



Safety

Is the Public safe if we introduce hydrogen into the existing gas systems?





Safety and Risk

- **RISK = Likelihood of untoward Event x Consequences**
- Risk can be increased if probability of event increases
- Risk can be increased if consequences more severe
- Risk to public is sum of all risks affecting entire population and can be expressed in terms of expected number of fatalities per year





Key Factors

- Hydrogen is known to be more reactive than natural gas
- Hydrogen is known to affect materials in a different way to natural gas
- Hydrogen has low ignition energy





Hydrogen Reactivity

- Higher flame speed can lead to higher overpressures during an explosion event
- Possible risk of transition to detonation (TTD) resulting in very high pressures known to occur with 100% hydrogen, but does not occur for natural gas
- How much Hydrogen can be introduced before significantly higher overpressures likely?





Affect on Materials

- Will hydrogen cause premature failure of steel pipes?
- Will hydrogen permeate steel and plastic pipes?
- Will hydrogen escape through fittings or small gaps?





Affect on Materials

- Potential for new failure mechanisms or higher probability of failure for system with hydrogen included
- How much Hydrogen can be introduced before likelihood of adverse event increases significantly?





Ignition Energy

- Ignition energy of hydrogen much lower than for natural gas
- Hydrogen known to ignite readily from electrostatic charge
- Likelihood of escaping gas igniting may be much higher
- How will concentration of hydrogen affect likelihood of ignition of escaping gas?





Safety Work Package of NaturalHy

- Will attempt to answer these questions by:
 - Conducting explosion experiments and modelling studies to assess overpressures and conditions for TTD
 - Studying failure mechanisms and estimating failure frequency and leakage
 - Estimating ignition probability
 - Conducting risk assessments of selected sections of the gas infrastructure with varying hydrogen concentration to compare risk levels





Conclusions

- The hydrogen percentage may need to be limited to ensure that the safety of the public is not adversely affected
- What are your thoughts?

