ONLINE APPENDIX

Renewable Portfolio Standards

The Energy Journal

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Replicating Prior Results

In this section we replicate the results in papers from which we borrow empirical methods, Greenstone and Nath (2020) and Hollingsworth and Rudik (2019). Table A1 is a glossary of each variable used in this project, its definition, and its source. Table A2 replicates the summary statistics from Greenstone and Nath's Table 1. Differences are minor and result from differences in data sources. We compile data on individual state RPSs from the Database of State Incentives for Renewables and Efficiency (DSIRE) and use data from Hollingsworth and Rudik (2019), whereas Greenstone and Nath use data from individual state legislative documents, as well as the DSIRE database.

Those slight data differences help explain the small difference we see when we replicate Greenstone and Nath's Figure 3, which describes the main contribution we borrow their paper, their calculation of the net RPS requirement. We replicate that figure in Figure A1. The two figures are quite similar, with one notable exception being Arizona. Our calculations show Arizona's net requirement seven years after its RPS passage to be zero because it had existing renewables generation that exceeded the requirement. Because we account for more nonadditional renewables, our results will be likely to show less additional renewables caused by RPSs.

In Table A3 we replicate the first set of Greenstone and Nath Results (Table 2 in their paper). Using Greenstone and Nath's main specification (equation 9 in their paper), our results and theirs both show that RPSs raise retail electricity prices. States' average electricity prices rise by 1.3 cents per kWh seven years after an RPS is enacted. Residential rates rise a bit more, commercial and industrial less.

Table A4 replicates the second set of results from Greenstone and Nath, the effect of RPSs on CO_2 emissions (Table 5 in their paper). We both find that CO_2 decreases after RPS passage, by 3 percent after 7 years and by 10 to 13 percent after 12 years. Again, our results are largely similar to theirs, with minor differences due to the data differences discussed above.

Next we turn to Hollingsworth and Rudik (2019). Table A5 replicates their summary statistics. Most of the data match, except for those describing RPS requirements in the first two rows. Hollingsworth and Rudik compile their own dataset of RPS requirements from state legislative documents and the DSIRE database. We follow Greenstone and Nath (2020) and use RPS requirements from the LBNL.

The approach we follow builds off Hollingsworth and Rudik, but rather than using their measure of out-of-state REC demand, we amend it by using *net* out-of-state REC demand, subtracting from their measure the renewables each state generates itself. Before making that change, we first replicate their results in Table A6 and Table A7. Our results are similar to theirs. We both find that more stringent RPS policies are associated with more natural gas generation and more wind generation. Hollingsworth and Rudik additionally find that more stringent RPSs are associated with less coal generation. That difference comes from our use of different data for RPS requirements.[1]

In sum, we measure RPS stringency using LBNL, we calculate generation and emissions using EIA, and we gather information on individual state RPSs from DSIRE. Our replications show that despite a few differences in the underlying data, applying the methods of the other researchers yields similar results. RPSs are associated with increasing electricity prices and wind generation and falling CO_2 emissions.

[1] Hollingsworth and Rudik (2019) generously posted online their data and code, facilitating this replication of their methodology and results.

Appendix Table A1. Data Sources and Descriptions

Variable (1)	Description (2)	Source (3)
RPS Stringency		
RPS Gross Requirement (TWh)	On-books RPS requirement, by state and year	LBNL
RPS Net Requirement (TWh)	RPS requirement less renewable energy generated in year before RPS was passed, by state and year	LBNL
Net Out-of-State REC Demand (TWh)	Sum of given state's trading partners' RPS gross requirement less their contemporaneous in-state renewables generation, by state and year	LBNL, Hollingsworth and Rudik (2019)
Total Net REC Demand (TWh)	Total net REC demand each state faces, from its own RPS goal and its out-of-state demand (RPS Net Requirement + Net Out-of-State REC Demand), by state and year	Created by Feldman and Levinson
Outcome Variables		
Coal (TWh)	Coal generation, by state and year	EIA
Natural Gas (TWh)	Natural gas generation, by state and year	EIA
Wind (TWh)	Wind generation, by state and year	EIA
Solar (TWh)	Solar generation, by state and year	EIA
Renewables (TWh)	Total renewables generation, by state and year	EIA
CO_2 (MMT)	CO_2 emissions, by state and year	EIA
SO_2 (MMTs)	SO_2 emissions, by state and year	EIA
NO_x (MMTs)	NO_x emissions, by state and year	EIA
Industrial Price (Cents per kWh)	Price of retail electricity in industrial sector	EIA, BLS
Total Price (Cents per kWh)	Price of retail electricity averaged across all sectors	EIA, BLS
Residential Price (Cents per kWh)	Price of retail electricity in residential sector	EIA, BLS
Commercial Price (Cents per kWh)	Price of retail electricity in commercial sector	EIA, BLS
Other Covariates		
Democratic State Legislature Control	Indicator for whether Democrats had control of state house and senate	NCSL
Republican State Legislature Control	Indicator for whether Republicans had control of state house and senate	NCSL
Split State Legislature Control	Indicator for whether Democrats and Republicans each controlled one chamber of the state house and senate	NCSL

House Seats Won by Democrats	Number of state house seats won by Democrats in most recent election	Klarner (2018)
Senate Seats Won by Democrats	Number of state senate seats won by Democrats in most recent election	Klarner (2018)
House Seats Won by Republicans	Number of state house seats won by Republicans in most recent election	Klarner (2018)
Senate Seats Won by Republicans	Number of state senate seats won by Republicans in most recent election	Klarner (2018)
House Seats Won by Third Party	Number of state house seats won by third party in most recent election	Klarner (2018)
Senate Seats Won by Third Party	Number of state senate seats won by third party in most recent election	Klarner (2018)
GDP per Capita, Mining ($)	Mining sector per capita GDP in each state	BEA, DHHS, CDC
GDP per Capita, Manufacturing ($)	Manufacturing sector per capita GDP in each state	BEA, DHHS, CDC
State GDP per Capita, Total ($)	Statewide economy per capita GDP	BEA, DHHS, CDC
Cost of Wind ($ per MWh)	Average (across continental U.S.) cost of installing wind turbines each year, in dollars per MWh generated	LBNL
Cost of Solar ($ per MWh)	Average (across the continental U.S.) cost of installing utility-scale solar panels each year, in dollars per MWh generated	LBNL
Wind Speed (m/s)	Average wind speed in each state in 1998	NASA
Solar Irradiation (kWh/m^2/day)	Average solar irradiation (measured by direct normal irradiance) in each state in 1998	NREL
Wind Instrument	Cost of Wind × Wind Speed	Created by Feldman and Levinson
Solar Instrument	Cost of Solar × Solar Irradiation	Created by Feldman and Levinson
Net Metering	Indicator for if a state has a net metering program	DSIRE, Hollingsworth and Rudik (2019)
Mandatory Green Power Option	Indicator for whether state has mandatory green power option program	DSIRE, Hollingsworth and Rudik (2019)
Public Benefits Fund	Indicator for whether state has public benefits fund program	DSIRE, Hollingsworth and Rudik (2019)

LCV House Score	League of Conservation Voters house score, by state	Hollingsworth and Rudik (2019), LCVS
LCV Senate Score	League of Conservation Voters senate score, by State	Hollingsworth and Rudik (2019), LCVS
Renewable Energy Lobby	Indicator for whether state has chapter of American Solar Energy Society (ASES often lobbies for renewables other than solar)	ASES
Total Net RECs Available to Buy (TWh)	Number of RECs available for each state to purchase (to use toward RPS goals); sum of given state's trading partners' renewables generation less their RPS requirements (counterpart to Net Out-of-State REC Demand)	Created by Feldman and Levinson
Electricity Sales (TWh)	Total retail electricity sales, by state and year	EIA

Notes: ASES = American Solar Energy Society; BEA = Bureau of Economic Analysis; BLS = Bureau of Labor Statistics; CDC = Centers for Disease Control and Prevention; DSIRE = Database for State Incentives for Renewables and Efficiency; DHHS = Department of Health and Human Services; EIA = Energy Information Administration; LBNL = Lawrence Berkeley National Laboratory; LCVC = League of Conservation Voters Scorecard; NCSL = National Conference of State Legislatures; NREL = National Renewable Energy Laboratory.

Appendix Table A2. Replication of Statistics from Greenstone and Nath (2020)

Variables	Feldman and Levinson (1)	Greenstone and Nath (1)
Total Price (Cents/kWh)	11.43	11.4
	(3.51)	—
Residential Price (Cents/kWh)	13.36	13.4
	(3.82)	—
Commercial Price (Cents/kWh)	11.82	11.8
	(3.54)	—
Industrial Price (Cents/kWh)	8.52	8.5
	(3.06)	—
CO_2 Emission (MMTs)	47.95	48.0
	(51.77)	—
Total Generation (TWh)	80.46	80.5
	(79.06)	—
RPS Eligible Generation (TWh)	8.32	8.9
	(16.25)	—
RPS Eligible Generation (Percentage of Total)	12.0	13.5
	—	—
Total Capacity (GW)	20.26	20.3
	(18.78)	—
RPS Eligible Capacity (GW)	2.36	2.5
	(4.66)	—
RPS Eligible Capacity (Percentage of Total)	13.0	14.2
	—	—
Public Benefit Funds	0.36	0.41
	(0.48)	—
Net Metering	0.52	0.66
	(0.5)	—
Green Power Purchasing	0.08	0.07
	(0.27)	—
Observations	754	—

Notes: Column (1) is estimated using our data. Column (2) is copied Greenstone and Nath Table 1. Means and standard deviation (in parentheses). Averaged over RPS states. Public Benefit Funds, Net Metering, and Green Power Purchasing refer to the proportion of RPS states that have those programs. Standard deviations were not reported in Greenstone and Nath Table 1. We report the standard deviations with our means, but not with theirs.

Appendix Table A3. Replication of Greenstone and Nath (2020): Effect of RPS Policies on Average Retail Electricity Prices

	Total Price		Residential Price		Commercial Price		Industrial Price	
	(1b), F&L	(1b), G&N	(2b), F&L	(2b), G&N	(3b), F&L	(3b), G&N	(4b), F&L	(4b), G&N
Mean, 7 years	0.345	0.36	0.231	0.21	0.352	0.39	0.739	0.80
(β_3)	(0.233)	(0.23)	(0.226)	(0.23)	(0.228)	(0.22)	(0.436)	(0.46)
Trend	0.164	0.14	0.253*	0.22	0.102	0.09	0.019	0.01
(δ_3)	(0.096)	(0.09)	(0.101)	(0.09)	(0.101)	(0.09)	(0.104)	(0.09)
Effect of RPS 7 Years After Passage ($6\,\beta_3 + \delta_3$)	1.329	1.22	1.749	1.51	0.964	0.92	0.856	0.89
	(0.677)	(0.58)	(0.711)	(0.62)	(0.692)	(0.60)	(0.544)	(0.49)
Mean, 12 Years	0.418	0.39	0.342	0.27	0.413	0.40	0.658	0.68
(β_3)	(0.304)	(0.28)	(0.300)	(0.28)	(0.305)	(0.27)	(0.395)	(0.40)
Trend, 12 Years	0.140	0.14	0.211	0.19	0.084	0.09	0.057	0.07
(δ_3)	(0.083)	(0.07)	(0.088)	(0.07)	(0.091)	(0.08)	(0.095)	(0.08)
Effect of RPS 12 Years after Passage ($11\,\beta_3 + \delta_3$)	1.957	1.91	2.668	2.41	1.337	1.39	1.290	1.46
	(0.973)	(0.77)	(1.029)	(0.87)	(1.028)	(0.87)	(0.960)	(0.80)
Mean at $\tau = -1$	11.43	11.4	13.36	13.4	11.82	11.8	8.52	8.5
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other State Programs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300

Notes: Replicates column b of Greenstone and Nath Table 2. Standard errors in parentheses. *p<0.05.

Appendix Table A4. Replication of Greenstone and Nath (2020)

Panel A

	log(CO_2 Emissions), F&L (1)	log(CO_2 Emissions), G&N (2)
Effect of RPS 7 Years after Passage ($6\ \beta_3 + \delta_3$)	-0.033	-0.03
	(0.115)	(0.11)
Effect of RPS 12 Years after Passage ($11\ \beta_3 + \delta_3$)	-0.103	-0.13
	(0.156)	(0.14)
Mean at $\tau = -1$	47.95 MMTs	48.0 MMTs
State Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Other State Programs	Yes	Yes
Observations	1,300	1,300

Panel B

	log(CO_2 Emissions), F&L (1)	log(CO_2 Emissions), G&N (2)
7 Years after Passage	-0.098	-0.10
($6\ \beta_3 + \delta_3$)	(0.075)	(0.06)
12 Years after Passage	-0.173	-0.26
($11\ \beta_3 + \delta_3$)	(0.123)	(0.11)
Region Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Other State Programs	Yes	Yes
Observations	312	312

Notes: Replicates Table 5 in Greenstone and Nath. Standard errors in parentheses. Panel A reports analysis at the state level. Panel B reports analysis at the REC market level. See Greenstone and Nath for a definition of each REC market.

Appendix Table A5. Replication of Hollingsworth and Rudik (2019): Summary Statistics

Variables	Feldman and Levinson (1)	Hollingsworth and Rudik (2)
In-State Requirement (TWh)	0.878	1.55
	(3.788)	(6.48)
Out-of-State Requirement (TWh)	6.172	11.03
	(13.68)	(21.69)
Wind (TWh)	0.765	0.75
	(2.647)	(2.61)
Solar (TWh)	0.0248	0.02
	(0.168)	(0.12)
Coal (TWh)	36.84	36.40
	(35.73)	(35.44)
Natural Gas (TWh)	14.59	12.90
	(31.23)	(26.53)
LCV State Senate Score	48.44	48.44
	(33.97)	(33.97)
LCV State House Score	45.92	45.92
	(26.72)	(26.72)
REC Multiplier Level	0.027	0.03
	(0.184)	(0.18)
ACP Binary	0.095	0.10
	(0.294)	(0.29)
ACP Level: Primary	4.525	4.53
	(15.09)	(15.09)
ACP Level: Secondary	1.298	1.30
	(8.166)	(8.17)
Unbundled RECs Binary	0.195	0.20
	(0.397)	(0.40)
Years of REC Banking	0.406	0.41
	(1.079)	(1.08)
Mandatory Green Power Option Binary	0.063	0.06
	(0.243)	(0.24)
Public Benefits Fund Binary	0.240	0.24
	(0.427)	(0.43)
Lagged Retail Electricity Price	7.976	7.98
	(3.071)	(3.07)
Median Income $100k	0.550	0.55
	(0.086)	(0.09)
RGGI Membership Dummy	0.055	0.06
	(0.229)	(0.23)
RGGI Membership × RGGI CO_2 Allowance Price	0.136	0.14
	(0.577)	(0.58)
Observations	1,050	1,050

Notes: Replicates Table A1 in Hollingsworth and Rudik. Means reported, standard deviation in parentheses. Averaged over all states in the sample. The main discrepancy between our data set and Hollingsworth and Rudik's is the in-state and out-of-state REC requirements. Our data come from the LBNL database; Hollingsworth and Rudik's come from the DSIRE database and state documents. RGGI = Regional Greenhouse Gas Initiative (northeastern states).

Appendix Table A6. Replication of Hollingsworth and Rudik (2019): Effect of RPS Stringency on Generation

	Coal (TWh) (1a), F&L	Coal (TWh) (1b), H&R	Natural Gas (TWh) (2a), F&L	Natural Gas (TWh) (2b), H&R	Wind (TWh) (3a), F&L	Wind (TWh) (3b), H&R
Out-of-State Requirement (TWh)	-0.049	-0.067*	-0.129*	-0.027	0.014	0.000
	(0.058)	(0.032)	(0.056)	(0.039)	(0.020)	(0.001)
In-State Requirement (TWh)	-0.050	-0.130*	0.312*	0.240*	0.134*	0.073*
	(0.138)	(0.076)	(0.148)	(0.101)	(0.041)	(0.018)
Observations	1,050	1,050	1,050	1,050	1,050	1,050

Notes: Replication of Hollingsworth and Rudik Table 1. Standard errors in parentheses. * p<0.05.

Appendix Table A7. Replication of Hollingsworth and Rudik (2019): Effect of RPS Stringency on Generation after Dropping Nonparallel Trends

	Coal (TWh) (1a), F&L	Coal (TWh) (1b), H&R	Natural Gas (TWh) (2a), F&L	Natural Gas (TWh) (2b), H&R	Wind (TWh) (3a), F&L	Wind (TWh) (3b), H&R
Out-of-State Requirement (TWh)	-0.033	-0.057*	-0.077	-0.007	0.026	0.013*
	(0.047)	(0.012)	(0.041)	(0.014)	(0.017)	(0.003)
In-State Requirement (TWh)	0.002	-0.113*	0.410*	0.304*	0.137*	0.075*
	(0.109)	(0.029)	(0.164)	(0.033)	(0.027)	(0.007)
Observations	903	903	903	903	1,029	1,029

Notes: Replication of Hollingsworth and Rudik Table 2. Standard errors in parentheses. * p<0.05. States that did not have parallel trends were dropped. See Hollingsworth and Rudik (2019) for details.

Appendix Table A8. Full Regression of REC Demand on Generation and Emissions

	Coal (TWh) (1)	Natural Gas (TWh) (2)	Wind (TWh) (3)	Solar (TWh) (4)	CO_2 Emissions (MMT) (5)
Total Net REC Demand (TWh)	-0.400*	0.020	0.015	0.001	-0.364*
	(0.033)	(0.049)	(0.018)	(0.001)	(0.027)
LCV House Score	0.009	0.024	-0.002	0.014*	0.003
	(0.015)	(0.023)	(0.008)	(0.003)	(0.013)
LCV Senate Score	-0.019	-0.011	-0.007	-0.001	-0.018*
	(0.011)	(0.016)	(0.006)	(0.002)	(0.009)
Mandatory Green Power Option	2.904*	-5.101*	2.429*	-0.462*	1.719*
	(1.046)	(1.563)	(0.582)	(0.187)	(0.869)
Public Benefits Fund	0.618	-3.374*	-2.106*	0.286	-1.342
	(0.848)	(1.267)	(0.472)	(0.151)	(0.705)
Net Metering	-1.210	0.248	-1.671*	-0.066	-1.335*
	(0.727)	(1.086)	(0.405)	(0.130)	(0.604)
Restructured Electricity Market	0.043	1.380	2.673*	-0.672*	-0.114
	(0.853)	(1.275)	(0.475)	(0.152)	(0.709)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	1,530	1,530	1,530	1,530	1,530
R^2	0.96	0.91	0.47	0.30	0.98

Notes: Standard errors in parentheses. * $p<0.05$. This table shows the full estimation of equation (4).

Appendix Table A9. Full Regression of In-State and Out-of-State REC Demand on Generation and Emissions

	Coal (TWh)	Natural Gas (TWh)	Wind (TWh)	Solar (TWh)	CO_2 Emissions (MMT)
	(1)	(2)	(3)	(4)	(5)
Net In-State REC Demand (TWh)	-0.476*	1.081*	0.873*	0.333*	-0.484*
	(0.103)	(0.150)	(0.052)	(0.016)	(0.085)
Net Out-of-State REC Demand	-0.385*	-0.183*	-0.149*	-0.062*	-0.3410*
(TWh)	(0.038)	(0.055)	(0.019)	(0.006)	(0.031
LCV House Score	0.010	0.010	-0.014	0.009*	0.005
	(0.015)	(0.022)	(0.008)	(0.002)	(0.013)
LCV Senate Score	-0.018	-0.019	-0.013*	-0.004*	-0.017
	(0.011)	(0.016)	(0.006)	(0.002)	(0.009)
Mandatory Green Power Option	2.800*	-3.651*	3.601*	-0.009	1.555
	(1.054)	(1.546)	(0.533)	(0.163)	(0.875)
Public Benefits Fund	0.628	-3.514*	-2.219*	0.242	-1.326
	(0.848)	(1.244)	(0.429)	(0.131)	(0.704)
Net Metering	-1.212	0.277	-1.648*	-0.057	-1.338*
	(0.727)	(1.066)	(0.368)	(0.112)	(0.604)
Restructured Electricity Market	0.080	0.861	2.253*	-0.834*	-0.056
	(0.854)	(1.253)	(0.432)	(0.132)	(0.710)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	1,530	1,530	1,530	1,530	1,530
R^2	0.96	0.91	0.57	0.48	0.98

Notes: Standard errors in parentheses. * $p<0.05$. This table shows the full estimation of equation (5) using electricity and emissions as dependent variables.

Appendix Table A10. Full Regression of REC Demand on Electricity Prices

	Industrial Price (Cents per kWh)	Total Price (Cents per kWh)	Commercial Price (Cents per kWh)	Residential Price (Cents per kWh)
	(1)	(2)	(3)	(4)
Net In-State REC	-0.094*	-0.090*	-0.131*	-0.064*
Demand (TWh)	(0.020)	(0.019)	(0.019)	(0.021)
Net Out-of-State REC	-0.019*	-0.016*	-0.026*	-0.019*
Demand (TWh)	(0.007)	(0.007)	(0.007)	(0.008)
LCV House Score	-0.010*	-0.008*	-0.009*	-0.007*
	(0.003)	(0.003)	(0.003)	(0.003)
LCV Senate Score	0.004	0.006*	0.004*	0.008*
	(0.002)	(0.002)	(0.002)	(0.002)
Mandatory Green	-0.661*	-0.702*	-0.609*	-0.924*
Power Option	(0.202)	(0.192)	(0.197)	(0.212)
Public Benefits Fund	0.974*	1.075*	1.158*	0.965*
	(0.162)	(0.154)	(0.158)	(0.171)
Net Metering	0.327*	0.166	0.189	0.017
	(0.139)	(0.132)	(0.136)	(0.146)
Restructured Electricity	-0.677*	-0.814*	-0.937*	-1.023*
Market	(0.164)	(0.155)	(0.160)	(0.172)
State Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	1,530	1,530	1,530	1,530
R^2	0.86	0.89	0.88	0.89

Notes: Standard errors in parentheses. * $p<0.05$. This table shows the full estimation of equation (5) using average retail electricity prices as dependent variables.

Appendix Table A11. First-Stage IV Results: Net In-State REC Demand

	Net In-State REC Demand (TWh)	
	All Instruments (1)	Instruments with Complete Observations (2)
Solar Instrument	-0.007*	
	(0.003)	
Wind Instrument	-0.005	
	(0.003)	
Net Out-of-State REC Supply (TWh)	-0.003	0.017*
	(0.007)	(0.002)
Democratic State Legislature Control	-0.686	0.371*
	(0.376)	(0.179)
Split State Legislature Control	-0.997*	0.091
	(0.356)	(0.168)
Percentage of State House Seats Won by Democrats	0.267	
	(2.021)	
Percentage of State Senate Seats Won by Democrats	2.480*	
	(0.772)	
Percentage of State House Seats Won by Third Party	-14.29	
	(21.85)	
Percentage of State Senate Seats Won by Third Party	18.66	
	(14.42)	
State GDP per Capita, Mining Sector (Millions of $)	-349.000*	-7.750
	(85.900)	(34.100)
State GDP per Capita, Manufacturing Sector (Millions of $)	1.110	236.000*
	(189.000)	(56.400)
State GDP per Capita, Total (Millions of $)	356.000*	17.200*
	(45.700)	(8.720)
Renewable Energy Lobby	0.292	-0.443*
	(0.637)	(0.199)
State Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Observations	576	1,530
F statistic	28.85	16.94

Notes: Standard errors in parentheses. * $p<0.05$. This table shows the first stage of 2SLS instrumental variable approach for the in-state demand instrument. Column (1) reflects the first specification, which includes all instruments. Column (2) reflects the second specification, which includes only those instruments that have observations for all state-years.

Appendix Table A12. First-Stage IV Results: Net Out-of-State REC Demand

	Net Out-of-State REC Demand (TWh)	
	All Instruments	Instruments with Complete Observations
	(1)	(2)
Solar Instrument	0.026*	
	(0.005)	
Wind Instrument	-0.050*	
	(0.006)	
Net Out-of-State REC Supply (TWh)	-0.064*	-0.028*
	(0.015)	(0.006)
Democratic State Legislature Control	-1.663*	0.925
	(0.801)	(0.490)
Split State Legislature Control	-3.736*	-1.113*
	(0.758)	(0.458)
Percentage of House Seats Won by Democrats	-0.612	
	(4.306)	
Percentage of Senate Seats Won by Democrats	1.675	
	(1.645)	
Percentage of House Seats Won by Third Party	-202.100*	
	(46.540)	
Percentage of Senate Seats Won by Third Party	61.830*	
	(30.710)	
State GDP per Capita, Mining Sector (Millions of $)	498.000*	-243.000*
	(183.000)	(93.300)
State GDP per Capita, Manufacturing (Millions of $)	961.000*	112.000
	(402.000)	(154.000)
State GDP per Capita, Total (Millions of $)	-38.100	184.000*
	(97.400)	(23.800)
Renewable Energy Lobby	-1.225	-0.424
	(1.357)	(0.543)
State Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Observations	576	1,530
F statistic	53.07	24.48

Notes: Standard errors in parentheses. * $p<0.05$. This table shows the first stage of instrumental variable approach for the out-of-state demand instrument. Column (1) reflects the first specification, which includes all instruments. Column (2) reflects the second specification, which includes only those instruments that have observations for all state-years.

Appendix Table A13. Full IV Results: Total Net REC Demand on Electricity and Carbon

Panel A

	Coal (TWh)	Natural Gas (TWh)	Wind (TWh)	Solar (TWh)	CO_2 Emissions (MMT)
	(1)	(2)	(3)	(4)	(5)
Total Net REC Demand (TWh)	-0.517*	0.417*	-0.126*	-0.044*	-0.336*
	(0.0825)	(0.086)	(0.045)	(0.020)	(0.062)
LCV House Score	0.040	0.003	0.014	0.024*	0.033
	(0.027)	(0.029)	(0.015)	(0.007)	(0.021)
LCV Senate Score	-0.035	-0.016	-0.016	-0.006	-0.035*
	(0.021)	(0.022)	(0.011)	(0.005)	(0.016)
Mandatory Green Power Option	9.946*	-9.682*	-1.479	-0.594	5.735
	(4.034)	(4.199)	(2.176)	(0.994)	(3.027)
Public Benefits Fund	2.614	3.599	-1.828	-0.432	2.872
	(3.038)	(3.163)	(1.639)	(0.749)	(2.280)
Net Metering	3.448	1.945	0.787	-0.699	4.340*
	(2.069)	(2.153)	(1.116)	(0.510)	(1.553)
Restructured Electricity Market	92.560*	160.600*	45.160*	1.013	182.200*
	(2.803)	(2.918)	(1.513)	(0.691)	(2.104)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	576	576	576	576	576
R^2	0.96	0.97	0.81	0.53	0.99

Panel B

	Coal (TWh) (1)	Natural Gas (TWh) (2)	Wind (TWh) (3)	Solar (TWh) (4)	CO_2 Emissions (MMT) (5)
Total Net REC Demand (TWh)	0.197	-1.280*	0.171*	0.033	-0.396*
	(0.149)	(0.244)	(0.077)	(0.024)	(0.112)
LCV House Score	0.034	-0.030	0.004	0.015*	0.002
	(0.017)	(0.029)	(0.090)	(0.003)	(0.013)
LCV Senate Score	-0.027*	0.008	-0.009	-0.002	-0.018*
	(0.012)	(0.020)	(0.006)	(0.002)	(0.009)
Mandatory Green Power Option	3.636*	-6.694*	2.621*	-0.423*	1.680*
	(1.139)	(1.870)	(0.586)	(0.186)	(0.854)
Public Benefits Fund	-0.889	-0.095	-2.500*	0.205	-1.261
	(0.982)	(1.613)	(0.506)	(0.160)	(0.737)
Net Metering	-0.415	-1.482	-1.463*	-0.024	-1.378*
	(0.805)	(1.322)	(0.415)	(0.131)	(0.604)
Restructured Electricity Market	-2.450*	6.804*	2.021*	-0.805*	0.019
	(1.098)	(1.803)	(0.565)	(0.179)	(0.824)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	1,530	1,530	1,530	1,530	1,530
R^2	0.95	0.86	0.45	0.29	0.98

Notes: Standard errors in parentheses. * $p<0.05$.
This table shows the full IV results of instrumenting for total (combined in-state and out-of-state) RPS stringency on electricity generation and carbon emissions. Panel A shows the results from the first specification, which includes all instrumental variables, some of which are not available for all state-years in our sample. Panel B shows the results from the second specification, which includes only those instruments that have observations for all state-years.

Appendix Table A14. Full IV Results: In- and Out-of-State REC Demand on Electricity and Carbon

Panel A

	Coal (TWh)	Natural Gas (TWh)	Wind (TWh)	Solar (TWh)	CO_2 Emissions (MMT)
	(1)	(2)	(3)	(4)	(5)
Net In-State REC Demand (TWh)	0.317	-1.166*	0.744*	0.937*	-0.298
	(0.381)	(0.410)	(0.194)	(0.086)	(0.275)
Net Out-of-State REC Demand (TWh)	-0.628*	0.627*	-0.242*	-0.175*	-0.341*
	(0.099)	(0.107)	(0.051)	(0.023)	(0.072)
LCV House Score	0.010	0.060	-0.017	-0.011	0.032
	(0.032)	(0.034)	(0.016)	(0.007)	(0.023)
LCV Senate Score	-0.034	-0.018	-0.015	-0.004	-0.035*
	(0.022)	(0.023)	(0.011)	(0.005)	(0.016)
Mandatory Green Power Option	11.050*	-11.780*	-0.327	0.705	5.785
	(4.230)	(4.547)	(2.156)	(0.959)	(3.054)
Public Benefits Fund	4.491	0.038	0.131	1.776*	2.957
	(3.273)	(3.518)	(1.668)	(0.742)	(2.363)
Net Metering	2.851	3.078	0.164	-1.401*	4.313*
	(2.171)	(2.334)	(1.107)	(0.492)	(1.567)
Restructured Electricity Market	83.960*	176.900*	36.180*	-9.104*	181.800*
	(4.816)	(5.177)	(2.455)	(1.092)	(3.478)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	576	576	576	576	576
R^2	0.96	0.97	0.82	0.57	0.99

Panel B

	Coal (TWh) (1)	Natural Gas (TWh) (2)	Wind (TWh) (3)	Solar (TWh) (4)	CO_2 Emissions (MMT) (5)
Net In-State REC Demand (TWh)	3.000*	-4.338*	1.306*	0.574*	1.107*
	(0.487)	(0.761)	(0.189)	(0.060)	(0.335)
Net Out-of-State REC Demand (TWh)	-0.287	-0.751*	-0.025	-0.061*	-0.655*
	(0.198)	(0.310)	(0.077)	(0.024)	(0.137)
LCV House Score	-0.002	0.009	-0.011	0.008*	-0.017
	(0.022)	(0.035)	(0.009)	(0.003)	(0.015)
LCV Senate Score	-0.049*	0.032	-0.018*	-0.006*	-0.029*
	(0.015)	(0.024)	(0.006)	(0.002)	(0.010)
Mandatory Green Power Option	7.458*	-10.860*	4.168*	0.314	3.729*
	(1.528)	(2.388)	(0.594)	(0.187)	(1.052)
Public Benefits Fund	-1.357	0.416	-2.690*	0.114	-1.513
	(1.209)	(1.890)	(0.470)	(0.148)	(0.832)
Net Metering	-0.285	-1.623	-1.411*	0.001	-1.308
	(0.989)	(1.546)	(0.385)	(0.121)	(0.681)
Restructured Electricity Market	-3.973*	8.465*	1.404*	-1.099*	-0.797
	(1.371)	(2.142)	(0.533)	(0.168)	(0.944)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	1,530	1,530	1,530	1,530	1,530
R^2	0.93	0.81	0.53	0.39	0.98

Notes: Standard errors in parentheses. * $p<0.05$.
This table shows the full results of instrumenting for in-state and out-of-state RPS stringency on electricity generation and carbon emissions. Panel A shows the results from the first specification of instruments, which includes all instrumental variables, some of which are not available for all state-years in our sample. Panel B shows the results from the second specification, which includes only those instruments that have observations for all state-years

Appendix Table A15. Full IV Results: REC Demand on Electricity Prices

Panel A

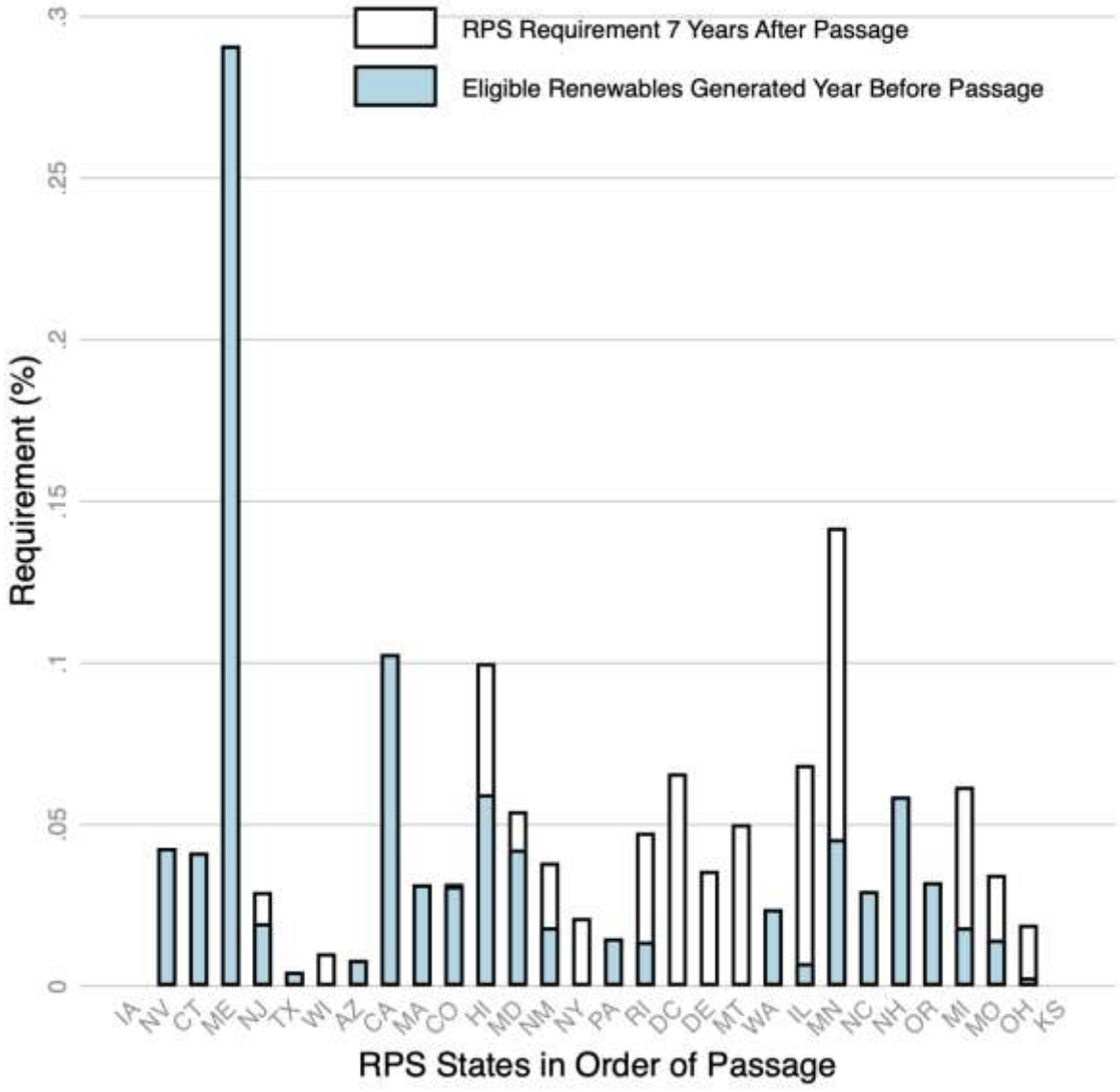
	Industrial Price (Cents per kWh) (1)	Total Price (Cents per kWh) (2)	Commercial Price (Cents per kWh) (3)	Residential Price (Cents per kWh) (4)
Net In-State REC Demand (TWh)	-0.047	-0.085	-0.129*	-0.050
	(0.052)	(0.053)	(0.055)	(0.058)
Net Out-of-State REC Demand (TWh)	-0.027*	-0.026	-0.038*	-0.020
	(0.014)	(0.014)	(0.014)	(0.015)
LCV House Score	-0.018*	-0.015*	-0.015*	-0.015*
	(0.004)	(0.004)	(0.005)	(0.005)
LCV Senate Score	-0.006*	-0.003	-0.007*	0.001
	(0.003)	(0.003)	(0.003)	(0.003)
Mandatory Green Power Option	-1.813*	-1.865*	-1.764*	-2.223*
	(0.576)	(0.588)	(0.606)	(0.641)
Public Benefits Fund	-0.173	-0.487	-0.273	-0.559
	(0.445)	(0.455)	(0.469)	(0.496)
Net Metering	0.0358	0.295	0.508	0.364
	(0.295)	(0.302)	(0.311)	(0.329)
Restructured Electricity Market	0.687	0.809	-0.765	0.852
	(0.656)	(0.669)	(0.691)	(0.730)
State Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	576	576	576	576
R^2	0.95	0.95	0.95	0.95

Panel B

	Industrial Price (Cents per kWh) (1)	Total Price (Cents per kWh) (2)	Commercial Price (Cents per kWh) (3)	Residential Price (Cents per kWh) (4)
Net In-State REC	0.035	0.101	0.169*	0.140
Demand (TWh)	(0.073)	(0.072)	(0.078)	(0.081)
Net Out-of-State REC	0.061*	0.075*	0.065*	0.089*
Demand (TWh)	(0.030)	(0.030)	(0.032)	(0.033)
LCV House Score	-0.006	-0.004	-0.006	-0.003
	(0.003)	(0.003)	(0.004)	(0.004)
LCV Senate Score	0.003	0.004	0.001	0.005*
	(0.002)	(0.002)	(0.002)	(0.003)
Mandatory Green	-0.498*	-0.455*	-0.218	-0.662*
Power Option	(0.229)	(0.227)	(0.243)	(0.253)
Public Benefits Fund	0.748*	0.795*	0.823*	0.643*
	(0.181)	(0.179)	(0.192)	(0.200)
Net Metering	0.444*	0.310*	0.359*	0.183
	(0.148)	(0.147)	(0.158)	(0.164)
Restructured	-1.062*	-1.300*	-1.539*	-1.577*
Electricity Market	(0.205)	(0.203)	(0.218)	(0.227)
State Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	1,530	1,530	1,530	1,530
R^2	0.84	0.87	0.84	0.86

Notes: Standard errors in parentheses. * $p<0.05$.
This table shows the full results of instrumenting for in-state and out-of-state RPS stringency on electricity prices. Panel A shows the results from the first specification of instruments, which includes all instrumental variables, some of which are not available for all state-years in our sample. Panel B shows the results from the second specification, which includes only those instruments that have observations for all state-years.

Appendix Figure A1. Replication of Figure 3 of Greenstone and Nath (2020)



Notes: This figure replicates Figure 3 from Greenstone and Nath (2020). It shows each state's RPS requirement 7 years after RPS passage, in the black rectangles. The light blue shading shows the renewables generated in each state in the year before RPS passage that are eligible to be used toward the RPS. The figure above and Figure 3 in Greenstone and Nath (2020) are quite similar, with differences in Arizona, where Greenstone and Nath do not consider Arizona's renewables to be eligible, whereas we do. We also leave Kansas's RPS slot blank because Kansas passed an RPS in 2009 but repealed it in 2015, less than 7 years later.