Deepwater Gas Pipelines direct from the Middle East to India

"A project whose time has come"

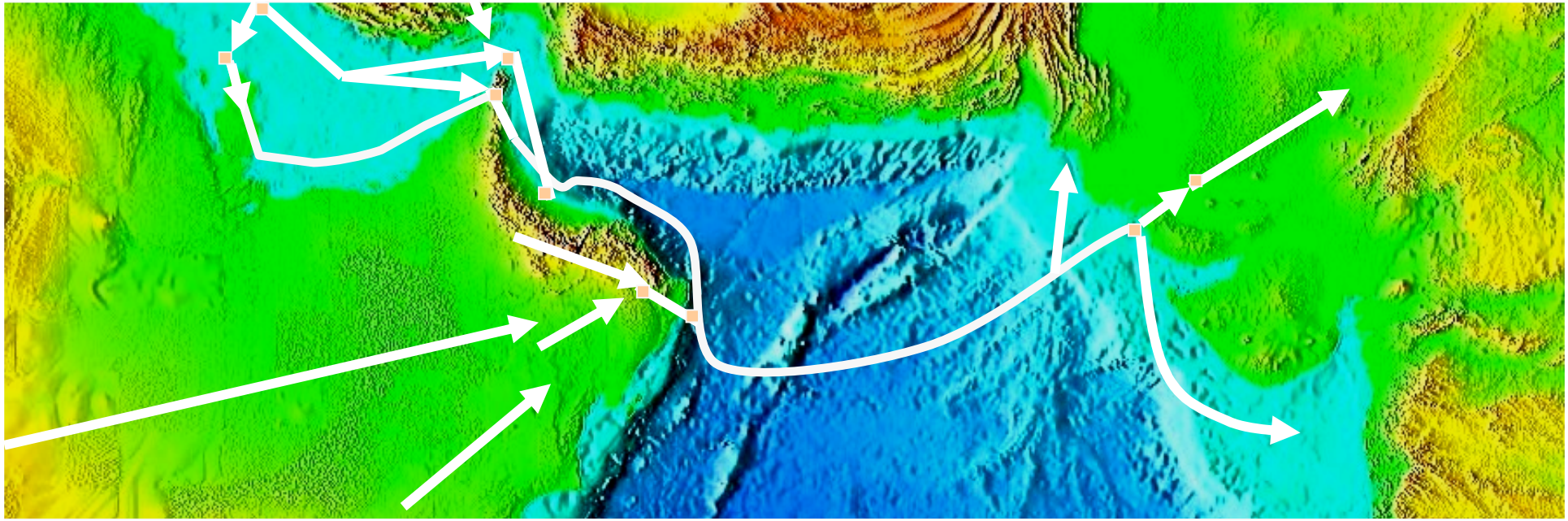
October 2008

SAGE

Middle East to India
Deepwater Pipeline

Building on Previous Experience

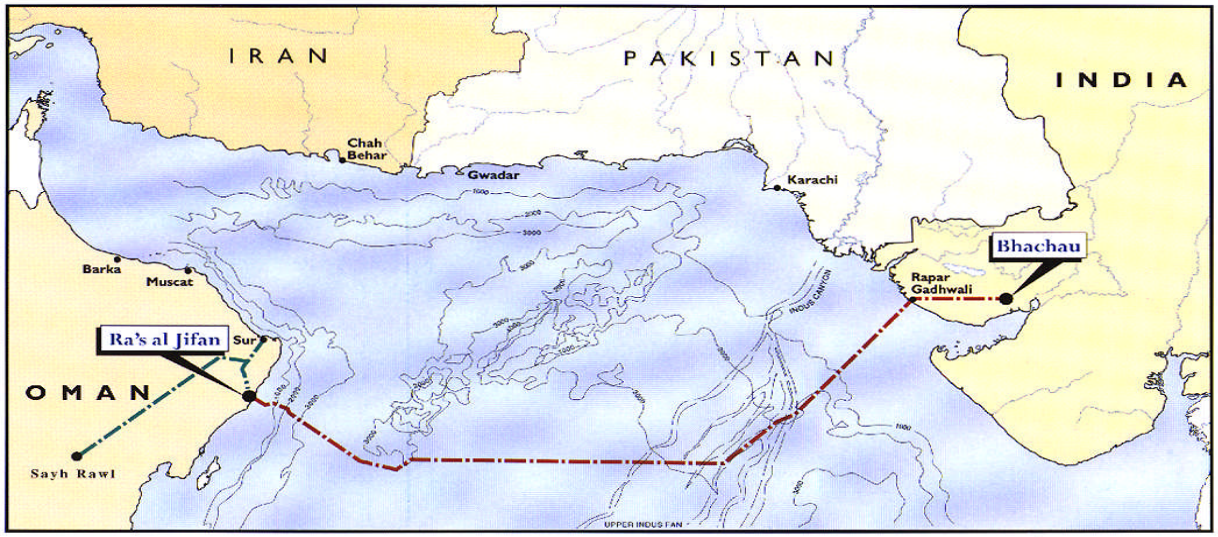
SAGE will build on the extensive study of the deepwater route started during the mid 1990's, strengthened by the development work now undertaken by SAGE and the major body of industrial deepwater pipelay experience over the last decade. SAGE will reach water depths of around 3,500 meters and will be over 1,000km in length.



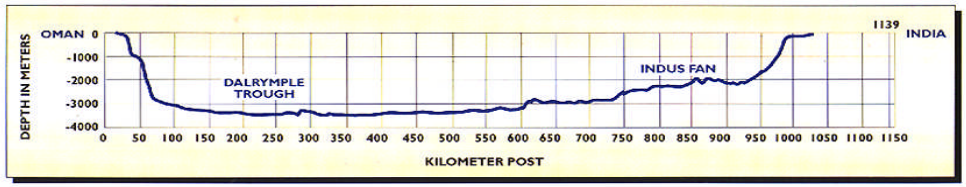
- Multiple gas sources expected from across the Gulf region and Middle East
- Gas Gathering network will grow with its "Hub" in UAE, Oman or elsewhere
- Landfall locations to be set by Gas source and Commercial considerations
- Fully surveyed route from the 1990s project used as "base case" for costings

History

Deepwater pipeline technology was first developed over 10 years ago on the Oman-India project……..



Subsea Route and Sea Bottom Profile



……and has now matured

Building on Previous Experience

SAGE

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:

- 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.

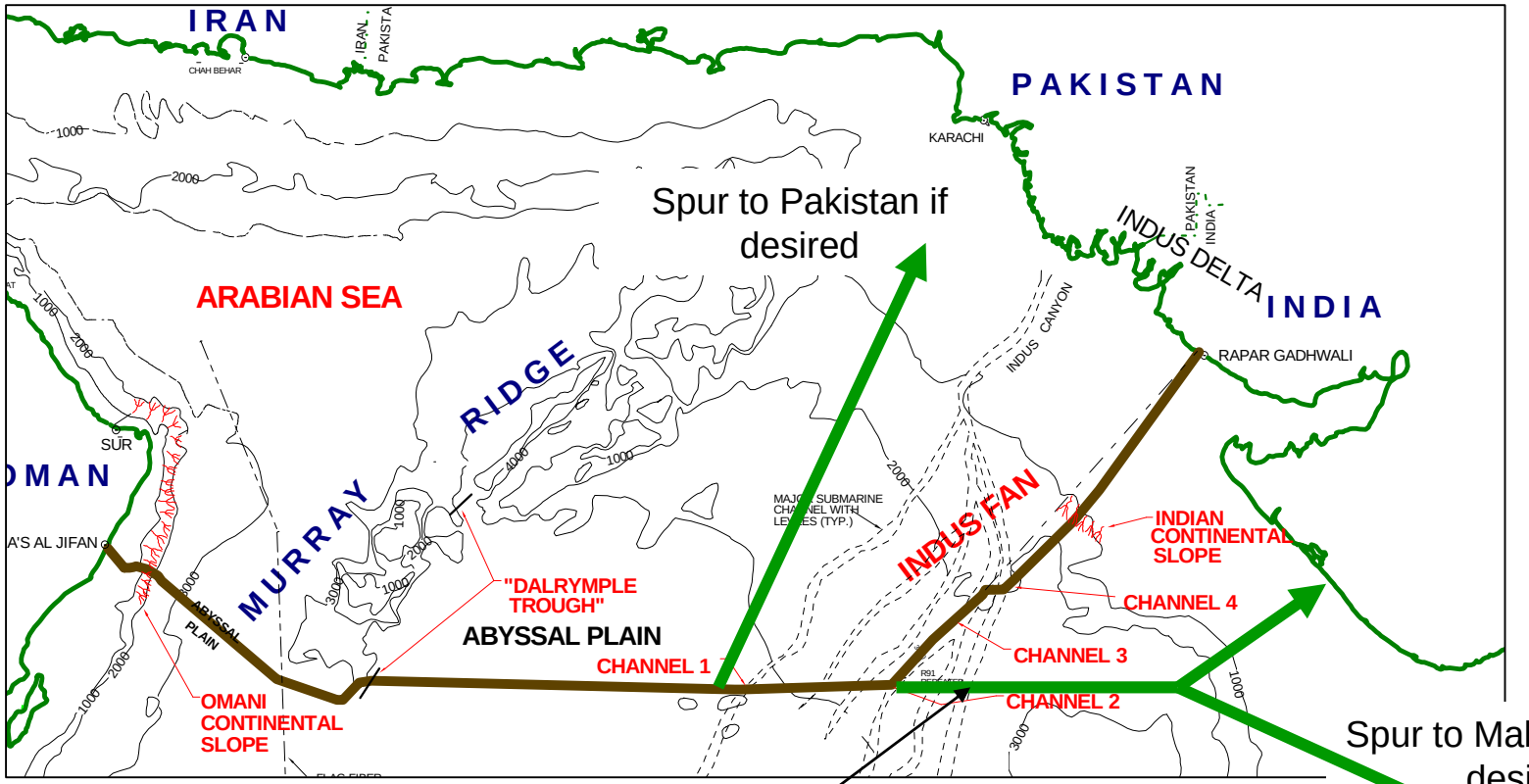
Building on Previous Experience

What makes SAGE's Risk Profile lower now?

- New generation, large lay vessels.
- Several mills can manufacture pipe (also in India).
- Era of damaging cost escalation appears to be over.
- New and improved design methods for free-spanning and geo-hazards.
- Better positioning capabilities during pipelay to avoid seabed hazards.
- Deepwater repair systems available.
- New testing and commissioning philosophies developed by SAGE with DnV permits use of 28-inch pipe:

The work has shown that it is possible to document that a 28" OD pipeline with a 42mm nominal wall thickness made of DNV-SAWL-450 F (steel having a SMYS of 450MPa) exposed to light heat treatment to have sufficient safety level.

Building on Previous Experience



Possible re-route suggested by *INTECSEA* to minimize mud flow exposure in Channel 4; the revised route is also shorter

Project Features - Technical

- The pipelay industry has continued to reach into ever deeper water until today, Heerema's new pipelay barge is specified to work beyond 3500m.
- SAGE has a conservative design, well inside current technology guidelines.
- SAGE establishes a natural gas "Energy Corridor" to form a new and politically neutral energy route infrastructure as additional lines are subsequently installed.
- 31.1 Million Standard Cubic Meters per day from each line (1.1BCFD).
- Western Indian gas markets are as close to Middle East as to new gas reservoirs off the Indian East Coast.

Key success factors

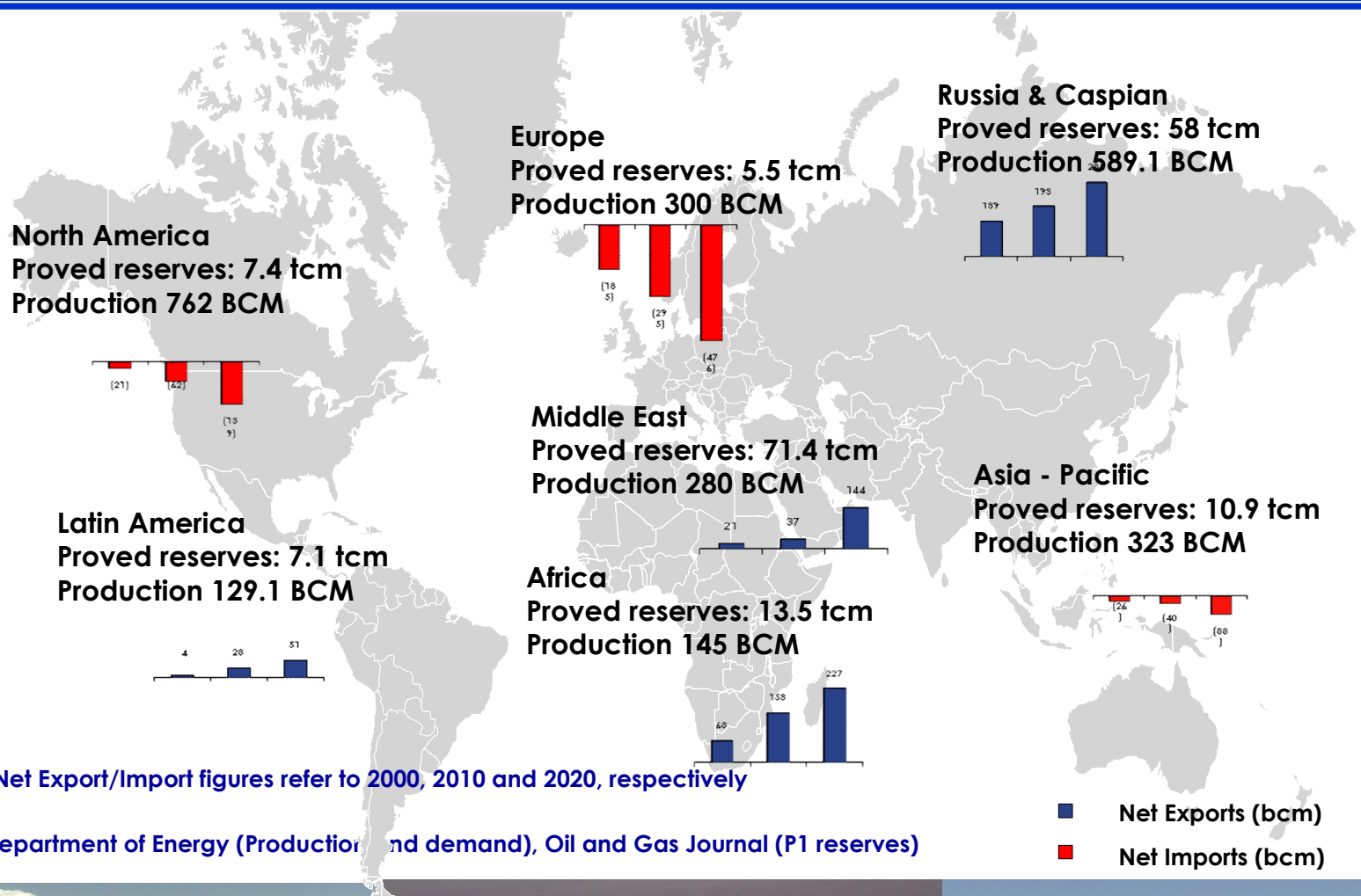
SAGE project has economic and technical viability:

- World class design and build consortium; low project risk.
- Route outside of Straits of Hormuz and neighbours' EEZs gives SAGE a desirable low political risk profile.
- Non-volatile, long-term bi-partisan pricing different from and complementary to LNG "spot-market" price volatility for stable, superior financial risk profile.
- Replaces wasteful use of Naphtha for fertiliser production
- "Green Energy" and carbon reduction benefits.
- SAGE provides an historic opportunity to West and South Asia for convergence of regional economic interests.

The SAGE Project – Key team members

Mr. T.N.R. Rao	▪ Former Petroleum Secretary, Govt. of India and "Architect of the Oman-India Pipeline" ▪ Chairman of the SAGE Advisory Board ▪ Founder Chairman, Hydrocarbons Education & Research Society, Indian School of Petroleum. ▪ Founder Chairman – University of Petroleum & Energy Studies
Subodh Jain	▪ Director: INOX-AIR PRODUCTS Ltd. ▪ Director: South Asia Gas Enterprise PVT Ltd ▪ Director: Siddho Mal & Sons, New Delhi ▪ Former Senior Advisor to original Oman-India Pipeline team
Peter M Roberts	▪ Director: South Asia Gas Enterprise PVT Ltd ▪ Director: VerdErg Ltd, London ▪ Former Project Director of original Oman-India Pipeline
Dr Herman Franssen	▪ Senior Consultant to SAGE ▪ Member of the SAGE Advisory Board. ▪ President, International Energy Associates, USA ▪ Former Economic Advisor to the Oman-India Pipeline project ▪ Former Economic Advisor to the Sultanate of Oman, Ministry of Petroleum
John Stearns	▪ Vice-President, Marine Pipeline Systems, INTEC Engineering Inc., Houston ▪ Former Project Director, Mardi Gras Transportation System ▪ Former Project Manager, Canyon Express Project
Rob Narold	▪ HMC Project Manager for new barge design and construction ▪ HMC Strategic Development Advisor ▪ Sr. Proposals Manager - Manager New Product Development ▪ HMC Deep Water Product Manager
Professor Alastair Walker	▪ Leading International Expert on Marine Pipeline Engineering ▪ Senior Consultant to SAGE ▪ Member of the SAGE Advisory Board ▪ Professor Emeritus, University of Surrey UK ▪ Visiting Professor, University College London
Richard Freeman	▪ Manager, Business and Sales Development, Corus Tubes (Energy), UK.

NATURAL GAS MARKET: GLOBAL PERSPECTIVE

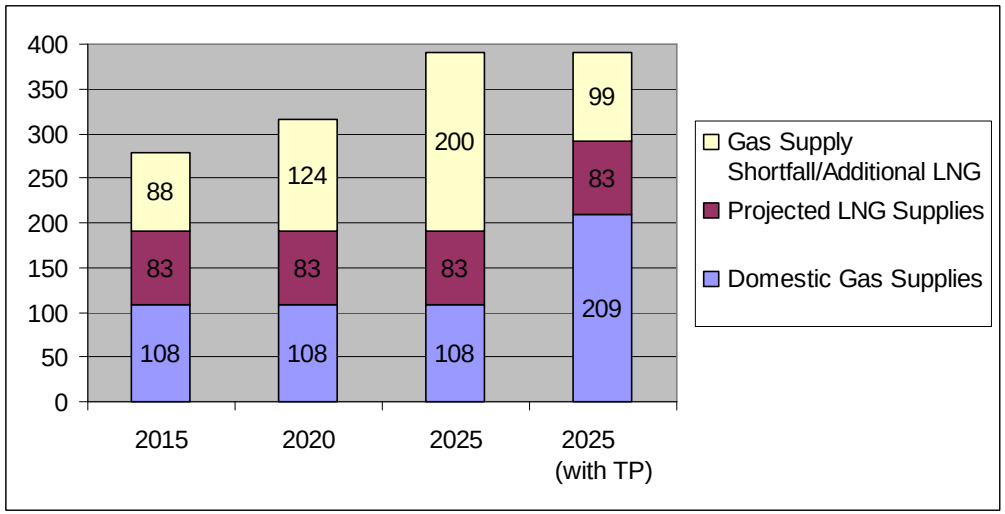


Notes: Net Export/Import figures refer to 2000, 2010 and 2020, respectively

Source: US Department of Energy (Production and demand), Oil and Gas Journal (P1 reserves)

Indian Power Industry

- The Indian Power Ministry wants 77 MMscmd gas but gets only 39 MMscmd.
- NTPC is investing $40bn in next 5 years to lift capacity from 28,000 to 50,000 MW.
- India plans its power capacity to rise from 135,000 to 200,000 MW by 2012: 20% will be from gas - more than twice figure now.
- A gas shortfall is expected for many years.
- By 2030, India may need 224 MMtoe/yr of gas, requiring over 150 TCF recoverable reserves - twice what may be available indigenously.



Projected Demand	2015	2020	2025
(MMSCMD)	279	315	391

TP : Transnational Pipelines

POTENTIAL GAS DEMAND AND SUPPLY (HIGH GROWTH SCENARIO)

Source:
PROSAD DASGUPTA
MD&CEO, PETRONET LNG LIMITED
London Conference 20th February 2008

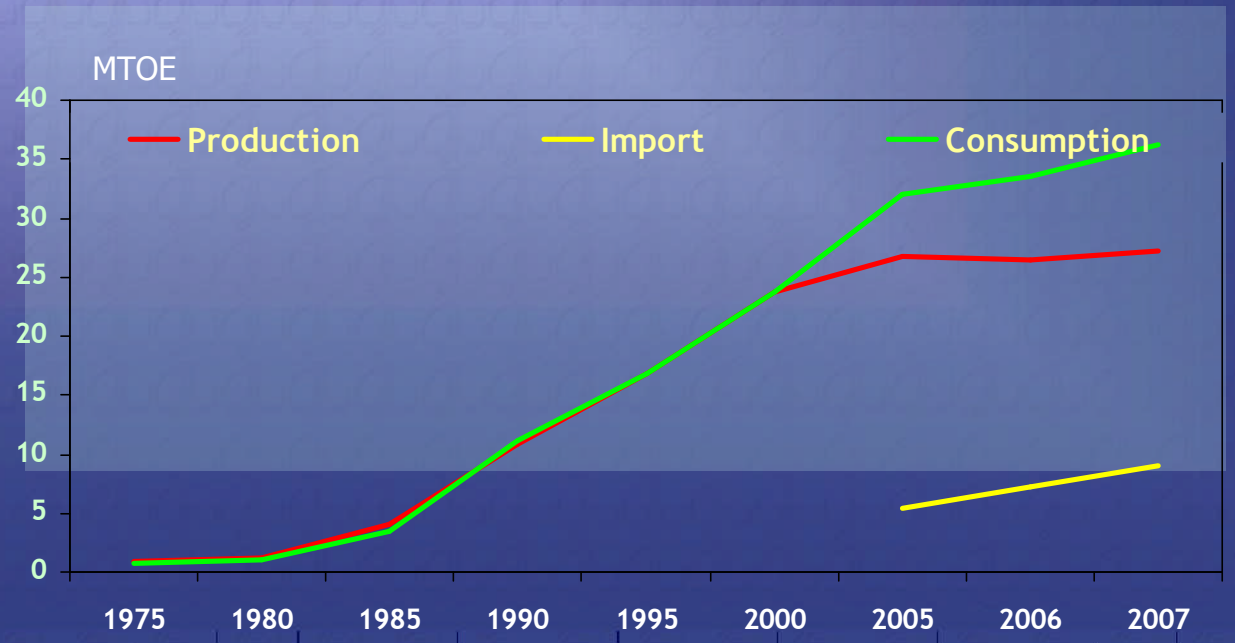
Indian Fertilizer Industry

- Expected Urea production in India will need 95 MMscmd of gas by 2017.
- The gas deficit of the Indian Fertiliser Industry is reported to be 20 to 30 MMscm per day.
- This deficit is currently met from LNG and naphtha.
- Dow Jones reported on 21 November 2007:
  - "We are now substituting almost 20% of our gas needs with naphtha….we are talking to gas suppliers, but the gas just isn't there." (attributed to a senior executive at Indian Farmers Fertiliser Cooperative).
  - "Naphtha consumption may cross 3.2 million tonnes in the year to March 2008 compared with less than 2.7 million tonnes in the last fiscal year." (attributed to a senior official in the Ministry of Chemicals and Fertilisers.)

India: Gas Scenario

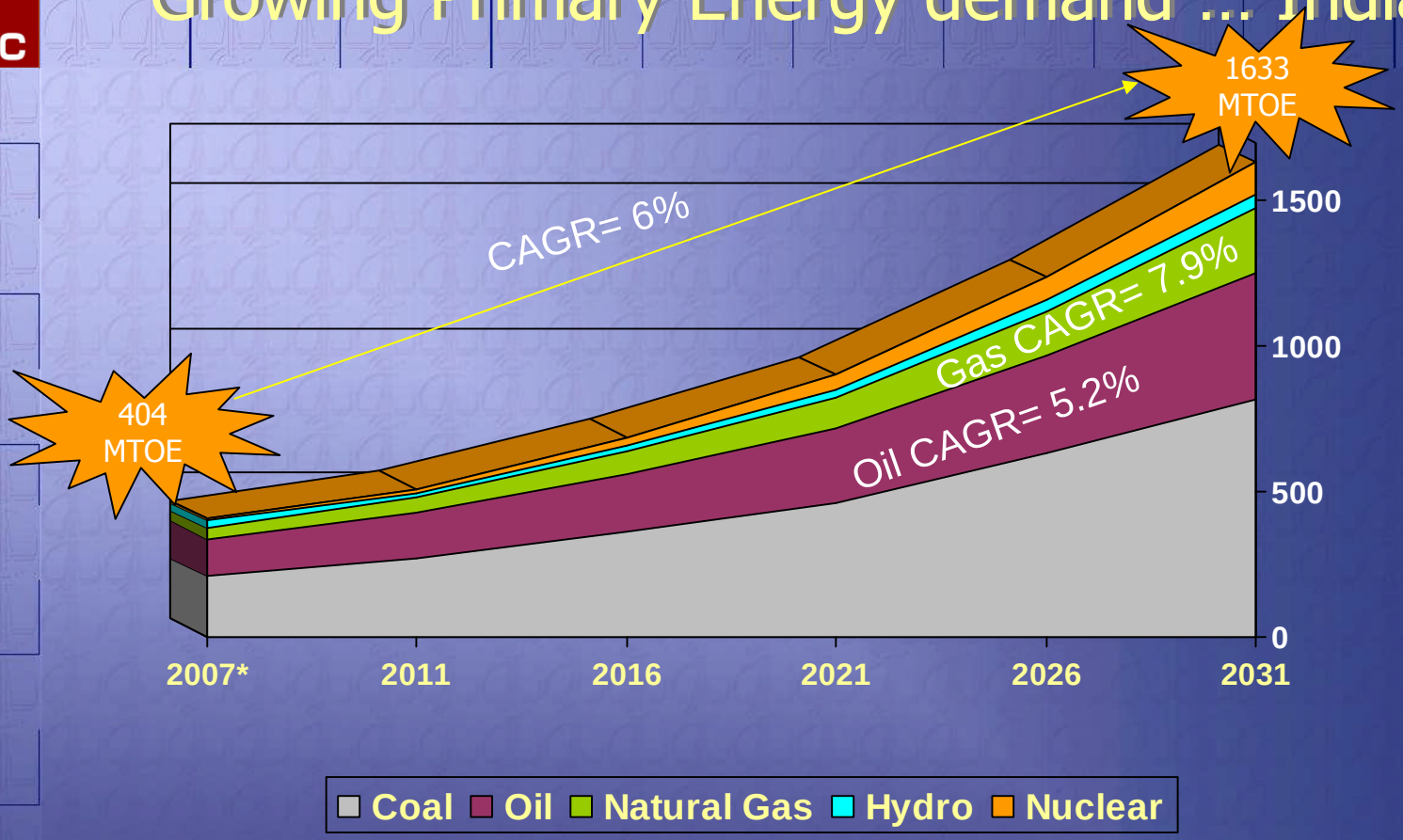
Data from paper given by Mr. R S Sharma, Chairman & Managing Director, ONGC, given on October 3rd 2008:

- Gas constitutes ~9% in Pry energy basket; likely to increase, thanks to Gas strikes at East coast
- Situation to improve by 2012.
- Demand-supply gap to exist



Source: BP Statistical Review 2008

Growing Primary Energy demand ... India



- With development of East Coast, new & marginal fields of West coast, CBM, UCG, and likely trans-national gas trunk lines- the gas demand seems to be achievable
- For oil, though importer for over 25 years, considering the dramatic rise in volume demand, the balance of trade for oil is a critical issue

*Source: BP Statistical Review 2007

Projected figure Source: Integrated Energy Policy

The Ministry of Petroleum and Natural Gas announced a doubling of the domestic gas distribution infrastructure on March 30th 2007:

"Expressions of Interest in 5 new natural gas pipelines on a “common carrier” basis will be invited soon. The total length..will be around 5000 km…estimated investment Rs. 18,000 crore (US $4 billion)….and add to the existing network of over 5600 km.

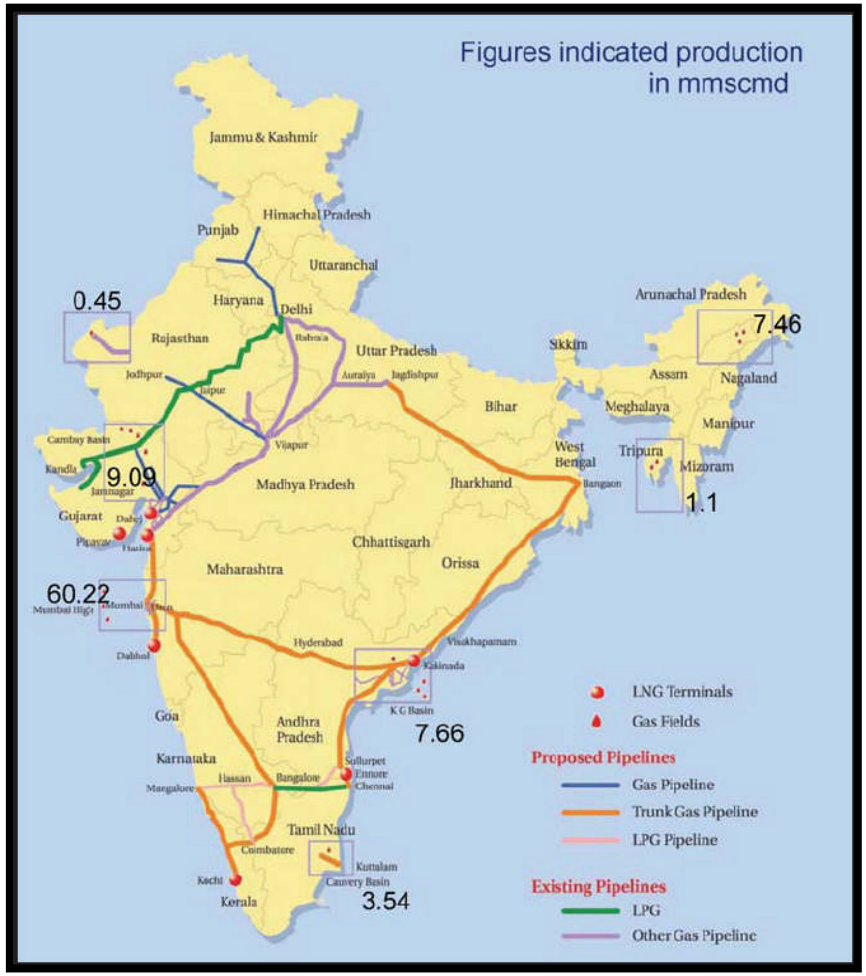
When commissioned, capacity is expected to increase from 140 MMscmd at present to around 280 MMscmd."

Reported by indianpetro.com 2nd April 2007

Dr. U. D. Choubey, Chairman and MD of GAIL, commented on 21st Feb. 2008 that upcoming investment in the gas supply chain could be $4bn to $5bn

31.5 MMscmd can be absorbed in Gujarat / Maharashtra even without new downstream investment…..

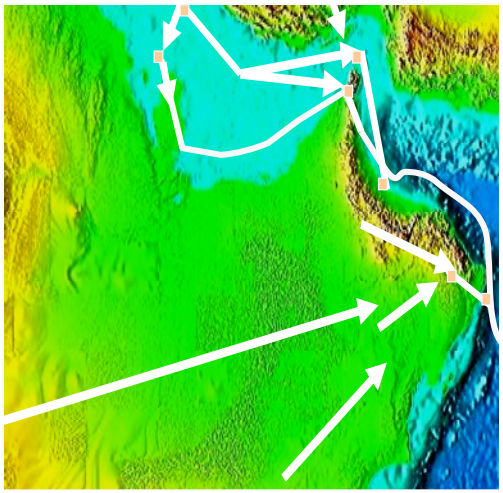
There will be no problem selling SAGE gas!



Source: KPMG

Energy Economics

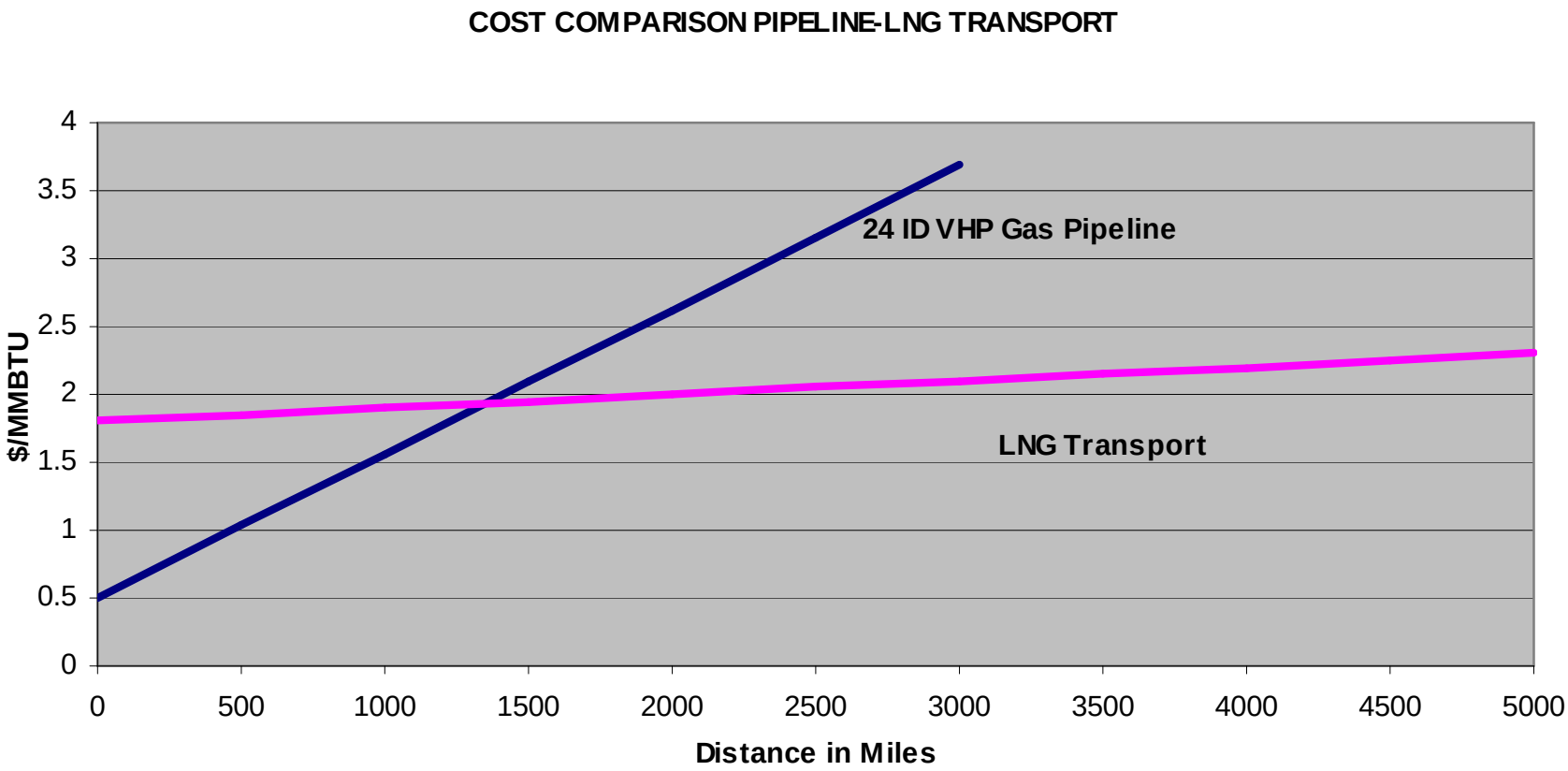
SAGE provides the connectivity between the "Gas Rich" Middle East and "Gas Hungry" India.



SAGE will act as a highly secure Common Carrier, carrying gas from multiple Middle East sources to multiple Indian users, for a tariff.

Investors are anticipated from both the Indian Gas Supply and Middle East Gas Purchase communities.

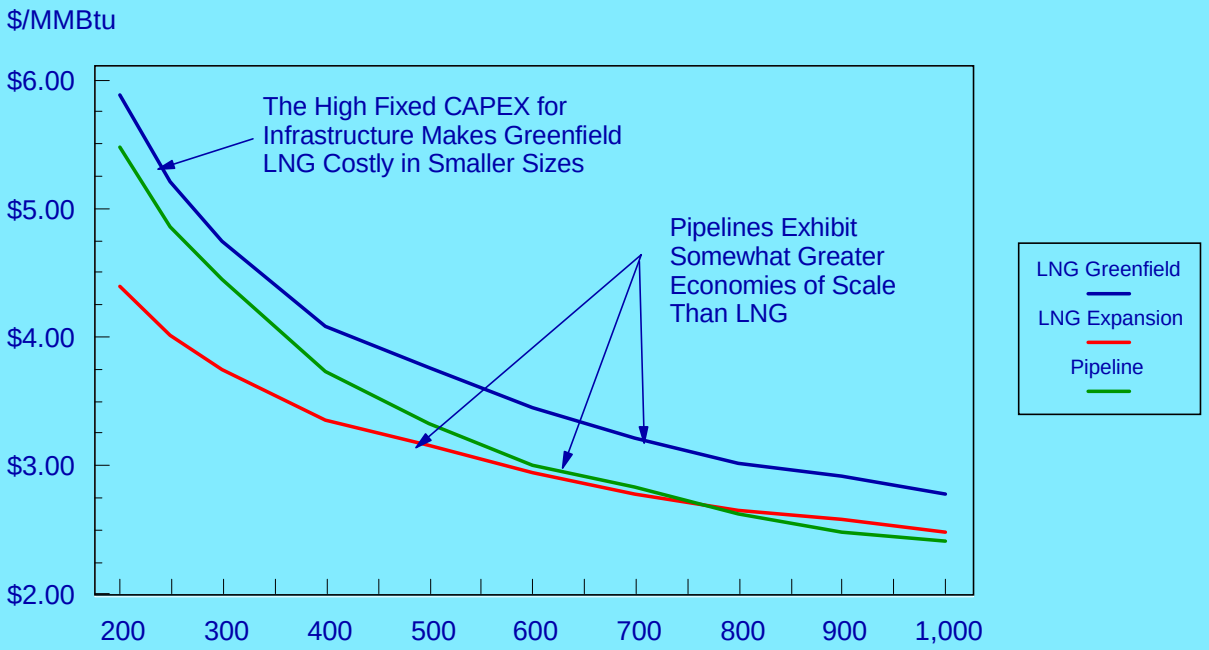
Pipelines are more economic than LNG for transportation distances below 1200 miles



Energy Economics

Pipelines are also more economic than LNG for volumes above 750 MMSCF per day.

THE SCALE EFFECT - THE COSTS OF MOVING GAS OVER 1,200 MILES BY PIPELINE AND AS LNG (GREENFIELD AND EXPANSION PROJECTS)



Source: JAMES T. JENSEN
Jensen Associates
49 Crescent Street; Weston, MA 02493 U.S.A.
Website JAI-Energy.com

Energy Economics

THE INFLATIONARY PRESSURES HAVE A SIGNIFICANT EFFECT ON THE COMPETITION

- The Past Three Years Has Seen a Dramatic Increase in Construction Costs
- While the Costs of Pipeline Construction Have Risen Substantially, Those of LNG Liquefaction and Regasification Have Been Especially Hard Hit
- At the Turn of the Decade, LNG Plant Construction Costs Were Approaching $200/Ton of Capacity
- But Current Costs are a Multiple of That Level and There Have Been Several "Problem Trains" That Have Been Quoted at $1,200 and Above

Source: JAMES T. JENSEN
Jensen Associates
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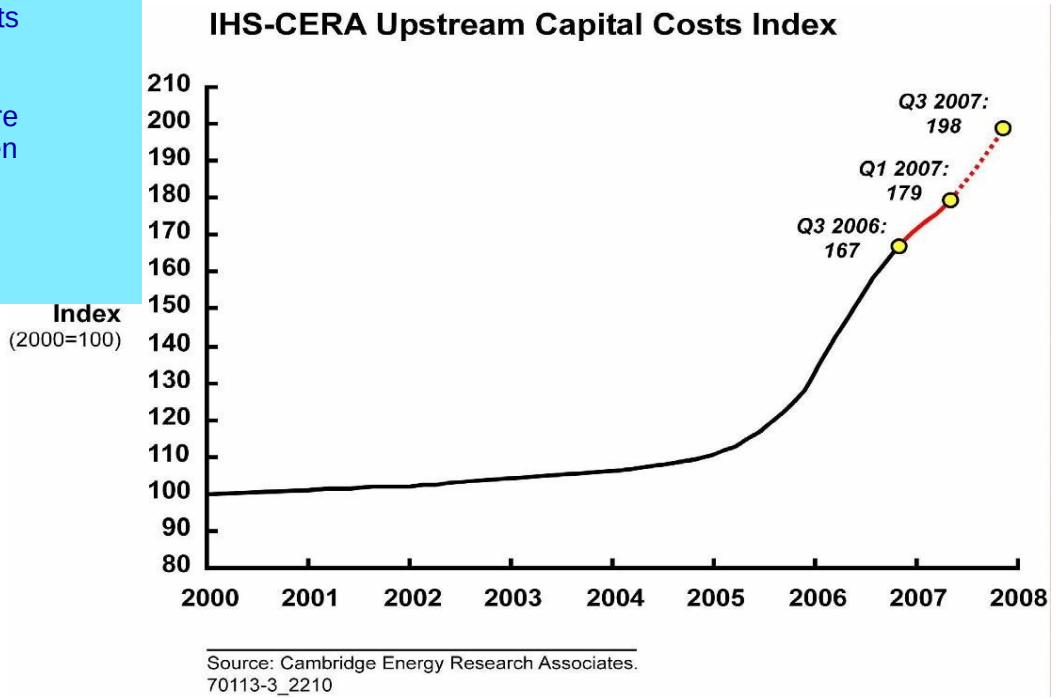
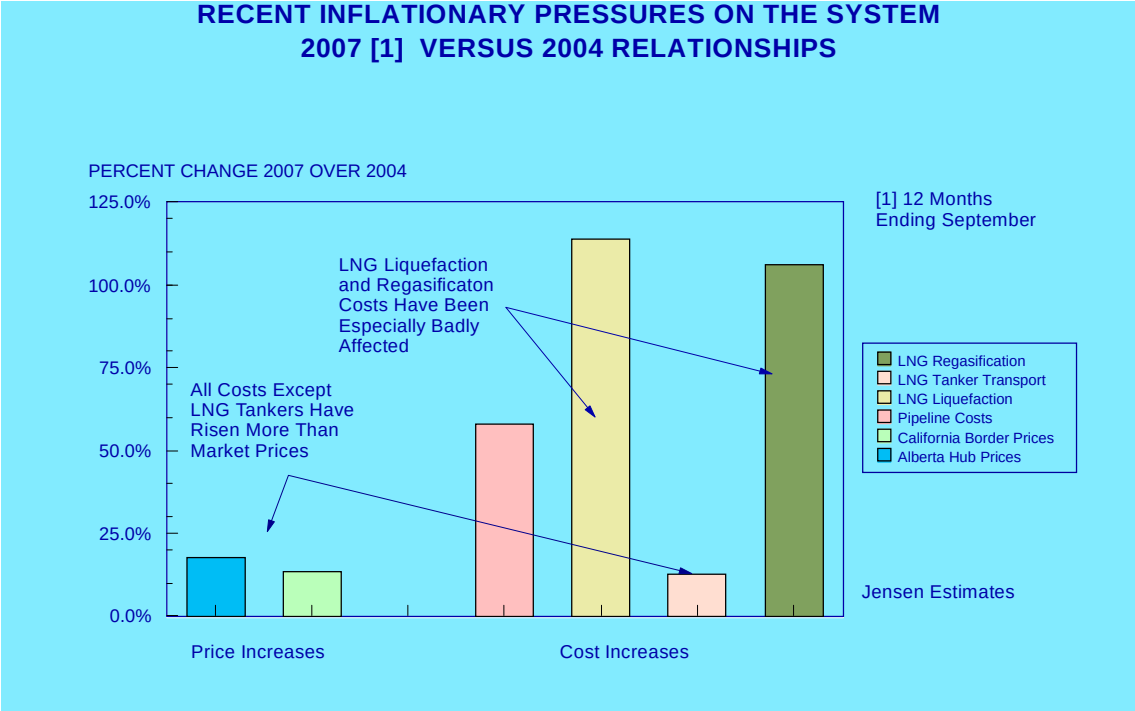
Costs have been rising, with LNG particularly hard hit. This has delayed several projects.



Energy Economics

LNG costs have risen twice as fast as pipeline costs, further enhancing the fundamental advantage of pipeline transportation:



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…..but very recent reports suggest that steel costs are now falling rapidly, which will further help SAGE economics.

GROWTH IN PIPELINES

Name	Route
Nord Stream	Russia - Germany
Nabucco	Turkey - Austria
South Stream	Russia – South Europe
White Stream	Georgia - Ukraine-Europe
Pricaspiysky	Turkmenistan – Kazakhstan - Russia
Trans - Adriatic	Greece - Italy
Trans - Sahara	Nigeria - Algeria - Europe
Trans - Caspian	Kazakhstan – Turkmenistan – Central Europe

Name	Route
Blue Stream	Russia - Turkey
Baltic Pipeline	Russia – Germany - Sweden
Green Stream	Libya – Italy
Central Asia-China	Turkmenistan - China
Medgaz	Algeria to Spain
Galsi	Algeria to Italy
Poseidon	Turkey - Greece - Italy



CONCLUSIONS of previous slides:

- Importing gas by pipeline from the Middle East to West and North India is the natural "default" method. LNG economics work better over longer distances.
- Ten years ago this underlying reality was obscured by the water depth challenge. Now this is resolved, pipeline transportation is again preferred.
- The era of projects being hindered by explosive cost escalation may be coming to an end.
- India is increasingly willing and able to pay more for gas. The growth of CNG in India is just one reason.

PETRONET LNG LIMITED

SECTORWISE GAS DEMAND

(MMSCMD)

	2007-08	2008-09	2009-10	2010-11	2011-12
Power	79.70	91.20	102.70	114.20	126.57
Fertilizer	41.02	42.89	55.90	76.26	76.26
City Gas	12.08	12.93	13.83	14.80	15.83
Industrial	15.00	16.05	17.17	18.38	19.66
Petrochemicals/ Refineries/Internal Consumption	25.37	27.15	29.05	31.08	33.25
Sponge Iron/ Steel	6.00	6.42	6.87	7.35	7.86
Total	179.17	196.64	225.52	262.07	279.43



Energy Economics

DEMAND:

- India will continue to need more gas. Prices are rising. Press reports mention India paying $18/MMBTU or more for spot LNG and $6-$11/MMBTU for longer-term supplies.

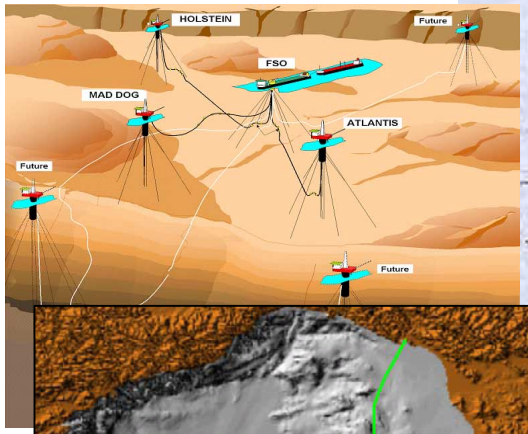
SUPPLY:

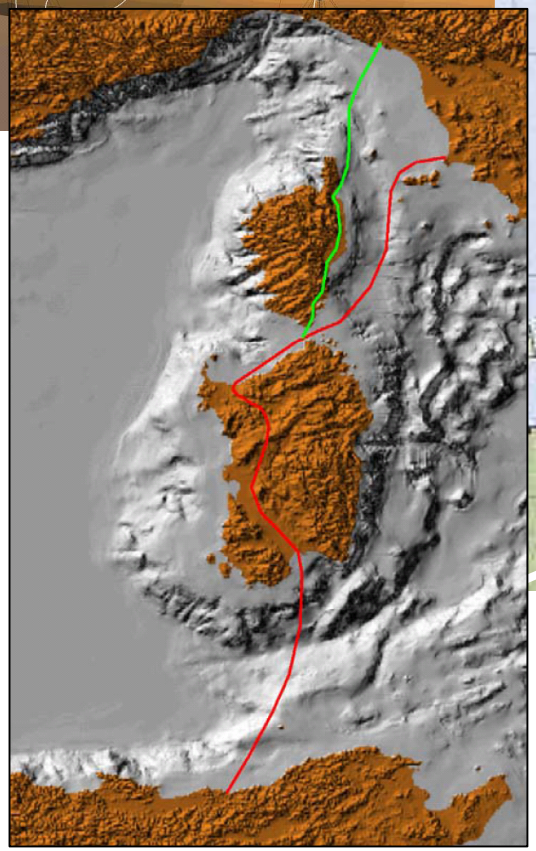
- Over 2000 TCF gas reserves possibly available in the Middle East. Only 8 TCF required for each SAGE line.

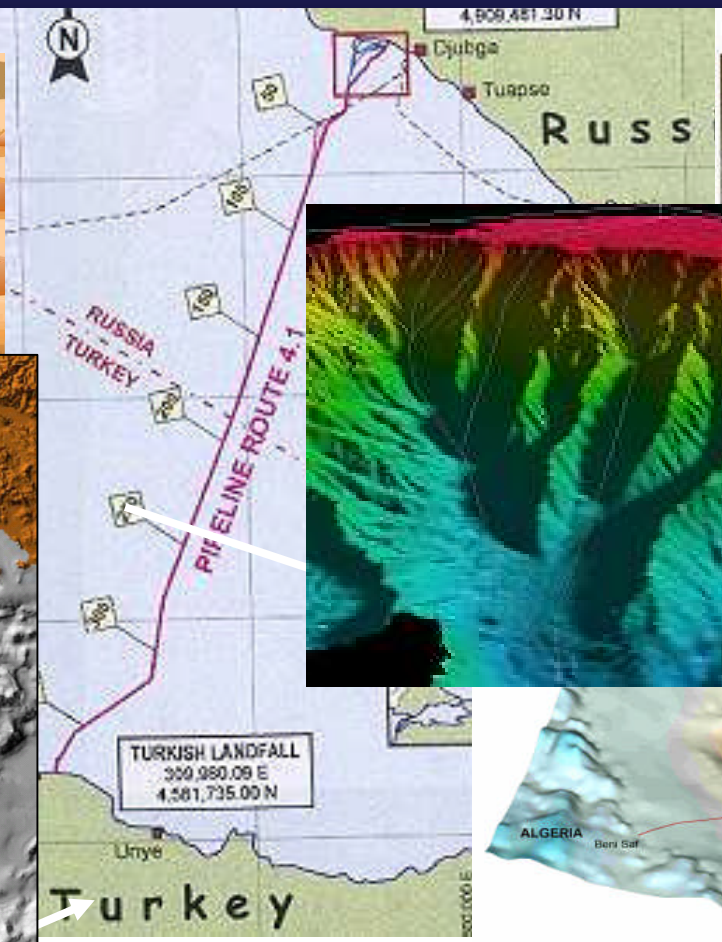
SAGE: Independent feasibility study by **CRISIL** estimates:

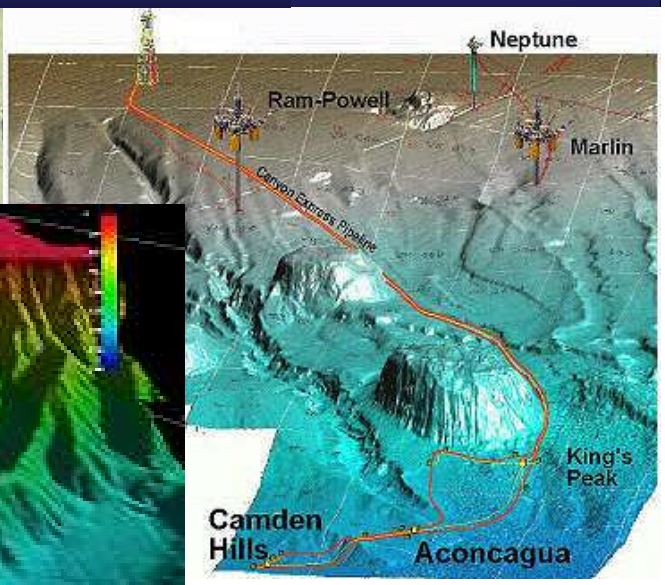
- Project cost of $3.5 Billion for first line from Oman Coast to India requires a tariff of $1.8 per MMBTU.
- Bringing the gas from, for example, Qatar to the Oman deepwater pipeline compression station adds $1.7/MMBTU.
- CRISIL's total tariff from wellhead to Gujarat is $3.5/MMBTU.

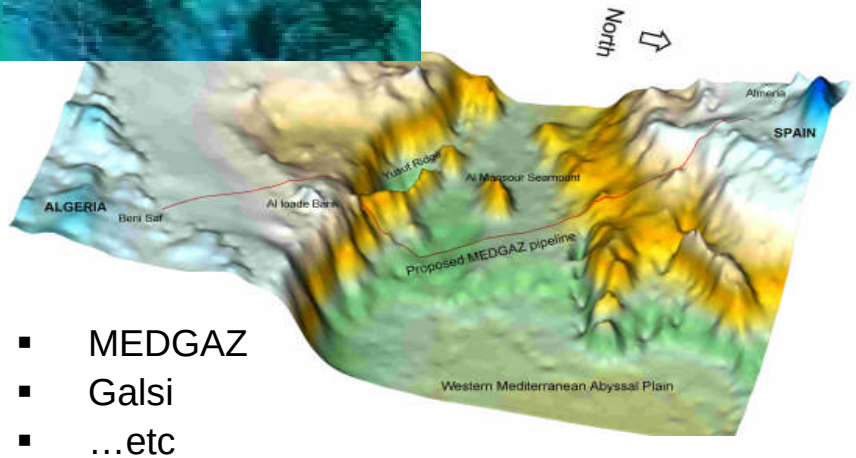
experience of deepwater pipelines







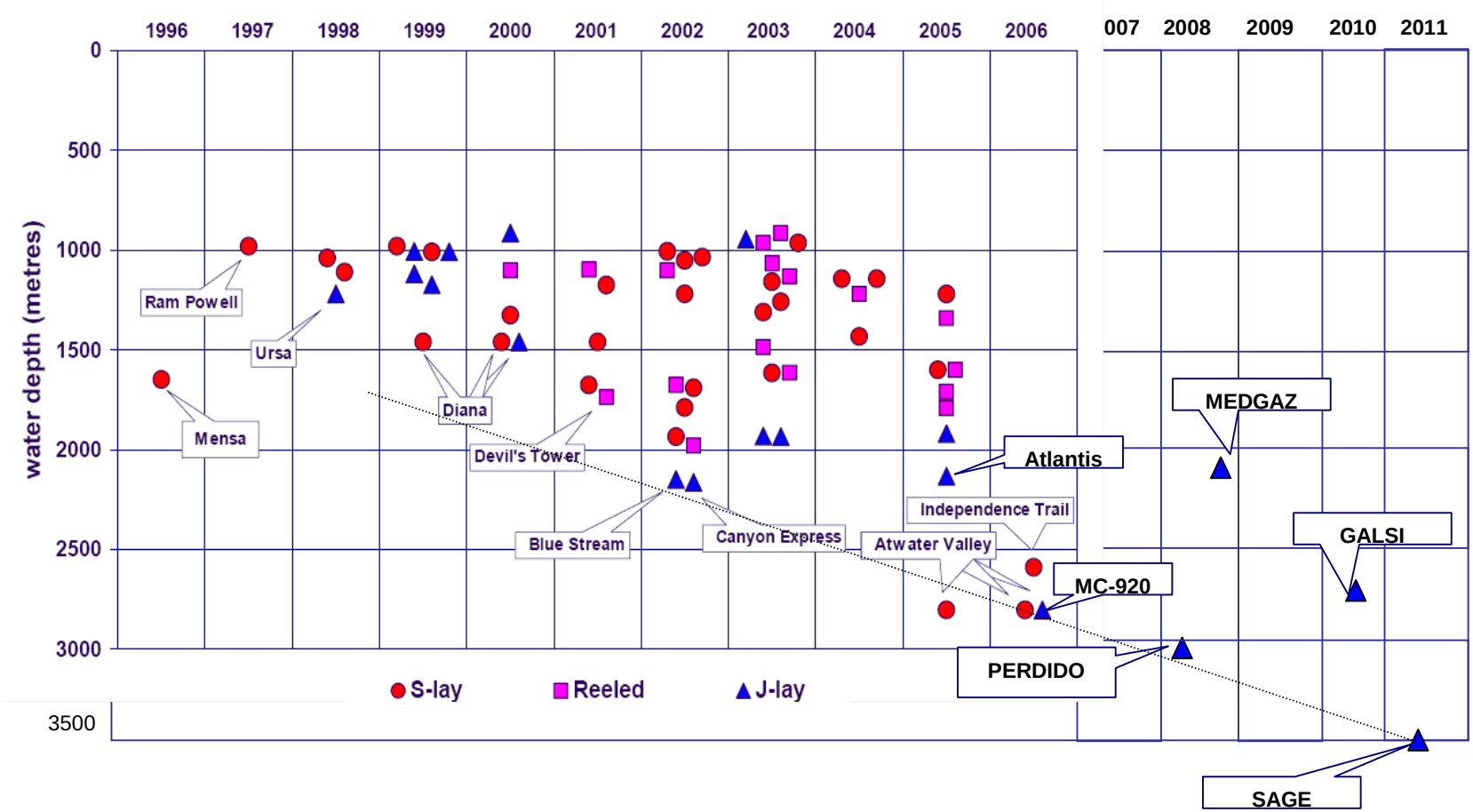




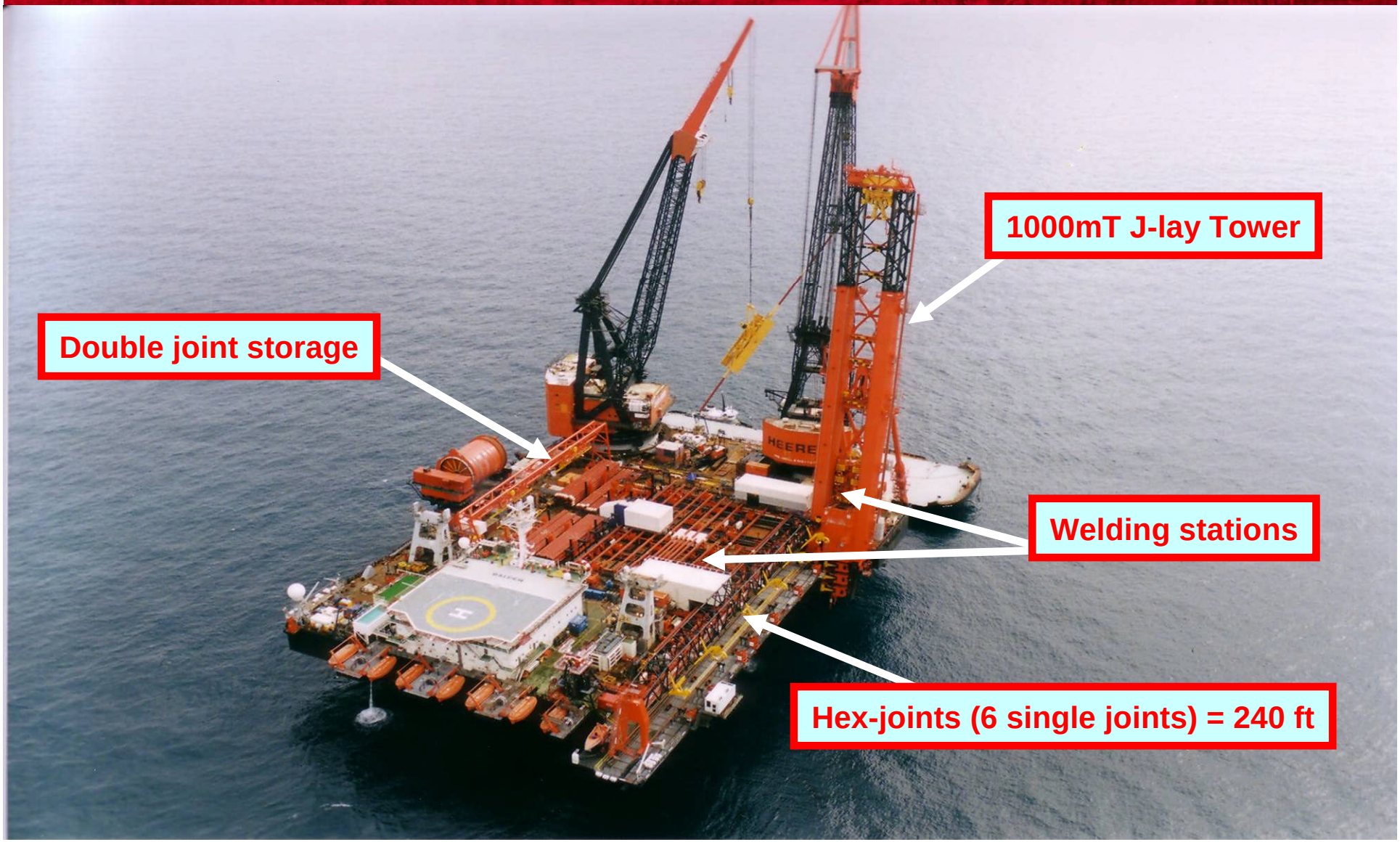
- Bluestream
- Canyon Express
- Mardi Gras

- MEDGAZ
- Galsi
- …etc
- SAGE

Deepwater trend towards SAGE



Existing J-lay vessel "BALDER".....



……and HMC's planned new J-lay vessel

- 2 x 5,500mT cranes.
- 2000mT J-lay system
- Pipe sizes up to 32” OD
- Accommodates 450 pax

Assessment of Risk Levels during Operation

Zone	Calculated Failure Probability	'Safety' Level
Oman Shelf	9.81×10^{-2}	0.04
Oman Shelf Break	2.87×10^{-4}	14.0
Upper Oman Slope	9.18×10^{-4}	4.4
Lower Oman Slope	1.44×10^{-3}	27.8
Abyssal Plain (Oman Side)	1.56×10^{-4}	25.6
Murray Ridge*	2.69×10^{-3}	14.9
Dalrymple Trough*	5.37×10^{-3}	7.4
Abyssal Plain (Indian Side)	6.60×10^{-4}	6.1
Indus Fan (Excl. Ch. 1, 2, 4)	4.27×10^{-4}	9.4
Indus Fan Channel 1	2.17×10^{-4}	18.4
Indus Fan Channel 2	3.09×10^{-4}	12.9
Indus Fan Channel 4	7.27×10^{-4}	5.5
Lower Indian Slope	1.96×10^{-4}	20.4
Upper Indian Slope	3.22×10^{-4}	12.4
Indian Shelf Break	1.15×10^{-3}	3.5
Indian Shelf	9.86×10^{-2}	0.04

Note:
"Safety" Level means "how much safer than acceptable is it?"

What does this tell us?

- The deepwater environment is an outstandingly safe, protective and benign location for a gas pipeline.
- The only areas requiring mitigation are the conventional shallow sections near the beach at each end, like on any other pipeline, where trenching and rock-dumping is conventionally applied. This protects the line against anchors and fishing activity.
- The risk from Sabotage is insignificant.

The SAGE Project – Why now?

- SAGE has become commercially viable as Indian gas buying price has risen towards World levels, and SAGE technology has lowered transport costs.
- Pressing need for energy in India - gas can be absorbed.
- Steel prices expected to fall as Global economy slows.
- Natural Gas is environmentally friendly - growth of CNG distribution and power generation infrastructure in India.
- Technical viability: huge new HMC barge with twice existing capacity. Several mills can manufacture the pipe.
- "Outside Hormuz" route without incursion into Iranian or Pakistani waters or Economic Exclusion Zones.
- LNG "spot market" (currently falling) and CAPEX risks complemented by long-term gas pipeline supply contracts.
- Unsatisfied regional appetite for large-scale investment in regional infrastructure; lack of "good projects" like SAGE.

The SAGE Project – Current Activity

- DnV input - SAGE economic upgrade by introducing heat treatment into pipe mill Quality Control techniques.
- ***INTECSEA*** Inc. (a WorleyParsons company) has completed cost/route study of onshore Gas Gathering system.
- CRISIL (leading Indian Rating and Financial Research agency) completing Feasibility Study for Indian and Gulf Investors/Private Equity in response to interest shown.
- SAGE technology being shared with Indian & UK Pipe Mills. Mills are enthusiastically implementing test programs.
- Middle Eastern Pipeline and Upstream Companies are being encouraged to join SAGE Consortium.
- Ongoing contact with Indian entities (GAIL/ONGC/IOC/NTPC) as well as Indian Ministries of Oil & Gas/Fertilizer/Power and Foreign Affairs. SAGE is now a recognised project in India.

The SAGE Project – Benefits to Qatar

- Qatar has substantial LNG business with little complementary pipeline activity. SAGE can help offset this dependence.
- Balancing the dependence on LNG with diversification into pipeline business may be particularly useful during periods of global economic downturn, such as that expected over the coming years.
- An new LNG plant might now cost over $10 Billion, more than 40% more expensive than an equivalent pipeline to India.
- It now appears that large quantities of gas can readily be sold at the Indian landfall for around $8/MMBTU, greatly increasing gas sales from Qatar to India to the benefit of both Countries.
- The pipeline delivery system up to the Indian coast can remain in Qatari ownership, if desired.

Conclusion:

Why haven't multiple natural gas pipelines already been built from the Middle East to India?

Because in the past, the water was too deep and Indian gas prices were too low.

This is no longer the case.

SAGE
Middle East to India
Deepwater Pipeline

"A project whose time has come"