Asia/World Energy Outlook 2015

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The Institute of Energy Economics, Japan (IEEJ)
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Introduction

Findings from “Asia/World Energy Outlook 2015”

1. Energy Situation in Asia towards 2040

2. Lower Price Scenario towards 2030

3. Climate Change: Issues and Uncertainties
Primary Energy Demand by Region (World)

Source: IEEJ, Asia/World Energy Outlook 2015

- Asia: Increase (2013-2040) = 3,281 Mtoe, Average Annual Growth Rate (2013-2040) = 1.8%
- Africa: Increase = 622 Mtoe, Average Annual Growth Rate = 2.3%
- Latin America: Increase = 533 Mtoe, Average Annual Growth Rate = 1.8%
- Middle East: Increase = 447 Mtoe, Average Annual Growth Rate = 1.8%
- FSU & Non-OECD Europe: Increase = 167 Mtoe, Average Annual Growth Rate = 0.5%
- OECD Europe: Increase = 24 Mtoe, Average Annual Growth Rate = 0.1%
- Oceania: Increase = 22 Mtoe, Average Annual Growth Rate = 0.0%

World:
- 2013: 13,600 Mtoe
- 2040: 19,000 Mtoe (1.4-fold increase)

North America:
- 2013: 8,700 Mtoe
- 2040: 19,000 Mtoe (1.4-fold increase)
Primary Energy Consumption by Source

Solid lines: Reference

The percentages indicate the shares of total global/Asian primary consumption.

Source: IEEJ, Asia/World Energy Outlook 2015
Energy self-sufficiency in Asia

Source: IEEJ, Asia/World Energy Outlook 2015

Solid lines: Reference
World Primary Energy Supply (By Energy)

Source: Institute of Energy Economics, Japan, Asia/World Energy Outlook 2015
What do lower prices bring?
Various factors influence oil price

**Supply**
- OPEC’s policy
- Fiscal break-even price
- OPEC’s spare capacity
- Increases in production of unconventional oil

**Demand**
- Economic growth
- Stock in developed countries
- Oil use policy in developing countries
- Car ownership and fuel economy

**Money**
- Stock prices and exchange rates
- Expected inflation
- Money supply
- Risk appetite
- New investment commodity and technology

**Risk**
- Political situation in producing countries
- Foreign policy
- Terror to related facilities
- Unusual weather, disaster and accident
- Strike, etc.

*Source: IEEJ, Asia/World Energy Outlook 2015*
“History doesn’t repeat itself, but it does rhyme”

❖ Oil price

- Decreases in demand and increases in supply by non-OPEC following high price after the oil crises
- Severer competition in OPEC
- Easy supply-demand balance affected by the Netback pricing
- Decreases in emerging economies’ demand by the Asian financial crisis
- Expansion of OPEC production quota and excess production by the members over their quota
- Sharp drop of demand by the Lehman shock
- Expansion of production capacity by Saudi Arabia and others
- Increases in supply by non-OPEC and OPEC
- Slow growth of global demand

Source: BP
We may see lower prices than the Reference Scenario

Background of the scenarios

<table>
<thead>
<tr>
<th>Reference</th>
<th>Lower Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demand</strong></td>
<td></td>
</tr>
<tr>
<td>Energy conservation and fuel switching in transport sector progress along the trend.</td>
<td>Strong energy conservation and fuel switching by non-fossil fuel progress.</td>
</tr>
<tr>
<td><strong>Supply</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Conventional resources</strong></td>
<td></td>
</tr>
<tr>
<td>Development in each country follows its historical trend.</td>
<td>Competition among low-cost producers such as OPEC, Russia, etc. continues.</td>
</tr>
<tr>
<td><strong>Unconventional resources</strong></td>
<td></td>
</tr>
<tr>
<td>Production growth in the United States declines in and after 2020s.</td>
<td>OPEC loses effectively its power as a cartel organisation.</td>
</tr>
<tr>
<td>Slow development is seen in other countries.</td>
<td><strong>Unconventional resources</strong></td>
</tr>
<tr>
<td></td>
<td>Reaches to the highest levels both inside and outside the United States.</td>
</tr>
</tbody>
</table>

Assumption of oil price

Source: IEEJ, Asia/World Energy Outlook 2015

Note: Future prices are in $2014.
Need for Higher Cost Oil Production

Source: Prepared by IEEJ based on IEA data and others
Depressed production in traditional exporting regions

❖ Crude oil production in selected regions [2030]

- Africa: 11.0 Mb/d (Reference), 9.1 Mb/d (Lower Price)
- Former Soviet Union: 15.4 Mb/d, 13.6 Mb/d
- Latin America: 13.5 Mb/d, 13.8 Mb/d
- North America: 16.9 Mb/d, 17.3 Mb/d
- Middle East: 34.7 Mb/d, 29.2 Mb/d

❖ Natural gas production in selected regions [2030]

- Africa: 0.37 Tcm, 0.35 Tcm
- Middle East: 0.86 Tcm, 0.65 Tcm
- Asia: 0.74 Tcm, 0.7 Tcm
- Former Soviet Union: 1.14 Tcm, 0.94 Tcm
- North America: 1.11 Tcm, 0.98 Tcm

Source: IEEJ, Asia/World Energy Outlook 2015
Benefit for importing countries

❖ Crude oil net imports/exports in selected regions [2030]

- **Middle East**: $-457 billion
- **Former Soviet Union**: $-148 billion
- **Africa**: $-115 billion
- **China**: $-217 billion
- **Western Europe**: $-102 billion
- **United States**: $-150 billion
- **Japan**: $50 billion

* Among the modelled 15 regions. Nominal value.

Source: IEEJ, Asia/ World Energy Outlook 2015
Lower Price is good for Global Economy but...

- Changes in real GDP [2030, compared with the Reference Scenario]

Source: IEEJ, Asia/World Energy Outlook 2015
## From IPCC 5th Assessment Report (AR5)

### Scenarios in IPCC AR5 WG3

<table>
<thead>
<tr>
<th>Concentration of CO$_2$-eq in 2100, ppm CO$_2$-eq</th>
<th>Sub-category</th>
<th>Change in GHG emissions from 2010 to 2050, %</th>
<th>2100 temperature change relative to 1850-1900 (°C)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>450 (430-480) Overshoot (vast majority)</td>
<td>-72 to -41</td>
<td>1.5 - 1.7</td>
<td></td>
</tr>
<tr>
<td>500 (480-530) No overshoot</td>
<td>-57 to -42</td>
<td>1.7 - 1.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-55 to -25</td>
<td>1.8 - 2.0</td>
<td></td>
</tr>
<tr>
<td>No overshoot</td>
<td>-16 to +7</td>
<td>2.1 - 2.3</td>
<td></td>
</tr>
<tr>
<td>550 (530-580) Overshoot</td>
<td>-49 to -19</td>
<td>2.0 - 2.2</td>
<td></td>
</tr>
<tr>
<td>(580-650) No overshoot</td>
<td>-38 to +24</td>
<td>2.3 - 2.6</td>
<td></td>
</tr>
<tr>
<td>(650-720) Overshoot</td>
<td>-11 to +17</td>
<td>2.6 - 2.9</td>
<td></td>
</tr>
<tr>
<td>(720-1000) No overshoot</td>
<td>+18 to +54</td>
<td>3.1 - 3.7</td>
<td></td>
</tr>
</tbody>
</table>

*Temperatures in parentheses include carbon cycle and climate system uncertainties

Source: IPCC AR5 WG3

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### RCP2.6
- **450 (430-480)**
  - Sub-category: Overshoot (vast majority)
  - Change in GHG emissions from 2010 to 2050, %: -72 to -41
  - 2100 temperature change relative to 1850-1900 (°C)*: 1.5 - 1.7

### RCP4.5
- **500 (480-530)**
  - Sub-category: No overshoot
  - Change in GHG emissions from 2010 to 2050, %: -57 to -42
  - 2100 temperature change relative to 1850-1900 (°C)*: 1.7 - 1.9
- **550 (530-580)**
  - Sub-category: No overshoot
  - Change in GHG emissions from 2010 to 2050, %: -49 to -19
  - 2100 temperature change relative to 1850-1900 (°C)*: 2.0 - 2.2
  - Sub-category: Overshoot
  - Change in GHG emissions from 2010 to 2050, %: -16 to +7
  - 2100 temperature change relative to 1850-1900 (°C)*: 2.1 - 2.3
- **(580-650)**
  - Change in GHG emissions from 2010 to 2050, %: -38 to +24
  - 2100 temperature change relative to 1850-1900 (°C)*: 2.3 - 2.6
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  - 2100 temperature change relative to 1850-1900 (°C)*: 2.6 - 2.9
- **(720-1000)**
  - Change in GHG emissions from 2010 to 2050, %: +18 to +54
  - 2100 temperature change relative to 1850-1900 (°C)*: 3.1 - 3.7

### RCP6.0

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*Temperatures in parentheses include carbon cycle and climate system uncertainties

Source: IPCC AR5 WG3
IPCC 5th Assessment Report v.s. IEEJ Outlook

- **Fossil CO₂ emissions**

  - **RCP6.0** (720-1000ppm category)
  - **RCP4.5** (580-720ppm categories)
  - **RCP2.6** (450ppm category)

- **2050**
  - 50.4 Gt
  - -3.4 Gt

- **Below Zero**

- **Reference**
- **Adv. Technologies**
- **Adv. Tech. +CCS**
- **50% reduction by 2050**

※Calculated using MAGICC 6.0

IEEJ: Asia/World Energy Outlook 2015
How Much is Temperature Change?

Temperature change from 1850-1900

Reference
Adv. Tech. + CCS
50% reduction by 2050

IEEJ: Asia/World Energy Outlook 2015
<table>
<thead>
<tr>
<th>Party</th>
<th>Date of submission</th>
<th>Target type</th>
<th>Reduction target</th>
<th>Base year</th>
<th>Target year</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>Mar 6</td>
<td>Absolute emissions</td>
<td>40%</td>
<td>1990</td>
<td>2030</td>
<td>GHG</td>
</tr>
<tr>
<td>United States</td>
<td>Mar 31</td>
<td>Absolute emissions</td>
<td>26〜28%</td>
<td>2005</td>
<td>2025</td>
<td>GHG including LULUCF</td>
</tr>
<tr>
<td>Russia</td>
<td>Apr 1</td>
<td>Absolute emissions</td>
<td>25〜30%</td>
<td>1990</td>
<td>2030</td>
<td>GHG</td>
</tr>
<tr>
<td>China</td>
<td>Jun 30</td>
<td>GDP intensity</td>
<td>60〜65%</td>
<td>2005</td>
<td>2030</td>
<td>CO₂</td>
</tr>
<tr>
<td>Japan</td>
<td>Jul 17</td>
<td>Absolute emissions</td>
<td>26%</td>
<td>2013</td>
<td>2030</td>
<td>GHG</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Sep 24</td>
<td>Reduction from BAU</td>
<td>29%</td>
<td>BAU</td>
<td>2030</td>
<td>GHG</td>
</tr>
<tr>
<td>Brazil</td>
<td>Sep 30</td>
<td>Absolute emissions</td>
<td>37% (43% for 2030)</td>
<td>2005</td>
<td>2025</td>
<td>GHG</td>
</tr>
<tr>
<td>India</td>
<td>Oct 1</td>
<td>GDP intensity</td>
<td>33〜35%</td>
<td>2005</td>
<td>2030</td>
<td>GHG</td>
</tr>
</tbody>
</table>
Comparison of INDCs by country

Note: Japan’s 2020 target does not include reduction by nuclear power. China’s target is for CO$_2$, while others are for GHG.
Comparison of INDCs with the Reference/Adv. Tech. Scenarios

**MtCO\(_2\)-eq**

- Reference
- INDC
- IEA Bridge
- 50% reduction by 2050

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Mitigation and Adaptation Costs

There is a trade-off relationship among the mitigation, adaptation and damage costs. It is impossible to reduce all three costs at the same time.

It would be realistic to expect a balance among the three, while minimizing the total cost.

Mitigation
To reduce or prevent emission of greenhouse gases.

Trade-off

Adaptation
To take appropriate action to prevent or minimize the damage caused by climate change.

Damage

Mitigation and Adaptation Costs

IEEJ: Asia/World Energy Outlook 2015
Mitigation vs. Adaptation Costs in 2100

- Mitigation cost (A)
- Damage + adaptation cost (B)

Reduction from the Reference Scenario

2014 USD trillion/year

Total (A+B)
Example of the calculation of the long-term optimal path

Sensitivity analysis compared with the "normal" assumptions:

① Mitigation cost: 2 times
② Damage: one half
③ Climate sensitivity: 2.5°C
④ Damage: 2 times
⑤ Mitigation cost: one half
⑥ "Low" discount rate

Optimal path for climate sensitivity of 3°C and "normal" discount rate assumption

Example of the calculation of the long-term optimal path
Conclusion: Addressing climate change issues

Mitigation, adaptation and damage costs

- The **uncertainty** is **extremely large**.
- **A trade-off** between “**mitigation**” and “**adaptation**” costs
  
  Optimal & realistic is to minimize the **total cost**
  
  **Future R&D** should aim to **reduce cost hike**.

Climate sensitivity

- **“Climate sensitivity”** may be **lower** than previous studies (IPCC AR5, WG1).

- **With lower climate sensitivity**, damage becomes smaller,
  
  **a less ambitious mitigation path being optimal**.

INDCs (Intended Nationally Determined Contributions)

- The current **INDCs** do not curb GHG emissions sufficiently.
  
  Parties should **reduce emissions further**.

Actions required considering **various scenarios and options other than only** the “450ppm” scenario.

- **Innovative technologies** must be developed
  
  including CCS, CCU and artificial photosynthesis.
IEEJ’s **Asia/World Energy Outlook 2015**
Will be available at the site below:
http://eneken.ieej.or.jp/en/whatsnew/421.html