TRANSITION OF WEO IN THE LAST 10 YEARS

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Introduction

The IEA's World Energy Outlook (WEO) has been getting high reputation among energy experts around the world. The author is a regular and enthusiastic reader for a long time as well as having opportunity to be a reviewer now. At the same time, the author has been sensing changes in the IEA's basic posture in recent years just as referred in the recent IEEI article contributed by Prof. Arima[i]. To identify the "change" specifically, the author has carried out a quantitative analysis by comparing the past 10 years WEOs' data from WEO2010 to WEO2019. The major findings are as follows.

- In the last 10 years, the outlook of nuclear power generation has been declined year by year due to cost increase exceeding the IEA's forecast.
- In the last 10 years, the outlook of solar PV power generation has been continuously increased, due to promotion policies and cost reduction exceeding the IEA's forecast.
- Nuclear power and CCS are used to play a leading role in reducing carbon emissions in the 2°C Scenario, but since 2016 they have been partly replaced by solar PV and wind power, and the gap in their contribution is expanding.
- CO_2 emissions in the 2℃ (2D) Scenario have been declining every year due to carbon budget constraints. For adjusting the whole story with the above, global primary energy demand outlook, a prerequisite of CO_2 emissions, has been yearly revised downward without clear explanation.

WEO Scenarios

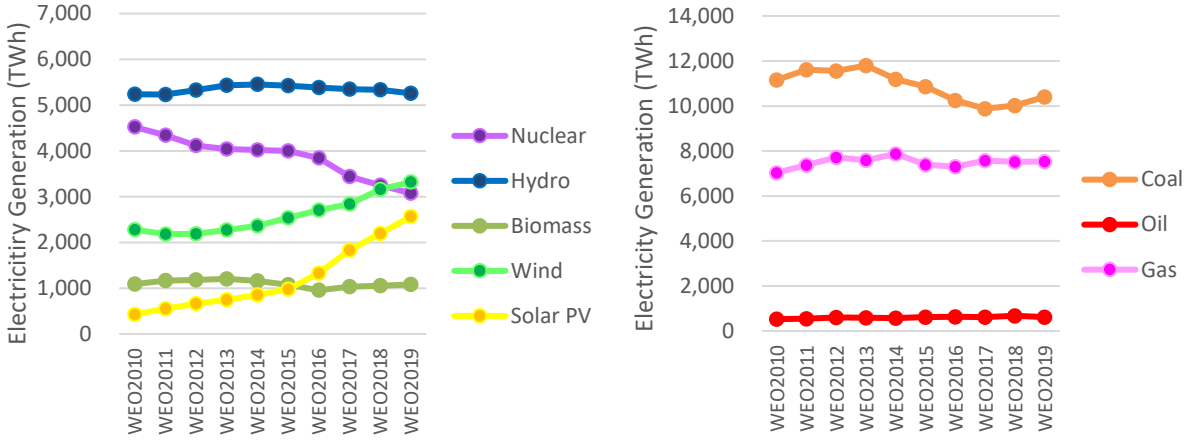
In the WEO, the central scenario is explained in detail and then the 2D scenario is presented for comparison with a view to providing useful implications. In this paper, the author analyzed outlook data of the central scenario and the 2D scenario in the WEO Annex for the past 10 years. While the names of central scenario and the 2D scenario have been changed from NPS and 450 Scenario to STPS and SDS respectively, for the sake of simplicity, this paper calls them the Central Scenario and the 2D Scenario respectively.

Findings

Changes in Central Scenario: Solar PV/Wind and Nuclear

Having compared WEOs in the last 10 years, no remarkable changes were detected in primary energy demand, final energy consumption, total electricity demand and CO_2 emissions in the Central scenario. On the other hand, significant changes were observed in the global electricity generation by energy source. Figure 1 depicts outlook of electricity generation from renewable energy and nuclear power (left) and from fossil fuels (right) in 2030. .

Figure 1　Global electricity generation outlook by source for 2030 in WEOs (Central Scenario)



As Figure 1 (left) shows, outlook of solar PV power generation for 2030 has increased six times in the last 10 years and wind power has increased by 50%. It means that the solar power growth was projected very low in the WEO2010 and that it has been continuously revised upwards in the last 10 years. The situation is the same for wind power though its growth is more modest. On the contrary, outlook of nuclear power generation for 2030 has decreased by 32% in 10 years. It means that the nuclear power growth was projected high in the WEO2010 and it had been continuously revised downwards during the same period.

The above changes come from continuous decline of the generation cost estimate of solar PV and wind and continuous increase of the one of nuclear[ii], as electricity generation by energy source is calculated to minimize total generation cost in the Central Scenario.

As for the fossil fuel electricity generation in 2030, outlook of coal power has reduced by 7% in average (at maximum 11%, WEO2017) and outlook of gas power has increased by 7% in average

(at maximum 14%, WEO2014). Even with those changes, coal will remain as the largest single power source among all energy sources by 2030 due to its cheap cost.

Changes in 2D Scenario

Figure 2 depicts outlook of world electricity generation by energy source in 2030 in 2D Scenario in the past 10 years. The outlook of solar PV and wind has been increasing since WEO2015 while the outlook of nuclear has been decreasing which shows the same trends with the Central Scenario. The total of solar PV and wind (dotted line in Figure 2) became on a par with nuclear in the WEO2015. In 2016 following the adaptation of the Paris Agreement, the leading role of nuclear in power sector decarbonization was taken over by solar PV and wind.

Figure 2 Global electricity generation outlook by source for 2030 in WEOs (2℃ Scenario)

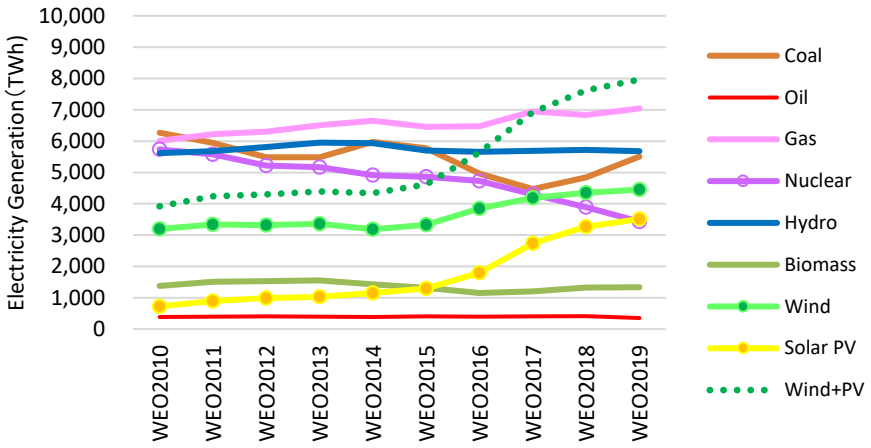
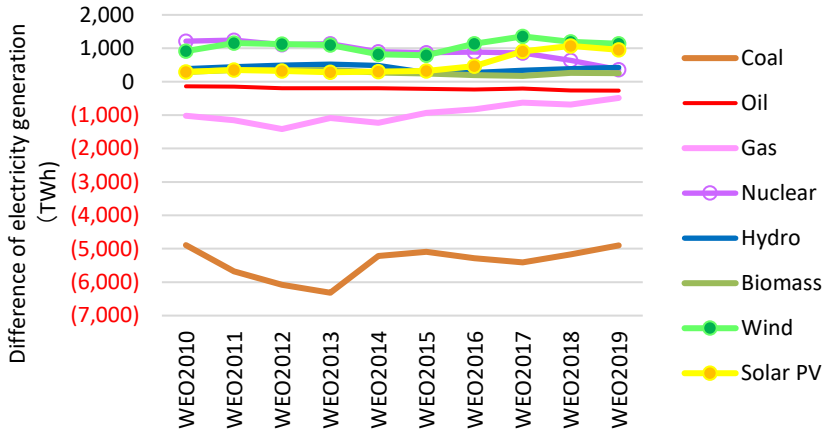


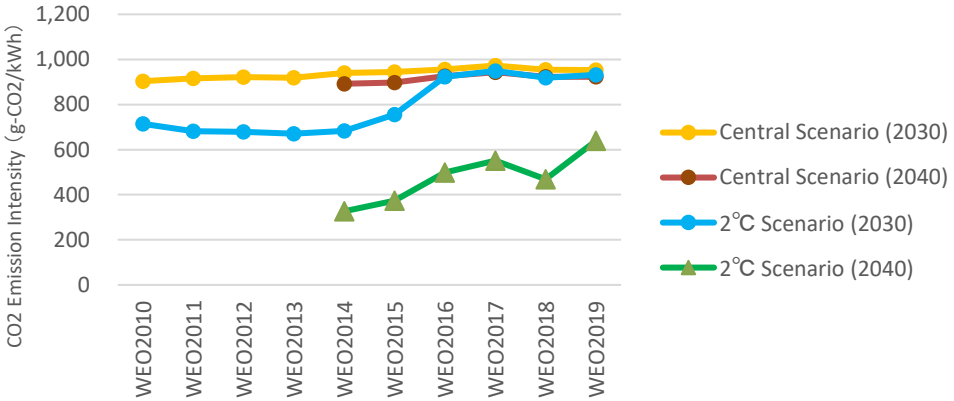
Figure 3 depicts the difference of electricity generation by energy source in 2030 between Central Scenario and 2D Scenario. Due to the nature of 2D Scenario, the difference of all fossil power sources with CO_2 emissions are negative and the difference of all zero-emission non-fossil power sources are positive. The negative difference of coal is by far the largest among fossil fuels while it irregularly changes.

Figure 3　Difference of electricity generation by source for 2030 between two scenarios in WEOs



To figure out the cause of this irregular change, emission intensity (CO_2 emission per unit electricity generation) of coal fired power generation was calculated for both scenarios for the cases of 2030 and 2040. Figure 4 depicts that there are few differences among WEOs in the Central Scenario. On the other hand, in the 2D Scenario, 2030 emission intensity increased after WEO2014, and reached to the same level with the Central Scenario at WEO2016. 2040 emission intensity had kept increasing except for WEO2018. What do those changes mean?

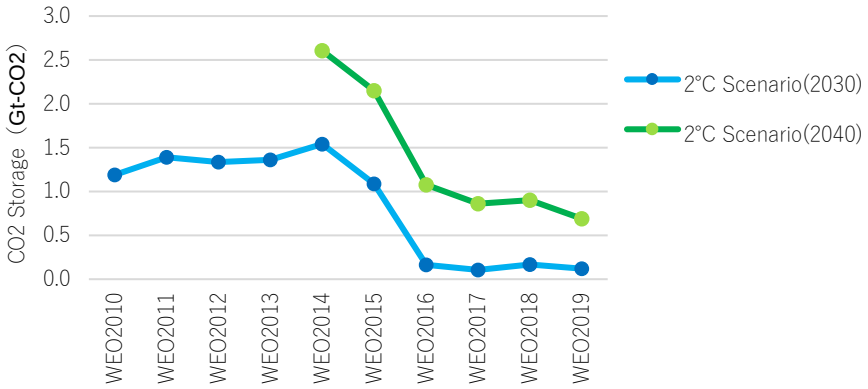
Figure 4 Global CO_2 Emission Intensity of Coal-fired Power Generation in WEOs



There are two ways to reduce CO_2 emission intensity from fossil-fired power generation; one is efficiency improvement and the other is utilization of carbon capture and storage (CCS). Therefore, the increase in CO_2 emission intensity depicted in Figure 4 should be explained by downward revision of energy efficiency assumption and/or downward revision of CCS use assumption. While

power generation efficiency of coal fired power generation in 2D Scenario, calculated from WEOs data, shows slight reduction (it is no wonder as 2D Scenario assumes no more new coal-fired power plants build in the future), it is negligible. It means that these emission intensity increases are mostly attributed to lowering assumption of CCS utilization. The amount of CO_2 storage can be calculated from WEOs data, and Figure 5 depicted CO_2 storage amount assumed in 2D Scenario for 2030 and 2040.

Figure 5 CO_2 Storage Assumed in 2℃ Scenario in WEOs



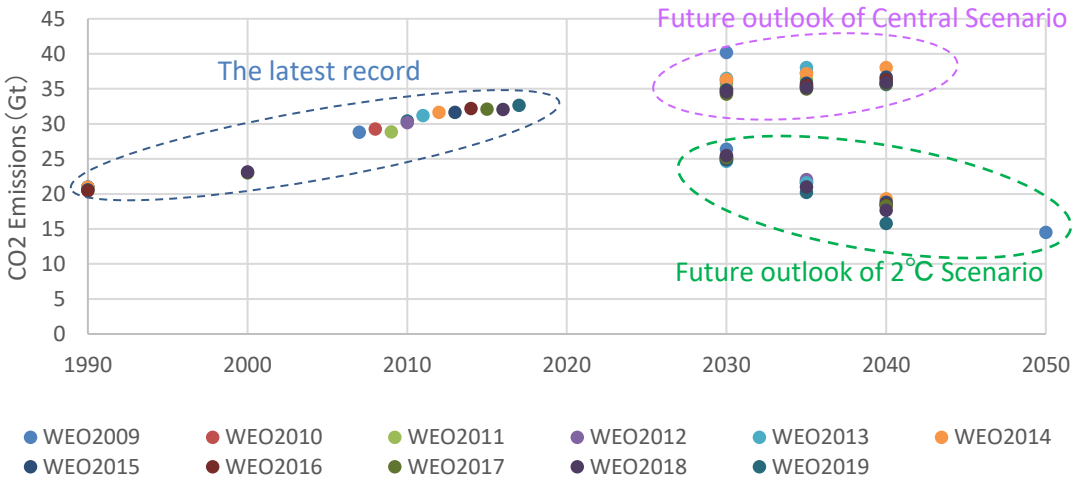
As shown in Figure 5 , earlier 2D Scenario between WEO2010 and WEO2014 assumed to store 1.5Gt CO_2 from coal-fired power plants in 2030, i.e. around 20% of CO_2 from global coal-fired power plants is treated with CCS. However, the stored CO_2 amount was reduced to almost zero in WEO 2016, i.e. no coal-fired power plants with CCS, and this assumption has been kept to date. While 2D Scenario in WEO2014 assumed to store more than 2.5Gt CO_2 in 2040, 60% of total emission from coal-fired power plants, this assumption was substantially lowered by 1.5Gt in WEO2016.

This downwards revision of CCS assumption coincided with upwards revision of solar PV and wind in WO2015 shown in Figure 2. Apparently, the role of CCS for power sector CO_2 emissions reduction has been entirely (case for 2030) or partly (for 2040) replaced by solar and wind in the 2D Scenario.

Change in CO_2 Emission Outlook

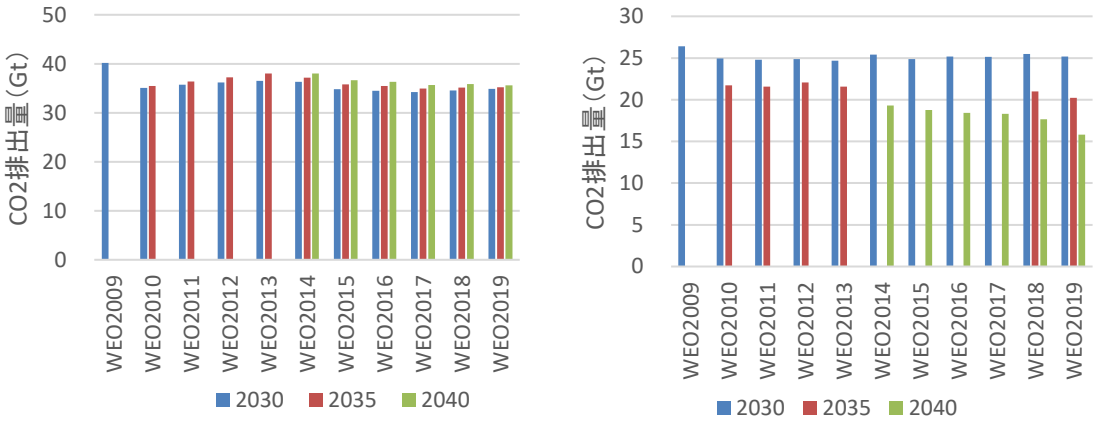
Figure 6 depicts the latest record and future outlook of annual CO_2 emissions in WEOs. There are significant gaps between future outlook in Central Scenario and in 2D Scenario, and they are widening over the years as the former is increasing and the latter is declining. This figure also shows that there is variance among future outlook of CO_2 emissions in the same scenario.

Figure 6 Record and future outlook of annual CO_2 emissions in WEOs



To see if there is a certain trend in their change, Figure 7 is drawn to show CO_2 emission outlook by scenario for each WEO in the Central Scenario (left) and the 2D Scenario (right).

Figure 7 Outlook of Global CO_2 emissions in WEOs in Central Scenario (left) and 2℃ Scenario (right)

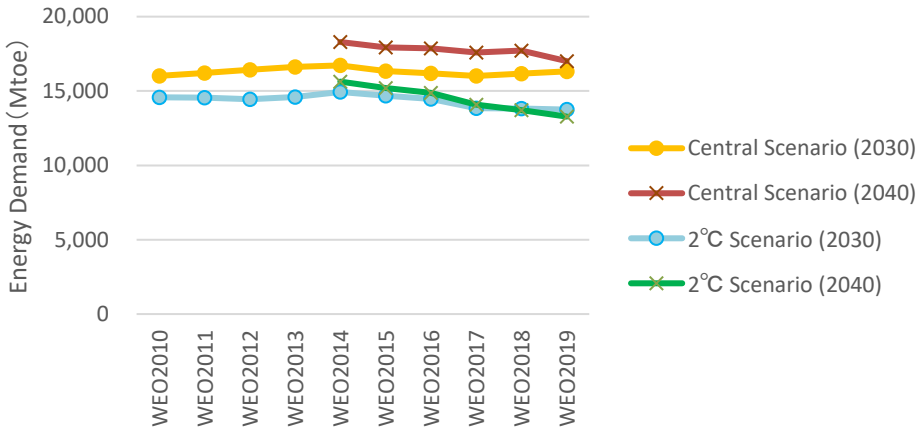


In the Central Scenario (left), while the level of outlook of CO_2 emissions dropped in WEO2010 and WEO 2015, no significant change is observed since then. On the other hand, in the 2D Scenario (right), outlook for 2035 and 2040 has been declining year by year. This trend is caused by “carbon budget” restriction that cumulative CO_2 emission should not exceed a certain level to achieve 2℃ target. To keep this restriction, current CO_2 emission increase must be offset with the future emission reduction. Given CO_2 emission outlook in the 2D Scenario is determined simply by such a carbon budget restriction, it is questionable to call it an “outlook”.

The CO_2 emission restriction in 2D Scenario forces reduction of primary energy demand outlook as

well. Figure 8 depicts outlook of global primary energy demand by scenario. In 2D Scenario, global primary energy demand outlook for 2040 in WEO2019 is 15% lower than the one in WEO2014. The 2D Scenario is furtively factoring in such big reduction of energy demand without clear explanation how to achieve it.

Figure 8 Outlook of global primary energy demand by scenario



Reportedly, European countries are calling[iii] the IEA to make 2D Scenario (or even 1.5D Scenario) as the main scenario. Such pressure could further increase if Democrats take back the White House. However, if the 2D Scenario or 1.5D Scenario becomes the central scenario, it cannot be called as “outlook” any more. WEO could be better to stand for “Weird Environmental Obsession” rather than “World Energy Outlook”.

For a long time, IEA has been establishing strong confidence among energy stakeholders all over the world through collection of wide range of energy data, neutral, transparent and elaborate analysis and production of well-grounded outlook. While the WEO receives various inputs from peer reviewers all over the world, it does not need adoption by Member countries unlike the IPCC SPM, which has been guaranteeing the independence from political interference, The IEA is strongly expected to maintain this independence and continue to deliver WEO backed by robust data for “messages reflecting energy reality”, not influenced by the spur of the moment or political pressure.

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i Jun Arima, “IEA Should Deliver Messages Reflecting Energy Reality” (2020) http://ieei.or.jp/wp-content/uploads/2020/05/IEA-Should-Deliver-Messages-Reflecting-Energy-Realities.pdf

ii According to “Part B: Outlook for Nuclear Power” in WEO2014, capital cost has the largest impact to LCOE of nuclear power, as ±3% variance of capital cost can change LCOE by -25% to +30%. If political support and or power utilities’ financial credit may be lowered or lost, capital cost of nuclear power is

increased to rise LCOE to uncompetitive level. And that was the background for the reduction of outlook of nuclear power generation.

[iii] Reuters, "Investors step up pressure on global energy watchdog over climate change" (2019)
https://www.reuters.com/article/climate-change-energy-investors/exclusive-investors-step-up-pressure-on-global-energy-watchdog-over-climate-change-idUKL8N27V3OB

Mission 2020, "JOINT LETTER TO IEA" (2020)
https://mission2020.global/letter-to-IEA/