JOHNS HOPKINS

Grand slams and "small ball": We need systemic carbon pricing, ….yet policy details also matter!

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HEPG Session on
"Coherence or Confusion:
What is the Environmental Agenda for the Power Sector?"
Tucson, AZ, 12 Dec. 2019

Outline

- History quiz

1. If we want to decarbonize, we can't just tinker—enforce law of one price!
2. Technology mandates can waste money & hurt the environment, relative to carbon pricing
3. Need leadership to expand geographic & sectoral scope of state initiatives
4. Details of policy matter!
   - REC trading
   - Border Cost Adjustment (power trades)

History Quiz

- *What was the major issue in the 1974 Connecticut gubernatorial election?*
- *How did Sen. Mitchell propose in 1985 to solve the acid rain problem?*

- *How much more expensive was Title IV SO_2 trading than anticipated?*
  - How many pages was Title IV?
  - How many pages was Waxman-Markey?
- *How many distinct rules/programs to address carbon did the Maryland CCC consider in 2019?*
  - What fraction of MD emissions reductions by 2040 are to be from the power sector?

- *Previously: we argued about small reductions*
  - California AB32 Goal: Reduce to 1990 levels

Gov. Schwarzenegger is joined by international leaders with a consistent record of addressing the global threat of climate change, New York Governor George Pataki and other environmental and industry leaders at a bill signing for AB 32 on Treasure Island in San Francisco on Tuesday, September 27, 2006.

The Sun | NEWS | FABULOUS | MONEY | TECH | TRAVEL | MOTORS | DEAR DE

BO-ING GREEN Boris Johnson vows to make UK carbon-neutral by 2050 and Corbyn-neutral by 2020 as he reveals Conservative manifesto

David Wooding
24 Nov 2019, 0:14 | Updated: 24 Nov 2019, 0:14

19 Comments

BORIS Johnson vowed to tackle climate change yesterday and quipped he will make Britain "Corbyn- neutral by 2020".

The PM warned of a festive horror show if the Labour leader forms a government next month.

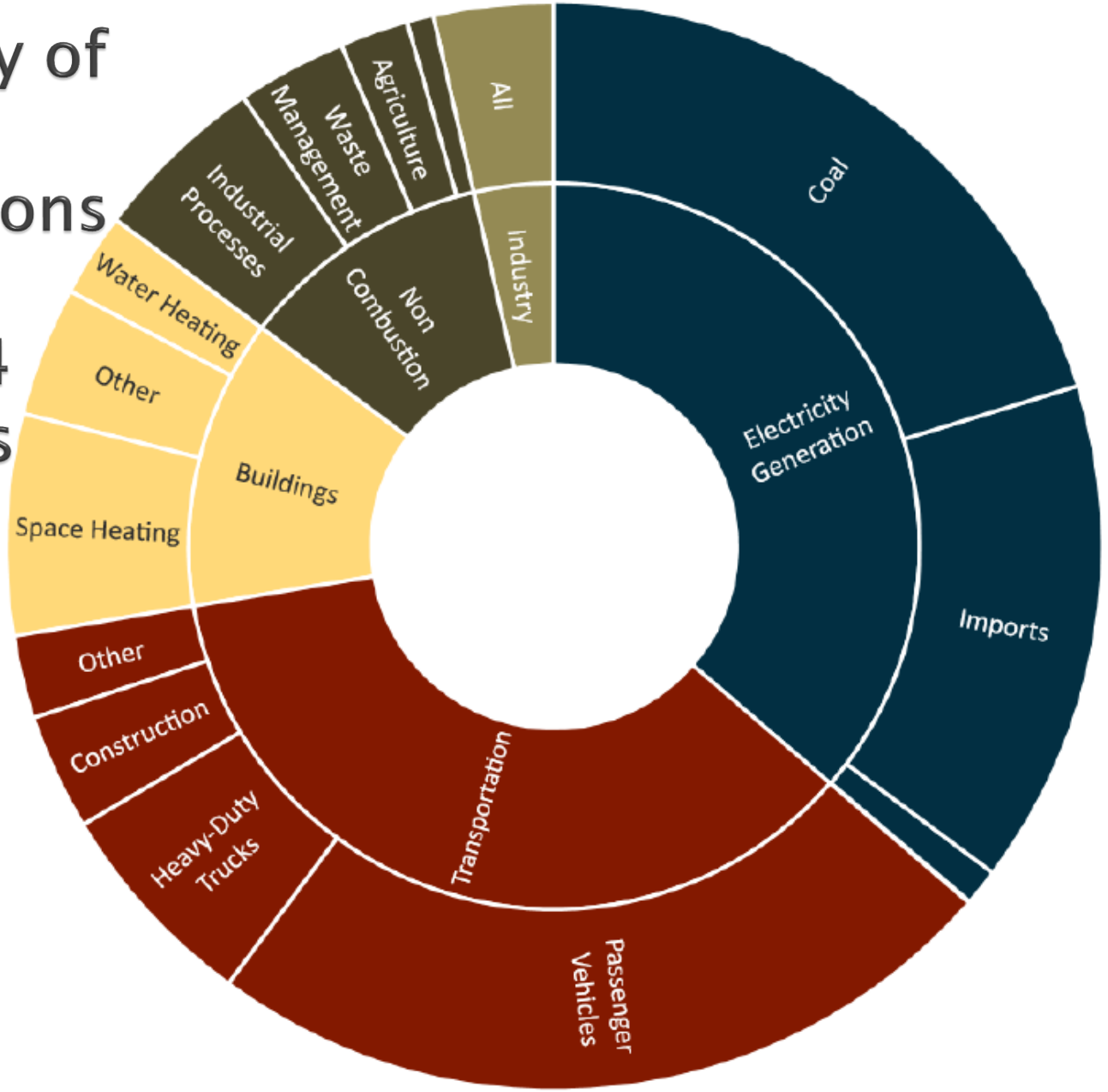
- *Now the goal is (near) carbon neutrality*

1. We can't get there without consistent, economy-wide carbon pricing

- ***Inefficiencies in today's modest policies now may waste $100Ms.***
  - E.g., RPS may buy C reductions at double or more of the most efficient policies
- ***Similar % inefficiencies in 2050 will mean we will fail to meet our goals***
  - NYISO "The cost to comply with New York's landmark carbon legislation is an "astounding number" that was so high that it was left it out of the final analysis for fear it would be a distraction, according to the report's author. Regardless, they say, placing a price on carbon will cut the cost." (*Utility Dive*, Oct. 9, 2019)
  - Wasted money means unnecessarily high emissions

The complexity of planning carbon reductions

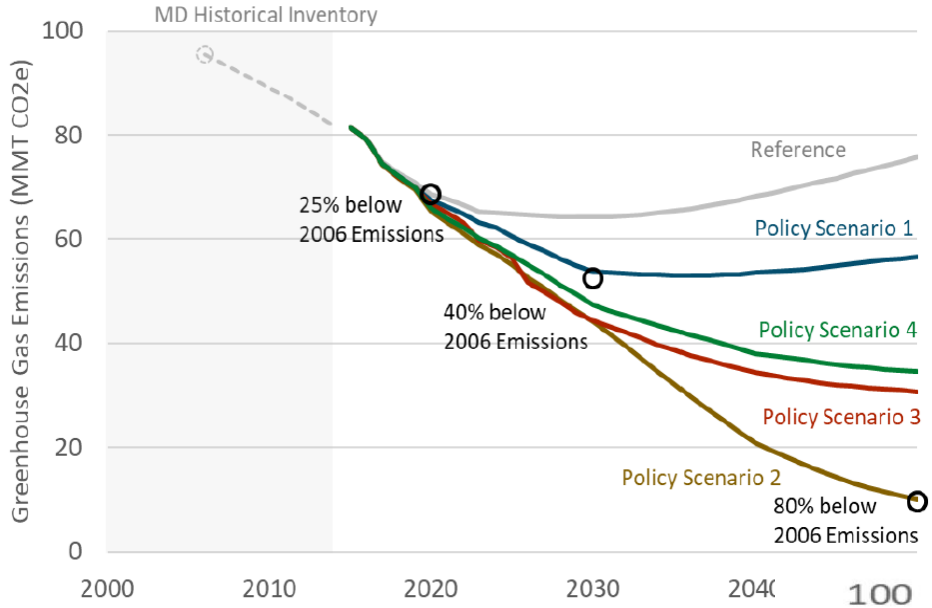
Maryland 2014 GHG emissions



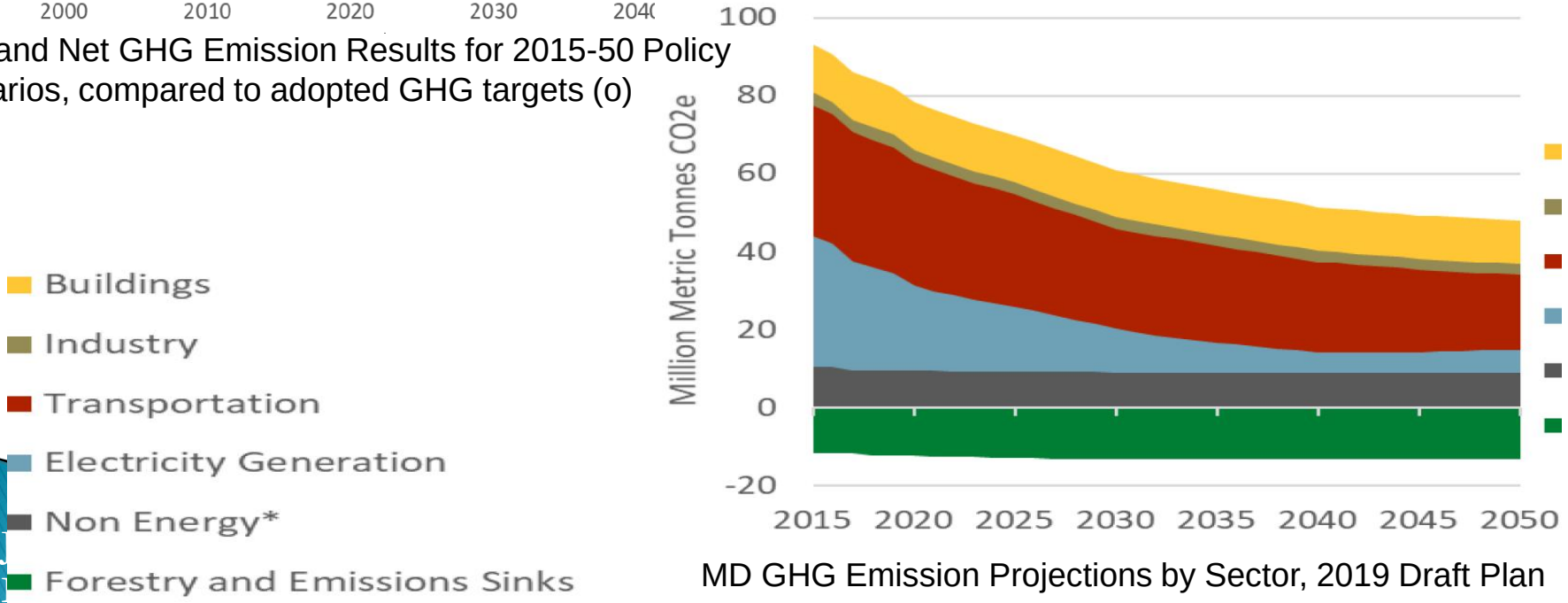
Maryland Dept. Env., The Greenhouse Gas Emissions Reduction Act, 2019 GGRA Draft Plan, Oct. 2019

The plan: ~50 programs considered in 6 sectors

(MDE, op. cit.)



Maryland Net GHG Emission Results for 2015-50 Policy Scenarios, compared to adopted GHG targets (o)



MD GHG Emission Projections by Sector, 2019 Draft Plan

Measures Adopted in MD CCC 2019 Plan

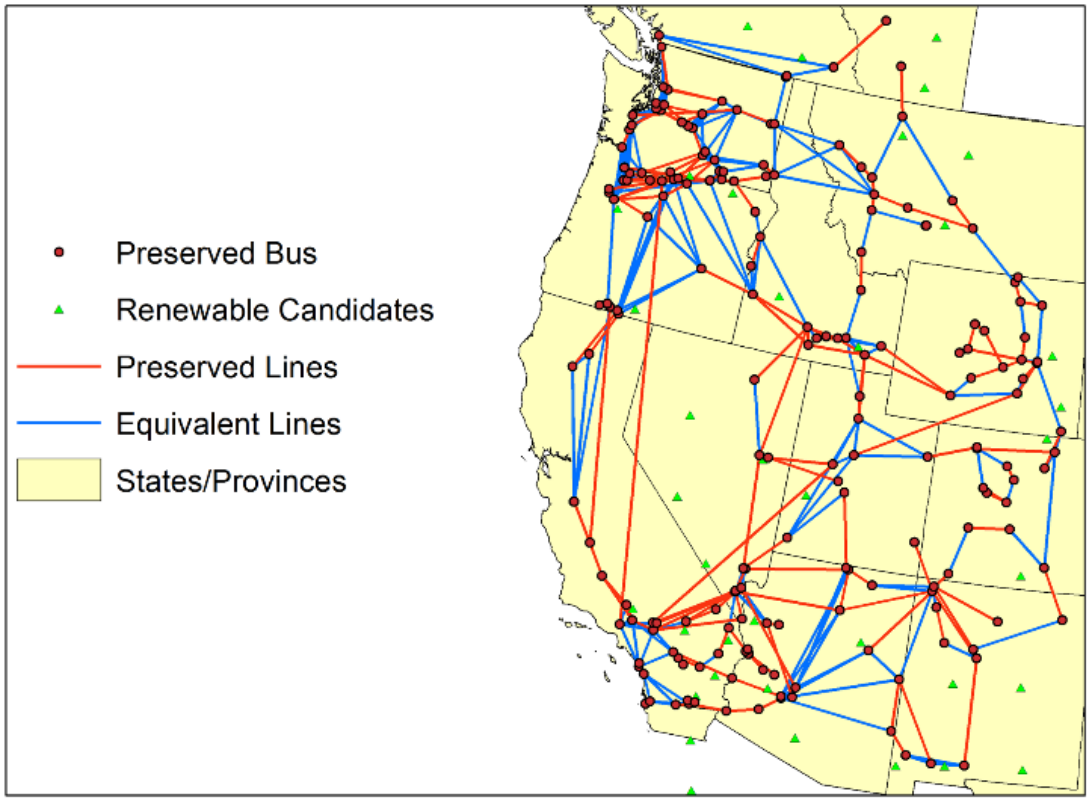
- Little stakeholder interest in broadening RGGI (more states, more sectors), or C pricing in general
  - (LBJ)
- Excitement over concrete technologies, targets
  - Concern over lack of specific technology targets in 2030s
  - Lesson of CoNAES 1978: we are likely to be very wrong on what clean technologies will "win"
- Luckily, MDE sees what must be done in the absence of federal action
  - RGGI expansion (VA, NJ, ?PA)
  - Transportation Climate Initative

2. Inefficiency of present electric policies: Paying $2 but getting $1 or $0.50 worth

- ***California 60% RPS by 2030: incremental carbon reductions at several times the least-cost approach***
  - RPS doesn't shut down coal capacity elsewhere in west
  - Limited renewable trading with other states
  - Negative mid-day power prices→ massive curtailment by 2030
  - *ERCOT example:* Levin, Kwan, Botterud, *Energy Policy*, 2019
- ***California bulk/retail pricing disconnect***
  - → wave of rooftop solar, at twice cost of bulk solar
  - CAISO ESDER initiative: reward BTM electricity storage, but not much cheaper thermal storage
  - Retail pricing reform is as important an issue as carbon pricing

JHSMINE: WECC 300 Bus Network

(Munoz, Hobbs, Kasina, *IEEE TPWRS*, 2016;
Hobbs, Xu, Ho, Donohoo, Kasina, Ouyang, Park, Eto, & Satyal, *IEEE Power & Energy Mag.* July 2016)



Optimize transmission & generation cost….

…. By choosing values of decision variables…:

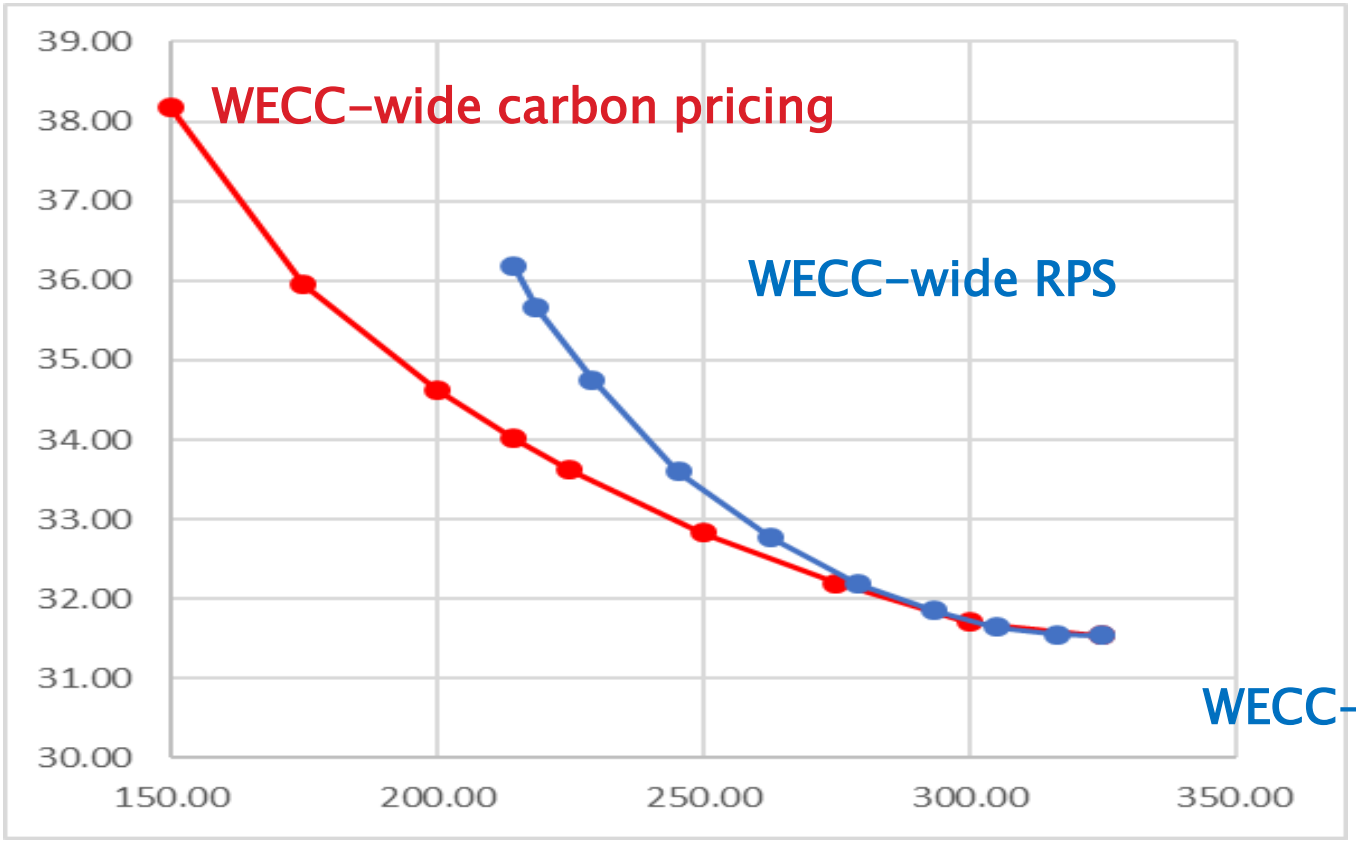
- Transmission investment
- Gen investment & dispatch

…While respecting constraints:

- Load balances (300 buses)
- Transmission flow (pipes & bubbles or linearized DC load flow)
- Generator limits
- Policies

WECC 2034: Westwide RPS vs Carbon Cap

(Qingyu Xu, Ph.D. Dissertation, Dept. Env. Health & Eng., JHU, Dec. 2019; Preliminary, do not cite)



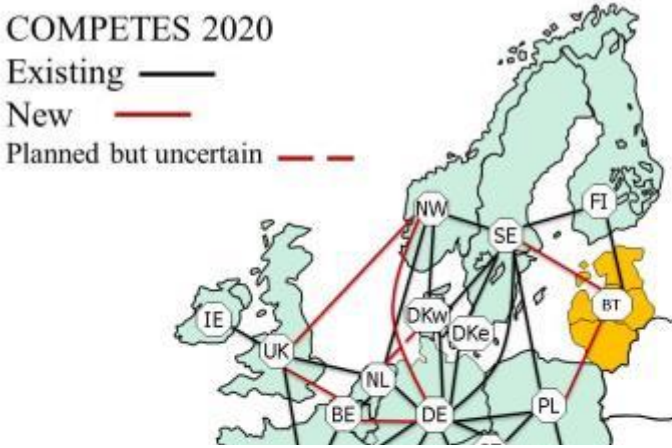
- ***Assumes efficient REC trading; costs much higher otherwise*** *(Perez, Sauma, Munoz, Hobbs, The Energy J, 2016)*
  - See EU example below

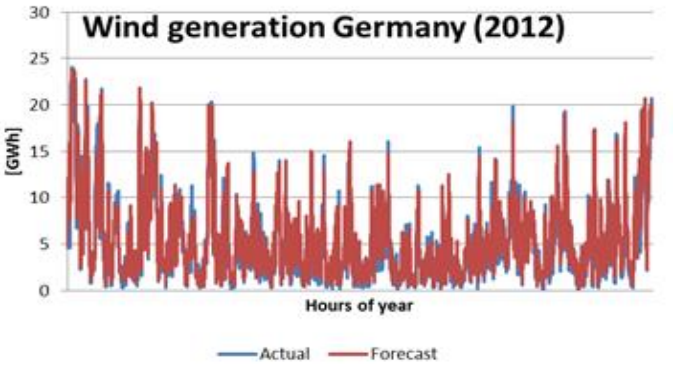
Netherlands Environmental Assessment Agency/JHU Study of 2030 EU Market

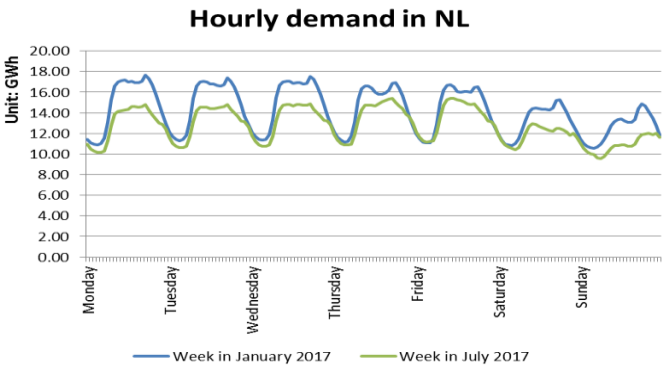
(Ozdemir, Hobbs, van Hout, Koutstaal, *Energy Policy* in press (Cambridge EPRG Working Paper 1911, 2019))

COMPETES model (Rijkers, Hobbs, IEEE TPWRS 2012):

- Generator capacity expansion
- 22 node pan-European network
  - Flows limited by NTC
  - Locational marginal pricing
- Generation / Load
  - Renewables:
    - Renewable policies EU+UK
    - 1200 Hourly load/variable renewables
  - Loads: perfectly inelastic (ENTSO-E Vision 1, 2016)
  - Generators (ENTSO-E Mid-Term Adequacy scenario; policy-driven retirements)
- LP size: 3.2M variables x 4.4M rows



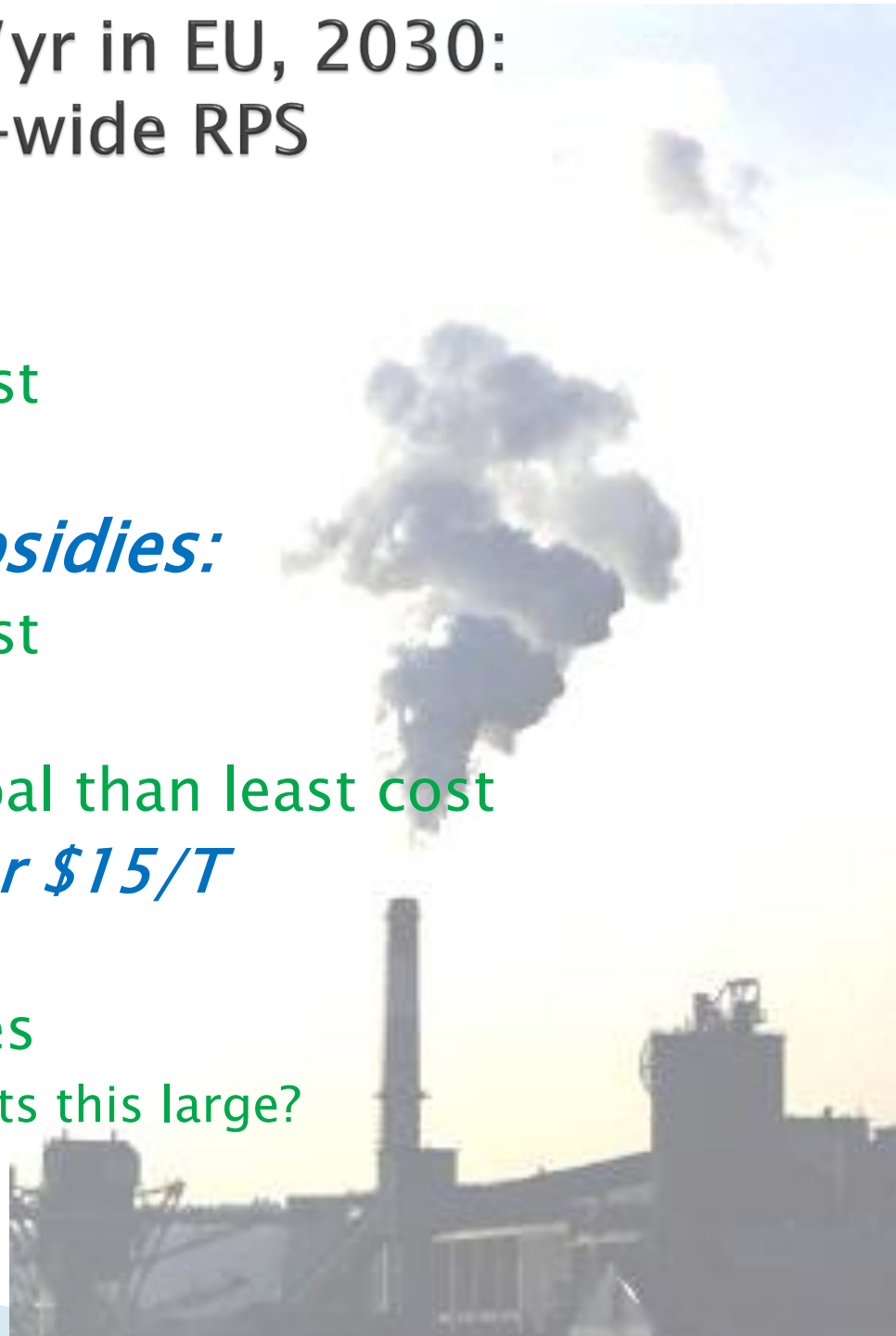




Cost of attaining 471 MT/yr in EU, 2030: Emissions Trading vs. EU-wide RPS

(preliminary results, do not cite)

- ***Least cost/ETS way:***
  - €69.1B/yr incremental cost
  - 54% renewable energy
- ***Renewable capacity subsidies:***
  - €74.6B/yr incremental cost
  - 60% renewable energy
  - Half the gas, 10% more coal than least cost
- ***Relative to 638 MT/yr under $15/T***
  - €31/T cost for ETS
  - €64/T renewable subsidies
    - Are the learning curve benefits this large?



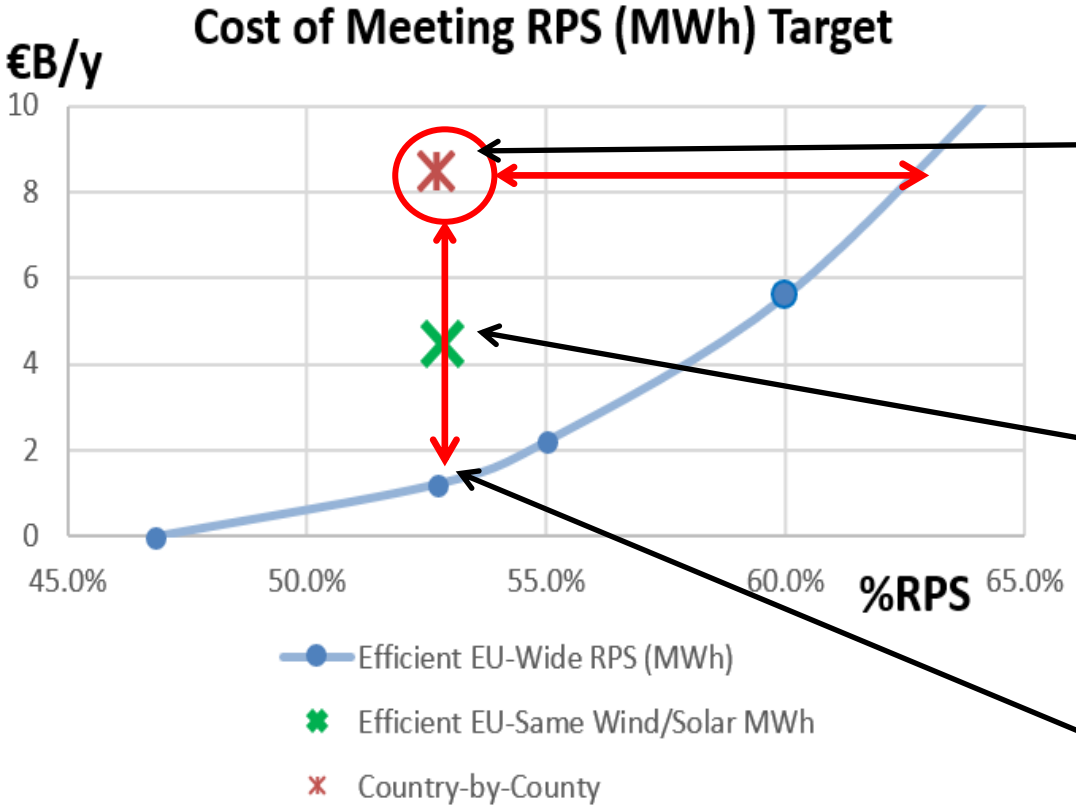
3. Making C trading more effective – there's no substitute for geographic expansion!

- ***Estimated RGGI leakage ~50%*** *(Fell, Manilov, JEEM, 2018)*
- ***Partial Fixes:***
  - Border Cost Adjustment policies (marginal effect)
  - UK allowance price floor→ ETS allowances sold to Poland?
    - With fixed cap, rearrange emissions and increase cost
  - Proposed Maryland Clean and Renewable Energy Standard (2019)
    - Won't lower RGGI emissions

4. Details of Policy Really Matter (Ozdemir et al., op. cit.)

What if no REC trade?: Country vs EU-wide Markets

ENTSO-E's 2030 "Sustainable Transition" Country-by-Country targets
→ 52.7% renewable MWh



Country-by-Country:
- 77GW On-S Wind
- 35GW Off-S Wind
- 114GW Solar

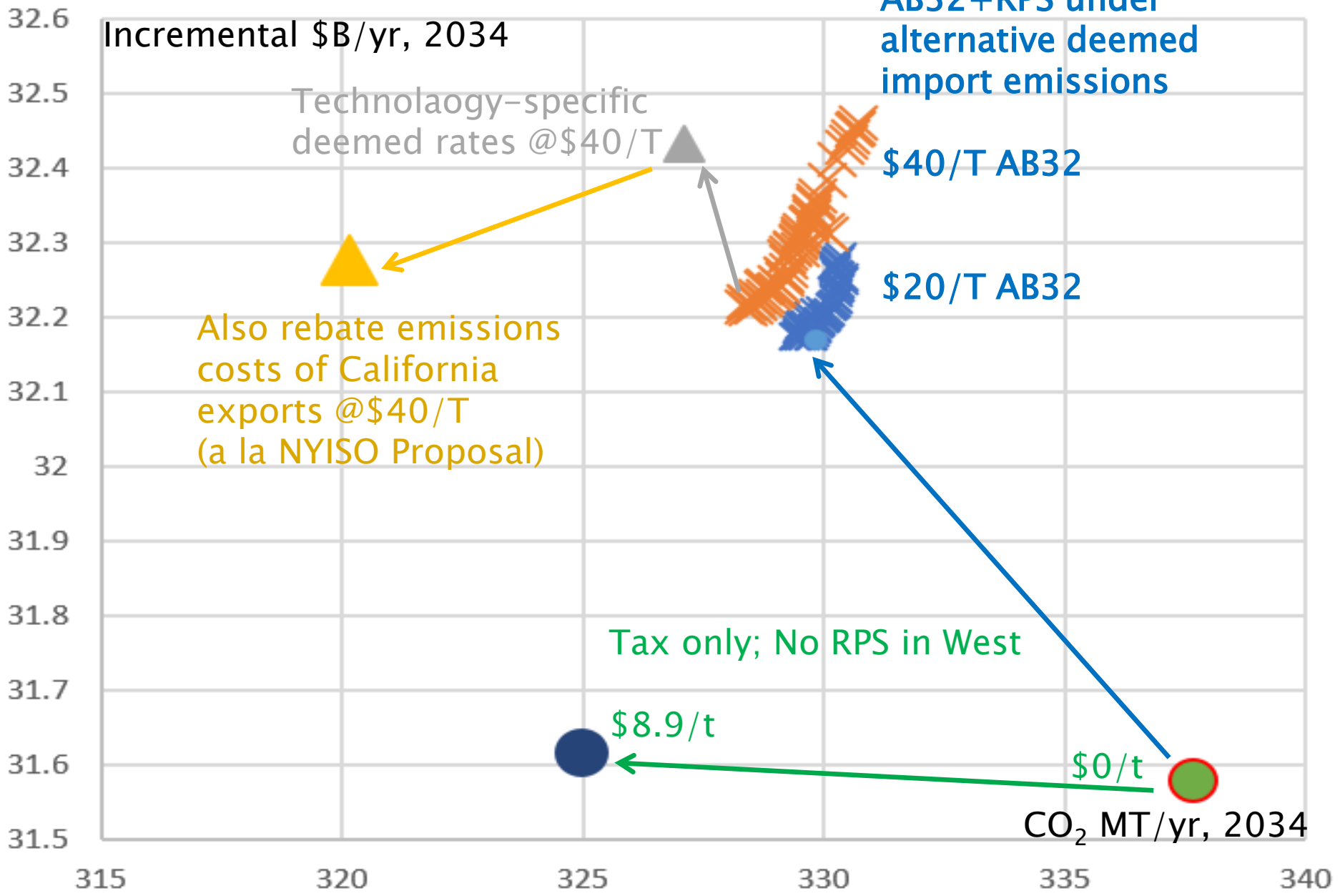
EU-wide: Same MWh of Wind, Solar:
- 72GW On-S Wind
- 34GW Off-S Wind
- 89GW Solar

Same EU MWh Renewables:
- 133GW On-S Wind
- 0GW Off-S Wind
- 49GW Solar

~Half of inefficiency due to wrong mix, half to wrong *locations*

Tinkering with AB32: Resulting WECC-Wide CO_2, Cost

(Qingyu Xu, op. cit., preliminary, do not cite)



Conclusions

- ***Need***
  - Systemic price as main driver in long run
  - Efficient electric sector policies: technology carve-outs generally increase cost
  - Expand state initiatives
  - Mind the details: e.g, REC trading, border cost adjustments