4th ICEPIM & OMIC GAS 2018

Value Addition in Natural Gas Utilisation.

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OMIC Gas 2018, Mumbai

World Natural Gas Scenario

- As per IEO-2017, Natural Gas accounts for the largest growth, in world primary energy consumption, among all energy source. Natural gas consumption growth is second only to renewable.
- Its relative fuel efficiency and low CO2 emission makes it cleanest key fossil fuel and most desired by industries.
- EIA 2017, has projected the world consumption of natural to be 177 tcf by 2040, from 124 tcf at 2015, growing to 45%.
- This consumption growth of gas , is largely on account of non-OECD (Organization of Economic Cooperation and Development) countries with India at the highest, annual growth 4.9% against 1.9% of other non-OECD country.
- Gas consumption by OECD , consisting of mostly European countries , have reached to almost plateau level with annual growth less than one percent.

- To meet the growing demand of natural gas , IEO 2017, has projected the increase of supply by 47% from year 2015 level, up to year 2040. mostly from Middle East, China, USA and Russia.
- The supply in form of LNG, through shipment, is estimated to be tripled from 12 tcf in 2015, to 31 tcf by 2040. LNG export by USA is estimated to account 60% of its total natural gas export.
- Australia and North America are setting up number of liquefaction plant to meet the world requirement.
- In addition to the strong growth of LNG shipment, pipeline supply also increases in EIA projection. Pipeline flow are projected to continue to account for 48% of total in 2040, as pipeline infra is further developed.

Figure 2. World energy consumption by energy source
quadrillion Btu

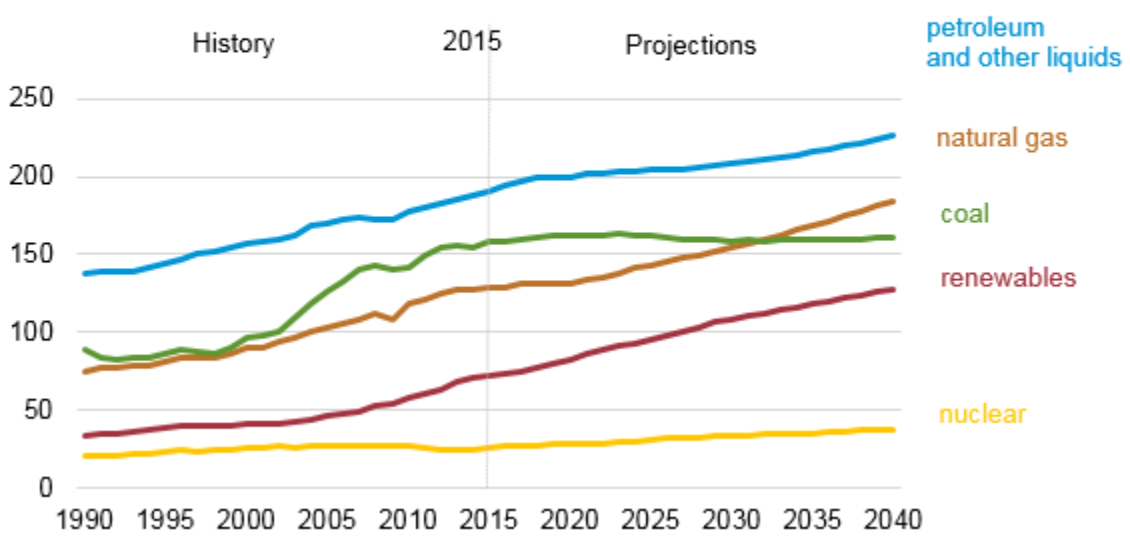
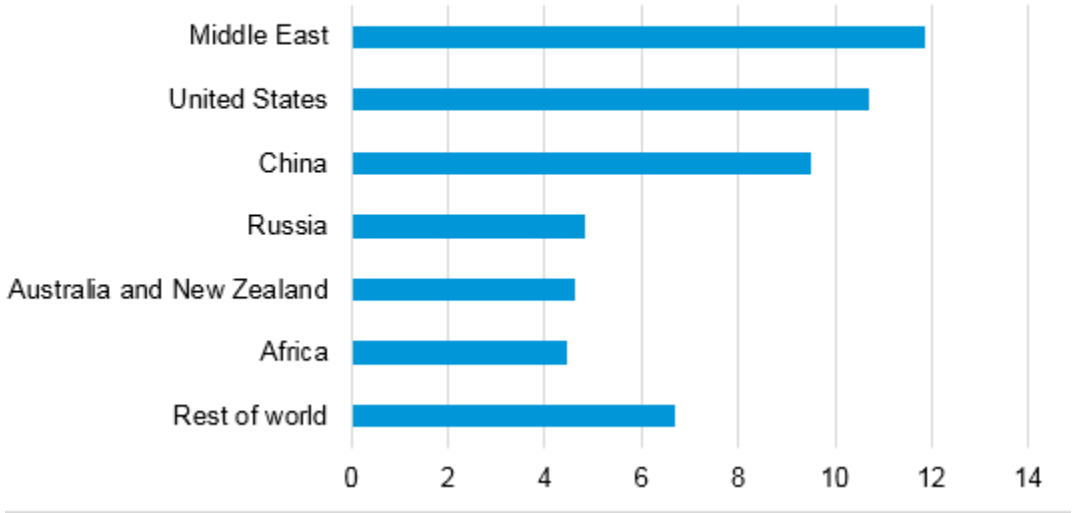


Figure 4. World increase in natural gas production, 2015-40 (trillion cubic feet)



Indian Natural Gas Scenario

- As per BP energy outlook 2017, India's energy consumption grows at 4.2% per annum, fastest among all major economy in the world and also with highest fossil fuel consumption growth in the world.
- In the fuel mix, the Indian fossil fuel demand is projected to be 86% by 2035,compared to 92% in 2015.This reduction is due to replacement with renewable and nuclear. The gas demand expands by 162% by year 2035 from 2015 level. Oil demand expands 120% and coal 105%. Renewable and nuclear to grow @ 699% and 317%, respectively.
- The Indian demand growth of gas is 4.9%/year, 4.0% for oil and 3.6% of coal. The rise in growth rate of gas demand is due to falling growth in demand of oil & coal.

BP Energy Outlook

Country and regional insights – India

	Level		Shares		Change (abs.)		Change (%)		Change (annual)*	
	2015	2035	2015	2035	1995-2015	2015-2035	1995-2015	2015-2035	1995-2015	2015-2035
Primary energy consumption (units in Mtoe unless otherwise noted)										
Total	701	1603			449	902	179%	129%	5.3%	4.2%
Oil† (Mb/d)	4.1	9.2	28%	27%	2.6	5.0	163%	121%	4.9%	4.0%
Gas (Bcf/d)	4.9	12.8	7%	7%	3	8	169%	162%	5.1%	4.9%
Coal	407	833	58%	52%	267	426	190%	105%	5.5%	3.6%
Nuclear	9	36	1%	2%	7	27	399%	317%	8.4%	7.4%
Hydro	28	55	4%	3%	11	27	64%	97%	2.5%	3.5%
Renewables (including biofuels)	16	129	2%	8%	16	113	>1000%	712%	>10%	>10%
Power	343	799			222	457	184%	133%	5.4%	4.3%
Supply										
Oil (Mb/d)	1.0	0.9			0.3	-0.1	33%	-9%	1.4%	-0.5%
Gas (Bcf/d)	3	7			1	4	56%	154%	2.2%	4.8%
Coal	284	580			151	296	113%	104%	3.9%	3.6%

*Compound annual growth rate

†Oil supply includes crude oil, shale oil, oil sands, natural gas liquids, liquid fuels derived from coal and gas, and refinery gains, but excludes biofuels. Oil demand includes consumption of all liquid hydrocarbons, but excludes biofuels.

- As per MOPNG 15-16, India's total consumption of gas has been 131 mmscmd, consisting of domestic supply 70 mmscmd and balance through LNG import.
- Out of total domestic consumption 56% has been in energy sector such as power plant, city gas supply network, refinery fuel and balance 44% for non energy sector such as feed stock for fertiliser, petrochemicals.
- The power generating unit alone consumed 22% of total gas supply. This is expected to increase due to increase in Indian energy consumption at the annual growth rate of 4.2% .
- The utilisation of gas by various states and industrial sector is shown in following sheets.

II.16 State-wise Utilisation of Domestic Natural Gas in India

(in MMSCM)

Item	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16 (P)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) Onshore							
Gujarat	2406	2231	2103	1993	1585	1405	1403
Assam	2522	2509	2736	2716	2695	2732	2807
Arunachal Pradesh	12	14	14	14	8	9	8
Tripura	562	610	644	647	816	1140	1332
Tamil Nadu	1163	1106	1277	1199	1298	1175	990
Andhra Pradesh	1478	1383	1362	1246	1168	519	569
Rajasthan	221	384	557	634	920	1080	1190
West Bengal (CBM)	8	36	69	96	141	203	261
Madhya Pradesh (CBM)	0	0	1	1	2	1	1
Jharkhand (CBM)	0	0	4	3	3	2	2
Total (a)	8373	8272	8765	8549	8636	8265	8562
(b) Offshore							
Eastern Offshore	15740	21348	16394	10184	5611	4991	4521
Western Offshore	22122	21342	21111	20902	20216	19280	17931
Gujarat Offshore	299	292	212	142	111	110	68
Total (b)	38162	42982	37716	31228	25938	24381	22521
Grand Total (a+b)	**46535**	**51254**	**46481**	**39777**	**34574**	**32646**	**31083**
of which							
ONGC	22462	22471	22507	22931	22765	21415	20529
OIL	2248	2193	2490	2470	2477	2527	2667
PSC Regime	21824	26590	21484	14375	9332	8704	7887

CBM: Coal Bed Methane P: Provisional

Note: Utilisation is sum of sales and internal consumption

Source: ONGC, OIL and DGH.

II.17 Sector-wise Consumption of Natural Gas

(in MMSCM)

Sector	2011-12	2012-13	2013-14	2014-15	2015-16 (P)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
(a) Energy Purpose					
Power	22628.46	16077.71	11283.62	10719.80	10889.20
Industrial	283.75	269.40	155.89	394.51	401.11
Manufacture	29.61	0.00	104.84	138.30	144.22
Road Transport	0.00	0.00	66.30	0.02	0.00
City or Local Natural Gas Distribution Network	5598.79	5779.84	5837.79	5415.49	5463.89
Tea Plantation	175.28	182.10	195.72	180.48	188.24
Internal Consumption for Pipeline System	385.14	386.82	372.13	350.57	409.58
Refinery	4256.87	3890.54	3968.48	4575.20	5076.54
Miscellaneous	9063.73	7975.90	7479.30	5941.23	4110.47
Total (a)	**42421.62**	**34562.30**	**29464.05**	**27715.60**	**26683.25**
(b) Non-Energy Purpose					
Fertilizer Industry	14003.32	14733.29	15869.37	15190.30	16134.61
Petrochemical	1857.69	2485.96	2404.66	2889.67	3733.28
Sponge Iron	1333.26	1105.74	274.12	153.59	544.32
LPG Shrinkage	1068.37	1027.29	981.85	1005.48	754.19
Total (b)	**18262.64**	**19352.29**	**19530.01**	**19239.04**	**21166.40**
Grand Total (a+b)	**60684.26**	**53914.59**	**48994.06**	**46954.64**	**47849.65**
Total in MMSCMD	**165.80**	**147.71**	**134.23**	**128.64**	**131.09**

Note: P: Provisional

1. Re-classification among the sectors of consumption of natural gas under energy and non-energy sectors, has been done depending on usage. Sectors where natural gas is being used as feedstock are classified as consumption of gas under non-energy purpose whereas those sectors where natural gas is being used as fuel are classified as consumption of gas under energy purpose .
2. Includes LNG

Source: PPAC

- Natural gas supplied consists of pre dominantly methane. The composition is specific to supply points. Typical composition of gas supplied to HVJ line of Gail, ex-Hazira is as under

Sl no	constituents	volume %
1	Methane (C1)	80.65 to 83.24
2	Ethane (C2)	6.69 to 7.79
3	Propane (C3)	3.62 to 4.37
4	Butane (C4)	1.36 to 1.65
5	Pentane (C5)	0.19 to 0.39
6	Hexane & heaviers (C6+)	0.03 to 0.16
7	CO2	4.34 to 5.55
8	N2	0.04 to 0.06

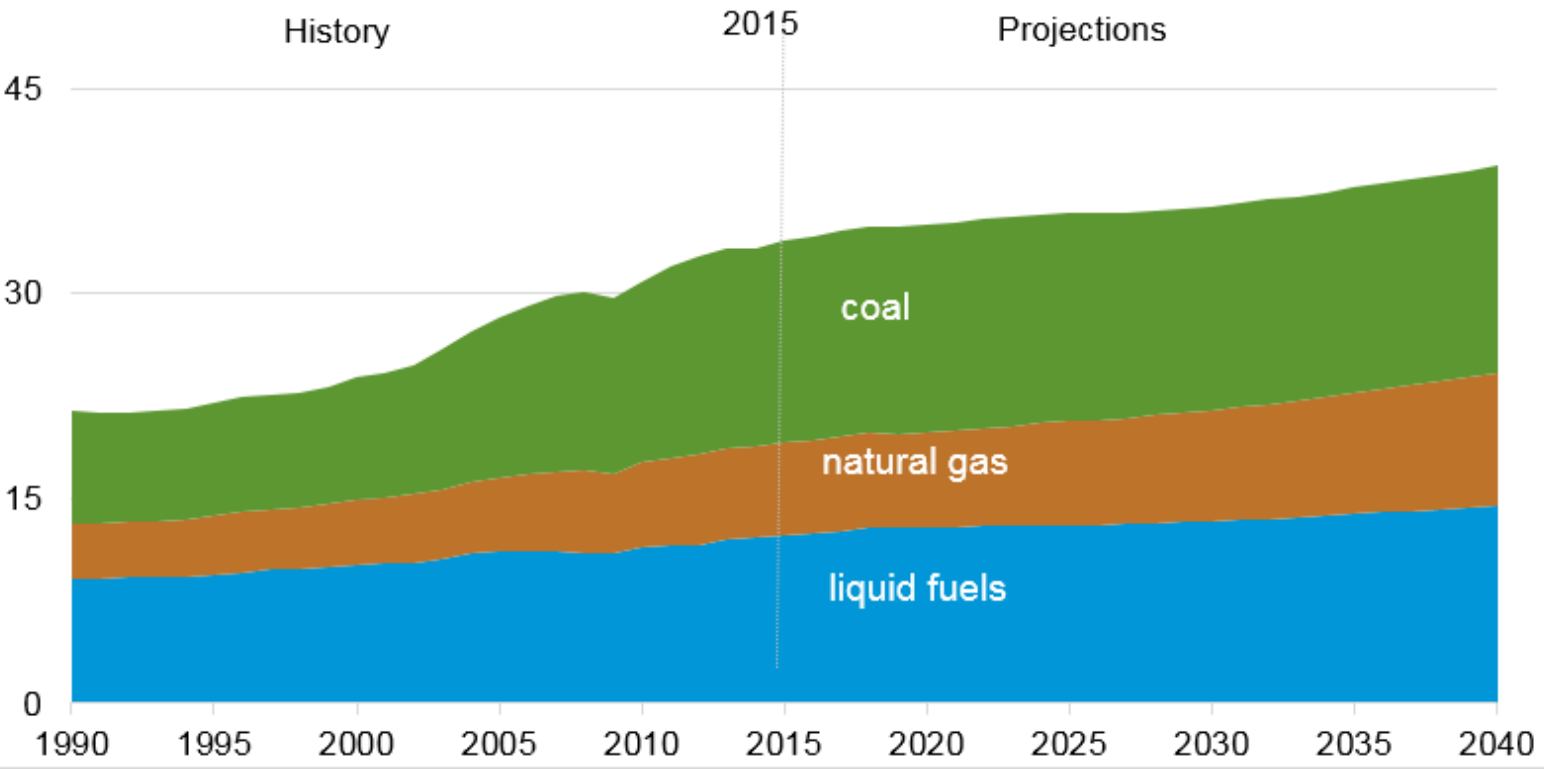
- Various constituents of natural gas are valued differently for different type of industries, such as

Sl No	Constituents of gas	Optimal Utilities
1	Methane	Power
2	Ethane & Propane	Ethylene & Propylene Production, NH3, mainly for Urea Production, matching with dynamic prodn of CO2 with H2.
3	Butane	Packed domestic fuel with Propane, Production of Butadiene & Synthetic rubber
4	Pentane	An excellent Solvent for industries. Aerosol Industries.

- Methane is best suited for power generation because the heating value of methane in terms of per unit mass is highest of all constituents of gas and CO2 emission is least .
- High CO2 emission, which gives rise to global warming is to be restricted to maintain the global rise in temperature below 2 degree C from pre industrial level as per Paris convention of UNFCC, which India is signatory.
- Use of C2+, for fuel purpose, is its suboptimal use, because these are highly valued constituents for petrochemicals, which otherwise could be utilized there. This is an addition to more CO2 emission and less heating value in per mass unit.

Figure 8. World energy-related carbon dioxide emissions by fuel type

billion metric tons



Indian Petrochemicals

- As per the special reports on Petrochemicals issued by Platts in Sept 14, Indian Polyethylene (PE) & Polypropylene (PP) demand is projected to grow @ 7%, from 2013 to 2025 as against 5% in previous block, but shall continue to be deficit of PE &PP by 4.3 mmt.
- PE &PP is produced by polymerization of ethylene and propylene, which feedstock is either gas or naphtha.
- The yield of Ethylene from gas feed is maximum ,as high as 90 %, through ABB Lummus and Stone &Webster Technology , being followed by most of the industries.
- The feed to ethylene &propylene is comprised of 33% from gas and balance Naphtha.

- In many power plants rich gas (C2+) is being used as fuel , which can be avoided, if C2+ components are extracted from supply gas and only methane is fed to power industries. The methane content of natural gas being supplied to industries is more than sufficient to meet the power requirement.
- The extraction cost is not very high due to advancement in Turbo expansion Technology. The cost, at grass root level (land cost not included) comes out in order of 140-150 crore INR, per million of natural gas feed, which produces LPG and Naphtha additionally.
- Setting up of C2+ extraction plant upstream of power units, at strategic location with logistic consideration can avoid the suboptimal utilization of valued constituents in gas.

- The major gas supply points in India are, at Hazira, Uran and Dahej. The quantity, composition and source are as under

Supply Station	source	Quantity mmscmd	C1 volume %	C2+ in Volume %	C2+ in KT/D	Remarks
Hazira	B&S asset	30	82-82.5	13-13.5	4.78	No C2+ Extraction
Uran	MH Asset	9.5	98-98.5	1-1.5	0.16	C2+ Extracted
LNG	Import	60	90-90.5	9.5-10	8.14	C2+ partial extraction

- From above table , we can see that , total around 13 KT/D of C2+ potential exists in above three streams. If we take 22% of above C2+ potential being consumed by power industries , then around 3 KT/D of C2+ is being consumed by power sector alone, which otherwise can be better utilised by petrochemicals and others.
- Though the shortfall in heat requirement by power sector due to removal of C2+ component will have to be compensated by additional volume of C1 , but, in terms of mass, the compensated C1, will be less than C2+ and consequently low CO2 emission in mass term.
- It is estimated that CO2 emission shall reduce by around 10%, by weight if C2+ is replaced with C1 in supply to power sector.

- Opal Dahej has design capacity of handling 1 mmt/year of C2+, in addition to 1.5 mmt/year of naphtha (dual feed cracker). Understand, they have tied up with ONGC for meeting the feed requirement , consisting of around 900 KT naphtha from Hazira and 800 KT C2+ , from C2/C3 plant Dahej, per year. Shortfall is planned to be made up through import.
- The gap in feedstock of Opal, can be bridged with Hazira, which has potential of producing more than 1.7 mmt/year of C2+, and a part of which is supplied to power industries, keeping the requirement of Pata Petrochemical in place.
- This shall not only add value to petrochemical feed , but reduce the CO2 emission as well.

CONCLUSION

The consumption of C2+ in power industries can be replaced with methane, and the same can be better utilized in petrochemicals, in demand. This can be obtained by setting up extraction unit , upstream power plant, at strategically and logistically suitable location. The installation cost is nominal due to advancement in turbo expansion technology. This shall not only bring about the optimal utilization of natural gas, but reduce the CO_2 emission as well to protect from global warming.

THANX