



Energy Transition : How far we can go?

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Contents

1. About GJETC

2. Energy Transition : How far we can go?

1. About GJETC

1) Purpose

- **Japan and Germany are facing similar challenges**
 - They should establish a **long-term and risk-minimizing** energy strategy based on public consensus and sound research.
 - At the same time, the ecological modernization should maintain, or even strengthen **the international competitiveness.**
- **The German-Japanese Energy Transition Council (GJETC)** strives to support both nations to find solutions and strategies to master these challenges.

1. About GJETC

2) GJETC Consortium



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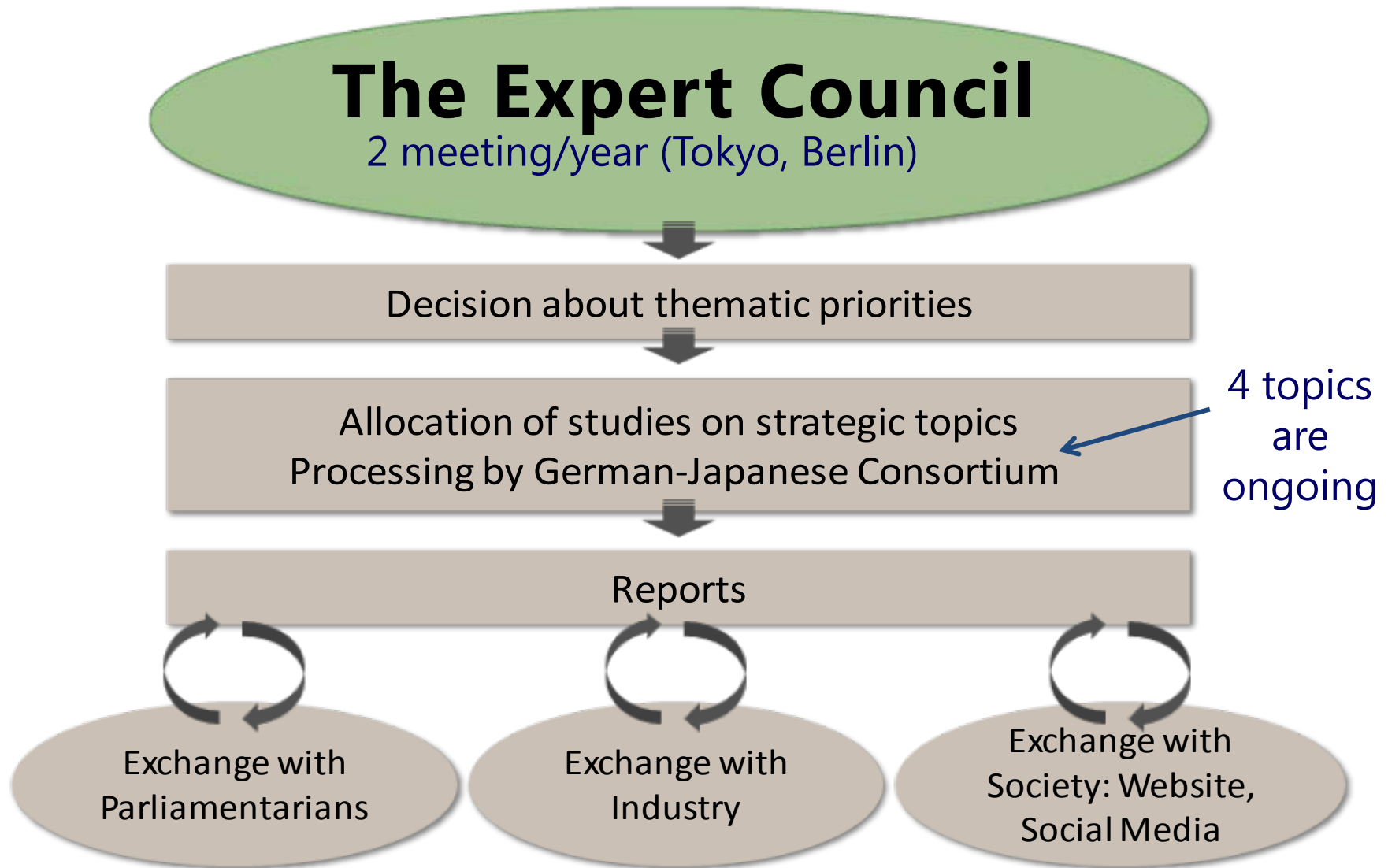


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1. About GJETC

3) Dialogue-oriented and Knowledge-based Operation



4 topics are ongoing

1. About GJETC

4) Ongoing Study Program - 4 strategic topics -

1. Energy transition as a central building block of a future industrial policy: Comparison and analysis of **longterm energy transition scenarios**
2. Strategic framework and **socio-cultural aspects** of the energy transition
3. Allocation of roles and business segments of established and **new participants** in the energy sector currently and within a **future electricity market** design
4. Energy **end-use efficiency** policies and the development of energy service markets

1. About GJETC

5) Future GJETC Activities and Schedule

Secretariat

Interim report

Finalisation of the studies
by G-J consortia

Finalisation of studies and
fact sheets for the public

Final report on results incl.
studies and fact sheets

Council

3rd meeting (J): Sep. 4-5, 2017
Discussion on the final study results
and fact sheets

Stakeholder dialogues: Sep. 5, 2017

4th meeting (G): Mid-Feb. 2017
Conclusions and recommendations;
Final report;
Prolongation of the council's work

Public closing conference

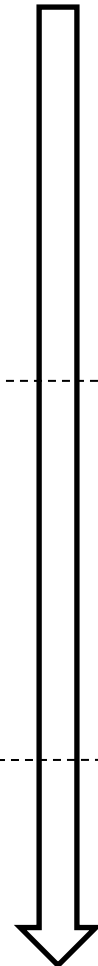
Month

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2018



2. Energy Transition

1) Paris Agreement : A step towards global action

❖ Evaluation of Paris Agreement

Good!!



Over 180 countries, including emerging countries such as China and India, agreed to take actions to reduce emissions.

Using bottom-up approach to add individually set reduction targets rather than a top-down approach used by Kyoto agreement where the reduction targets were set first and then allocated to the countries.

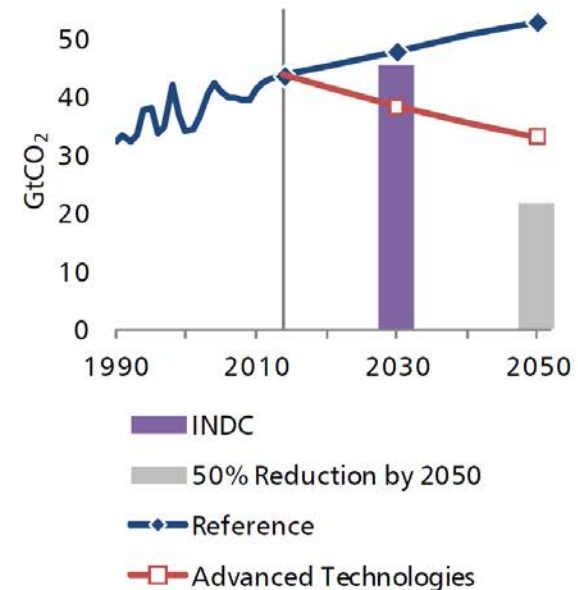
Method is to evaluate the total target numbers every five years and decide any additional efforts if necessary.

Challenges



Global GHG emissions will increase from the current level.

❖ GHGs emissions



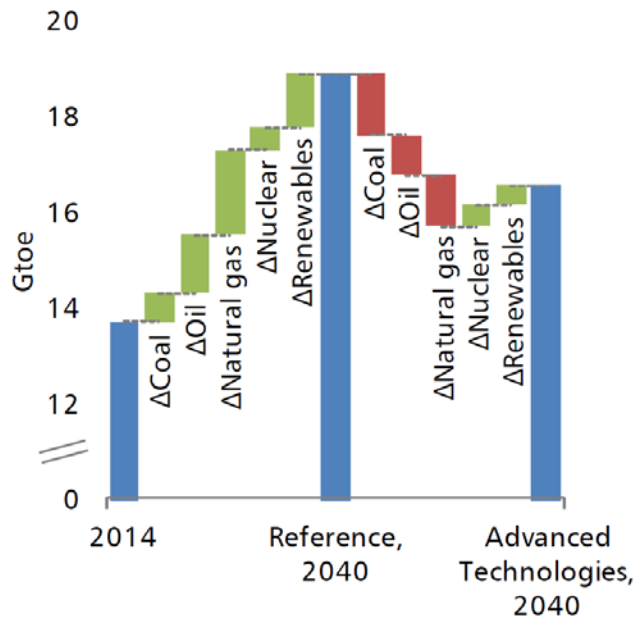
GHG emissions in 2030 under submitted INDC which are set voluntarily by each country are expected to increase from the current level of emissions. Trend will be subdued but 50% reduction by 2050 cannot be achieved.

It is necessary to achieve the target agreed under the Paris Agreement and further reduce emissions. It is essential to promote reduction worldwide via technology transfer as well as technology innovation.

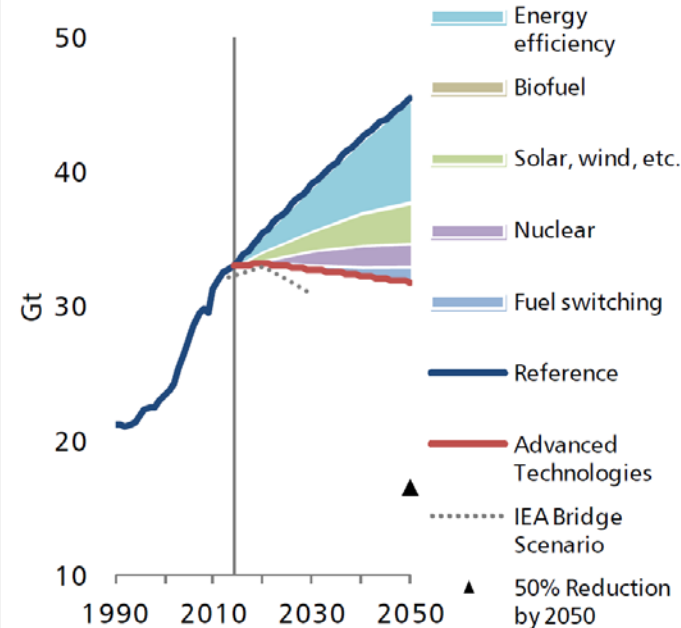
2. Energy Transition

2) Global Actions Will Reduce CO₂ by 3.8%

❖ Changes in primary energy consumption



❖ CO₂ emissions and reduction



In the Advanced Technologies Case where the maximum possible CO₂ reduction measures (assuming social acceptance) are introduced, energy consumption in 2040 is smaller than the Reference Case by 2,343 Mtoe or 12%.

CO₂ emissions in the Advanced Technologies Case will peak at around 2020 and will start to decline after. By 2050, emissions will be reduced by 3.8% from 2014 level and by 13.7 Gt from the Reference Case level which is equivalent to 42% of the global emissions.

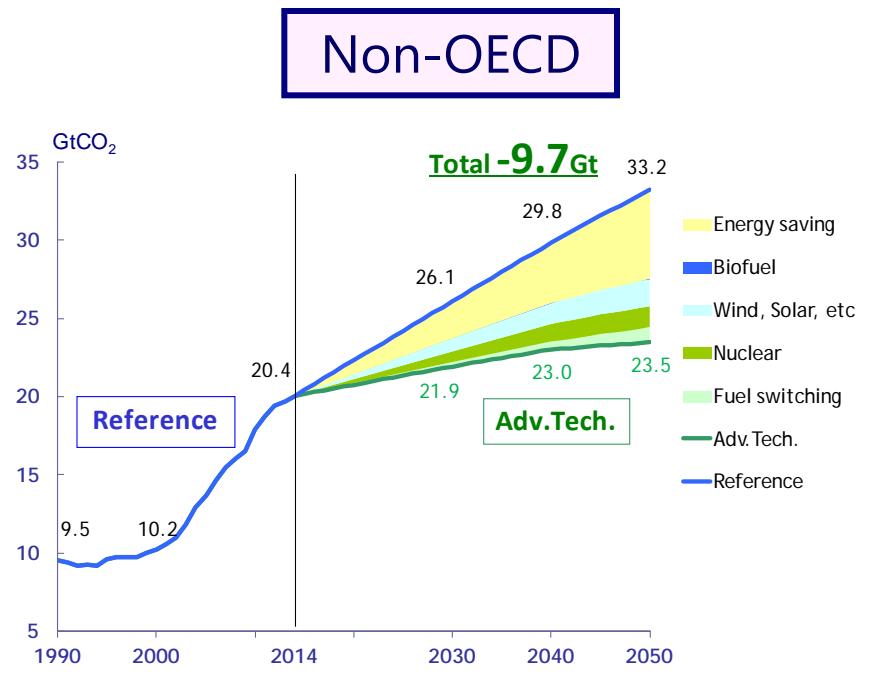
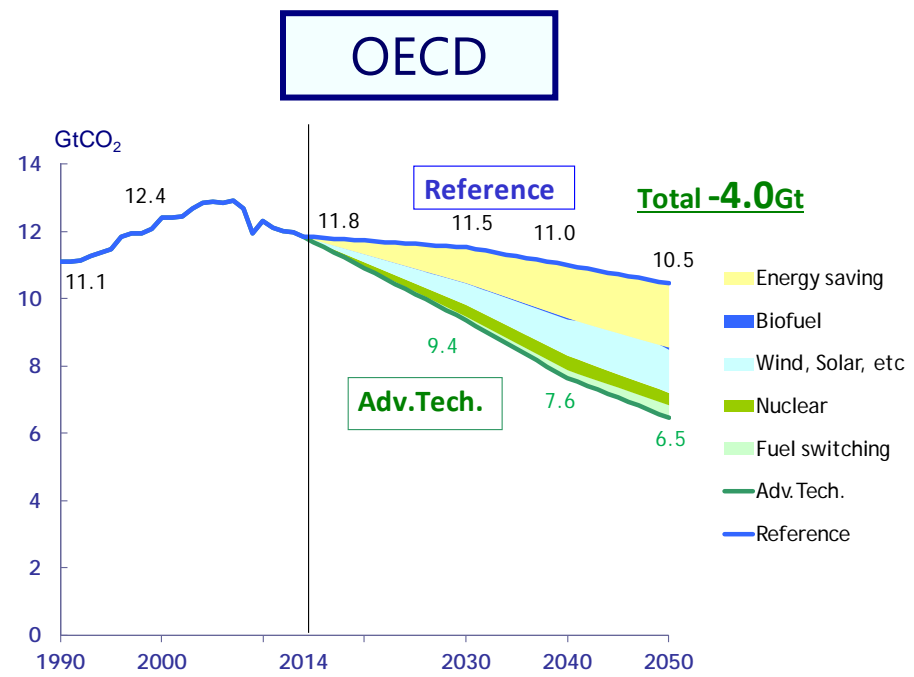


Energy and environmental technologies

	2014	2040		2050	
	Historical	Reference	Advanced Technologies	Reference	Advanced Technologies
Nuclear (GW)	399 (2015)	612	846	694	992
Thermal efficiency					
Coal-fired	37%	41%	41%	42%	45%
Natural gas-fired	41%	52%	53%	54%	57%
Solar photovoltaic (GW)	175	857	1,433	1,216	2,080
CSP (GW)	4	84	220	153	407
Wind (GW)	366	1,170	1,764	1,572	2,417
Biomass power generation (GW)	76	201	226	244	268
Biofuel (Mtoe)	73	120	174	122	203
Share in annual vehicle sales					
PHEV	0%	7%	19%	8%	21%
EV/FCV	3%	8%	26%	10%	36%
Average fuel efficiency of new vehicle sales (km/L)	15	21	28	23	33

CSP: Concentrated solar power, PHEV: Plug-in hybrid electric vehicle, EV: Electric vehicle, and FCV: Fuel cell vehicle

CO2 emission reduction by technology (OECD and non-OECD)



Excludes CCS

- Various technologies are required to reduce CO₂ emissions. In OECD, energy saving is responsible for the largest share at 47% (or 1.9 Gt). It is followed by renewable energy at 32% (or 1.3 Gt), nuclear at 9% (or 0.4 Gt), and fuel switching at 9% (or 0.4 Gt).
- In Non-OECD countries, energy saving is responsible for more than half of the 9.7 Gt reduction. Supportive measures concerning technology transfer and the establishment of efficiency standards are important to realize those CO₂ emission reduction while further enhancing energy security.

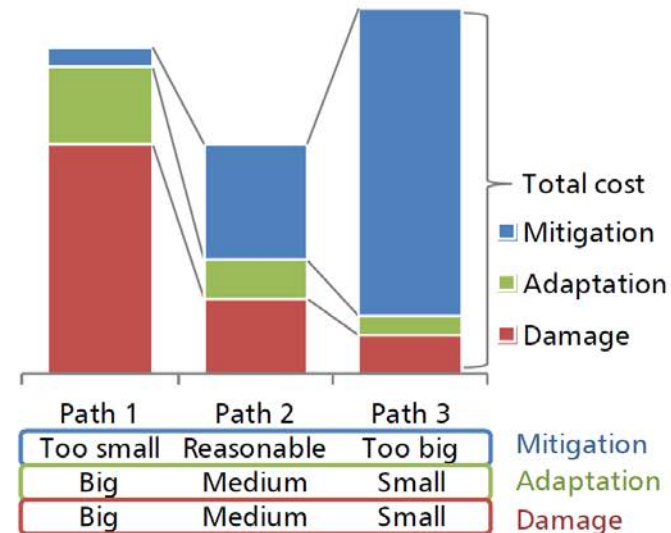
2. Energy Transition

3) Total Cost Minimizing Approach

❖ Mitigation + Adaptation + Damage = Total cost

Mitigation	<p>Typical measures are GHG emissions reduction via energy efficiency and non-fossil energy use.</p> <p>Includes reduction of GHG release to the atmosphere via CCS.</p> <p>These measures <i>mitigate</i> climate change.</p>
Adaptation	<p>Temperature rise may cause sea-level rise, agricultural crop drought, disease pandemic, etc.</p> <p><i>Adaptation</i> includes counter measures such as building banks/reservoir, agricultural research and disease preventive actions.</p>
Damage	<p>If mitigation and adaptation cannot reduce the climate change effects enough to stop sea-level rise, draught and pandemics, <i>damage</i> will take place.</p>

❖ Image of total cost for each path



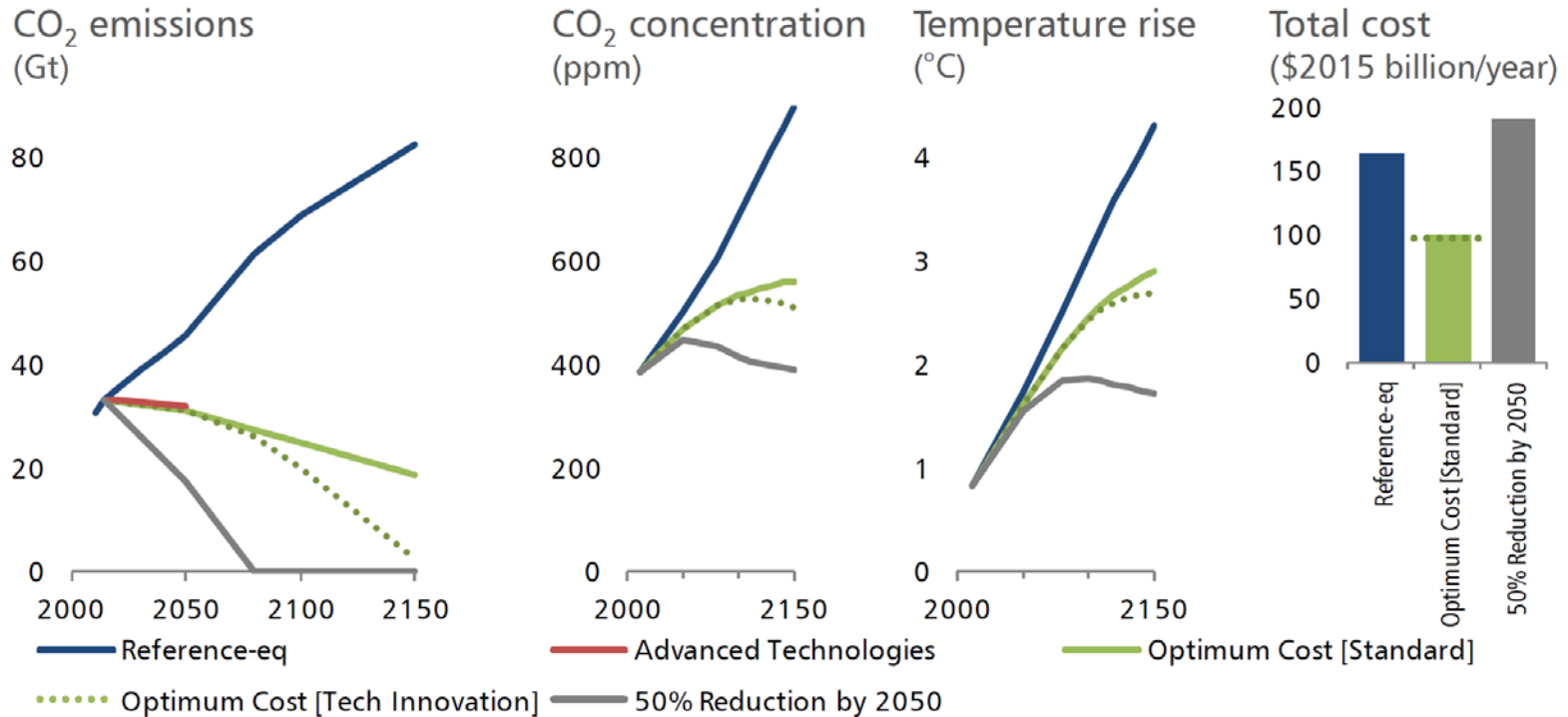
Without any measure against climate change, no mitigation cost incurs. On the other hand, adaptation costs and damage will become massive. Tough mitigation measures will reduce adaptation costs and damage but mitigation costs will be notably big.

Climate change issue is a long-term challenge which influences vast areas for many generations. From the sustainability point of view, combination of different measures which reduces the total cost of mitigation, adaptation and damage is important.

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4) What Total Cost Minimizing Approach means?

❖ In the ultra long-term paths



CO₂ emissions of the Optimum Cost Path will be much lower than the Reference Case equivalent emissions but not as low as the 50% Reduction by 2050 Case emissions. Emissions in 2150 will be 50% lower than the current level and temperature will rise by about 3°C.

If technology innovations reduce mitigation, temperature rise reaches the peak of 2.7°C around 2150 and will start to go down. Total cost will be around \$100 billion which is much lower than both Reference Case equivalent and 50% Reduction by 2050 Case.

2. Energy Transition

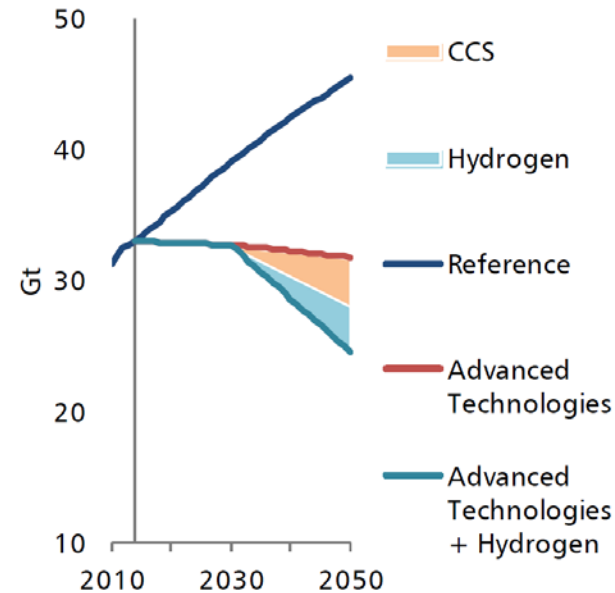
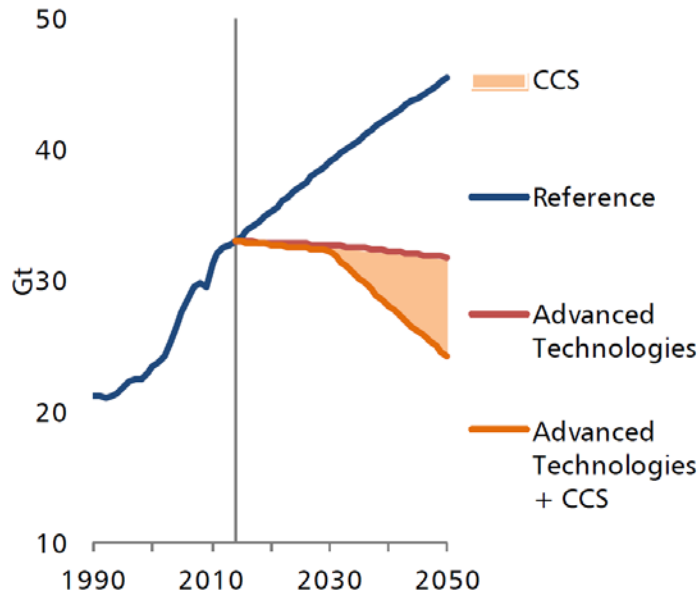
5) Examples: Technology Development for meeting “ 2 °C Scenario”

Technologies		Description	Challenges
Technologies to reduce CO ₂ emissions	Next Generation Nuclear Reactors	Fourth-generation nuclear reactors including very high temperature and fast reactors are being developed internationally.	Expanding support for research and development of next-generation nuclear reactors, etc.
	Nuclear Fusion	Technology for fusing hydrogen and other elements with small atomic numbers to create energy as the sun does. Deuterium as nuclear fusion fuel exists abundantly and universally. Nuclear fusion does not emit spent fuel as high-level radioactive waste.	Technology for continuous nuclear fusion and containing it a fixed space, reduction of the energy balance and costs, building fundraising and international cooperation systems for large-scale technology development, etc.
	Space Photovoltaic (SPS)	Technology for implementing solar photovoltaic electricity generation in outer space with more abundant sunlight than on earth and for transmitting generated electricity through microwaves wirelessly to earth for use on ground	Developing wireless energy transmission technology, reducing costs for transporting construction materials to outer space, etc.
Technologies to sequestrate CO ₂ or to remove CO ₂ from the atmosphere	Hydrogen production and usage	Producing hydrogen by converting fossil fuel through steam reforming. CO ₂ emissions are subjected to CCS (carbon capture and storage) technology to make hydrogen production free from carbon.	Cutting hydrogen production costs, improving hydrogen production efficiency, developing necessary infrastructure, etc.
	CO ₂ sequestration and usage (CCU)	Producing carbon compounds as chemical materials from CO ₂ with electrochemical, photochemical, biochemical and thermochemical methods to eliminate CO ₂ from the atmosphere	Improving CO ₂ volume for capture and effective use and efficiency dramatically, etc.

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6) A case of Zero Carbon Hydrogen with CCS

❖ CO₂ emissions and reduction



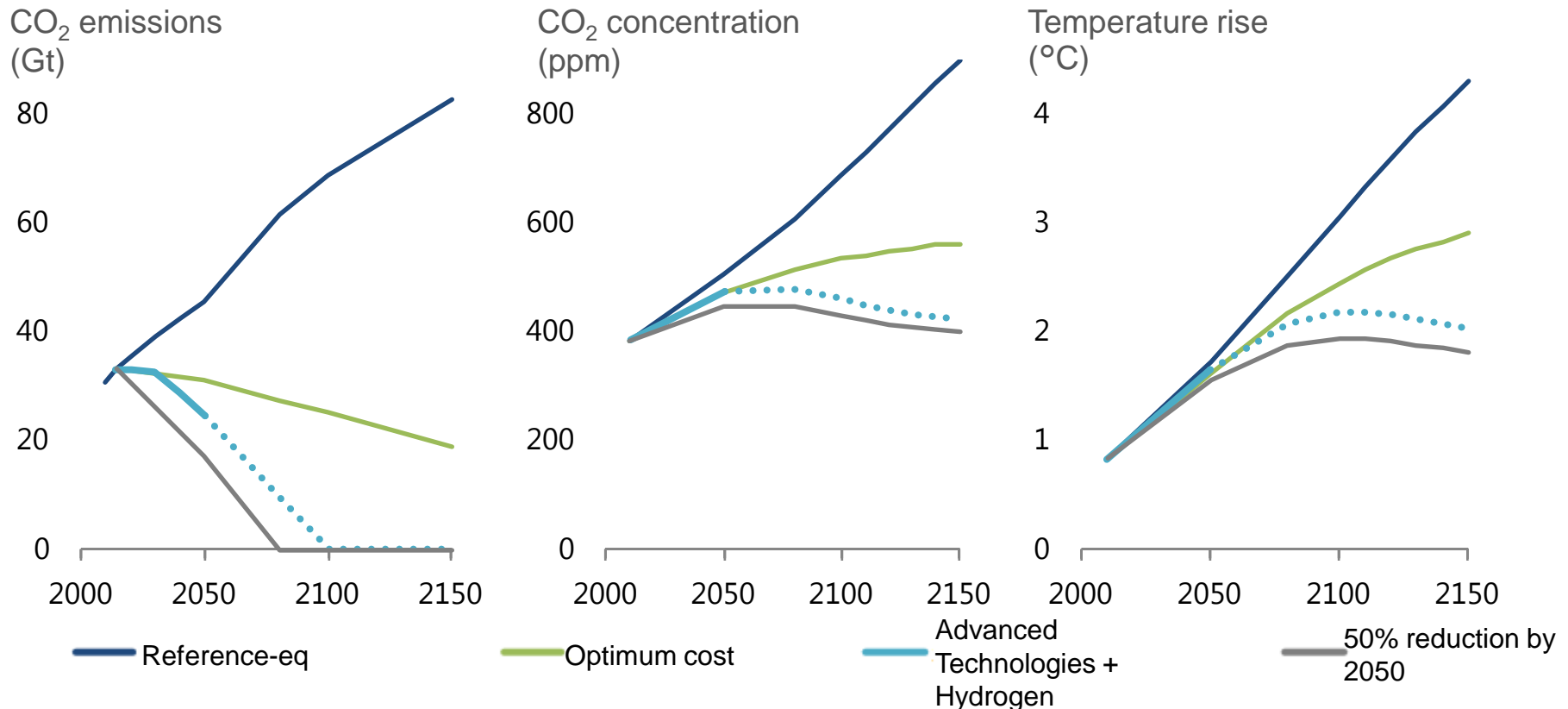
Although there are not small numbers of technical and economical hurdles to be overcome both for CCS and for hydrogen, about 7 Gt of CO₂ can be reduced by 2050.

CCS, however, does not contribute to secure directly energy supply. Hydrogen requires more exhaustible resources such as coal and natural gas for its production. There is no perfect technologies/energy source to solve all of the problems.

2. Energy Transition

7) Hydrogen Can Be a Promising Option

❖ In the ultra long-term paths



CCS and hydrogen, though having technological and economic problems to be solved, are expected to contribute to cutting CO₂ emissions by some 7 Gt in 2050.

If technological innovation allows the CO₂ emission reduction trend to be maintained, the temperature rise will peak at around 2.2 °C in 2100 and fall back to around 2.0 °C in 2150.

Conclusion

- 1. Japan and Germany are facing similar challenges, although there are some differences as well. GJETC attempts to find solutions for those challenges.**
- 2. Paris Agreement is an epoch-making agreement, but difficult to achieve when economic growth and measures to address Climate Changes need to coexist.**
- 3. The desirable approach not to give up “2°C scenario” is to minimize the total cost(damage, adaptation and mitigation) together with new technologies such as producing zero-carbon hydrogen from fossil fuels with CCS. CCU technologies leading to negative carbon would make further contribution.**



**Thank you
for your
attention.**

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