Methane to Markets

India Sector Overview

Advancing Project Development in India
through Public Private Partnerships

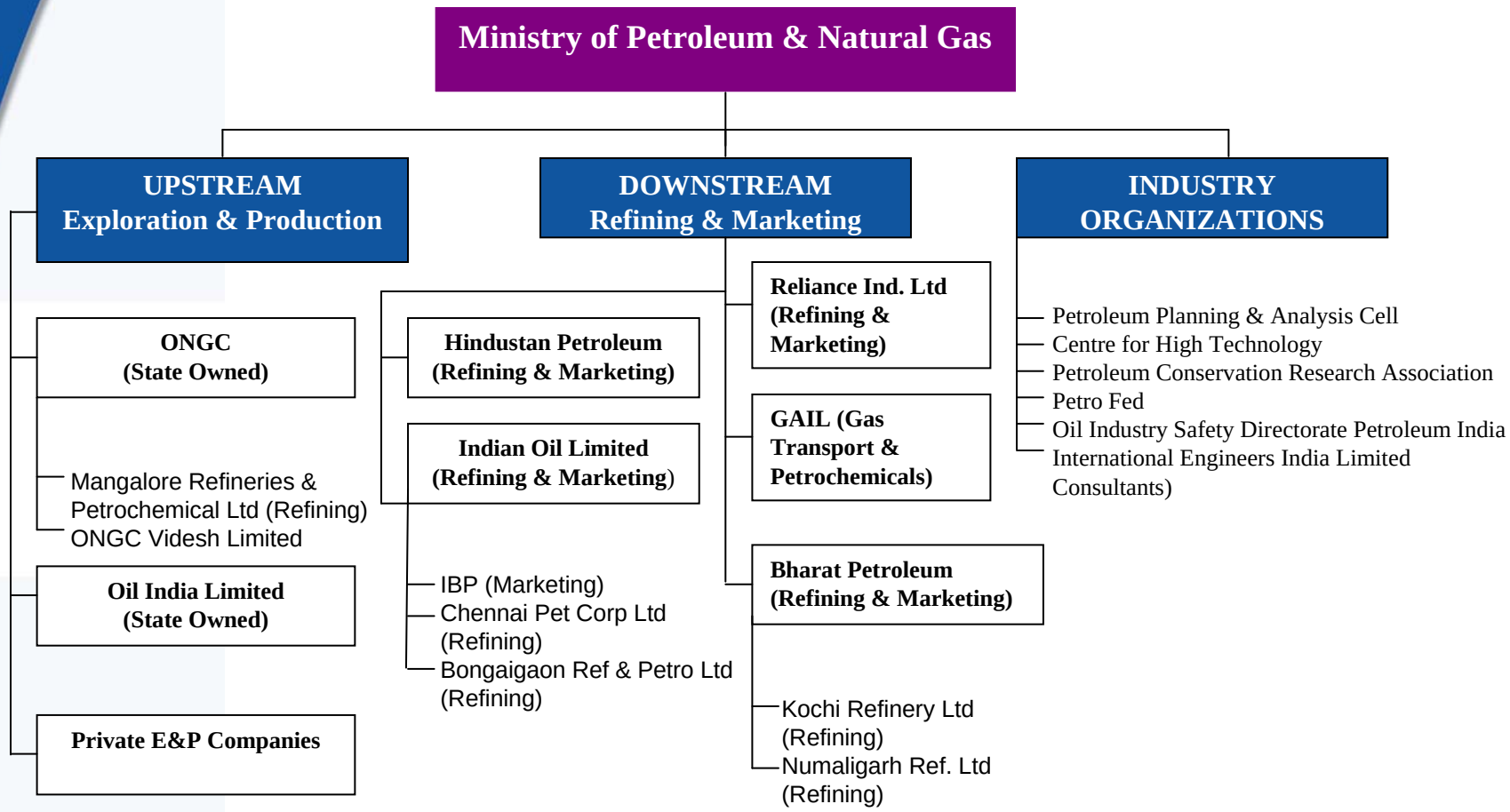
22 – 23 February, 2007

Methane to Markets

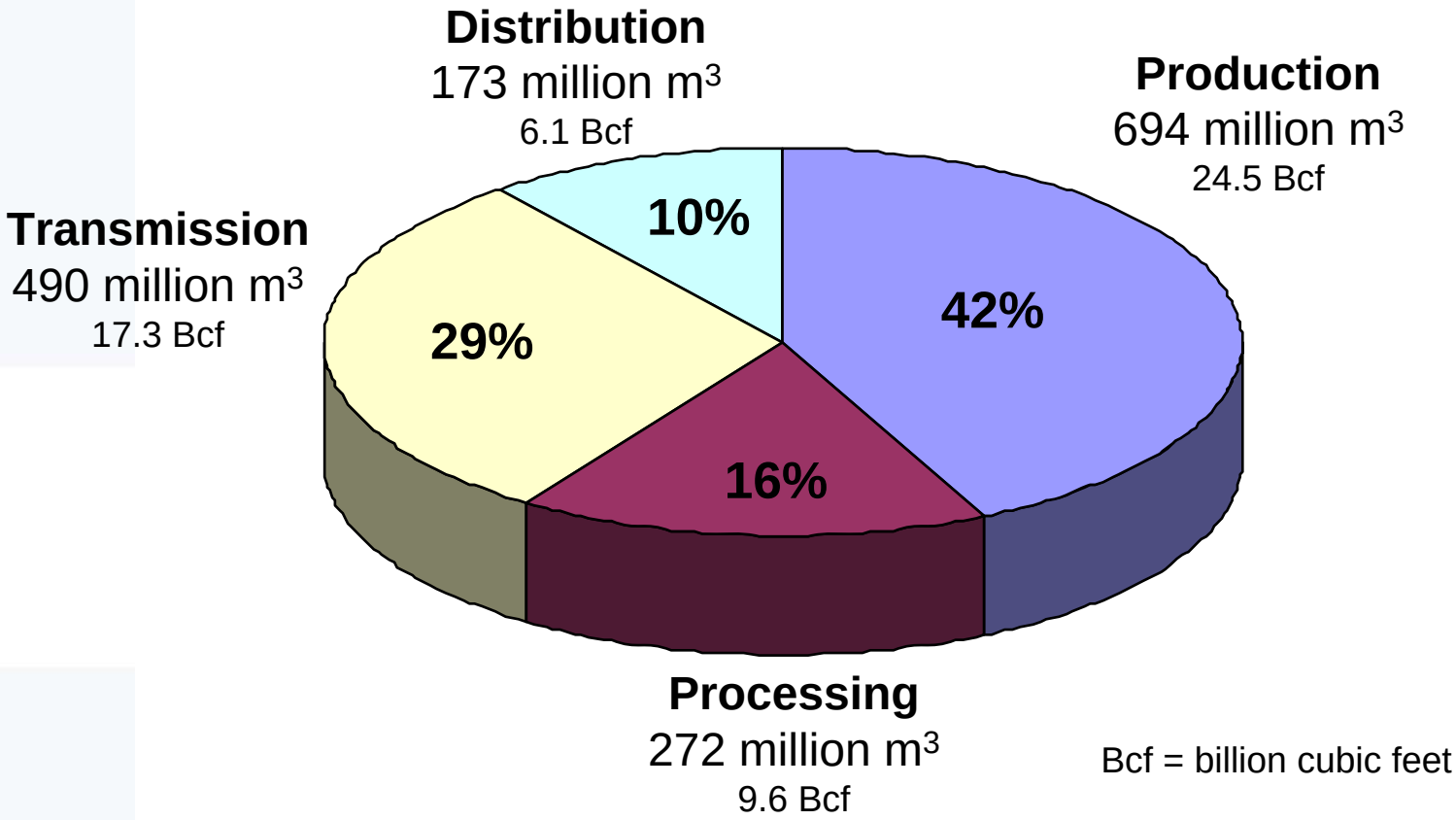
India Sector Overview: Agenda

- Indian Oil and Gas
- Methane Emissions from the Oil and Gas Industry
- Production Sector
- Processing Sector
- Transmission Sector
- Discussion Questions

Indian Petroleum and Natural Gas Industry Organization



India Oil and Gas Methane Emissions in 2005



Bcf = billion cubic feet

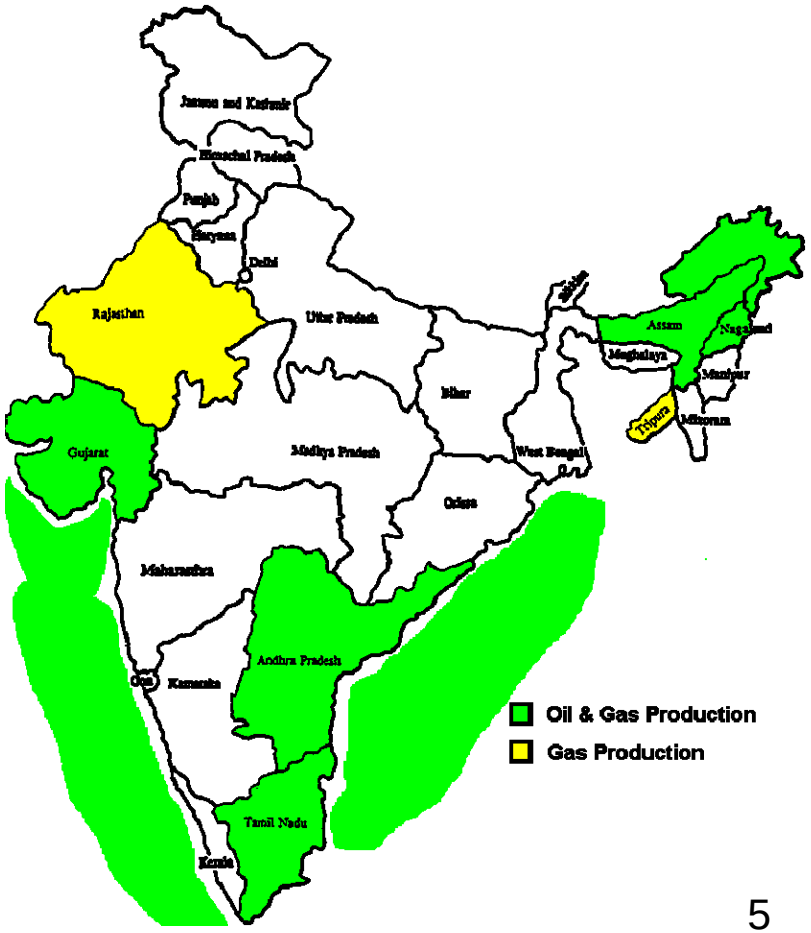
Sources: 1 – EPA. *Global Anthropogenic Emissions of Non-CO2 Greenhouse Gases 1990-2020* (EPA Report 430-R-06-003)
2 - US Natural Gas STAR program success points to global opportunities to cut methane emissions cost-effectively, Oil and Gas Journal, July 12, 2004

Methane to Markets

Indian Oil and Gas Production

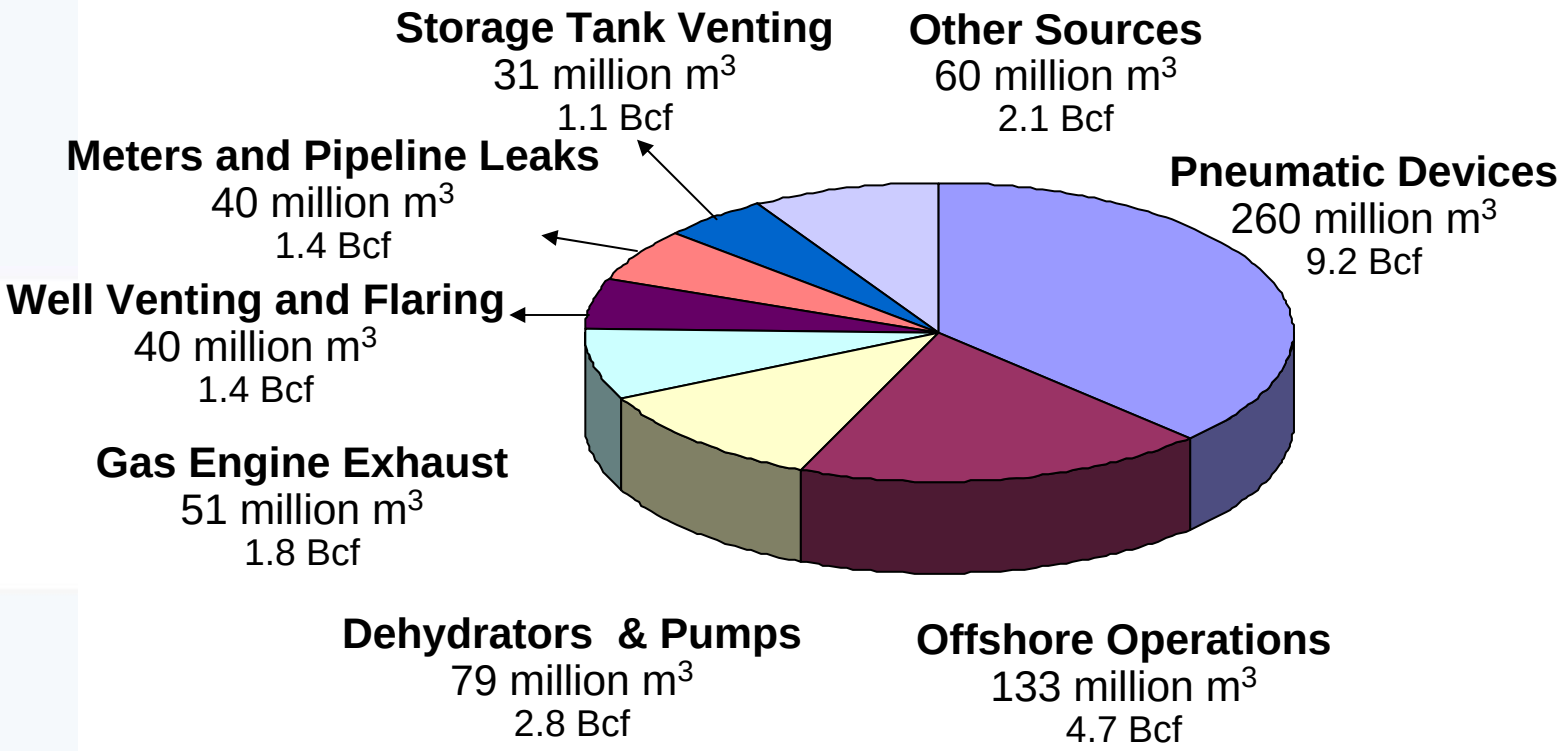
- The majority of Indian oil and natural gas is produced offshore

2004 - 2005 Indian Oil and Gas Production		
Onshore	**Oil Production ('000 Tonnes)**	**Gas Production (Million m^3)**
Gujarat	6,187	3,710
Assam/Nagaland	4,703	2,249
Arunachal Pradesh	83	40
Tripura		497
Tamil Nadu	391	678
Andhra Pradesh	226	1,707
Rajasthan		213
Onshore Total	11,590	9,094
Offshore		
ONGC	18,165	17,313
JVC/Private	4,226	5,356
Offshore Total	22,391	22,669
Total Production	33,981	31,763



India Production Sector Methane Emissions (2005)

Total Production Emissions: 694 million m^3



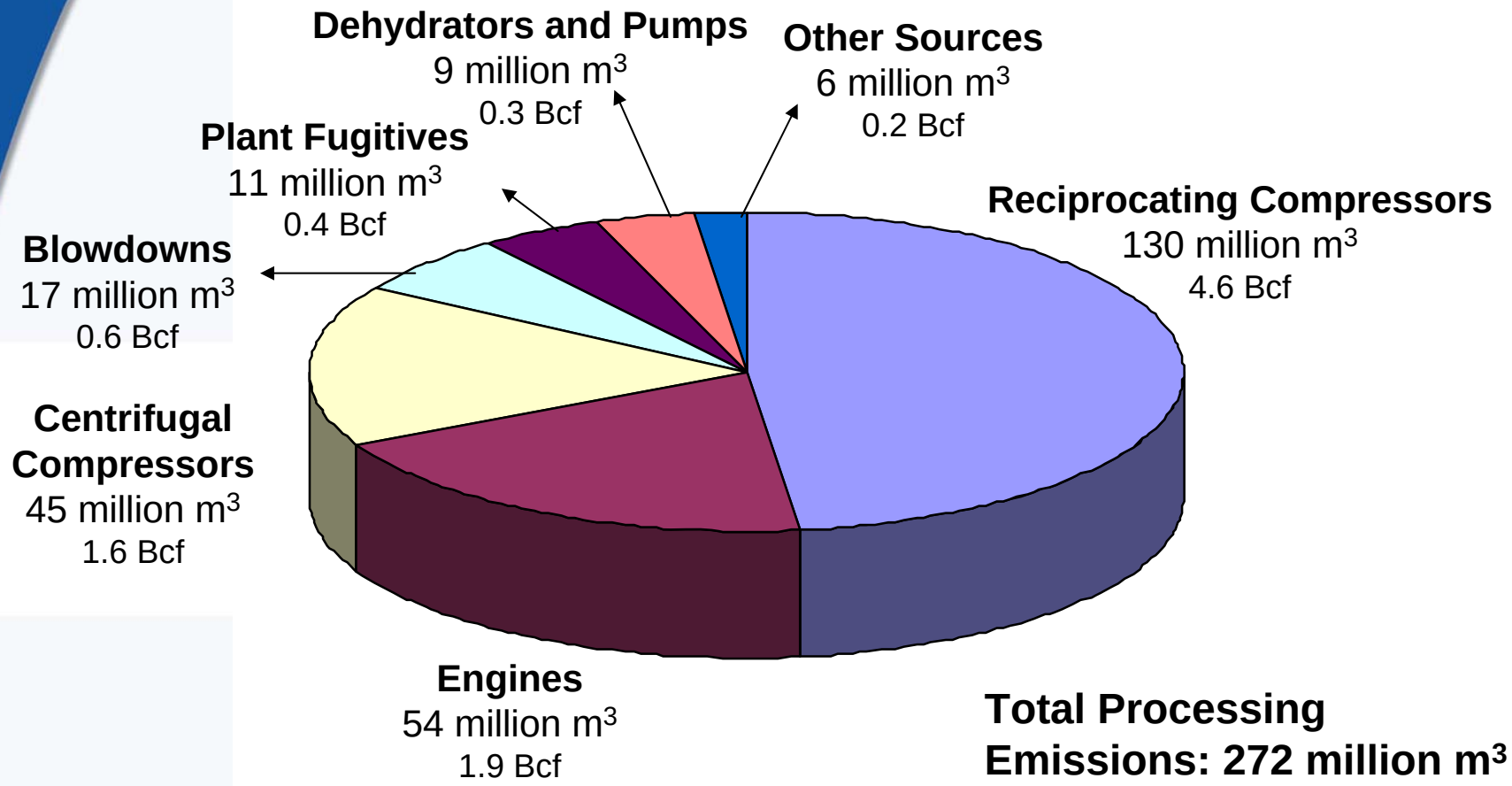
Sources: *US Natural Gas STAR program success points to global opportunities to cut methane emissions cost-effectively*, Oil and Gas Journal, July 12, 2004
Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2004

Indian Processing Sector

- India currently operates 11 gas processing plants
- These plants prepare the gas for transportation in the transmission system and extract valuable LPGs

Plant	Gas Capacity (million m^3/day)
Gas Authority of India (GAIL)	
Maharastra, Auraiya	12.0
Gandar gas plant, Gujurat	5.0
Lakwa, Assam	2.0
Vijaipur, Guna, Madhya Pradesh	15.0
Vaghodia, Vadodora, Gujarat	2.5
Usar, Raigad, Maharashtra	5.0
Niko Resources Ltd.	
Hazira, Hazira	3.5
Oil & Natural Gas Corp (ONGC)	
Aknleshwar, Gujarat	0.5
Hazira, Surat, Gujarat	1.2
Uran, Raigad, Maharashtra	16.0
Oil India Ltd. (OIL)	
Duliajan, Assam	2.0

India Processing Sector Methane Emissions (2005)



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India Natural Gas Transmission

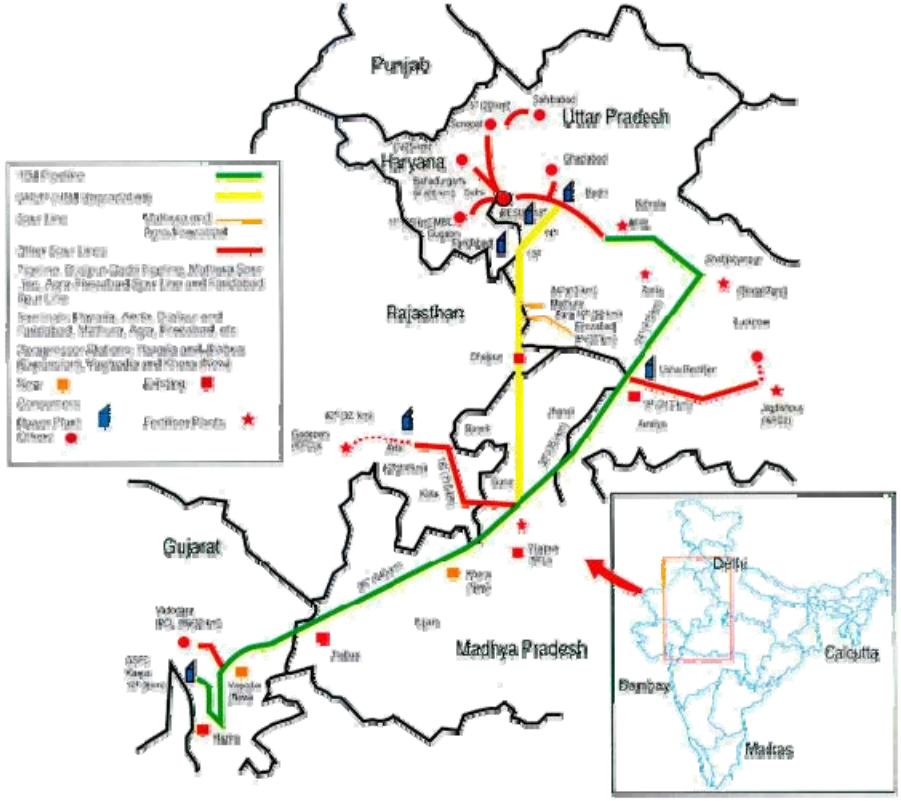
- Current natural gas transmission infrastructure supports the transportation of approximately 90 to 100 million m^3 per day (3.2 to 3.5 Bcf per day)

Owner	Onshore (km)	Offshore (km)
Gas Authority of India (GAIL)	4,601	
Oil & Natural Gas Corp (ONGC)		810
Oil India Limited (OIL)	100	
Gujarat State Petroleum Corporation (GSPC)	180	
Other	673	
Total	**5,554**	**810**

- Most infrastructure installed in the North West for transportation of gas to shore to end users

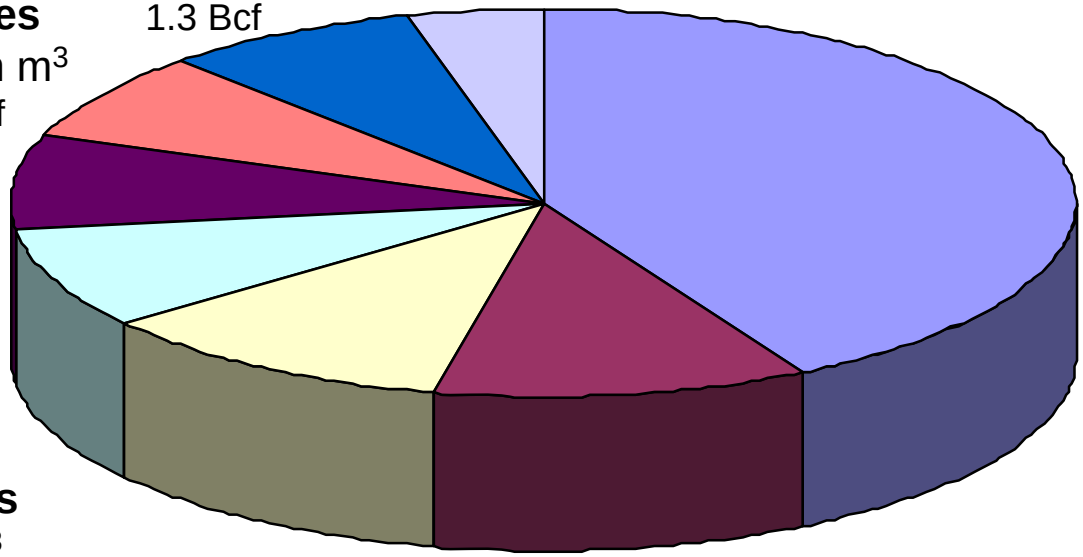
Hazira-Vijaipur-Jagdishpur (HVJ) Pipeline

- Major cross country pipeline connecting Gujarat, Madhya Pradesh, Rajasthan, Uttar Pradesh, Haryana, and Delhi
- Over 2,800 km (1,700 miles) of 0.9 meter (36 inch) diameter pipe



Source: GAIL

India Transmission Sector Methane Emissions (2005)



Other Sources
19 million m^3
0.7 Bcf

Total Transmission Emissions: 490 million m^3

Station Fugitives
36 million m^3
1.3 Bcf

Pipelines
37 million m^3
1.3 Bcf

Station Venting
40 million m^3
1.4 Bcf

Reciprocating Compressors
204 million m^3
7.2 Bcf

Centrifugal Compressors
40 million m^3
1.4 Bcf

Engines
57 million m^3
2.0 Bcf

Pneumatic Devices
57 million m^3
2.0 Bcf

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Indian Methane Emission Reduction Opportunities

- Production
  - Vapor Recovery Units
  - Pneumatic Devices
  - Dehydrators
- Processing
  - Compressor Seals
  - Directed Inspection and Maintenance
- Transmission
  - Compressor Seals
  - DI&M
  - Pipeline Maintenance

Methane to Markets

Discussion Questions

- What are the major sources of methane emissions in your operation(s)?
- What technologies or practices have you identified to help reduce methane emissions in your operation(s)?
- How can these technologies be improved upon or altered for use in your operation(s)?
- What is stopping you from implementing these technologies (technological, economic, lack of information, manpower, etc.)?