Impact of natural gas depletion on oil production
due to the interconnect between Natural gas and oil production

By
Robert Babak Madadi Howard
Senior Commodities Risk Analyst
Advanced Commodities Global Consulting

Agenda

1- NGL component of total liquids production

2- FSU supply constraints

3- South Parse/North Dome

4- Gas injection

5- Tar Sands oil production

6- Oil and Gas price ratio

7- Heavy Oil and Hydrocracking

8- US Shale Gas

9- Price Effects

10- Hard Choices

11- Mitigation – Phoenix Recovery Plan

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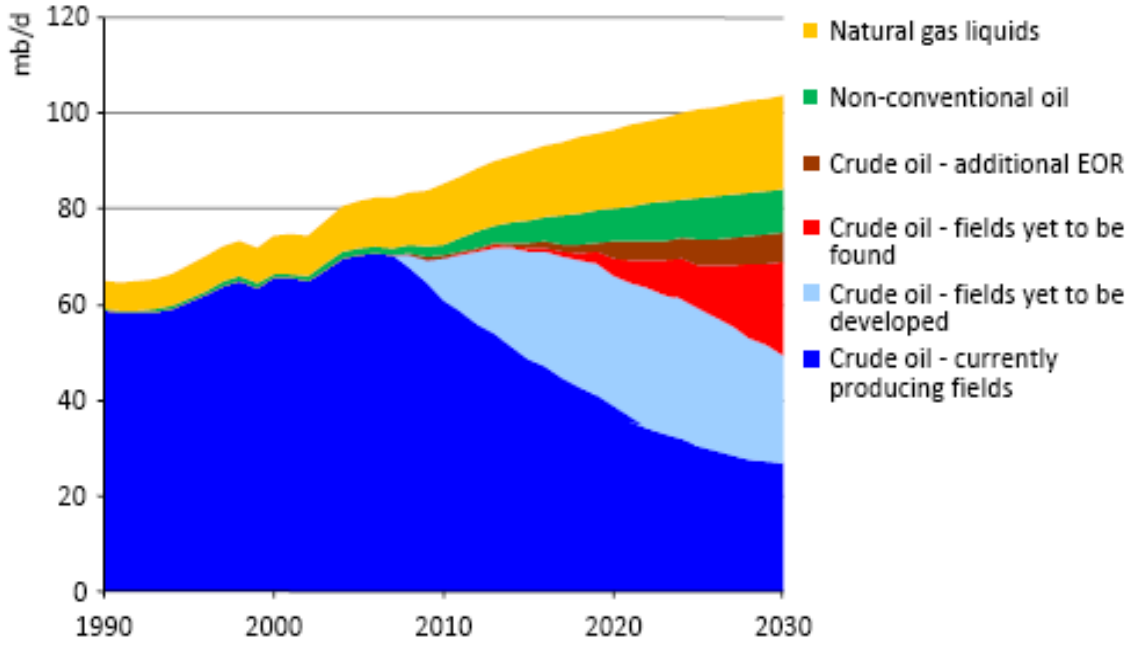
Natural Gas Liquids

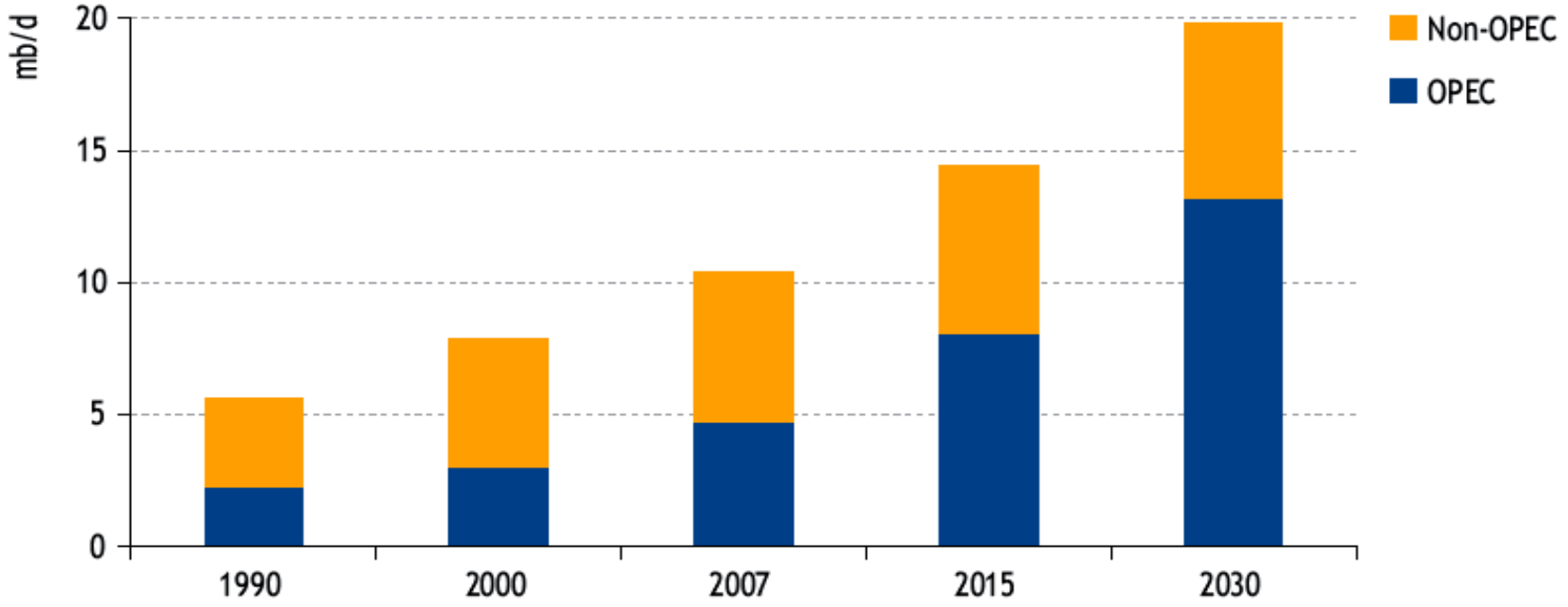
approximately 10.5 mb/d or 10% of total liquids production



World Oil Production by Source,
Reference Scenario IEA WEO 2008

Natural Gas Liquids

Figure 11.11 ● *World natural gas liquids production by OPEC and non-OPEC countries in the Reference Scenario*



IEA WEO 2008

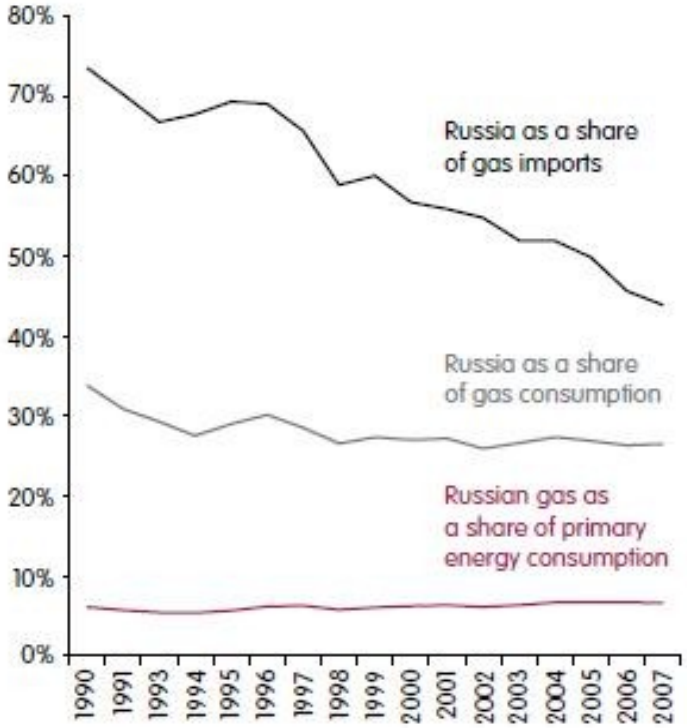
Natural Gas Liquids

Three quarters of the world's official natural gas reserves are located in the FSU and Middle East

Supply constraints with Russian and Middle Eastern Gas supplies are likely to significantly impact availability of Natural Gas Liquids

Russian Supply Issues

Russia supplied 40% of EU Gas in 2007
Russian Gas production may peak in 2010



Source: Eurostat; BP Statistical Review of World Energy

EU27 dependence on Russian gas, 1990-2006

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Russian Infrastructure issues

"However, there's no time to be lost, because the forecasts predict an energy crisis. Capital assets deterioration is now 60% in the oil extraction sector, 80% in the oil refine sector, 55% in the power industry. The coal industry is in permanent crisis. Gas companies have to reduce gas recovery because the most profitable fields are running low.

Your readers are well aware of the fact that the pipeline transport, too, has enough problems: One fourth of the total length of trunk pipelines has been operating for over 30 years, yet another one third has been operating for over 20 years. It is widely understood that FPC urgently needs large (up to $30 billion a year) investments."

head of the specialized Committee for energy, transport and communications of the State Duma Vladimir S. Katrenko

Russia and NGL

As the worlds largest gas producer and exporter when Russian gas supplies decline the availability of spare natural gas for NGL may become problematic

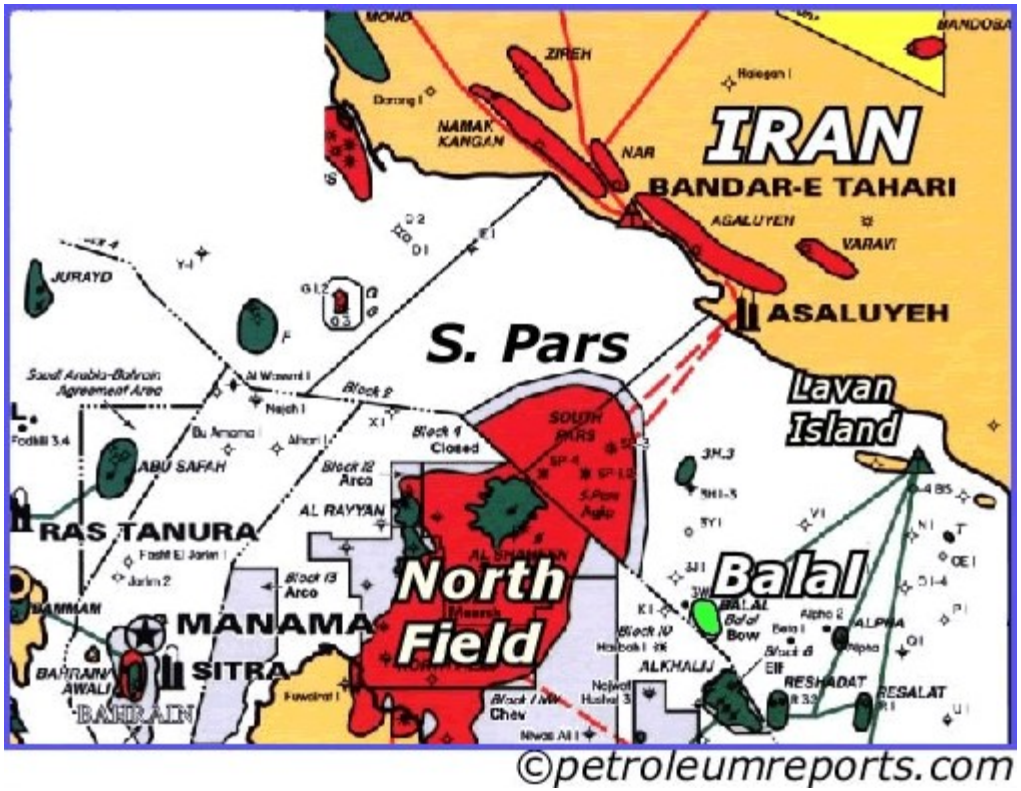
Geographic concentration of M.E. Gas supply

"61% of the Middle East's Uncommitted Gas is in a Single Gas Field – The North Field in Qatar and South Pars in Iran."

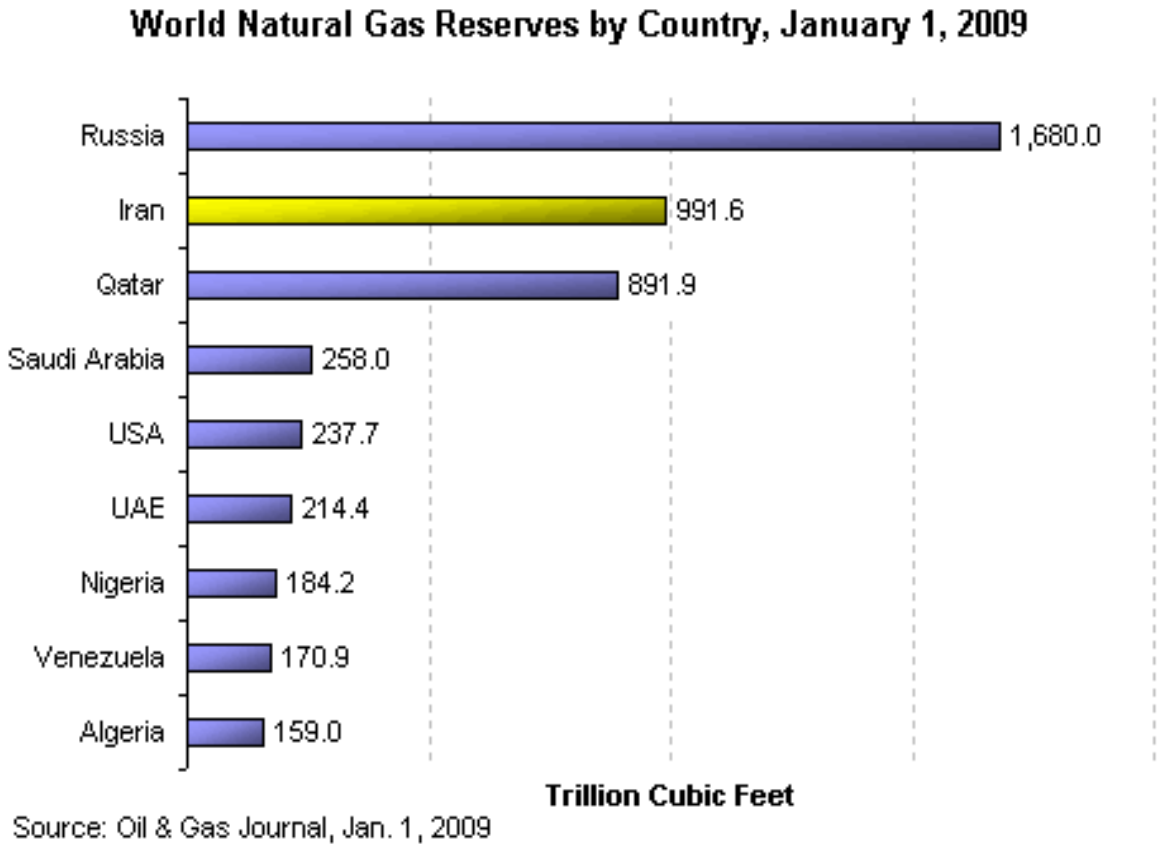
"And if One includes the Additional Uncommitted Gas in Iran, those two countries Account for Nearly 90% of the Uncommitted Gas in the Entire Middle East."

James T. Jensen – Jensen Associates Feb 20, 2007

Geographic concentration of M.E. Gas supply



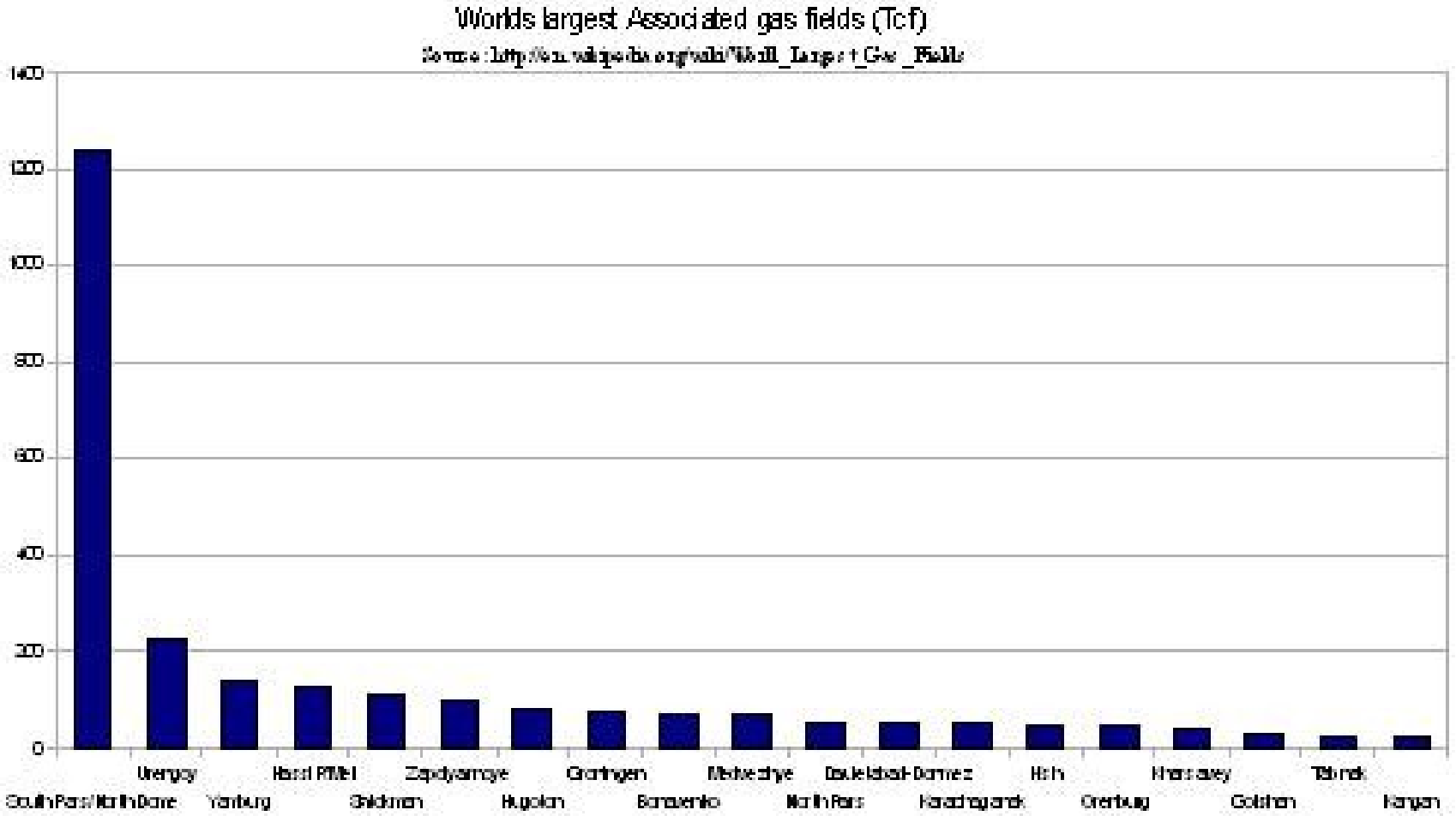
Gas Reserve Uncertainties



Perception Gap

Iran's almost permanent gas shortage and Qatar's moratorium on additional development projects in the North Dome have raised concerns regarding the accuracy of reserve estimates

Is the South Pars/North Dome field a statistical anomaly?



Off the record

Off the record discussions with senior experts suggest that the South Pars / North Dome gas reserves may be as little as 1/6th officially reported estimate

Gas injection

Conventional oil production is also dependant on gas.

For example Iran, OPECs second largest oil exporter is using up to 30% of its natural gas for re-injection to maintain oil production.

Russia also makes extensive use of gas injection to maintain oil production.

Gas injection EOR common through out the oil industry.

Gas injection

Once gas depletion has begun the price of gas may exceed that of oil. If natural gas becomes significantly more expensive than oil it may no longer be economic to use gas injection to recover oil.

This factor alone may place a significant amount of global oil production and reserves out of reach

Tar Sands oil production

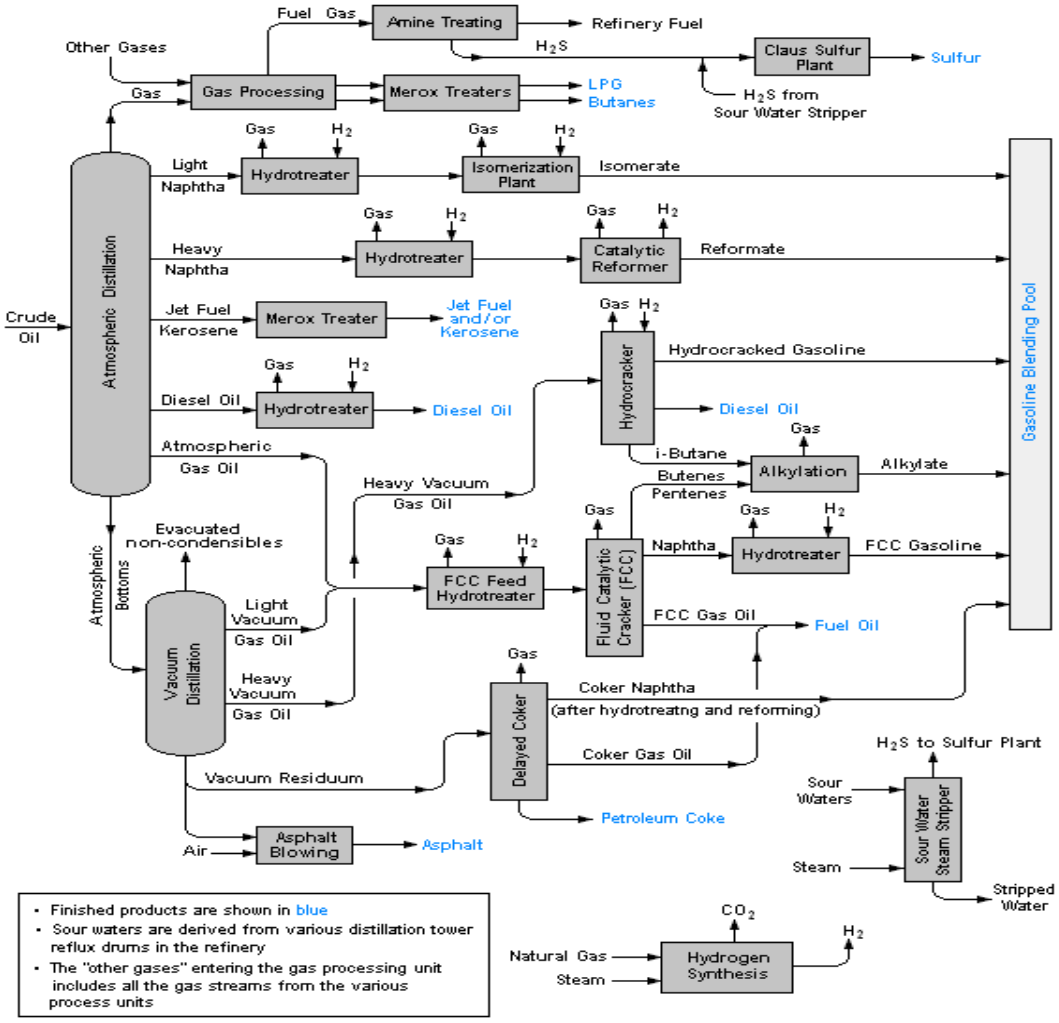
Tar sand oil production is dependent on natural gas to heat the tar and essentially to provide a source of energy and hydrogen to turn tar into a liquid fuel.

Critically while natural gas is cheaper than oil on an energy basis it pays to convert gas to oil using tar sands.

Once gas becomes scarce it may not pay to produce Tar sands. It is not viable to turn $100bbl gas into $60 bbl oil

Oil and Gas Price ratio

Heavy Oil and Hydrocracking



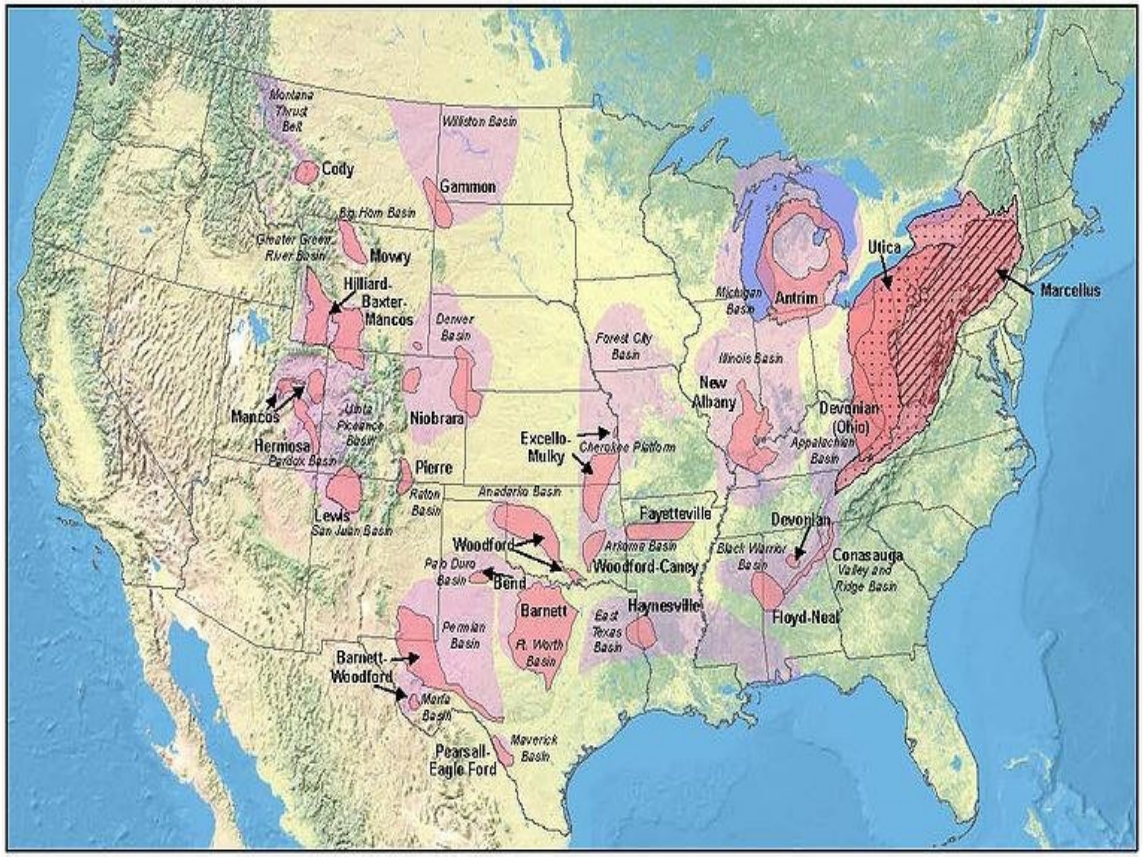
Heavy Oil and Hydrocracking

As with Tar sand oil production heavy oil is dependent on natural gas to provide a source of energy and hydrogen to turn tar into a liquid fuel.

Once gas becomes scarce the price of heavy oils dependent on natural gas for hydrogenation will rise.

The price of oil is set by the price of the marginal barrel.

US Shale Gas



United States Shale Gas Plays

www.eia.doe.gov
Energy Information Administration
Office of Oil and Gas

Shale Gas Plays
Basins

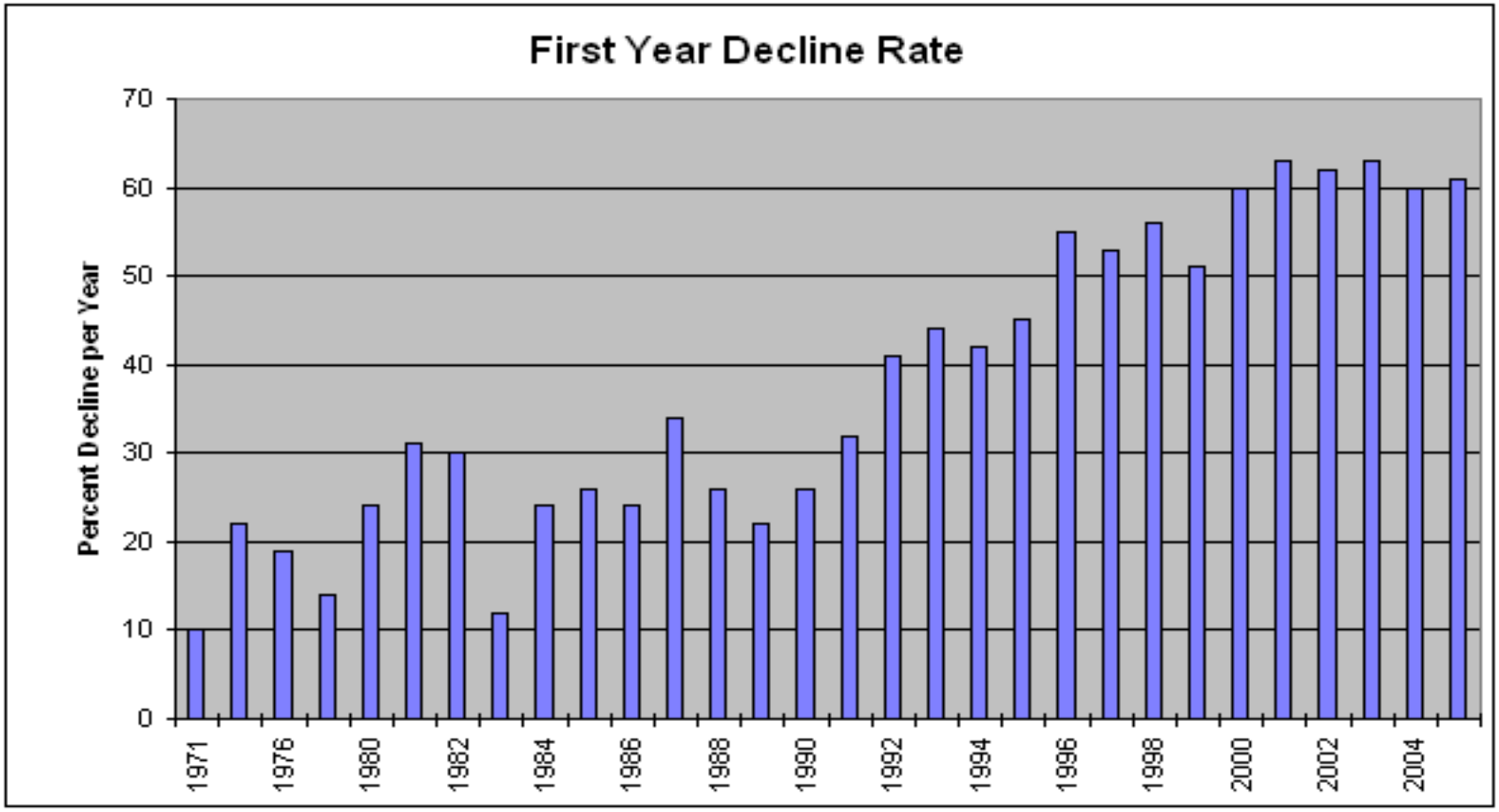
Stacked Appalachian Plays
Marcellus
Utica
Devonian (OH shale)

November 2008
Miles
0 150 300 600

N

US Shale Gas

Source: www.theoildrum.com



US Shale Gas

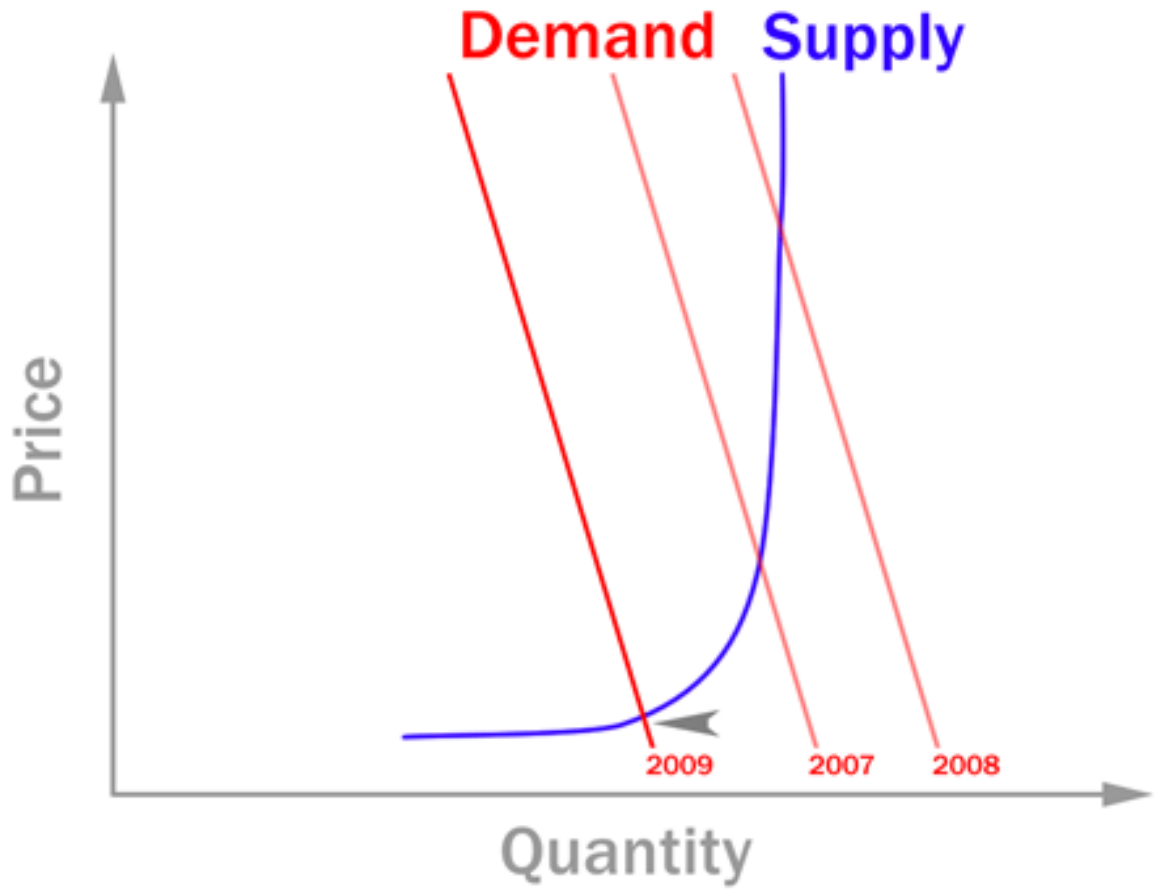
The US shale gas resource are vast,

However due to the high depletion rate the EROEI may be very low

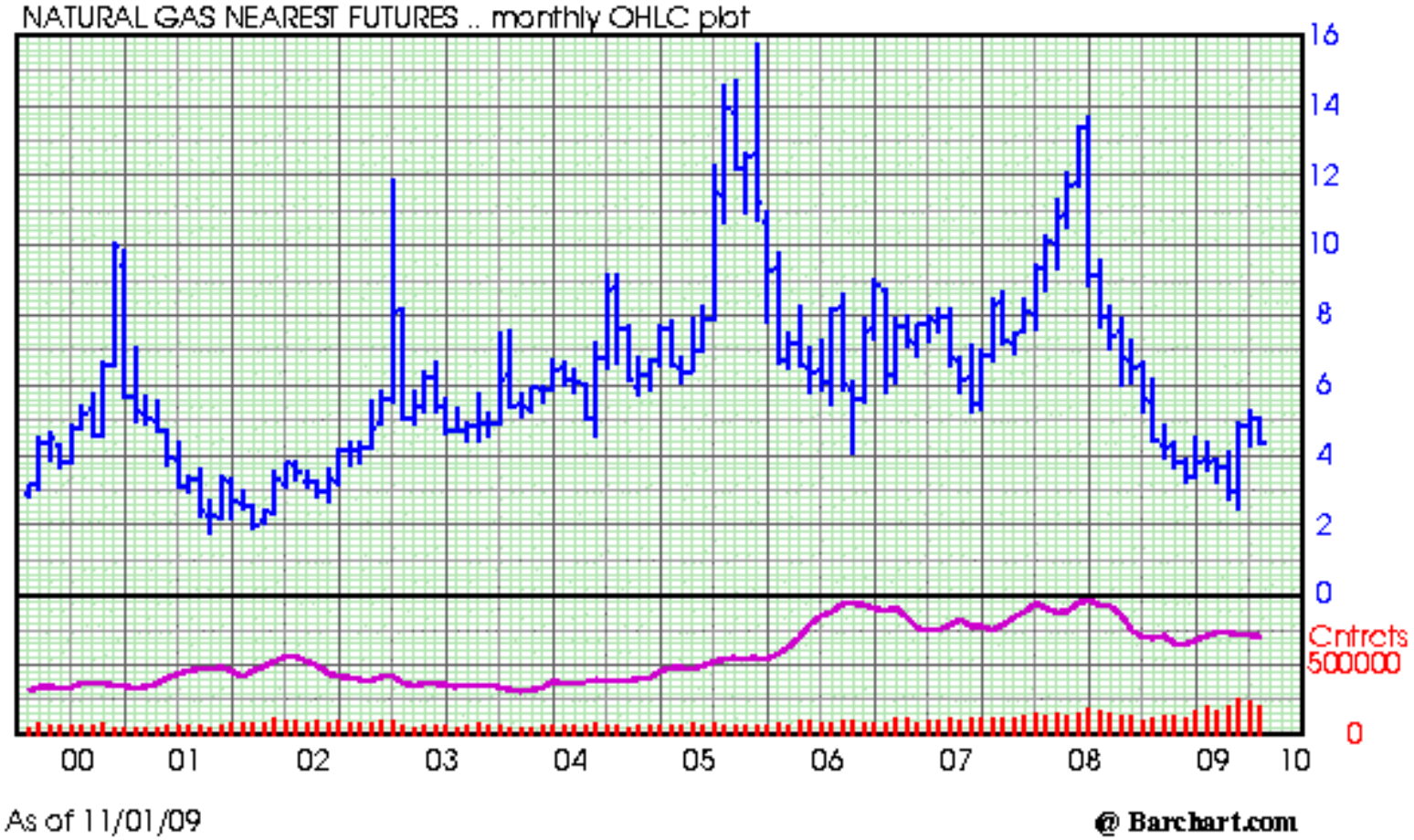
Low EROI generally translates to low long term profitability

Price Effects

Source: www.theoildrum.com



Price Effects



Hard Choices

95% of the worlds transportation runs on liquid fuels

Once gas supply begins to peak we will have to chose between transportation and

- Food
- Heating
- Electricity
- Plastics etc.

Mitigation
Phoenix Recovery Plan

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Mitigation
Phoenix Recovery Plan

A targeted approach with specific EROEI boosting strategies could potentially transform much of the worlds marginal oil, gas and coal fields into valuable reserves

Mitigation
Phoenix Recovery Plan

The plan will attempt to deal with:

- Reserve constraints
- EROEI constraints
- Liquid fuel constraints
- Net Present Value\Discount Pricing
- Capital constraints
- ROI and Profitability

Mitigation
Phoenix Recovery Plan

There is no easy or quick fix to the global peak in net energy.

We can only hope to mitigate in the short term

The future is optimistic if the correct infrastructure is in place soon

Before we use up the last of the energy seed corn

The information challenge

Solutions must be appropriately contextualised to promote productive behaviour

The challenge is to provide detailed information in terms of time, nature and magnitude of effect only to appropriate groups to avoid misinterpretation

"We have only two modes - complacency and panic."

Dr James R. Schlesinger

Summary

Without mitigation strategies due to the interconnect between oil and gas production, once gas production begins to decline

A significant portion of total liquids production is at risk