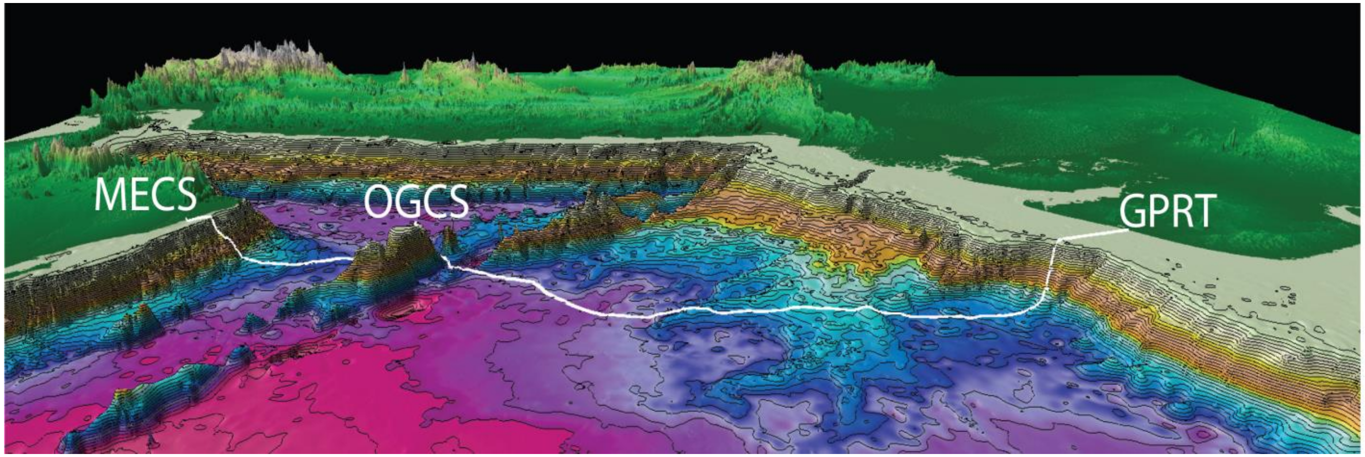
# *The Middle East to India Gas Pipeline:*
# *A Win-Win situation for all*




**PHD Conference on**

**"Translational Gas Pipelines; A win-win situation for all"**

13th August, 2013 10:30 am at PHD House, New Delhi

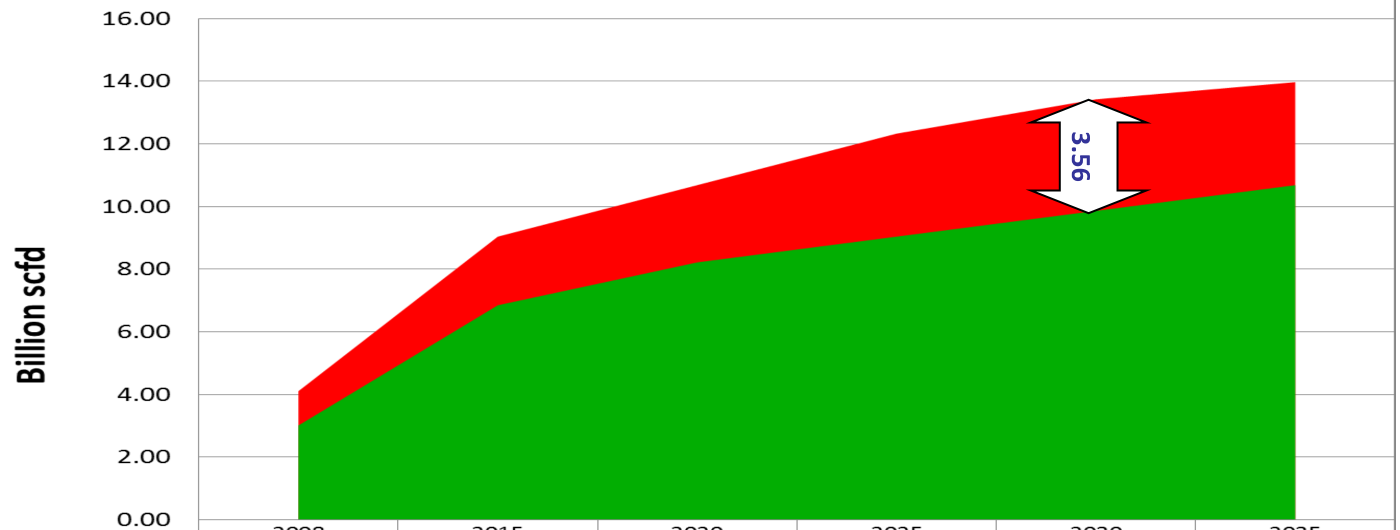
*Ian Nash Director of Operations, Peritus International*

# Overview

- India's need and how the Middle East to India Deepwater Pipeline MEIDP can contribute
- Review the LNG/ Pipeline gas economic cut-off
- Long Distance International Gas pipelines providing a safe and secure long term solution
- Summarise key features of MEIDP and why this pipeline is now technologically feasible

# Indian Natural Gas Reserves

- US Department of Energy Predicts a shortfall of 3560MSCFD by 2030
- Indigenous KG-D6 reserves have not lived up to expectations




| | 2008 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|
| India Gas Consumption | 4.11 | 9.04 | 10.68 | 12.33 | 13.42 | 13.97 |
| India Domestic Gas Production | 3.01 | 6.85 | 8.22 | 9.04 | 9.86 | 10.68 |

U.S. Department of Energy, DOE/EIA-0484(2011)

# International Supply of Gas to India

- Over 2,000 TCF of natural gas reserves are held by countries with which India has a traditional trading relationship, including Qatar, Iran and Turkmenistan
- Iran is looking for export solutions for its vast reserves of Natural Gas
- Qatar is looking for new export markets with the advent of Shale Gas explosion in USA
- Iraq is building its Gas development and looking for Export solutions
- Onshore Pipelines such as IPI and TAPI have significant security and supply issues

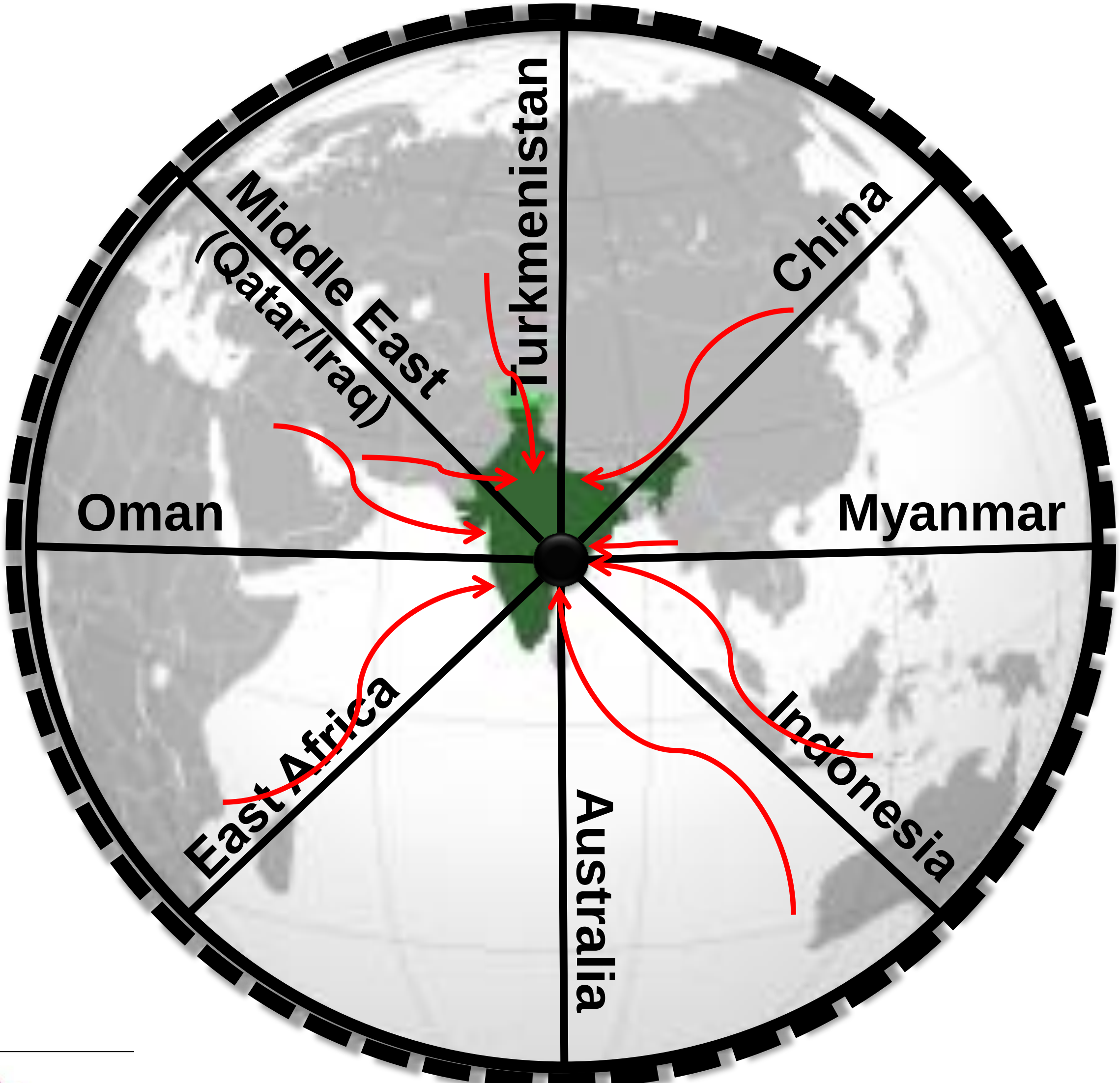
**Table 7. World natural gas reserves by country as of January 1, 2011**

| Country | Reserves (trillion cubic feet) | Percent of world total |
|---|---|---|
| **World** | **6,675** | **100.0** |
| **Top 20 countries** | **6,067** | **90.9** |
| Russia | 1,680 | 25.2 |
| Iran | 1,046 | 15.7 |
| Qatar | 896 | 13.4 |
| Saudi Arabia | 275 | 4.1 |
| United States | 273 | 4.1 |
| Turkmenistan | 265 | 4.0 |
| United Arab Emirates | 228 | 3.4 |
| Nigeria | 187 | 2.8 |
| Venezuela | 179 | 2.7 |
| Algeria | 159 | 2.4 |
| Iraq | 112 | 1.7 |
| Australia | 110 | 1.6 |
| China | 107 | 1.6 |
| Indonesia | 106 | 1.6 |
| Kazakhstan | 85 | 1.3 |
| Malaysia | 83 | 1.2 |
| Egypt | 77 | 1.2 |
| Norway | 72 | 1.1 |
| Uzbekistan | 65 | 1.0 |
| Kuwait | 63 | 0.9 |
| **Rest of world** | **608** | **9.1** |

2300tcf
34.8%

# India As A Hub






## Onshore Pipeline

- Turkmenistan
- Iran
- China?

## Offshore Pipeline

- Qatar
- Iraq
- Oman
- Iran
- Myanmar

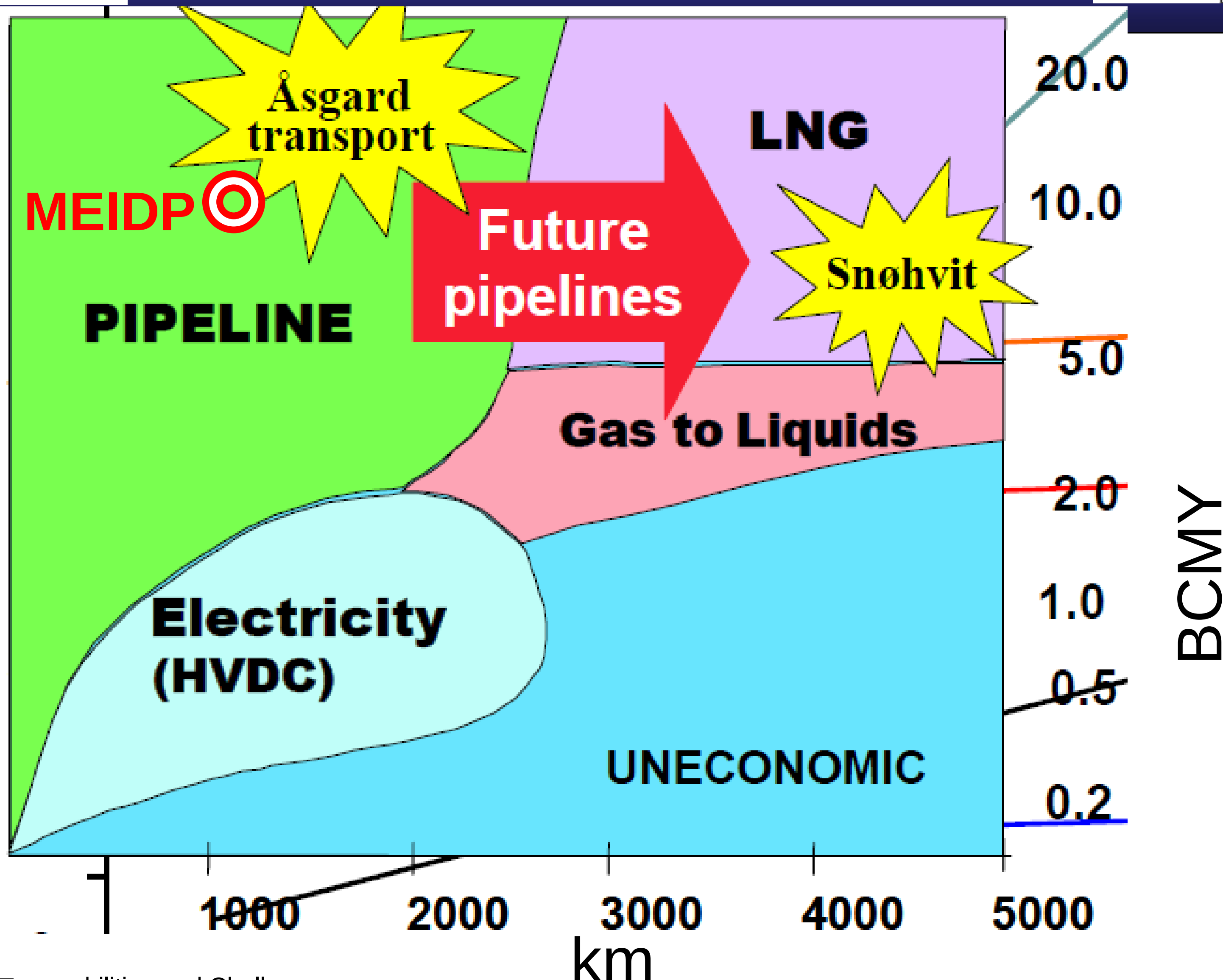
## LNG

- Qatar
- East Africa
- Australia
- Indonesia



Proprietary to South Asia Gas Enterprise PVT Ltd

# Competitiveness of Pipelines



# Optimal Offshore Transportation To India (WC)

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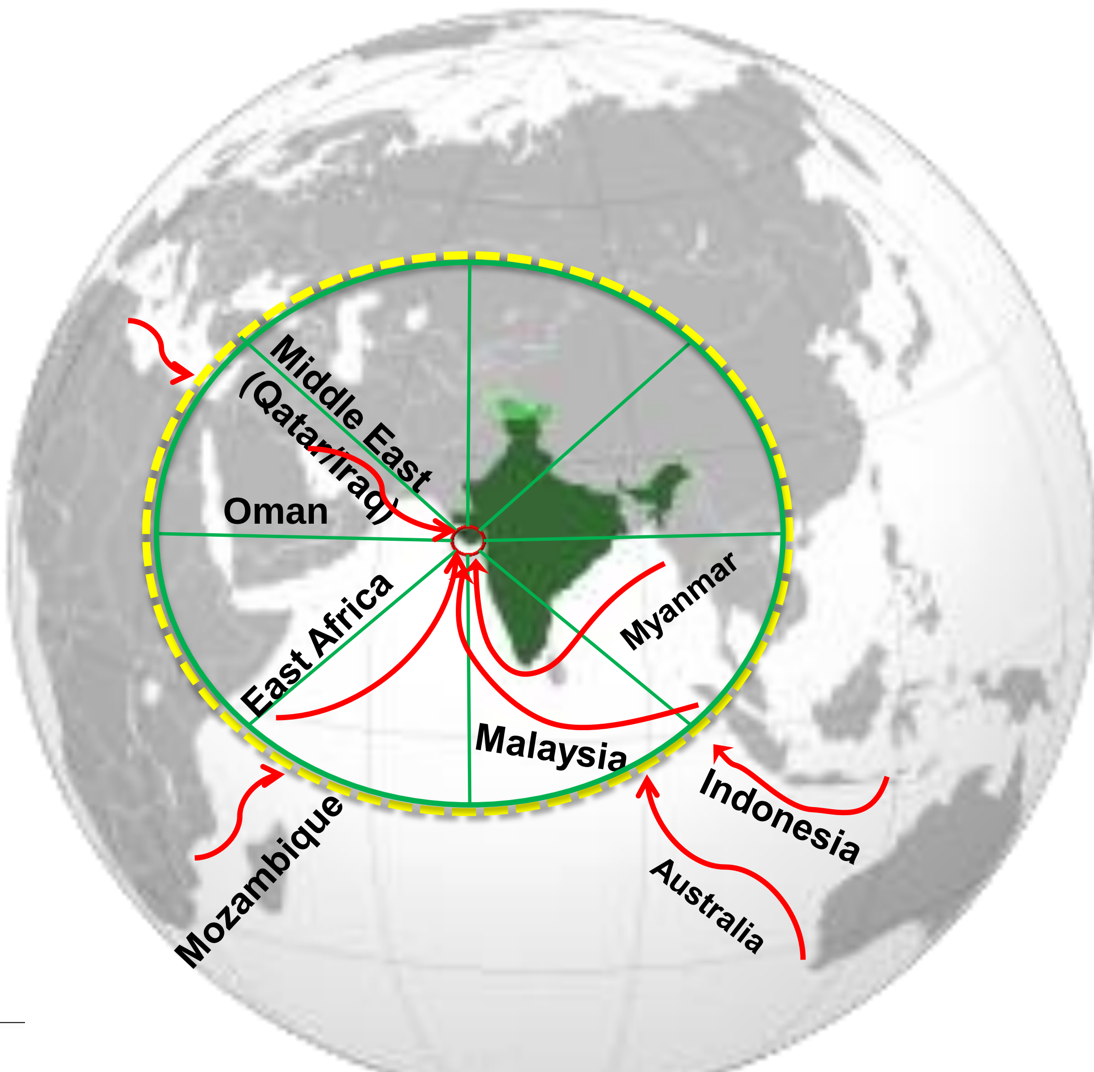
PROGRESS HARMONY DEVELOPMENT
Estd. - 1905




## Offshore Pipeline

- Qatar
- Iraq
- Oman
- Iran
- Myanmar
- Malaysia
- East Africa (North)

## LNG

- East Africa (South)
- Australia
- Indonesia
- North Africa
- Western Med

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# LNG Landed Prices Aug 2013

Natural Gas Overview: World LNG Prices

Federal Energy Regulatory Commission • Market Oversight • www.ferc.gov/oversight

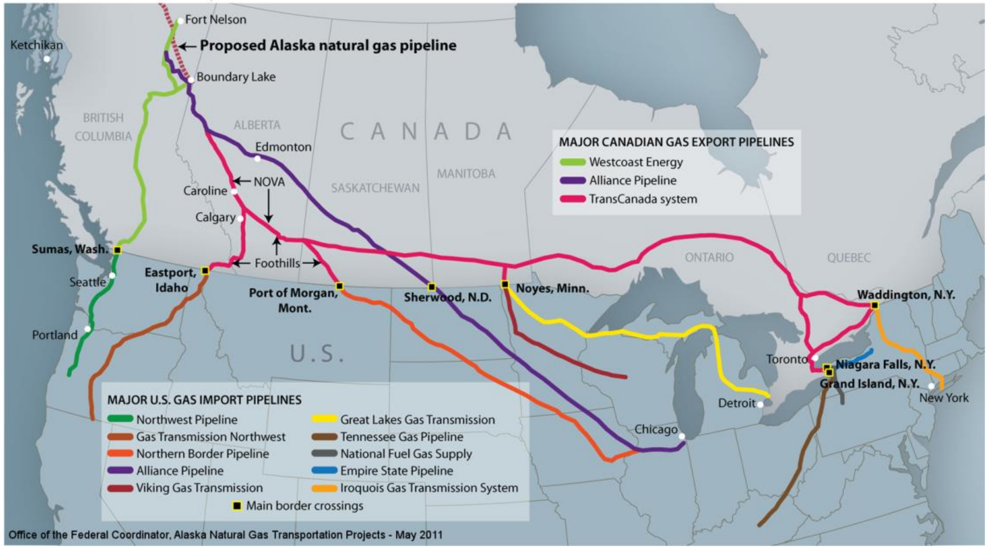
## World LNG Estimated August 2013 Landed Prices

# Transnational Gas Pipeline Regions

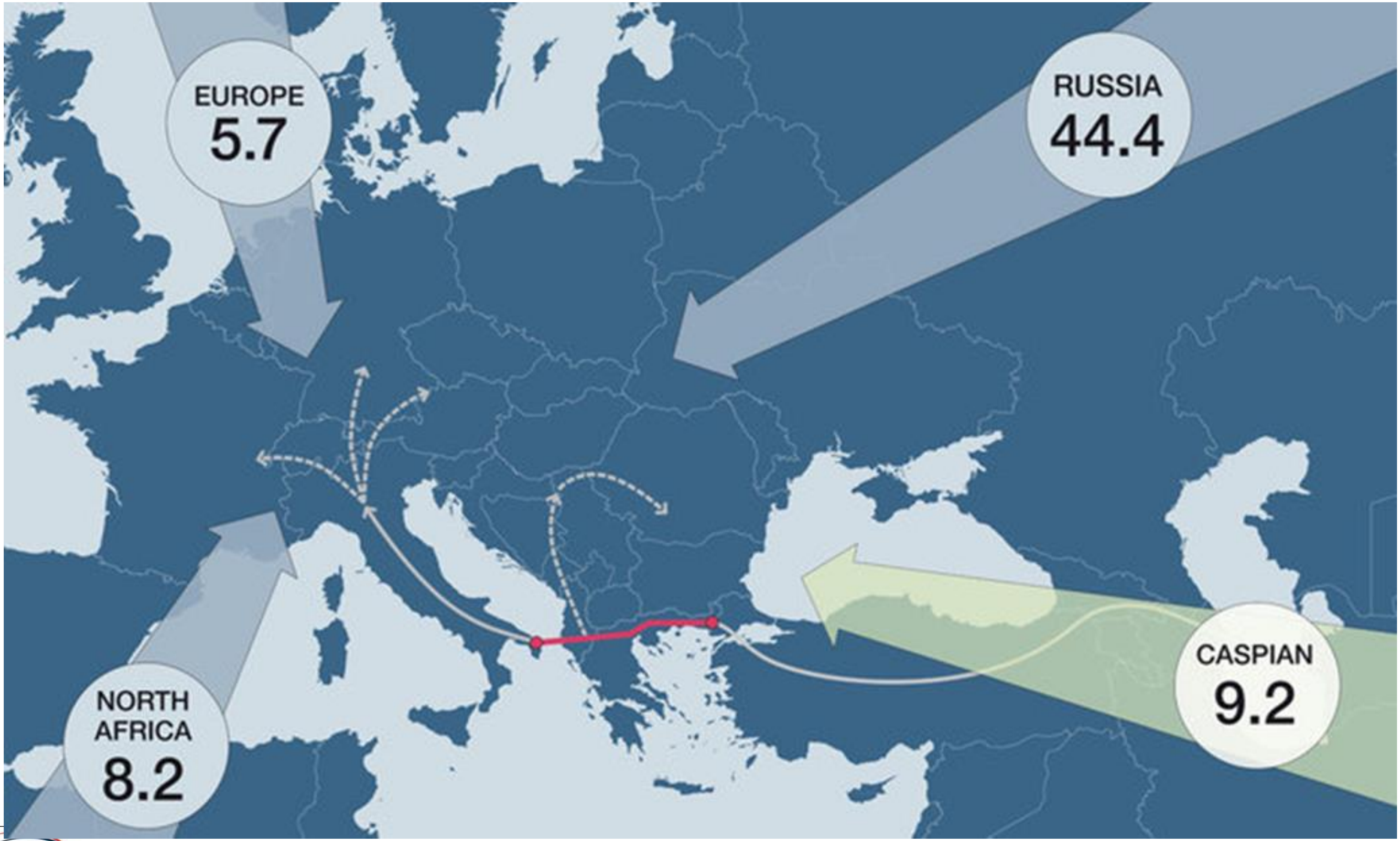


- Northern Europe
- China
- Russia to Europe
- USA to Canada
- West Africa


MAJOR CANADA, U.S. EXPORT-IMPORT GAS PIPELINES




# European Transnational Pipelines



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# Current and Planned Long Distance

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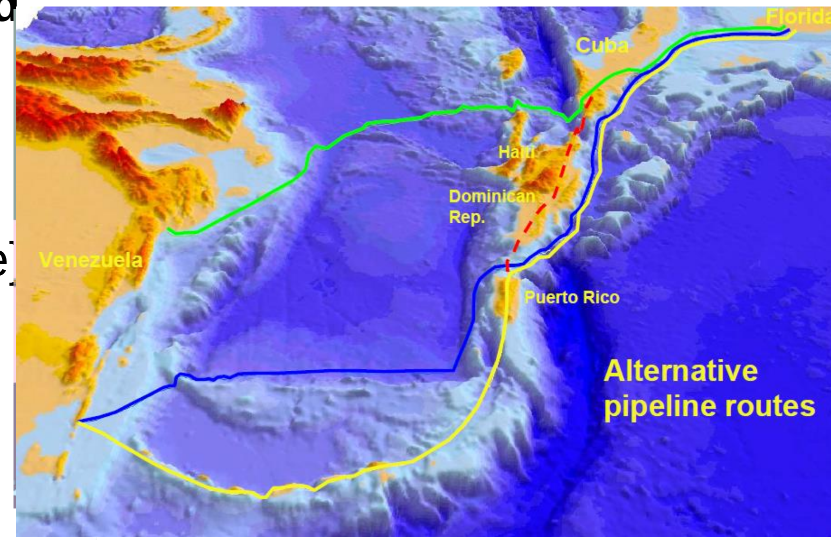
## Long Distance Subsea Pipelines are Safe and Reliable Worldwide

- Nordstream 1200km 48” 2 off {Russia → Germany} (2 further planned)
- FranPipe 840km 42” {Norway → France}
- ZeePipe 1400km 42” {Norway → Belgium}
- Europipe 650km 42” {Norway → Germany}
- Langeled 1170km 42” {Norway → UK}
- Gulfstream 1200km 36” {Alabama → Florida USA}
- West Africa Pipeline 569km 20” {Nigeria → Benin → Togo → Ghana}
- Malampaya 504km 24” {Philippines}
- Polarled 482km 36” {Artic Circle → Norway}
- Southstream 925km 32” {Russia → Bulgaria}
- Galsi 550 km 28” {Algeria → Italy}
- East Med Pipeline 910km {Israel Greece}





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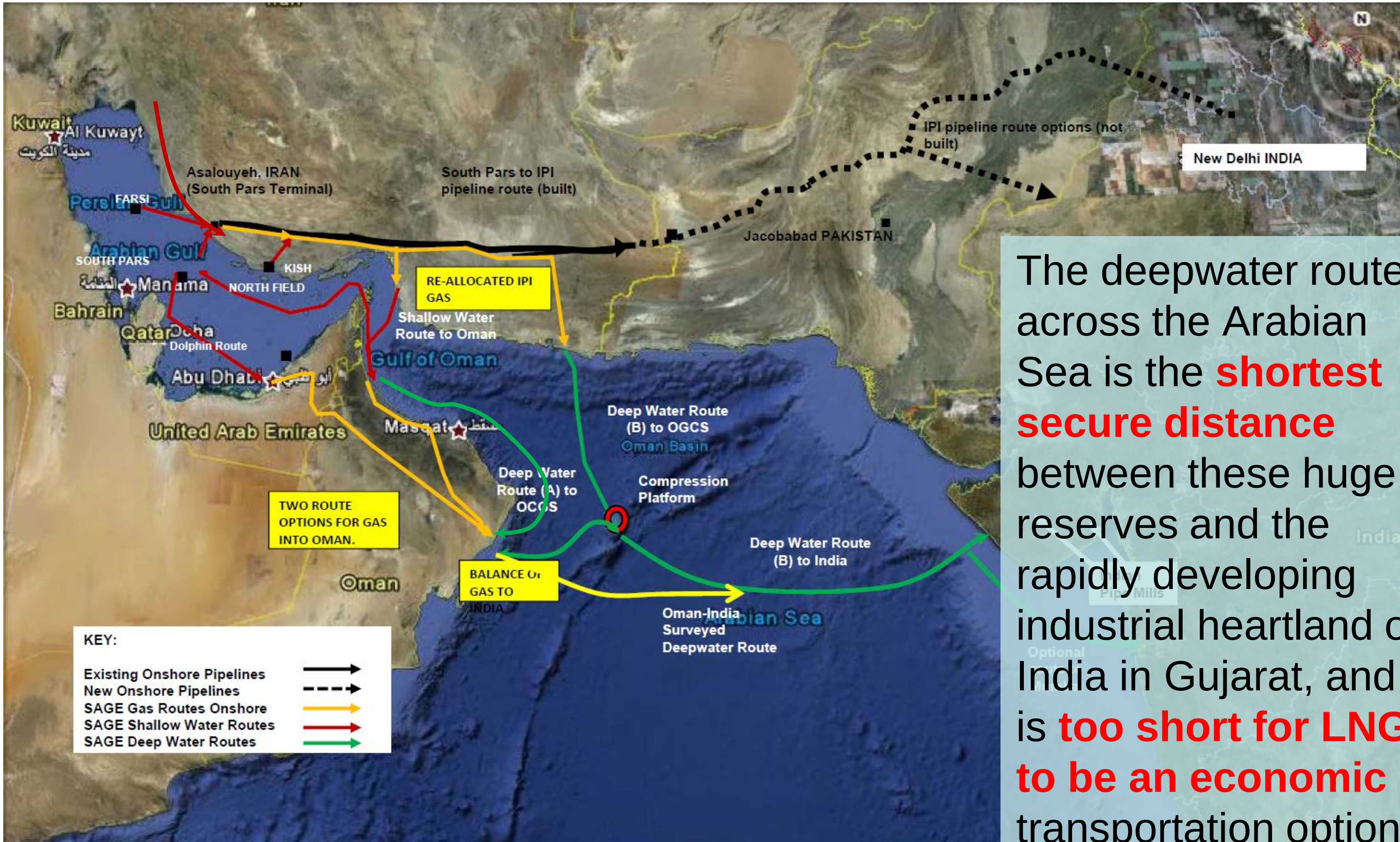
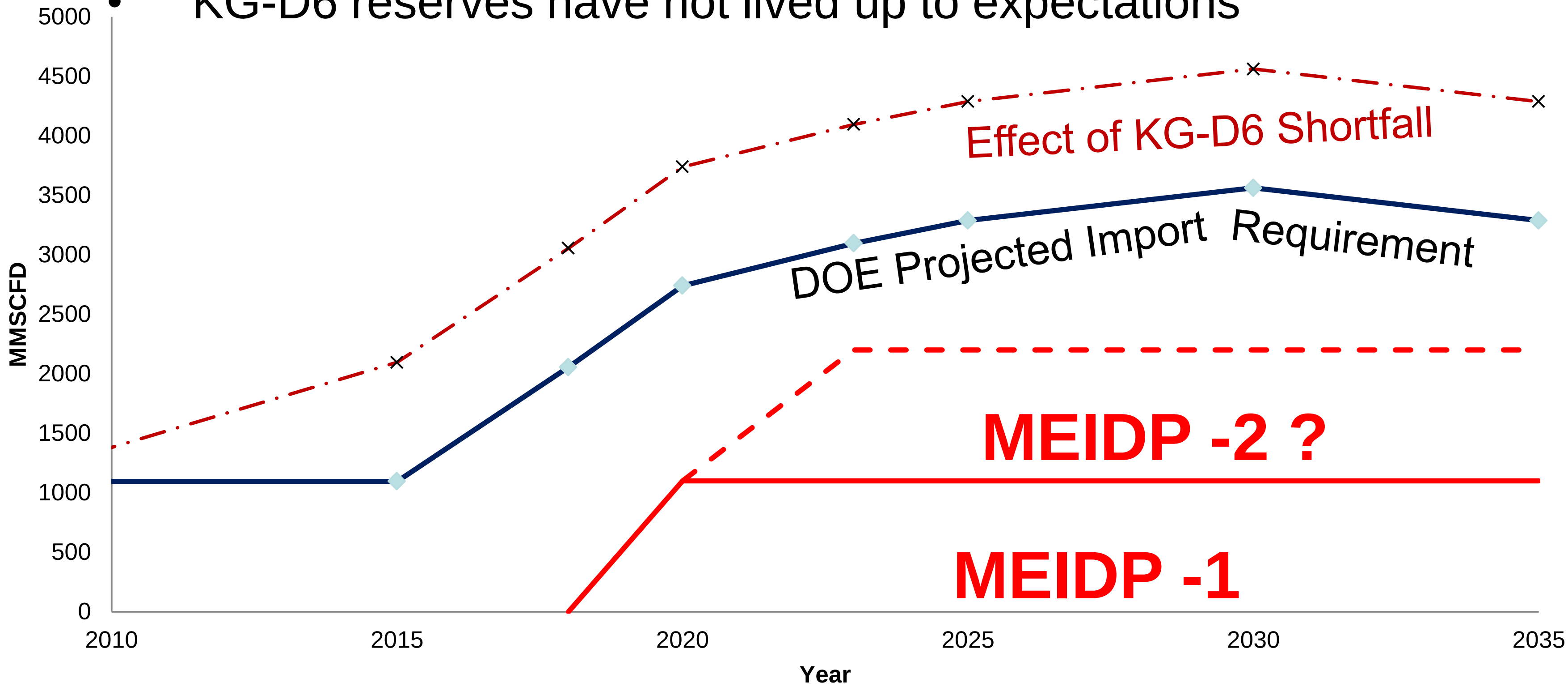
# Middle East Gas Routes to India




The deepwater route across the Arabian Sea is the **shortest secure distance** between these huge reserves and the rapidly developing industrial heartland of India in Gujarat, and is **too short for LNG to be an economic** transportation option

## MEIDP Provides

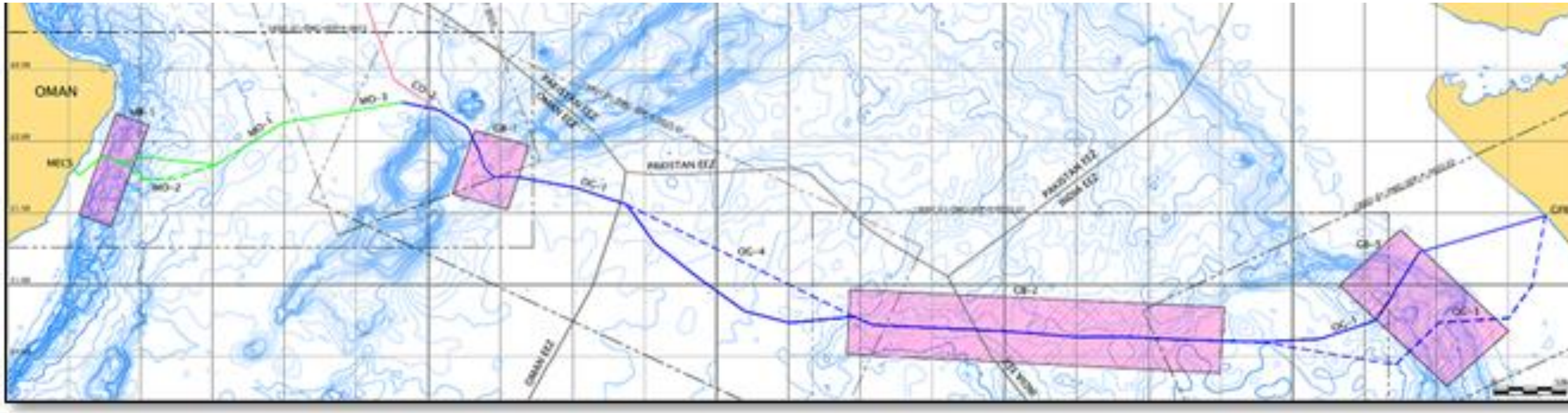
- Up to ¼ of Shortfall in Indigenous Supply
- KG-D6 reserves have not lived up to expectations

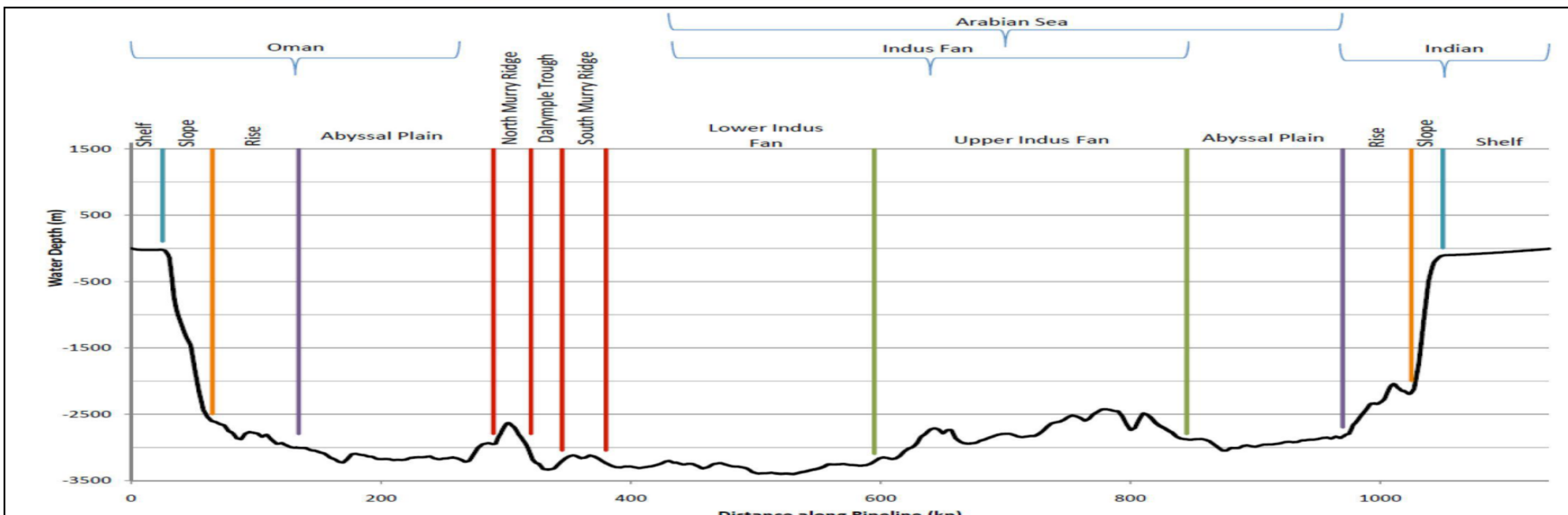



U.S. Department of Energy, DOE/EIA-0484(2010)

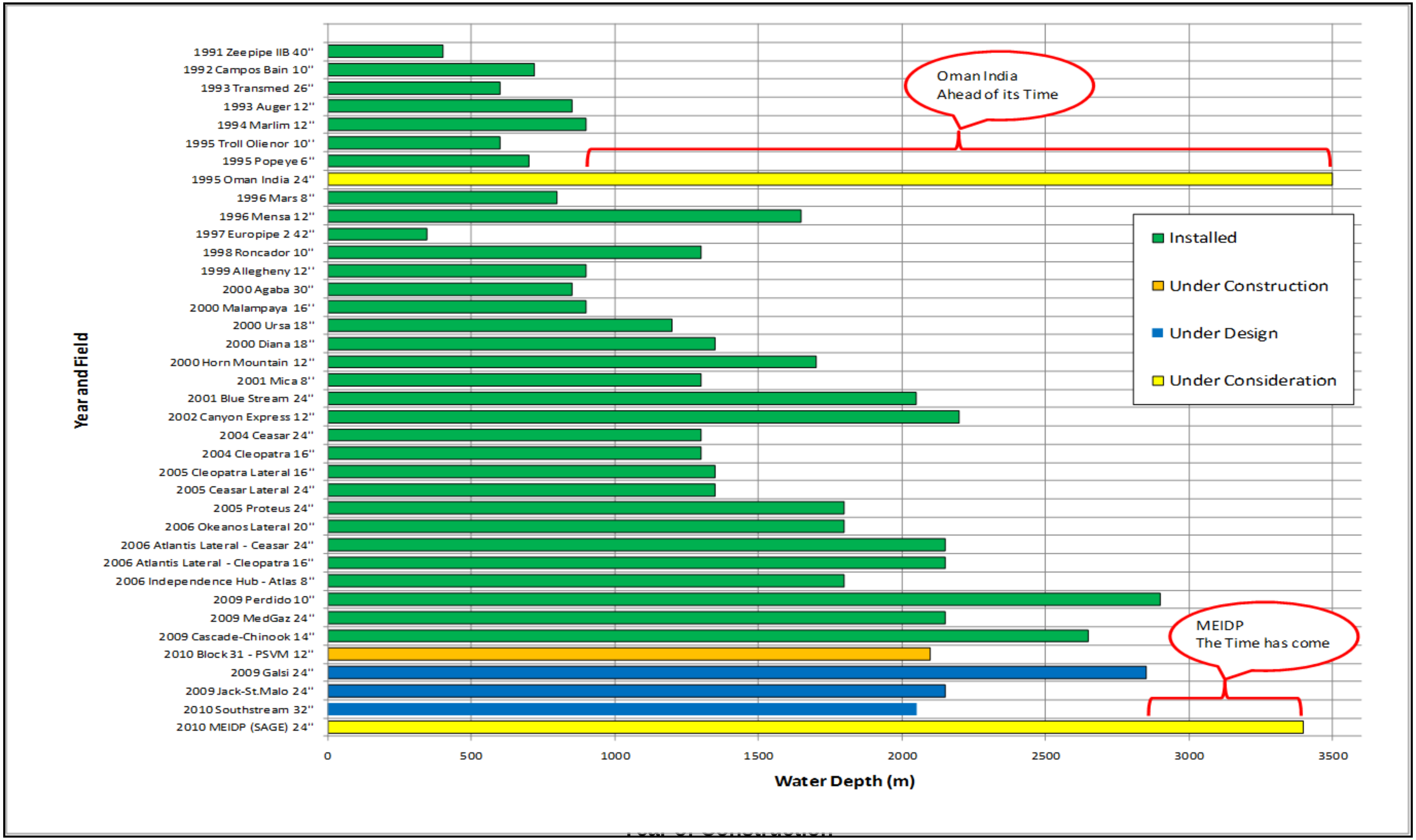
*Projected Gas Import Requirements (MMSCFD thru 2035)*

# Reconnaissance Survey



# Deepwater Project Progression



# Comparison With OIP



## Technical Risk Issues facing the project in 1995:

- Pipe mill upgrades needed to manufacture linepipe.
- Lack of lay vessel with enough tension capability. Conversion work needed to lay pipe to 3,500m water depth.
- Incomplete understanding of seismic activities and mitigation methods – mudflows, fault lines & slope failures.
- No qualified deepwater pipeline repair system was available.

## However even in 1995, 15 years ago:

- These were not considered to be fatal impediments by the industry and three competitive bids were received and evaluated before the gas was re-assigned elsewhere.

## What makes SAGE's Risk Profile lower now?

- New generation, large lay vessels ready to build.
- Several mills can manufacture pipe, particularly in India.
- Era of damaging cost escalation appears to be over.
- New and improved design methods for free-spanning and geo-hazards have been developed.
- Better positioning capabilities are now available during pipelay to avoid seabed hazards.
- Deepwater repair systems are now available.
- New testing and commissioning philosophies developed by SAGE with DnV permits use of 27-inch pipe.

# Working in Partnership

**SAGE has signed MOUs and Agreements to Co-operate in developing MEIDP with:**

### Pipe Mills
- Tata (CORUS) steel
- Welspun
- JindalSAW

### Engineering & Consultancy:
- Peritus International Ltd.
- Engineers India Ltd.
- Intecsea (UK) Ltd.
- FUGRO GeoConsulting Ltd.

### Installation Contractors
- Saipem SpA
- Heerema Marine Contractors

SAGE

### Suppliers and Takers
- Indian Oil Corporation
- GAIL
- Oman Ministry of Oil and Gas
- NIGEC

### Certification Bodies:
- .Det Norske Veritas

# Conclusions

- Indian has and will continue to have a demand for imported gas
- Available supplies from within the Middle East the region
- Importance of energy security by diversification
- The technology has advanced in the past decade (in 1990's at the very edge of technology but not yet proven; today proven technology).
- Economics works at significantly less that the cost of LNG (liquefaction, transportation and gasification).
- The project is financially sound and feasible
- Indian politics and Strategic Planning
- Geopolitics

# The Middle East to India Deepwater Pipeline Reconnaissance Survey

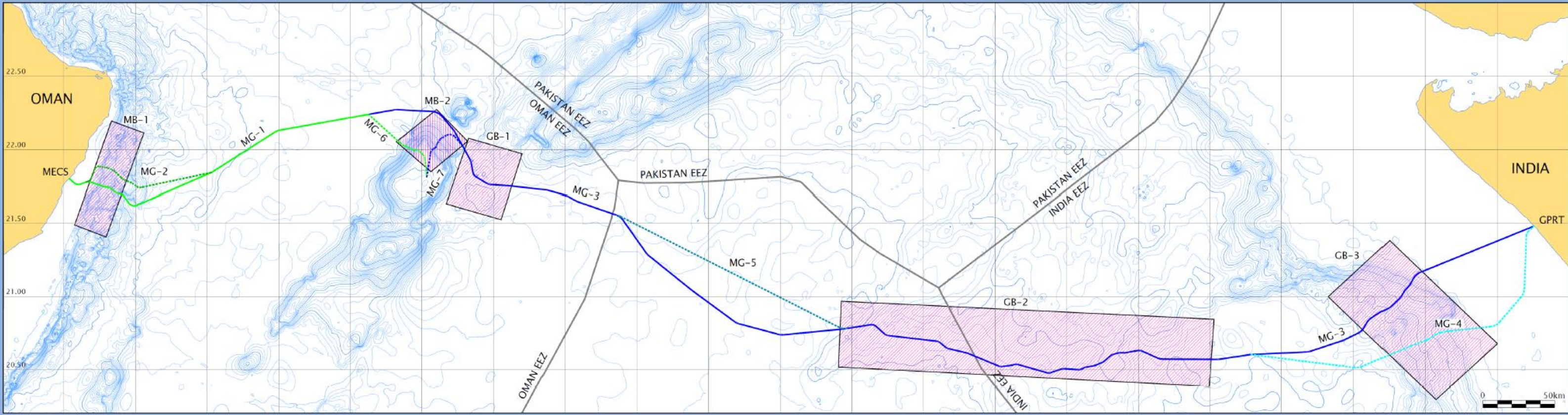
By Ian Nash

## 1 Objectives

The MEIDP Reconnaissance Survey combines Area/Block route corridor surveys of critical areas of the pipeline route including the Omani and Indian continental slopes, the Arabia-India plate boundary and associated features such as the Qalhat Seamount, Murray Ridge and Dalrymple Horsetail, Indus river abyssal fan.

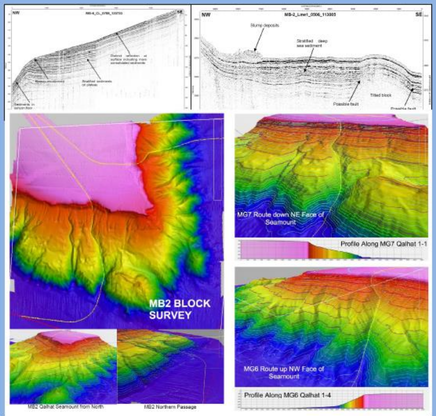
In May and June 2013 the MV Fugro Gauss performed the geophysical survey including:

- Multibeam echo sounder (12kHz - EM122 & 70kHz -EM710)
- Backscatter imagery
- 35kHz & 2-7kHz sub-bottom profiler (SES-2000 Deep)



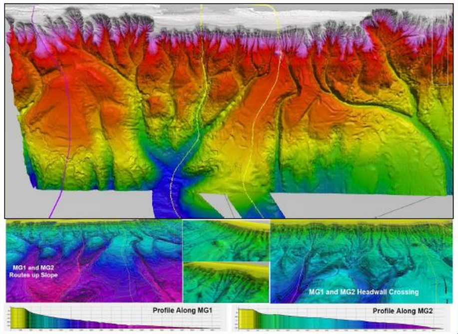

## 2 Projection Parameters

| | |
|---|---|
| Projection | Lambert Conformal Conic with 2 standard parallels (LCC2SP) |
| Hemisphere | North |
| Latitude of Origin | 20° N |
| Longitude of Origin | 66° E |
| Latitude of 1st Parallel | 21° N |
| Latitude of 2nd Parallel | 22° N |
| False Easting | 800,000m |
| False Northing | 0m |




## 3 Omani Continental Slope – Block MB1

The seabed in Box MB-1 is dominated by large canyons and channels coming down the slope and extending seawards from the continental shelf. The water depth at the shelf break is aprox 100m. a large amount of small channels and gullies at the shelf break. As the channels continue down the slope, they merge into larger channels and canyons and at the foot of the slope, the majority of them have merged into four major canyons. One of the largest canyon complex is seen in the south. It comprises three large tributaries at the foot of the slope and is almost 6km wide. The water depth at the canyon mouth is 2900m. Along the slope there are several evidences of slumping and sliding, however slump scars are almost entirely found within the channel walls. No slump scars have been detected in the areas in between the canyons and channels. The shelf and slope show homogeneous sediments on the slope between the canyon complexes. On the shelf, there are outcropping / sub-cropping rock and hard ground. The soft seabed sediments are of varying thickness on the shelf but generally less than 2m. The canyons and channels on the slope appear to contain various amounts of coarser sediment.




## 4 Qalhat Seamount – Block MB2

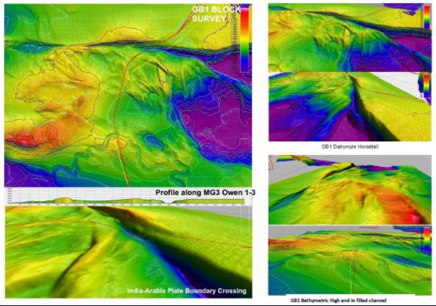
The high Qalhat Seamount located approximately 280km east of the Oman coast within the Omani EEZ and could potentially be used to locate floating compression facilities should a route direct from the Persian gulf be adopted. The seamount rises from a water depth of 3000m in the deep sea area to about 300m at the shallowest point on the plateau, a rise of 2700m. In order not to lose the opportunity of collecting geophysical data on the seamount, the survey included the most likely routes up the eastern slope and down the northern slopes, together with parts of the plateau area. The history of the Qalhat Seamount is not completely known however the presence of a strong magnetic anomaly in the vicinity of the seamount and a typical flat morphology. Evidence suggest that the Qalhat Seamount is a volcanic guyot. The general gradients of the eastern slope are around 20˚ with the upper slope area having gradients between 25˚ and 29˚. Deep canyons and gullies dissect the slopes and there is frequent evidence of slumping and sliding along the slopes.

## 5 Owen Fracture Zone – Block GB1

The GB-1 block is characterized by two main structures, a central part which comprises the westernmost extension of the Upper Indus Fan complex as well as the east flank of the Qalhat Seamount, and the deep basins of the Dalrymple Trough in the north. A distinct fault crosses the area in an almost north-south direction into the southernmost end of the pull apart basin of the Dalrymple trough at the Dalrymple Horsetai. This fault is the tectonic plate boundary between the Arabian and Indian plates that extends over 800km in 5 main fault segments of up to 220km length. At the MEIDP crossing point of the Dalrymple Horsetail the Owen Fracture Zone takes the form of a strike-slip right lateral fault. The best estimate for slip rate along this fault is 2mm/year (7mm/yr max). On entering the Dalrymple trough the fault line breaks up into a series of spreading normal faults. At the location of the pipeline crossing, the surface relief of the fault forms a 200m deep canyon, 1.3km wide and water depth of 3200m.

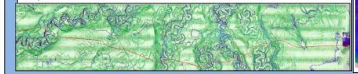
Another distinct feature in the area is a bathymetrical high in the south, at the top of the slope to the deep Arabian Abyssal Plain basin. The high is about 6km wide at its widest point and approximately 19km long. The shallowest part, 2630m, is found on the southern part of the high.

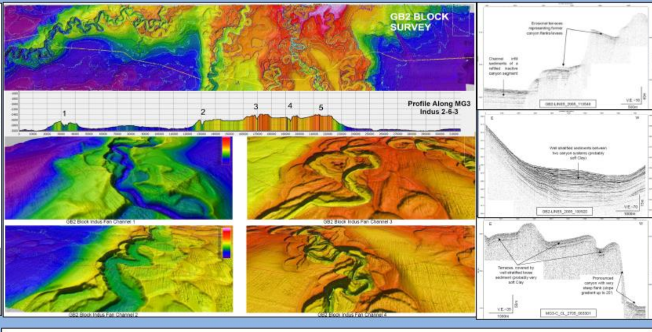
To the east of the bathymetric high, there is a 1km wide, approximately 40m deep meandering channel. Parts of the channel are almost entirely in filled by pelagic sedimentation and barely visible in the seafloor.

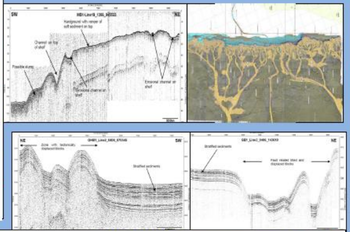



## 6 Indus Fan – Block GB2

The seafloor in the survey area of Box GB-2 is characterized by two topographical main structures: The channel/levee systems of the Indus fan which dominate the central part of the box; and the deep sea basins in the easterly and westerly sections of GB-2. The channel/levee system is characterized by central channels with a series of adjacent terraces and numerous abandoned channel loops, which are partially refilled by the overspill sediments from active canyon areas. The pipeline route crossing the Indus River Abyssal Fan crosses five turbidity current channels up to 200m high, in water depths between 2100m - 3200m. With the exception of Channel 1 the channels follow a meandering flow pattern with general N-S direction. Channel side slopes up to 25° have been detected. Channel 1 on the western edge of the block follows a meandering E-W direction. Generally the seabed is covered by a fine grained soft to very soft clay, deposited by turbidity currents and mass wasting events. The sedimentary levees are a result of overspill sediments and deposits on both sides of the canyon/channels.

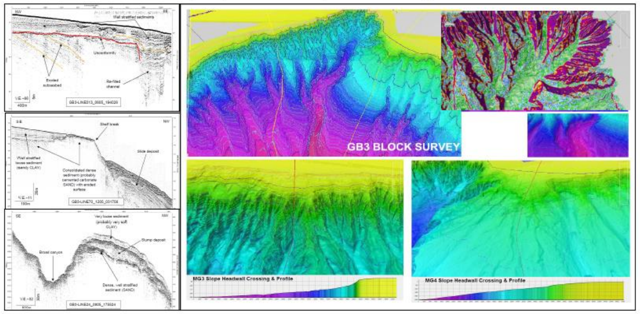




## 7 Indian Continental Slope – Block GB3

The seabed in the survey area of Box GB-3 consists of a narrow shelf section at the eastern edge of the box and a broad area covering the continental slope in the middle and western part of the survey area. The water depth ranges from 70m at the East to around 150m at the shelf break. The water depth ranges from 150m at the shelf break to around 2500m at the base of the slope. The upper slope area is dominated by numerous steep incised gullies with slopes of up to 30 ˚ observed near the shelf break (see slope map below). Down slope, most of the gullies join together to form smaller canyons, which then form major canyons. Between the canyons sediment ridges/mounts are developed. Slump deposits can be observed in MBES data which usually end up at the base of the slope contained within canyon walls




## 8 Conclusion

The survey must be seen to be a great success for all concerned. The next stage of the project is to finalise of the route. The data will allow the detailed assessment of the 5 critical route areas (Indian Slope, Indus Fan, Owen Fracture Zone, Qalhat Seamount and Omani Slope), which will in turn allow a full definition of the intervention works required to safely install the MEIDP. This assessment is very important in order to allow the project to move forward to remove any doubts that remain about its technical viability.



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