

**Carbon Border Measures:  
Policies to Combat Leakage and Encourage Climate Ambition**  
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**Estimations of Carbon Leakages under  
Ambitious NDCs and the Policy Implications**

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# Simulation Cases

Cases	Club*			Non-Club	
	Members	Emission reduction targets	BCA <sup>**</sup> , <sup>***</sup>	Members	Emission reduction targets
<b>Club1</b>	<b>Club1 (Europe)</b>	NDC targets (collaborative reductions within Club1)	No BCA	US, Japan, other countries	NDC targets  <b>Zero carbon prices</b>
<b>Club1-CTAX0</b>			<b>BCA (EITE) against non-club</b>		
<b>Club1-CTAX0 +BCA EITE</b>			<b>BCA (I&amp;S) against non-club</b>		
<b>Club1-CTAX0 +BCA I&amp;S</b>					
<b>Club2</b>	<b>Club2 (Europe, US, Japan)</b>	NDC targets (collaborative reductions within Club2)	No BCA	other countries	NDC targets  <b>Zero carbon prices</b>
<b>Club2-CTAX0</b>			<b>BCA (EITE) against non-club</b>		
<b>Club2-CTAX0 +BCA EITE</b>			<b>BCA (I&amp;S) against non-club</b>		
<b>Club2-CTAX0 +BCA I&amp;S</b>					

Note:

\*Emission trading schemes (ETS) is assumed to be available within Club members. (i.e., same carbon prices within the club)

\*\*BCA on "all Energy intensive sectors (EITE)" or "Iron & Steel (I&S) alone " are assumed.

\*\*\*The imposed import tariffs for BCA are estimated using the difference in carbon prices between club and non-clubs.

- Baseline GDP and CO<sub>2</sub> emissions are calibrated to those of the current policy scenario of IEA-WEO 2018, in which COVID-19 impacts are not considered.

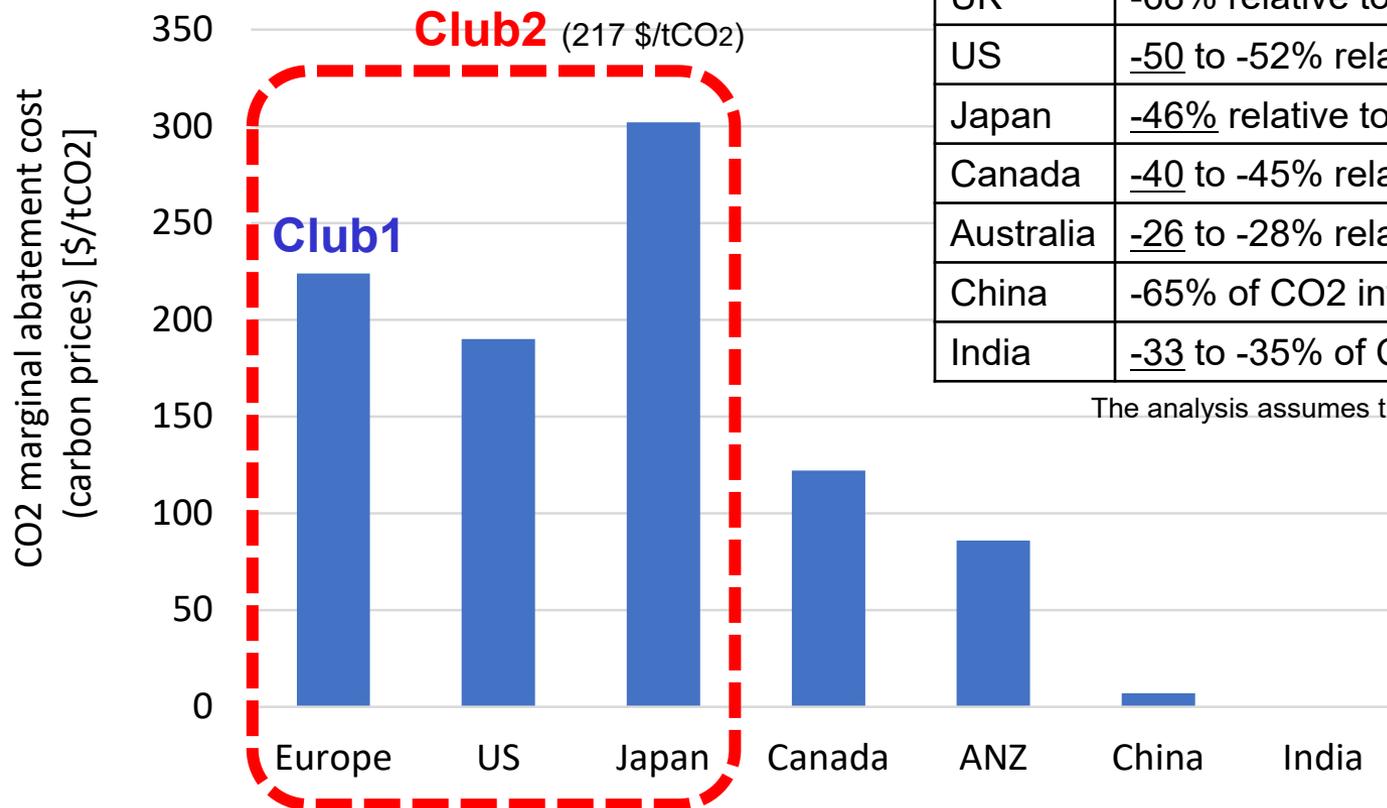
- "Europe" covers EU and non-EU European countries (UK, Norway, Switzerland, and Iceland).

- EITE={Iron & Steel, Chemical, Non-ferrous metals, Non-metallic minerals, Paper & pulp}.

- This analysis assumes only carbon tariff by BCA, and does not assume export rebates.

# Carbon Prices of NDCs in 2030

This and the following estimations are conducted by using an energy-economic model, **DEARS**.



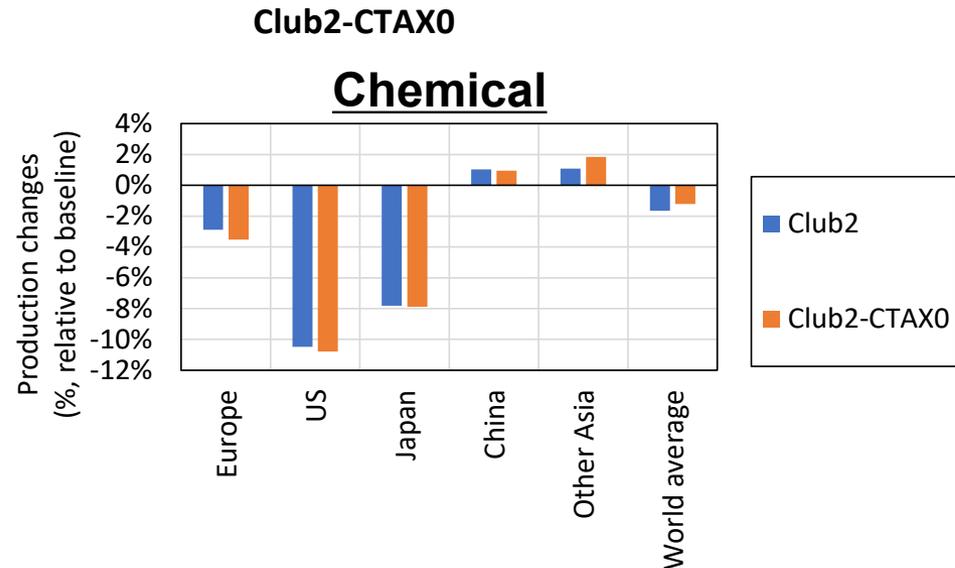
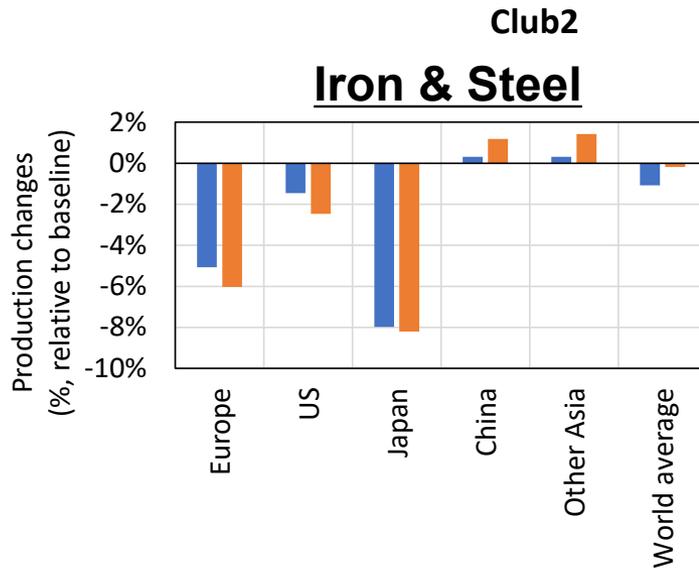
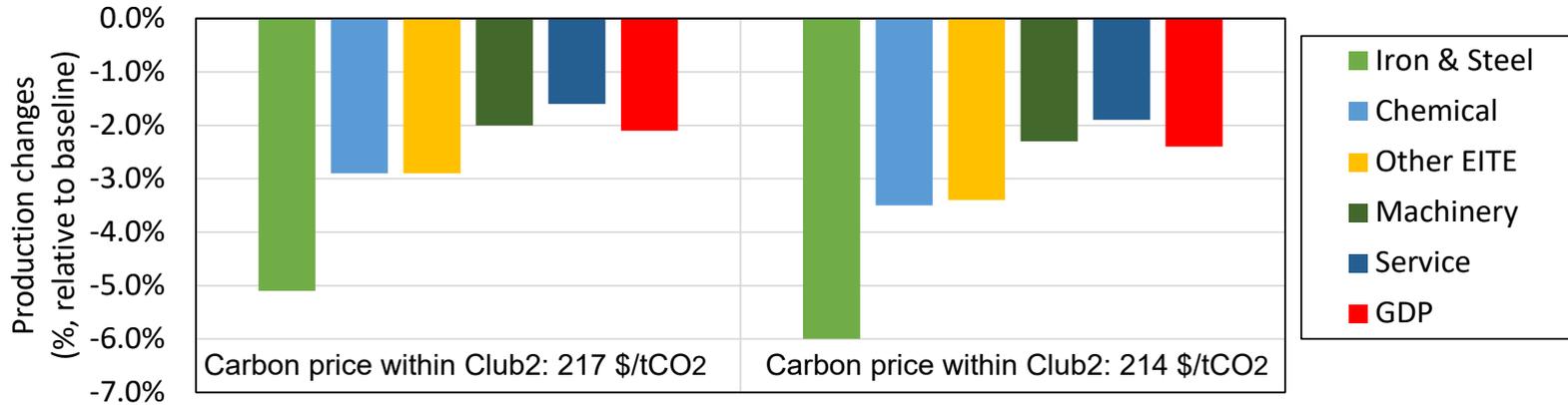
	2030 NDCs
EU	-55% relative to 1990
UK	-68% relative to 1990
US	<u>-50</u> to -52% relative to 2005
Japan	<u>-46%</u> relative to 2013 (challenging to -50%)
Canada	<u>-40</u> to -45% relative to 2005
Australia	<u>-26</u> to -28% relative to 2005
China	-65% of CO2 intensity relative to 2005
India	<u>-33</u> to -35% of CO2 intensity relative to 2005

The analysis assumes the lowest targets of emission reductions.

**Estimated carbon prices to achieve the NDCs differ greatly among countries.**

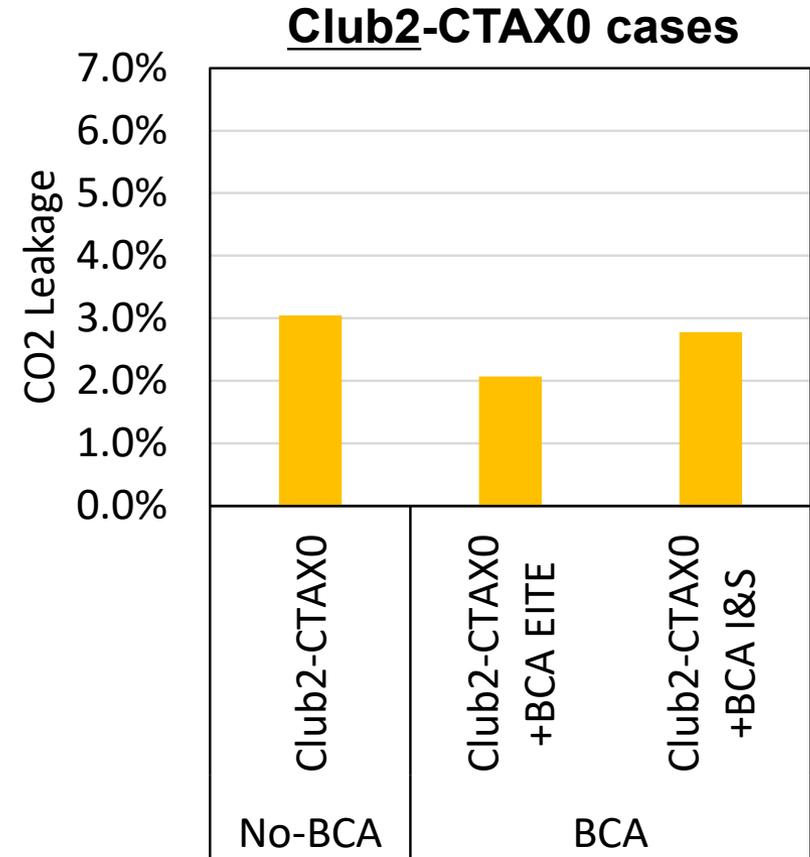
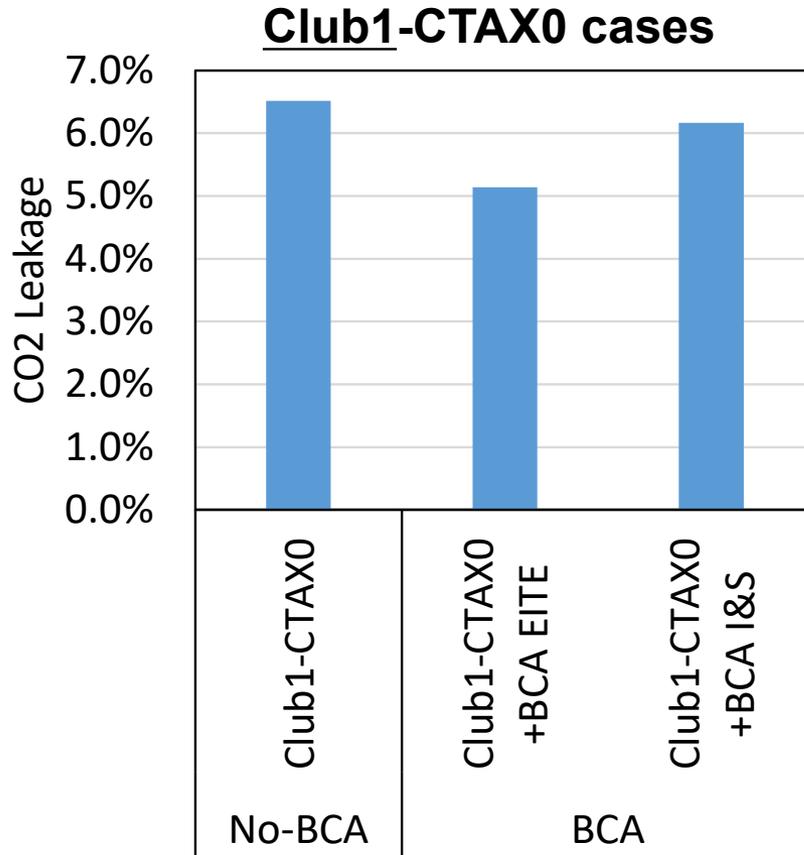
# Impacts of the NDC targets and the international competitiveness

## Economic impacts in Club2 (Europe, US, Japan)



- Negative economic impacts in the countries with high carbon prices are estimated. In particular, energy-intensive sectors have large negative impacts.
- In some regions, e.g., China, India, energy-intensive productions increase.

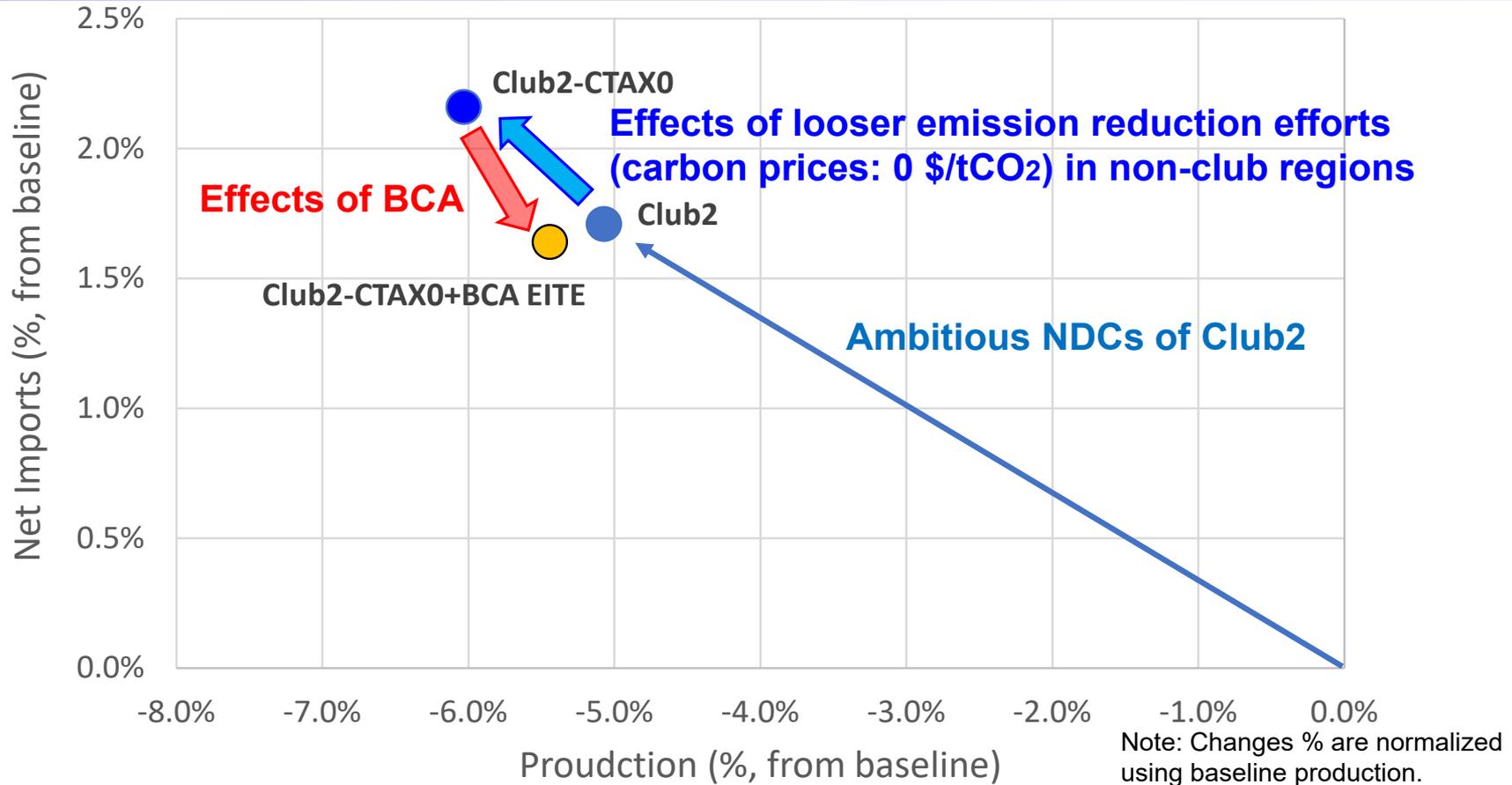
# Impacts of the NDC targets on CO<sub>2</sub> leakage and the mitigation effects by BCA



Note: The leakage rate defines the rate of non-club's emission increases from the baseline over club's emission decreases from the baseline.

- Under zero carbon prices outside the club, the leakage rate is reduced by about 1% point when BCA is implemented in all the energy-intensive sectors (EITE).
- When BCA is covered only to the Iron & Steel sector, the reduction in the leakage rate is small.

# Effects of the BCA on international competitiveness (Iron & Steel sector of Club2 in 2030)



- The international competitiveness of Club2 (Europe, US, and Japan) in iron and steel sector (and EITE) will decrease (the productions decrease and net imports increase) under ambitious NDCs of the Club.
- BCA will be able to mitigate carbon leakage. But basically it will be more important that all countries achieve their NDC targets and seeking more ambitious targets in the countries with relatively low carbon prices achieving the NDCs .

- ◆ **Estimated carbon prices to achieve the NDCs differ greatly among countries.**
- ◆ **We estimate considerable carbon leakage under the NDCs from Club 2 in energy-intensive sectors (EITE).**
- ◆ **Use of a CBAM can mitigate leakage from the EITE sectors by a third (reducing leakage from 3% to 2%).**
- ◆ **The effects of CBAM will vary across countries. Countries who import EITE products will experience larger effects from a CBAM than countries who are not large importers.**
- ◆ **Trade conflicts induced by CBAM can arise and would diminish effective global climate change mitigation.**
- ◆ **Globally coordinated among emission reduction efforts, e.g. using a carbon price, may be a better a leakage reduction mechanism than a CBAM.**

# Appendix

# Methodology for analyzing BCA: DEARS Model

An energy-economic model, **DEARS (Dynamic Energy-economic Analysis model with multi-Regions and multi-Sectors)\***

- ◆ Integration model of a top-down-typed economic module (of computational general equilibrium approach based on international input-output tables) and bottom-up-typed energy systems module
- ◆ Intertemporal non-linear optimization model (Maximization of global consumption utility)
- ◆ Evaluation time period: up to the middle of this century (10 years steps)
- ◆ World divided into 18 regions (US, EU, Japan, China, India,...)
- ◆ Non-energy sectors: 16 sectors
- ◆ Energy: 8 types of primary energy and 4 types of secondary energy
- ◆ Economic module that represents **international economic structures based on input-output tables of GTAP (Global Trade Analysis Project) database. The baseline GDP by region/country are calibrated to those of the IEA-WEO2018.**
- ◆ Simplified energy systems module
  - ✓ Bottom-up modeling for technologies in energy supply (e.g. , power generation) and CCS (carbon capture and storage)
  - ✓ Primary energy (8 types): coal, crude oil, natural gas, hydro & geothermal, wind, PV, biomass and nuclear
  - ✓ Top-down modeling for energy demand (residential sector: price and income elasticities of demand for energy and income, industrial and transport sectors: price elasticity, linked to the economic module)
  - ✓ Final energy (4 types): solid, liquid and gaseous fuels and electricity