Analysis of China's Development

Prospect for Shale Gas Industry

China Petrochemical Corporation

Exploration & Production Research Institute

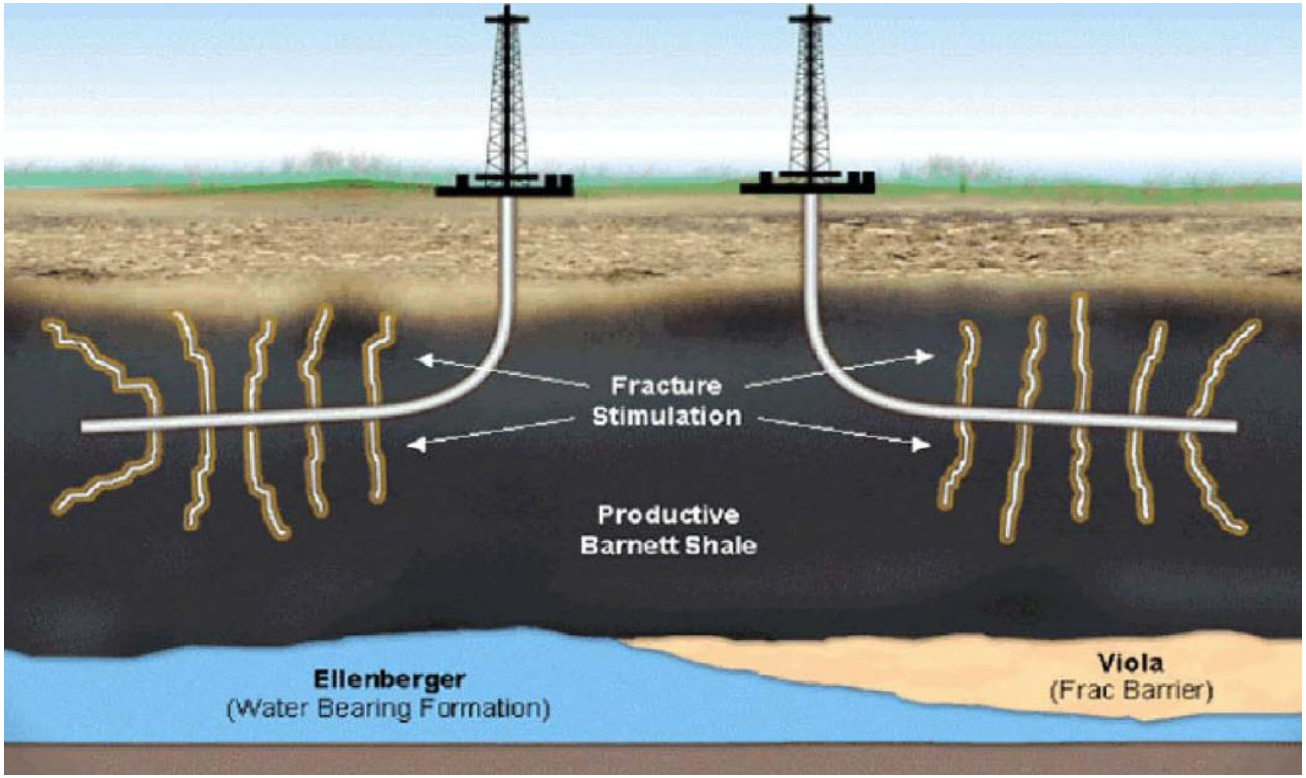
Preface

Since energy security is vital to economic development and social stability, close attention has been paid by countries throughout the world, with certain protective measures taken to ensure energy security.

The significance of the development of unconventional oil and gas industry as a good complement to conventional oil and gas industry has become a universal recognition against the background when the strategic status of oil and gas industry is gaining importance.

Preface

1. The definition of shale gas



Shale Gas: Shale gas is the natural gas concentrated in shale formation in various modes of occurrence.

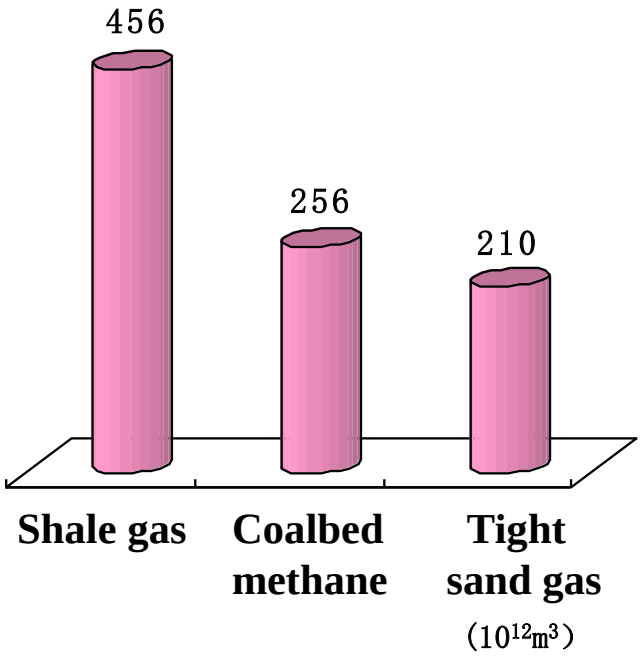
Preface

2. The world wide shale gas reserves

Area	Shale gas	Coalbed methane	Tight sand gas
North America	108.7	85.4	38.8
Latin America	59.9	1.1	36.6
Western Europe	14.4	4.4	10.0
Central Europe＋Western Europe	1.1	3.3	2.2
Former Soviet Union	17.7	112.0	25.5
Middle East＋North Africa	72.1	0.0	23.3
Sub-Saharan Africa	7.8	1.1	22.2
Central Asia＋China	99.8	34.4	10.0
Pacific(OECD)	65.5	13.3	20.0
Other Asia Pacific	8.9	0.0	15.5
South Asia	/	1.1	5.5
The world	456.0	256.1	209.6

From:Rogner （2001）

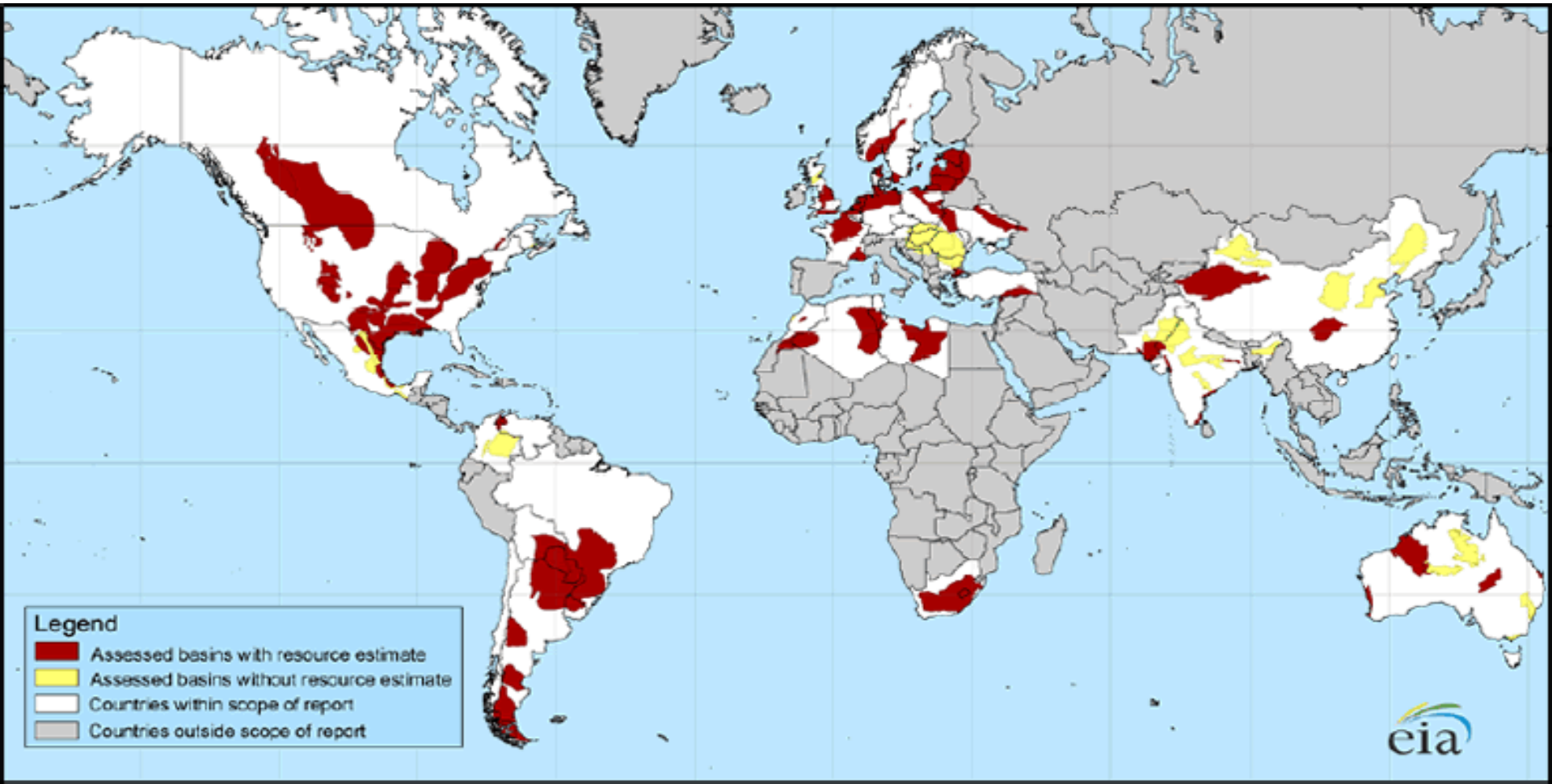
($10^{12}m^3$)



Preface

3. How much the world's total recoverable resources of shale gas ?

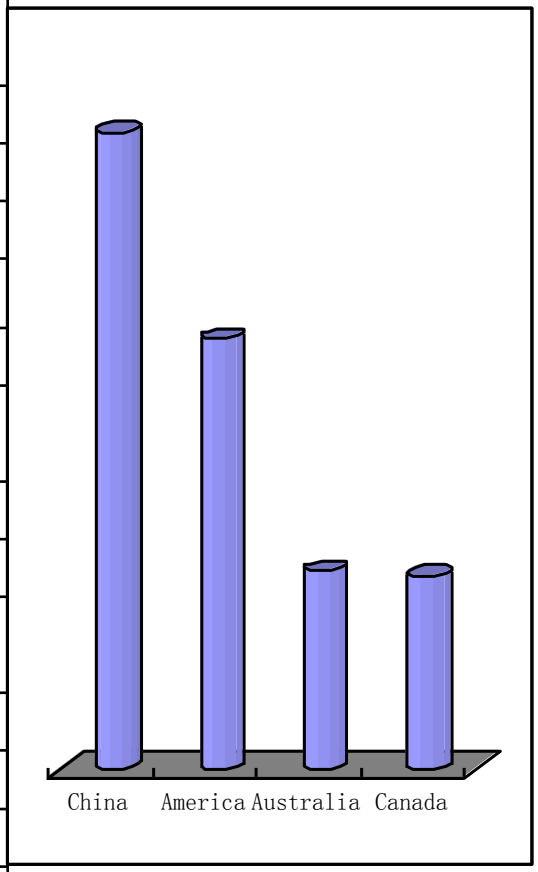
- **USGS Report** http://geology.com/energy/world-shale-gas/



3. How much the world's total recoverable resources of shale gas ?

EIA shale gas resource assessment in 2011
（billion cubic meters ）

Area	country	Proven recoverable reserves of natural gas	Shale gas technically recoverable resources
China	China	3028.1	36082.5
America	America	7711.8	24394.6
Australia	Australia	3113.0	11206.8
Canada	Canada	1754.6	10980.4
Mexico	Mexico	339.6	19272.3
Northern South America		5176.1	849.0
Southern South America	Argentina	379.2	21904.2
	Other	1214.2	11914.3
Africa	South Africa	-	13725.5
	Other	6143.9	15763.1
Western Europe		3919.6	10527.6
Eastern Europe		1350.2	7556.1
South Asia		1913.1	3226.2
Total above		28328.3	187402.6
Global Total		187034.7	-

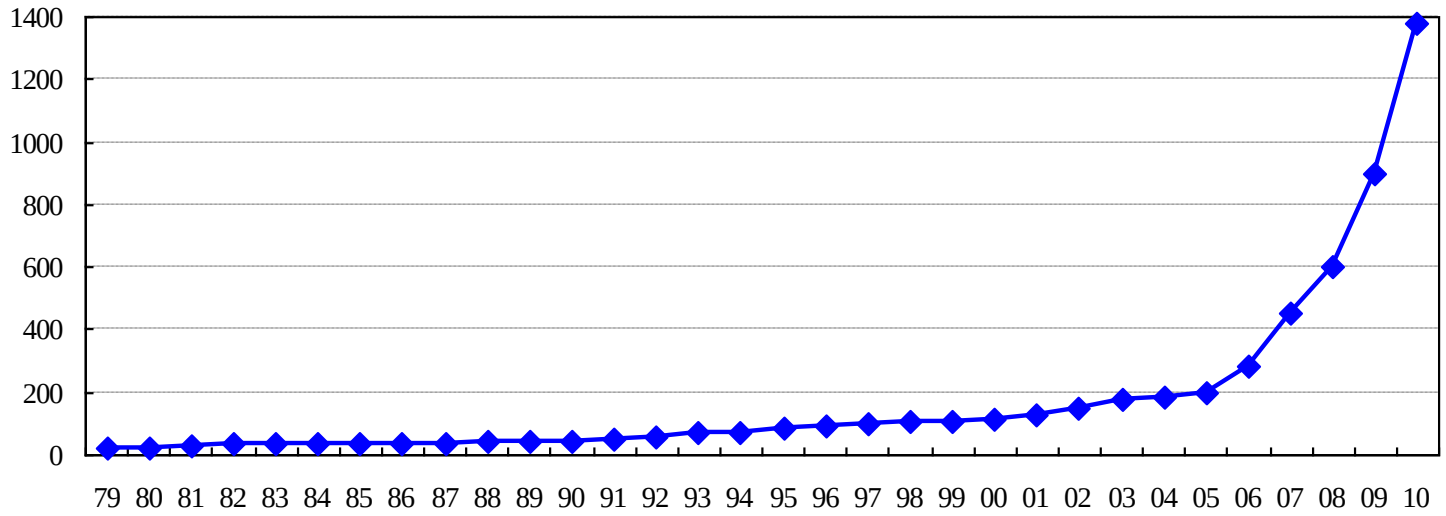


From EIA (2011)

4. A substantial increase in U.S. shale gas production

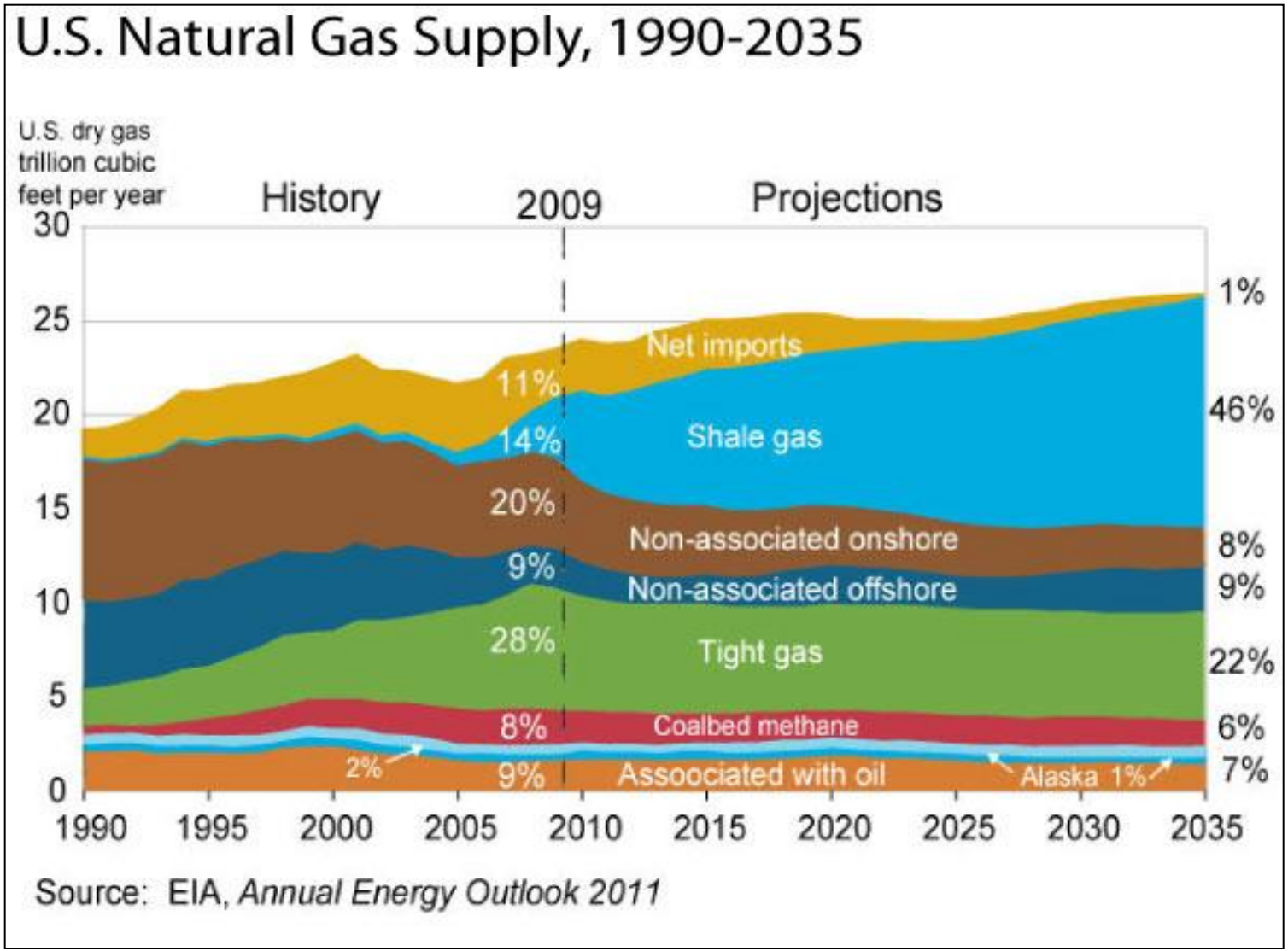
Proved reserves of 2 trillion cubic meters in U.S.,

and annual output was 137.8 billion cubic meters in 2010.



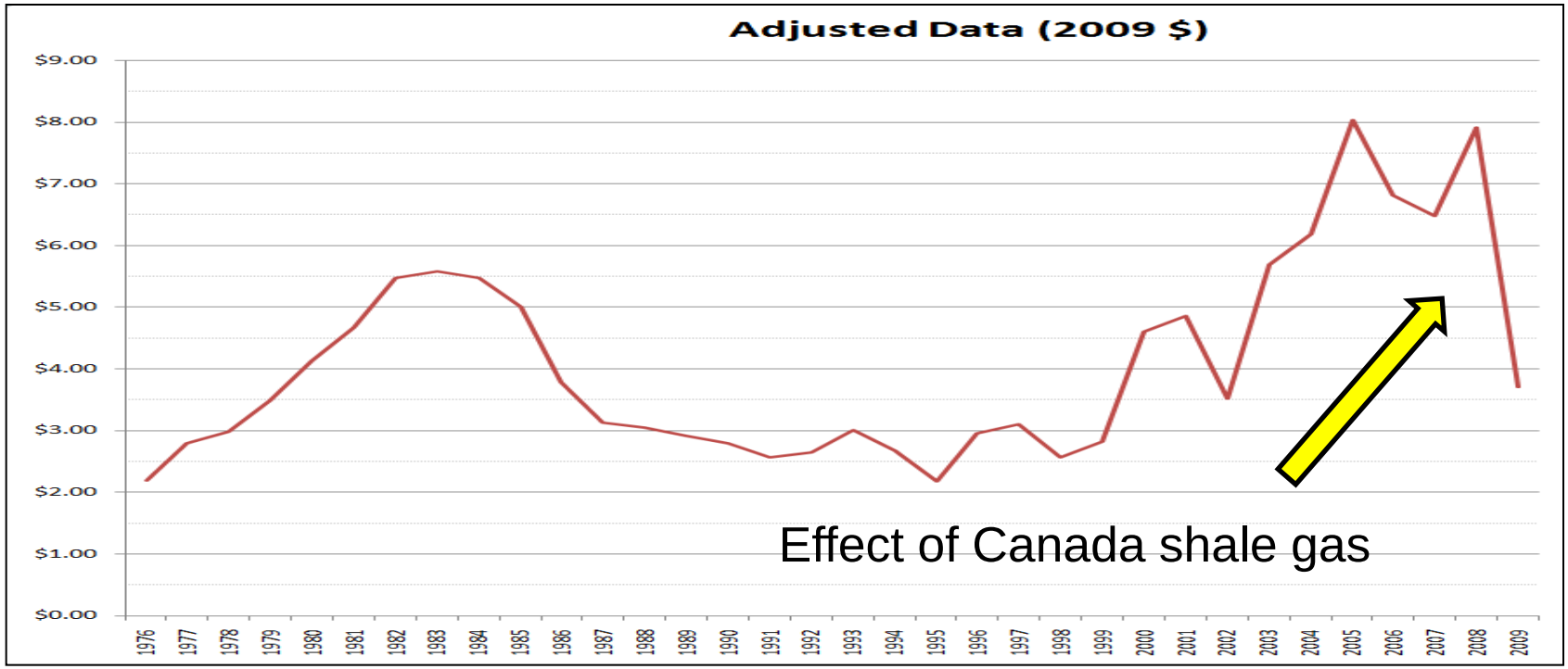
Shale gas becomes a reality and important source of oil and gas with the high oil price.

4. A substantial increase in U.S. shale gas production



5. Shale Gas Effects.....

Import less gas
Gas will replace oil in many applications
Gas will partly replace coal for the generation of electrical power (less CO2)
The world energy game is changing……



Source by Maurice

Catalog

1. The current development situation of shale gas industry in China

2 . The development prospect of shale gas industry in China

3. Solutions and suggestions for the development of shale gas industry

1. The current situation

(1) Still in the infancy on the whole

the History of Shale Gas Development in China

20th century	**Some primary research on shale gas reservoirs was conducted by several Chinese scholars.**
2005	**Investigation of shale gas resources and evaluation concerning the geological conditions of reservoir formation have been strengthened.**

In *Implementation Scheme for China's Oil and Gas Resource Strategic Investigation* to be executed, shale gas is selected to be the strategic priority of unconventional oil and gas investigation, and strive to achieve business development around 2015.

(2) Shortage of industrial policy

China is a giant consumer of oil and gas. However, the production capacity of domestic natural gas is limited in relation to its bulky demand, and there is a tendency for the demand gap to widen each year. As a way to address the shortage of natural gas supply, Chinese government has enhanced the development and utilization of unconventional natural gas resources.

(2) Shortage of industrial policy

Coalbed Methane

The development of coalbed methane was listed in the "eleventh five-year plan" of energy development, and a series of preferential policies were instituted:

1. *Notification of Tax Policies on the Facilitation of Coalbed Methane Extraction*
2. *Notification of Further Foreign Cooperation in Exploitation of Coalbed Methane*
3. Various support policies such as monopoly-breaking, tax preference and financial subsidy

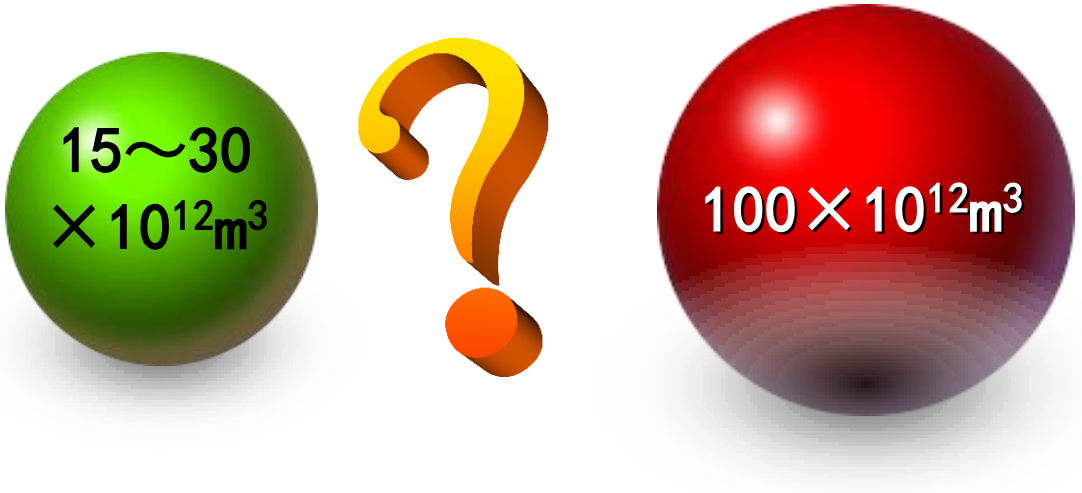
Shale Gas

Catalog

2. The development prospect

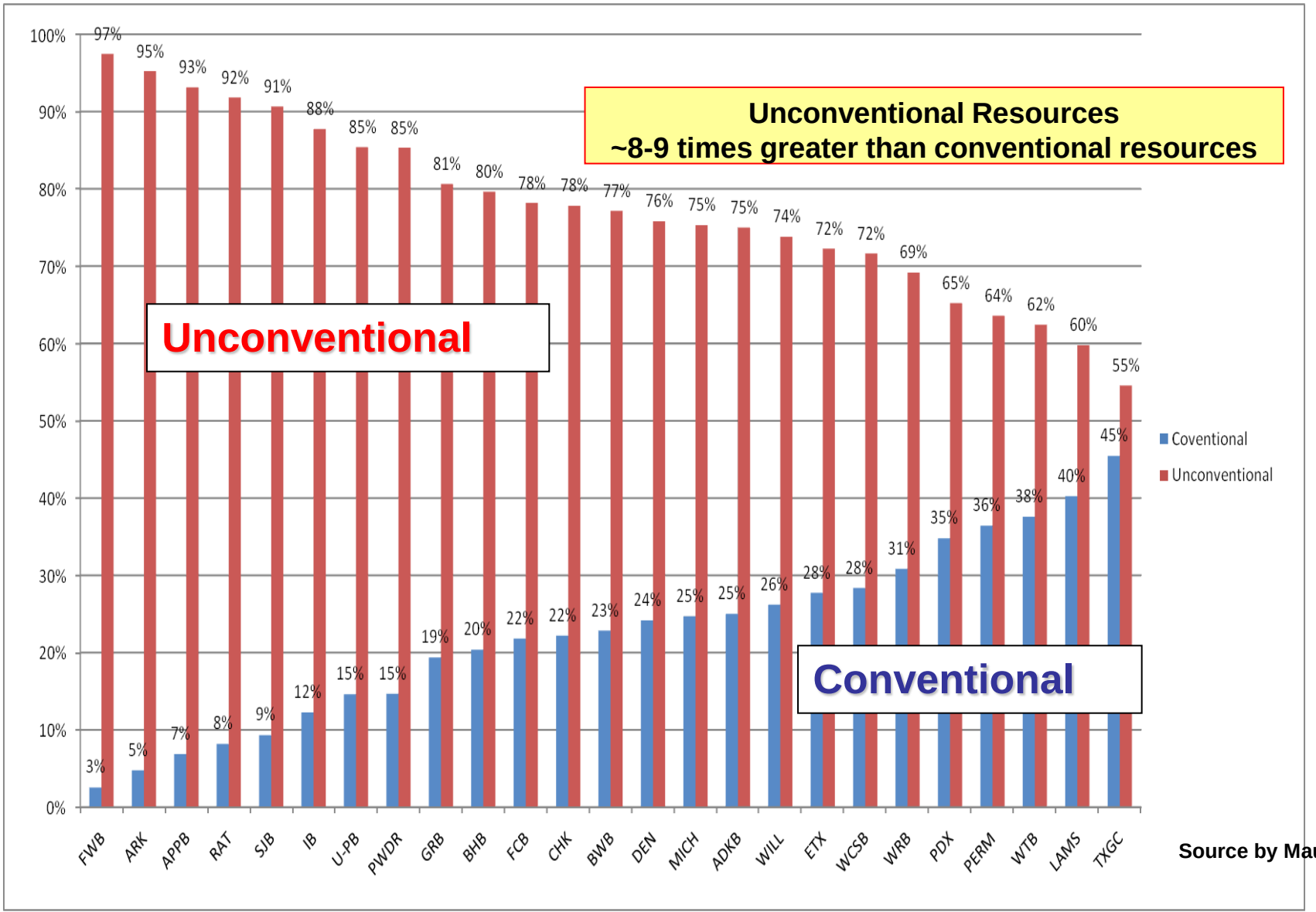
(1) The abundance of shale gas resources

It has been concluded from the assessment of shale in some regions of China by domestic research institutes and scholars that China is rich in shale gas resources.



2. The development prospect

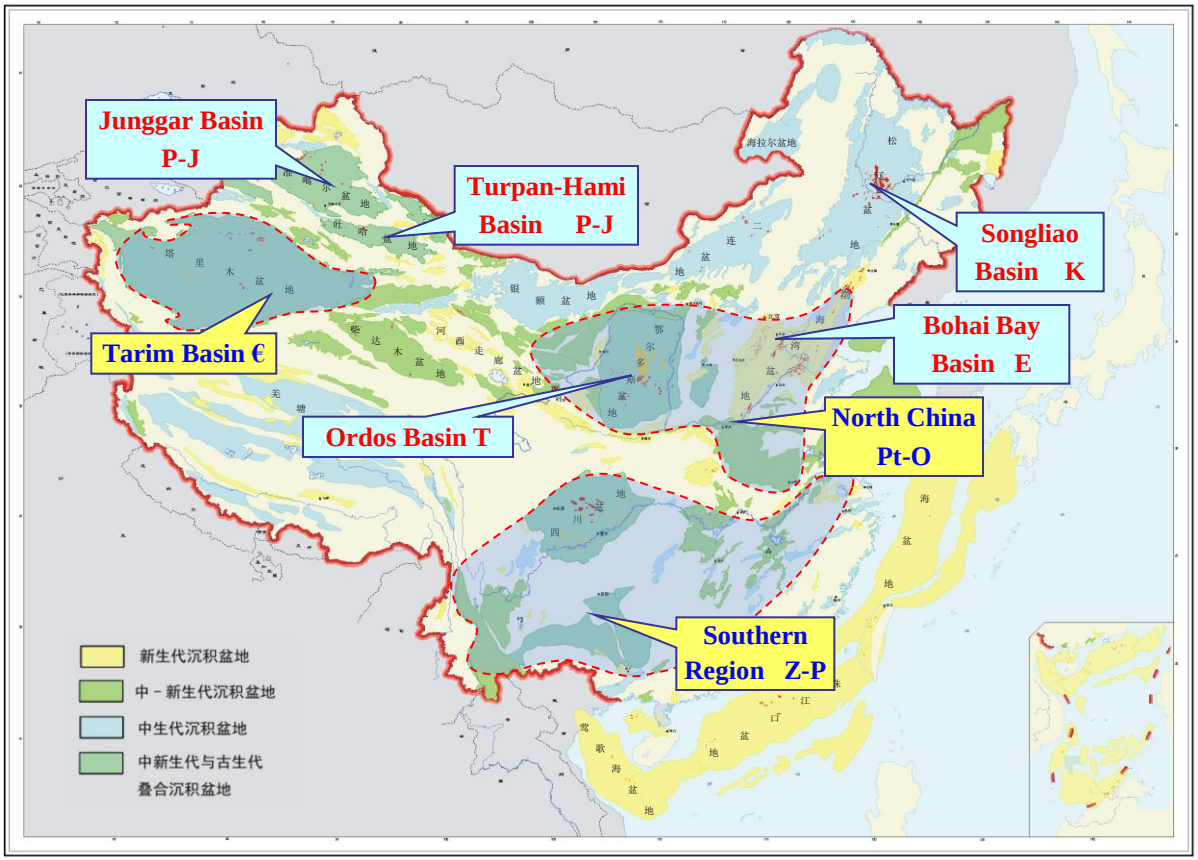
Shale Gas resources in the US...



Source by Maurice

(2) Extensive distribution of shale gas

China's land area of shale gas exploration



Type：

(1)continental

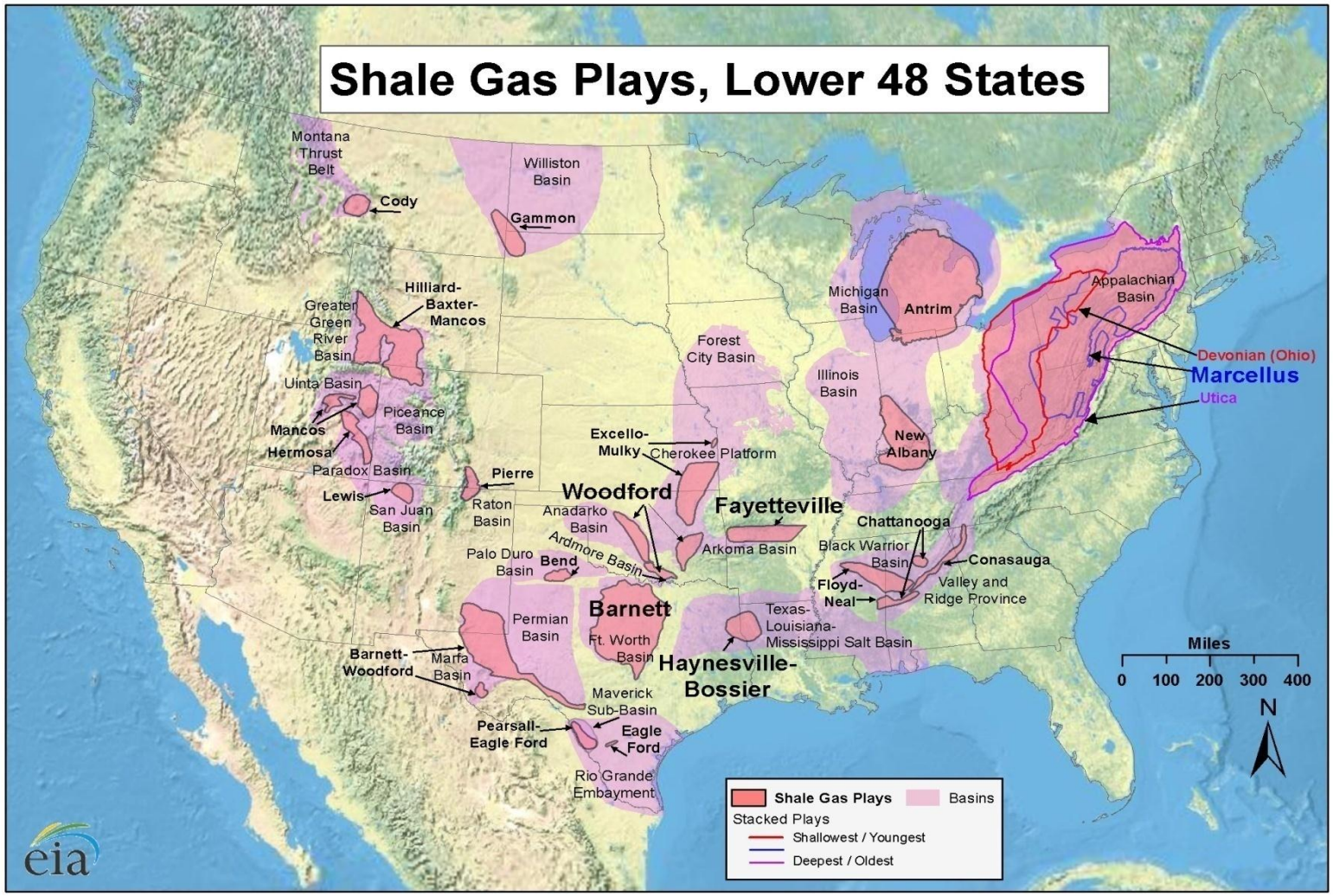
(2)marine

Distribution：

(1)three basins of marine deposit

(2)five basins of continental deposit

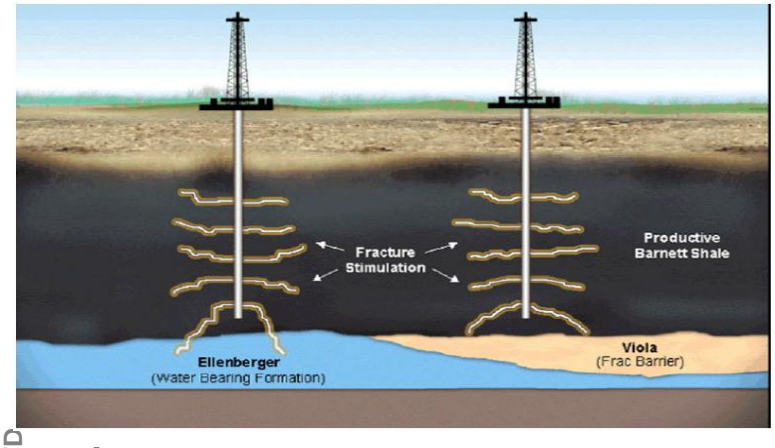
Shale Gas Areas in the US...

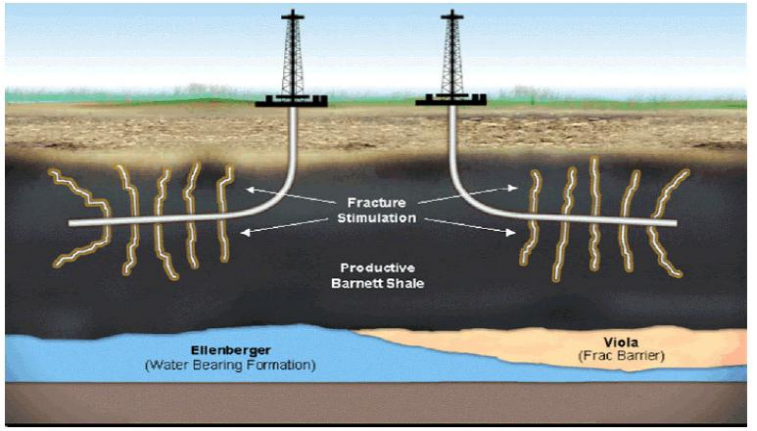


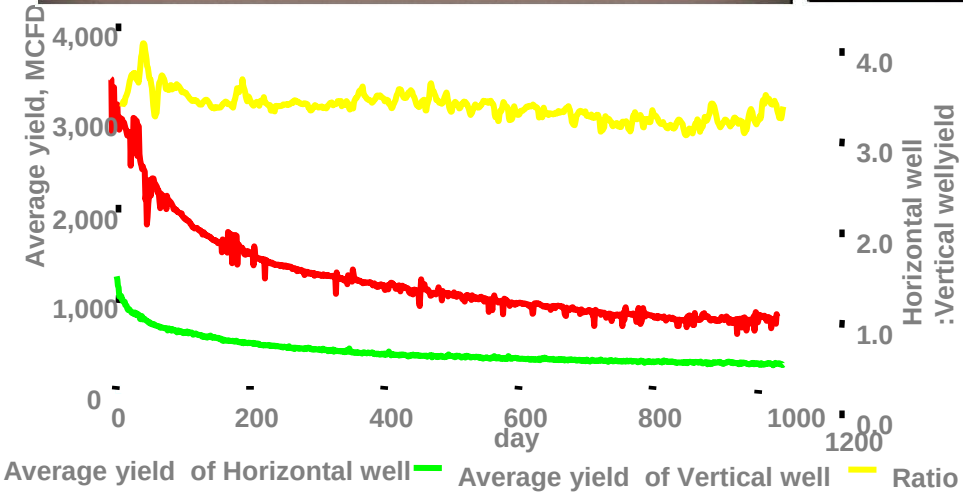
Source: Energy Information Administration based on data from various published studies.
Updated: March 10, 2010

(3) The technical bottleneck in shale gas development

The mining technology of shale gas was named one of the international top ten oil technological progress in 2009.





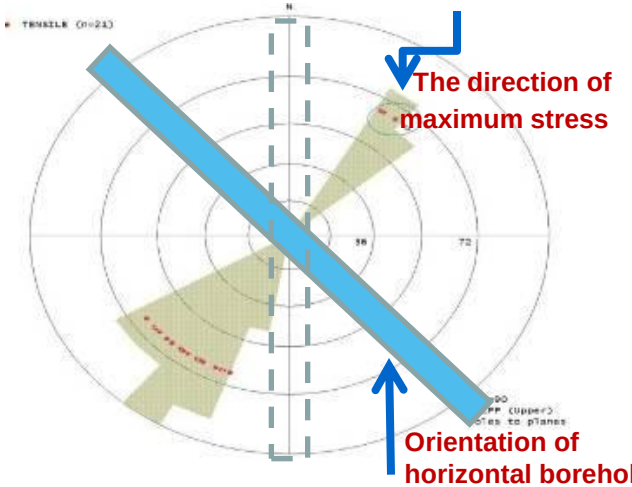


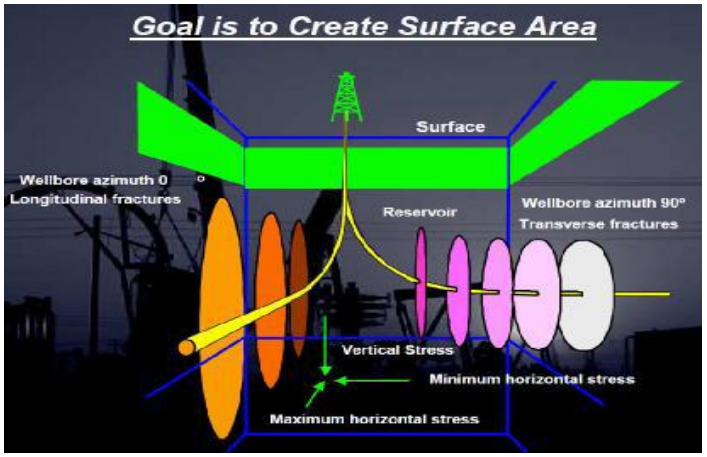
- **Increase the well productivity**
- **Reduce the surface facilities**
- **Cost is 1.5-2 times vertical well**
- **Well production is 3-4 times the vertical well**

2. The development prospect

1) Improve the horizontal drilling technology

The design of horizontal borehole location and direction mainly base on the geostress data.



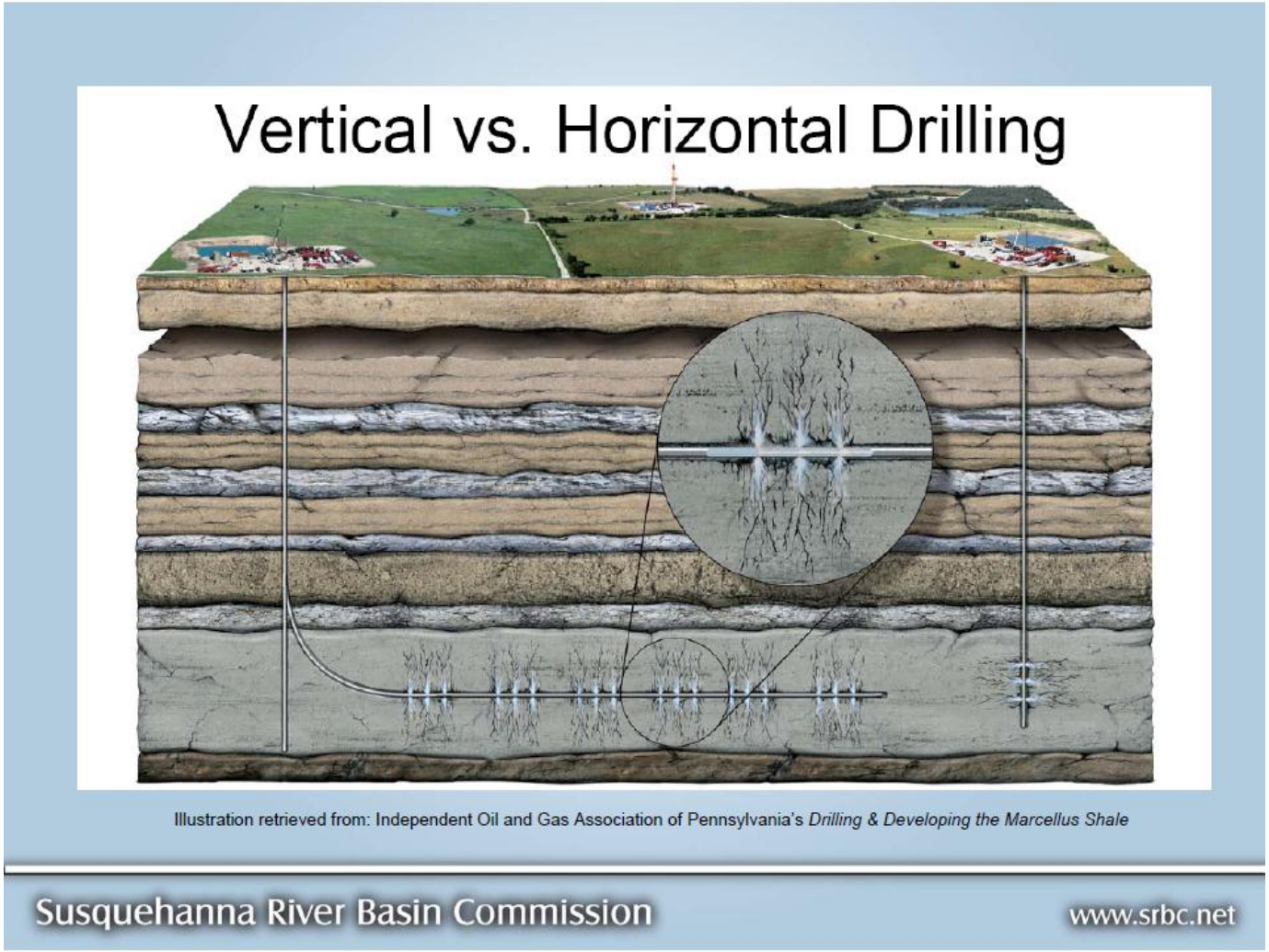


Horizontal borehole position should be in low stress areas, high porosity zone, brittle mineral rich region and the kerogen-rich areas. It provides favorable conditions for later fracturing.

The direction of horizontal borehole drills along the direction of minimum horizontal stress. The post-fracture perpendicular to the horizontal borehole direction. The effect of fracture change is good.

2. The development prospect

Greatly increase the open area of shale



2) Advanced technology for horizontal well fracturing

Multi-level horizontal well fracturing—Virtual construction site

Fracturing equipment

Water supply pipeline

Acid tank

Sand unit

(3) The technical bottleneck in shale gas development

New technology plays a crucial role on the rapid development of shale gas,and promots shale gas production of U.S.. The development of shale gas resources in China is still in its infancy.The factors including the deficiency in managerial experiences and immaturity of technology restrict the industrialization of China’s shale gas.

Catalog

3. Solutions and suggestions

In view of China's flourishing demand for natural gas, the production of conventional natural gas alone is far from satisfying the demand, and the development of unconventional natural gas industry is one of the effective means to mitigate the contradiction between energy supply and demand.

Faced with this situation, it is necessary to seize the opportunities and make good use of the environment advantages, so as to facilitate the development of shale gas industry, the implementation of take-over strategy of natural gas resources and the adjustment of China's energy structure.

3. Solutions and suggestions

(1) To learn from America's experiences

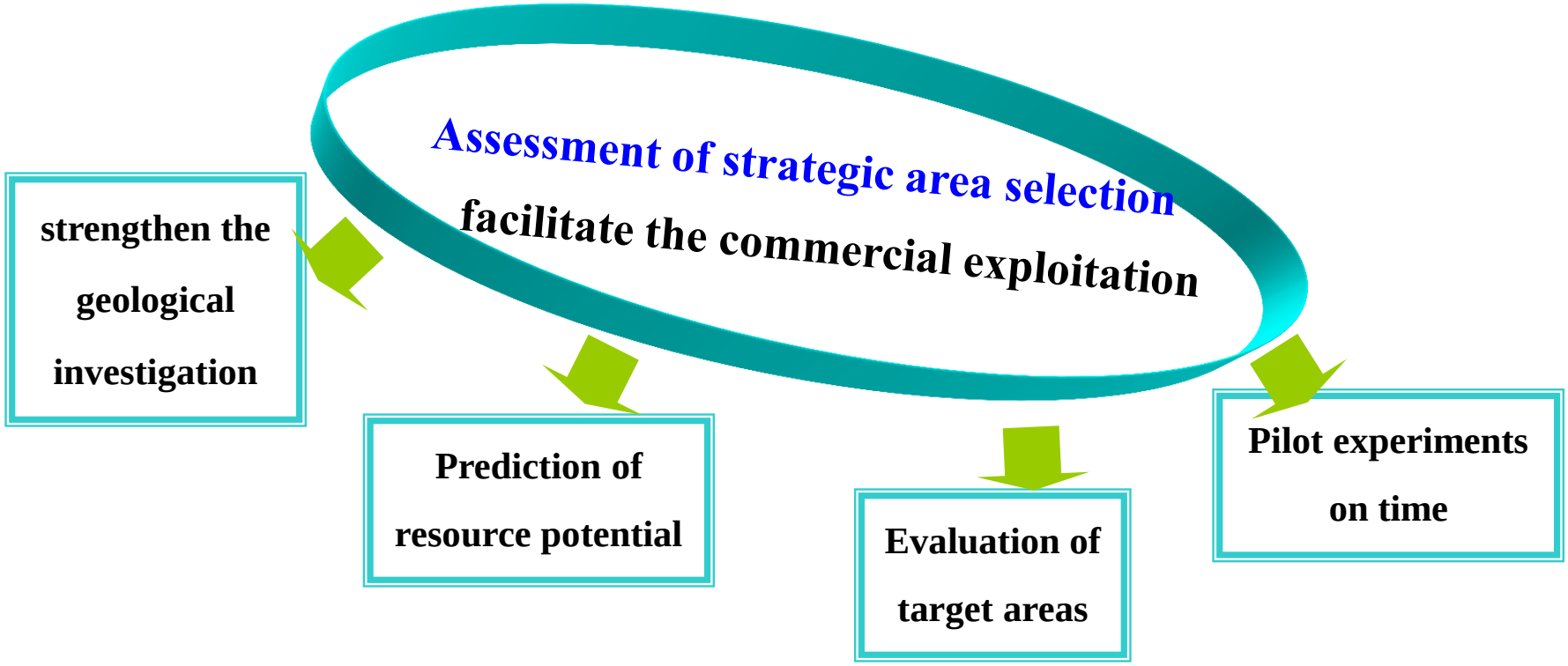
1) **The all-out policy support** U.S. government provisions the tax subsidy policies on unconventional energy exploitation, sets up the research fund in unconventional oil and gas resources.

2) **Technological breakthrough and application** Series advanced and low-cost shale exploitation technology has been developed, which greatly increase the well production of shale gas.

3) **Gas pipeline network and urban gas supply** Rely on the existing pipeline network substantially reduce the early stage input in the terminals, and quickly realized the marketization of shale gas.

3. Solutions and suggestions

(2)To facilitate the assessment of strategic area selection and implement the measures.



(2)To facilitate the assessment of strategic area selection and implement the measures.

Strengthen the geological investigation Investigation focused on the development and distribution of shale strata rich in organic matters and the geological conditions should be strengthen. The research area is concentrated on Paleozoic marine shale formation rich in organic matters (TOC>1.0%) in Yangtz platform in southern China, as well as Cenozoic lacustrine shale formation rich in organic matters（TOC>1.0%） in northern China.

(2)To facilitate the assessment of strategic area selection and implement the measures.

Prediction of resource potential

The prediction of resource potentials should be performed reasonably, including the content characteristics of shale absorbed gas, reservoir characteristics of shale, composition and mechanical properties of rocks and minerals, potential prediction of shale gas resources.

(2)To facilitate the assessment of strategic area selection and implement the measures.

Evaluation of target areas

Evaluation and optimization of target areas should be carried out, including geological evaluation, development economic evaluation, evaluation and selection of favorable blocks.

(2)To facilitate the assessment of strategic area selection and implement the measures.

Pilot experiments should be initiated on time

One or two typical areas should be selected for the pilot experiments, including resource potential prediction, shale gas reservoir characteristics, analysis of reservoir formation mechanism, and the application of advanced exploration and exploitation technology (horizontal well drilling, staged fracturing, comprehensive test and so on), etc..

3. Solutions and suggestions

(3) The combination of introduction and independent innovation, and the enhancement of research on key technology to get well prepared for large-scale economic development.

Advanced technology and methods are the most reliable approaches to exploration and exploitation of shale gas. The successful application of horizontal well technology, multi-section fracturing technology, hydraulic fracturing technology and micro-seismic technology, seismic reservoir prediction and completion technology underlies the exploitation of shale gas in America.

3. Solutions and suggestions

Research the geological properties of China,

Introduce advanced technology from abroad,

Form the appropriate core technology system,

Establish the demonstration projects in China.

Sino-US memorandum of understanding on cooperation in the field of shale gas **was signed in 2009.**

(4) The formulation of support policies on shale gas industry to provide policy guidance for the health development of shale gas industry

1) National energy development plan

The tax system of China's petroleum industry is relatively extensive with no special finance and taxation policies on shale gas exploitation so far. The conduction of overall planning and systematic management is needed on the part of government and petroleum companies, and shale gas resources should be incorporated into long-term development and planning system with its development objectives, stages and status defined scientifically.

(4) The formulation of support policies on shale gas industry to provide policy guidance for the health development of shale gas industry

2) Formulation of preferential tax policies

We should learn from other countries, especially America ,when tax policy innovation is implemented. Zero tax rate was once implemented in America to promote greatly on unconventional natural gas development , which is much to be learnt by the successors.

(4) The formulation of support policies on shale gas industry to provide policy guidance for the health development of shale gas industry

3) Develop financial support policies

The shale gas industrial support policies could be performed with reference to those on coalbed methane, such as monopoly-breaking, tax preference and financial subsidy.

Summary

- With abundant shale gas resources and enormous potentials for exploration.
- Appropriate economic environment and policy measures in place gradually.
- Seize the opportunities and accelerate the development.

The Future…

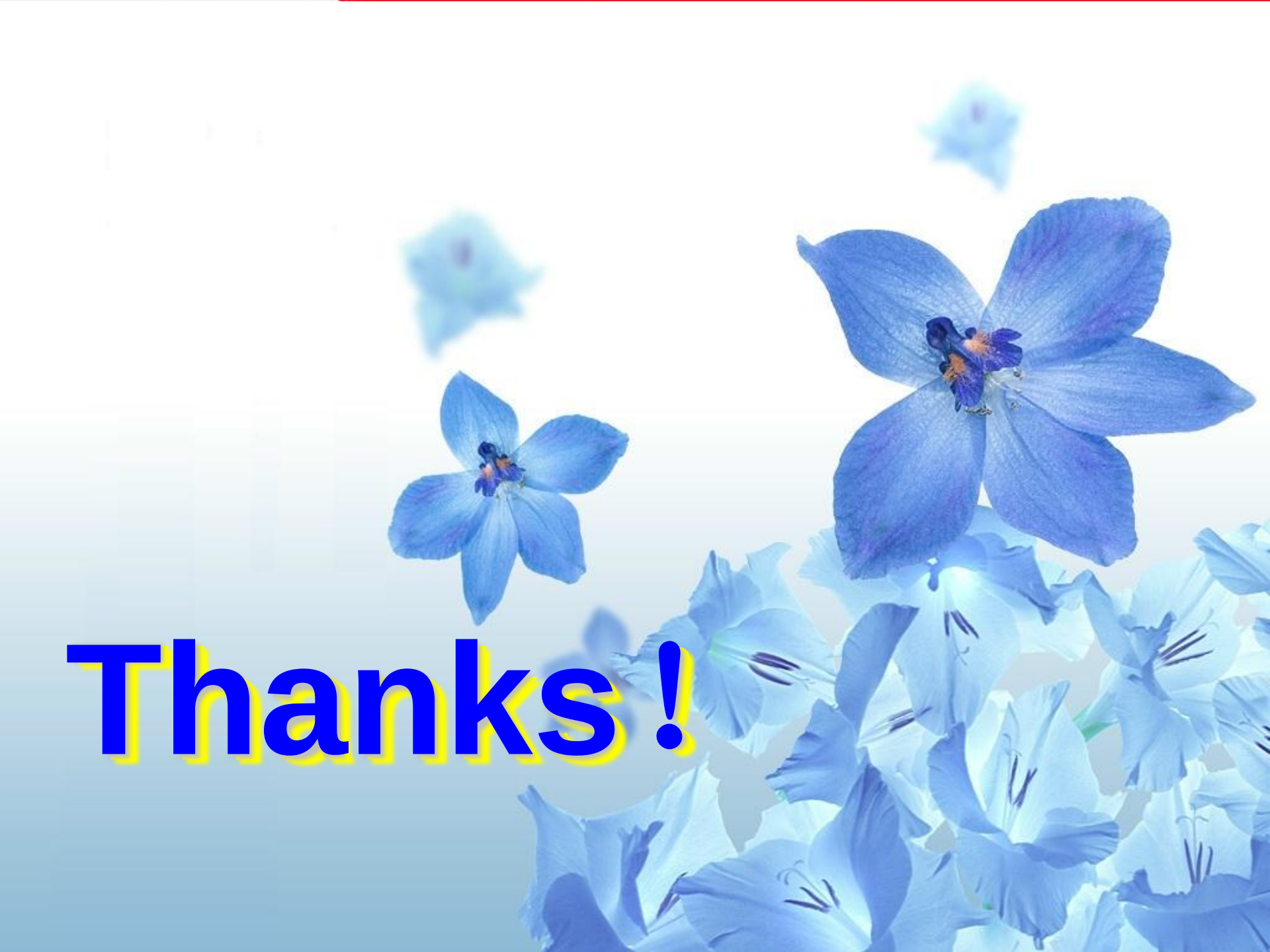
Shale gas is changing our world view in several ways

No shortage of fossil fuels, oil will be partly replaced by gas, so will coal

More resource and reserves studies are needed, around the world, current estimates are very likely low

CH4 will bridge the gap between fossil fuels and renewables over the next 50-100 years.

——by Maurice


Thanks !