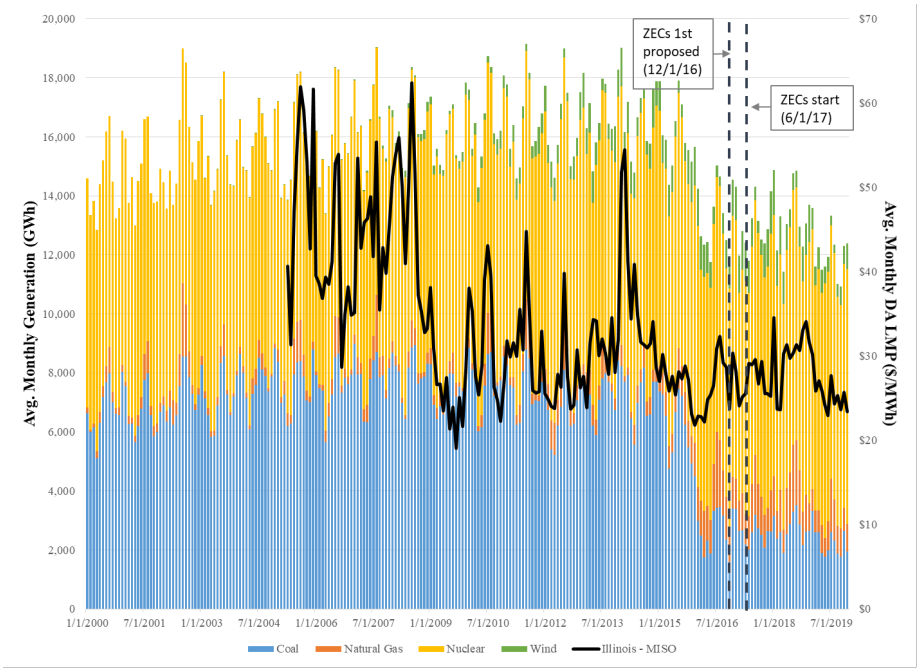
Online Appendix to Adler & Kiesling, "The Effect of Zero Emission Credits in Illinois and New York on Wholesale Power Market and Environmental Outcomes"

A Supplementary Figures

Section A.1 presents the historical monthly average generation and locational marginal price (LMP) for the Illinois and New York areas over the period 2000–2019 (an extension of Figures 2 - 4). Section A.2 displays a series of graphs showing the raw trends in our various outcomes of interest for both our control group and our treatment group - namely Illinois or New York.

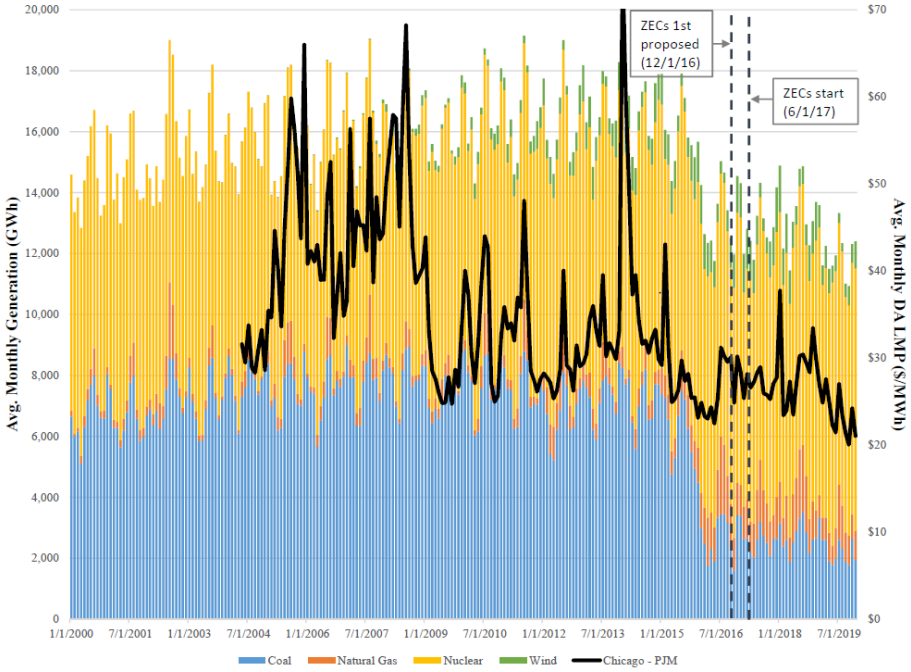
A.1 Trends in Generation and LMP (2000-2019)

Figure A.1: Avg. Generation and MISO DA LMP (2000-2019)



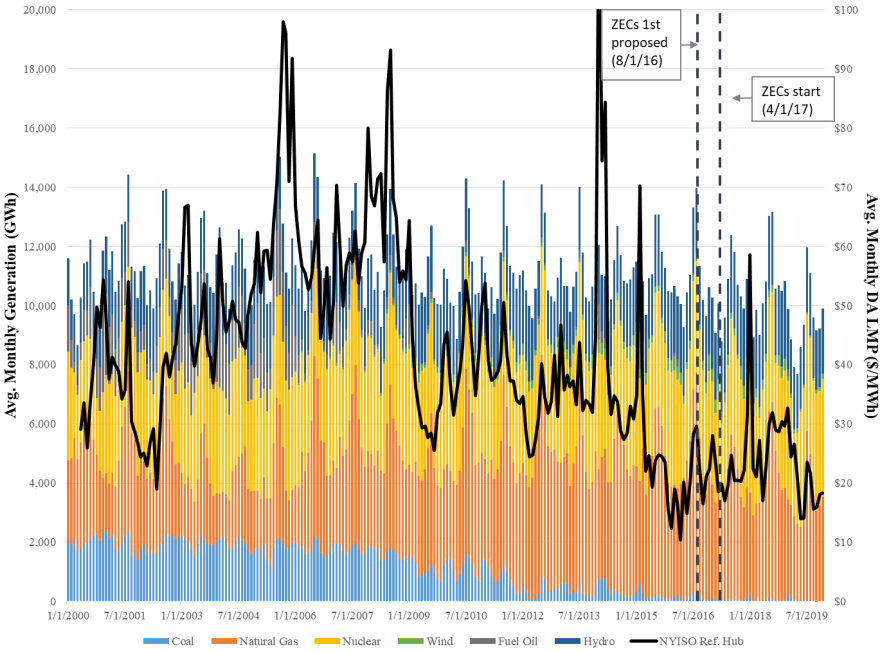
Notes: Total generation by fuel type from EIA Form 923 for power plants in Illinois. MISO average day-ahead monthly LMP for the Illinois Hub.

Figure A.2: Avg. Generation and PJM DA LMP (2000-2019)



Notes: Total generation by fuel type from EIA Form 923 for power plants in Illinois. PJM average day-ahead monthly LMP for the Chicago Hub.

Figure A.3: Avg. Generation and NYISO DA LMP (2000-2019)

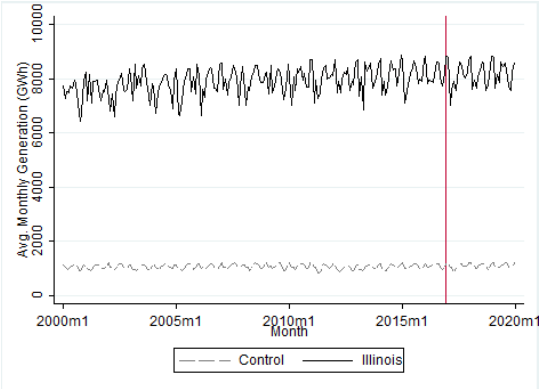


Notes: Total generation by fuel type from EIA Form 923 for power plants in Illinois. NYISO average day-ahead monthly LMP for the NYISO Reference Hub.

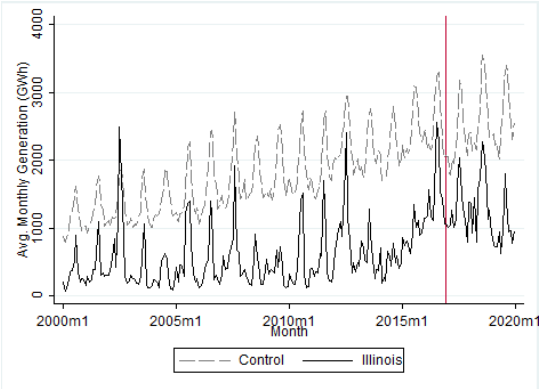
A.2 Trends in Outcomes Before and After ZEC Program Announcement

Figure A.4: Illinois Monthly Avg. Net Generation (GWh)

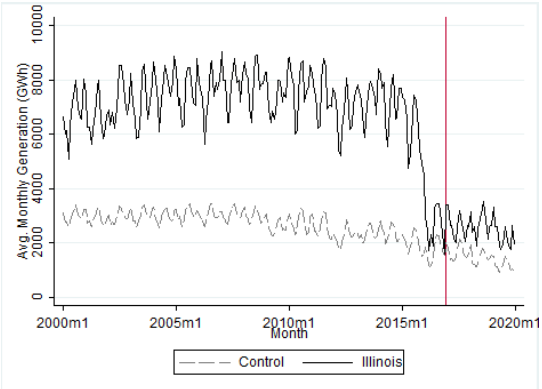
(A) Nuclear



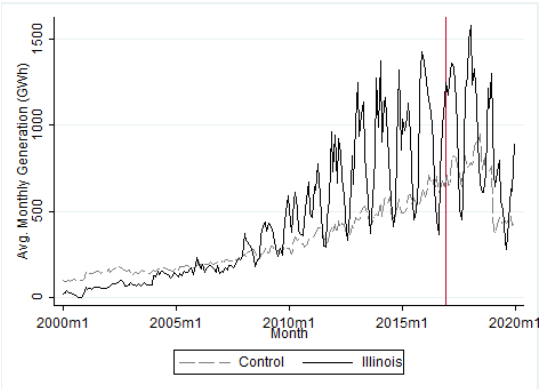
(B) Natural Gas



(C) Coal



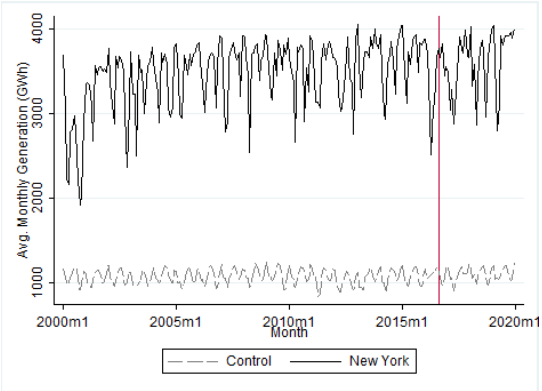
(D) Non-Hydro Renewables



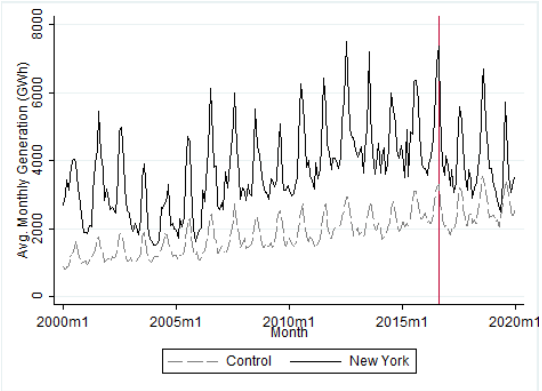
Notes: Monthly average net generation from EPA's Form 923 for 2000 - 2019. "Control" refers to our control group of all non-neighboring states to both Illinois and New York. Vertical line indicates the announcement of the ZEC program in Illinois.

Figure A.5: New York Monthly Avg. Net Generation (GWh)

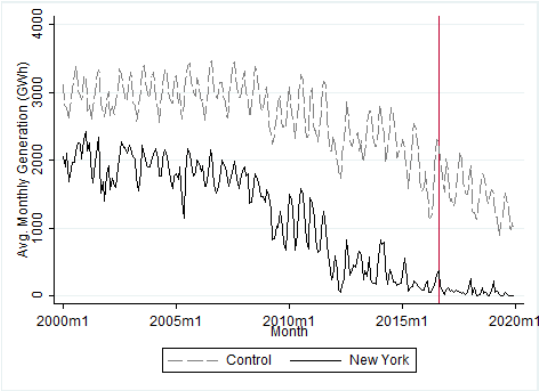
(A) Nuclear



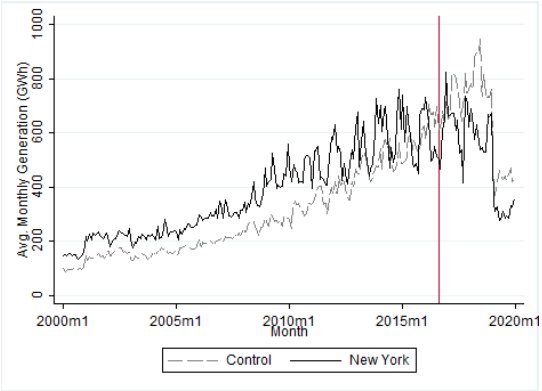
(B) Natural Gas



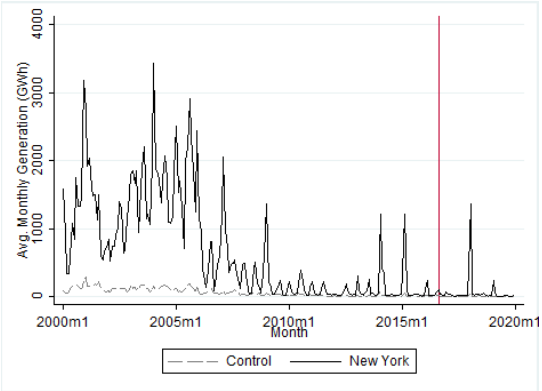
(C) Coal



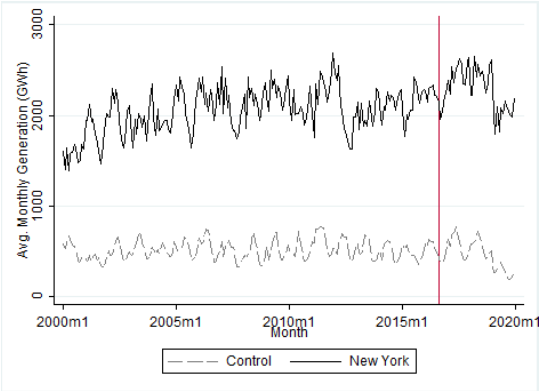
(D) Non-Hydro Renewables



(E) Fuel Oil



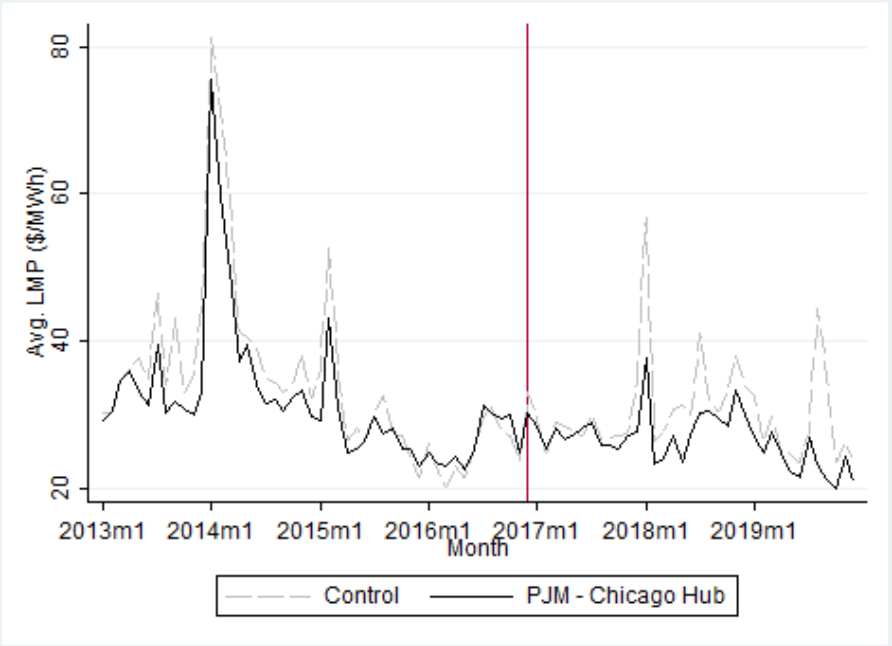
(F) Hydro



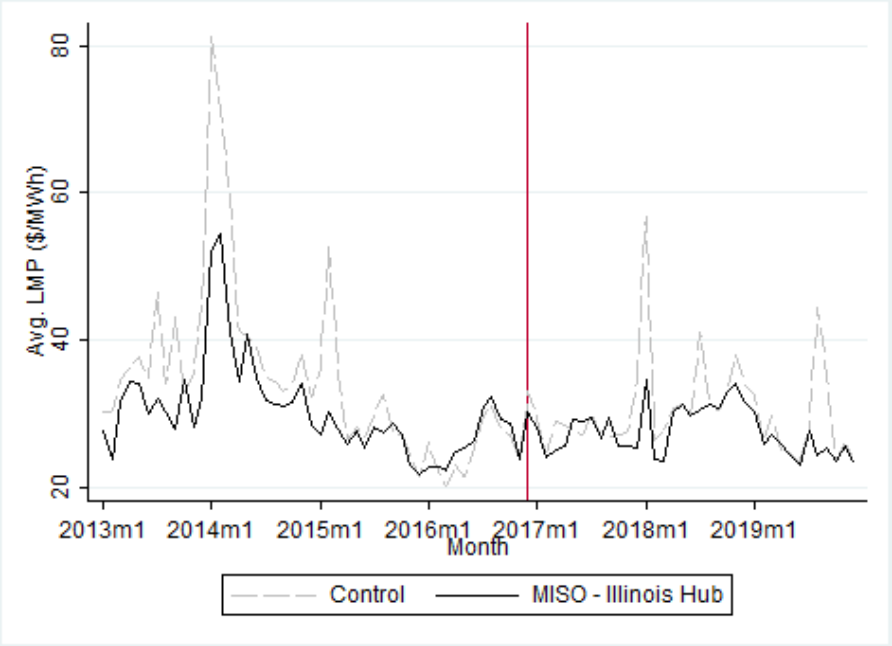
Notes: Monthly average net generation from EPA's Form 923 for 2000 - 2019. "Control" refers to our control group of all non-neighboring states to both Illinois and New York. Vertical line indicates the announcement of the ZEC program in New York.

Figure A.6: Illinois Monthly Avg. LMP ($/MWh)

(A) PJM – Chicago Hub

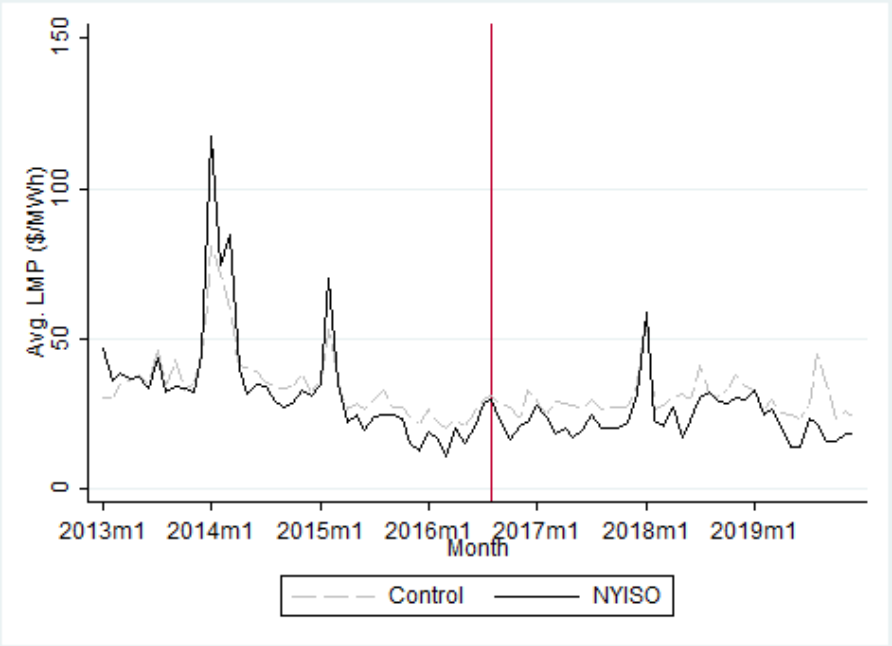


(B) MISO – Illinois Hub



Notes: Monthly average LMP from major RTOs for 2013 - 2019. "Control" refers to our control group of prices from all non-neighboring hubs for both Illinois and New York. Vertical line indicates the announcement of the ZEC program in Illinois.

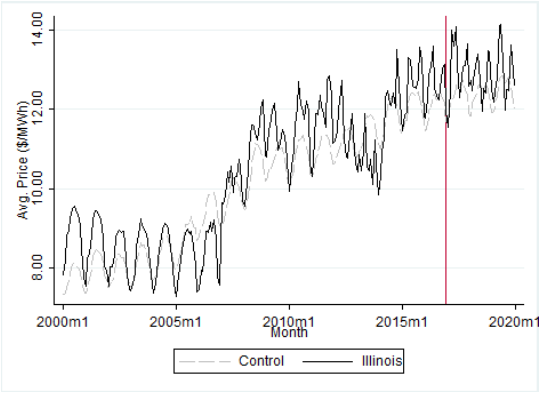
Figure A.7: New York Monthly Avg. LMP ($/MWh)



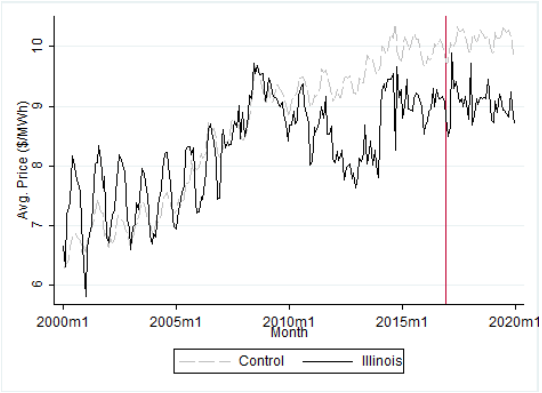
Notes: Monthly average LMP from major RTOs for 2013 - 2019. "Control" refers to our control group of prices from all non-neighboring hubs for both Illinois and New York. New York refers to the NYISO reference hub. Vertical line indicates the announcement of the ZEC program in New York.

Figure A.8: Illinois Monthly Avg. Retail Prices ($/MWh)

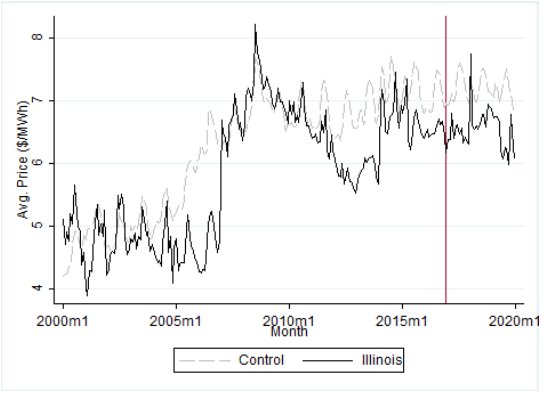
(A) Residential



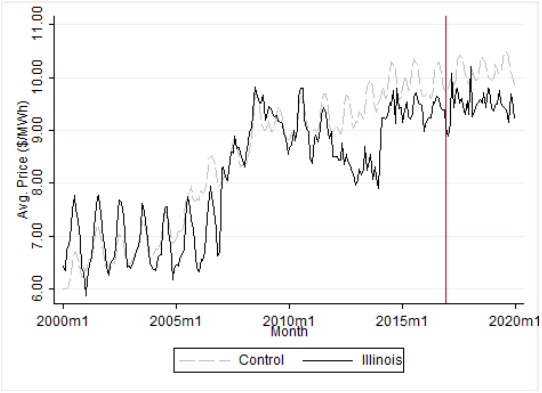
(B) Commercial



(C) Industrial



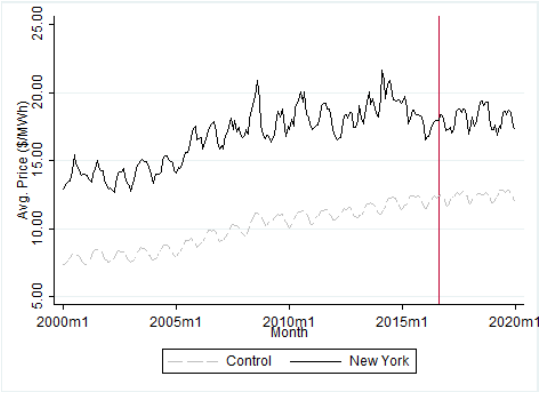
(D) Total



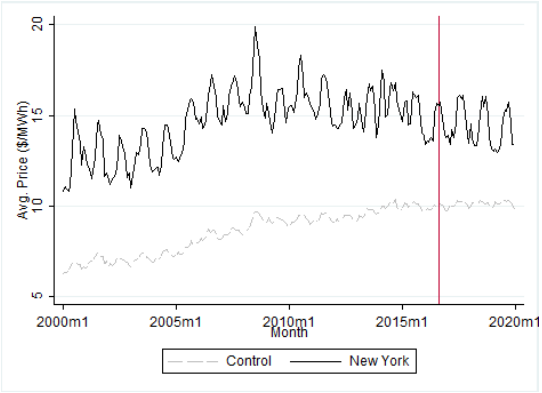
Notes: Monthly average retail prices from EPA's Form 861 for 2000 - 2019. "Control" refers to our control group of all non-neighboring states to both Illinois and New York. Vertical line indicates the announcement of the ZEC program in Illinois.

Figure A.9: New York Monthly Avg. Retail Prices ($/MWh)

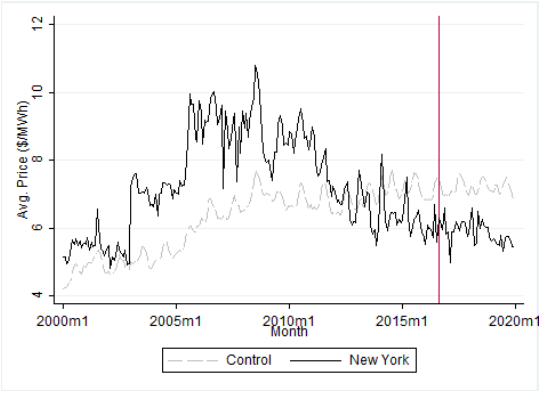
(A) Residential



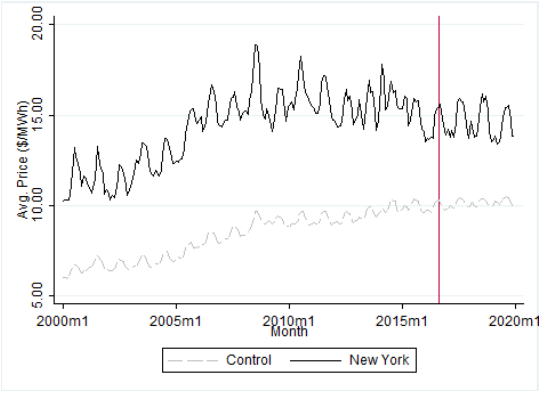
(B) Commercial



(C) Industrial



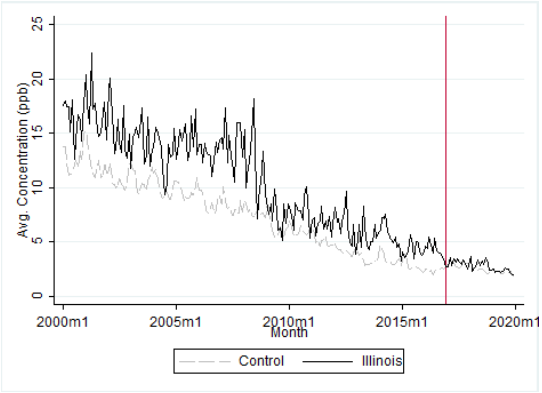
(D) Total



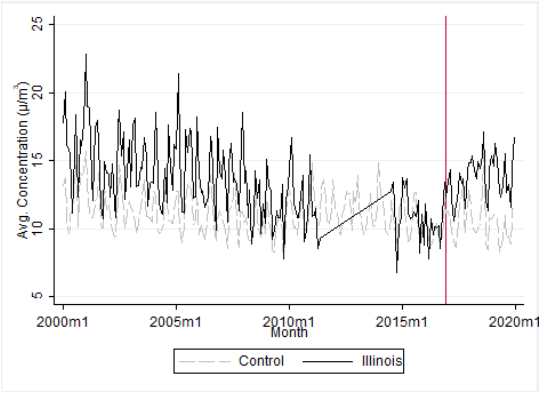
Notes: Monthly average retail prices from EPA's Form 861 for 2000 - 2019. "Control" refers to our control group of all non-neighboring states to both Illinois and New York. Vertical line indicates the announcement of the ZEC program in New York.

Figure A.10: Illinois Air Quality

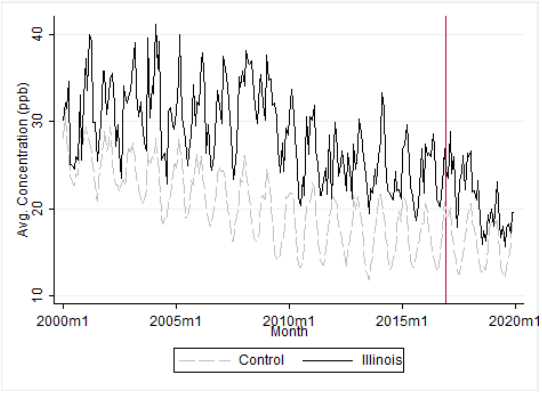
(A) SO_2



(B) $PM_{2.5}$



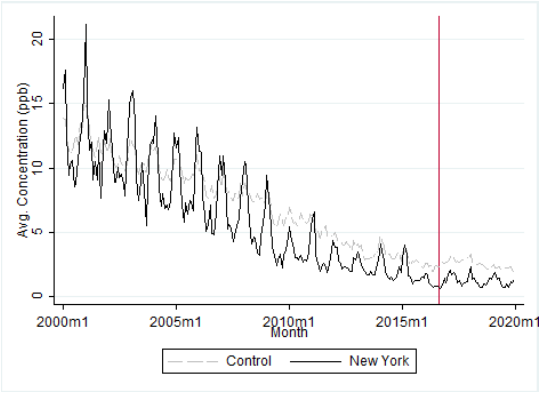
(C) NO_2



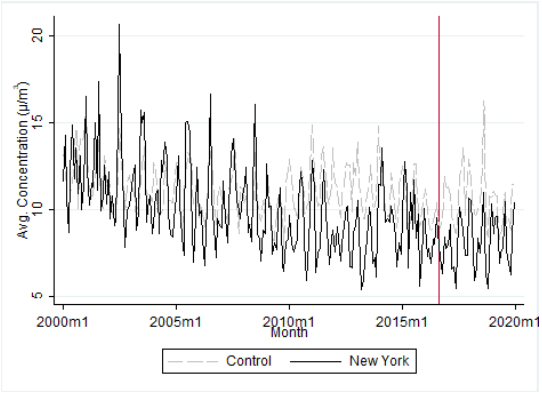
Notes: Monthly average concentrations from EPA's AirData monitoring network for 2000 - 2019. "Control" refers to our control group of all non-neighboring states to both Illinois and New York. Data on $PM_{2.5}$ in Illinois is missing in the dataset from June 2011 - June 2014. Vertical line indicates the announcement of the ZEC program in Illinois.

Figure A.11: New York Air Quality

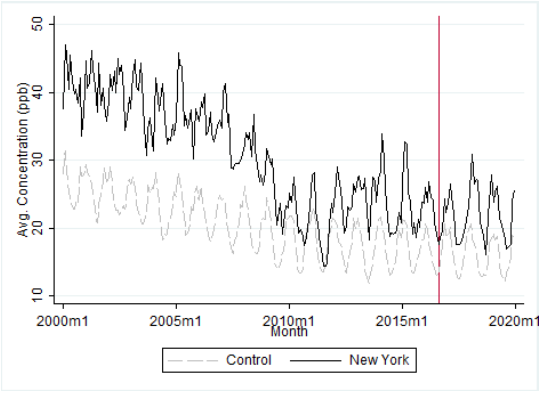
(A) SO_2



(B) $PM_{2.5}$



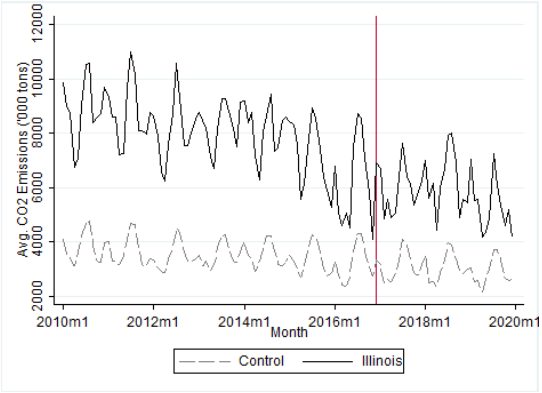
(C) NO_2



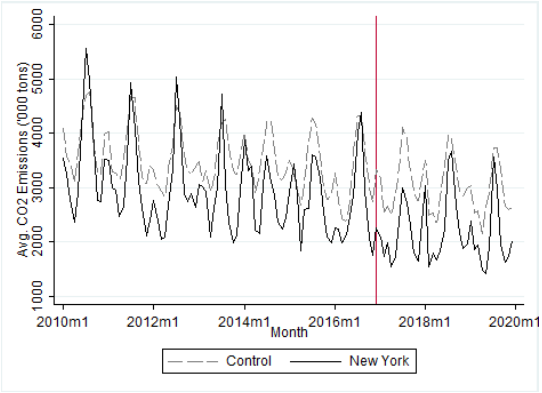
Notes: Monthly average concentrations from EPA's AirData monitoring network for 2000 - 2019. "Control" refers to our control group of all non-neighboring states to both Illinois and New York. Vertical line indicates the announcement of the ZEC program in New York.

Figure A.12: CO_2 Emissions

(A) Illinois



(B) New York



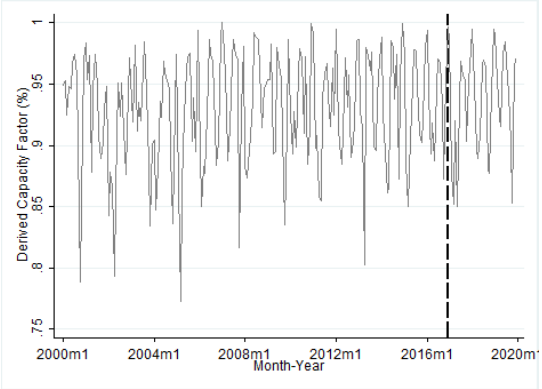
Notes: Monthly average emissions in thousands of tons from EPA's CEMS database for 2010 - 2019. "Control" refers to our control group of all non-neighboring states to both Illinois and New York. Vertical line indicates the announcement of the ZEC program in each state.

A.3 Trends in Derived Nuclear Capacity Factors

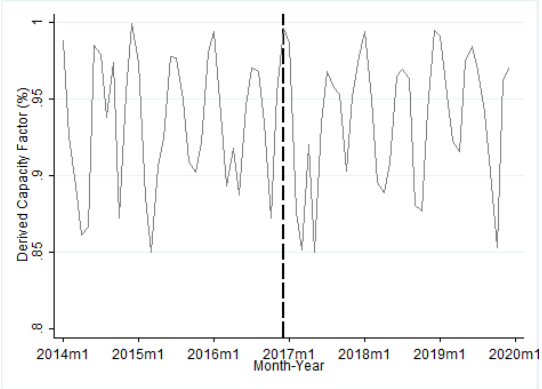
One measure of a power plant's utilization is its capacity factor. Using our data on power generation from EIA Form-923, we derive a measure of capacity by finding the maximum monthly generation within a year and dividing it by the number of hours in that month. We can then calculate a monthly capacity factor using this derived capacity. The Figure A.13 below presents the trends in capacity factors for nuclear power plants in Illinois, New York, and nationally.

Figure A.13: Derived Monthly Nuclear Capacity Factor

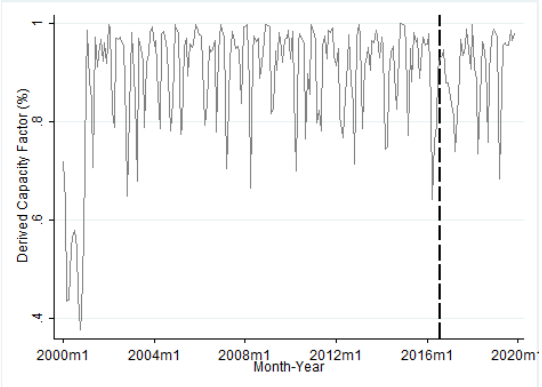
(A) Illinois (2000–2019)



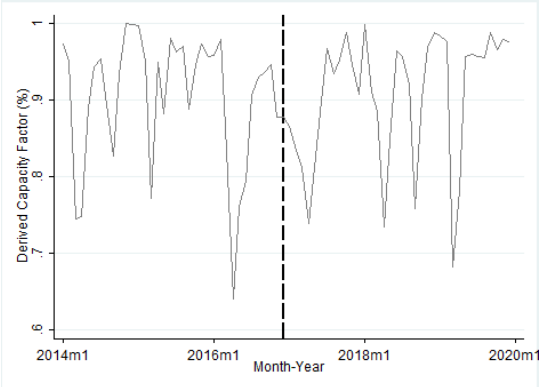
(B) Illinois (2014–2019)



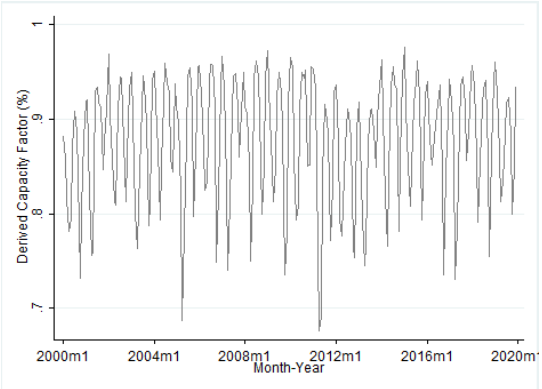
(C) New York (2000–2019)



(B) New York (2014–2019)



(E) National (2000–2019)



Notes: Monthly average derived capacity factor as described in Section A.3 using data from EIA-923. Vertical line indicates the announcement of the ZEC program in each state.

B Supplementary Tables

Table B.1 in Section B.1 displays annual additions and retirements for Illinois, New York, and all non-neighboring states (e.g. the control group). In the main paper, we only present our estimates from Equations (1) and (2) where we have supporting evidence of parallel trends (see Section A.2). In Sections B.2 and B.3, we present results for all outcome variables regardless of any pre-existing trends from estimating Equation (1) and Equation (2), respectively.

B.1 Retirements and Additions by State

Table B.1: Plant Openings and Retirements (2010-2019)

Panel A. Illinois

Year	Coal		Natural Gas		Wind	
	Additions	Retirements	Additions	Retirements	Additions	Retirements
2010	0	391	0	21	500	0
2011	0	696	0	167	692	0
2012	1,766	1,000	7	8	809	0
2013	0	7	0	166	0	0
2014	0	2	0	2	0	0
2015	0	439	628	15	273	0
2016	0	1,118	54	10	184	0
2017	0	0	1	4	278	0
2018	0	0	0	10	331	0
2019	0	2,241	2	6	585	0

Panel B. New York

Year	Coal		Natural Gas		Wind	
	Additions	Retirements	Additions	Retirements	Additions	Retirements
2010	0	0	676	104	0	0
2011	0	75	692	18	130	0
2012	0	0	0	328	238	0
2013	0	101	7	2	94	0
2014	0	0	0	23	16	0
2015	3	0	1	2	0	0
2016	0	400	8	3	78	0
2017	0	0	2	65	2	0
2018	0	0	772	0	160	0
2019	0	0	0	2	0	0

Panel C. Non-Neighboring States (Total)

Year	Coal		Natural Gas		Wind	
	Additions	Retirements	Additions	Retirements	Additions	Retirements
2010	4,263	996	6,425	1,444	4,172	0
2011	2,419	1,996	9,483	2,274	5,645	37
2012	3,953	9,484	9,248	4,501	10,950	13
2013	1,008	4,049	7,147	6,223	614	10
2014	106	2,829	8,474	3,898	3,872	99
2015	3	12,570	4,470	4,898	7,617	399
2016	0	5,044	6,927	8,080	7,698	43
2017	0	3,394	8,258	3,741	4,953	57
2018	0	11,289	12,894	6,573	5,345	3
2019	0	9,480	4,498	4,266	7,455	129

Notes: All units in MW of nameplate capacity. Data from EIA-860M from January, 2020.

B.2 Difference-in-Difference: Before and After ZECs

B.2.1 Nuclear Generation

Table B.2: Nuclear Generation (Illinois, Pre- and Post- Implementation)

	(1)	(2)	(3)	(4)
Total Load	0.08***	0.07***	0.07***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
6-mo. Post	82.81**	21.50	-14.91	53.78
	(35.87)	(35.75)	(36.07)	(43.56)
ZEC Start	122.53***	64.62	17.76	111.80**
	(44.86)	(44.32)	(45.50)	(49.95)
6-mo. Post x Illinois	508.76***	516.30***	526.61***	515.34***
	(35.62)	(35.24)	(34.80)	(35.49)
ZEC Start x Illinois	978.09***	984.31***	992.82***	983.52***
	(45.20)	(44.70)	(43.97)	(44.96)
Constant	717.21***	723.72***	915.16***	802.84***
	(37.75)	(37.85)	(41.17)	(40.44)
R-squared	0.98	0.98	0.98	0.98
N	8,880	8,880	8,880	8,880
State-by-Year FE	Yes	Yes	Yes	Yes
Season FE		Yes		
Month FE			Yes	
Season-by-Year FE				Yes

Estimation of Equation (1) with various time fixed effects, where the outcome variable is monthly nuclear generation by state in GWh from EIA Form 923 for 2000 - 2019. New York and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

Table B.3: Nuclear Generation (New York, Pre- and Post- Implementation)

	(1)	(2)	(3)	(4)
Total Load	0.08***	0.07***	0.06***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
8-mo. Post	-39.69	-38.54	-50.88	17.06
	(30.82)	(30.96)	(31.66)	(24.14)
ZEC Start	-89.37**	-52.46	-65.80	-16.21
	(45.42)	(45.77)	(47.07)	(43.46)
8-mo. Post x New York	322.86***	324.78***	327.16***	324.57***
	(30.92)	(30.96)	(31.01)	(31.06)
ZEC Start x New York	640.28***	643.12***	646.65***	642.81***
	(46.56)	(46.17)	(45.69)	(46.37)
Constant	658.08***	642.52***	828.26***	731.71***
	(36.04)	(36.03)	(39.47)	(37.51)
R-squared	0.97	0.97	0.97	0.97
N	8,880	8,880	8,880	8,880
State-by-Year FE	Yes	Yes	Yes	Yes
Season FE		Yes		
Month FE			Yes	
Season-by-Year FE				Yes

Estimation of Equation (1) with various time fixed effects, where the outcome variable is monthly nuclear generation by state in GWh from EIA Form 923 for 2000 - 2019. Illinois and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

B.2.2 Non-Nuclear Generation

Table B.4: Impacts on Other Generation (Illinois, Pre- and Post- Implementation)

	(1) Coal	(2) Natural Gas
Nuclear Generation	-0.14***	-0.71***
	(0.03)	(0.05)
Total Load	0.28***	0.63***
	(0.02)	(0.02)
6-mo. Post	295.14**	-321.86**
	(129.98)	(144.20)
ZEC Start	195.40	-208.48
	(132.73)	(157.21)
6-mo. Post x Illinois	172.04*	-418.38***
	(99.13)	(120.96)
ZEC Start x Illinois	82.58	-250.37*
	(104.48)	(149.35)
Constant	975.42***	-1489.47***
	(88.87)	(112.43)
R-squared	0.98	0.99
N	8,880	8,880
State-by-Year FE	Yes	Yes
Season-by-Year FE	Yes	Yes

Estimation of Equation (1) where the outcome variable is monthly net generation by state in GWh from EIA Form 923 for 2000 - 2019. New York and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

Table B.5: Impacts on Other Generation (New York, Pre- and Post- Implementation)

	(1) Natural Gas	(2) Non-Hydro Renewable	(3) Fuel Oil	(4) Hydro
Nuclear Generation	-0.70***	0.00	-0.02**	-0.11***
	(0.05)	(0.01)	(0.01)	(0.04)
Total Load	0.64***	0.00	0.02***	0.06***
	(0.02)	(0.01)	(0.01)	(0.01)
8-mo. Post	-121.06**	25.58**	-7.76***	-84.53***
	(57.16)	(11.16)	(2.32)	(21.02)
ZEC Start	-73.46	77.85***	-7.55	-129.64***
	(69.86)	(21.59)	(6.67)	(36.04)
8-mo. Post x New York	308.44***	23.65*	-19.20***	33.49
	(84.74)	(13.15)	(2.98)	(46.33)
ZEC Start x New York	330.19***	-80.22**	10.16	238.36***
	(102.32)	(40.82)	(7.00)	(68.61)
Constant	-1509.59***	324.09***	-51.86	292.08***
	(105.98)	(41.84)	(33.82)	(57.02)
R-squared	0.99	0.97	0.86	0.94
N	8,880	8,880	8,880	8,880
State-by-Year FE	Yes	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes	Yes

Estimation of Equation (1) where the outcome variable is monthly net generation by state in GWh from EIA Form 923 for 2000 - 2019. Illinois and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

B.2.3 Retail Prices

Table B.6: Impacts on Retail Prices (Illinois, Pre- and Post- Implementation)

	(1) Residential	(2) Commercial	(3) Industrial	(4) Total
Sales (MWh)	-0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
6-mo. Post	0.17***	-0.03	0.12**	0.08
	(0.06)	(0.08)	(0.06)	(0.06)
ZEC Start	0.22**	-0.05	0.06	0.06
	(0.10)	(0.09)	(0.08)	(0.08)
6-mo. Post x Illinois	-0.30***	-0.07	-0.35***	-0.26***
	(0.08)	(0.07)	(0.06)	(0.05)
ZEC Start x Illinois	-0.78***	-0.41***	-0.76***	-0.55***
	(0.10)	(0.10)	(0.11)	(0.09)
Constant	9.93***	8.17***	5.39***	7.83***
	(0.03)	(0.12)	(0.21)	(0.08)
R-squared	0.97	0.95	0.95	0.97
N	8,880	8,867	8,867	8,880
State-by-Year FE	Yes	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes	Yes

Estimation of Equation (1) where the outcome variable is the monthly average retail price. Data from EIA's Form 861 for 2000 - 2019 on monthly average retail prices by state. New York and neighboring states to both Illinois and New York are excluded from this analysisis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

Table B.7: Impacts on Retail Prices (New York, Pre- and Post- Implementation)

	(1) Residential	(2) Commercial	(3) Industrial	(4) Total
Sales (MWh)	-0.00*	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
8-mo. Post	0.11***	-0.03	0.07*	0.06
	(0.04)	(0.04)	(0.04)	(0.04)
ZEC Start	0.23***	-0.05	0.01	0.01
	(0.09)	(0.06)	(0.05)	(0.06)
8-mo. Post x New York	0.43***	0.53***	0.11***	0.48***
	(0.04)	(0.05)	(0.04)	(0.04)
ZEC Start x New York	0.95***	1.46***	0.29***	1.12***
	(0.10)	(0.09)	(0.09)	(0.07)
Constant	10.07***	8.19***	5.44***	7.94***
	(0.03)	(0.13)	(0.21)	(0.08)
R-squared	0.97	0.96	0.95	0.97
N	8,880	8,867	8,867	8,880
State-by-Year FE	Yes	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes	Yes

Estimation of Equation (1) where the outcome variable is the monthly average retail price. Data from EIA's Form 861 for 2000 - 2019 on monthly average retail prices by state. Illinois and neighboring states to both Illinois and New York are excluded from this analysisis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

B.2.4 Air Quality

Table B.8: Impacts on Air Quality (Illinois, Pre- and Post- Implementation)

	(1) SO2	(2) NO2	(3) PM2.5
6-mo. Post	0.11	-1.13**	0.64**
	(0.19)	(0.48)	(0.28)
ZEC Start	0.20	-0.62	2.45***
	(0.42)	(0.83)	(0.65)
6-mo. Post x Illinois	-1.92***	-2.83***	0.68*
	(0.19)	(0.69)	(0.37)
ZEC Start x Illinois	-1.95***	-2.30***	-0.13
	(0.29)	(0.75)	(0.50)
Constant	7.16***	23.23***	11.43***
	(0.09)	(0.15)	(0.12)
R-squared	0.87	0.85	0.51
N	8,733	8,072	8,676
State-by-Year FE	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes

Estimation of Equation (1) where the outcome variable is monthly ambient concentrations of a local air pollutant by state from EPA's AQS Database for 2000 - 2019. New York and neighboring states to and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

Table B.9: Impacts on Air Quality (New York, Pre- and Post- Implementation)

	(1) SO2	(2) NO2	(3) PM2.5
8-mo. Post	0.01	-0.51	-0.08
	(0.11)	(0.36)	(0.29)
ZEC Start	-0.11	-1.53***	0.37
	(0.25)	(0.49)	(0.45)
8-mo. Post x New York	-0.36***	-3.78***	-0.96***
	(0.11)	(0.31)	(0.26)
ZEC Start x New York	-0.76***	-5.84***	-1.01**
	(0.27)	(0.51)	(0.39)
Constant	7.14***	23.37***	11.61***
	(0.08)	(0.13)	(0.11)
R-squared	0.87	0.85	0.51
N	8,733	8,072	8,713
State-by-Year FE	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes

Estimation of Equation (1) where the outcome variable is monthly ambient concentrations of a local air pollutant by state from EPA's AQS Database for 2000 - 2019. Illinois and neighboring states to and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

B.3 Difference-in-Difference: Short-Term Breakdowns

B.3.1 Nuclear Generation

Table B.10: Nuclear Generation (Illinois, Short Term Breakdown)

	(1)	(2)	(3)	(4)
Total Load	0.08***	0.07***	0.07***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
6-mo. Post	82.81**	22.67	-14.86	53.78
	(35.89)	(35.76)	(36.14)	(43.57)
ZEC Start (1-6mo.)	106.75**	57.85	14.26	28.78
	(45.28)	(44.79)	(45.64)	(51.61)
ZEC Start (7-12mo.)	216.34***	103.31**	26.40	106.19**
	(53.51)	(52.52)	(56.15)	(49.85)
ZEC Start (1 year+)	186.48***	74.71	-14.10	165.48***
	(60.30)	(59.07)	(63.65)	(61.20)
6-mo. Post x Illinois	508.55***	516.37***	526.66***	515.38***
	(35.63)	(35.24)	(34.80)	(35.49)
ZEC Start (1-6mo.) x Illinois	944.10***	949.55***	956.70***	948.86***
	(45.69)	(45.04)	(44.16)	(45.30)
ZEC Start (7-12mo.) x Illinois	1180.76***	1193.32***	1209.82***	1191.72***
	(52.92)	(52.73)	(52.37)	(53.21)
ZEC Start (13mo.) x Illinois	1392.10***	1404.44***	1420.63***	1402.87***
	(59.77)	(59.44)	(58.78)	(59.95)
Constant	708.18***	720.72***	915.66***	798.67***
	(37.18)	(37.35)	(40.50)	(40.65)
R-squared	0.98	0.98	0.98	0.98
N	8,880	8,880	8,880	8,880
State-by-Year FE	Yes	Yes	Yes	Yes
Season FE		Yes		
Month FE			Yes	
Season-by-Year FE				Yes

Estimation of Equation (2) with varying time fixed effects, where the outcome variable is monthly nuclear generation by state in GWh from EIA Form 923 for 2000 - 2019. New York and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

Table B.11: Nuclear Generation (New York, Short Term Breakdown)

	(1)	(2)	(3)	(4)
Total Load	0.08***	0.07***	0.06***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
6-mo. Post	-39.75	-37.10	-48.86	17.05
	(30.82)	(30.96)	(31.65)	(24.14)
ZEC Start (1-6mo.)	-131.69**	-87.96*	-101.94*	-57.35
	(51.76)	(51.53)	(52.31)	(49.65)
ZEC Start (7-12mo.)	-6.04	19.43	7.93	23.37
	(40.70)	(41.29)	(43.41)	(41.19)
ZEC Start (1 year+)	-65.89	-6.55	-20.75	18.37
	(51.82)	(52.06)	(55.23)	(53.97)
6-mo. Post x New York	322.65***	324.76***	327.21***	324.56***
	(30.93)	(30.96)	(31.01)	(31.07)
ZEC Start (1-6mo.) x New York	583.41***	586.09***	589.19***	585.83***
	(52.86)	(52.18)	(51.41)	(52.44)
ZEC Start (7-12mo.) x New York	753.10***	757.11***	761.76***	756.72***
	(41.42)	(41.35)	(41.25)	(41.52)
ZEC Start (13mo.) x New York	665.05***	671.29***	678.50***	670.68***
	(53.16)	(52.90)	(52.54)	(53.14)
Constant	651.08***	638.31***	822.81***	727.05***
	(35.73)	(35.71)	(38.84)	(37.64)
R-squared	0.97	0.97	0.97	0.97
N	8,880	8,880	8,880	8,880
State-by-Year FE	Yes	Yes	Yes	Yes
Season FE		Yes		
Month FE			Yes	
Season-by-Year FE				Yes

Estimation of Equation (2) where the outcome variable is monthly net generation by state in GWh from EIA Form 923 for 2000 - 2019. Illinois and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

B.3.2 Non-Nuclear Generation

Table B.12: Impacts on Other Generation (Illinois, Short Term Breakdown)

	(1) Coal	(2) Natural Gas	(3) Non-Hydro Renewables
Nuclear Generation	-0.14***	-0.71***	-0.01
	(0.03)	(0.05)	(0.01)
Total Load	0.28***	0.63***	0.00
	(0.02)	(0.02)	(0.01)
6-mo. Post	295.14**	-321.85**	98.58***
	(130.00)	(144.23)	(27.28)
ZEC (1-6mo.)	154.10	-93.95	200.45***
	(135.83)	(158.60)	(42.69)
ZEC (7-12mo.)	201.23	-200.98	201.19***
	(132.55)	(157.67)	(36.50)
ZEC (1 year+)	183.86	-80.78	198.74***
	(147.34)	(177.80)	(40.16)
6-mo. Post x IL	172.04*	-418.30***	278.05***
	(99.15)	(120.99)	(37.68)
ZEC (1-6mo.) x IL	118.69	-203.94	-130.89**
	(105.28)	(148.09)	(55.76)
ZEC (7-12mo.) x IL	-133.76	-527.60***	495.33***
	(107.68)	(168.32)	(59.50)
ZEC (1 year+) x IL	41.92	-581.10***	211.99***
	(120.21)	(188.44)	(72.27)
Constant	976.15***	-1497.37***	311.66***
	(88.99)	(112.21)	(41.09)
R-squared	0.98	0.99	0.96
N	8,880	8,880	8,880
State-by-Year FE	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes

Estimation of Equation (2) where the outcome variable is monthly net generation by state in GWh from EIA Form 923 for 2000 - 2019. New York and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

Table B.13: Impacts on Other Generation (New York, Short Term Breakdown)

	(1) Coal	(2) Natural Gas	(3) Non-Hydro Renewables	(4) Fuel Oil	(5) Hydro
Nuclear Generation	-0.17***	-0.70***	0.00	-0.02**	-0.11***
	(0.03)	(0.05)	(0.01)	(0.01)	(0.04)
Total Load	0.27***	0.64***	0.00	0.02***	0.06***
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
8-mo. Post	187.58***	-121.06**	25.59**	-7.76***	-84.53***
	(64.28)	(57.17)	(11.17)	(2.32)	(21.02)
ZEC (1-6mo.)	163.42**	-70.64	33.61	-11.51*	-115.13***
	(78.65)	(72.35)	(36.80)	(6.94)	(28.69)
ZEC (7-12mo.)	101.06	-71.08	121.27***	-4.83	-146.02***
	(72.48)	(76.11)	(24.87)	(6.03)	(49.32)
ZEC (1 year+)	71.56	-42.08	127.43***	-15.54**	-141.13**
	(83.98)	(90.02)	(30.73)	(7.90)	(60.63)
6-mo. Post x NY	-345.83***	308.15***	23.90*	-19.08***	33.48
	(79.47)	(84.75)	(13.15)	(2.98)	(46.35)
ZEC (1-6mo.) x NY	-544.31***	519.09***	-108.57*	-33.42***	168.18***
	(94.00)	(108.69)	(59.72)	(7.79)	(58.93)
ZEC (7-12mo.) x NY	-404.69***	-49.33	-22.03	98.05***	378.60***
	(89.89)	(125.46)	(23.82)	(6.44)	(107.18)
ZEC (1 year+) x NY	-639.06***	571.19***	-65.85	-341.06***	475.65***
	(105.05)	(140.65)	(49.29)	(9.10)	(118.81)
Constant	949.62***	-1512.13***	318.94***	-50.90	293.16***
	(83.11)	(105.96)	(41.07)	(33.89)	(56.98)
R-squared	0.98	0.99	0.97	0.86	0.94
N	8,880	8,880	8,880	8,880	8,880
State-by-Year FE	Yes	Yes	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes	Yes	Yes

Estimation of Equation (2) where the outcome variable is monthly net generation by state in GWh from EIA Form 923 for 2000 - 2019. Illinois and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

B.3.3 Wholesale Prices

Table B.14: Impacts on LMP (Illinois, Short Term Breakdown)

	(1) Chicago Hub - PJM	(2) Illinois Hub - MISO
8-mo. Post	8.91***	8.97***
	(1.27)	(1.28)
ZEC (1-6mo.)	8.98***	9.05***
	(1.50)	(1.50)
ZEC (7-12mo.)	16.36***	16.42***
	(3.25)	(3.25)
ZEC (1 year+)	8.91**	9.12**
	(3.95)	(3.96)
8-mo. Post x IL	-4.03**	-3.85**
	(1.81)	(1.81)
ZEC (1-6mo.) x IL	-3.90**	-2.24
	(1.91)	(1.91)
ZEC (7-12mo.) x IL	-10.04**	-11.57***
	(3.86)	(3.86)
ZEC (1 year+) x IL	-6.84	-8.18*
	(4.15)	(4.15)
Constant	31.41***	31.25***
	(1.44)	(1.45)
R-squared	0.40	0.39
N	1,642	1,642
Hub-by-Year FE	Yes	Yes
Season-by-Year FE	Yes	Yes

Estimation of Equation (2) where the outcome variable is the monthly average hub LMP. Monthly average LMP data from 2013 - 2019 for reference nodes in NYISO, SPP, ERCOT, ISO-NE, MISO, and PJM. Hub prices for New York and neighboring states to both Illinois and New York are excluded from this analysis. Standard errors clustered by hub-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

Table B.15: Impacts on LMP (New York, Short Term Breakdown)

	(1) NYISO Reference Hub
8-mo. Post	6.15***
	(0.79)
ZEC (1-6mo.)	8.24***
	(0.87)
ZEC (7-12mo.)	11.00***
	(2.10)
ZEC (1 year+)	8.95***
	(2.53)
8-mo. Post x NY	-0.69
	(0.43)
ZEC (1-6mo.) x NY	-4.07***
	(1.16)
ZEC (7-12mo.) x NY	-1.58*
	(0.94)
ZEC (1 year+) x NY	-4.66*
	(2.42)
Constant	32.73***
	(1.12)
R-squared	0.40
N	1,642
Hub-by-Year FE	Yes
Season-by-Year FE	Yes

Estimation of Equation (2) where the outcome variable is the monthly average hub LMP. Monthly average LMP data from 2013 - 2019 for reference nodes in NYISO, SPP, ERCOT, ISO-NE, MISO, and PJM. Hub prices for Illinois and neighboring states to both Illinois and New York are excluded from this analysis. Standard errors clustered by hub-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

B.3.4 Retail Prices

Table B.16: Impacts on Retail Prices (Illinois, Short Term Breakdown)

	(1) Residential	(2) Commercial	(3) Industrial	(4) Total
Sales (MWh)	-0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
6-mo. Post	0.17***	-0.03	0.12**	0.08
	(0.06)	(0.08)	(0.06)	(0.06)
ZEC (1-6mo.)	0.82***	0.23**	0.33***	0.31***
	(0.11)	(0.11)	(0.11)	(0.09)
ZEC (7-12mo.)	0.21**	-0.05	0.06	0.06
	(0.10)	(0.09)	(0.08)	(0.08)
ZEC (1 year+)	0.16	-0.21*	-0.10	-0.07
	(0.13)	(0.12)	(0.11)	(0.10)
6-mo. Post x IL	-0.30***	-0.07	-0.35***	-0.26***
	(0.08)	(0.07)	(0.06)	(0.05)
ZEC (1-6mo.) x IL	-0.81***	-0.41***	-0.80***	-0.57***
	(0.11)	(0.11)	(0.12)	(0.09)
ZEC (7-12mo.) x IL	-0.61***	-0.39***	-0.53***	-0.47***
	(0.11)	(0.09)	(0.10)	(0.07)
ZEC (1 year+) x IL	-1.00***	-0.39***	-0.79***	-0.63***
	(0.13)	(0.13)	(0.13)	(0.10)
Constant	9.93***	8.18***	5.40***	7.84***
	(0.03)	(0.12)	(0.21)	(0.08)
R-squared	0.97	0.95	0.95	0.97
N	8,880	8,867	8,867	8,880
State-by-Year FE	Yes	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes	Yes

Estimation of Equation (2) where the outcome variable is the monthly average retail price. Data from EIA's Form 861 for 2000 - 2019 on monthly average retail prices by state. New York and neighboring states to both Illinois and New York are excluded from this analysisis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

Table B.17: Impacts on Retail Prices (New York, Short Term Breakdown)

	(1) Residential	(2) Commercial	(3) Industrial	(4) Total
Sales (MWh)	-0.00*	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
8-mo. Post	0.11***	-0.03	0.07*	0.06
	(0.04)	(0.04)	(0.04)	(0.04)
ZEC (1-6mo.)	0.36***	0.01	0.10*	0.10
	(0.10)	(0.08)	(0.06)	(0.06)
ZEC (7-12mo.)	0.09	-0.10	-0.10	-0.07
	(0.09)	(0.06)	(0.06)	(0.06)
ZEC (1 year+)	0.14	-0.24**	-0.18**	-0.16**
	(0.11)	(0.11)	(0.07)	(0.08)
8-mo. Post x NY	0.43***	0.53***	0.11***	0.48***
	(0.04)	(0.05)	(0.04)	(0.04)
ZEC (1-6mo.) x NY	1.05***	1.83***	0.26***	1.37***
	(0.12)	(0.10)	(0.10)	(0.09)
ZEC (7-12mo.) x NY	0.74***	0.72***	0.36***	0.64***
	(0.09)	(0.07)	(0.08)	(0.06)
ZEC (1 year+) x NY	1.26***	1.44***	0.14	1.20***
	(0.12)	(0.13)	(0.11)	(0.09)
Constant	10.08***	8.20***	5.45***	7.96***
	(0.03)	(0.13)	(0.21)	(0.08)
R-squared	0.97	0.96	0.95	0.97
N	8,880	8,867	8,867	8,880
State-by-Year FE	Yes	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes	Yes

Estimation of Equation (2) where the outcome variable is the monthly average retail price. Data from EIA's Form 861 for 2000 - 2019 on monthly average retail prices by state. Illinois and neighboring states to both Illinois and New York are excluded from this analysisis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

B.3.5 Air Quality

Table B.18: Impacts on Air Quality (Illinois, Pre- and Post- Implementation)

	(1) SO2	(2) NO2	(3) PM2.5
6-mo. Post	0.11	-1.13**	0.64**
	(0.19)	(0.48)	(0.28)
ZEC (1-6mo.)	0.16	-3.42***	1.09**
	(0.39)	(0.70)	(0.50)
ZEC (7-12mo.)	0.21	-0.57	2.44***
	(0.42)	(0.84)	(0.66)
ZEC (1 year+)	-0.54	-1.57*	2.08***
	(0.46)	(0.95)	(0.71)
6-mo. Post x IL	-1.92***	-2.83***	0.68*
	(0.19)	(0.69)	(0.37)
ZEC (1-6mo.) x IL	-1.90***	-1.99***	-0.17
	(0.28)	(0.76)	(0.51)
ZEC (7-12mo.) x IL	-2.25***	-4.19***	0.09
	(0.35)	(0.99)	(0.70)
ZEC (1 year+) x IL	-1.94***	-6.42***	-0.99
	(0.37)	(1.07)	(0.83)
Constant	7.21***	23.30***	11.46***
	(0.09)	(0.16)	(0.12)
R-squared	0.87	0.85	0.51
N	8,733	8,072	8,676
State-by-Year FE	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes

Estimation of Equation (2) where the outcome variable is monthly ambient concentrations of a local air pollutant by state from EPA's AQS Database for 2000 - 2019. New York and neighboring states to and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

Table B.19: Impacts on Air Quality (New York, Pre- and Post- Implementation)

	(1) SO2	(2) NO2	(3) PM2.5
8-mo. Post	0.01	-0.51	-0.08
	(0.12)	(0.36)	(0.29)
ZEC (1-6mo.)	-0.25	-3.07***	0.91**
	(0.25)	(0.53)	(0.46)
ZEC (7-12mo.)	0.02	0.06	-0.18
	(0.30)	(0.65)	(0.67)
ZEC (1 year+)	-0.35	-1.58**	-0.28
	(0.31)	(0.72)	(0.70)
8-mo. Post x NY	-0.36***	-3.78***	-0.96***
	(0.11)	(0.31)	(0.26)
ZEC (1-6mo.) x NY	-0.71***	-5.32***	-1.00**
	(0.27)	(0.62)	(0.41)
ZEC (7-12mo.) x NY	-0.87***	-6.89***	-1.03**
	(0.31)	(0.58)	(0.49)
ZEC (1 year+) x NY	-1.03***	-8.86***	-1.72***
	(0.34)	(0.72)	(0.56)
Constant	7.15***	23.30***	11.69***
	(0.08)	(0.14)	(0.12)
R-squared	0.87	0.85	0.51
N	8,733	8,072	8,713
State-by-Year FE	Yes	Yes	Yes
Season-by-Year FE	Yes	Yes	Yes

Estimation of Equation (2) where the outcome variable is monthly ambient concentrations of a local air pollutant by state from EPA's AQS Database for 2000 - 2019. Illinois and neighboring states to and neighboring states to New York and Illinois are excluded from this analysis. Standard errors clustered by state-by-year in parentheses. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.