Effects of Renewable Portfolio Standards on Bioenergy: An Econometric Approach

SOFAC Annual Meeting 2022

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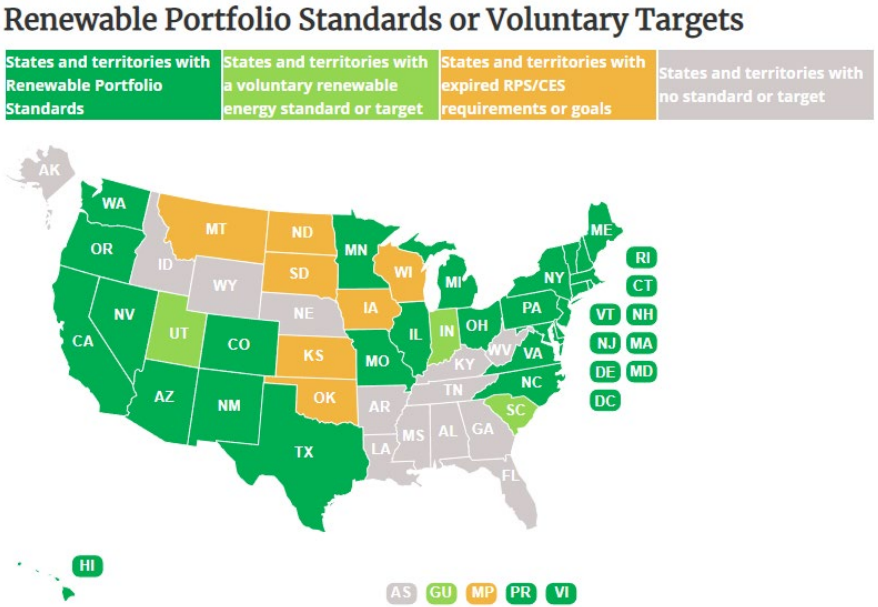
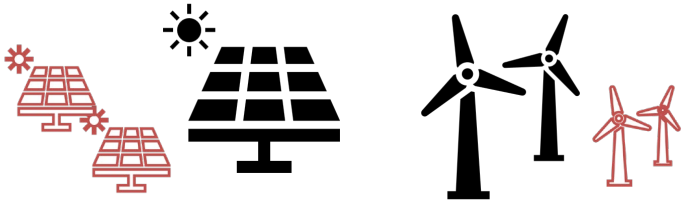
What is the RPS policy?



- To increase electricity generation from and capacity for renewable sources.
- Currently, there are **32 RPS** policies in place in the US (in addition to nine other state renewable portfolio goals).
- 13 states have no such policy.

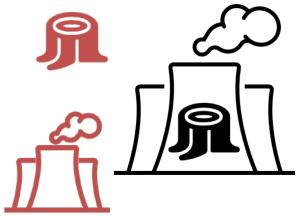
Source: NCSL (https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx)

What are we investigating?



Solar and wind

1. Install new capacity



Biomass-fueled plants

Co-firing plants

1. Install new capacity
2. Burn more biomass in bio-fueled plants
3. Increase the usage of biomass in **existing** cofiring plants

How do we evaluate the effect?

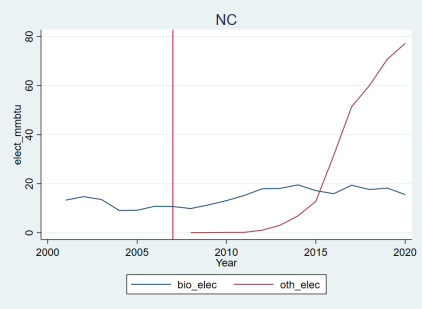
We employed both difference-in-differences and synthetic control method:

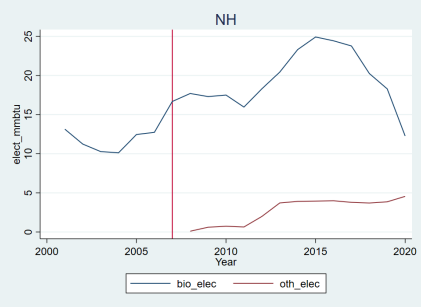
- DiD:

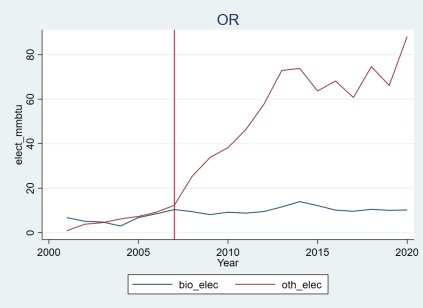
$$Y_{it}^{j} = \beta_o^j + \beta_1^j RPS_i + \beta_2^j Post_t + \beta_3^j RPS_i * Post_t + \gamma_i^j + \delta_t^j + \epsilon_{it}^j$$

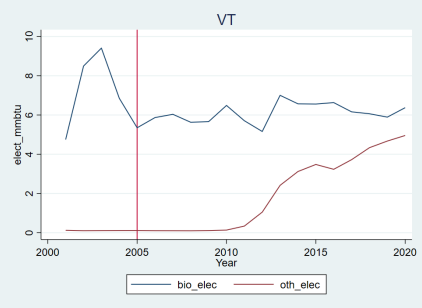
  - j=1: bio-energy
  - j=2: other renewables
- Y_{it}^{j} fuel consumption in mmBTUs (EIA Form 923)
- RPS_i=1 for ME, NC, NH, OR, VT, WA; RPS_i=0 for 13 control states
- $Post_t$=1 for the years after the state RPS policy, otherwise $Post_t$=0
- γ_i^j state fixed effect, δ_t^j year fixed effect

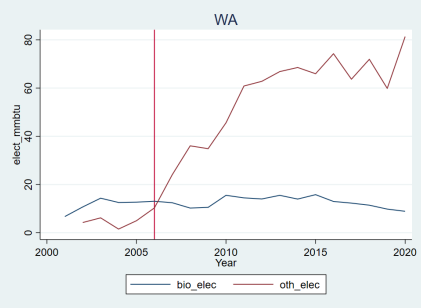
What have we found?

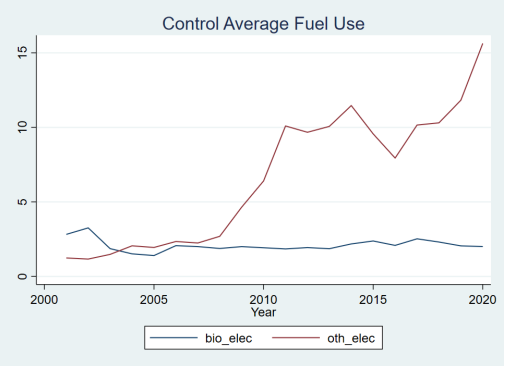












Bio-energy treatment effect

Bio-energy DID	(1) ME	(2) NC	(3) NH	(4) OR	(5) VT	(6) WA
rps_effect	-2.394***	-0.856	0.450	0.320	-3.919***	-0.0723
	(0.576)	(0.687)	(0.698)	(0.654)	(0.884)	(0.860)
Observations	945	940	913	931	878	961
R-squared	0.165	0.184	0.187	0.189	0.199	0.182
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes

Finding 1：RPS policies have had limited (or even negative) impact on biomass electricity investments

Other renewables treatment effect

Other-Renewables DID	(1) ME	(2) NH	(3) NC	(4) OR	(5) VT	(6) WA
rps_effect	-1.694	-1.197	12.91***	5.484	-11.72**	13.69**
	(3.718)	(1.090)	(1.211)	(4.655)	(4.579)	(4.617)
Observations	207	203	207	228	219	221
R-squared	0.403	0.415	0.376	0.311	0.424	0.366
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes

Finding 2: Investments in wind and solar have been positively impacted by the policies in NC, WA; negatively in VT.

Co-fire percentage treatment effect

Co-fire percentage DID	(1) ME	(2) NC	(3) NH	(4) OR	(5) VT	(6) WA
rps_effect	0.0113	0.0313	0.563***			-0.0274
	(0.0222)	(0.0245)	(0.0298)			(0.0236)
Observations	518	609	483	468	468	493
R-squared	0.018	0.028	0.086	0.016	0.016	0.016
Number of sid	38	45	36	35	35	37
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes

Finding 3: Electricity providers are bypassing intermediate investments in co-firing that could extend the lifetime of existing energy infrastructure.

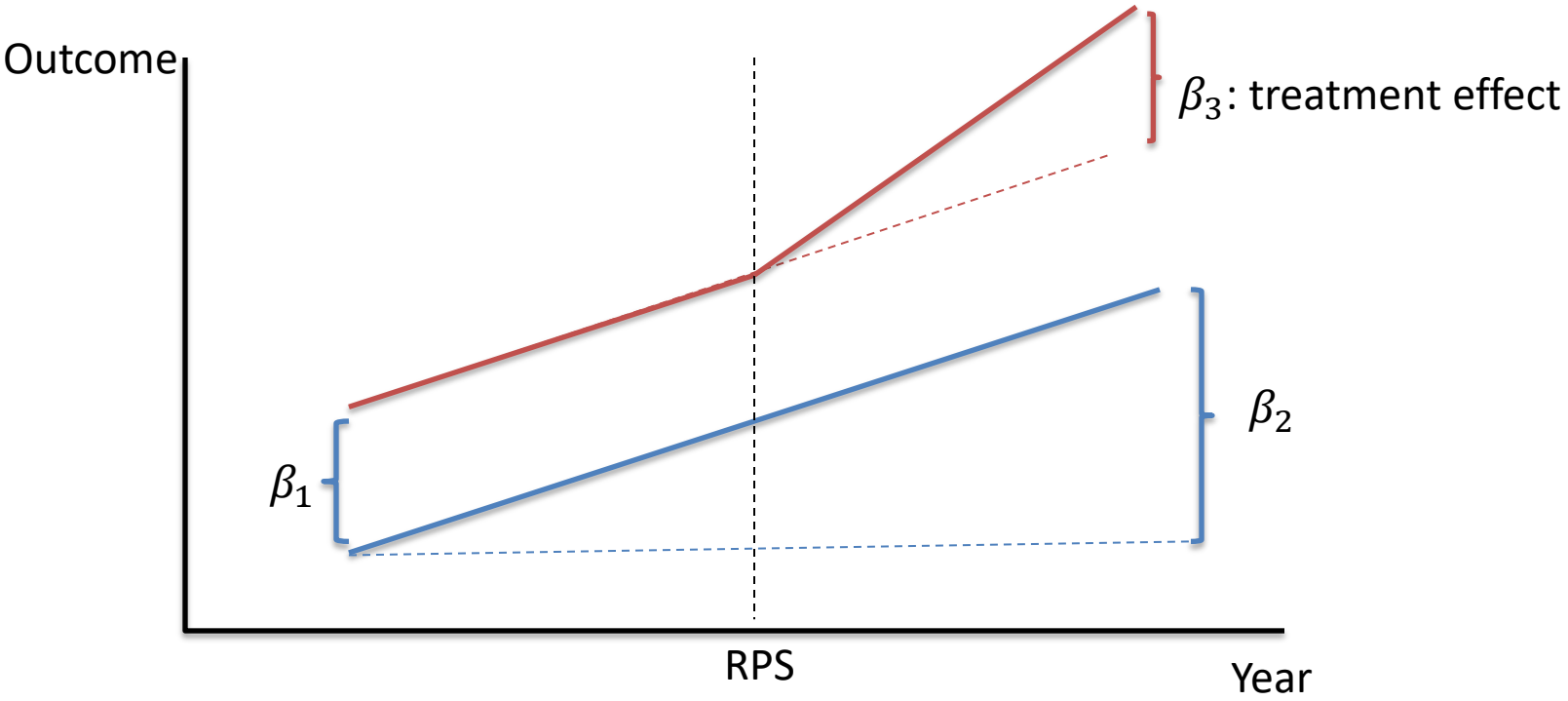
Next Steps

- Expanding the analysis to additional states
- Assessing intensive vs. extensive margin effects
- Additional analysis of state-level trends

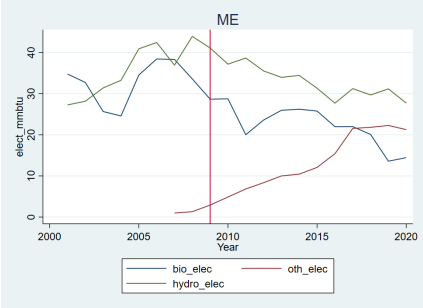
Thank you for listening!

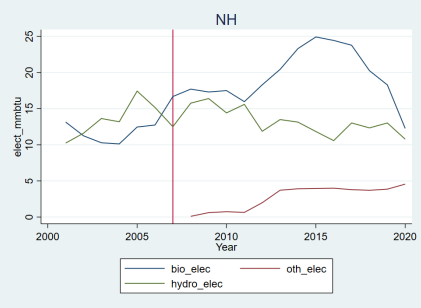
Q&A

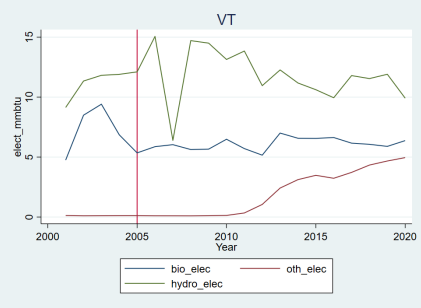
Difference-in-differences visualized

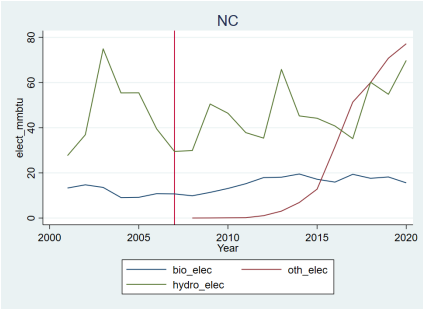


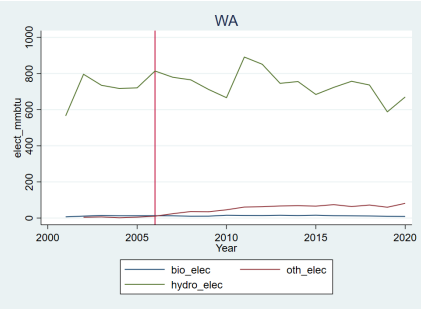
Hydro power

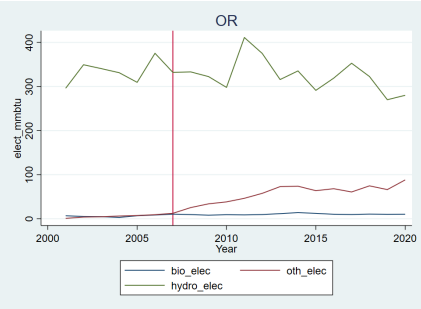

ME
elect_mmbtu
0
10
20
30
40
2000
2005
2010
2015
2020
Year
bio_elec
oth_elec
hydro_elec

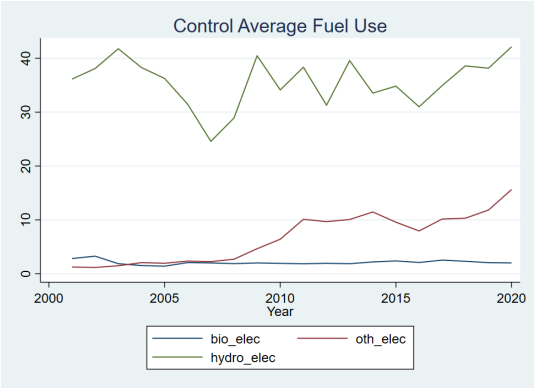

NH
elect_mmbtu
0
5
10
15
20
25
2000
2005
2010
2015
2020
Year
bio_elec
oth_elec
hydro_elec


VT
elect_mmbtu
0
5
10
15
2000
2005
2010
2015
2020
Year
bio_elec
oth_elec
hydro_elec


NC
elect_mmbtu
0
20
40
60
80
2000
2005
2010
2015
2020
Year
bio_elec
oth_elec
hydro_elec


WA
elect_mmbtu
0
200
400
600
800
1000
2000
2005
2010
2015
2020
Year
bio_elec
oth_elec
hydro_elec


OR
elect_mmbtu
0
100
200
300
400
2000
2005
2010
2015
2020
Year
bio_elec
oth_elec
hydro_elec


Control Average Fuel Use
0
10
20
30
40
2000
2005
2010
2015
2020
Year
bio_elec
oth_elec
hydro_elec