# Hydrogen versus Natural Gas Pipeline Energy Capacity

Volume flow and energy throughput of hydrogen in a natural gas pipeline at the same pressure drop, from densities and heating values, with compression power.

**Method:** Pipeline flow scaling with gas density

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Natural gas molar mass | 17.400 | kg/kmol |
| Natural gas gross heating value per Nm³ (MJ) | 39.800 | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Density ratio | 0.11586 | |
| Volume flow ratio at the same pressure drop | 2.9378 | |
| Hydrogen gross heating value per Nm³ (MJ) | 12.751 | |
| Energy throughput ratio | 94.122 | % |
| Compression power per unit energy delivered, ratio | 3.1213 | |

**Notes for this case**

• Equal pressure drop in turbulent flow (same friction factor) gives v ∝ 1/√ρ, so hydrogen flows about 3 times faster by volume while carrying about a third of the energy per Nm³: the energy capacity is about 80–98 % of natural gas. Compression power scales with volume flow, about 3 times more per unit energy. Ideal gases; compressibility and line-pack differences are ignored.

## Formula and method

$$\frac{Q_{H_2}}{Q_{NG}} = \sqrt{\frac{\rho_{NG}}{\rho_{H_2}}}, \quad \frac{\dot{E}_{H_2}}{\dot{E}_{NG}} = \frac{HHV_{H_2}}{HHV_{NG}}\sqrt{\frac{\rho_{NG}}{\rho_{H_2}}}$$

### Variables

| | | |
|---|---|---|
| $M_{NG}$ | Natural gas molar mass | kg/kmol |
| $HHV_{NG}$ | Natural gas gross heating value per Nm³ (MJ) | - |
| $\rho_{H_2}/\rho_{NG}$ | Density ratio | - |
| $Q_{H_2}/Q_{NG}$ | Volume flow ratio at the same pressure drop | - |
| $HHV_{H_2}$ | Hydrogen gross heating value per Nm³ (MJ) | - |
| $\dot{E}_{H_2}/\dot{E}_{NG}$ | Energy throughput ratio | - |
| $P_{c,H_2}/P_{c,NG}$ | Compression power per unit energy delivered, ratio | - |

### Method and standards

Pipeline energy capacity.

### Assumptions and limits

- Same pressures and friction factor; ideal gases.

### References

Pipeline flow scaling with gas density

## Report details

| | |
|---|---|
| Report reference | FCC-C2DV-TYQZ (the same inputs always give the same reference) |
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| Calculator | Hydrogen versus Natural Gas Pipeline Energy Capacity |
| Method last reviewed | 17 November 2026 |
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| Release checks | 3 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/environmental/hydrogen-fuel-cells/hydrogen-pipeline-energy-capacity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.