ECE –WP6-Call of Interest: Equipment for Hydrogen project， 2024.1.17

HYDROGENZJU 浙江大学氢能研究院

Coordination of standardization on H_2 and high H_2 content blends pipelines

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Convenor of ISO/TC197/SC1/AHG 2 H2 and high H2 content blends pipelines

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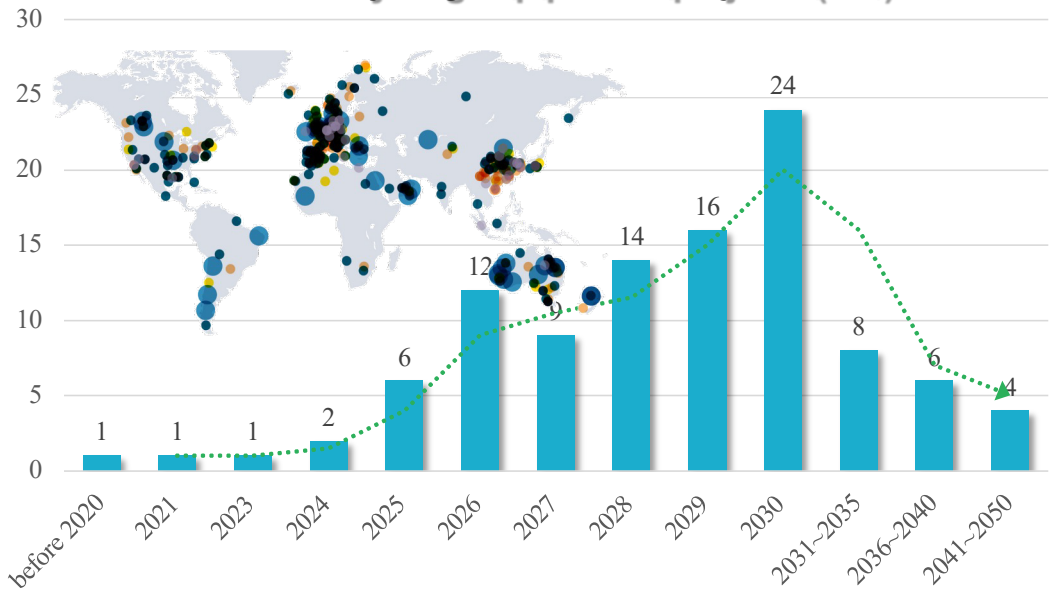
Hydrogen pipelines will play a crucial role

- **Hydrogen will play an important role in the global energy transformation and the construction of new energy system.**
- **Many countries, such as USA ,German, UK, China etc, regard hydrogen pipelines as an important part of their national hydrogen energy strategies!**
- **China will build over 5000 kilometers of hydrogen pipelines by 2030.**

The number of hydrogen pipelines projects (IEA)



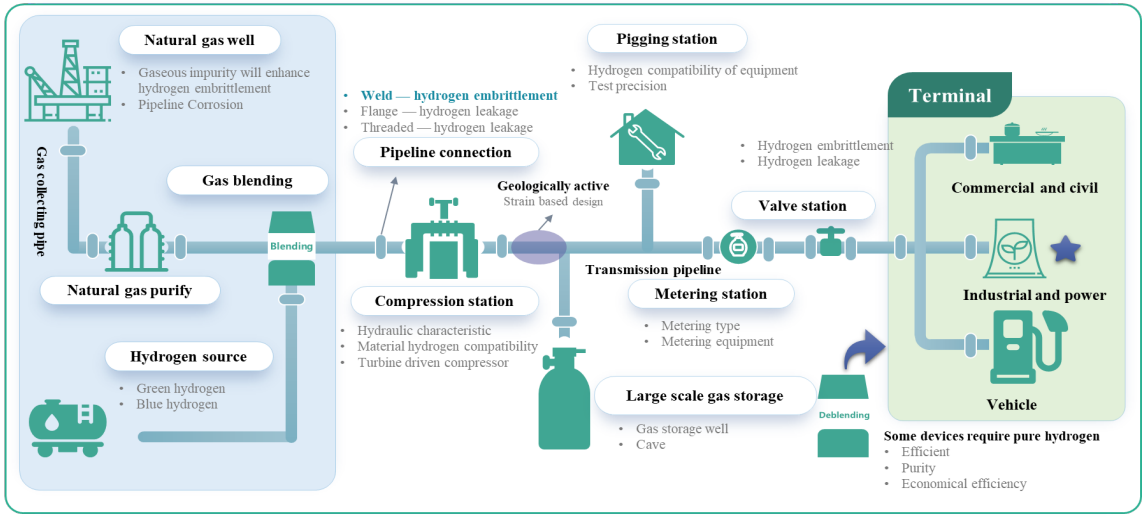
A representative project in China

Phase I :~400 km
Pressure: 6.3 MPa

Phase II :1000 km

Repurposing has been a crucial area

- **Repurposing of natural gas pipelines will be a crucial part of future hydrogen pipelines layouts!**



Schematic of repurposing natural gas pipelines

Overview of Europe hydrogen backbone network

Year	2030	2050
Overall length, km	32,616	57,662
Length of repurposed pipelines, km	16,864 (51.7%)	34,290 (59.4%)

Repurposing VS. *New Pipeline*

More than 50% **By 2050(DVN)**

Advantages:

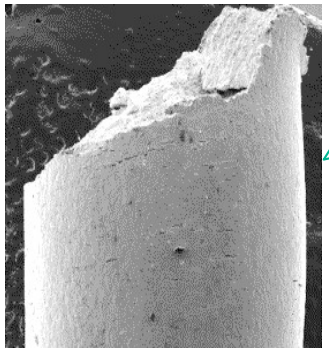
- ✓ Less investment cost (10%~35%);
- ✓ Shorter time to put into service;
- ✓ Avoid waste of NG facilities.

Challenges:

- ✓ Greater resistance on legal (treaty, statutory, and contractual) and regulatory obstacles;
- ✓ Pipeline operations are more complex.

Technical difficulties of hydrogen pipelines

- **Hydrogen behaviors: leakage, combustion , explosion; embrittlement; higher sound velocity**
- **Challenge: hydrogen compatibility, design and operation, inspection, risk management**

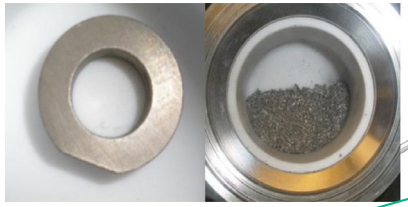


Metal Embrittlement:

- ✓ Decrease in plasticity
- ✓ Decrease in fracture toughness
- ✓ Accelerated fatigue crack growth

Polymer Embrittlement:

- ✓ Hydrogen leakage and permeation
- ✓ Hydrogen damage



Magnet: hydrogen decrepitation;
Resistor: zero drift, influence on stability;
…

Process and operation:

- ✓ Hydrogen has a lower volumetric calorific value;
- ✓ Guidelines for hydrogen velocity;
- ✓ Mixing and separation of hydrogen;
- ✓ Thermal Characteristics;
- ✓ …

Consequences of accidents:

- ✓ Failure probability;
- ✓ Failure consequence;
- ✓ Quantitative risk assessment;
- ✓ Emergency management;
- ✓ …

Current status of standards and gaps

Large movement has been made in the pipeline industry. With the increase in pressure and transportation quantity, users of the current standards find that increased costs have not led to safer services. It is necessary to find a way to balance between security and economics.

Representative standards			
ASME B31.12–2019	Hydrogen piping and pipelines	ASME STP-PT-006-2007	Design guidelines for hydrogen piping and pipelines
CGA G-5.6-2005 (R2013)	Hydrogen Pipeline Systems	AIGA 033-14	Hydrogen Pipeline Systems

Current status

Excessive conservatism in design

- ✓ Material performance factor which are not technically justified

Non-specialized evaluation methods

- ✓ 1 mile to extract samples for destructive testing;
- ✓ Over prescriptive sampling and testing requirements that are not risk or system based

Objectives

Performance-based design method

- ✓ Based on mechanical properties of materials in hydrogen environments;

Economical evaluation methods for existing NG pipelines

- ✓ Economical and safe sampling method;
- ✓ Establish a database for materials performance

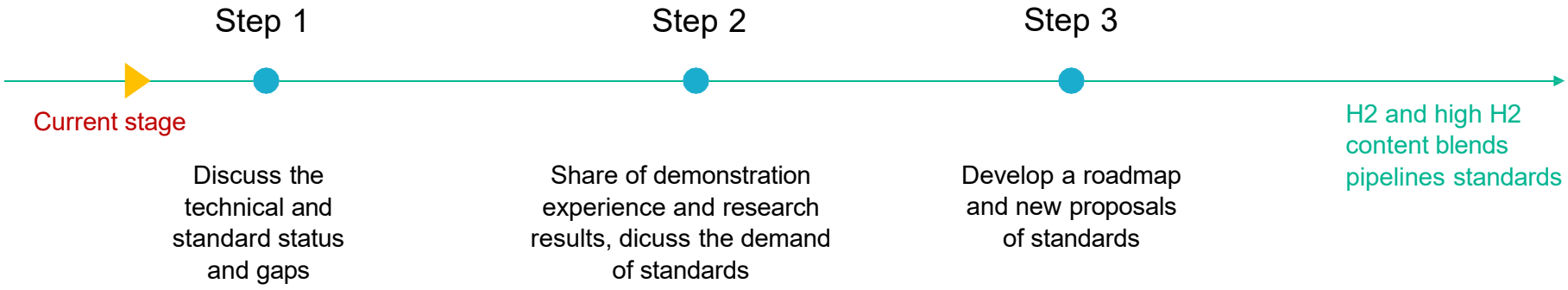
ISO/TC97/SC1/AHG2

ISO/TC97/SC1/AHG2 was activated to promote coordination of standardization on H2 and high H2 content blends pipelines.

Title: H2 and high H2 content blends pipelines.

Convenor: Prof. Jinyang ZHENG.

Terms of Reference: discuss and research on technologies and standards for hydrogen and high content hydrogen blended natural gas pipelines, develop a roadmap for future hydrogen pipeline standards development.



Call for experts

- **ISO/TC 197/SC1 is requesting that all interested P-members and O-members invite their appropriate experts to join AHG2.**
- **The desired scope of expertise should include but not limited to standardization of,**
  - **Metal/Nonmetal hydrogen pipelines**
  - **Re-purposing of natural gas pipelines for hydrogen or high content hydrogen blended natural gas transmission**
  - **Integrity management of pipelines**
  - **Hydrogen compatibility**
  - **Hydrogen risk assessment**
  - **Hydrogen pipelines inspection**
  - **Hydrogen velocity**
- **Experts not currently registered in the ISO community are invited to contact their respective national standardization member bodies (NSBs) to be able to take part in this work.**
- **For more detailed information on AHG2, please contact the AHG2 secretariat (Yanmei Yang: yangym@cnis.ac.cn, Zhengli Hua: huazl@zju.edu.cn) by January 26th, 2024.**

Thanks for your attention !