WELCOME
TO
PRESENTATION
ON
H2 BLENDING IN NG/ CGD NETWORK

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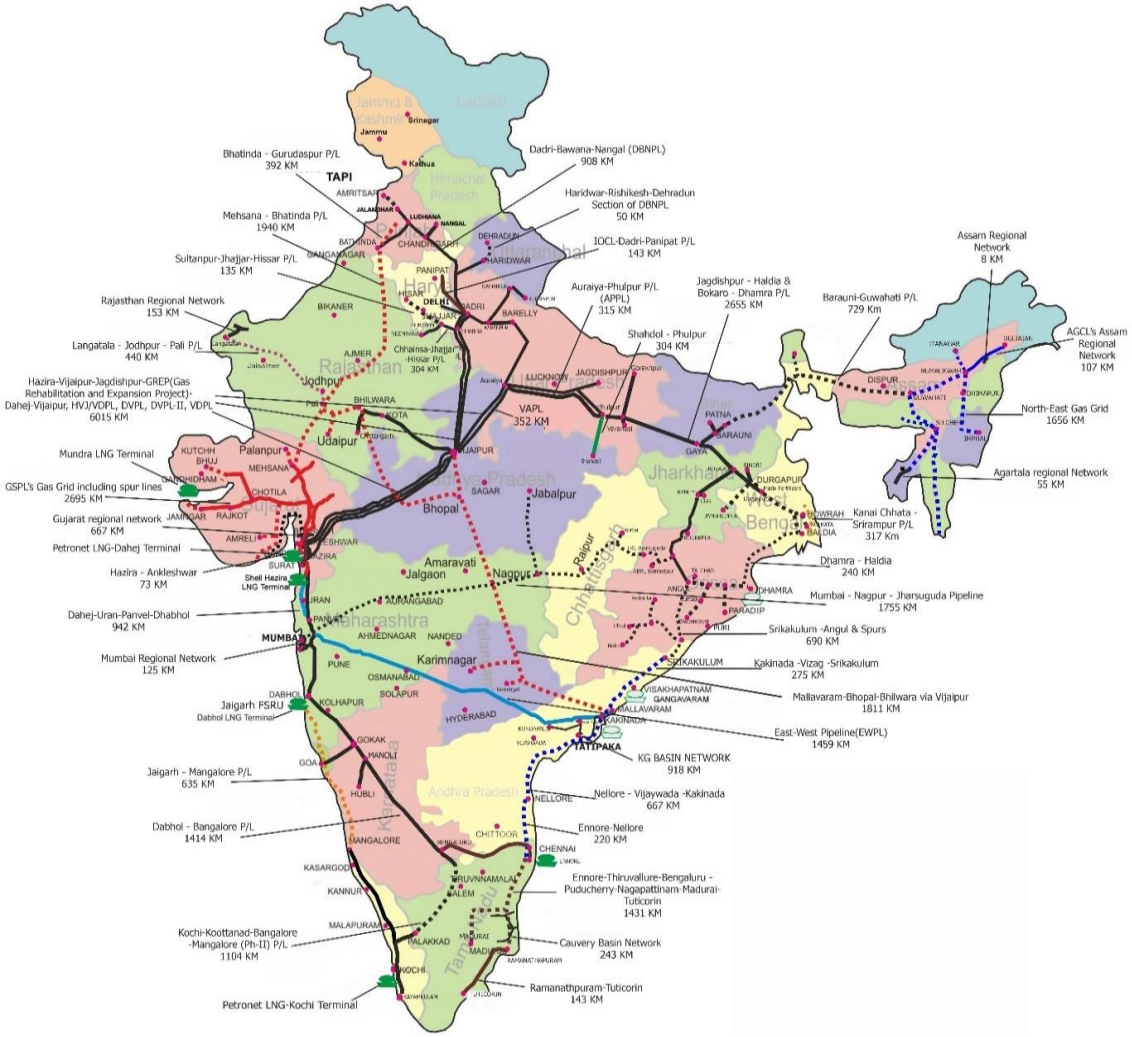
NATURAL GAS PIPELINE INFRASTRUCTURE IN INDIA

Details		Length (km)	Total (km)
Authorized Natural Gas Pipelines	Common Carrier	32,072	33622
	Tie-in connectivity	770.5	
	Dedicated	779.6	
Operational Natural Gas Pipelines	Common Carrier	23,298	24623
	Tie-in connectivity	178.4	
	Dedicated	653	
	STPL	493.7	
Under Construction Natural Gas Pipelines	Common Carrier	10,009	10860
	Tie-in connectivity	594.1	
	Dedicated	121.6	
	STPL	135	

Source : PNGRB ; as on Dec'2023



GAIL's NATURAL GAS PIPELINE INFRASTRCUTURE

Sl. No.	Network	Length (km)
1	Agartala Network	65
2	Cauvery Basin	272
3	Chhainsa-Jhajjar-Hissar Pipeline Network (CJPL)	444
4	Dabhol-Bengaluru Pipeline Network (DBPL)	1148
5	Dadri-Bawana-Nangal Pipeline Network	984
6	Dahej-Uran-Dabhol Pipeline Network	945
7	Gujarat Regional Pipeline Network	633
8	Integrated HVJ	6727
9	Jagdishpur-Haldia-Bokaro-Dhamra (JHBDPL)	2952
10	KG Basin Pipeline Network	917
11	Kochi-Koottanad-Bengaluru-Mangaluru Pipeline Network (KKBMPL)	643
12	Mumbai Regional Pipeline Network	125
13	Dedicated Networks	225
	Total Length	**16080**

Data as on Dec' 2023

PROPERTIES OF HYDROGEN VIS-À-VIS NATURAL GAS

Parameter	Natural Gas	Hydrogen
Physical properties	Mixture of hydrocarbon gases. It is colourless , odourless, combustible. Lighter than air	Hydrogen is a gas of diatomic molecules. It is colorless, odourless, non-toxic, and highly combustible. Lightest and smallest element.
Corrosive properties	Non-corrosive	Diffusible hydrogen may cause embrittlement in materials such as steel, copper etc.
Flame Color	Burns with a visible blue flame	Burns with a pale-blue, almost-invisible flame, making hydrogen fires difficult to see
Combustion	Clean burn, so its combustion does not produce solid particles or sulphur.	Combustion of hydrogen does not produce carbon dioxide (CO2), particulate, or sulfur emissions
Ignition Point	564 °C	535 °C
Flammability Limits	~5% - 15% (volume % in air)	~4% - 74% (volume % in air)
Calorific value (in mass)	~12500 kcal/kg	~33000 kcal/kg
Minimum Ignition Energy (MIE)	0.2 mJ	0.019 mJ
Energy density per volume	Hydrogen is 1/3rd of Natural Gas	

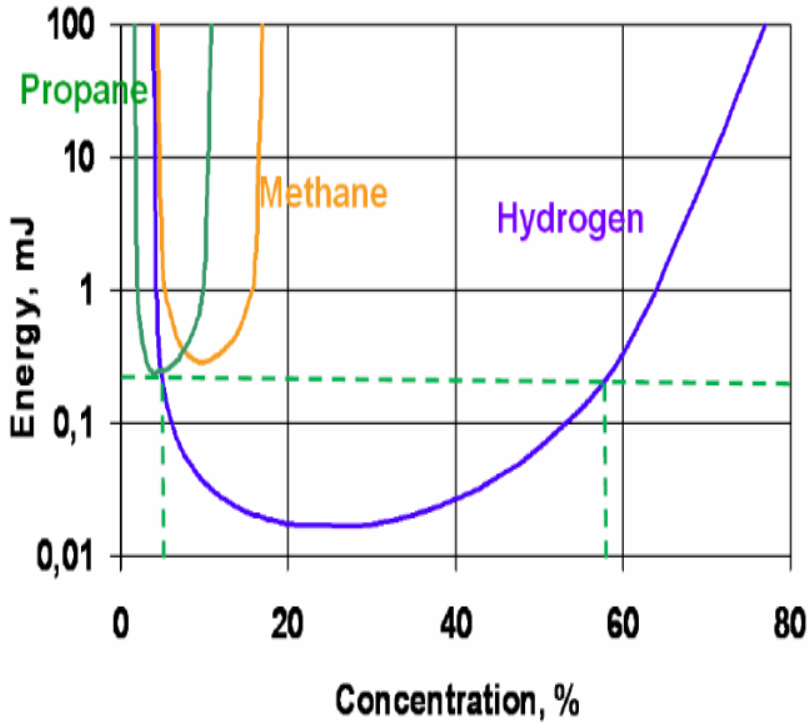


Figure: MIE of various components

GAIL'S INITIATIVE FOR BLENDING OF HYDROGEN IN CGD/ NG NETWORK

To leverage the existing pipeline infrastructure , GAIL commissioned a study in Aug'2021 for assessment of blending of H2 with Natural gas and CGD networks

To find out the maximum % of Hydrogen to be blended in the existing NG / CGD network without making any changes.

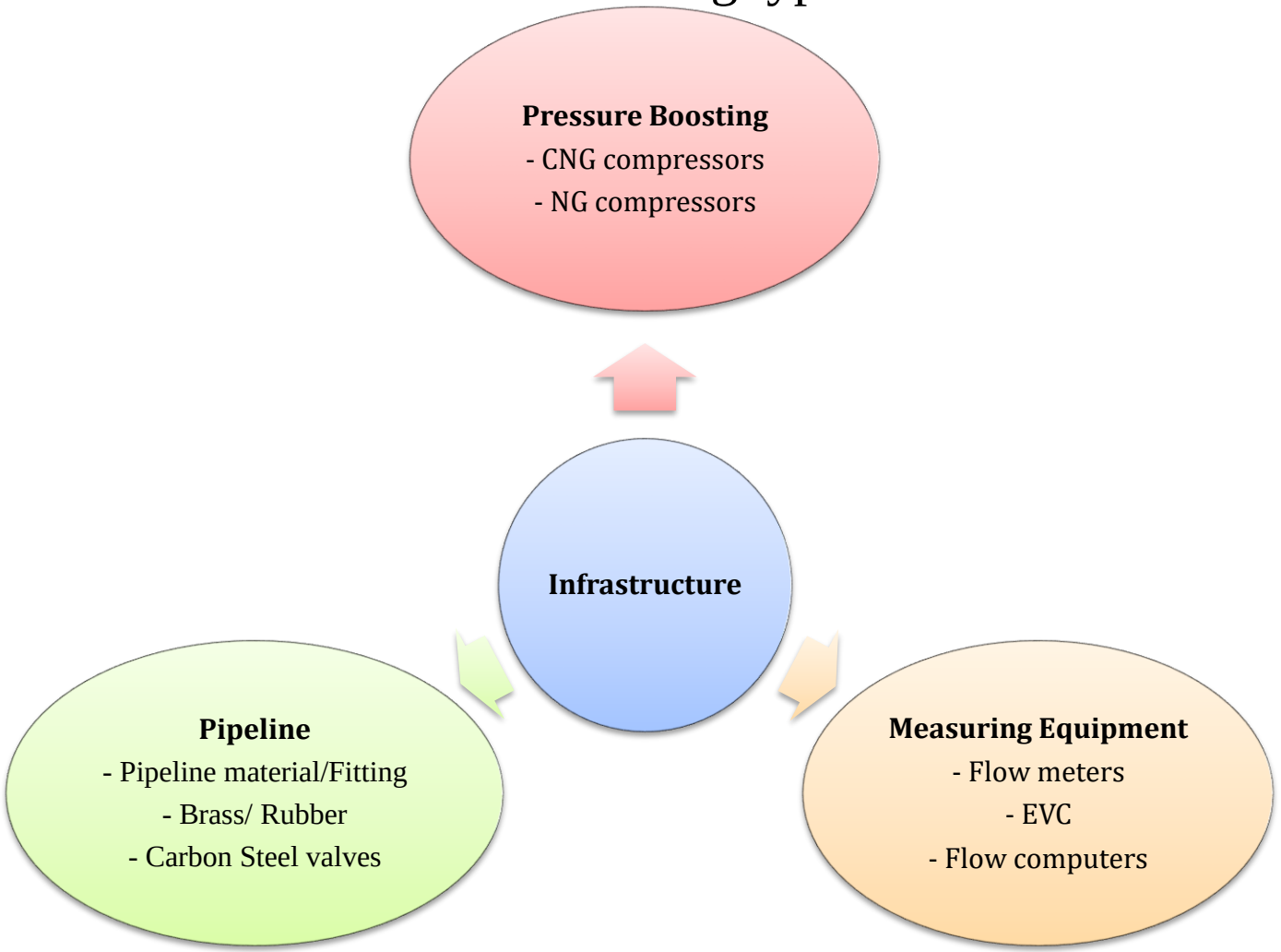
To establish the maximum % of Hydrogen to be blended in existing NG / CGD with minor modifications (such as fitting, metering skids, etc.)

To ascertain the maximum percentage of Hydrogen that can be blended in existing NG / CGD with modification in compressors etc. but excluding line pipe.

How to make future new gas pipelines / CGD networks ready for Hydrogen transportation through blending in Natural gas

CLASSIFICATION OF NG/CGD INFRASTRUCTURE FOR STUDY

The infrastructure network is classified into following types:



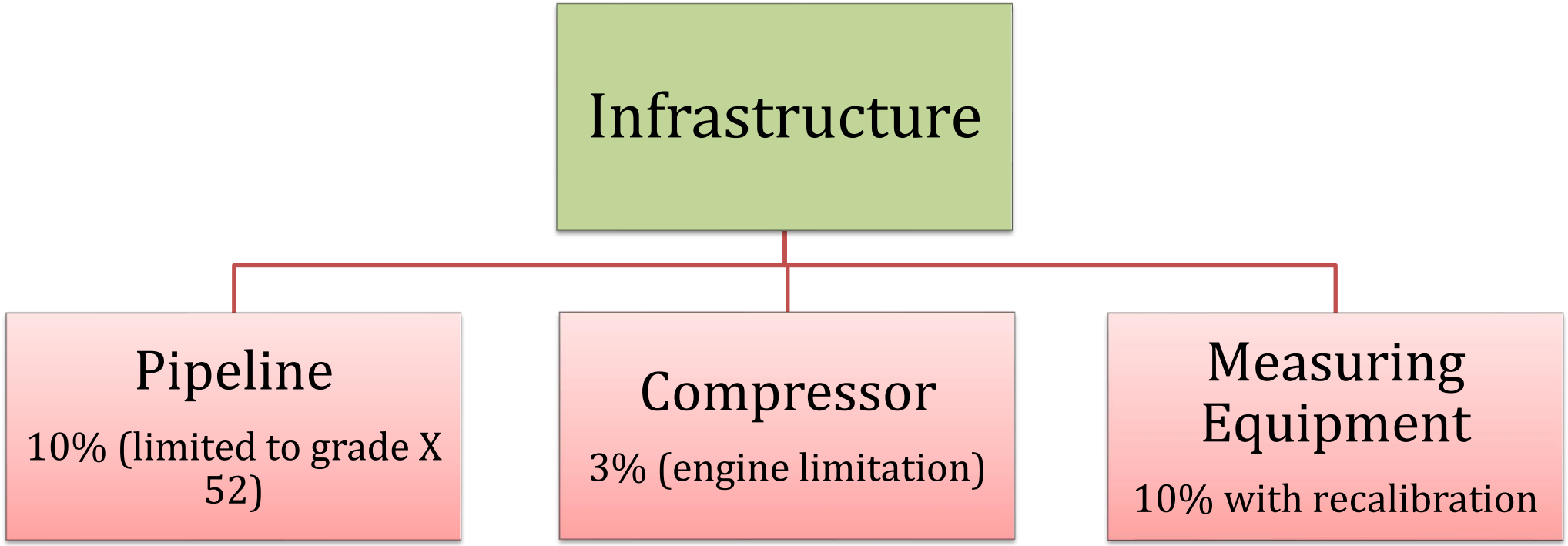
PRIMARY FINDINGS

Based on the data collected for CGD network and end users, study of literatures & international standards, relevant regulations, discussion with vendors, extant practice/experience, preliminary limits for safe % of hydrogen blending in the CGD networks are as follows;

- Up to 10% for Pipeline material/Fitting/Brass/Rubber. However, Line pipe is limited to only up to Grade X-52.
- Up to 20% in the Carbon Steels Valves.
- Up to 10% in the Instrumentation equipment's. However, flow meters, EVC and flow computers need to be recalibrated for use in Hydrogen mixed system.
- Up to 25% in the CNG Compressors.
- Up to 3% in the Engine drivers.
- Up to 3% in the Dispenser.
- Up to 10% in the Domestic Burners.
- Up to 3% in the vehicle engines
- Up to 25% for the Electrical equipment

MAXIMUM BLENDING PERCENTAGES

Maximum blending percentages are as under:



Note: For CNG cylinders, hydrogen limit is 2% as per IS 15490.

WAY FORWARD

- For furthering our know-how on increasing hydrogen blending percentages in prime movers (Engines / Turbines) vendors Viz M/s Siemens , M/s Cummins , M/s Burckhardt etc. to be contacted for participation in the equipment testing under higher blending percentages.
- For assessing admissible % of hydrogen blending in higher grade pipes, Pipe material testing is being carried out in collaboration with IIT Kanpur under 2 scenarios:
  - ✓ Soaked sample
  - ✓ In-situ sample
- Tests
  - ✓ Tensile test
  - ✓ Fracture toughness
  - ✓ Fatigue crack growth rate test

Test result: CS pipe of X 60 grade has been tested by soaking the sample in hydrogen environment at ~ 100 bar for 48 hours and test was conducted in open environment : No significant changes were observed in these tests.

- In-situ testing shall be carried out subsequently. Based on testing results, study shall progress further.

THANK YOU