End User Safety Evidence (EUSE) Programme

Energy Innovation Summit 2024

Brad Bannerman
Project Engineer - Future Energy & Investment

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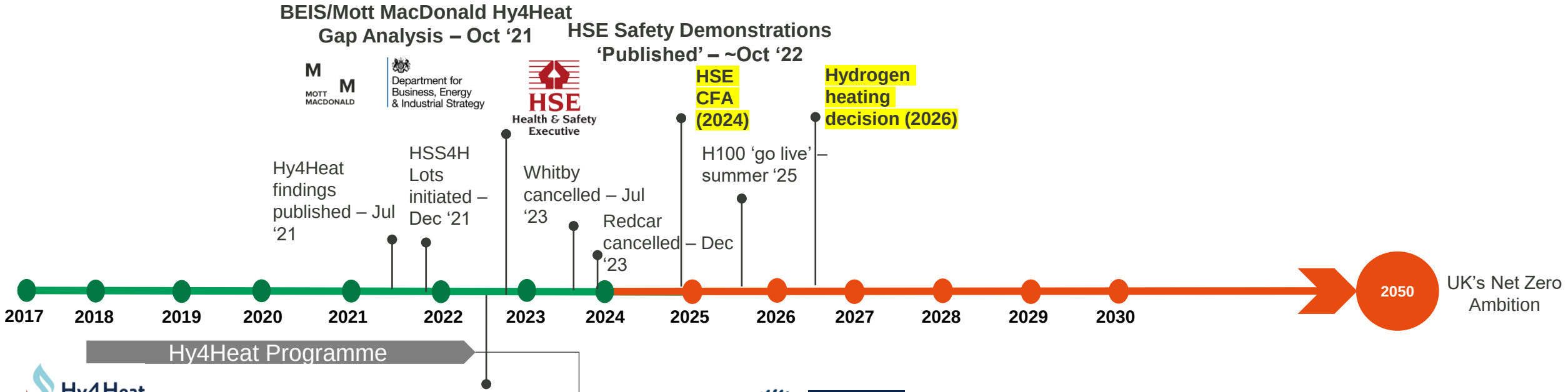
Agenda

1. Hydrogen End User Safety Research in the UK
2. EUSE Programme Overview
3. Notable Projects
4. What's Next?

1.

Hydrogen End User Safety Research in the UK

1. Hydrogen End User Safety Research in the UK



Proved that it was **technically possible for hydrogen to be made as safe as natural gas** for heating and cooking in certain types of houses.

Put forward "conservative" mitigation measures to enable this and stated that "**substantial further work will need to be done".**

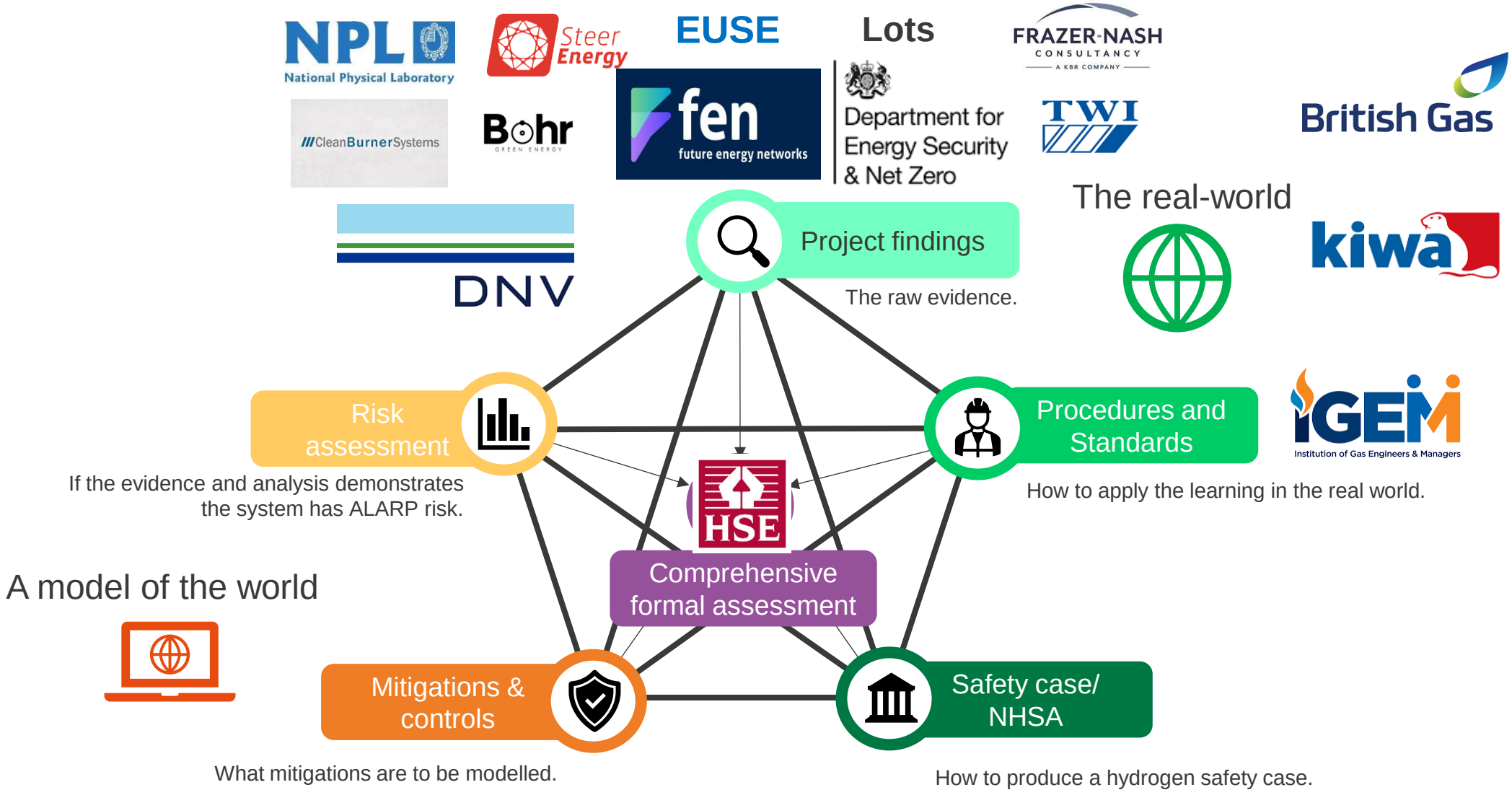
HSS4H – Included 5 research 'Lots' and BSI PAS, IGEM H, and training standards.
EUSE – Individual research projects covering any gaps remaining after initiation of HSS4H Lots.

Requires amalgamation of all the research from Hy4Heat, HSS4H, and EUSE.

Relevant interpretation into robust risk demonstration (QRA) and practical guidance for engineers (via Standards).

HSE CFA and Heat Policy Decision

1. Hydrogen End User Safety Research in the UK



1. Hydrogen End User Safety Research in the UK

(Everything We Do) We Do It For HSE and DESNZ.

3 ‘key’ questions that we have had to answer

1. Can we provide “complete” evidence coverage of the HSE’s 65 evidence demonstrations for policy decision?

   Project findings

2. Can we demonstrate that the comparative risk profile of hydrogen is “as safe as” natural gas?

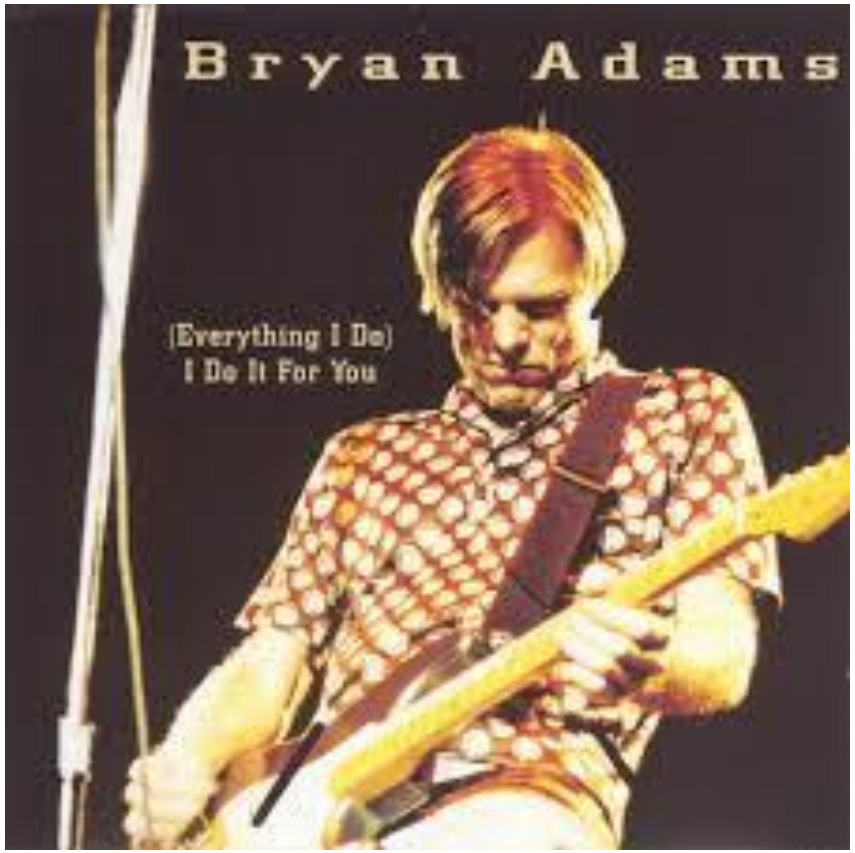
   Risk assessment

   Mitigations & controls

3. Can we translate the evidence to show “how” we would convert properties to hydrogen safely AND practicably?

   Procedures and Standards

   Safety case/ NHSA



2.

EUSE Programme Overview

2. EUSE Programme Overview

Project	Completion Date
1 – Ignition Consequence (NGN)	August 2024
2 - Multiple QRA assessments (NGN)	June 2023
3 - End User Behaviour – Impact on Safety (Cadent)	June 2023
4 - Conversion strategy – Pipework (Cadent)	October 2023
5 - Retrofit EFV (SGN)	August 2023
6 - Domestic Ventilation (WWU)	August 2023
7 - Hazardous areas within buildings (WWU)	June 2023
8 - Ignition Probability in Small Services (SGN)	July 2023
9 - AIVs in medium services (Cadent)	September 2023
10 - Implications of hydrogen purity (Cadent)	March 2024
11 – Specific Fire & Risks (SGN)	October 2023
12 – Domestic Hydrogen Detector Research (NGN)	March 2024
13 – Dispersion of Helium Releases in Domestic Properties (Cadent)	June 2024
14 – Domestic Gas Installation Safety Control/HyBreak (NGN)	February 2026
15 – IGEM Downstream Hydrogen Standards Development (Cadent)	October 2024
16 – Air Ingress in Isolated Installations	November 2024

- Initial programme of 10 projects initiated in 2022.
- Programme has extended to include a further 6 projects.
- ~£8 million programme.
- Led by the UK GDNOs in support of planned village-scale trials.
  - Scope of research focused on domestic end users.
  - In absence of trials, research has become more critical to inform HSE's CFA of hydrogen for heat

2. EUSE Programme Overview

- **Preventing leakage**
  - **“Hydrogen Conversion Strategy – Pipework”** project.
- **Limiting the impact of leakage**
  - **“Retrofit EFV”** project.
  - **“Domestic Hydrogen Sensor Research”** project.
- **Understanding hydrogen accumulation and dispersion after a leak**
  - **“AIVs in Medium Services”, “Dispersion of Helium Releases in Domestic Properties”, “Domestic Ventilation”** projects.
- **Understanding the consequences of ignition**
  - **“Ignition Consequences”, “Ignition Probability in Small Services”, “Specific Fire and Risks”** projects.
- **Understanding the customer**
  - **“End User Behaviour – Impact on Safety”** project.
  - Experience from the Village Trials (planning stages) in Whitby and Redcar.

3.

Notable Projects

3. Notable Projects

Hydrogen Conversion Strategy – Pipework

- Hy4Heat had already proven that a **non-leaking installation in natural gas will be non-leaking in hydrogen.**
- Repurposing existing gas installation pipework in domestic properties is a critical enabler of hydrogen heating.
- Assuring the integrity of “hidden” pipework in domestic properties is a challenge.
- This project investigated novel, **non-intrusive**, inspection methods that would provide sufficient assurance of existing pipework integrity without the need for an **intrusive visual inspection.**
- **Outcome: An elevated pressure test procedure was put forward in collaboration with British Gas.**
    - Research showed that a **1 barg test with air** would provide the greatest probability of identifying any defects ahead of conversion.

3. Notable Projects

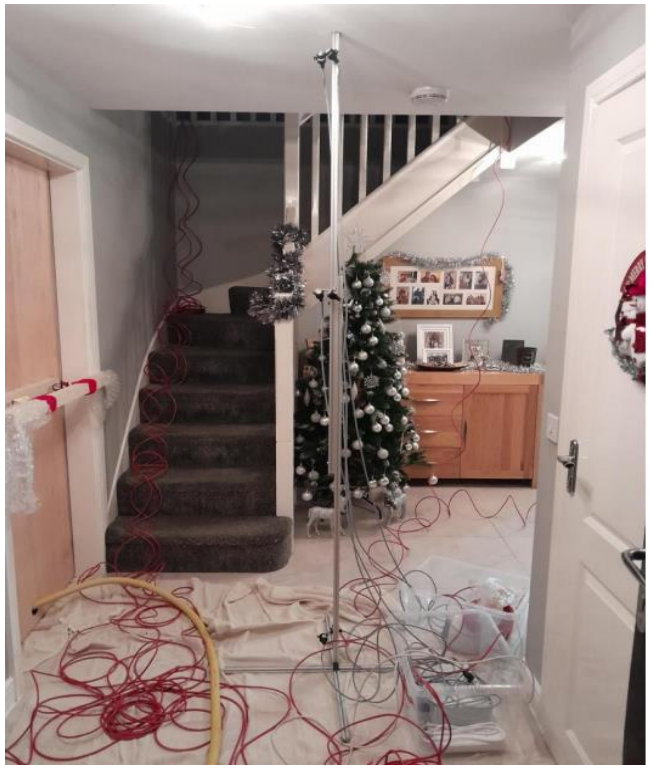
Domestic Hydrogen Sensor Research

- The Quantitative Risk Assessment (QRA) identifies hydrogen detectors as the most effective risk mitigation measure.
- There are three types of sensor being considered in the UK:
  - **‘Local’** – alerting householder only.
  - **‘Remote’** – alerting gas emergency service to dispatch an emergency engineer.
  - **‘Smart’** – additional function to isolate the gas supply at the meter.
- Project developed a design specification for **a remote domestic hydrogen gas detector** to support early trials.
- **Outcome: Options for sensor and communications technologies identified (no one size fits all). Though some are unsuitable.**
  - Solid polymer electrochemical sensor was the best performer.
  - LoRaWAN achieved the best long-range signals in the area surveyed (bottom right image).

3. Notable Projects

Dispersion of Helium Releases in Domestic Properties

- Majority of hydrogen accumulation testing and modelling prior to this project had been conducted in purpose-built test houses or laboratory environments.
- Helium release testing was undertaken in 12 domestic properties, at various leak rates and locations. Leak rates:
  - 1.6 m^3/h – equivalent to a 2 mm hole at 20 mbar.
  - 6 m^3/h – equivalent to a 4 mm hole at 20 mbar.
  - 20 m^3/h – equivalent to a 7.5 mm hole at 20 mbar.
- Project enabled further validation of accumulation modelling, as well as providing recommendations for the use of gas detection and ventilation as part of conversion.
- **Outcome: Results support refining of ventilation requirements proposed by Hy4Heat. Optimum locations for hydrogen detectors also better understood.**



3. Notable Projects

End User Behaviour – Impact on Safety

- Series of focus groups and national survey undertaken to better understand customer attitudes and behaviours towards:
  - Hydrogen as an alternative fuel source.
  - General gas safety.
  - Potential mitigation measures associated with hydrogen operation.
- **Outcome: Quantitative updates to risk modelling and quantitative understanding of acceptance of mitigation measures – enables flexible application of mitigation measures on property-by-property basis.**

4.

What's Next?

4. What's Next?

- **Full focus on delivering the necessary evidence to support HSE and UK Government's (via DESNZ) assessment of hydrogen for heating in the UK.**
- **September 2024**
  - HSE deadline for evidence to support Comprehensive Formal Assessment.
  - Includes the translation of all research into engineering standards being written by IGEM.
- **September 2024 – June 2025**
  - Support HSE, as necessary, throughout their ongoing review of evidence.
  - Provide any further evidence to DESNZ to support the 2026 policy decision.
- **2026 planned policy decision**
  - Potential to expand programme to look at non-domestic and industrial users more specifically.

Thank you

Brad Bannerman

M 07929 877321

E brad.bannerman@cadentgas.com

Cadent

Your Gas Network