The impacts of US'withdrawal from Paris Agreement on carbon emission space and mitigation cost of other regions and China's response [1, 2]

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Introduction

- Paris Agreement is helpful to reduce the global greenhouse gases to a certain extent, but not sufficient to achieve the 2 ℃ target.
- However, President Trump of the U.S. declared to withdraw from the Paris Agreement, which is shocking due to the important role that the U.S. has played in the international climate negotiation and governance.
- Hence, it is of importance to address such questions as: How will the U.S.'withdrawal affect the implementation of the Paris Agreement, global climate governance and China's climate policy? How should China react to the new situation?
- To answer the aforementioned questions, it is necessary to evaluate how the carbon emission space, carbon price, and macroeconomic costs of other parties will be affected by the U.S.'withdrawal.

Method and scenario

This study uses a global dynamic CGE model of China's provincial and the global economy [3], which has been applied systematically to analyze air pollution reduction [4], human health [5, 6], resource use [7], energy and climate mitigation policies [8–12] of China at the national [13, 14] and provincial levels [4–6, 8–12].

- The model includes 22 economic sectors in the baseline year of 2002.
- It is constructed using GAMS/MPSGE and is solved in a one-year time step until 2030.

Scenario setting

This study sets up a BaU scenario and four mitigation scenarios, including (Table 1):

- **No withdrawal scenario 27**: U.S. follow its obligation to reduce carbon emissions byby 27% in 2025 from 2005 to 4.11 Gt in 2030. All other countries also implement NDC commitment.
- **Withdrawal scenario 20**: U.S. only reduce by 20% in 2025 from 2005 level to 4.68 Gt in 2030. However, other countries need to make additional efforts to reduce more emissions to offset the extra emissions from the U.S. based on the population share.
- **Withdrawal scenario 13**: U.S. only achieves 50% of the NDC target by reducing the emissions by 13.5
- **Withdrawal scenario 00**: 2025 emissions of the U.S. are the same as 2005 level since President Trump renovates the traditional energy supply sectors by removing the constraint on coal mining, extraction of crude oil and natural gas, and by investing substantially in infrastructure construction.

Region	GDP (billion US$, 2002 constant price)			Population (million)		
	2005	2030	Annual growth rate 2005-2030 (%)	2005	2030	Annual growth rate 2005-2030 (%)
USA	10825	17229	1.88	297	361	0.79
China	1898	9380	6.60	1268	1339	0.22
EU	8989	12924	1.46	411	452	0.38
Japan	4403	5433	0.84	126	120	-0.19
India	598	4631	8.53	1140	1529	1.18
World	34320	68243	2.79	6444	8223	0.98

Target	Scenario	2030					2010-2030
		China	India	EU	Japan	US	Global cumulative emissions
NDC	NDC 27	11.01	5.55	2.76	1.09	4.11	985.63
	NDC 20	10.92	5.50	2.73	1.08	4.68	
	NDC 13	10.83	5.46	2.71	1.07	5.25	
	NDC 00	10.66	5.37	2.67	1.05	6.33	
2℃	2℃27	7.75	1.93	2.38	0.67	3.17	700.21
	2℃20	7.62	1.89	2.34	0.66	4.68	
	2℃13	7.53	1.87	2.31	0.65	5.25	
	2℃00	7.36	1.83	2.25	0.64	6.33	

Table 1: Scenario setting of this study.

- Under the NDC target, the global cumulative CO_2 emissions during the 2010–2030 periods are estimated to be 984.71 Gt based on UNFCCC and the SSP2 GDP.
- Emission pathway under 2 ℃ 27 scenario refers to the SSP2-26-SPA0 scenario of the IMAGE model in the SSP database of the Fifth Assessment Report [15].

Results

The compressing effects of the U.S. withdrawal are noticeable. **It leads to increasing its own emission space but this is at the cost of other regions.**

- Under the NDC target, Under NDC 20, 13, and 00 scenarios in 2030, it will result in a substantial decrease in CO_2 emissions spaces by 0.8%, 1.6%, and 3.2% in China, by 1.1%, 1.8%, and 3.3% in the EU, and by 0.9%, 1.8%, and 3.7% in Japan, respectively.
- Under the 2 ℃ target, the U.S. could gain additional emissions spaces by 48%, 66%, and 100% compared with the full implementation of its obligation in the 2 ℃ 27 scenario. The reduction rate will be 1.7%, 2.8%, and 5.0% in China, 1.7%, 2.9%, and 5.5% in the EU, and 1.5%, 3.0%, and 4.5% in Japan, respectively.

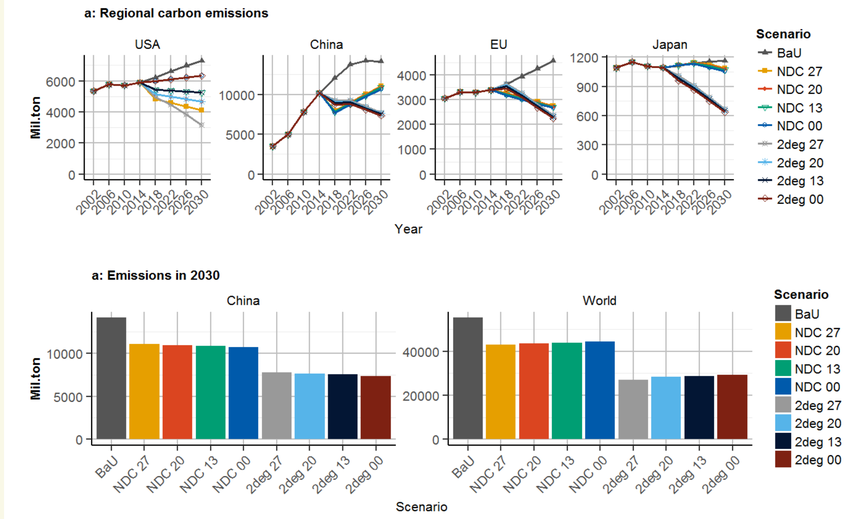

Figure 1: The carbon emission trajectories in different scenarios. (a) 2002–2030; (b) Global and China's emissions in 2030.

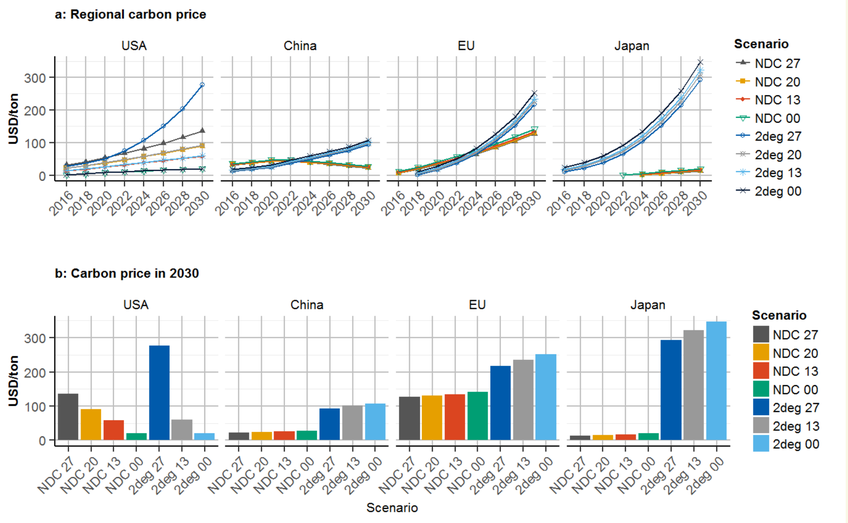

Figure 2: The carbon price in achieving NDC and 2 ℃ targets (2002 constant price). (a) 2016–2030; (b) in 2030.

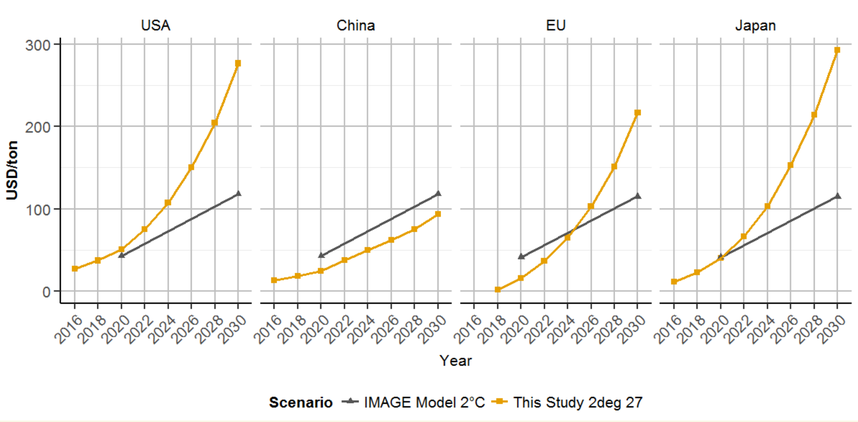

Figure 3: Comparing carbon price under the 2 ℃ scenario of this study with IMAGE model [15].

U.S. withdrawal will push up the carbon price of other regions.

- In 2030, under the NDC target, the carbon price will rise by 1.1–4.6 US$ t-1 in China, by 3.6–14.9 US$ t-1 in the EU, and by 1.8–7.6 US$ t-1 in Japan.
- Under the 2 ℃ target, the carbon price will increase by 4.4–14.6 US$ t-1 in China, by 9.7–35.4 US$ t-1 in EU, and by 16.0–53.5 US$ t-1 in Japan.

Carbon prices are quite close in 2020 but different in 2030 because:

- We don't consider much use of low-carbon technologies.
- We only accounts for energy combustion related carbon emissions. Therefore, carbon reductions must be achieved within the energy system.
- Carbon emission constraints are imposed on each country in this model while a global carbon emission constraint is imposed in the IMAGE model.

Results

U.S. withdrawal will cause additional macro-economic losses of achieving carbon mitigation targets in other regions.

- In 2030, under the NDC target, the additional GDP loss will be US$4.75–19.77 billion (per capita GDP loss of US$3.5–14.8) in China, 3.14–13.22 billion US$ (per capita GDP loss of US$6.9–29.3) in EU, and US$0.53–2.31 billion (per capita GDP loss of US$4.4–19.2) in Japan.
- Under the 2 ℃ target, the additional GDP loss will be US$21.98–71.1 billion (per capita GDP loss of US$16.4–53.1) in China, US$9.35–32.14 billion (per capita GDP loss of US$20.7–71.1) in EU, and US$4.13–13.45 billion (per capita GDP loss of US$34.3–111.7) in Japan.

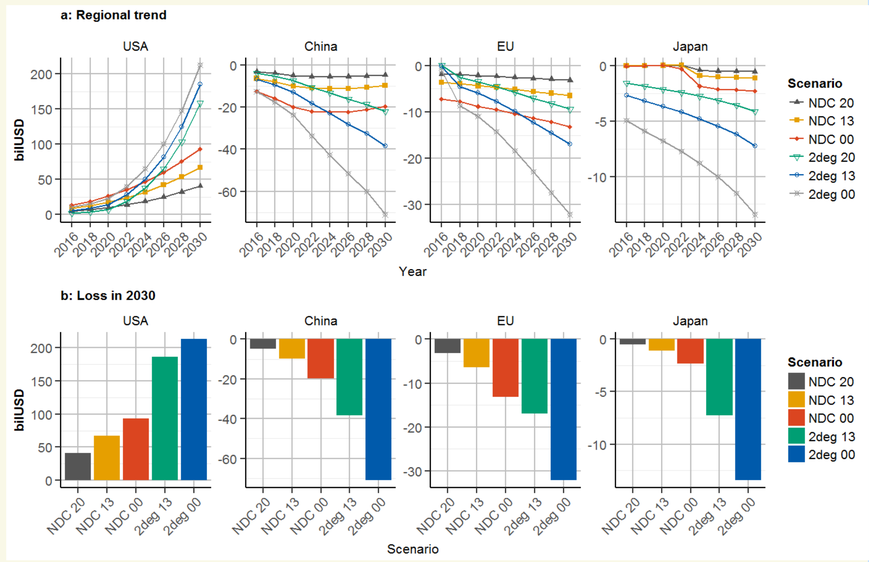

Figure 4: The additional GDP change under the NDC and 2 ℃ targets compared with full implementation of the U.S. obligation scenario (measured in US$, 2002 constant price): (a) 2016–2030 and (b) in 2030.

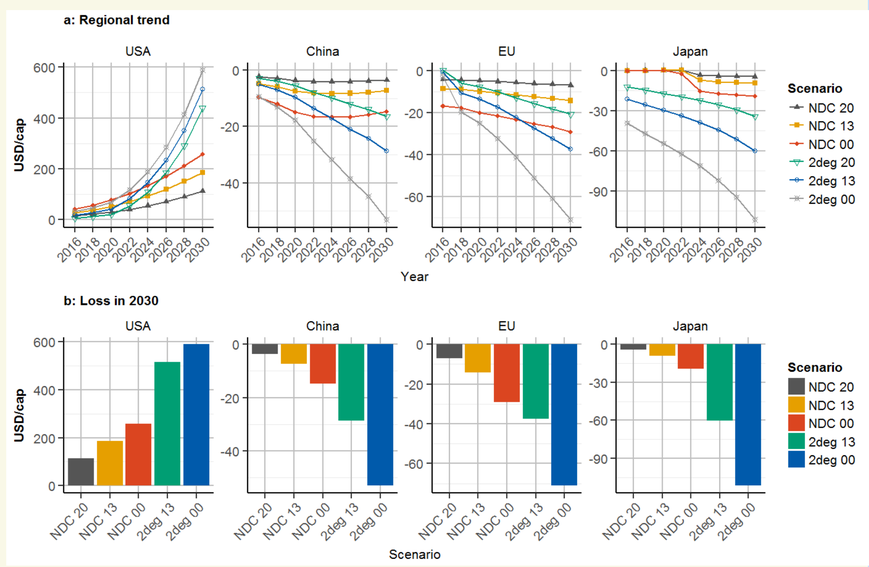

Figure 5: The additional per capita GDP change under the NDC and 2 ℃ targets compared with full implementation of the U.S. obligation scenario (measured in US$, 2002 constant price): (a) 2016–2030 period and (b) in 2030.

Discussion and Conclusion

What did we assess?

- This study explores the impacts of the U.S.'withdrawal from the Paris Agreement on the emission spaces, carbon prices, and macroeconomic effects in the main countries or regions due to the changed emission pathway of the U.S., given that the global cumulative carbon emissions are constant.

What were found?

- The results show that withdrawal of the U.S. from the Paris Agreement could win the U.S. substantial additional carbon emissions space and lower carbon prices.
- On the other hand, it will compress the emissions space and push up the macro-economic costs for other regions, and lead to significant change in the implementation of the Paris Agreement and global climate governance.

What shall China react?

- China faces mounting pressure from the international community to assume global climate leadership after the U.S. withdraws,
- We propose that China should reach the high ends of its domestic climate targets under the current NDCs;
- Internationally, China should facilitate the rebuilding of shared climate leadership, replacing the G2 with C5. Meanwhile, China needs to keep the U.S. engaged in climate cooperation.

Acknowledgements

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