“Untapping Tight Gas Reservoir” Commercial Incentives Global/Local

OMV Pakistan

PPEPCA Seminar

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Agenda

- What are Unconventional Gas Resources (UGR)?
- How important are UGR and mainly Tight Gas Resources (TGR) for US?
- Why is TGR almost neglected outside of US?
- What are the prevailing circumstances for TGR developments?
- Actual economics of some TGR Fields from the US
- What kind of incentives are existing to support TGR development?
- Conclusions

Unconventional Gas Resources (UGR)

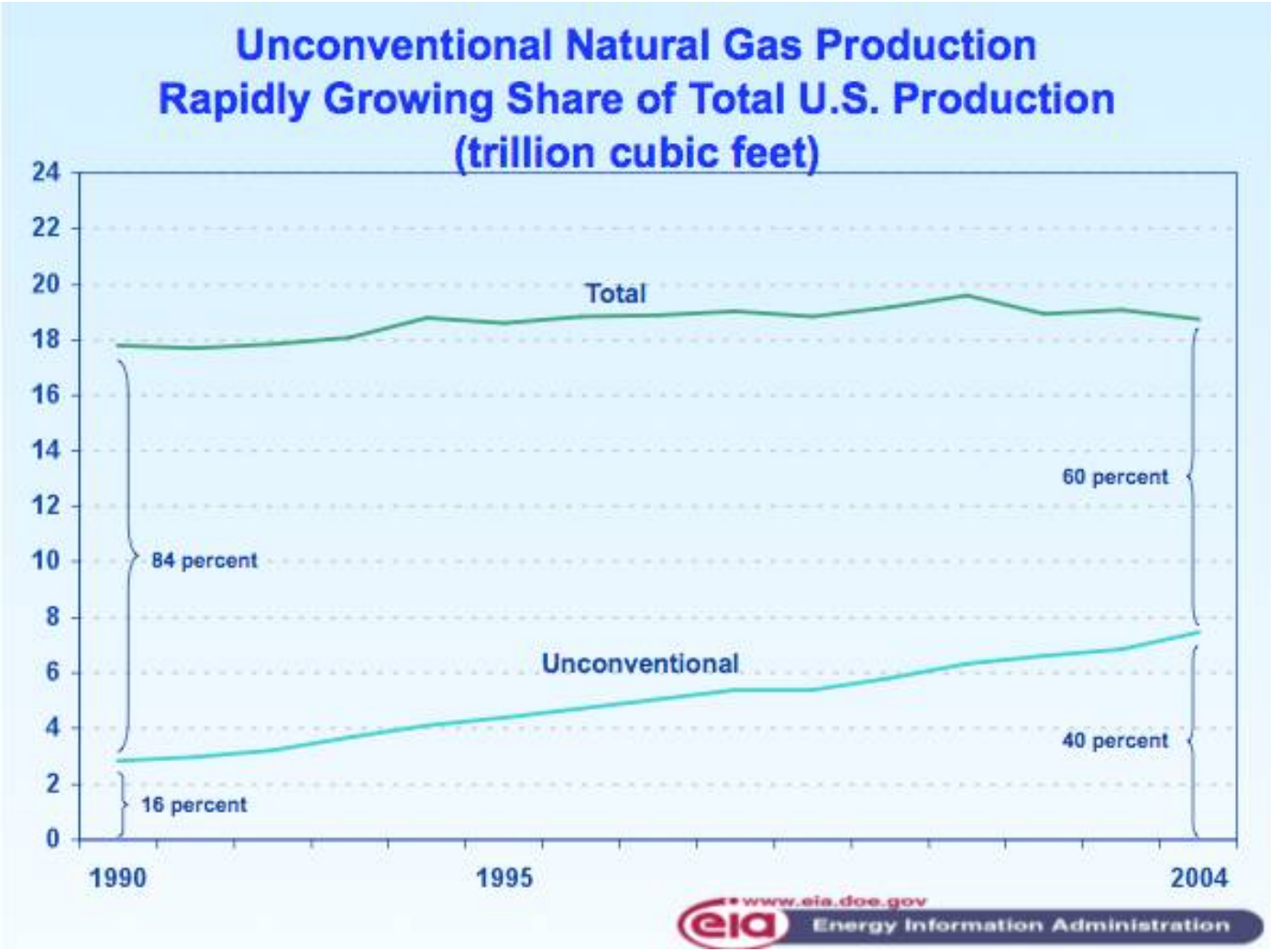
- Unconventional Gas Resources are Natural Gas Reservoirs,
  - which are difficult to develop and
  - expensive to produce

- Unconventional Gas Resources including
  - Tight Gas Sand Reservoirs (TGR)
  - Shale Gas
  - Coal Bed Methane
  - Deep Gas
  - Methane Hydrates

Importance of “Unconventional Gas Resources”

- Main Applications in United States
- Boosted in the late 1980 and early 1990
  - By the successful implementation of tax incentives
  - R/D projects sponsored by the US Department of Energy
- Outside the States mostly overlooked and the potential underestimated in the past
- Increasing gas demands and declining conventional gas reservoirs promoting UGR developments worldwide

US - Unconventional Gas Production



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US - Unconventional Gas Resources

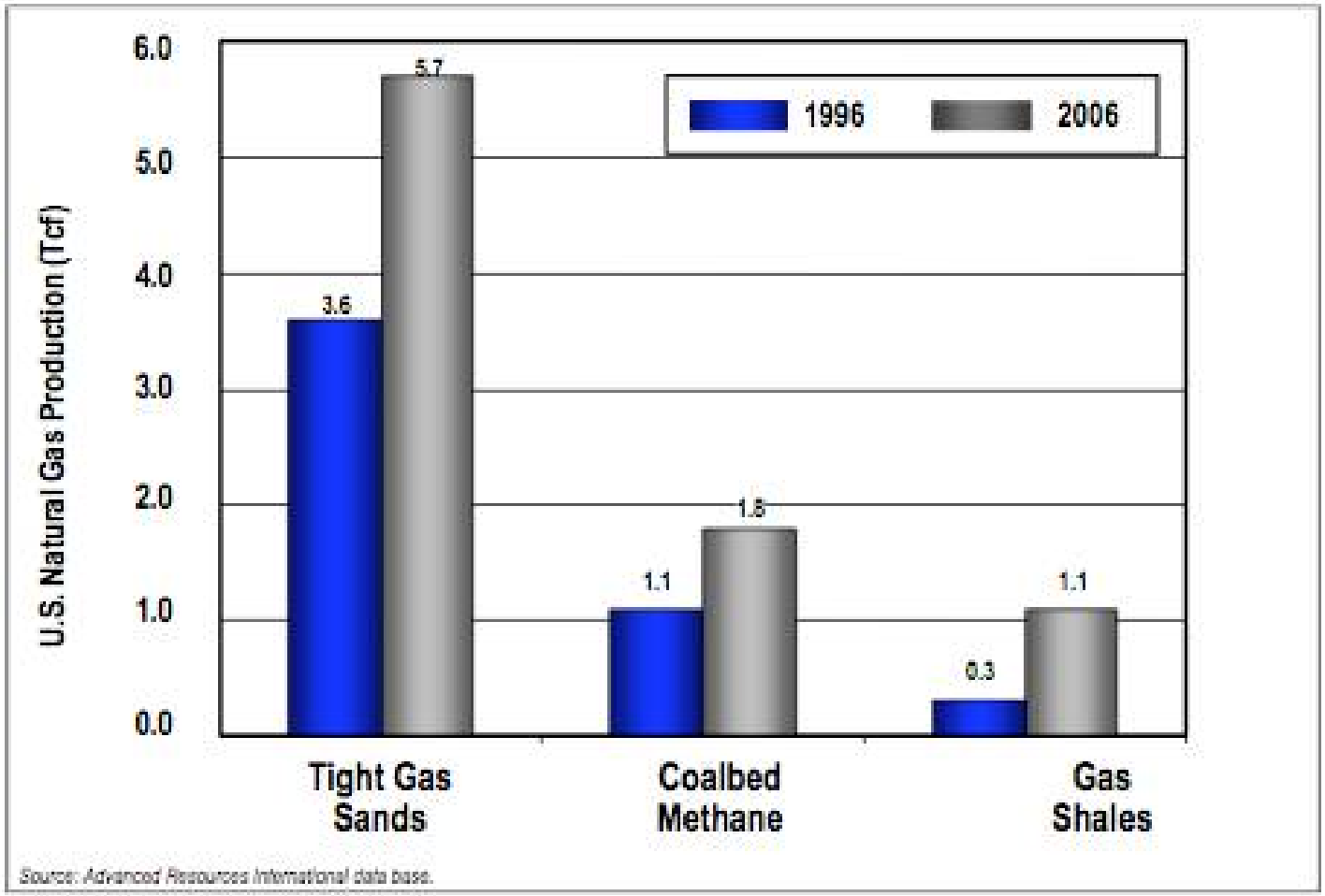

Figure 3. All Three Unconventional Gas Resources Have Seen Production Growth

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Tight Gas Reservoirs?

- **Technical definition:** Gas bearing sandstone or carbonate matrix which exhibits an in-situ permeability to gas of less than 1 mD
- **Economical definition:** Mostly economical producible only under improved gas price and/or tax conditions
- Main contributor to UGR Gas
- Even with technological advances, the challenge is finding a way to extract it economically
- The increasing natural gas demand promotes TGR

Worldwide Recognition of TGR

- Natural gas policies and market conditions have been unfavorable for TGR development in many countries.
- Chronic shortage of expertise in the specific technologies needed to develop these resources successfully.
- Additional capital is required in the capitalization of TGR and as a result, only limited development has taken place to date
- However Interest is growing due to higher gas demand
- During the last decade development of tight gas reservoirs has occurred outside US in Canada, Australia, Mexico, Venezuela, Argentina, Indonesia, China, Russia, Egypt, and Saudi Arabia.

Worldwide Unconventional Gas Resources Estimate

Region	Gas in Tight Sands
North America	1,371
Latin America	1,293
Western Europe	353
Central and Eastern Europe	78
Former Soviet Union	901
Middle East and North Africa	823
Sub-Saharan Africa	784
Centrally Planned Asia and China	353
Pacific	705
Other Asia Pacific	549
South Asia	196
World	7,406

End 2007: World 2P Conventional Gas Reserves: 6,263 TCF

Very little work has been done in South Asia and this number could have been much bigger

Distribution of Worldwide Unconventional Natural Gas Resources (Trillion Cubic Feet)

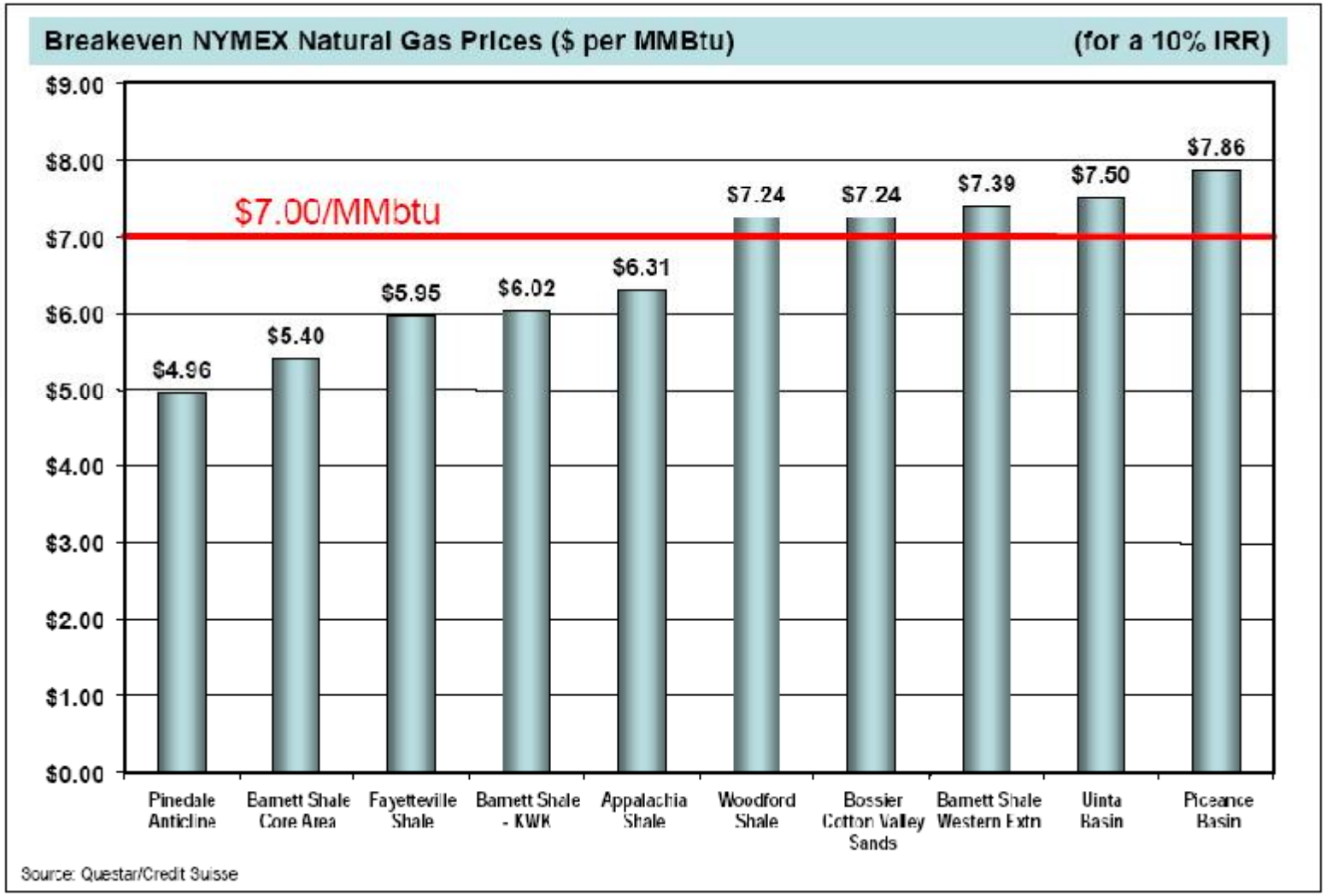
Source: Society of Petroleum Engineers - SPE Paper 68755, 2001
Authors: Kawata and Fujita, "Some Predictions of Possible Unconventional Hydrocarbons Availability Until 2100"

Economics of actual US Tight Gas Resources

Advanced Resources International (ARI – July-2007)

- 94 Unconventional Gas Resources were evaluated
  - 27 are economical only at a long term gas price of more than 6.30 USD/MSCF
  - 21 being marginally economic
  - 46 need higher gas prices to be profitable
- These economics are for US where infrastructure is well established and the cost of drilling & production services is much lower

Economic Breakeven of "Unconventional Gas Plays" cont.



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Economics of traditional “Unconventional Gas Plays”

		Tight Gas Sands Williams Fork/Mesaverde S.Piceance Basin Vertical wells & upto 10 Fracs	Tight Gas Sands Wasatch/Mesaverde Uinta Basin
Realized Gas Price[1] per MSCFD		$7.58	$6.80
Less:	Production Taxes	(0.45)	(0.39)
	LOE/Other	(0.86)	(0.52)
	F&D Costs	(2.34)[2]	(1.43)[3]
Net Margin		$3.93	$4.46
ROR		36%	52%

Approx. 1 BCFD & 2,200 wells

Economic Performance of two established Tight Gas Plays

[1] Mid-2007 Rockies strip with BTU/sales adjustment
[2] Assumes net EUR of 0.81 Bcf/well and D&C costs of 1.9 MMUSD
[3] Assumes net EUR of 2.1 Bcf/well and D&C costs of 3 MMUSD
EUR = Average gross estimated ultimate recoveries

Source: Advanced Resources International (ARI – July-2007)

Why are TGR Developments so expensive?

- **Drilling & Completion Technology:**
  - Horizontal wells; Multilateral wells; smaller Well Pattern
  - Complex Completion System
  - Excessive Stimulation Technology; Multifracs

- **Reserves Estimate:**
  - Estimated ultimate recovery (EUR) small for each well
  - Recovery Factors small
  - Reservoir Simulation model difficult to develop

- **Production Behavior of TGR wells:**
  - Short Peak production followed by sharp decline
  - 60% of the total production achieved in the first 3 to 5 years
  - Drainage area elliptical and small (not radial)
  - Production forecasts difficult to predict
  - Economical and technical risks extremly high

How to initiate a TGR development?

- **Operator**
  - Identify and analyze TGR development project
  - Define pilot project
  - Submit development concept to authorities

- **E&P Service Contractor**
  - Offer latest technologies and equipment,
  - Experienced people,
  - Discount for TGR campaign

- **Government authorities**
  - Provide Incentives to the E&P industry for TGR developments

Existing Incentive models

- **Higher gas price**
- **Fiscal incentive models**
  - Texas –Tax reductions until 50% of investments or 120 months are reached (Railroad Commission of Texas)
  - *§29 Tax Credit for Unconventional Fuels (*gas from tight formations), about $1.16 per thousand cubic feet (MCF) of gas in 2004
  - Tax reduction by 12% - example from Europe
  - **Canada** - After a project is approved by the Ministry, royalties will be calculated on a sliding scale ranging from 2 per cent of revenue at the start of production until all capital costs have been recovered, rising to 35 per cent of profit (or 5 per cent of revenue) after capital costs plus 105 per cent have been generated. (Sep 24, 2007 *The Globe and Mail*)

Conclusions

- Total World 2p Reserves (2007) are in the range of ~ 6,263 TCF
- Estimated Reserves of Tight Gas Reservoirs worldwide ~ 7,406 TCF
- Total 2p Gas Reserves number for Pakistan (June, 2007) ~ 32 TCF
- Possible Reserves of Tight Gas Reservoirs in Pakistan ~ 30 -- 40 TCF

- **To encourage "Tight Gas Resources Development" Incentive Models have to be implemented as**
  - Higher Gas Price
  - Fiscal Incentive
  - Or a combination of both