2 section for public review. Publishing 2023.
- CSA Group Research Renewable Gas Pathways for Codes and Standards
- CSA Group Research for hydrogen blending in end use appliances up to 15%

US

- Pilot projects by individual utilities organisations

What are the next steps collaboratively, what is the decision making process and who is responsible for this process?

- Information sharing at the codes and standards Working Group, deciding together to determine gaps and priorities
- UK Low carbon hydrogen standard consultation feedback

- H2 neighbourhood & H2 town proposal development
- Flow metering of H2 and gas/H2 blends
- Metering and billing of H2-gas blends
- Appliance performance and testing with blends and H2
- H2 fugitive emissions modelling and measurement
- Ministère de l'Énergie et des Ressources naturelles (MERN) du Québec will do regulation for blending H2 in natural gas this year.
- Regulatory policy updates - provincial governments in Canada
- Share learning and best practice from live field trials. Ultimate decisions will be from HSE and UK government, supported by industry

Who are the right people and organisations to take this action and collaboration forwards?

- International standards bodies (International Organisation for Standardisation for example)
- Canadian standards development organisations (Bureau de normalisation du Québec (BNQ) and CSA group for example)
- Natural Resources Canada
- British Standards Institute
- American Society of Mechanical Engineers
- NRC providing scientific support to the likes of CSA. Collaboration opportunity.
- Standards Council of Canada
- UK Health & Safety Executive
- Gas Technology Institute
- UK Ofgem (for billing)
- Gas distributors (Québec)
- MERN Québec - regulation
- Environment Agency
- End users of the system, particularly where there are risks to those users (e.g. industrial processes)
- SGN gas networks for gas distribution network
- TUV-NEL for H2 and blend metering
- Kiwa for Appliance testing with H2 and blends
- DNV for pipeline standards and testing
- Le bureau du développement de l'hydrogène et des bioénergies (at MERN Québec)
- British Columbia Oil and Gas Commission (BCOGC) works with the University of British Columbia to inform of Hydrogen projects, and technical research summaries.
- CSA Z662 has members across various standards who bring the info back to the committee.
- Scientific and engineering community needs to continue publishing results
- CSA Group H2 Community
- CSA Group Research
- Institute of Gas Engineers & Managers (IGEM) have launched a Hydrogen knowledge centre with the aim of having a central repository for evidence supporting hydrogen blending and 100%h2
- CSA Group research

Standards and connections for centralised versus localised blending

What has happened in the past 12 months?

UK

- Designing Hydeploy 3 - large scale blending pilot
- Transmission pipeline spec for 2% H2
- Distribution network spec for 20% H2 max without replacing all existing appliances
- Hydrogen neighbourhood trial by 2023, followed by a large hydrogen village trial by 2025, and potentially a hydrogen town pilot before the end of the decade.
- Centralised blend for 2%, local for >10% H2
- Localised trials (HyDeploy) testing blends at Keele University and Winlaton
- BEIS leading on assessing 'technical model' options for blending - i.e., where/how hydrogen is injected
- UK Track 1 clusters announced for large scale H2 production
- Looked at impact of hydrogen on some metallic assets in gas networks by examining some of the data behind existing industry standards
- Started offline testing of decommissioned steel high-pressure assets in the FutureGrid project - could be used to inform/update standards

Canada

- Centralised blending more difficult for Canada
- No blending taking place in the British Columbia pipeline system over 100 psi. Pilot projects in progress. Blending projects in discussion stages.
- Localised - Hydrogen hubs with 100% H2 needed for the long term.
- Hubs will be localised in regions where H2 is needed. Blending for the short term to begin the transition to 100%.

What are the next steps collaboratively, what is the decision-making process and who is responsible for this process?

- Protocols for consumer billing of H2 blends
- Governments - for example, Scottish target for 1 million homes on zero-carbon heating by 2030
- Information sharing at the codes and standards working group, deciding together to determine gaps and priorities
- Development of '100% H2 ready' gas appliances
- Collaborate on commonalities. Natural gas networks have unique characteristics. Localised studies will be required to convince decision makers.
- Québec will launch its strategy for green H2 and biofuels this year.
- Share both test results and evidence gaps as there is so much to do and so little time
- Québec is working with BNQ and CSA for a standard related to carbon intensity
- The Hy4Heat programme in the UK was a good example of collaboration across the supply chain

Who are the right people and organisations to take this action and collaboration forwards?

- Pipelines technical standards CAN/BNQ; This code is published by the Bureau de normalisation du Québec (BNQ) as a National Standard of Canada

- MERN Québec - regulation
- Natural Resources Canada
- Gas distributors (Québec)
- Énergir
- Gazifère
- Gas price – distribution: Régie de l'Énergie du Québec
- NRC providing scientific support to the likes of CSA, BNQ. Collaboration opportunity
- Canadian standards development organisations
- International standards bodies
- Standards Council of Canada
- Health and Safety Executive UK
- UK Research and Innovation (UKRI) collaborative funding between UK & Canada

Other activities to share

NRC currently conducts 4 projects (funded by Natural Resources Canada (NRCan)) that are relevant:

- Gap analysis in codes and standards for the entire H2 value chain
- Life Cycle Analysis methodology to assess the carbon intensity for H2 production pathways
- Appliances compatibility towards H2/natural gas blends
- Material testing methods for distribution pipeline materials to assess compatibility towards blends

WORKSHOP 2 | 17th February 2022

Developing materials and infrastructure standards for blending

What has happened in the past 12 months?

UK

- Regulatory approval for blending 20% hydrogen into natural gas networks in Northern England.
- Looked at adding to the body of knowledge of impact of hydrogen on some metallics (interpretation of American Society of Mechanical Engineers standards)
- UK is moving from desktop studies to consumer pilots with hydrogen blends
- Government research programmes such as Hy4Heat are developing the evidence base for standards development

Canada

- 5% of blending in Fort Saskatchewan for residential use by ATCO energy and for regulations is in progress
- Regulatory development is in progress for accepting H2 in Québec. Percentage of H2 allowed in natural gas is not yet established
- Markham Ontario has a 2% Blending Project that started in Q1 2022, 3600 downstream customers
- NRC started work on material testing, to be focused on distribution pipeline materials as well as appliances compatibility, including testing in the Canadian Centre for Housing Technologies
- CSA is setting H2 Production Standards
- Measurement Canada is assessing H2 impact on metering
- Each province has its own regulations - then communicate across them
- Holding seminars will help inform our members of the current activities, research and demonstration projects to aid in their assessment of the impact on our existing suite of standards, and to identify gaps and new opportunities for standards solutions to enable the deployment of hydrogen across Canada
- Many individual stakeholders are conducting their own research, and there are various funding mechanisms available. The work can be siloed, with many not aware of what others are doing. The creation of the NRCan and Standards Council of Canada (SCC) led codes & standards working group will aim to tackle this.

US

- A lot of interest in blending in the US - looking at learning from the UK experience.
- Gas Technology Institute (GTI) has H2 Sensor Research Underway
- Recent studies / conversations with infrastructure companies have revealed various steel pipeline vintage classes and timeframes that have varying ‘readiness’ factors based on age. Pre 70s (good), 80s (poor), and post 90s (better)
- Southern California Gas Company (SoCalGas) Demo
- California Energy Commission (CEC) just released Notice of Funding Opportunity - $5.6M funding for investigating blending for power generation and industrial use. In conjunction with SoCalGas study, and others, California Public Utilities Commission (CPUC) will look to set injection standards from these results

- Utilities are concerned with their respective assets and want to test them to ensure confidence in safety.

What are the next steps collaboratively, what is the decision making process and who is responsible for this process?

- Most of the standards relevant in British Columbia will be developed provincially - BCOGC and Technical Safety British Columbia.
- The current UK blending approval is under a Health and Safety Executive (HSE) exemption - collaboration would be useful to bring the exemptions together and change the regulations for hydrogen.
- Cooperation between national regulators and readiness to accept results from other jurisdictions.
- Lots of collaboration in the European Union - but not cross Atlantic
- Develop international standards - this can be a slow process.
- Regulators need to get together - cooperate more
- It is on the provincial government to approve the process
- Direction des approvisionnements et des biocombustibles in MERN Québec is responsible for the new regulation about green H2 allowed in natural gas
- Régie du bâtiment du Québec (RBQ) in Québec is responsible for the construction aspect / civil security
- NRC is conducting a project building a lifecycle assessment-based methodology to assess the carbon intensity of hydrogen production up to distribution to point of use. Working with CSA and other federal labs.
- MERN Québec finance a new National standard for Canada with BNQ and CSA for determining carbon intensity of hydrogen
- Billing Standard for changing / variable calorific value is required as H2 levels change by node / season
- NRC and UBC created a collaboration centre to address R&D challenges such as this. Open for collaboration.
- We need to work from the same dataset to drive the decision-making process
- Funding for H2 production / network construction/modernization
- In Québec - H2 100% for the long term and blending for the short term.

Who are the right people and organisations to take this action and collaboration forwards?

- International collaboration between regulators
- Publish new evidence so that the results can be peer reviewed and shared.
- Proper innovation funding by regulators - system in UK works well under RIIO and this stimulated a lot of research.
- Québec: RBQ / MERN / Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) and Government
- ISO
- Research and development organisations such as NRC and University of British Columbia Collaboration Centre can provide scientific input with international collaborators
- Research funding agencies need to clarify the existing and required collaboration mechanisms
- National standards bodies (British Standards Institute, Standards Council of Canada):
- International standards bodies (For example ISO)
- Canadian standards development organisations (for example CSA group)
- Government regulators (e.g., NRCan)

- Industry participants
- Cross standard committees

Developing materials and infrastructure standards for distribution

What has happened in the past 12 months?

UK

- Lot of results/evidence coming from H21, H100 and FutureGrid projects enabling repurposing of gas networks
- UK Government moved forward requesting plans for a Hydrogen Village.
- Gas networks going beyond their remit as gas transporters to deliver hydrogen projects.
- Developing whole systems projects - electrons, molecules, water supply, electricity, and gas infrastructure.
- Moved into consumer pilots using blends, look towards 100% H2 development

Canada

- CSA is seeking input on Z662 oils and gas standard to address H2 issues for next revision - not certain what can be done to have alignment with international standards.
- New standards will be brought up but for the moment the H2 distribution networks are subject to standards in place (they need to be revised)
- NRC started work on material testing, to be focused on distribution pipeline materials while Canmet-Materials (NRCan lab) focuses on transmission pipeline materials. Canmet is involved in CSA relevant committees

What are the next steps collaboratively, what is the decision making process and who is responsible for this process?

- What can be done to help define energy exchange rules between Electric independent system operator and gas distribution system operators and transmission system operators to help storage as H2 in the gas grid?
- Share information, publish and peer review
- Regulators to share information
- There is an opportunity in Canada as energy (electricity and gas) are mostly a provincial jurisdiction
- Standards needed for systems that have been tested under high pressure
- Standardise calorific value measurement across networks. As will be variable with different blends - make the gas network smart!
- Large consumer outreach and public consultation to gain confidence
- MéridaLabs testbed at UBC

Who are the right people and organisations to take this action and collaboration forwards?

- In Québec, all the infrastructure / distribution network are under the authority of the RBQ with federal standards and BNQ and everything that goes in (the products / fluids) are regulated and quality analysed by the MERN. All that with the ministry of environment, gas distributors.

- Mechanical engineering standards like ASTME-ANSI (American National Standards Institute) that has data for materials to provide data
- Research organisations can provide the data and analysis to inform the decision-making process

Other activities to share

- Canadian federal regulations likely to look to experience in Provinces
- One of the DNV Joint Industry Projects across countries to check hydrogen readiness of gas network equipment.
- Details on odorant research in the UK can be found here.
- Codes of Canada working group about to be set up. Aim to bring wide range of stakeholders to perform gap analysis to inform standards

ANNEX | List of workshop attendees' organisations

Canada

- BC Oil & Gas Commission
- Conseil national de recherches Canada / National Research Council of Canada
- CSA Group
- Énergir
- FortisBC
- Ministry of Energy, Mines and Low Carbon Innovation, Government of British Columbia
- Ministère de l'Énergie et des Ressources naturelles du Québec / Ministry of Energy and Natural Resources (Québec)
- Natural Resources Canada
- Standards Council of Canada
- The Transition Accelerator
- Triple E Energy Advisors Inc.
- University of British Columbia

United States

- California Public Utilities Commission
- GHD Inc

United Kingdom

- British Consulate-General Calgary
- British Consulate-General Vancouver
- Cadent gas
- Department for Business, Energy & Industrial Strategy
- Department for International Trade
- DNV
- Energy Institute, University of Chester
- GHD Ltd
- Innovate UK
- Innovate UK KTN
- Kiwa UK
- Northern Gas Networks
- Scottish Hydrogen and Fuel Cell Association
- SSE Energy Services
- UK Science and Innovation Network