Rate-based Emissions Trading with Overlapping Policies: Insights from Theory and an Application to China

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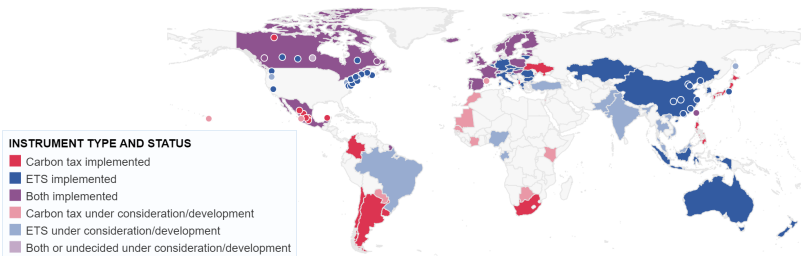
Table of Contents

Emission Trading Systems (ETSs)

- Emission trading is increasingly popular worldwide.
  - 19% of global GHGs covered by ETS

Compliance carbon pricing instruments around the world, 2024

Map shows jurisdictions with carbon taxes or emissions trading systems implemented, under development or under consideration, subject to any filters applied in the table below the map. The year can be adjusted using the slider below the map.



Mass-based v.s. Rate-based emission trading

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   - **Increasingly popular**: adopted by China, OBPS in Canada, Indonesia, and under consideration in India and Turkey...

Overlapping Climate Policies

- Globally, about two-thirds of countries have policies supporting renewable energy or promoting energy conservation (IEA 2023).
- **Climate policies interact with each other.**

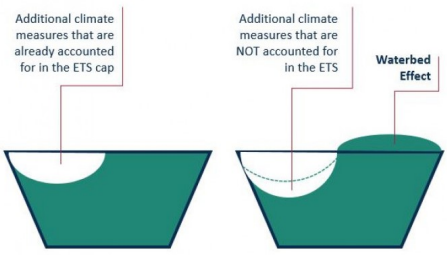
- Large literature on interactions between **cap-and-trade** and renewables support.

  (Sijm 2005; Fischer and Preonas 2010; Böhringer and Behrens 2015)

- and in China's context.

  (Fan et al. 2017; Wang et al. 2021; Chang et al. 2023; Yu et al. 2023; Ma et al. 2024)

- **Very limited focus on policy interactions for rate-based ETSs.**



Source: Clean Energy Wire.

Research Questions

- How do overlapping policies interact with different designs of rate-based ETS in general?
- How to improve the overall **cost-effectiveness** of emissions abatement by coordinating ETSs and overlapping policies?

Key Findings

- Rate-based ETSs' interaction with overlapping climate policies is different from mass-based ETSs.
- Overlapping policies in China can potentially improve the relative cost-effectiveness of China's rate-based ETS by more than two-thirds.

Table of Contents

Categorizing ETSs

Compliance Basis	**Mass-Based**	**Rate-Based**		
	Designated Sectors or Emitters	**Designated Sectors**	**Emitting Facilities Only**	
Benchmark Specification	**N/A**	**Uniform**	**Uniform**	**Differentiated**
ETS Description (Label)	Cap And Trade (CAT)	Uniform Sectoral Performance Standard (USPS)	Uniform Emitter Performance Standard (UEPS)	Differentiated Emitter Performance Standard (DEPS)

Categorizing ETSs

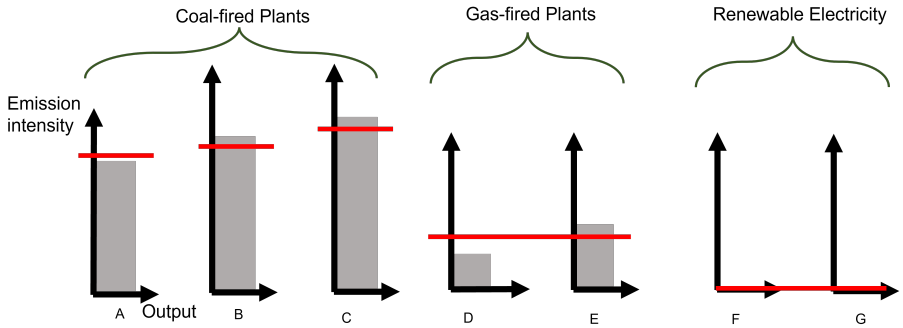


Figure: Graphic Illustration of the **Differentiated Emitter Performance Standard (DEPS)**

Categorizing ETSs

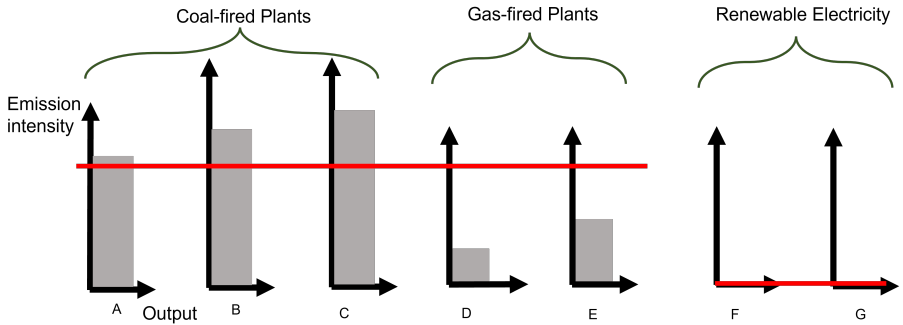


Figure: Graphic Illustration of the **Uniform Emitter Performance Standard (UEPS)**

Categorizing ETSs

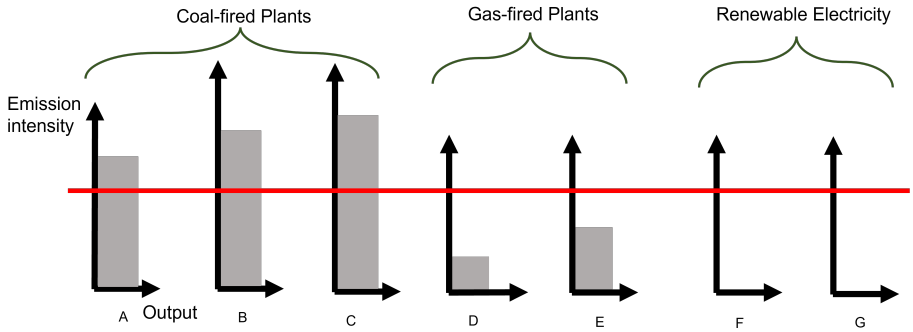


Figure: Graphic Illustration of the **Uniform Sectoral Performance Standard (USPS)**

Summary of Findings

- **CAT has waterbed effect**
  - Overlapping policies that reduce demand for allowances depress prices but have no effect on emissions.
- **USPS can have counterproductive effect**
  - Renewable subsides make generation cheaper, and lead to more output, more benchmark allocations, and more emissions.
- **UEPS and DEPS allows additional effects**
  - More renewable generation displaces emitting sources, reducing benchmark allocations and emissions.

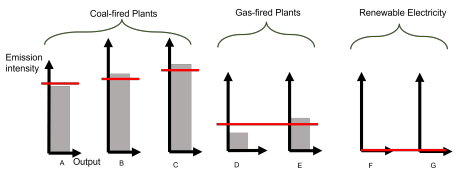
Table of Contents

The Numerical Model

- A general equilibrium model calibrated to China's economy (Goulder et al. 2023)
  - **General equilibrium framework** enables it to capture the interactions between all sectors and general equilibrium impacts.
  - **Richness in sector details** (11 fossil-based generating technologies and 4 non-fossil electricity generation technologies) to capture fuel-switching, production shifting, and efficiency improvement potentials within one sector.
  - **Multi-period** feature enables it to capture the outcomes in different coverage phases and different policy stringencies.

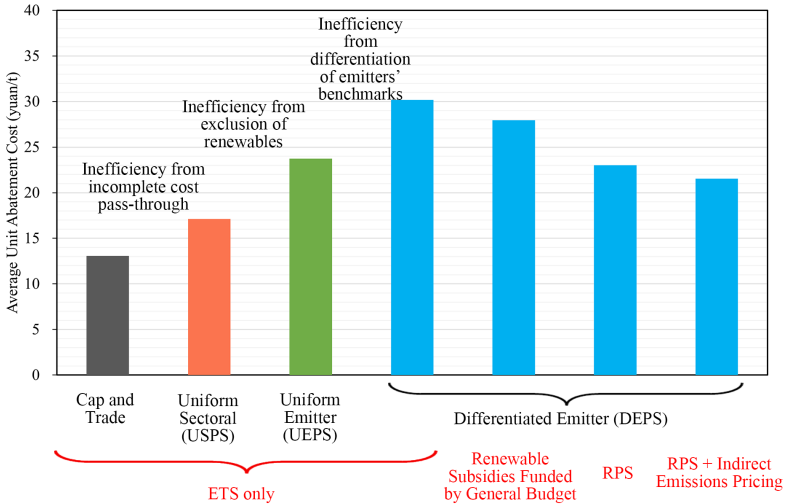
China's Policy Context

- **Nationwide ETS (DEPS)**
  - Phase 1: Covers only the electricity sector with four benchmarks (three for coal-fired power plants, one for gas-fired plants); excludes renewables.
  - Phases 2 and 3: Expansion to industrial sectors.



- **Potential overlapping policies**
  - **Indirect Emissions Pricing** considered.
  - **Overlapping national renewable goals in RPS form**:
    - Non-hydro RPS targets align with national goals: 18% in 2025, 26% in 2030, and 36% in 2035

Potential Overlaps under China's DEPS



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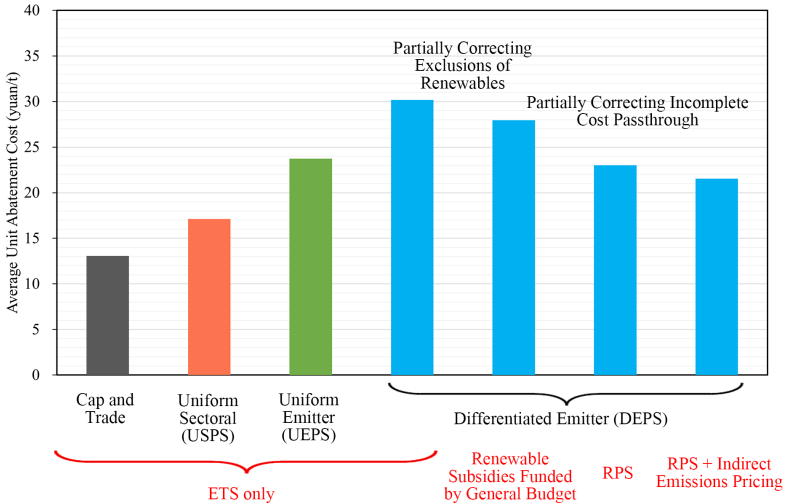


Potential Overlaps under China's DEPS

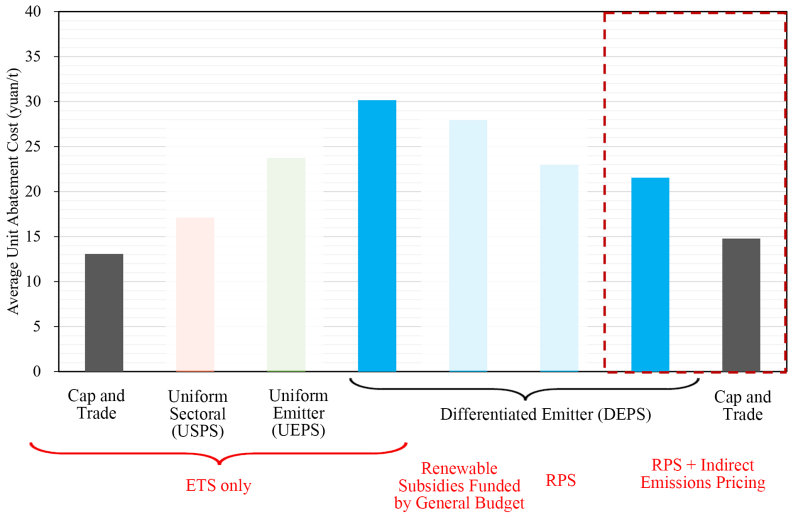


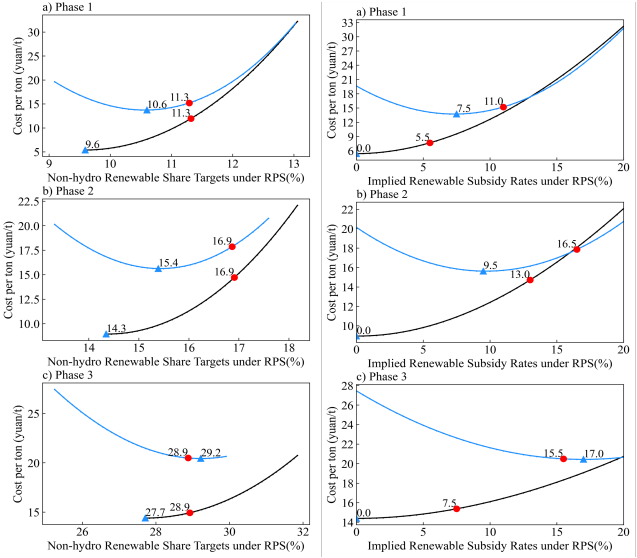
Table of Contents

Conclusions

- Rate-based ETS interacts differently with overlapping climate policies compared with a cap-and-trade.
- When first-best options are infeasible, overlapping policies can mitigate inefficiencies in rate-based systems:
  - **Indirect emissions pricing** reduces abatement cost by 8%.
  - **Renewable portfolio standard** reduces abatement cost by 24%.
  - Renewable portfolio standard + indirect emissions pricing reduce cost gap between rate-based ETS and CAT by 2/3.

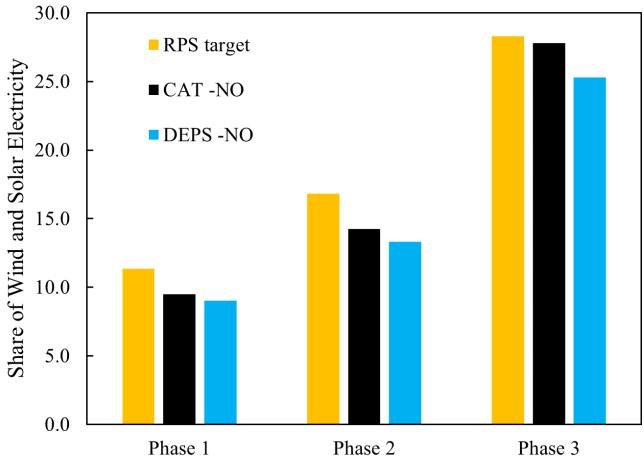
Table of Contents

Optimizing Overlapping Renewable Support Policies



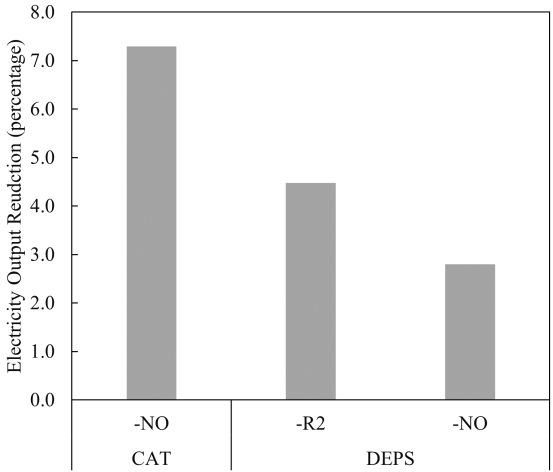
- Optimization of RPS targets can further enhance cost-effectiveness.
- Benefits of implementing a market-based mechanism for renewable energy support.

Renewable Shares



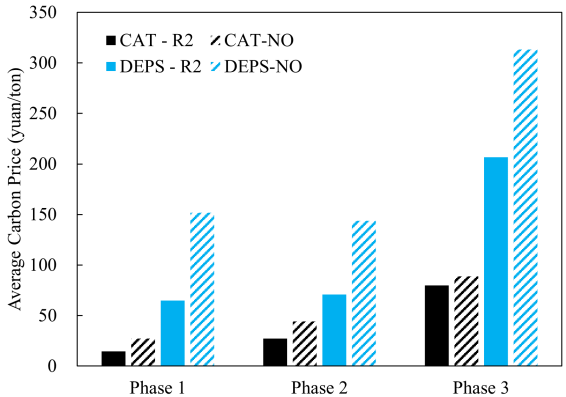
Back

Electricity Output



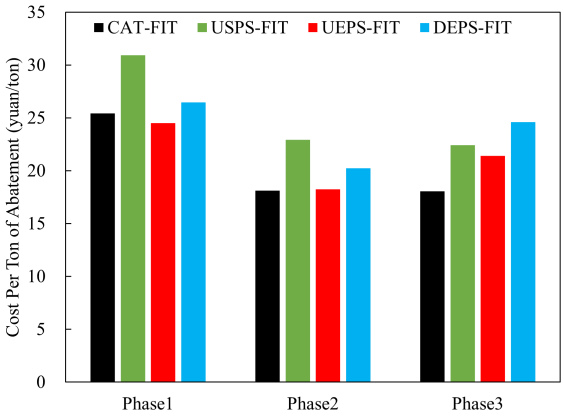
Back

Carbon Price



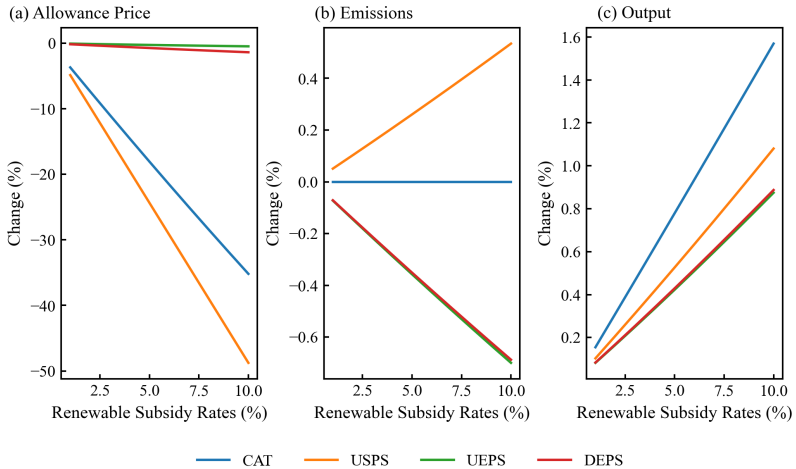
Back

FIT results

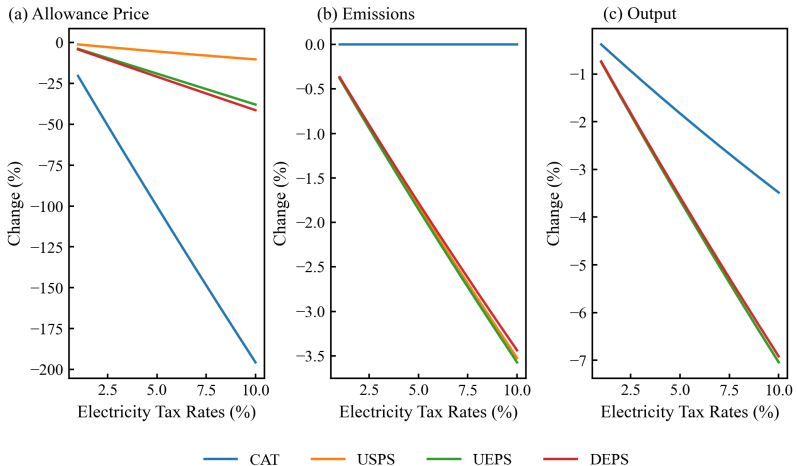


Back

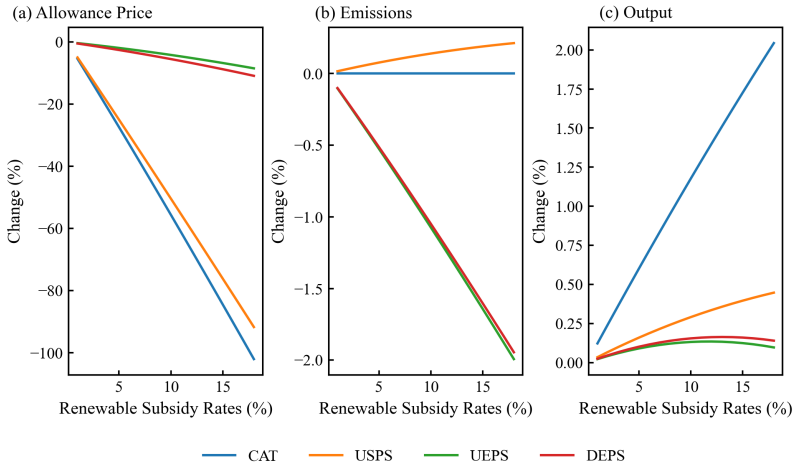
Theoretical Results: Overlapping Renewable Subsidies (Funded by General Budget)



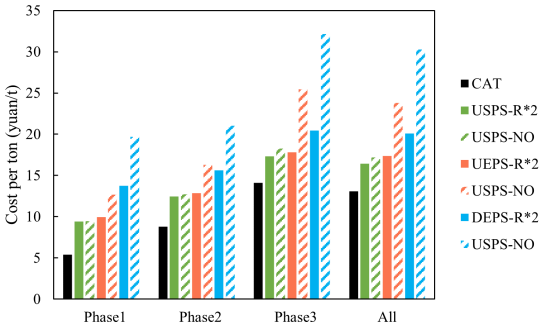
Theoretical Results: Overlapping Electricity Taxes



Theoretical Results: Overlapping Renewable Subsidies (Funded by Electricity Taxes)



Overlapping Policies and Alternative ETSs



- CAT-NO offers the most cost-effective abatement per ton to meet emissions targets.
- Differentiated benchmarks remain costly: Transitioning from DEPS to UEPS under current overlaps can reduce costs by 10-20%.
- Given overlaps, there are limited benefits from transitioning from UEPS to USPS.