



**ATCO**

WHEN TRUST MATTERS

# CASE Study: Quantitative Risk Assessment of hydrogen blended natural gas for an existing distribution network and end-use equipment in Fort Saskatchewan, Alberta

Zoë Wattis (DNV), Andrew Phillips (DNV), Kalen Jensen (ATCO)

Presented by Zoë Wattis (DNV) and Jacqueline Fusco (ATCO)

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# FORT SASKATCHEWAN HYDROGEN BLENDING

**IN FALL 2022**

2,100 ATCO customers became the first in Alberta to use a 5% hydrogen/natural gas blend



Mostly residential homes



Some small businesses

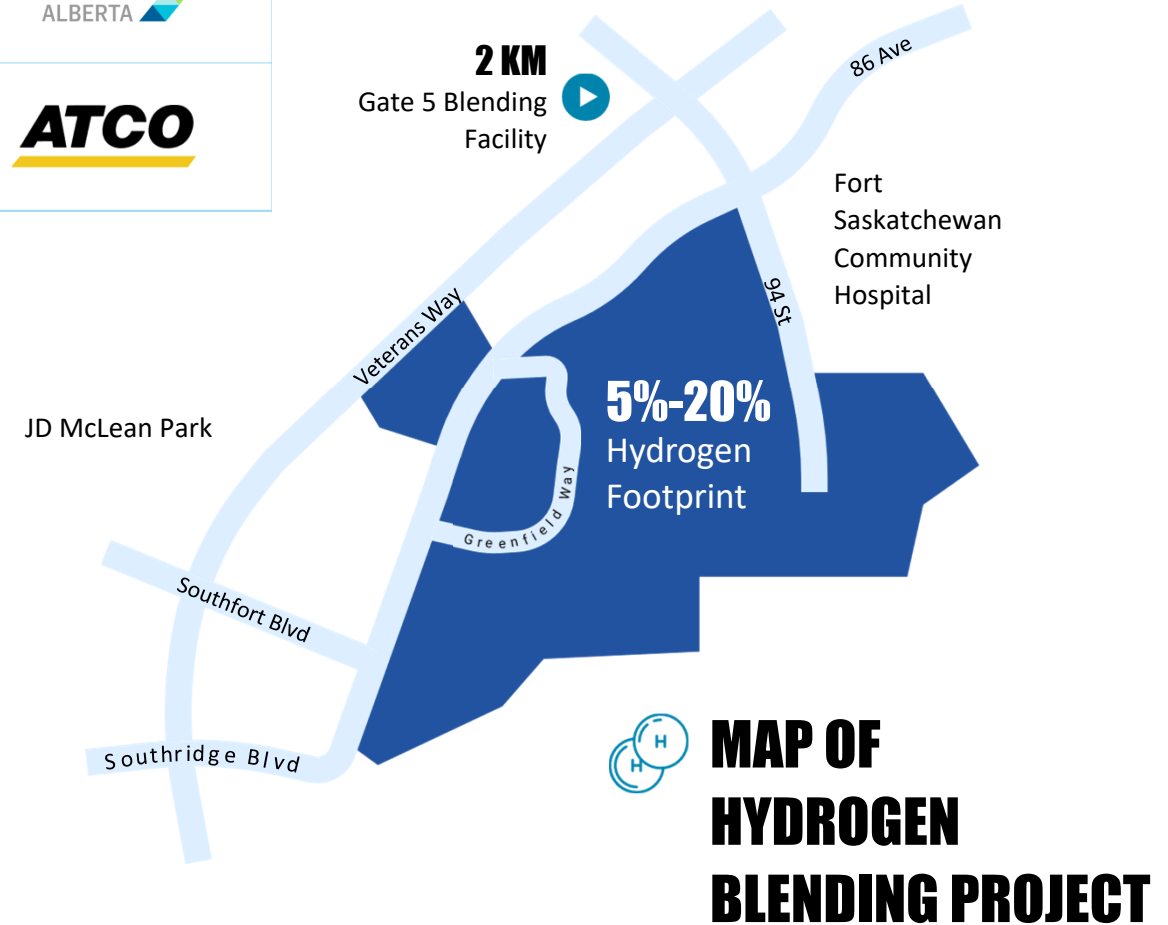


One school

EMISSIONS  
REDUCTION  
ALBERTA

**ATCO**

## PROJECT OVERVIEW



# ETHICS DRIVEN EXECUTION



## RULE 1

Health, safety, and welfare of the public and environment



## RULE 2

Competence



## RULE 3

Integrity, honesty, fairness, and objectivity



## RULE 4

Statutes, regulations, and bylaws



## RULE 5

Honour, dignity, and reputation



## ENGINEERING DESIGN AND REGULATORY COMPLIANCE



- Professional Work Products authenticated in compliance with APEGA guidelines and ATCO's Professional Practice Management Plan
- Engineering Management Plan to ensure competence and adherence to APEGA Code of Conduct
- Designed all systems to applicable codes

## OPERATIONS AND SAFETY



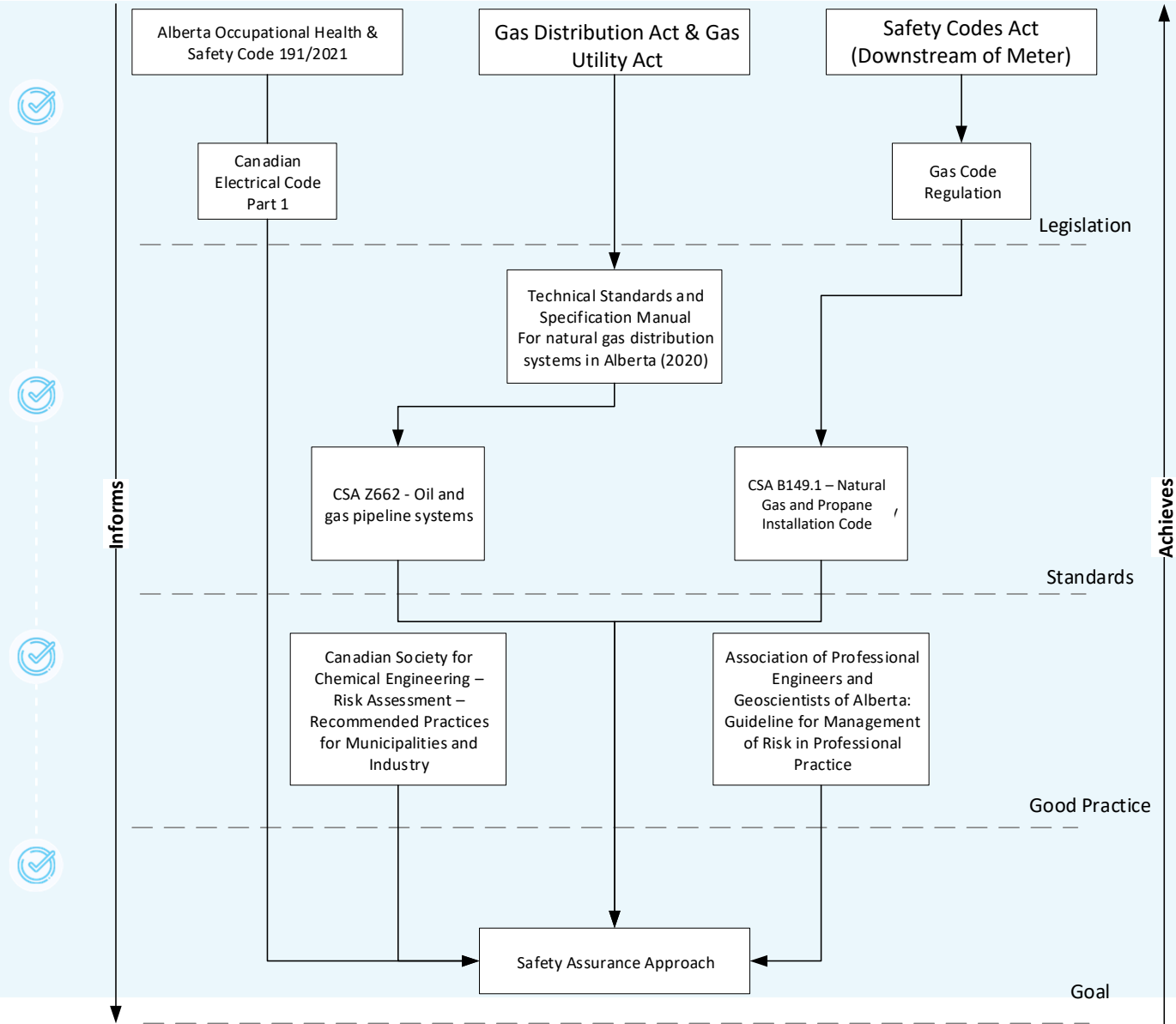
- Robust Organizational Change Management (OCM) Program – Risk/Engineering Assessments, Work Procedure (WP) reviews, technology/equipment validation, etc.
- Trained operators to own, operate, & maintain pure H<sub>2</sub>/H<sub>2</sub> blended systems

## CUSTOMER AND REGULATOR ENGAGEMENT



- Government and regulatory bodies consulted and supportive
- Customers and employees engaged via proactive consultation and feedback implemented into the OCM Program

# RELEVANT POLICIES



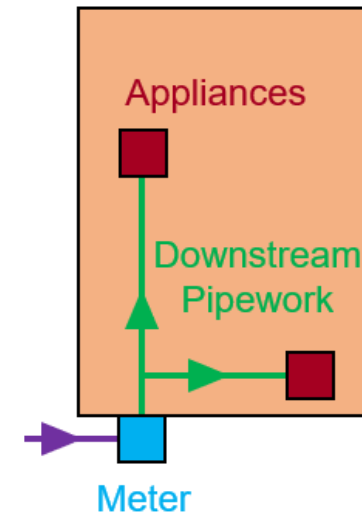
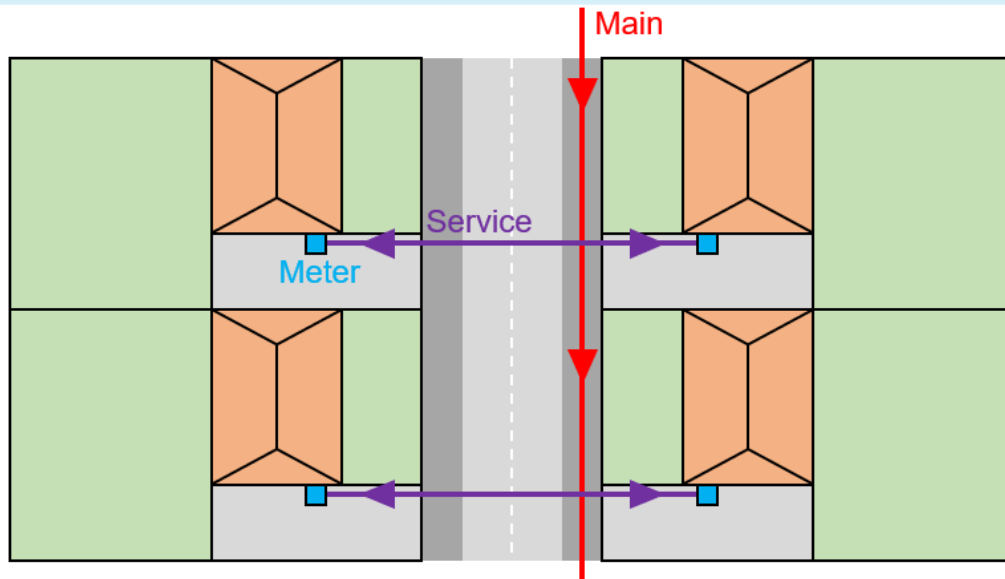
# METHODOLOGY

## Distribution System (Mains and Services)

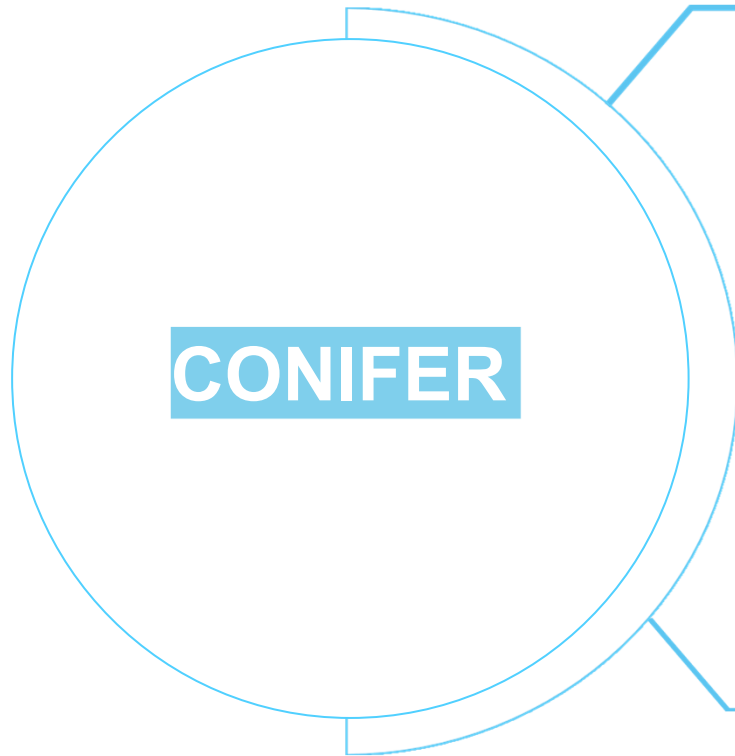
- Pilot study area divided into neighbourhoods and classified by main diameter and land use.
- Representative set of mains and services assessed using CONIFER to determine risk per meter.
- Risks extrapolated based on length of main of each type in each neighbourhood.

## End-User

- All properties assumed to have pressure regulator, outdoor meter and pipework to a range of appliances.
- Releases were assessed using CONIFER for a range of appliances to determine risk per appliance type.
- ATCO survey identified proportion of each house type with each appliance.



# THE CONIFER PACKAGE



## Includes releases from:

- Mains
- Services
- Downstream of ECV (meter, pipework, appliances)



## Hazards modelled include:

- Fires outdoors
- Explosions in buildings
- Generation of overpressure from delayed ignition in the open



## Risks quantified from:

- Different gases
- Different design options
- Different building types

# FAILURE FREQUENCIES

## Distribution System Failure Frequencies:

- Derived from historical performance of ATCO's natural gas network

## End-user Failure Frequencies:

- Developed for each appliance type based on a sample of ATCO's customer call out data

\* Research indicates no significant changes to failure frequencies when hydrogen is introduced

### Release Frequency across pilot study

Mains	0.51 per year
Services	1.01 per year
Meter & Regulator	5.5 per year
Customer Piping & Appliances	6.3 per year

\*Most are small and would not lead to significant fire/explosion hazards

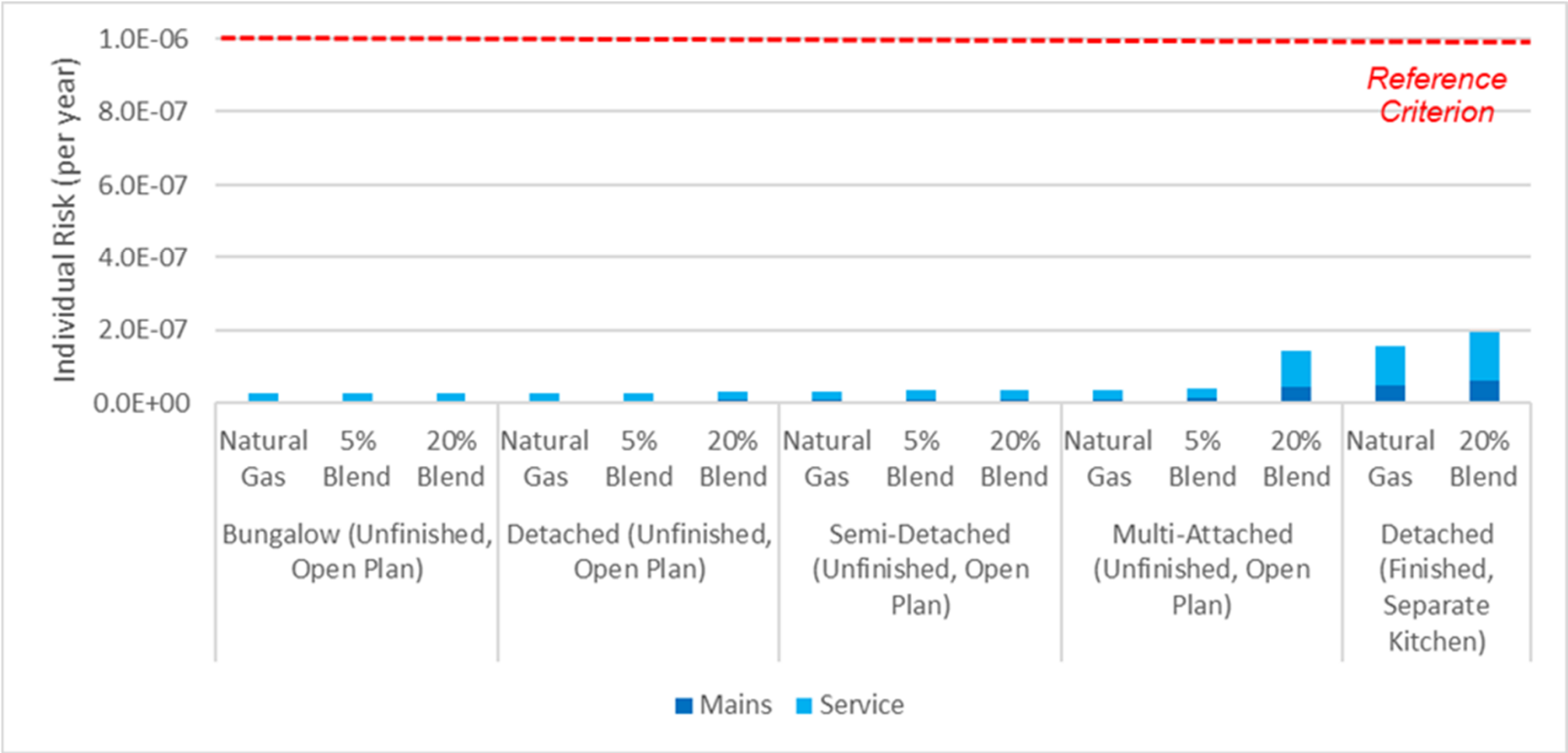
# INDIVIDUAL RISK CRITERIA

- Quantitative criteria introduced in the newest revision to CSA Z662 are based on the As Low As Reasonably Practicable (ALARP) principle.
- Annex B of CSA Z662 is labelled as informative but may be used by companies within their codes and practices.
- Although these criteria are applicable to distribution and not end-use equipment, they have been applied throughout the study to provide context.

Zone	Description	IR Criteria (per year)
Upper (Unacceptable)	Any activity or practice giving rise to risks within this region should be ruled out unless the activity or practice can be modified to reduce the degree of risk so that it falls on one of the regions below	$> 1 \times 10^{-4}$
Middle (Tolerable)	Risks in this region are typical of the risks from activities people are prepared to tolerate provided the nature and level of risks have been properly assessed and the results used to determine control measures. Within this region, the residual risks should be kept as low as reasonably practicable (ALARP) and periodically reviewed to ensure they still meet the ALARP criteria.	$1 \times 10^{-6}$ to $1 \times 10^{-4}$
Bottom (Broadly Acceptable)	Risks falling within this region are generally regarded as adequately controlled	$< 1 \times 10^{-6}$



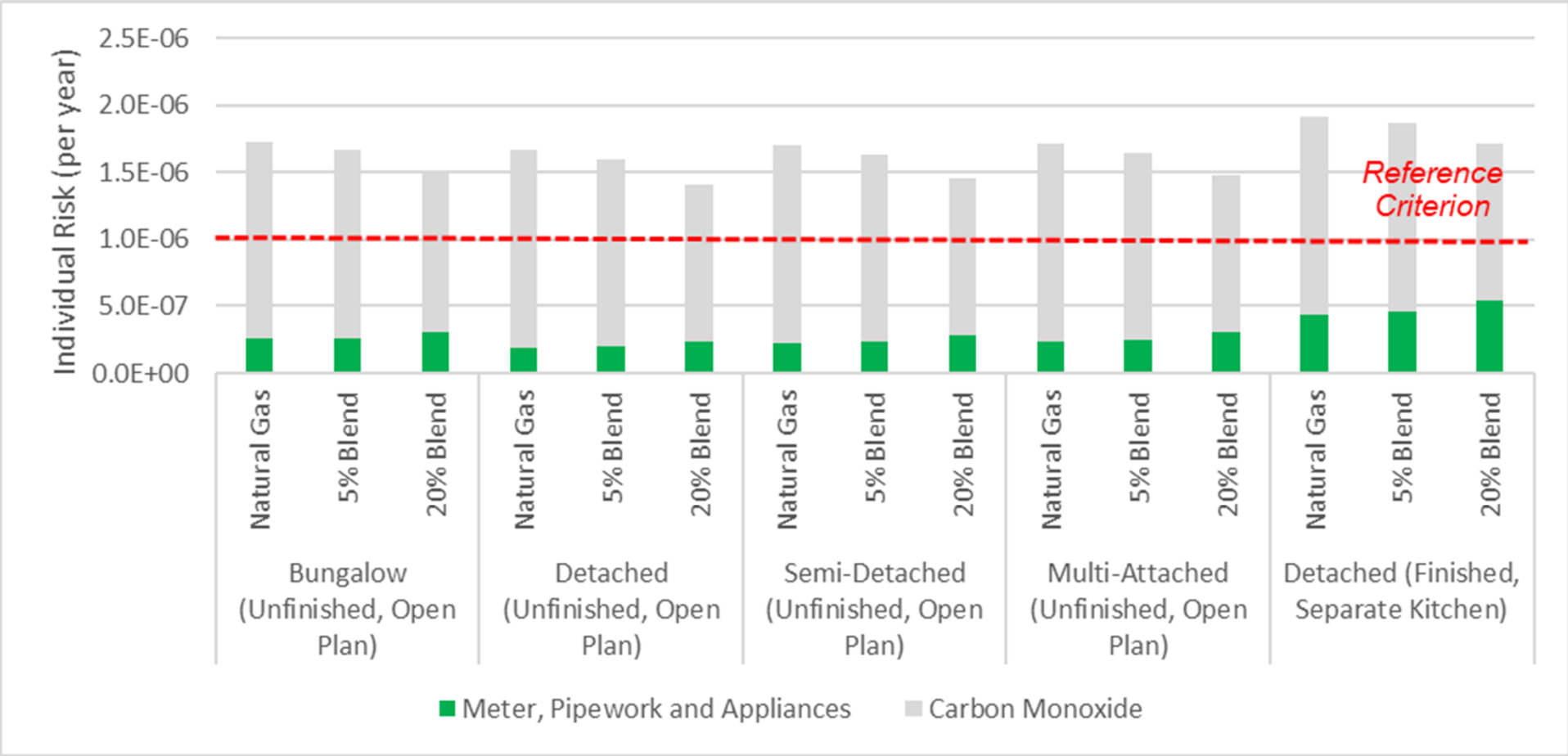
# DISTRIBUTION SYSTEM – INDIVIDUAL RISK (IR)



# DISTRIBUTION SYSTEM – DISCUSSION OF RESULTS

- Adding 5% or 20% hydrogen results in an increase in IR relative to natural gas.
- Even for 20% blend, the combined IR is significantly below the reference criterion.
- No risk reduction measures were warranted to convert the existing natural gas distribution system to hydrogen blended gas service.
- The highest IR from ignited releases is for a property with a finished basement supplied with a 20% blend.
- Risk comparators associated with analogous involuntary risks can help frame the QRA and perspective.
- For context, an individual is 47 times more likely to become a fatality as a result of an electrical fire and 291 times more likely to become a fatality as a result of a motor vehicle incident.

# END USER – INDIVIDUAL RISK



# END USER – DISCUSSION OF RESULTS

- Adding 5% or 20% hydrogen results in an increase in IR due to ignited releases from the customer meter, internal pipework and appliances relative to natural gas.
- However, total IR for end-user is comprised of risk from both CO poisoning and ignited gas.
- Overall decrease in IR for end-users.
- The IR for the 20% blend is between 10% and 15% lower than for natural gas depending on property configuration.
- The IR is dominated by risk associated with CO poisoning, so increase in IR due to ignited releases as a result of introducing hydrogen is relatively inconsequential.
- For context, an individual is 5 times more likely to become a fatality as a result of an electrical fire and 33 times more likely to become a fatality as a result of a motor vehicle incident.



**QUESTIONS?**

