YUKARI NIWA YAMASHITA

Board Member, Director, The Institute of Energy Economics, Japan (IEEJ)

M. De Montbrial, merci de votre invitation pour moi.

It is a great honor to be a part of this prestigious conference.

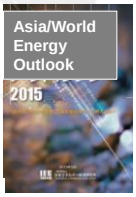
My presentation is a little bit technical that I am using slides.

IEE JAPAN

Addressing Climate Change
- Issues and Uncertainties -

Yukari Yamashita
The Institute of Energy Economics, Japan (IEEJ)
22 November 2015
World Policy Conference, Montreux

IEEJ's **Asia/World Energy Outlook 2015**
Will be available at
http://eneken.ieej.or.jp/en/whatsnew/421.html



Sometimes, it is useful to review the basics and I thought it is appropriate to share with you our recent energy outlook and conclusions with regard to climate change.

From IPCC 5th Assessment Report (AR5)

Scenarios in IPCC AR5 WG3

	Concentration of CO_2-eq in 2100, ppm CO_2-eq	Sub-category	Change in GHG emissions from 2010 to 2050, %	2100 temperature change relative to 1850-1900 (℃)*	
RCP 2.6	450 (430-480)	Overshoot (vast majority)	**-72 to -41**	**1.5 - 1.7**	
	500 (480-530)	No overshoot	-57 to -42	1.7 - 1.9	2 ℃
		Overshoot	-55 to -25	1.8 - 2.0	
	550 (530-580)	No overshoot	-49 to -19	2.0 - 2.2	
		Overshoot	-16 to +7	2.1 - 2.3	
RCP 4.5	(580-650)		-38 to +24	2.3 - 2.6	
	(650-720)		-11 to +17	2.6 - 2.9	
RCP 6.0	(720-1000)		+18 to +54	3.1 - 3.7	BAU

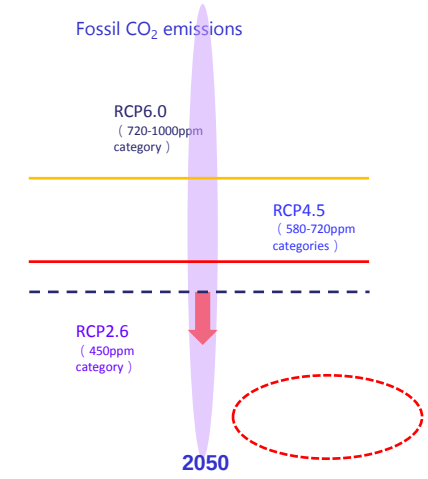
*Temperatures in parentheses include carbon cycle and climate system uncertainties

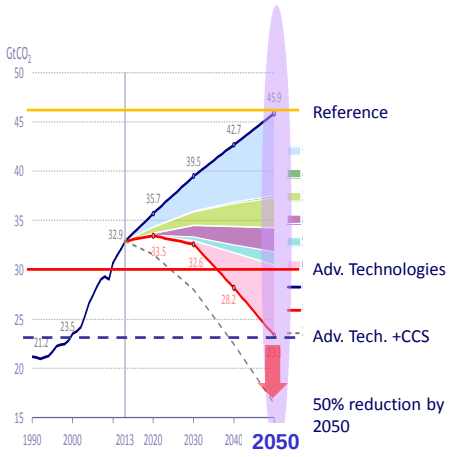
Source: IPCC AR5 WG3

1

- This is a table from the latest IPCC Report's Scenario. 450ppm scenario is highlighted to show that it is the most ideal scenario to keep the temperature rise below 2 degrees into the future beyond 2100 while both 500 and 550ppm also have potential to keep the temperature below 2 degrees until the end of this century.
- For the Representative Concentration Pathway (RCP) 2.6, which is a typical scenario for the "450ppm" category, the GHG concentration is estimated around 500 ppm CO_2-eq in 2100. In a longer term, the concentration declines to some 450 ppm.
- This scenario assumes 64% reduction of fossil CO_2 from 2010 to 2050, and negative emissions after 2070. It is much more ambitious than the "50% reduction by 2050" target. These numbers (i.e. -72 to -41% reduction of GHG emissions) was announced as an agreed target at the G7 this year.
- FYI, IEEJ's reference scenario which I will show you shortly is equivalent to the highest concentration category in this table. It is marked as BAU.

IPCC 5th Assessment Report v.s. IEEJ Outlook



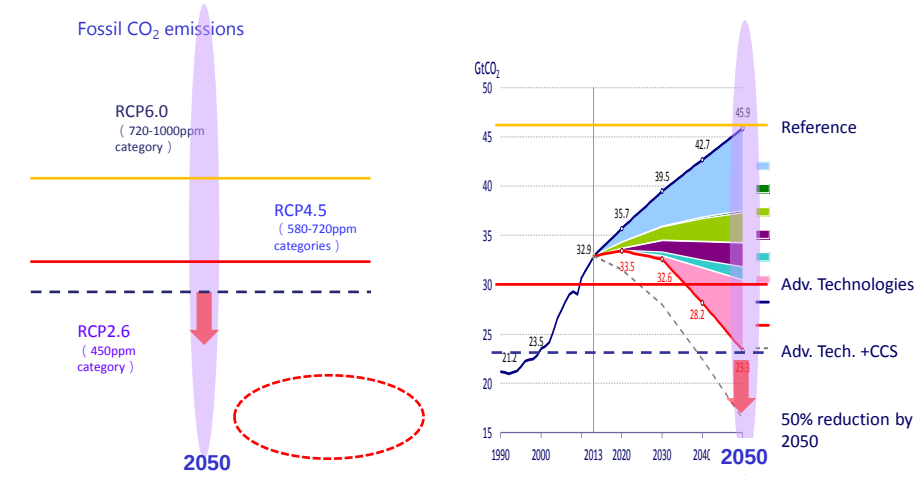


※Calculated using MAGICC 6.0
Meinshausen, M., S. C. B. Raper and T. M. L. Wigley (2011). "Emulating coupled atmosphere-ocean and carbon cycle models with a simpler model, MAGICC6: Part I – Model Description and Calibration." Atmospheric Chemistry and Physics 11: 1417-1456.

IEEJ: **Asia/World Energy Outlook 2015** 2

- Left chart is a comparison of energy-related CO2 emissions of a few scenarios from the table.
- 450ppm scenario is the lowest curve. Note the negative emission beyond 2070 which is circled in red dotted line.
- Right chart is from IEEJ's Energy Outlook 2015. Our "Advanced Technologies" Scenario where we assumed all the possible technologies in place and planned will be fully utilized around the world will reduce CO2 emissions down only to the red line. With CCS, it goes down to the blue dotted line.
- As shown by red arrow, use of advanced technologies combined with CCS is not enough to reach the so-called "50% reduction by 2050" target which is indicated by blue dotted line. It is also shown on the left chart with a red arrow that there is a big gap towards 450ppm scenario's trajectory.

IPCC 5th Assessment Report v.s. IEEJ Outlook



※Calculated using MAGICC 6.0
Meinshausen, M., S. C. B. Raper and T. M. L. Wigley (2011). "Emulating coupled atmosphere-ocean and carbon cycle models with a simpler model, MAGICC6: Part I – Model Description and Calibration." Atmospheric Chemistry and Physics 11: 1417-1456.

IEEJ: **Asia/World Energy Outlook 2015** 2

- The results of the Reference Scenario correspond to a level of GHG concentration in the atmosphere in 2100 in the range of 760-860 ppm (CO2-eq.), with the average temperature rise from 1850-1900 reaching between 2.8-4.0°C the same year.
- On the other hand, the Advanced Technologies Scenario is comparable to GHG concentrations in 2100 of 540-600 ppm (CO_2-eq.), with the average rise in temperature between 1.7 and 2.4°C. This is lower than 2.5°C and possibly lower than 2°C by 2100.

Intended Nationally Determined Contributions (INDCs) : major countries

Party	Date of submission	Target type	Reduction target	Base year	Target year	Coverage
EU	Mar 6	Absolute emissions	40%	1990	2030	GHG
United States	Mar 31	Absolute emissions	26 ~ 28%	2005	2025	GHG including LULUCF
Russia	Apr 1	Absolute emissions	25 ~ 30%	1990	2030	GHG
China	Jun 30	GDP intensity	60 ~ 65%	2005	2030	CO_2
Japan	Jul 17	Absolute emissions	26%	2013	2030	GHG
Indonesia	Sep 24	Reduction from BAU	29%	BAU	2030	GHG
Brazil	Sep 30	Absolute emissions	37% (43% for 2030)	2005	2025	GHG
India	Oct 1	GDP intensity	33 ~ 35%	2005	2030	GHG

IEEJ: **Asia/World Energy Outlook 2015**

4

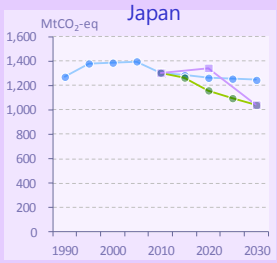
- In advance of the United Nations Climate Change Conference (COP21) in Nov. 2015, the participating countries have submitted the Intended Nationally Determined Contributions (INDCs) which present the post-2020 climate actions each country intends to take.
- By Oct 1st, 117 countries and regions (totaling 144 countries) have submitted their INDCs.
- The 8 major countries and regions shown above cover 65% of global GHG emissions in 2010.
- At first sight, the reported target numbers fall between 25 to 65% and look good.
- But if you look at carefully, you may notice that base years and target years are different and target type are different.
- EU, USA, Russia, Japan and Brazil are setting their targets in absolute value of GHG emissions while China and India set their target as GDP intensity and Indonesia set its target as a reduction from the BAU case.
- GDP intensity targets will give different emission results depending on the economic growth. If the economic growth is faster, emissions will get bigger.
- Moreover, it is almost impossible to understand whether or not the sum of INDCs are enough to meet the global target of keeping the temperature lower than 2 degrees.

Comparison of INDCs by country

United States

EU

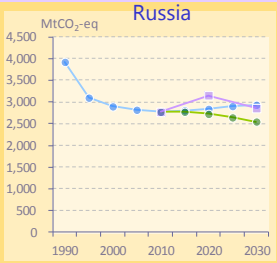
Japan



China

India

Russia



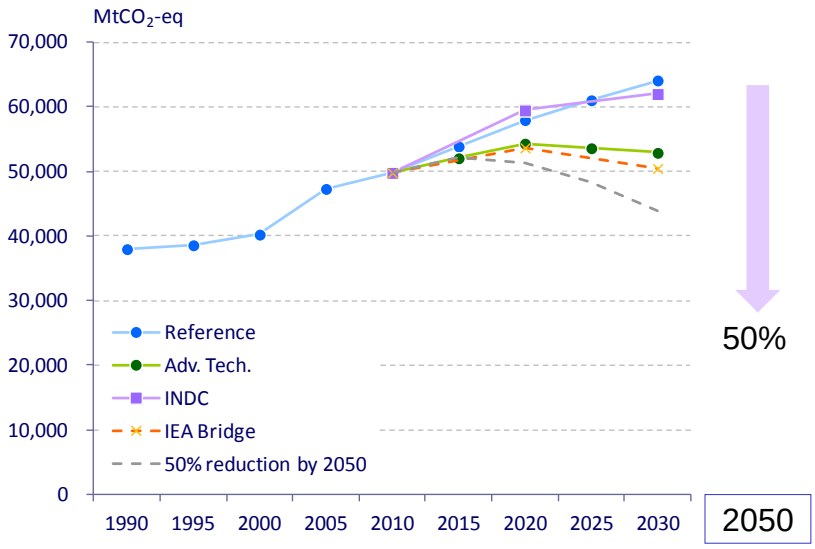
IEEJ: **Asia/World Energy Outlook 2015**

Note: Japan's 2020 target does not include reduction by nuclear power. China's target is for CO_2, while others are for GHG.

5

- This is a comparison of six countries from the table expressed in GHG emissions. Note that it is based on our GDP growth assumption used for our outlook. Reality may differ and other institutions' comparisons of INDCs which are announced nowadays may differ.
- The INDC targets of the United States and Japan are as ambitious as the Advanced Technologies Scenario. The target of EU is also positioned near the ATS.
- The targets of China and India exceed the Reference Scenario in terms of CO_2/GHG emissions. We understand that our assumption of GDP growth for India seems to be a little more optimistic than other institutions' estimation and thus much bigger than BAU numbers.

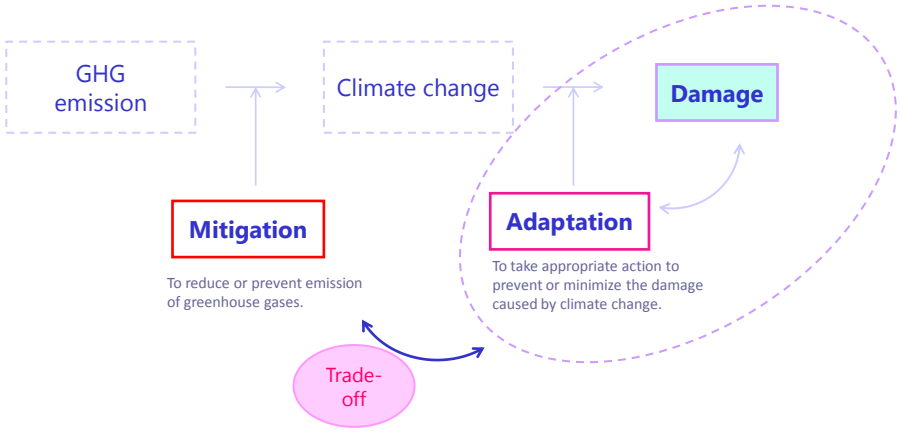
Comparison of INDCs with the Reference/Adv. Tech. Scenarios



IEEJ: **Asia/World Energy Outlook 2015**

The future evolution of global GHG emissions suggested by the INDCs of the 8 parties traces a path similar to that of the Reference Scenario. Thus, climate actions based on the INDCs are not sufficient to reach the Advanced Technologies Scenario, being far behind the target of "50% reduction by 2050."

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.

IEEJ: **Asia/World Energy Outlook 2015**

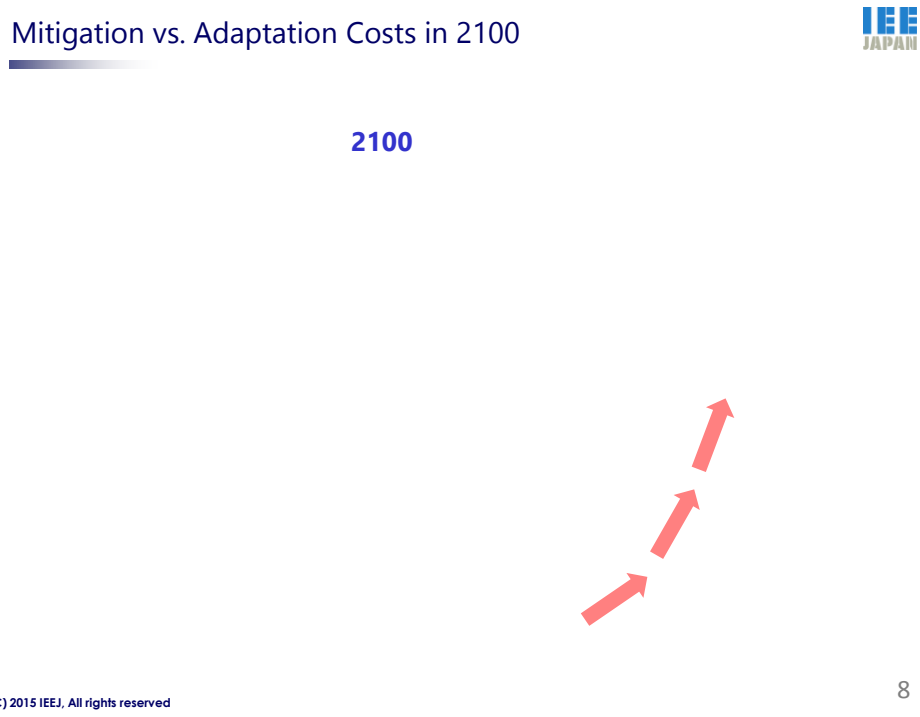
-Around the world, we are experiencing many extreme weather cases. For example, in Japan, we have more powerful typhoon these days which cause big land slides and many casualties. Moreover, when it rains it rains hard and with lightening or even with tornados that we have more damages done with such rain.

-While the submitted INDCs are not yet enough, should we keep on aiming at reaching the 50% target or even further down to the reduction level which 450ppm scenario suggests?

-450ppm target seems to me that it is like my diet target. Many of you may have a similar experience. We tend to remember our shape and our weight at the age of 20 and we keep aiming at reducing our weight down to that level. To me, the 450ppm target is like that. It is ideal, it is perfect but unfortunately it is not reachable. Maybe we should lower our expectation and be realistic.

-Alternatively, would it be more appropriate to aim at adaptation as well as mitigation (emission reduction) and try to balance the costs to address both?

-It seems that minimizing the costs of mitigation and adaptation is the optimal way to tackle the climate change challenge and it would be more realistic.



-This is a chart to show our example of cost estimation for mitigation, adaptation and damage for the year 2100.

-Blue dotted line shows mitigation cost, green dotted line shows adaptation and damage costs. Pink line is the total of all three.

- CO_2 reduction brings benefits (negative costs) to a certain extent due to the savings of fossil fuel consumption. If the reduction ratio exceeds that of the Advanced Technologies Scenario, however, the cost increases enormously as shown by red arrows.
    - The damage costs also become tremendous after 2100. Thus a long-term perspective is indispensable to address the problem of climate change.

- Thus the question of we keep aiming at meeting the “mitigation” target only? Or should we balance between “mitigation” efforts and “adaptation” challenges?

Uncertainty in estimating the long-term optimal path

Mitigation, adaptation and damage costs

- The **uncertainty** is **extremely large.**
- **Future R&D** should aim to **reduce cost hike.**

Climate sensitivity

- According to IPCC, some recent studies **suggest** that the “**climate sensitivity**” may be **lower** than previous studies (no more agreement on a best estimate of 3 ‘C).

- **With lower climate sensitivity**, damage caused by climate change becomes smaller, resulting in **a less ambitious mitigation path being optimal**.

Discount rate (social discount rate)

- With higher discount rates, future climate costs are valued less, resulting in smaller mitigation being optimal.

- It is important to note that there are so many uncertainties regarding the Climate Change issues.
  - First of all, there is a huge uncertainty regarding the costs of mitigation, adaptation and damage. Of course, the future R&D efforts should aim at reducing cost hikes as shown in our estimation as a spike of the curve.
  - “Climate Sensitivity” seems to be changing according to IPCC. Some recent studies suggest that the “climate sensitivity” may be lower than previous studies.
  - What it means? With lower climate sensitivity, damage caused by the climate change becomes smaller. And it will imply that mitigation path can be less ambitious and yet optimal.
  - Of course, there are a big uncertainty and huge debates about which discount rate to use for cost estimations.

Innovative technology development towards the future

Technology	
Reducing the emission of CO_2	**Next generation nuclear power**
	Nuclear fusion
	Space Solar Power System (SSPS)
Preventing the release of CO_2 to the atmosphere	**Bioenergy and Carbon Capture and Storage (BECCS)**
Utilizing the emitted CO_2	**Carbon Capture and Utilization (CCU)**
	Artificial photosynthesis

11

This is a list of a few innovative technologies which need to be developed and utilized if we are to mitigate CO_2 emissions more drastically beyond our “Advanced Technologies” scenario.

Conclusion: Addressing climate change issues

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

· From this point of view, it is necessary to take actions against climate change considering **various scenarios and options other than only** the “**450ppm**” scenario.

· As there is **a trade-off** relationship between “**mitigation**” and “**adaptation**” costs, it would be realistic to expect minimizing the **total cost**.

Otherwise no international agreements would be obtained.

· **Innovative technologies** including CCS, CCU and artificial photosynthesis must be developed to accomplish any sensible target.

10

-In conclusion, I would like to recap what I have introduced so far.

-As shown in the figures, the current INDCs submitted are not enough to mitigate GHG emissions. The parties meeting at the upcoming COP21 should reduce their emissions further.

-450ppm scenario is an ideal target which we may ultimately need to aim at but for more practical point of view, it may be more pragmatic to consider various scenarios and options other than only the 450ppm scenario. Just like our diet target, we need to be more realistic.

-Because of a trade-off relationship between “mitigation” and “adaptation” costs, it would be realistic to minimize the total cost.

-All these points are relevant to the COP negotiations, without bearing these mind, no international agreements would be obtained.

-Last but not least, developing and disseminating innovative technologies are important. These include CCS, CCU and artificial photosynthesis. Without these technologies we cannot accomplish any sensible target and for that the world need to collaborate.

Merci! Thank you!

13

That concludes my presentation on Climate Change.

If I can use one more minute, there is a slide I would like to share with you.

Lower prices, Advanced technologies, and Shale Revolution have various implications by region

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

-During this conference, there has been much discussion regarding geopolitical situation and this finding may be relevant.

-Our outlook 2015 ran “Lower Energy Price” scenario. This is one figure showing our estimation result.

-If the world strives to utilize low-carbon technologies and keep the energy demand at low level, and if unconventional energy supply becomes more widely available around the world not limited to the North America, the current lower energy price trend may continue to 2030.

-In this hypothetical scenario of lower energy price, all the consuming countries and these countries with unconventional energy resource will benefit. This chart shows the percentage difference of GDP from the reference scenario in year 2030 for different countries and regions.

-Traditional suppliers, namely, Russia and Middle East are the only ones to experience negative impact on their GDP under this scenario. What would be the implication of this to already complex uncertainties surrounding the world? And that is something to ponder upon.

-I shall leave on this. Thank you very much for your attention.