Strategic subsidies for renewable energy

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Background

- The climate change problem calls for a worldwide uniform price on carbon, ideally
  - However, politically difficult
- Instead (and sometimes in addition) we see a variety of other instruments in place
  - Efficiency standards
  - Renewable energy standards
  - Subsidies to renewables

World Bank State & Trends Report Charts
Global Growth of Carbon Pricing

Renewable Energy Obligations

RENEWABLES INTERACTIVE MAP
SEARCH RESULTS

REN21 Renewable Energy Policy Network for the 21st Century

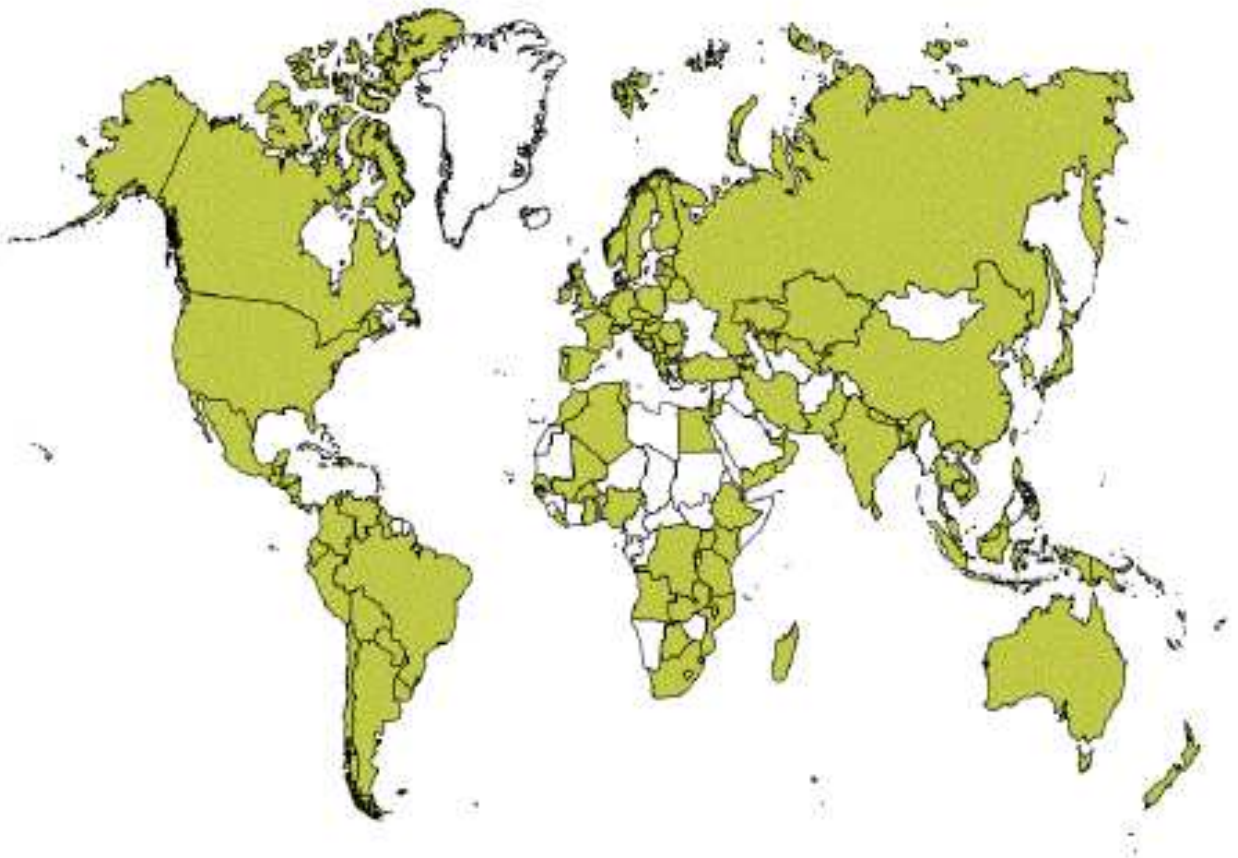
TECHNOLOGY:	All
TOPIC:	Policies
SUB-TOPIC(S):	Utility quota obligation; Obligation and mandate; Tradable renewable energy certificate (REC).

Renewable Energy Production Incentives

RENEWABLES INTERACTIVE MAP
SEARCH RESULTS

REN21 Renewable Energy Policy Network for the 21st Century

TECHNOLOGY:	All
TOPIC:	Policies
SUB-TOPIC(S):	Feed-in tariff; Energy production payment.

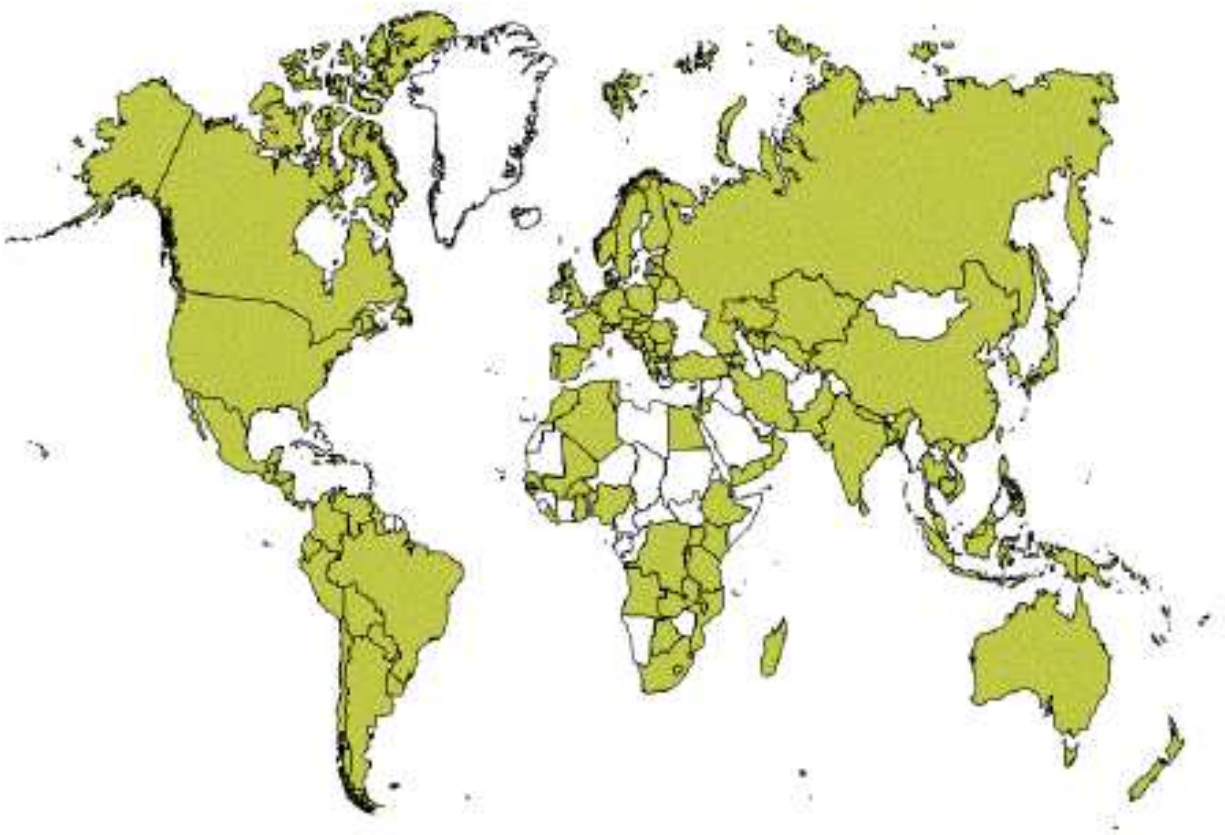


Renewable Energy Investment Incentives

RENEWABLES INTERACTIVE MAP
SEARCH RESULTS

REN21 Renewable Energy Policy Network for the 21st Century

TECHNOLOGY:	All
TOPIC:	Policies
SUB-TOPIC(S):	Capital subsidy, grant, or rebate; Tax incentives; Public investment, loans, or financing.



There are some rationales for supporting these technologies

- Downstream market failures (emissions)
  - Electricity market
    - Displace fossil sources with solar panels, wind turbines
  - Transport market
    - Displace oil with 2nd/3rd generation biofuels, electric cars
- Upstream market failures
  - New industries
  - Patented technologies
  - Imperfect competition
  - Learning spillovers
  - Network / scale externalities

Types of Subsidies

- Downstream (for deployment)
  - Carbon price
  - RPS
  - FiTs
  - PTC
- Upstream (for manufacturing)
  - Investment incentives
  - demonstration projects
  - public-private R&D
  - local content requirements

REUTERS

U.S. solar industry harmed by China, Taiwan imports - ITC

WASHINGTON Wed Jan 21, 2015 4:23pm GMT

- The U.S. International Trade Commission said on Wednesday imports of solar products from China and Taiwan injure U.S. producers, clearing the final hurdle for import duties on the goods.

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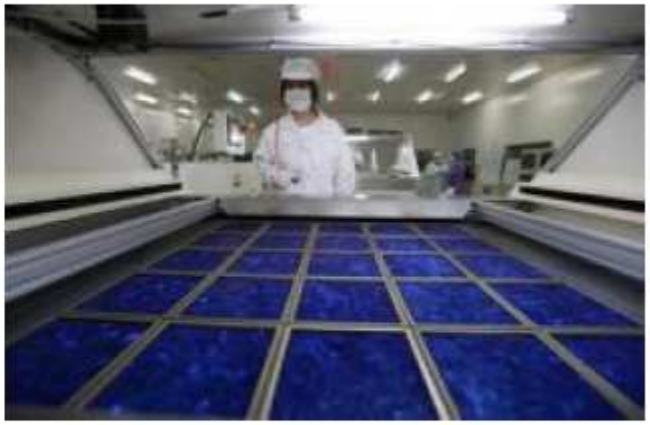
REUTERS

EU says China guilty of giving illegal aid to solar industry

Tue, Aug 27 2013

By Robin Emmott



BRUSSELS (Reuters) - The European Union has warned Beijing it has evidence Chinese solar companies benefit from illegal subsidies, people close to the issue said on Tuesday, but Brussels says it will not take action for now following a deal to defuse the row.

European companies accuse Chinese rivals of benefiting from unfair state aid allowing them to dump about 21 billion euros (18 billion pounds) worth of solar panels at below cost in Europe last year, putting European firms out of business.

The solar dispute, by far the biggest between China and the EU, threatened a wider trade war in goods from wine to steel until Brussels and Beijing agreed a minimum price for panels from China in late July and eased tensions.

But a nine-month investigation by the European Commission into China's solar industry has found Beijing broke World Trade Organisation rules by handing out cheap loans, land, interest-free credit lines and tax breaks to companies, people with knowledge of the situation told Reuters.

"There are clear indications that (Chinese) government policy influences the decision-making of the banks when deciding on the terms of financing to solar companies," said one person who declined to be named because the findings are not public.

REUTERS

China and Europe make up after averting trade war

BRUSSELS Thu Oct 24, 2013 3:58pm EDT

- Brussels initially moved to impose punitive duties on Chinese solar panels but Beijing threatened sanctions on goods including German cars and French wine. Both sides agreed a minimum price for panels from China in July.

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THE GLOBE AND MAIL

WTO rules against Ontario in green energy dispute

KAREN HOWLETT, BERTRAND MAROTTE and RICHARD BLACKWELL
The Globe and Mail
Published Tuesday, Nov. 20 2012, 7:15 AM EST
Last updated Tuesday, Nov. 20 2012, 12:56 PM EST

The World Trade Organization has ruled that a critical component of Ontario's green energy program breaches international trade law, according to sources.

A source familiar with the ruling said it is not favourable to the domestic content requirements contained in Ontario's so-called feed-in tariff program, the centrepiece of the green energy program that provides solar, wind and other renewable energy companies with long-term guaranteed revenue contracts.

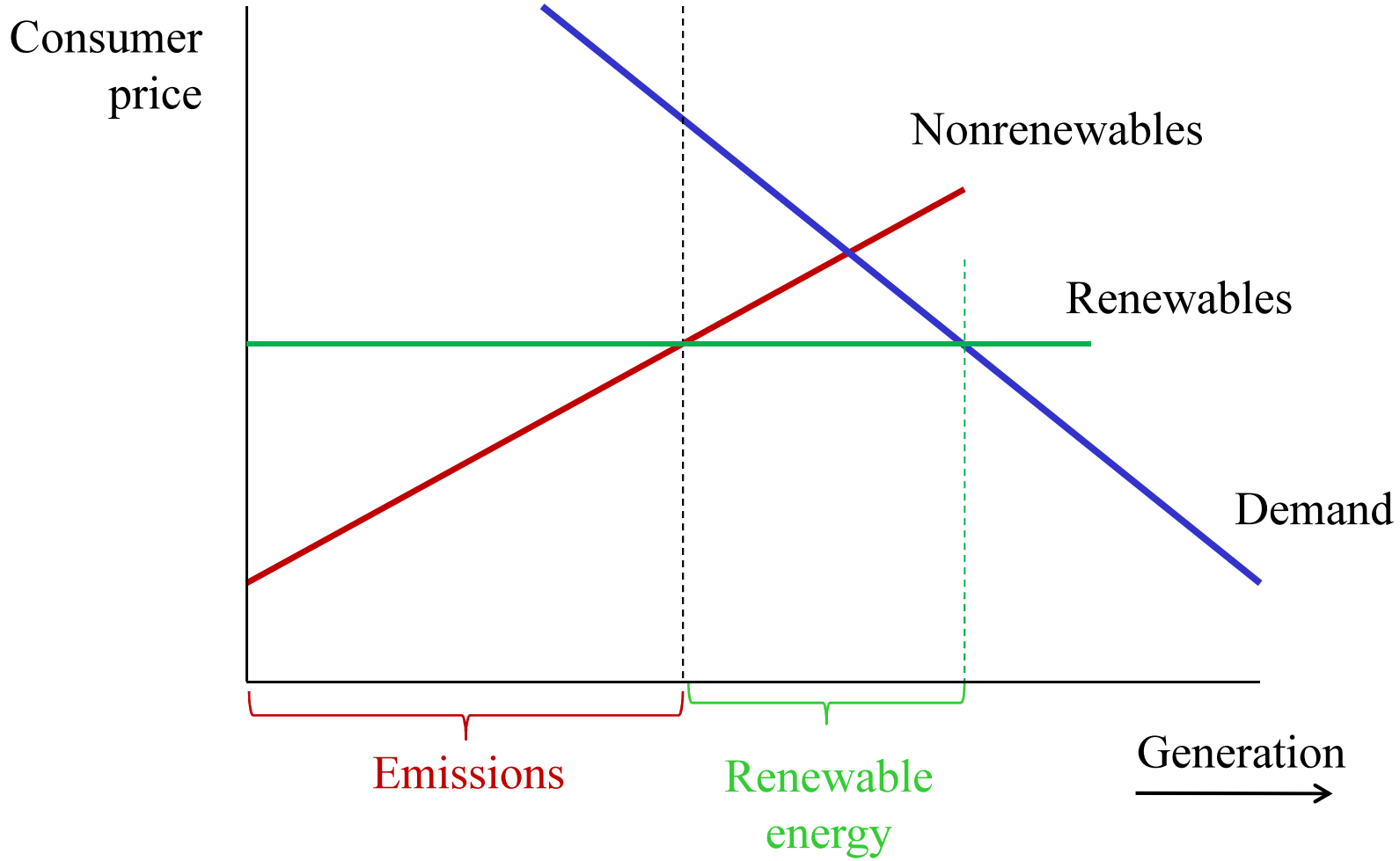
Research Questions

- Should technology policy be used as supplement to other climate policies?
- If yes, should technology policy be directed towards:
  - Subsidizing downstream use of renewable energy technologies, or
  - Subsidizing upstream technology suppliers?
- How does the policy context influence these answers?
  - Is a carbon price or renewable energy target in place?

Model Sketch

- Two regions
- Closed, competitive downstream markets
  - E.g. electricity or transport markets
- Cournot competition between upstream technology suppliers
  - Global price on technology
  - One firm in each region
- Broader climate policy pre-determined; regions choose renewable subsidies

Downstream product market:
No Policy



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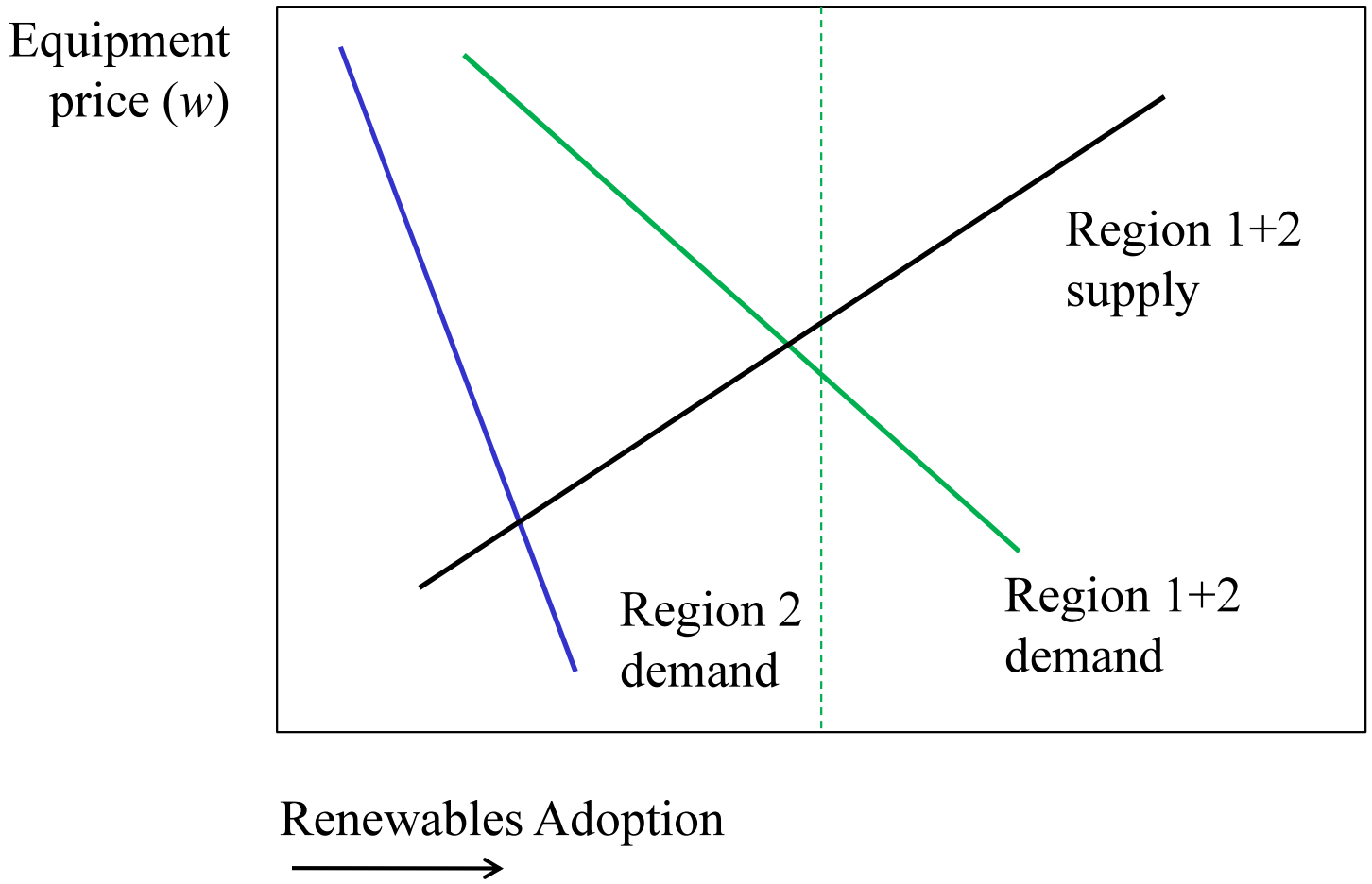
Renewable technology market

(abstracting from nonlinearities)



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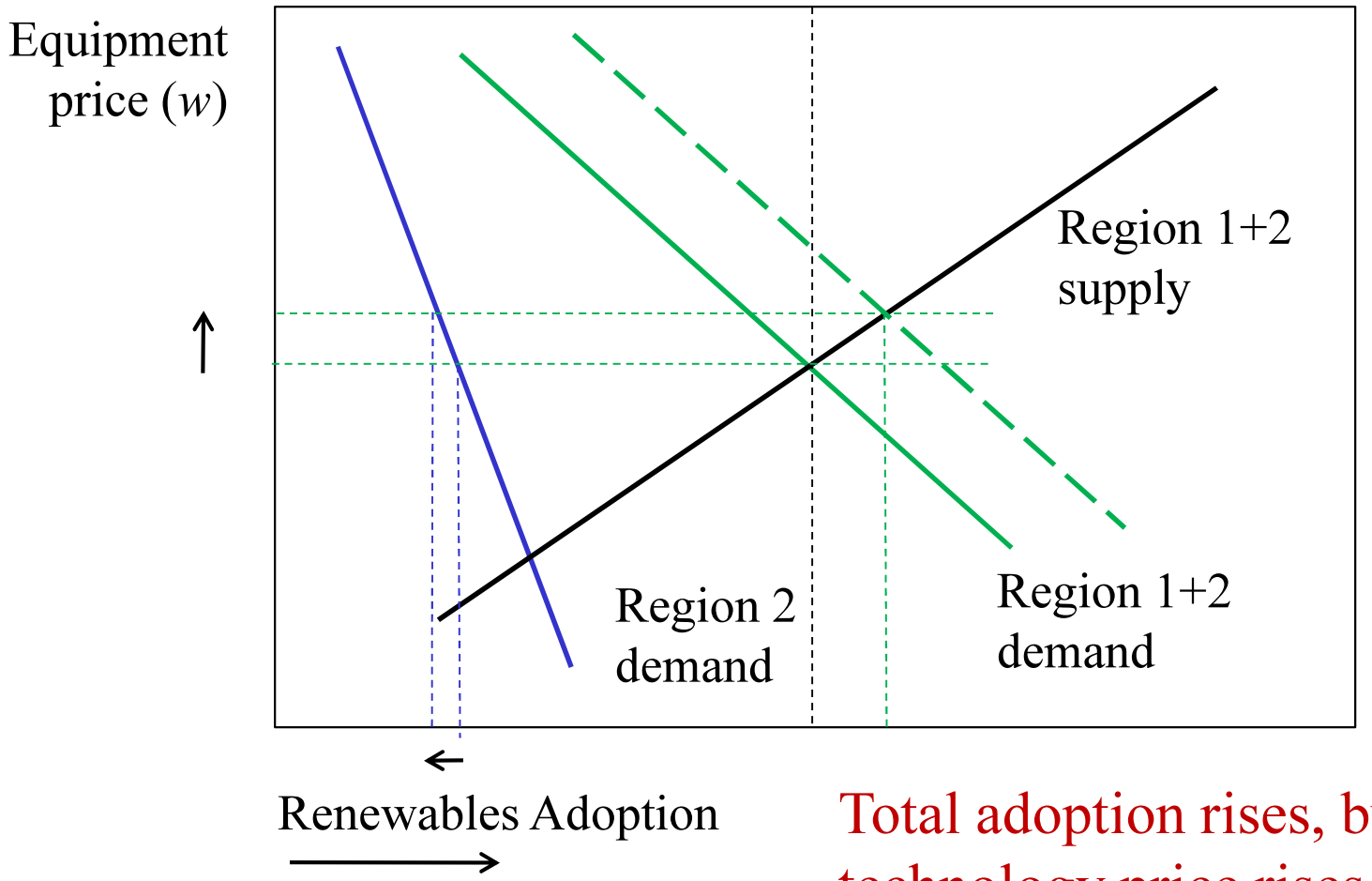
Renewable Technology market: Downstream subsidy



Total adoption rises, but technology price rises too and foreign adoption falls

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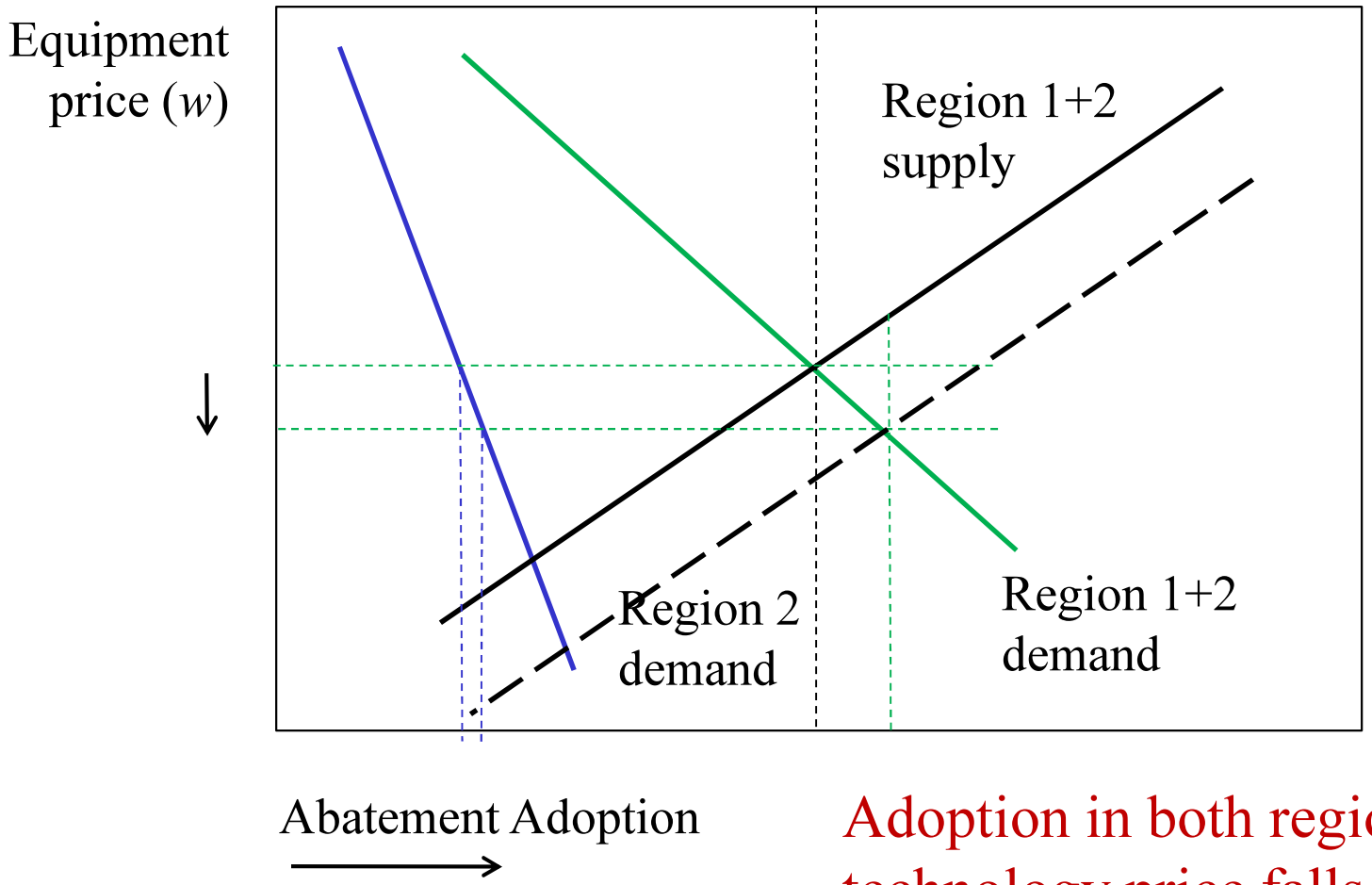
Abatement equipment market: Upstream subsidy



Adoption in both regions rises, technology price falls

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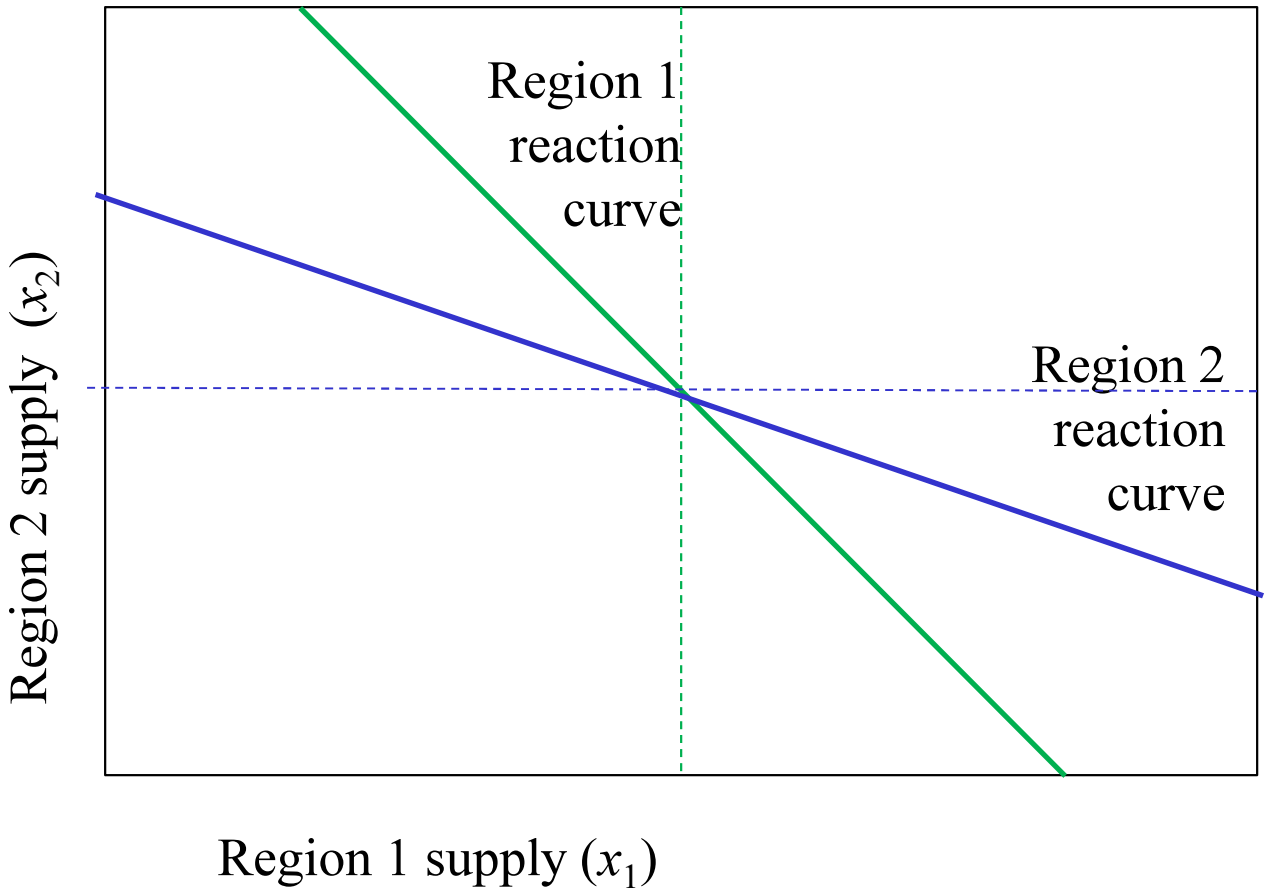
Upstream Cournot Market

(abstracting from nonlinearities)



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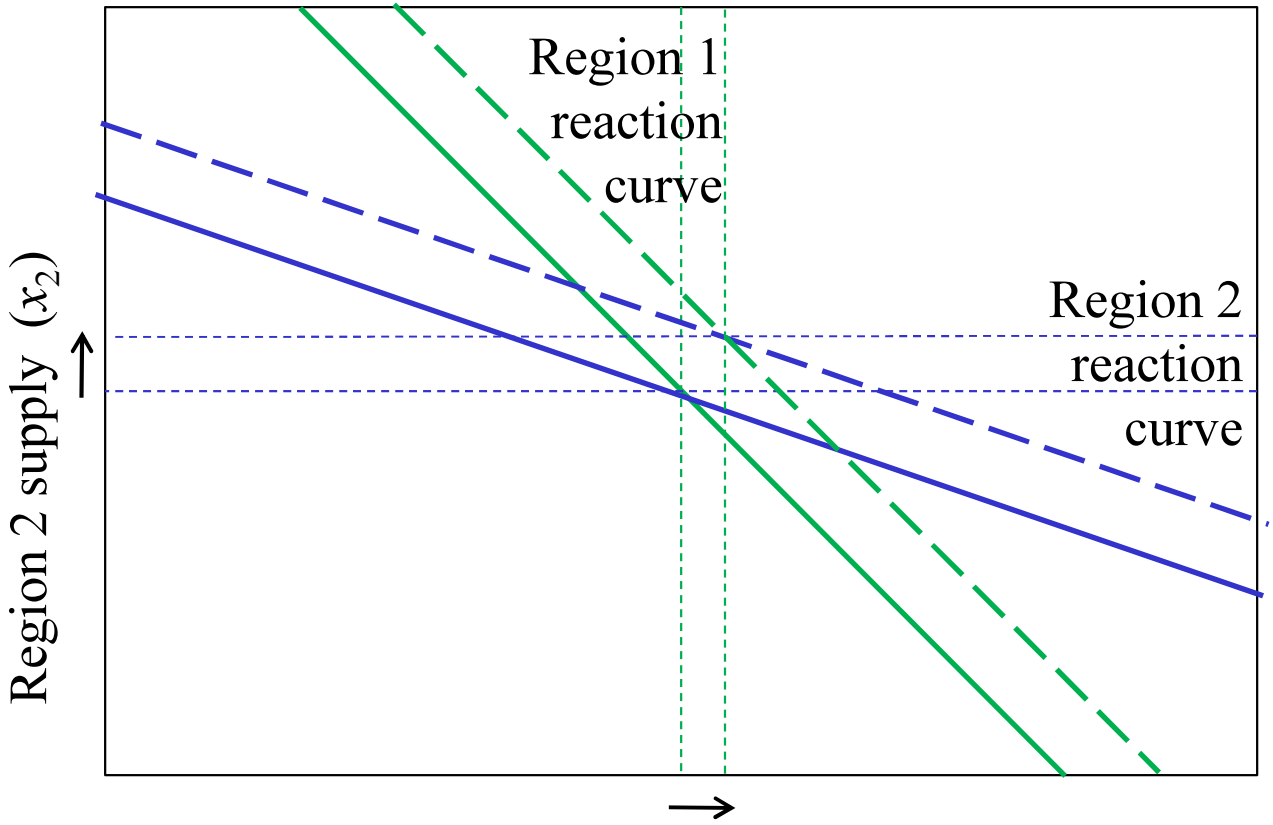
Upstream Cournot Market: Downstream Subsidy



Both regions expand supply

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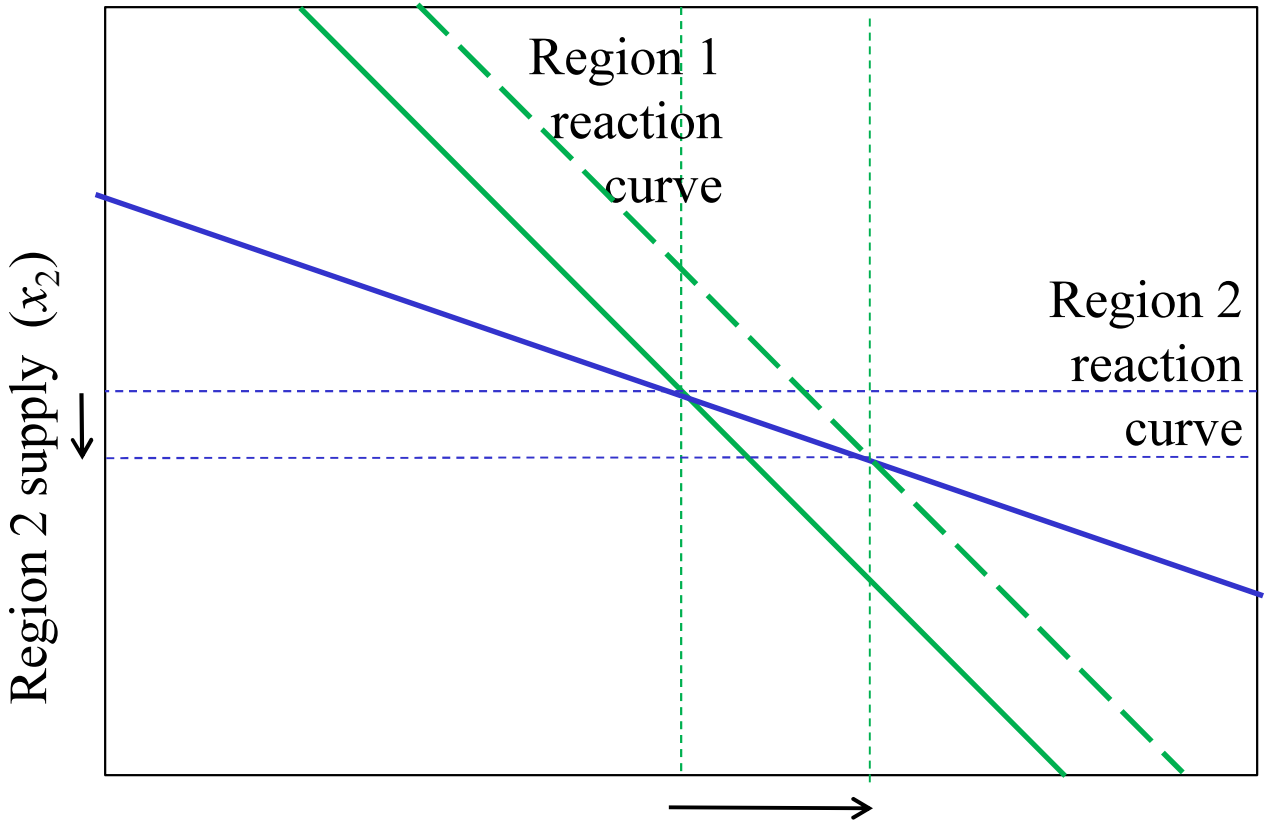
Upstream Cournot Market: Upstream Subsidy



Region 1 expands supply and crowds out Region 2 producers

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Downstream policy and carbon emissions

- Carbon price
  - Cheaper clean technologies encourage uptake and displace more fossil fuels, lower emissions
- Renewable energy standard
  - Lower net cost of renewable energy technologies make the standard less binding
  - Lower implicit tax on nonrenewables
  - Lower electricity price
  - > more demand and more emissions

Downstream policy and carbon leakage

	Carbon Price	Renewable Energy Target
Upstream subsidy	Lowers leakage	Increases leakage
Downstream subsidy	Increases leakage	Lowers leakage

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Globally Optimal Subsidies with Carbon Tax

- Bilateral policy:
  - Upstream subsidy to make up the difference between technology price and cost
  - Downstream subsidy (or carbon price) to make up for any carbon underpricing
- Unilateral policy:
  - Upstream subsidy
  - Downstream tax/subsidy to make up for any difference in carbon prices

Globally optimal policies with RPS

- Bilateral policies:
  - net cost of renewable technology to the downstream producer equals the marginal cost of production the external costs of additional renewable energy in each region
- Unilateral policy
  - Targets same net cost, but downstream subsidy in Region 1 is larger if it has a more ambitious RPS policy, shifting renewable technology adoption toward the region where nonrenewable energy will expand less

Regionally Optimal Subsidies

- Even stronger preference for an upstream subsidy, due to strategic trade incentive

- Interesting twist with an RPS: identical to the globally optimal subsidies if emissions are valued at the global cost of carbon

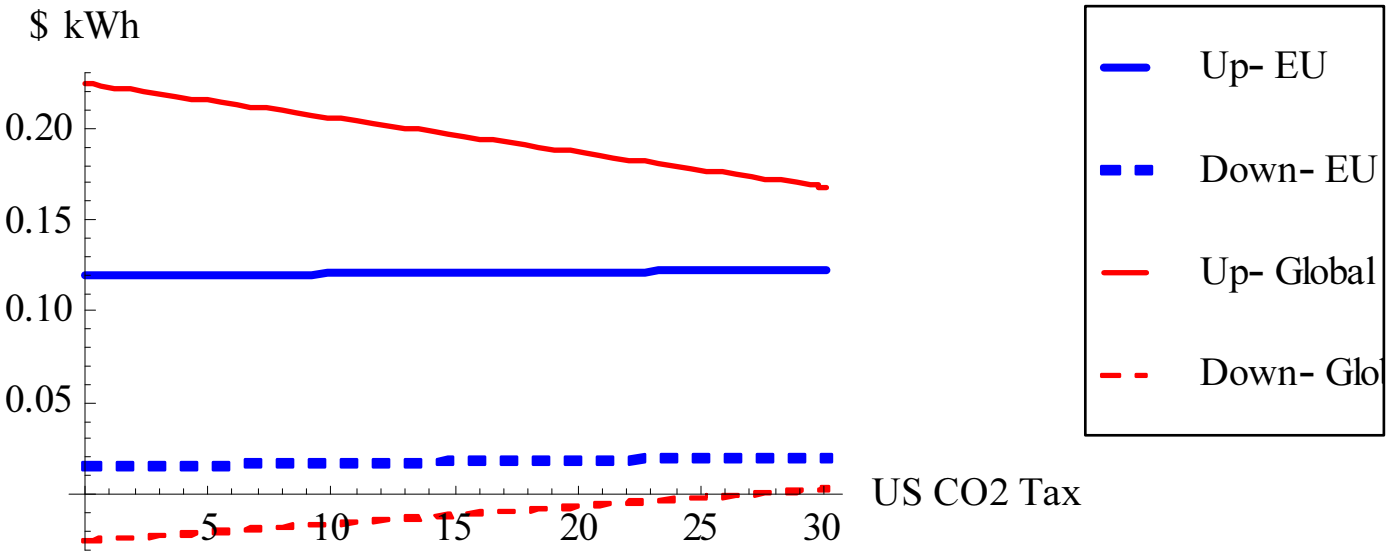
Numerical simulations

- for U.S., EU, based on other exercises
  - Fischer, Newell and Preonas (2013)
  - Fischer, Huebler and Schenker (2014)
- U.S. nonrenewable generation is dirtier

- New results!
  - Consider unilateral policies

Optimal unilateral subsidies with carbon prices

- Suppose EU prices CO2 at $30 (assumed SCC)
- EU prefers upstream subsidy + small downstream
- Planner wants bigger upstream subsidy and downstream tax in EU to shift more to U.S.



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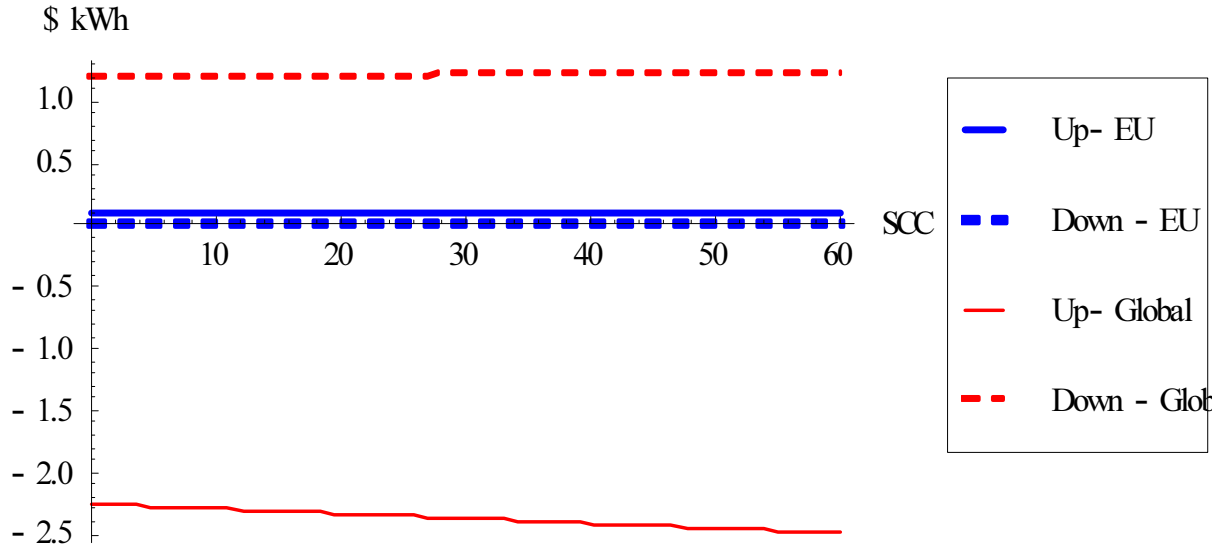
Optimal unilateral subsidies with binding RPS

- Each have binding targets
- EU prefers upstream
- Planner wants upstream tax and downstream subsidy (to raise RPS cost in U.S.)



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Conclusions

- Some legitimate rationales for subsidizing renewable energy, even with other climate policy in place
  - Market power, barriers for new technologies
- Rationale of emissions leakage depends on the policy context
  - Upstream more effective with carbon tax
  - But may expand emissions with binding RPS
- National perspective finds greater benefits in upstream subsidies

Extensions

- Numerical simulations
  - Refine
  - Adding China
- Knowledge spillovers
  - Do policy recommendations change with endogenous R&D and learning and spillovers?
- Overlapping carbon pricing policies

Thanks!

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Sensitivity of Optimal First-Stage Policies to Emissions Target (10% EE Undervaluation)