

Potential Integration of Chinese and European Trading Market: Welfare Distribution Analysis

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JUNE 2020



Research Background

Policy Overview

Analysis:

- Modelling Approach
- Scenarios Development
- Impact on Member States
- Limited Trading

Conclusion

Research Background

World Resources Institute (2017 - including land-use change and forestry)

- EU28 was responsible for 7.87 % of global GHG emission;
- China: 23.67 %;
- The US : 12.88 %.

Research Background

- EU takes 75 per cent of international carbon trading takes (European Commission, 2017);
- It cover 28 Member States (MSs) along with European Economic Area members;
- China has also announced a national ETS in 2015 and implemented the pilot in seven provinces (Zhang et al., 2014);

Research Background

- With the increasing tension for more significant abatement at the global scale, **coordinated action between China and the EU's ETS** could be a prominent solution for more effective global mitigation especially after the US withdrawal from the PA (zero chance that it will come on board with its national ETS system;

Research Background

- Integrating both EU and China trading market has been a centre of analysis of current research (Heindl and Voigt, 2012; Fragkos et al., 2018);
- The focal points only covers the macro perspective in both regions. The detail analysis on the national level, particularly for each EU MSs is out of scope.

Research Background - Literature Review-

- Gavard et al. (2013) analyzes the impact of trading in carbon permits between the EU ETS and Chinese electricity sector using the EPPA CGE model;
- Finding: European carbon price would decrease by more than 76% under condition of unlimited sector trading. The general equilibrium effect dominates the revenue effect, the EU is generally better off;

Research Background - Literature Review-

- Gavard et al. (2016) extends the analysis by adding the US in the integrated market, again the EU and now the US have welfare improvements;
- Alexeeva and Anger (2016) - a stylised partial market and general equilibrium analysis- confirms that the economic efficiency losses are diminished by integration. The EU MSs improves their TOT while the non-EU face competitiveness losses;

Research Background - Literature Review-

- This paper aims to re-assess and to evaluate the potential integration between China and the EU ETS;
- It focuses on the welfare effects on each EU MSs and finding the optimal level of limited trading by incorporating the existing climate targets;
- A recursive dynamic general equilibrium model of a GEMINI-E3 simulate the impact of with/without integrating the ETSs.

Policy Overview –the EU-

Aiming to achieve net-zero greenhouse gas emissions by 2050.

The 2030 climate & energy framework :

- at least 40% cuts in cuts in GHG from 1990 levels;
- 32 % share for renewable energy, and;
- 32.5 % improvement in energy efficiency.

Policy Overview –the EU-

- The ETS constitutes an exchange-tradable permits market for firms, characterized by one CO₂ price;
- For the non-ETS market, CO₂ abatement objectives are based on the so-called “Effort Sharing Decision”.

Table 1: European GHG emissions targets

	2020	2030	2040 [†]
ETS target in % of 2005 level	-21%	-43%	-68%
Non-ETS target in % of 2005 level	-10%	-30%	-50%
Total in % of 1990 level	-20%	-40%	-60%

[†] own computation.

Policy Overview

- the EU -

The target by country of 2040 is allocated using the same estimated coefficient GDP per capita in 2007

Table 2: Effort Sharing Decision (source: European Commission (2016b))

	GDP per capita in € 2013	ESD target 2020	ESR target 2030 in % of 2005 levels	Target 2040 [†]
Bulgaria (BGR)	5'800	20%	0%	-19%
Romania (ROU)	7'200	19%	-2%	-21%
Croatia (HRV)	10'200	11%	-7%	-26%
Hungary (HUN)	10'200	10%	-7%	-26%
Poland (POL)	10'200	14%	-7%	-26%
Latvia (LAT)	11'300	17%	-6%	-27%
Lithuania (LIT)	11'800	15%	-9%	-28%
Slovakia (SVK)	13'600	13%	-12%	-31%
Estonia (EST)	14'400	11%	-13%	-32%
Czech Republic (CZE)	14'900	9%	-14%	-33%
Portugal (POR)	16'300	1%	-17%	-35%
Greece (GRE)	16'500	-4%	-16%	-36%
Slovenia (SVN)	17'400	4%	-15%	-37%
Malta (MLT)	18'100	5%	-19%	-38%
Cyprus (CYP)	21'000	-5%	-24%	-43%
Spain (SPN)	22'100	-10%	-26%	-44%
Italy (ITA)	26'500	-13%	-33%	-50%
United Kingdom (GBR)	31'900	-16%	-36%	-55%
France (FRA)	32'100	-14%	-36%	-55%
Germany (DEU)	35'000	-14%	-37%	-57%
Belgium (BEL)	35'400	-15%	-38%	-57%
Finland (FIN)	37'400	-16%	-39%	-58%
Austria (AUT)	38'100	-16%	-39%	-59%
Netherlands (NLD)	38'700	-16%	-39%	-59%
Ireland (IRL)	39'000	-20%	-39%	-59%
Sweden (SWE)	45'400	-17%	-40%	-59%
Denmark (DNK)	45'500	-20%	-40%	-59%
Luxembourg (LUX)	85'600	-20%	-40%	-59%

These commitments refer to targets in the non-ETS part of the economy.

[†] own computation.

Policy Overview –China-

Table 3: China's emission intensity targets

	2020	2030	2040 [†]
Emission intensity targets in % of 2005 level	-40% to -45%	-60% to -65%	-75% to -80%

[†] own assumption.

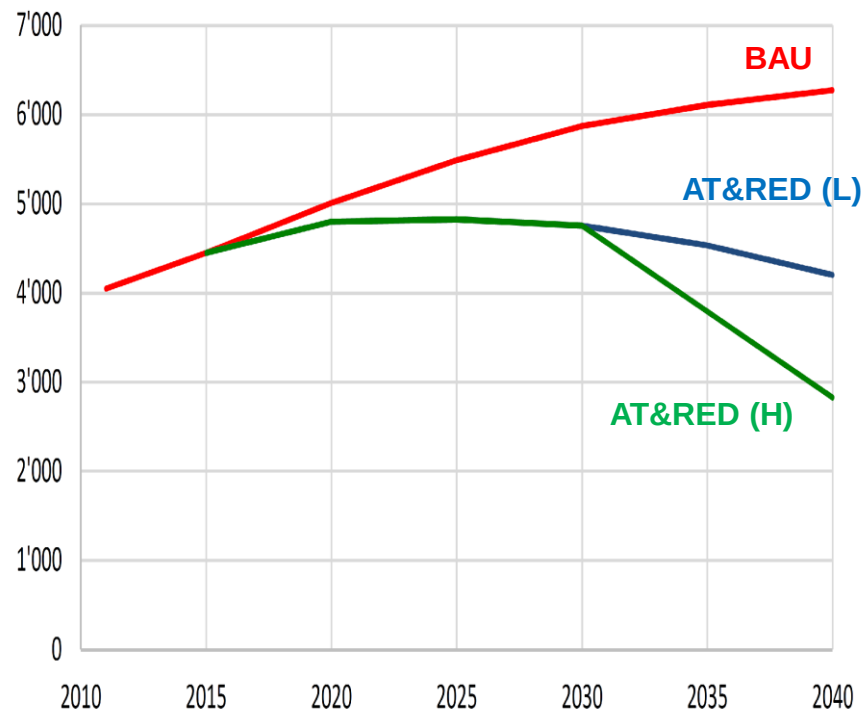
The annual emission intensity is targeted to fall at a minimum rate of 3.3 per cent during 2005-2020 and 3.1 per cent during 2020-2030. Following this trend, we assume that the emission intensity will fall at a minimum annual rate of 2.9 per cent during 2030-2040 and reduce at least by 75 to 80 per cent from the 2005 level

Policy Overview –China-

China Power Industry Tang et al. (2018) focuses only

- a. **Business as Usual (BAU):** CO₂ emission from power generation will increase 1.4 %/ year (4451 MtCO₂ in 2015 to 6274 MtCO₂ in 2040)
- b. **AT & RED:**
 - Renewable Share (Low Commitment): the CO₂ emissions peak at 4842 MtCO₂ in 2023. It decreases to 4755 MtCO₂ and 4203 MtCO₂ in 2030 and 2040;
 - Renewable Share (High Commitment): more significant emission reduction, achieving the level under 3000 MtCO₂ in 2040.

Chinese Emissions from Electricity Generation (MtCO₂)



Modelling Approach

- GEMINI-E3: multi-country, a multi-sector and a recursive computable general equilibrium model (Bernard and Vielle, 2008). built on the GTAP 9 data base (Aguiar et al., 2016) with 2011 as the reference year;
- Aggregation 28 EU MSs as individual regions, plus China and ROW;
- The EU ETS sectors include the petroleum products, the electricity generation, and energy-intensive industry;
- Energy goods: coal, crude oil, and natural gas;
- Others aggregated into agriculture, land transport, sea transport, air transport, and other goods and services;

- The analysis only considers CO2 emissions from energy combustion;
- Assessment of welfare cost of policies through compensating variation of income (CV);
- Welfare cost divided between the domestic component or deadweight loss of taxation (DWL) and the imported component or gains from terms of trade (GTT);
- The GTT represents spill-over effects due to changes in international prices which come mainly from the drop in fossil energy prices resulted from the decrease of world energy demand.

Reference Scenario

- Built on the period of 2011-2040 with yearly time steps with all prices given in €2017;
- Reproduce historical GDP, energy consumption, and related CO₂ emissions based on historical; population and international energy prices of 2011 to 2015, (the technical progresses associated with labor and energy consumption);
- Assumption post 2016 are based on the **EU reference scenario 2016** (European Commission, 2016a) and **World Energy Outlook** (International Energy Agency, 2019) for China.

Table 5: Key indicators on the reference scenario

	2015-2020	2020-2030	2030-2040
GDP growth per year in %			
EU28	1.5%	1.4%	1.5%
China	6.1%	4.8%	3.7%
World	3.1%	3.6%	3.4%
	2020	2030	2040
Total CO ₂ emissions in Mt CO ₂			
EU28	3'382	3'399	3'429
China	9'790	11'078	11'871
World	33'182	39'359	45'562
ETS CO ₂ emissions in Mt CO ₂			
EU28	1'629	1'648	1'670
China	5'010	5'872	6'274

Non Integrated Scenario

- The **EU ETS** sectors: full auctioned emission allowances. Redistribution to the allowances to MSs based on their emissions share;
- **The non-ETS sectors** implement a domestic CO2 tax, based on the ESR targets;
- **China ETS** market only includes the **electricity generation** while others are subject to a Chinese CO2 tax.

Table 6: Scenario results without ETS coupling

	Low commitment		High commitment	
	2030	2040	2030	2040
<i>Total emissions change*</i>				
EU28	-25.8%	-51.9%	-25.8%	-51.9%
China	-9.2%	-28.3%	-9.4%	-42.8%
<i>ETS emissions change*</i>				
EU28	-35.4%	-64.6%	-35.4%	-64.6%
China	-19.0%	-33.0%	-19.0%	-54.9%
<i>Non-ETS emissions change*</i>				
EU28	-16.8%	-39.9%	-16.8%	-39.9%
China	1.8%	-23.0%	1.4%	-29.2%
<i>ETS price in €</i>				
EU28	45	277	45	277
China	5	11	5	28
<i>Non-ETS price €</i>				
EU28	209	834	209	834
China	0	11	0	15
<i>Welfare change[†]</i>				
EU28	-0.15%	-2.09%	-0.15%	-2.10%
China	-0.46%	-1.47%	-0.45%	-2.13%

* percentage change with respect to baseline emissions

† in percentage of household consumption

Integrated Scenario

- Integrating ETS markets requires to define the allocation of allowance for each MSs from the non-integrated scenario;
- These allowances reflect an efficient allocation within the EU that equalizes the marginal abatement cost within firms and countries to the European ETS price.

Table 7: Scenario results with ETS coupling

	Low commitment		High commitment	
	2030	2040	2030	2040
<i>Total emissions change*</i>				
EU28	-14.3%	-32.5%	-14.3%	-38.7%
China	-12.5%	-33.9%	-13.0%	-46.6%
<i>ETS emissions change*</i>				
EU28	-11.6%	-24.8%	-11.6%	-37.5%
China	-25.7%	-43.6%	-25.7%	-62.1%
<i>Non-ETS emissions change*</i>				
EU28	-16.8%	-39.8%	-16.8%	-39.8%
China	2.3%	-23.1%	1.3%	-29.3%
<i>ETS price in €</i>				
EU28	8	17	8	40
China	8	17	8	40
<i>Non-ETS price €</i>				
EU28	216	908	216	897
China	0	6	0	8
<i>Welfare change †</i>				
EU28	-0.13%	-1.56%	-0.13%	-1.74%
China	-0.41%	-1.35%	-0.41%	-1.93%

* percentage change with respect to baseline emissions

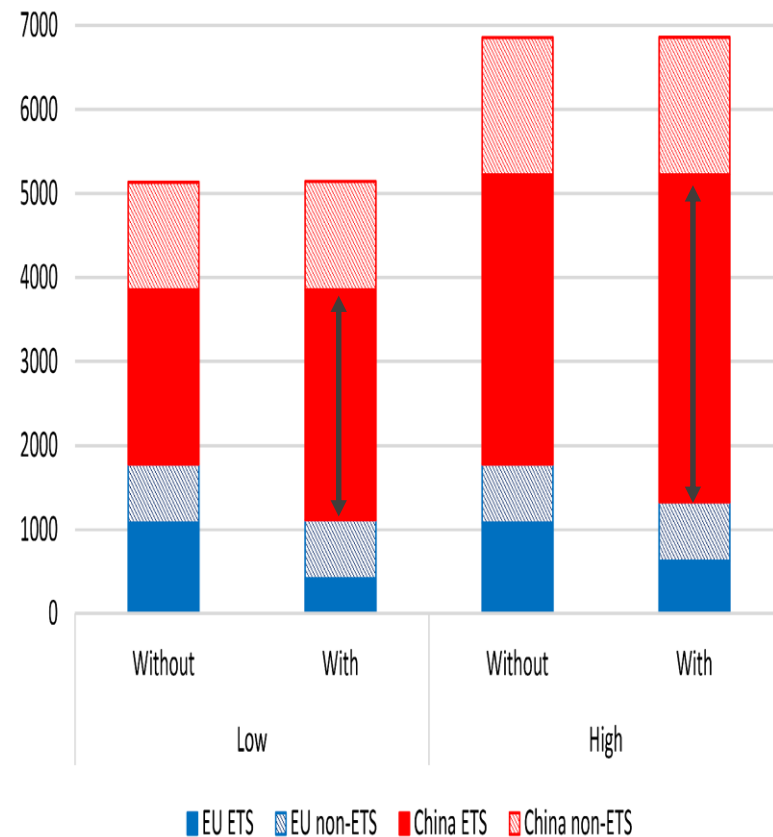
† in percentage of household consumption

Comparative Analysis

Table 8: Welfare decomposition in % of household consumption - Year 2040

	Low		High	
	Without	With	Without	With
<i>EU28</i>				
Welfare	-2.09%	-1.56%	-2.10%	-1.74%
GTT	2.63%	2.39%	2.62%	2.37%
Trade of quotas	–	-0.11%	–	-0.17%
DWL	-4.72%	-3.85%	-4.72%	-3.94%
<i>China</i>				
Welfare	-1.47%	-1.35%	-2.13%	-1.93%
GTT	-0.90%	-0.82%	-0.81%	-0.67%
Trade of quotas	–	0.24%	–	0.38%
DWL	-0.57%	-0.77%	-1.32%	-1.64%

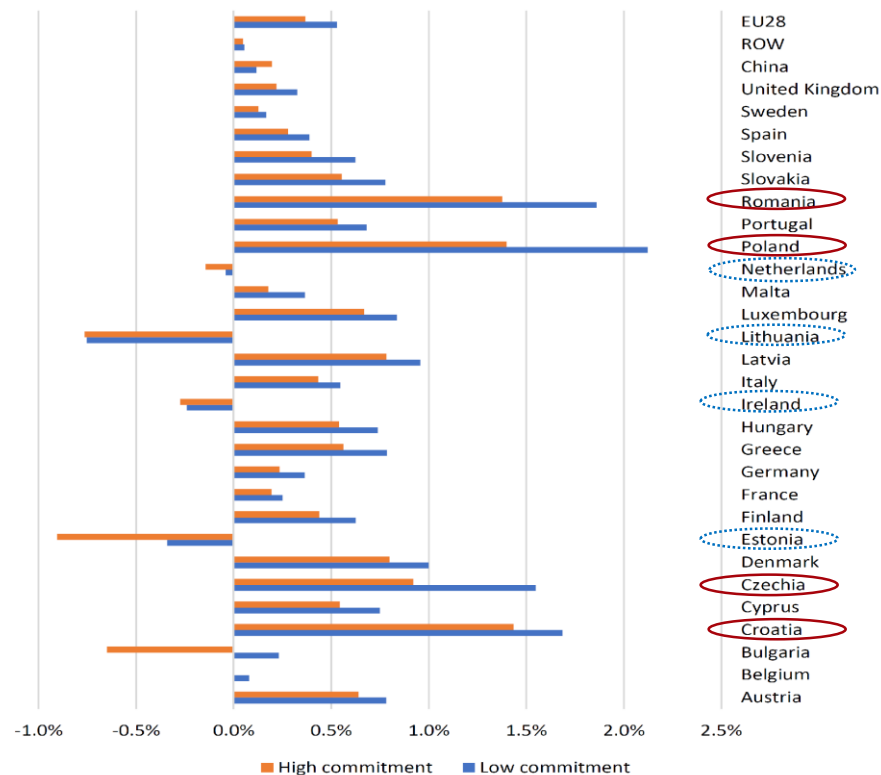
Abatement in Mt CO₂ - Year 2040



Impacts on EU MSs

- Poland, Romania, Croatia and the Czech Republic gain positive impacts as their welfare are improved by more than 1.5 %;
- Lithuania, Ireland, Estonia and the Netherlands have 1% welfare loss (their losses in term of trade overcompensate the decrease in the DWL).

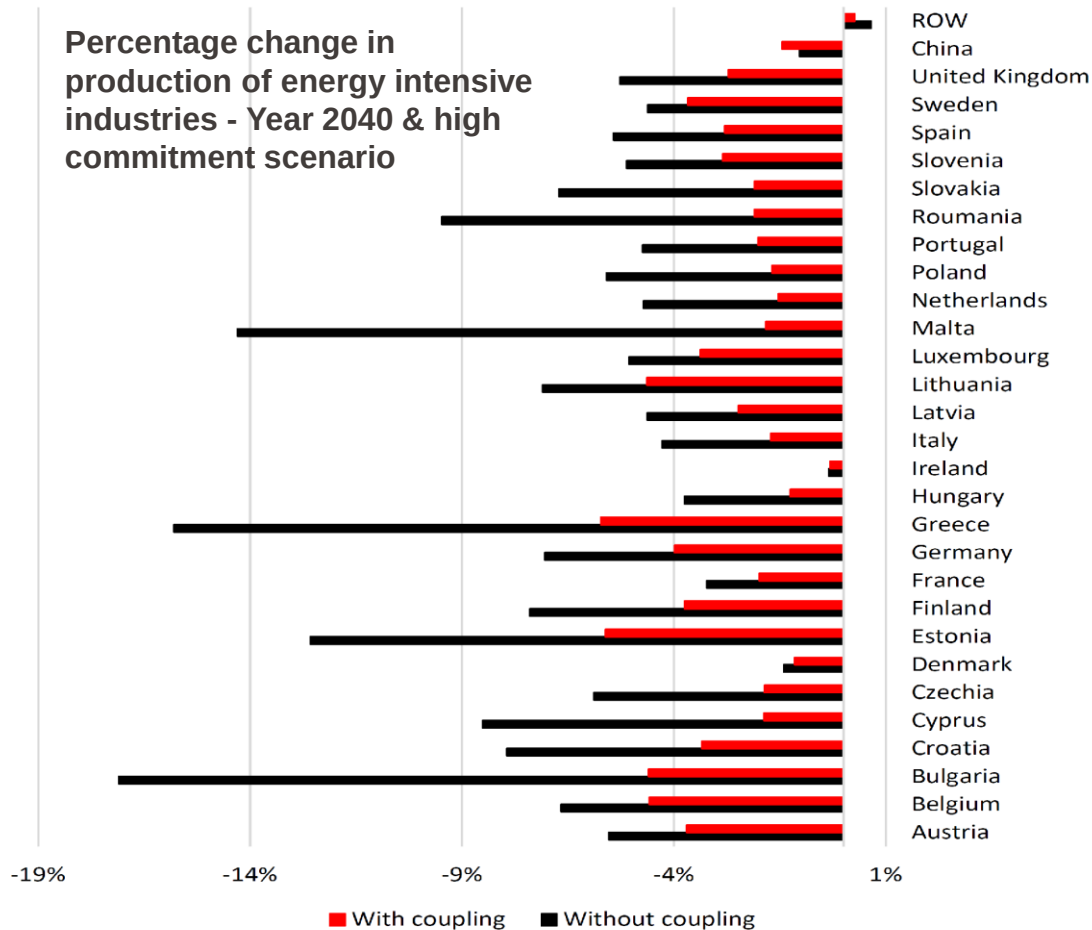
Welfare change in % of household consumption - Year 2040



Impacts on EU MSs

- Integrated EU and Chinese ETS market significantly reduce the loss of competitiveness of European energy intensive industries.

Percentage change in production of energy intensive industries - Year 2040 & high commitment scenario

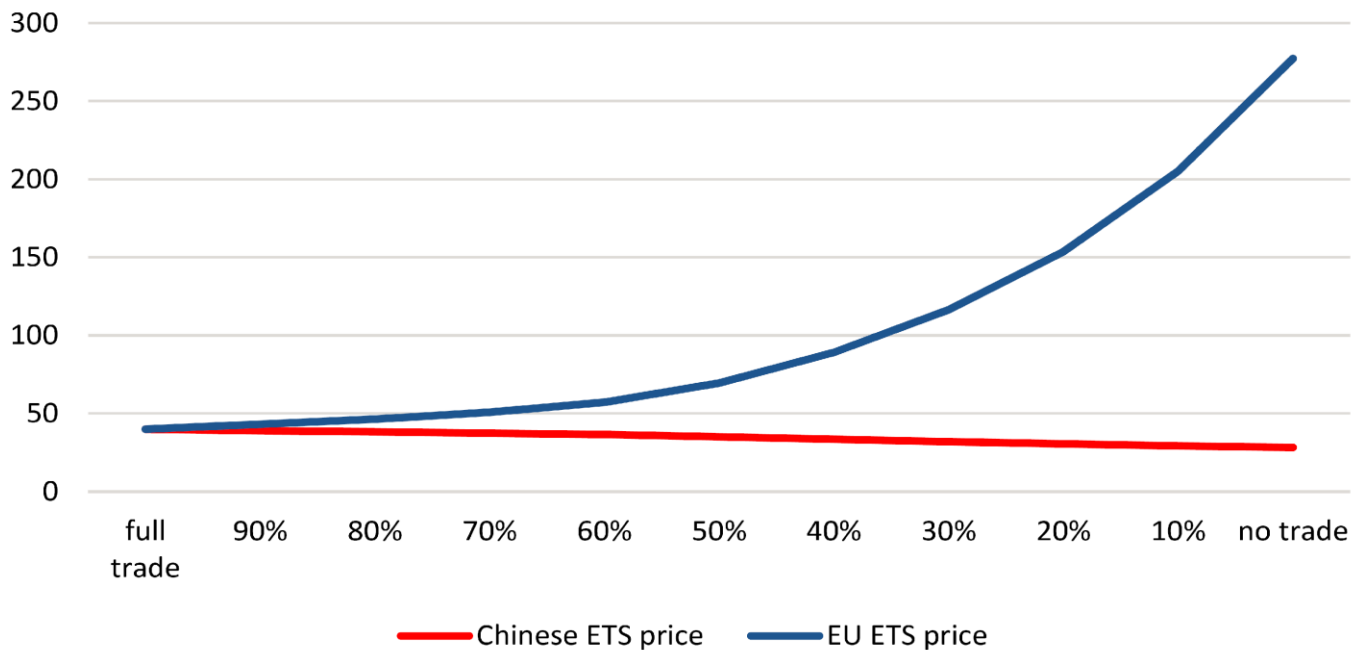


Limited Trading

- Full participation in the integrated market with unlimited trading might be politically unacceptable;
- The EU ETS legislation already allows the use of international credits, namely clean development mechanism and joint implementation instruments with some limits;
- Assuming that China put its high commitment to abate, we vary scenarios where the trading is limited from 10 to 90 per cent for EU.

Limited Trading

ETS prices in € with respect to trading limit - Year 2040 & high commitment scenario



Limited Trading

Table 11: Welfare decomposition with respect to trade limits - Year 2040 & high commitment scenario

	EU				China			
	Welfare	GTT	Trade of Quota	DWL	Welfare	GTT	Trade of Quota	DWL
full trade	-1.74%	2.37%	-0.17%	-3.94%	-1.93%	-0.67%	0.38%	-1.64%
90%	-1.73%	2.38%	-0.16%	-3.95%	-1.96%	-0.69%	0.35%	-1.62%
80%	-1.72%	2.39%	-0.14%	-3.97%	-1.97%	-0.70%	0.32%	-1.60%
70%	-1.72%	2.40%	-0.13%	-3.98%	-1.99%	-0.71%	0.30%	-1.58%
60%	-1.72%	2.41%	-0.12%	-4.01%	-2.01%	-0.72%	0.26%	-1.56%
50%	-1.72%	2.43%	-0.10%	-4.05%	-2.04%	-0.74%	0.22%	-1.52%
40%	-1.73%	2.46%	-0.07%	-4.11%	-2.07%	-0.76%	0.17%	-1.48%
30%	-1.76%	2.49%	-0.05%	-4.20%	-2.09%	-0.77%	0.12%	-1.44%
20%	-1.83%	2.53%	-0.03%	-4.32%	-2.11%	-0.79%	0.08%	-1.40%
10%	-1.94%	2.57%	-0.02%	-4.49%	-2.12%	-0.80%	0.04%	-1.36%
no trade	-2.10%	2.62%	0.00%	-4.72%	-2.13%	-0.81%	0.00%	-1.32%

in % of household consumption

- The critical point is on the 50 % trade limit;
- Limiting the trade of quotas to **30%** captures most of the welfare gain coming from CO2 trading to EU

Conclusion (1)

Integration of the Chinese and European trading markets is beneficial.

- A competitive carbon price that lower welfare costs for both regions;
- The EU: lower gain from terms of trade and experiences some trade loss by purchasing more emission quota;
- But these are overcompensated by minimum amount of the allocative inefficiency by trading with China;
- China's gains from the term of trade and the emission quota are exceeding a higher deadweight loss for more emission abatement under the integrated market scenario.

Conclusion (2)

For Each MSs:

- Welfare cost from abatement decrease to some notable countries in which ETS constitutes a large part of their economies such as Poland, Romania, the Czech Republic, and Croatia;
- For a few others such as the Netherland, Lithuania, Ireland, and Estonia face an unavoidable higher welfare cost because of the dominance effect of loss from trade.

Conclusion (3)

Should it be Limited:

- 30 per cent quota is likely to be a politically acceptable as captures most of the welfare gain coming from CO2 trading for the EU;
- China's welfare, in contrast, is linearly correlated to the trade limit, thus full trade is more preferable.

-End of Presentation-



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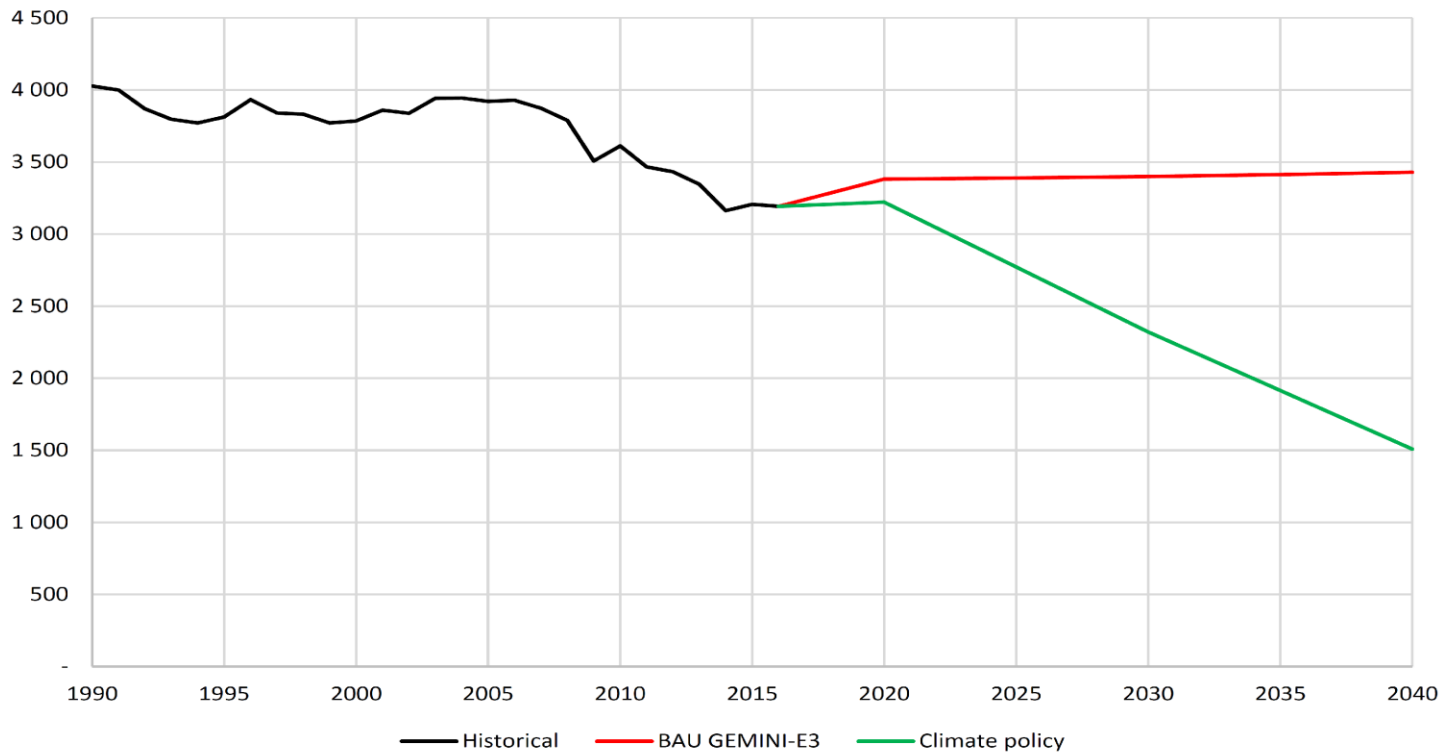
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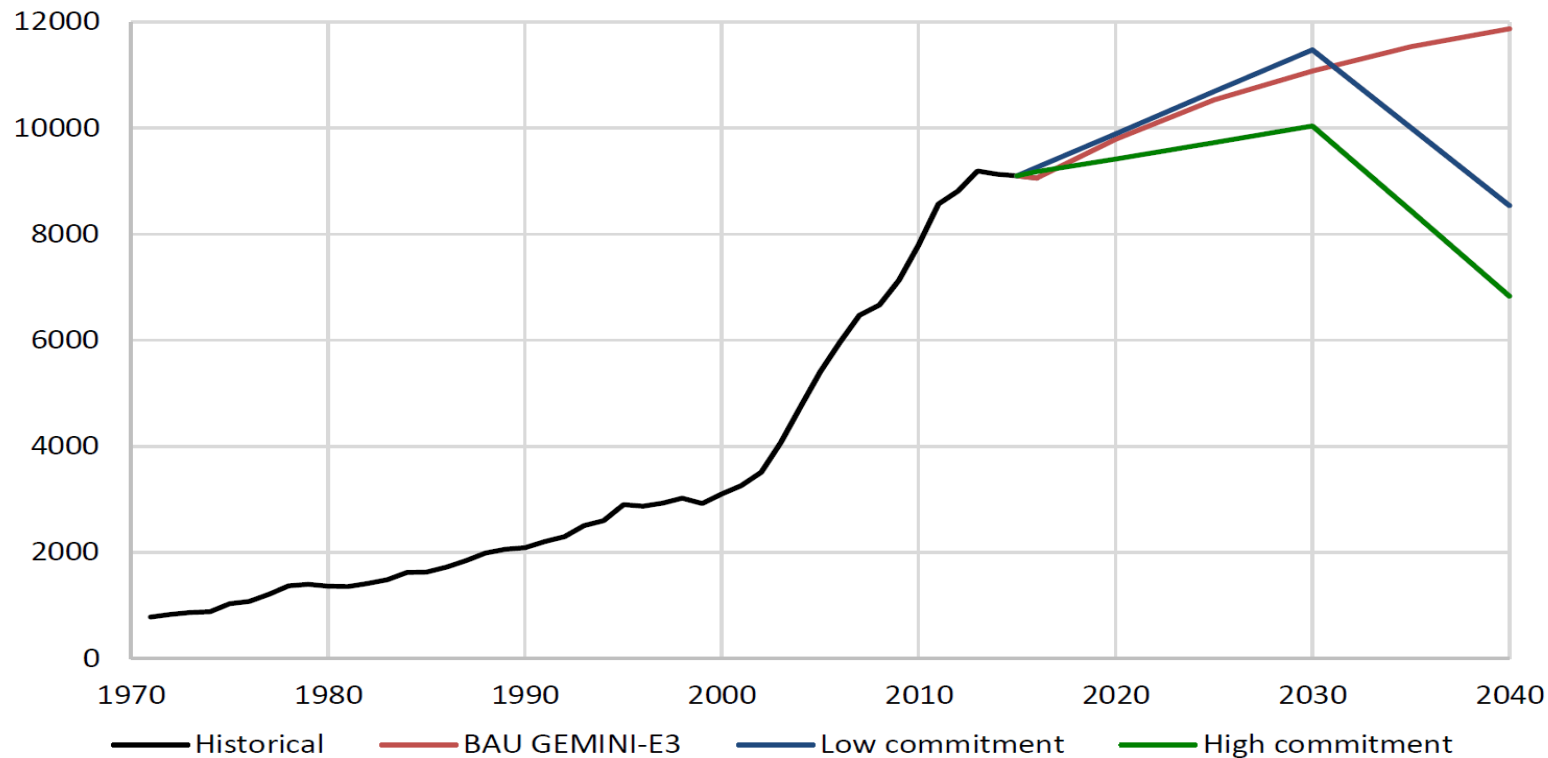
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Annex 1: EU Emission



Annex 2: China Emission



Annex 3: Impacts per MSs

Table 9: ETS Abatement, allowances and trading of quotas per Member State - Low commitment scenario

	Abatement in %		Allowances in Mt CO ₂	Trade in Mt CO ₂	Trade in % of allowances
	Without	With			
Austria	-53%	-19%	10	-7	75%
Belgium	-54%	-18%	16	-12	79%
Cyprus	-39%	-4%	2	-1	57%
Czechia	-74%	-30%	19	-31	167%
Denmark	-72%	-33%	6	-8	142%
Estonia	-43%	-4%	6	-4	67%
Finland	-61%	-23%	12	-12	99%
France	-50%	-19%	47	-29	63%
Germany	-70%	-25%	114	-166	146%
Greece	-59%	-16%	14	-14	104%
Hungary	-55%	-20%	9	-7	76%
Ireland	-63%	-26%	6	-6	99%
Italy	-56%	-21%	71	-55	78%
Latvia	-48%	-10%	1	-1	74%
Lithuania	-41%	-14%	3	-1	47%
Luxembourg	-53%	-12%	1	-1	87%
Malta	-41%	-6%	1	-1	58%
Netherlands	-54%	-23%	30	-20	68%
Poland	-76%	-30%	49	-96	195%
Portugal	-62%	-25%	8	-8	95%
Slovakia	-55%	-19%	8	-6	78%
Slovenia	-67%	-19%	2	-3	142%
Spain	-59%	-24%	52	-44	85%
Sweden	-46%	-19%	9	-5	50%
United Kingdom	-70%	-31%	62	-79	127%
Bulgaria	-70%	-23%	12	-19	160%
Romania	-65%	-23%	19	-23	122%
Croatia	-58%	-23%	31	3	82%
EU28	-65%	-24%	591	-664	112%
China	-33%	-44%	4'203	664	16%
China+EU28	-40%	-40%	4'794	—	—

Annex 4: Impacts per MSs

Table 10: ETS Abatement, allowances and trading of quotas per Member State - High commitment scenario

	Abatement in %		Allowances	Trade	Trade in
	Without	With	in Mt CO ₂	in Mt CO ₂	% of allowances
Austria	-53%	-27%	10	-6	56%
Belgium	-54%	-26%	16	-10	61%
Cyprus	-39%	-10%	2	-1	47%
Czechia	-74%	-46%	19	-19	104%
Denmark	-72%	-48%	6	-5	90%
Estonia	-43%	-11%	6	-3	55%
Finland	-61%	-34%	12	-8	69%
France	-50%	-27%	47	-22	46%
Germany	-70%	-39%	114	-113	99%
Greece	-59%	-29%	14	-10	73%
Hungary	-55%	-30%	9	-5	53%
Ireland	-63%	-37%	6	-4	68%
Italy	-56%	-31%	71	-40	56%
Latvia	-48%	-18%	1	-1	58%
Lithuania	-41%	-20%	3	-1	37%
Luxembourg	-53%	-21%	1	-1	68%
Malta	-41%	-12%	1	-1	49%
Netherlands	-54%	-32%	30	-15	49%
Poland	-76%	-48%	49	-60	122%
Portugal	-62%	-37%	8	-5	64%
Slovakia	-55%	-30%	8	-4	55%
Slovenia	-67%	-33%	2	-2	101%
Spain	-59%	-34%	52	-31	59%
Sweden	-46%	-27%	9	-3	35%
United Kingdom	-69%	-43%	62	-53	86%
Bulgaria	-70%	-39%	12	-13	108%
Romania	-65%	-37%	19	-15	81%
Croatia	-58%	-34%	32	3	56%
EU28	-65%	-37%	591	-452	76%
China	-55%	-62%	2'829	452	16%
China+EU28	-57%	-57%	3'421	—	—

Annex 5: Limited Trading

Table 12: Impact of trading limits on quotas trade, EU EEI production and domestic CO₂ abatement- Year 2040 & high commitment scenario

	Quota selling by China	% of quota bought by EU	EU EEI Production change in %	EU CO2 abatement in %	China CO2 abatement in %
full trade	452	76.5%	-2.6%	-38.7%	-46.6%
90%	424	71.8%	-2.6%	-39.5%	-46.4%
80%	401	67.8%	-2.7%	-40.2%	-46.2%
70%	374	63.2%	-2.8%	-41.0%	-46.0%
60%	342	57.8%	-2.9%	-41.9%	-45.7%
50%	294	49.7%	-3.0%	-43.3%	-45.3%
40%	236	40.0%	-3.3%	-45.0%	-44.8%
30%	177	30.0%	-3.6%	-46.7%	-44.3%
20%	118	20.0%	-4.0%	-48.4%	-43.8%
10%	59	10.0%	-4.5%	-50.2%	-43.3%
no trade	0	0.0%	-5.2%	-51.9%	-42.8%

Annex 6: Carbon Leakage

CO₂ leakage in % - Year 2040

