Issues and Prospects

Korea's Policy in energy development & possible cooperation agenda for NE Asia Region

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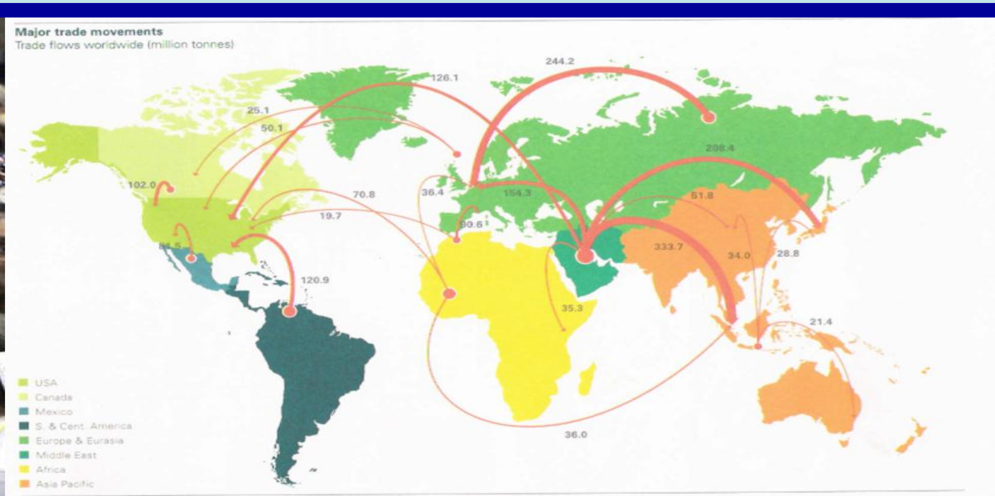


Contents

- Korean Government Policy and Master Plan
- Investment and Outputs
- Agenda for NE Asia cooperation

Korean Resource Development Policy

- **Focus on Overseas Development**

1978 - first government plan and development act
  - Ministry of Energy and Resources <動力資源部>
  - Master plan framework established

1997 - amendment of act,
  - Master plan framework revised
    10-year plan, revise every 3rd year

2001 - 1st Master Plan for Overseas Resource Development

2010 - 4th Master Plan for Overseas Resource Development

Korean Resource Development Policy

- **Focus on Specific Resource** [戰略 鑛種]

  2001 (1st Master Plan for Overseas Resource Development) : Petroleum, Natural Gas, Coal, Uranium, Iron, Copper, Zinc and rare earth are selected

  2007 (3rd Master Plan) : Add Nickel, delete rare earth

  2010 (4th Master Plan) : Add Lithium and rare earth

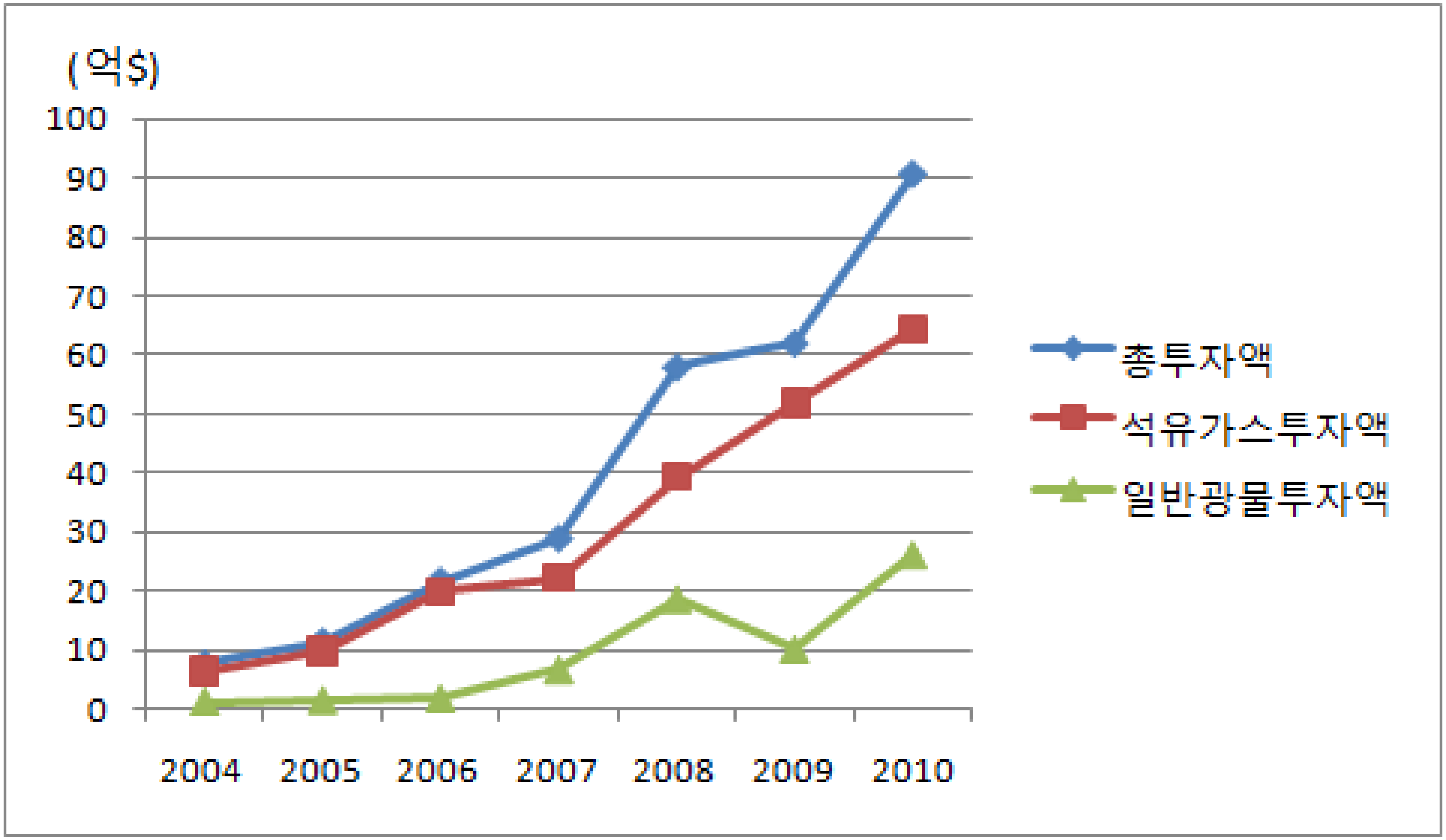
- **Focus on Amount** [確保率]**, not profit/revenue**

  Targets : amount secured by Korean institution, or ratio proportion to the total domestic consumption

Targets in Master Plans (ratio)

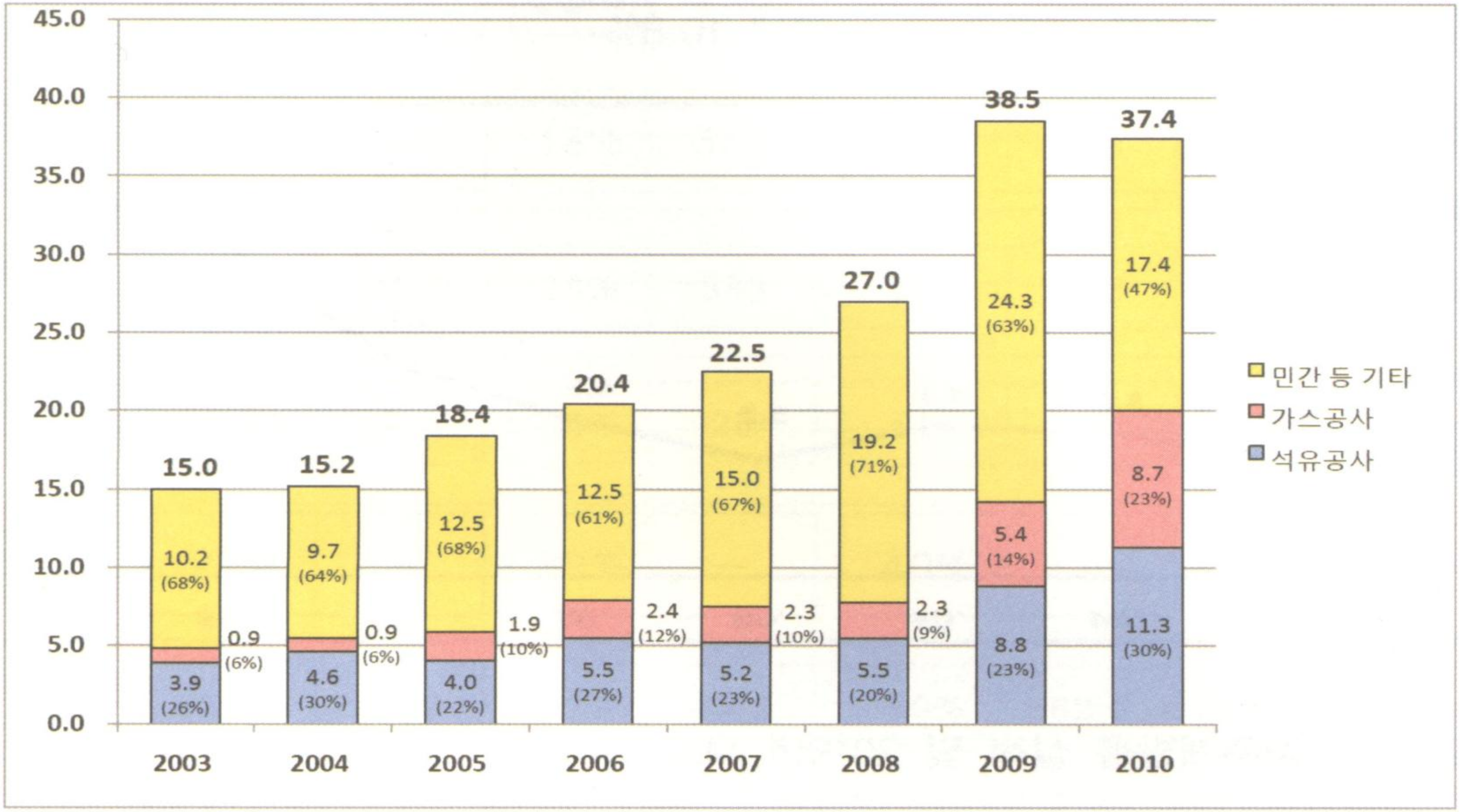
<table>
<tr><th>Master Plan (target year)</th><th>Petroleum</th><th>Natural Gas</th><th>Coal</th><th>Uranium</th><th>Copper</th><th>Irion</th><th>Zinc</th></tr>
<tr><td>1st (2010)</td><td>10%</td><td>30%</td><td>30%</td><td>10%</td><td>20%</td><td>10%</td><td>20%</td></tr>
<tr><td>2nd (2013)</td><td>15%</td><td>30%</td><td>35%</td><td>10%</td><td>20%</td><td>20%</td><td>40%</td></tr>
<tr><td>3rd (2016)</td><td colspan="2">28%</td><td>50%</td><td>15%</td><td>35%</td><td>30%</td><td>40%</td></tr>
<tr><td>4th (2019)</td><td>25%</td><td>45%</td><td>50%</td><td>30%</td><td>38%</td><td>35%</td><td>42%</td></tr>
<tr><td>Actual (2010)</td><td>7.4%</td><td>21.8%</td><td>48.3%</td><td>3.4%</td><td>6.0%</td><td>16.5%</td><td>32.3%</td></tr>
</table>

Investment (in 100 mil $)



Blue : total, Red : petro/NG, Green : minerals

Amount Secured (Petro/NG, 100 mil bbl)



Yellow : private inst. Red : KOGAS, Blue : KNOC

Korean Resource Development Policy

- **Future Resource – Technology R&D**

  Gas-Hydrates Development Technology
  Unconventional/Shale Gas Development Technology
  Drilling (also for geothermal)

- **Future Industry - Service Industry**

  Technology-based service companies :
  3-D seismic, Equipments, Drill ship / vessel
  Evaluation-based service companies : Finance, Law service

- **Future Cooperation – NE Asia**

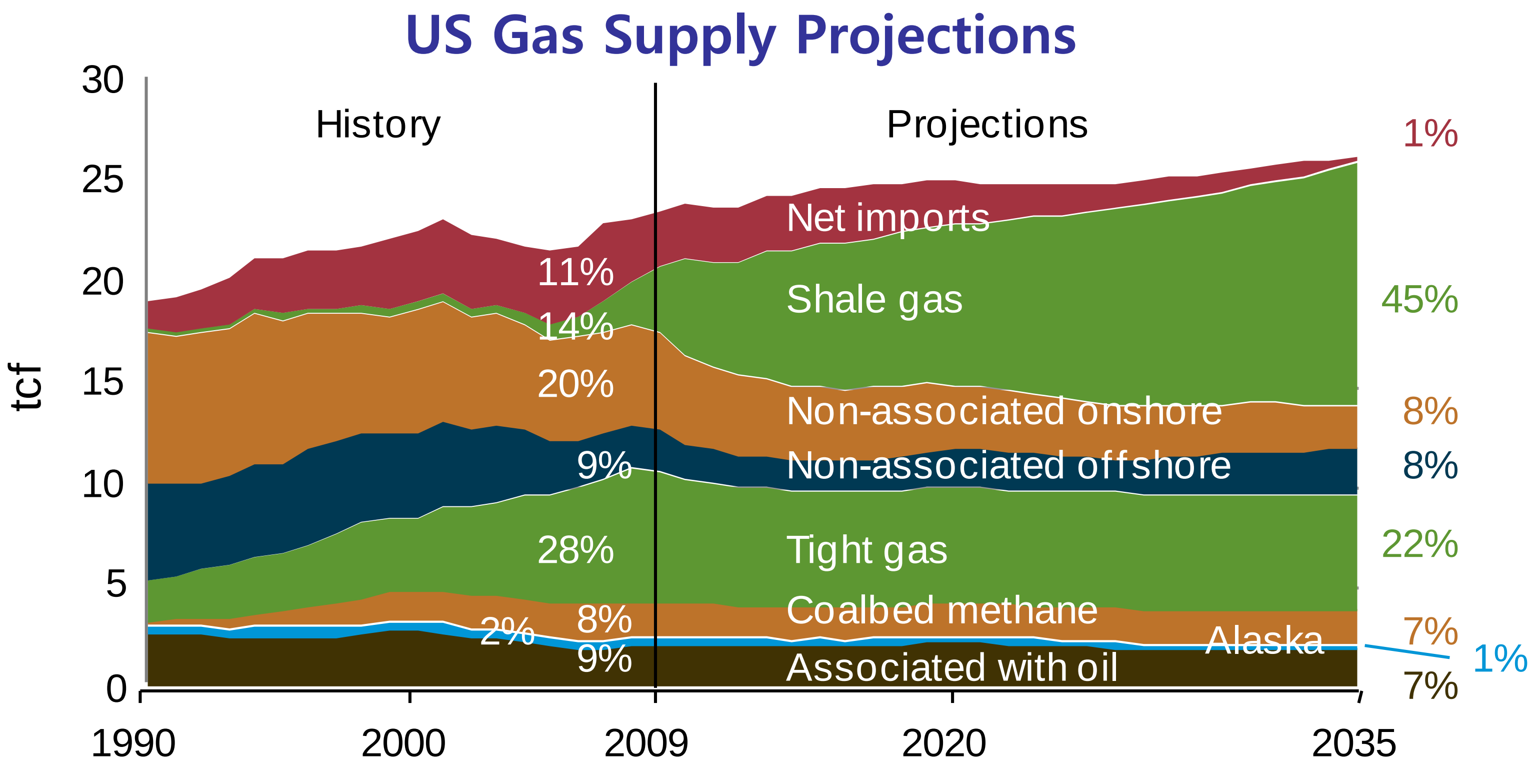
  Together with Energy Technology, Services and Unconventionals

Agenda for NE Asia Cooperation

- Unconventional Oil/Gas (Shale Gas) / EOR
  - Technology R&D
- Service Companies
  - Joint Ventures
- Natural Gas (LNG), post-earthquake/tsunami
  - Joint Markets ?

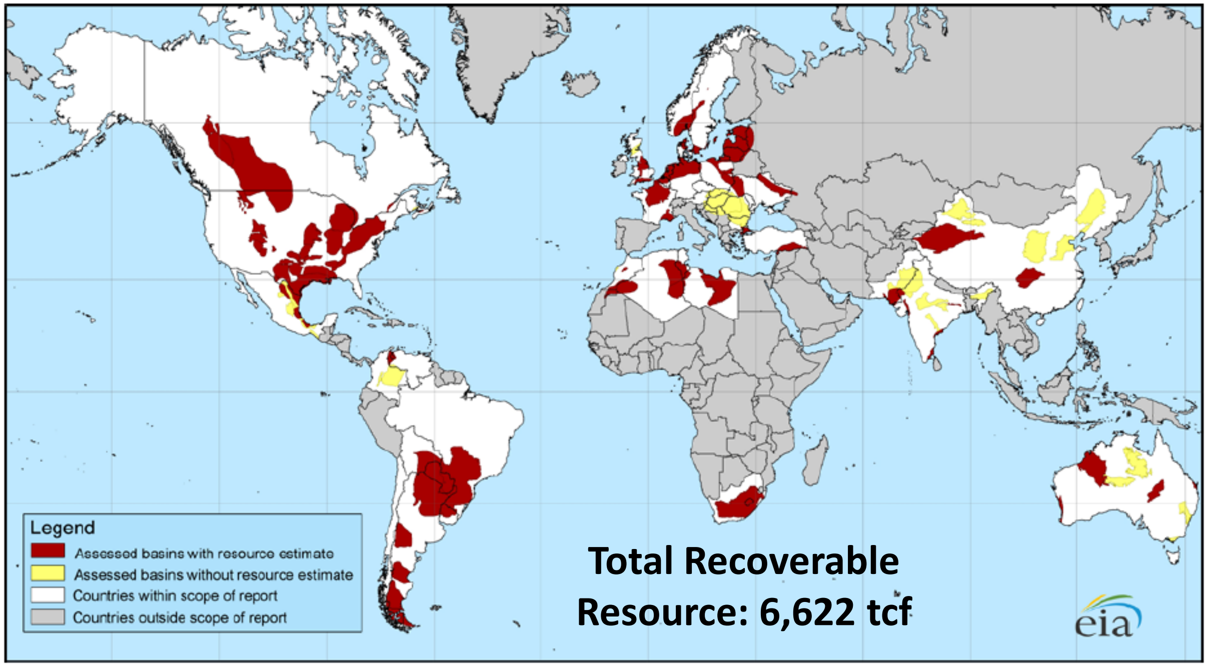
Agenda for NE Asia Cooperation

- **Unconventional Oil/Gas : Shale Gas**



Source : EIA/AEO2011

Unconventional Oil/Gas (Shale Gas(EIA)



Europe	Proven Natural Gas Reserves (tcf)	Technically Recoverable Shale Gas Resources (tcf)
France	0.2	180
Germany	6.2	8
Netherlands	49	17
Norway	72	83
UK	9	20
Denmark	2.1	23
Sweden		41
Poland	5.8	187
Turkey	0.2	15
Ukraine	39	42
Lithuania		4
Others*	2.71	19
Total		**639**

* Bulgaria, Hungary, and Romania.

South America	Proven Natural Gas Reserves (tcf)	Technically Recoverable Shale Gas Resources (tcf)
Venezuela	178.9	11
Colombia	4	19
Argentina	13.4	774
Brazil	12.9	226
Chile	3.5	64
Uruguay		21
Paraguay		62
Bolivia	26.5	48
Total		**1,225**

Africa	Proven Natural Gas Reserves (tcf)	Technically Recoverable Shale Gas Resources (tcf)
South Africa		485
Libya	54.7	290
Tunisia	2.3	18
Algeria	159	231
Morocco	0.1	11
Western Sahara		7
Mauritania	1	0
Total		**1,042**

Asia (incl. AU)	Proven Natural Gas Reserves (tcf)	Technically Recoverable Shale Gas Resources (tcf)
China	107	1,275
India	37.9	63
Pakistan	29.7	51
Australia	110	396
Total		**1,785**

North America		
US	272.5	862
Canada	62	388
Mexico	12	681
Total		**1,931**

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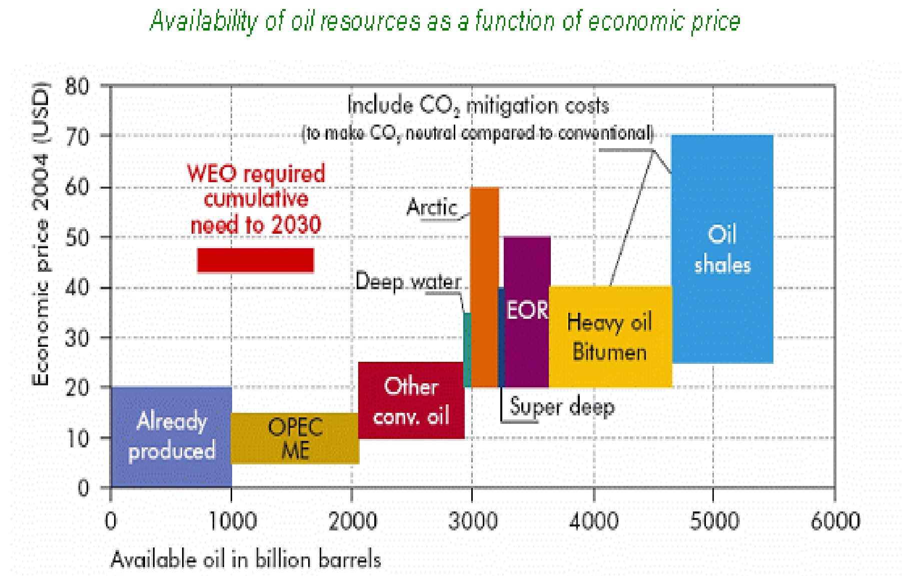
Agenda for NE Asia Cooperation

- **Unconventional Oil/Gas**

  also Gas-hydrates / CBM
   - China/Japan/Korea

Oil Supply and Cost Curve



Source : IEA (2005)

- **EOR**

  Conventional,
  also deep water, arctic

: 'Technology' resources

Asks high-level technology for efficient development
   water resource treatment / environmental protections
Possible Joint R&D, Joint Venture among NE Asian countries

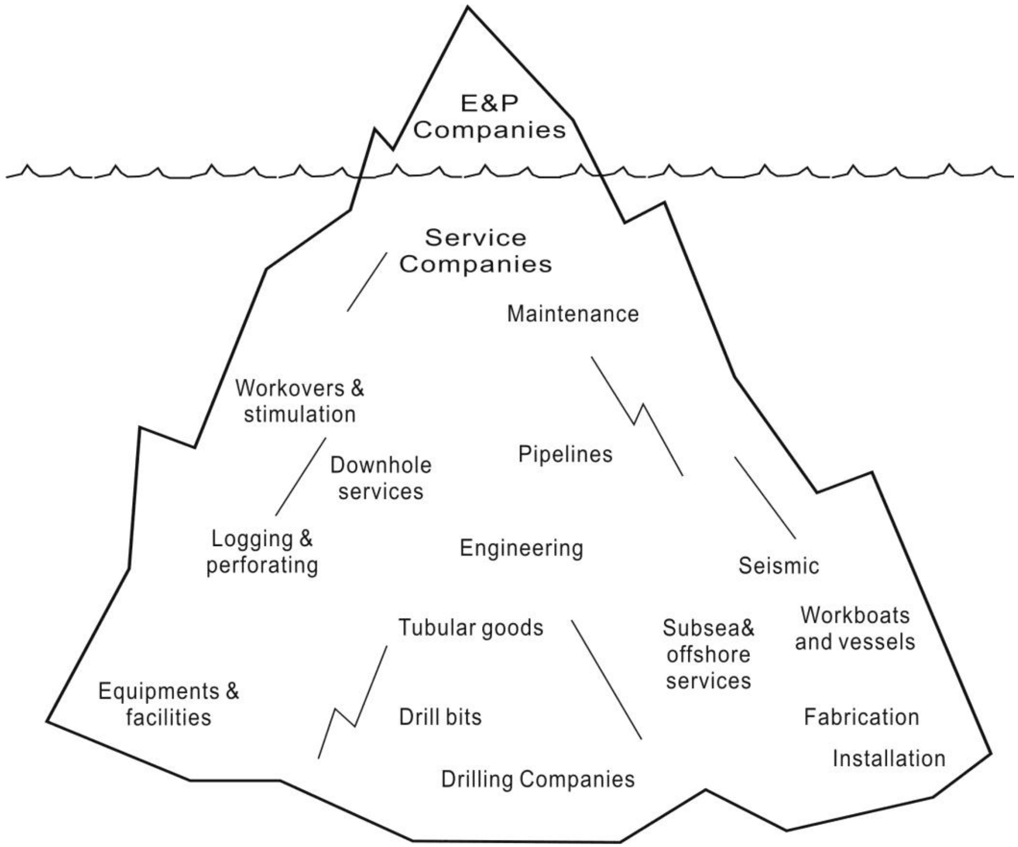
Agenda for NE Asia Cooperation

- **Service Companies**

  Pipelines, Drilling, Seismic, Equipments, Ship/vessels Finance, Maintenance etc.…

  : Close relations with E&P companies

  Required for better results



(Raymond and Leffler, 2006, Oil and Gas Production in Nontechnical Language, PennWell)

: NE Asia – lacks 'Good' service companies

Possible Joint Ventures among NE Asian countries

Agenda for NE Asia Cooperation

- **Asian Markets – post Quake/Tsunami situation**

  Especially LNG Markets
  - Japanese LNG demand expected to rise
  - Second option to Nuclear needed
  - China's demand will soar through 2020
  - All three NE Asian countries will be under pressure to secure additional supplies

: Finding NG Supply and Markets

Australia, Russia : Energy suppliers for NE Asia

Unconventional (Shale Gas) can be added

New market potential among NE Asian Countries

But then, do NE Asian countries need new 'market' ?

감사합니다