Executive Summary

Comparison of Mini / Micro LNG and CNG for commercialization of small volumes of associated gas

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The Global Gas Flaring Reduction Partnership (GGFR) provides its members with overviews of the potential solutions to recover and monetize the flared and/or associated gas. This study analyses two options that could be used for this monetization of small volumes (1 -15 MMscf/d): the LNG and CNG chain concepts.

Technologies are available for both concepts, with different maturity level from the gained experiences and for different transportation conditions (quantities, distances). The available technologies allow a choice of implementation options to suit the volume of gas to be transported and the distance from field to consumer.

The cost of the chain depends upon the parameters governing the gas recovery, its transportation and its delivery. Among these parameters the most important are the gas volume and the transportation distance.

As examples, two gas volumes (3 & 10 MMscf/d) and two ranges of distance to markets/consumers, have been evaluated for a projects with 15 year durations:

Long distance

Offshore

All cost in USD(2015)/MMBTU				
	Marine - 3MMSCFD / 550-800 MN		Marine - 10MMSCFD / 550-800 MN	
Items	LNG	CNG	LNG	CNG
Gas Treatment	0.42	0.42	0.21	0.21
Processing (liquefaction/Compression)	4.71	0.73	3.71	0.70
Transportation	3.36	6.43	2.86	5.22
Delivery	1.56	0.5	1.06	0.5
Total	10.05	8.08	7.84	6.63

Onshore

All cost in USD(2015)/MMBTU				
	Truck - 3MMSCFD / 750-1000 Ml		Truck - 10MMSCFD / 750-1000 Ml	
Items	LNG	CNG	LNG	CNG
Gas Treatment	0.42	0.42	0.21	0.21
Processing (liquefaction/Compression)	4.71	0.73	3.71	0.70
Transportation	4.93	8.81	4.68	8.79
Delivery	1.56	0.50	1.06	0.50
Total	11.62	10.46	9.66	10.20

Short Distance

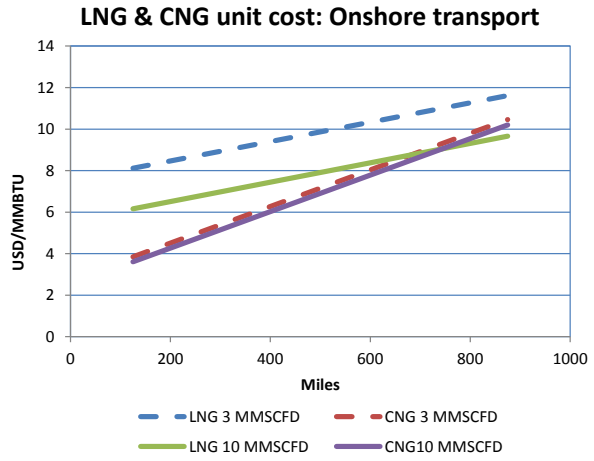
Offshore

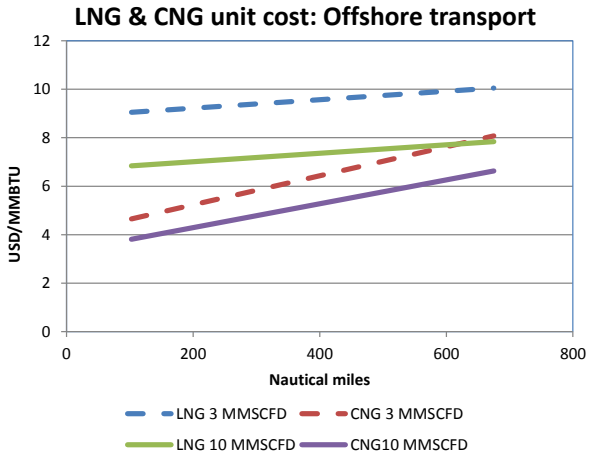
All cost in USD(2015)/MMBTU				
	Marine - 3MMSCFD / 55-150 MN		Marine - 10MMSCFD / 55-150 MN	
Items	LNG	CNG	LNG	CNG
Gas Treatment	0.42	0.42	0.21	0.21
Processing (liquefaction/Compression)	4.71	0.73	3.71	0.70
Transportation	2.36	3.00	1.86	2.40
Delivery	1.56	0.5	1.06	0.5
Total	9.05	4.65	6.84	3.81

Onshore

All cost in USD(2015)/MMBTU				
	Truck - 3MMSCFD / 0-250 Ml		Truck - 10MMSCFD / 0-250 Ml	
Items	LNG	CNG	LNG	CNG
Gas Treatment	0.42	0.42	0.21	0.21
Processing (liquefaction/Compression)	4.71	0.73	3.71	0.70
Transportation	1.43	2.20	1.18	2.20
Delivery	1.56	0.50	1.06	0.50
Total	8.12	3.85	6.16	3.61

The above data can be summarized as follows:





It should be noted that CNG is considered to be less suitable for larger gas volumes and longer distances due to the large CNG transport requirements (ships, barges or trucks) resulting from its lower volumetric efficiency; even with the best CNG container option, CNG requires at least twice the LNG chain transportation fleet for the same gas volume. The large scale of the CNG loading facilities also required for large gas volumes reinforces this conclusion.

From the comparison:

1. Gas treatment is similar for both options, although CNG may need slightly less treatment when the gas is relatively clean
2. LNG liquefaction is more complex than CNG compression, and requires more capital investment
3. CNG is perceived as being of a higher safety risk, due to the high operating pressure, in the range of 150 – 250 barg
4. The volumetric efficiency (reduction of the gas volume relative to atmospheric conditions) is 150 to 300:1 for CNG, compared to LNG at approximately 600:1
5. The higher capital costs of an LNG chain give CNG a cost advantage for smaller volumes and shorter distances. At higher volumes and longer distances, higher CNG chain operating costs reverse this advantage.
6. As noted above, CNG is considered to be less suitable for larger gas volumes and longer distances due to the large CNG transportation requirement (ships, barges or trucks). The large scale of the CNG loading facilities also required for large gas volumes reinforces this conclusion.
7. It is recommended that CNG should be limited to 5 MMscf/d and to 800 km in the case of road transportation for cost and operational complexity reasons, whilst CNG marine transportation is typically for large volumes and should be limited to less than 2,000 Nautical Miles

Experience in USA, China and Pakistan shows that the gas transportation solutions have been more developed when there is a gap in the traditional gas infrastructure (pipeline). The solutions are more oriented to LNG chains for higher quantities and longer distances whilst they are more developed for CNG as fuel for vehicles. It is also apparent that attractive gas prices are often the result of strategic public policies, with laws promoting reduction in emissions or incentives via differential taxation.

Finally the implementation of the solutions to recover and monetize the flared and/or associated gas needs to gather the conditions that make the project viable:

- The market demands
- The gas price attractiveness
- The existence of transportation infrastructure (road, river, etc.) to ensure a safe and reliable gas delivery.

The market currently offers some attractive niche opportunities:

- The gas to power, for electricity generation up to 50 MW
- CNG as fuel for vehicles
- LNG as fuel for large vehicles (trucks, locomotives, buses, etc.)
- LNG bunkering for ships, barges, ferries, etc.

The technologies and demand are there. The opportunities must be created.