

Descriptive Analysis

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1 Safe Harbor Rules

Begin-construction requirement enacted in early 2013 for PTC and ITC that was since clarified. Modified to mimic language in 1603 grant program and bonus depreciation, bond financing, etc.

2013 guidance: facility placed in service within two calendar years measured from statutory deadline to begin construction

1.1 Solar

- Solar ITC safe harbor rule made on February 9, 2018, the Bipartisan Budget Act of 2018.
- Original ITC deadline was placed in service date of December 31, 2015. Then ITC got extended on December 18, 2015 for projects placed in service before January 1, 2024. Even though credit rates awarded will depend on begin construction date after 2018, all projects must follow placed in service deadline.

1.2 Wind

- Safe Harbor for PTC (wind) more complicated:

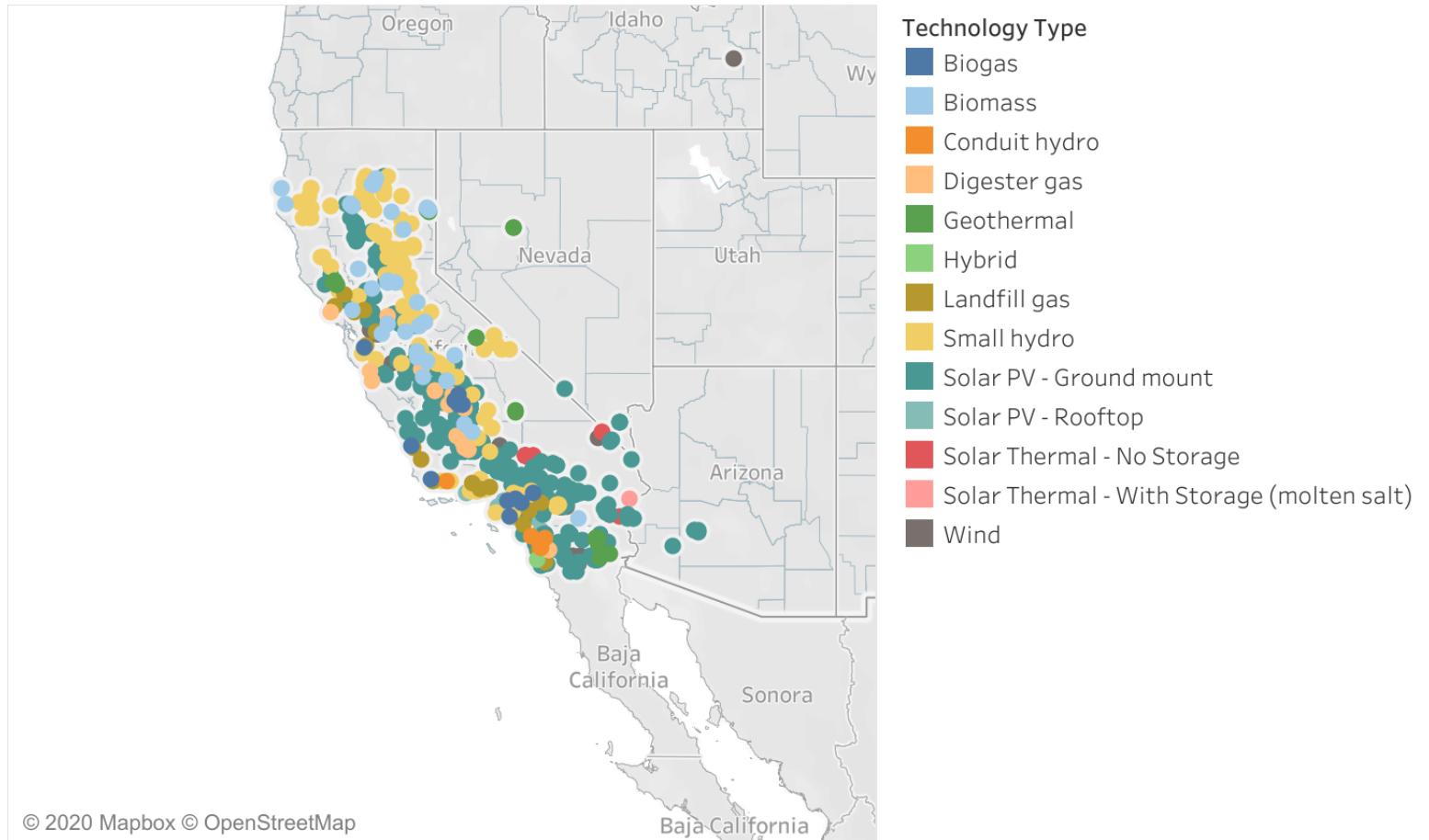
2 Case Study 1: California

2.1 RPS Program

- 2002: Program established by Senate Bill (SB) 1078 with initial requirement that 20% of retail sales must be served by renewable resources by 2017.
- 2003: Energy Action Plan I accelerates 20% deadline to 2010
- 2006: acceleration codified into law in SB 107
- 2004 Energy Action Plan II examined further goal of 33% by 2020
- 2005: Assembly Bill 200 modified requirements for electric corporations that serve customers outside of California and have >60k customer accounts in CA
- 2006: Executive Order establishes targets to increase bioenergy use/production
- 2006: Assembly Bill 1969 requires electrical corporations to purchase, at CPUC set price, renewable energy output from public water and wastewater facilities up to 1 MW
- 2007: modifies supplemental energy payments process (?)
- 2008: AB 3048 makes minor technical changes to clarify code(?)
- 2008: SB 280 amends PU Code 399.20 to make feed-in tariff for all renewable generators (previously limited to water/wastewater facilities) and increase program cap to 500 MW (from 250 MW)

Figure 1: Investor-owned utility RPS Contracts

Investor-Owned Utility RPS Contracts



- 2015: SB 350 mandated 50% RPS by 2030, with interim annual targets with three-year compliance periods; requires 65% of RPS procurement to be derived from long-term contracts of 10+ years
- 2017: All electricity retail sellers had an interim target to serve at least 27% of their load with RPS-eligible resources by December 31, 2017
- 2018: SB 100 increases RPS to 60% by 2030, requires all state's electricity to come from carbon-free sources by 2045

Administered by CPUC for California's retail sellers of electricity, which include large and small IOUs, electric service providers, and community choice aggregators. California Energy Commission certifies generation facilities as eligible resources and enforcing requirements for POU's.

The CPUC determines annual procurement targets and enforces compliance, reviews IOU procurement plans, reviews contracts for RPS-eligible energy, establishes standard terms and conditions used by IOUs in their contracts for eligible sources. Renewable energy tracking system is maintained by WREGIS.

In general, retail sellers met or exceed the interim 27% target and are on track to achieve their compliance requirements.

The big three IOUs collectively served 36% of sales with renewables. Small and Multi-jurisdictional utilities and ESPs had roughly 27%; CCAs served 50% with renewable power.

RPS resources include wind, solar PV, solar thermal, hydro, geothermal, bioenergy.

2.2 RPS Procurement Programs

1. Utility Scale Request for Offer

- The three largest investor-owned utilities in California contract for long-term, utility-scale supplies of renewable energy through annual competitive requests for offers called "RFOs." The CPUC established this program for

utility procurement of renewable energy to ensure that the utilities meet their RPS obligations through a transparent process.

2. Renewable Auction Mechanism

- The Renewable Auction Mechanism, or RAM, is a simplified market-based procurement mechanism for renewable distributed generation (DG) projects greater than 3 MW and up to 20 MW on the system side of the meter.

3. RPS Feed-in Tariff Program

feed-in tariff program for renewable generators less than 3 MW in size. This program offers up to 493.6 MW to eligible projects through a fixed-price standard contract to export electricity to California's three large investor owned utilities (IOUs). The ReMAT Program replaced the AB 1969 Feed-in Tariff Program in 2013.

4. Utility Solar Rooftop

- The Commission authorized Southern California Edison (SCE), Pacific Gas and Electric Company (PG&E), and San Diego Gas & Electric Company (SDG&E) to own and operate solar PV facilities (UOG) as well as to execute solar PV power purchase agreements with independent power producers (IPP) through a competitive solicitation process.

2.3 Regulation

CPUC regulates three IOUs (private electricity and natural gas providers) that comprise approximately three-quarters of electricity supply in California:

1. Pacific Gas and Electric
2. San Diego Gas and Electric
3. Southern California Edison

IOUs purchase power through contracts and operate their own generation facilities. Resumed procurement in 2002 after energy crisis; every 2 years CPUC holds Long Term Procurement Plan proceeding to review and adopt the IOUs' ten-year procurement plans; establishes rules for rate recovery of procurement transactions.

Utility rates are set to recover costs and earn a reasonable return as profits for investors in return for risk they bear for investing in new facilities.

Rest of California is powered by publicly owned utilities. Largest is Los Angeles Department of Water and Power, which provides service to 3.9 million customers. By contrast, these are non-profit public entities managed by locally elected officials or public employees (and would need to partner with tax equity investors....). Public utilities have access to tax-free bonds and co-ops have access to low-interest loans usually at the local level. POUs are not regulated by the CPUC and are not subject to the same energy efficiency mandates as the IOUs; however Energy Commission evaluates POUs.

Relevant Policies

- 2010: California Public Utilities Commission adopts Renewable Auction Mechanism

- Program to help IOUs procure RPS eligible generation in streamlined fashion by providing standard non-negotiable contracts and a standardized valuation process. Projects can then be submitted to the CPUC through an expedited regulatory review process.
- Initial program for renewable DG projects between 3-20 MW, and 1,000 MW...? No longer has caps, no longer limits geographic location of projects to service territory of the IOUs.

Facilitates quick simple transactions where projects can come online relatively sooner; IOUs submit annual RPS procurement plan filings

California Solar Initiative: pays for energy produced by solar energy systems on monthly basis over 5-year period of time at fixed incentive rate (\$/kWh)

Performance-based incentive for solar motivates installers and owners to focus on proper installation, maintenance, and performance of systems, since the payment is based upon actual energy produced. This provides policy makers and regulators assurances that the incentives are not squandered on systems with poor performance.

3 Case Study 2: Texas

RPS program requires 10,000 MW capacity by 2020...?

Compliance Premium awarded by ERCOT in conjunction with a REC that is generated by non-wind renewable generation.

Number Of Installations: 63,466

“Texas is poised to become a nationwide leader in solar energy, with more than 4 GW of capacity expected to be installed over the next 5 years, with appropriate state policy that removes market barriers and recognizes solar’s benefits.”

4 Things to look up

- When did placed in service switch to start construction?

5 Pre-2005 Credits

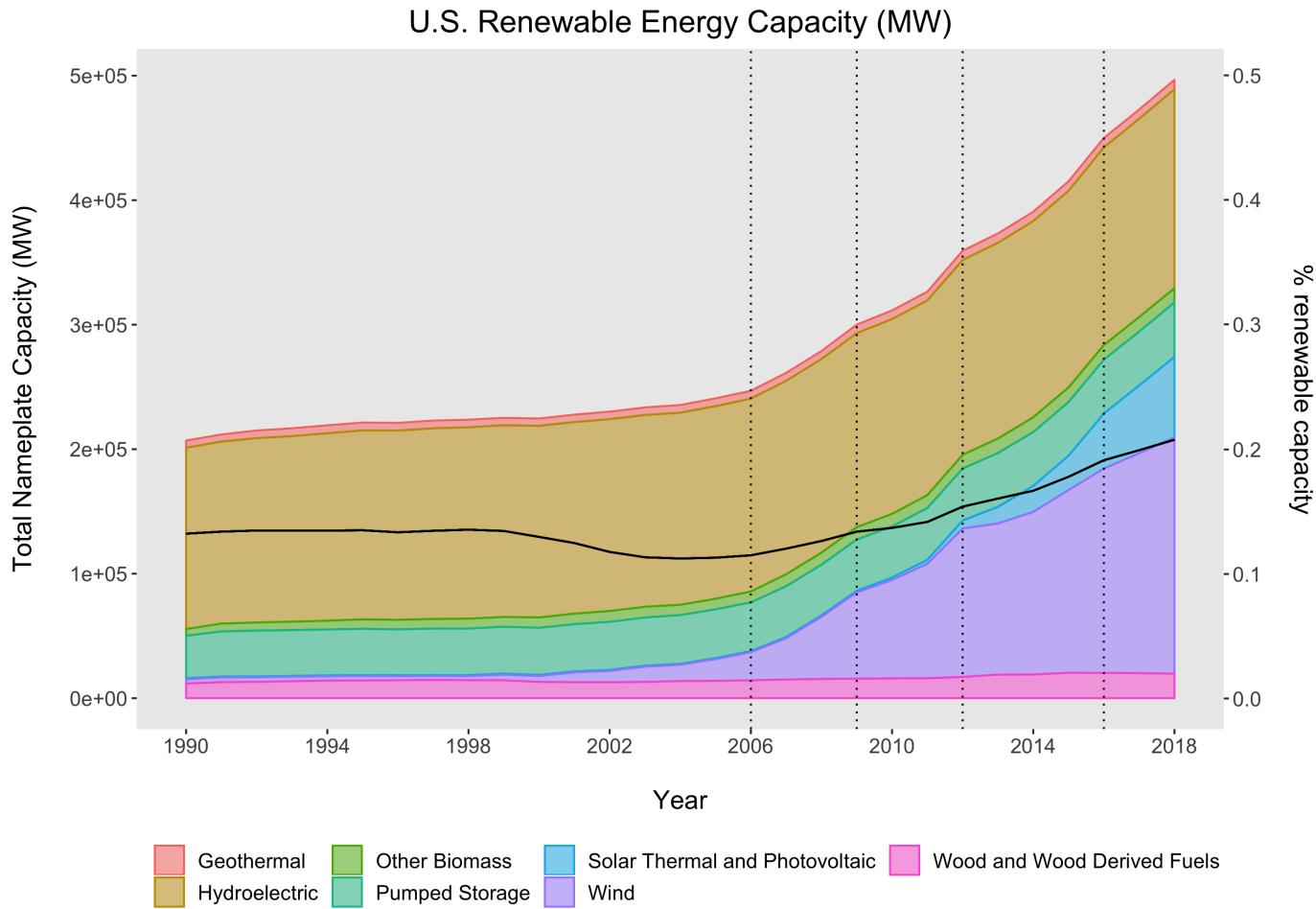
- Energy Policy Act of 1992
 - made 10% ITC for solar and geothermal permanent
 - first enactment of PTC for electricity generated using wind or closed-loop biomass
- Working Families Tax Relief Act of 2004
 - extended PTC through December 31, 2005; at this point PTC for poultry waste, too
- American Jobs Creation Act of 2004
 - Added open-loop biomass (including agricultural livestock waste), geothermal, solar, small irrigation power, and municipal solid waste (landfill gas and trash combustion); but limited to five-year PTC period
 - Open-loop biomass, small irrigation power and municipal solid waste received only half credit
 - Introduced PTC for refined coal, with rate of \$4.375 per ton on qualifying serviced placed in service before January 1, 2009

6 Relevant Policies 2005–Present

- After December 31, 2005, PTC for solar expires
- Energy Policy Act of 2005 (8/8/05)
 - increased solar ITC from 10% to 30% for 2006 and 2007
 - 30% ITC for fuel cell power plants,
 - 10% for stationary microturbine power plants placed in service during 2006 and 2007
 - extended PTC for all facilities except solar energy and refined coal for two years, through 2007
 - added PTC for hydropower (half-credit) and Indian Coal (seven-year period, \$1.50 per ton for first four years, then \$2.00 per ton for last three years)
 - extended PTC period from 5 to 10 years for all qualifying facilities (other than Indian Coal) for all qualifying facilities placed in service after August 8, 2005
- Tax Relief and Health Care Act of 2006 (12/20/06)
 - extended ITC through 2008
 - extended PTC through 2008 for all technologies but solar, refined coal and Indian coal through 2008
- Emergency Economic Stabilization Act of 2008 (10/3/08)

- extended credits for solar, fuel cells and microturbines through December 31, 2016
- provided 10% credit for geothermal heat pump property
- 30% credit for qualified small wind energy property
- 10% credit for combined heat and power (CHP)
- ITC all with placed-in-service deadline of December 31, 2016
- PTC for wind and refined coal extended through 2009
- PTC for closed-loop and open-loop biomass, geothermal, small irrigation, municipal solid waste, and hydropower extended two years through 2010
- added PTC for marine and hydrokinetic renewable energy; and new credit for steel industry fuel
- American Recovery and Reinvestment Act of 2009 (2/17/09)
 - extended PTC for wind through 2012 and for other technologies through 2013
 - allowed ITC or one-time grant in lieu of PTC for property placed in service or start construction in 2009 and 2010
- Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010
 - extended grant program for one year (through 2011)
- American Taxpayer Relief Act of 2012 (1/2/13)
 - extended PTC for wind through 2013,
 - changed placed-in-service PTC requirement to start construction
- Tax Increase Prevention Act of 2014 (12/19/14)
 - PTC and ITC in lieu of PTC option retroactively extended through 2014
- Consolidated Appropriations Act, 2016 (12/18/15)
 - extended the 30% credit rate for solar electric or heating property (but not fiber-optic) through 2019
 - Termination date changed from placed-in-service deadline to construction start date
 - Credit set at 26% for construction beginning in 2020; 22% for 2021
 - To qualify for a rate in excess of 10%, property must be placed in service by December 31, 2023
 - extended PTC expiration date for nonwind facilities through end of 2016
 - extended ITC in lieu of PTC option through 2016
 - extended PTC for Indian Coal through 2016
 - removed placed in service limit for Indian Coal
 - extended PTC for wind through 2019 with reduced rates each year
 - A permanent 10% ITC will remain for solar and geothermal
- Bipartisan Budget Act of 2018 (2/9/18)
 - retroactively extended PTC for nonwind and Indian Coal for tax year 2017
 - extended ITC for five years for fiber-optic solar, fuels cells, small wind, microturbine, CHP, geothermal heat pump property
 - For property eligible for 30% credit rate through 2019, credit rate reduced according to solar reduction schedule
 - All termination dates changed to construction start deadlines

7 EIA Annual Capacity Data



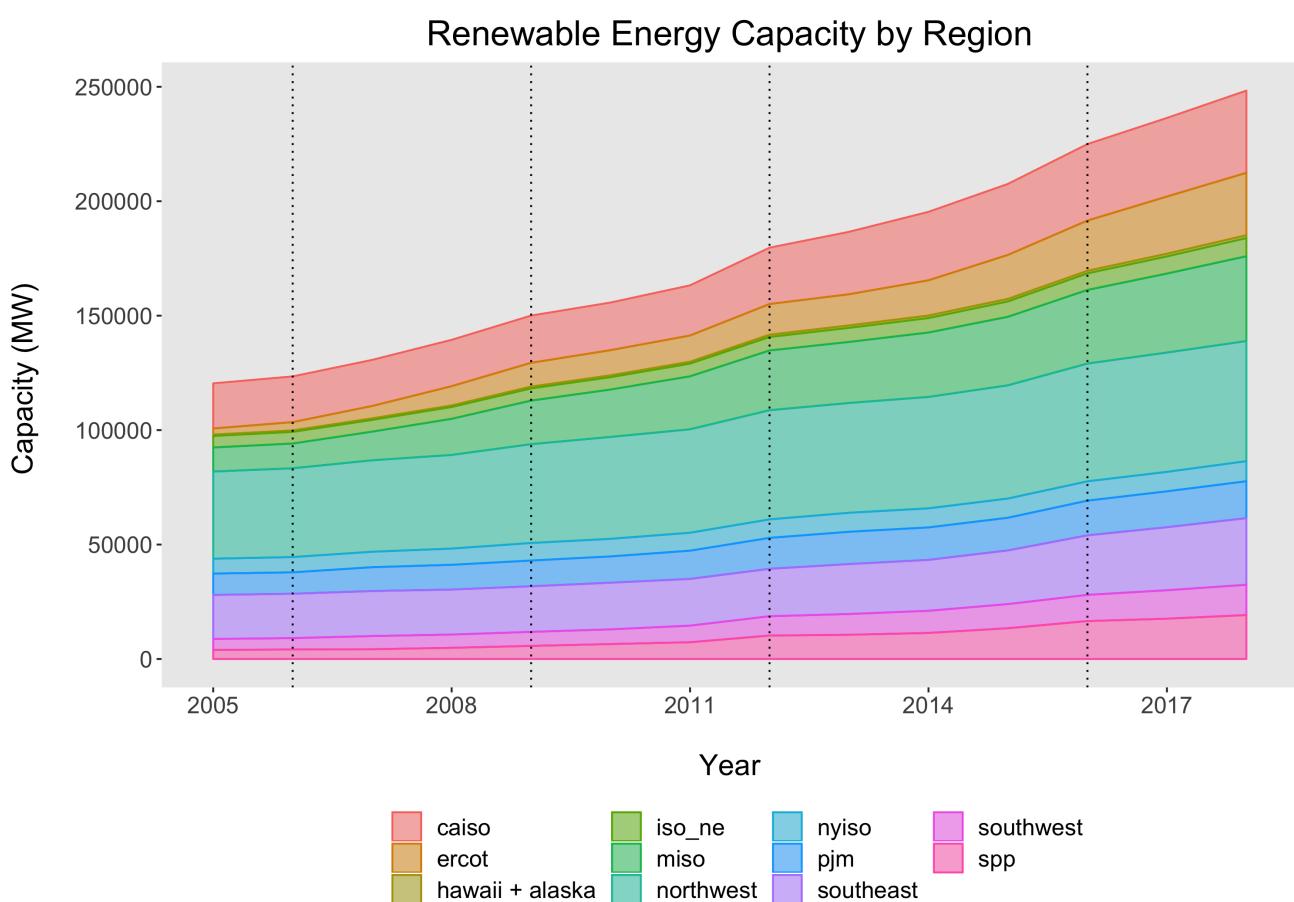
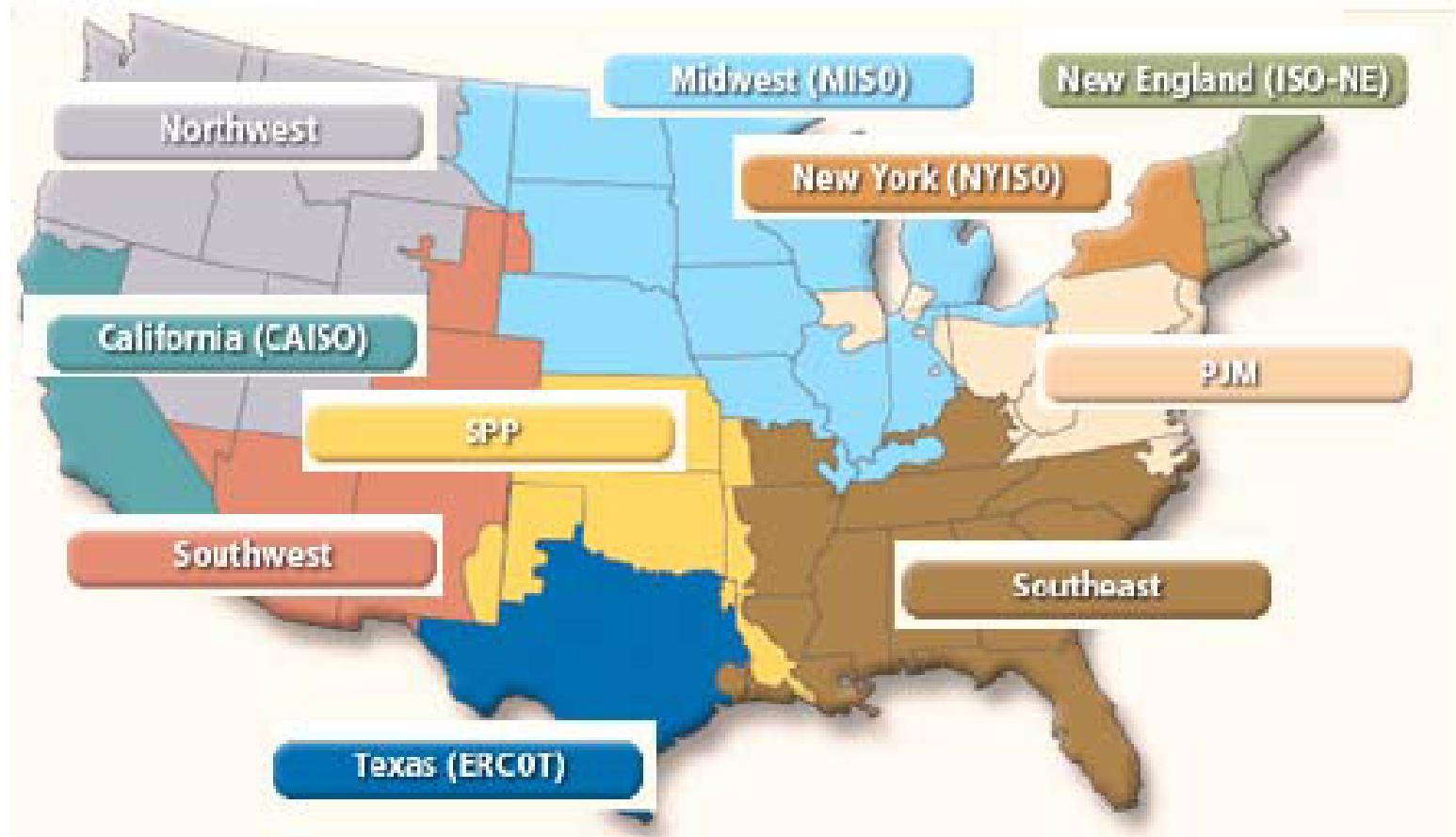
Comments

- Vertical lines at 2006 (ITC and PTC increase), 2009-2012 (loan grant program), 2016 (initial expiration)
- Renewables growth driven by solar (after 2012) and wind (after 2006)

Figure 2: Renewable capacity (as stock and percent of total capacity) by region in 2018

region	tot_region_renew	# Groups: 11	region	p_renew_region
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1 northwest	52469.		1 northwest	0.559
2 miso	37056.		2 caiso	0.442
3 caiso	35916.		3 spp	0.314
4 southeast	29114.		4 southwest	0.221
5 ercot	27287.		5 iso_ne	0.209
6 spp	19210.		6 ercot	0.206
7 pjm	16127.		7 hawaii + alaska	0.203
8 southwest	13216		8 nyiso	0.198
9 nyiso	8777.		9 miso	0.142
10 iso_ne	7927		10 southeast	0.131
11 hawaii + alaska	1236.		11 pjm	0.0824

Figure 3: FERC Power Markets



% Renewable Capacity by Region

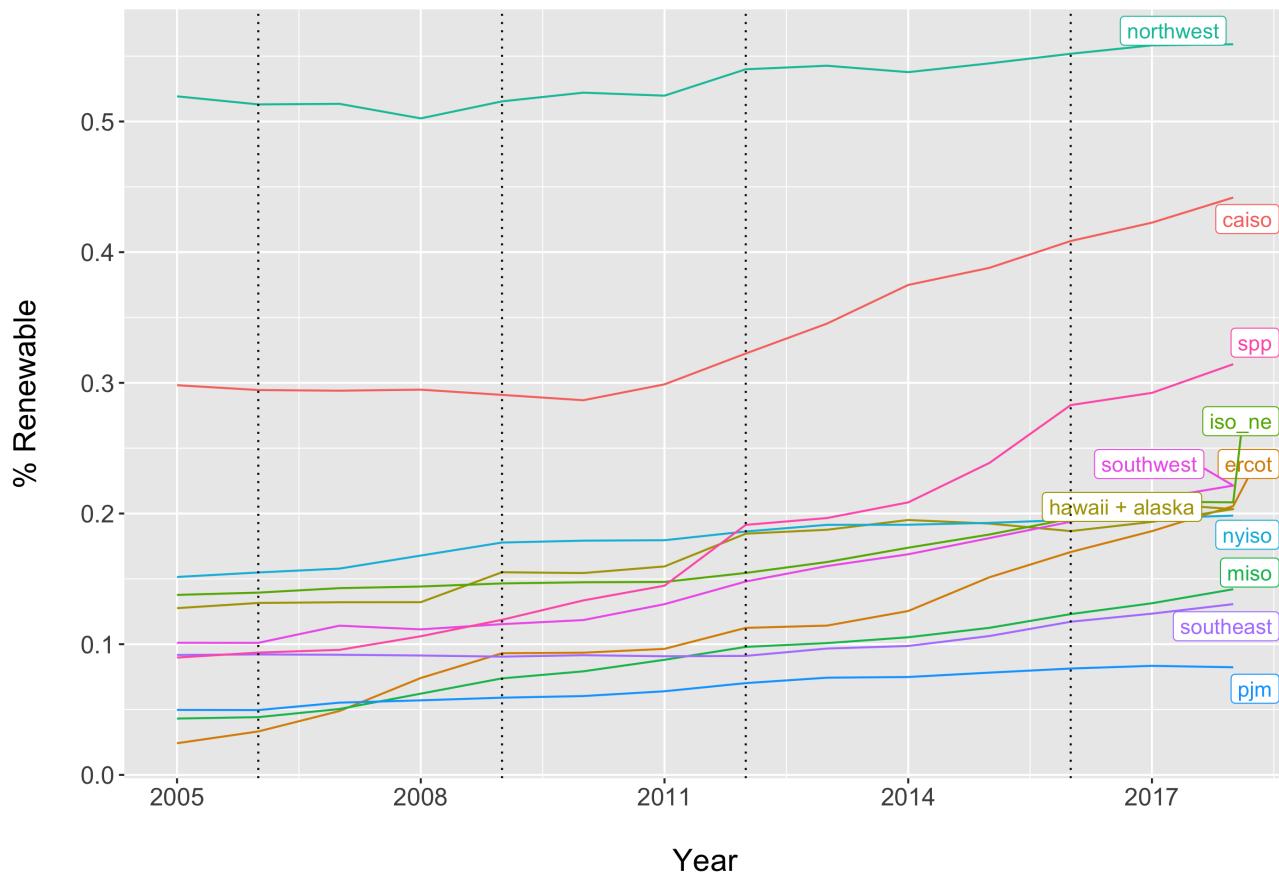
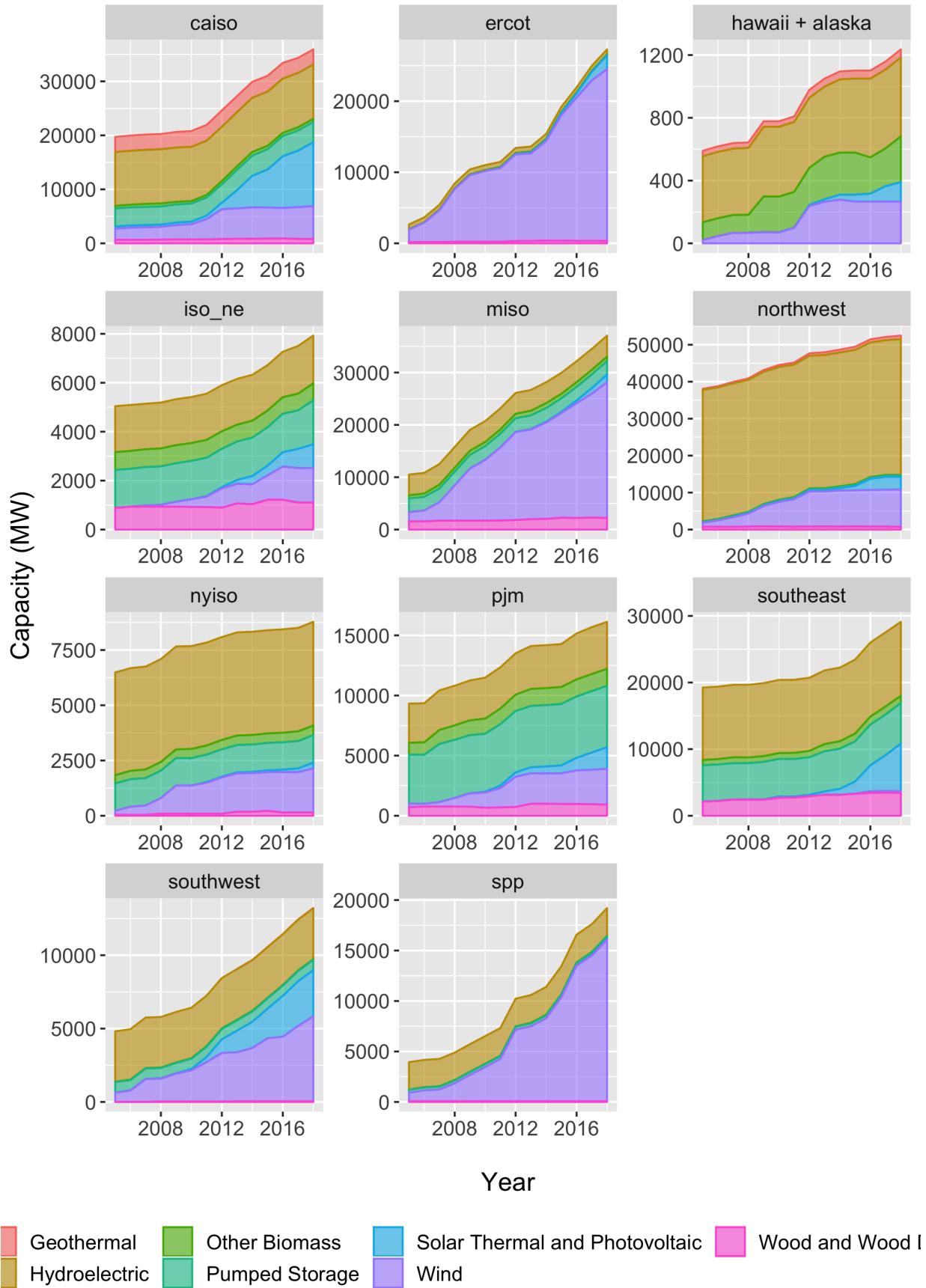
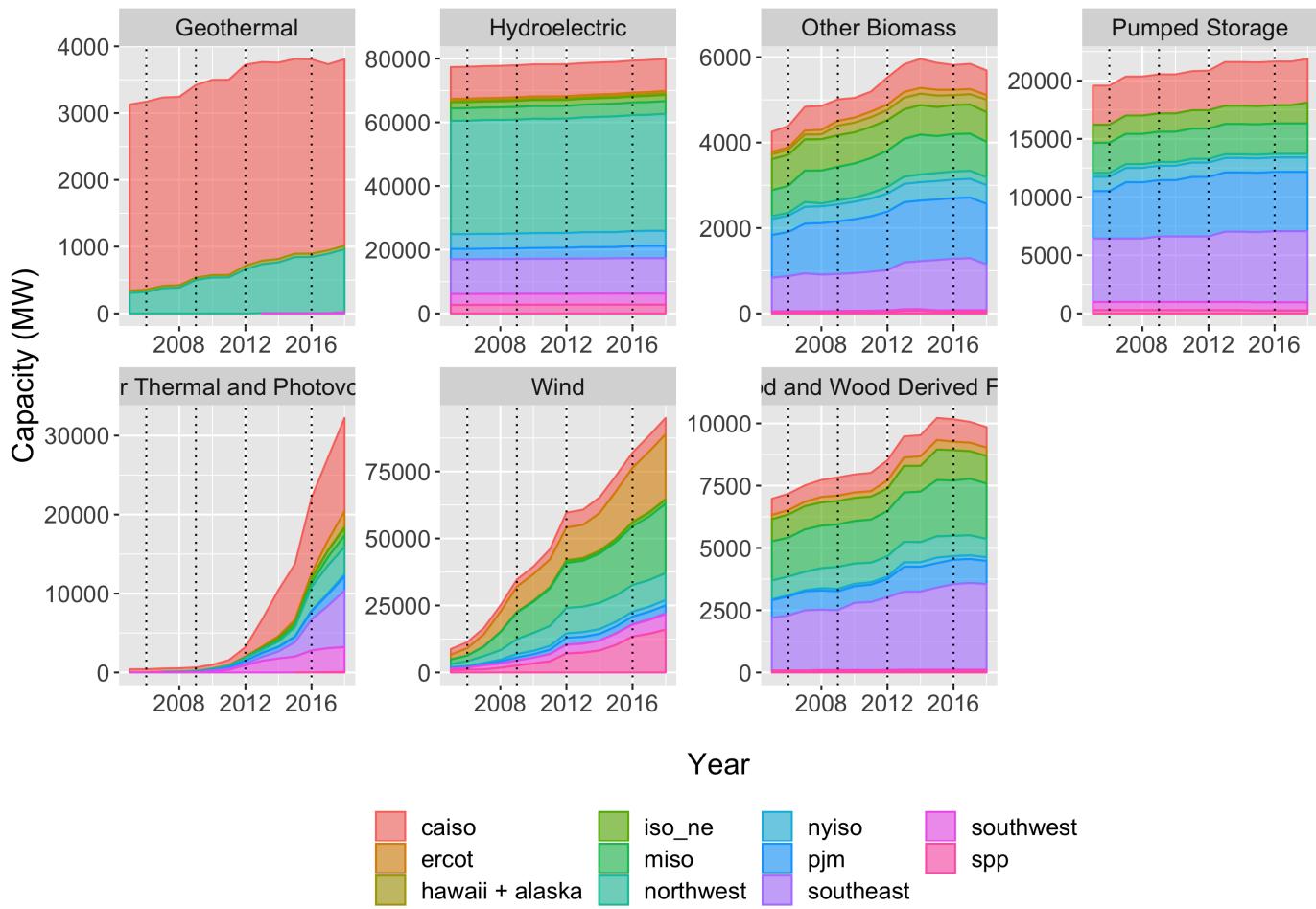
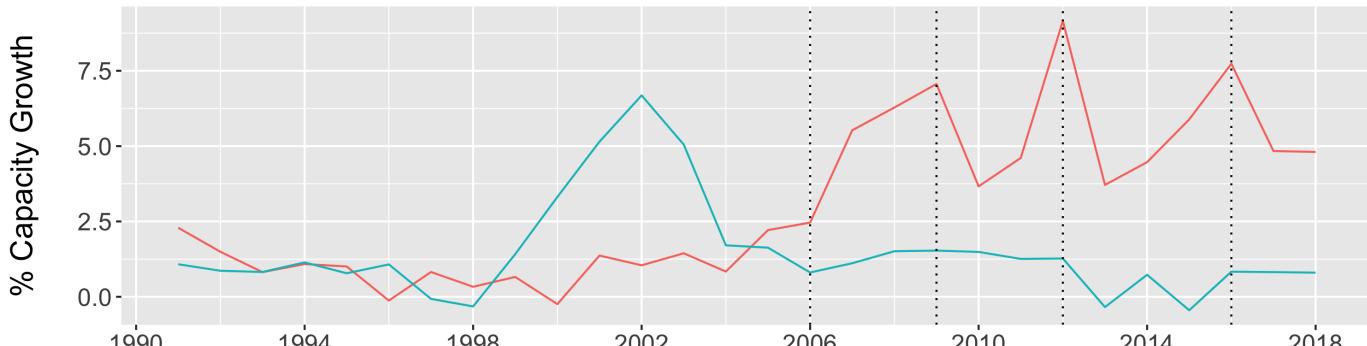


Figure 4: Renewable Energy Sources by Region

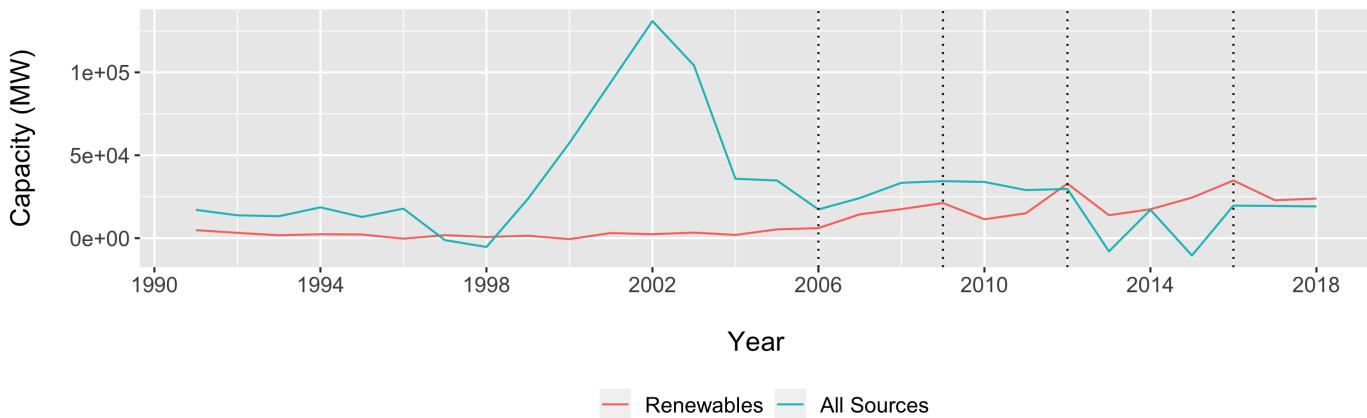




Annual capacity growth



Annual capacity additions (MW)

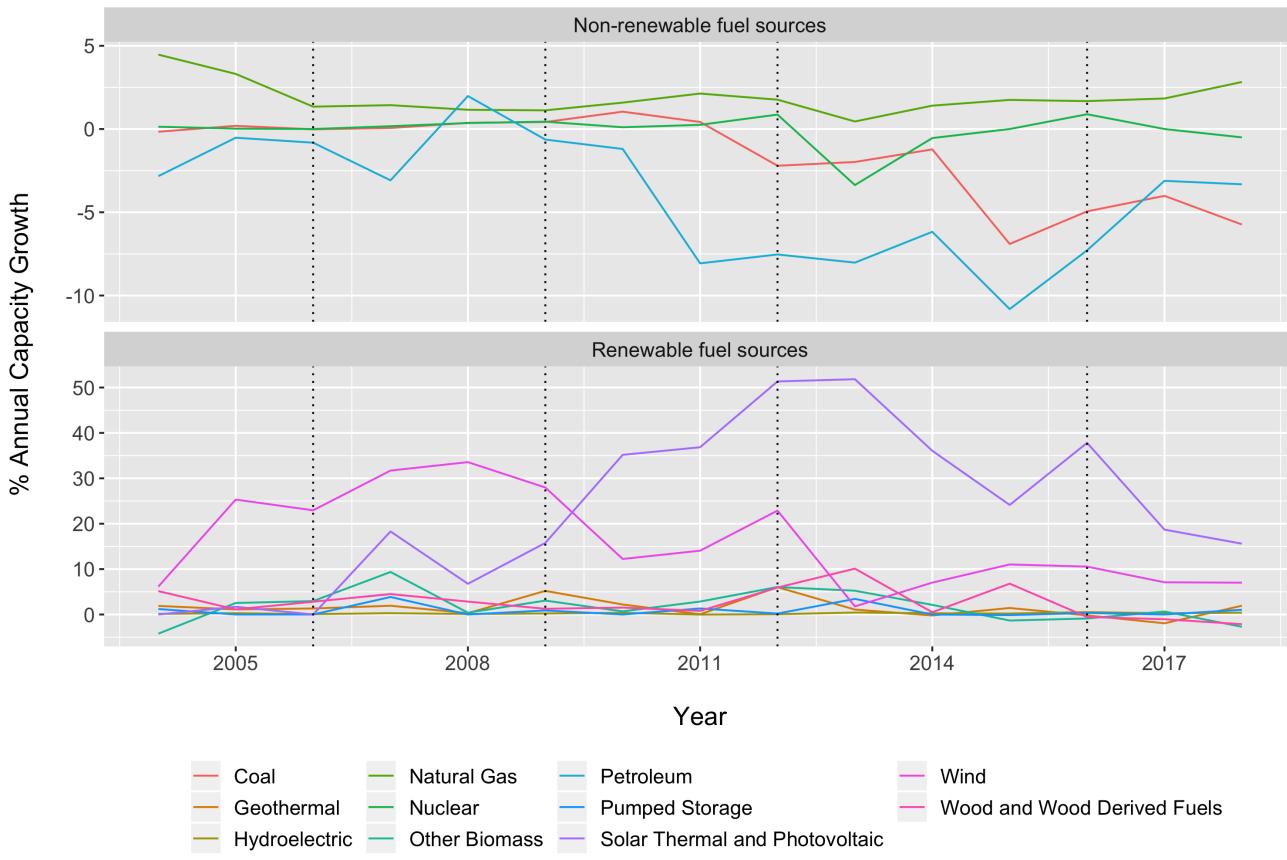


Vertical lines indicate the following policy changes:

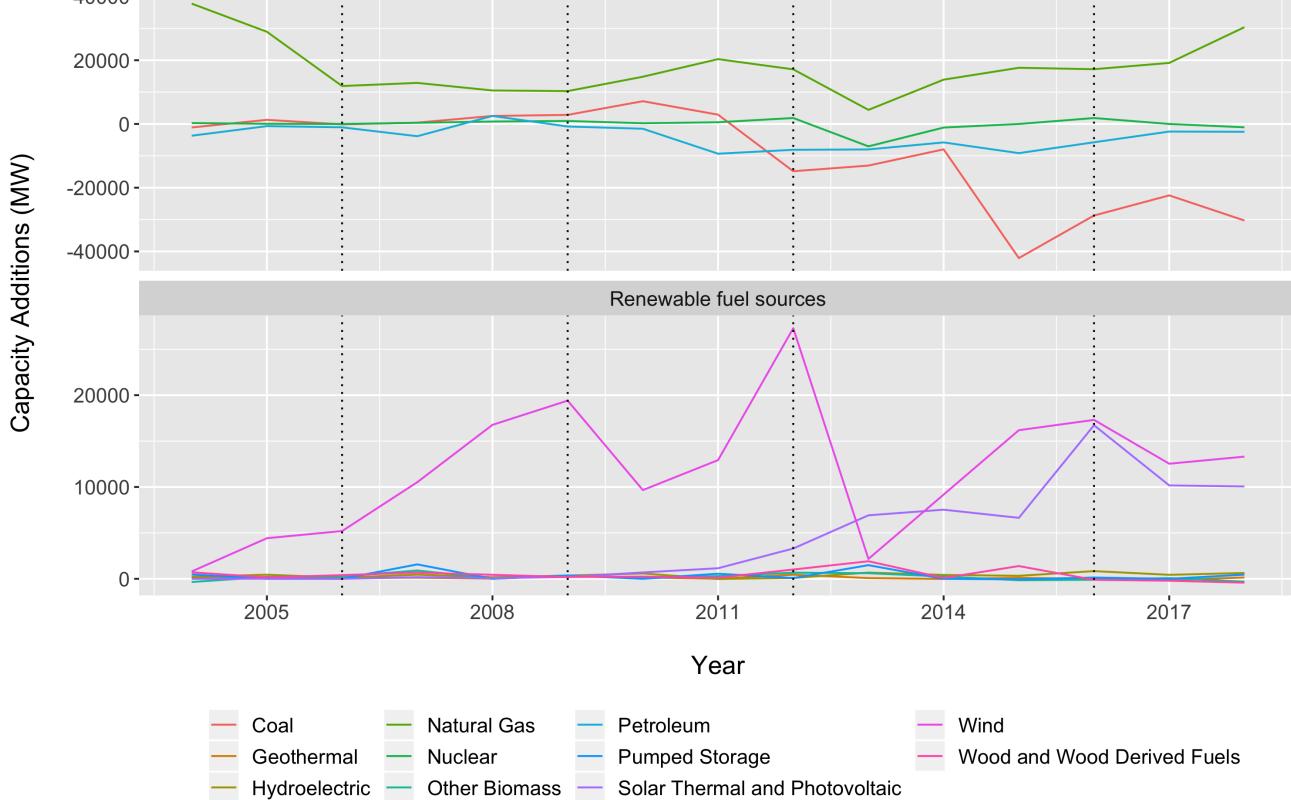
- 2006: First year of 30% ITC, 10-year PTC
- 2009-2012: Loan grants in lieu of ITC; ITC or loan grant in lieu of PTC
- 2016: Original end of ITC

There appear to be spikes in renewable capacity additions that align with these programs.

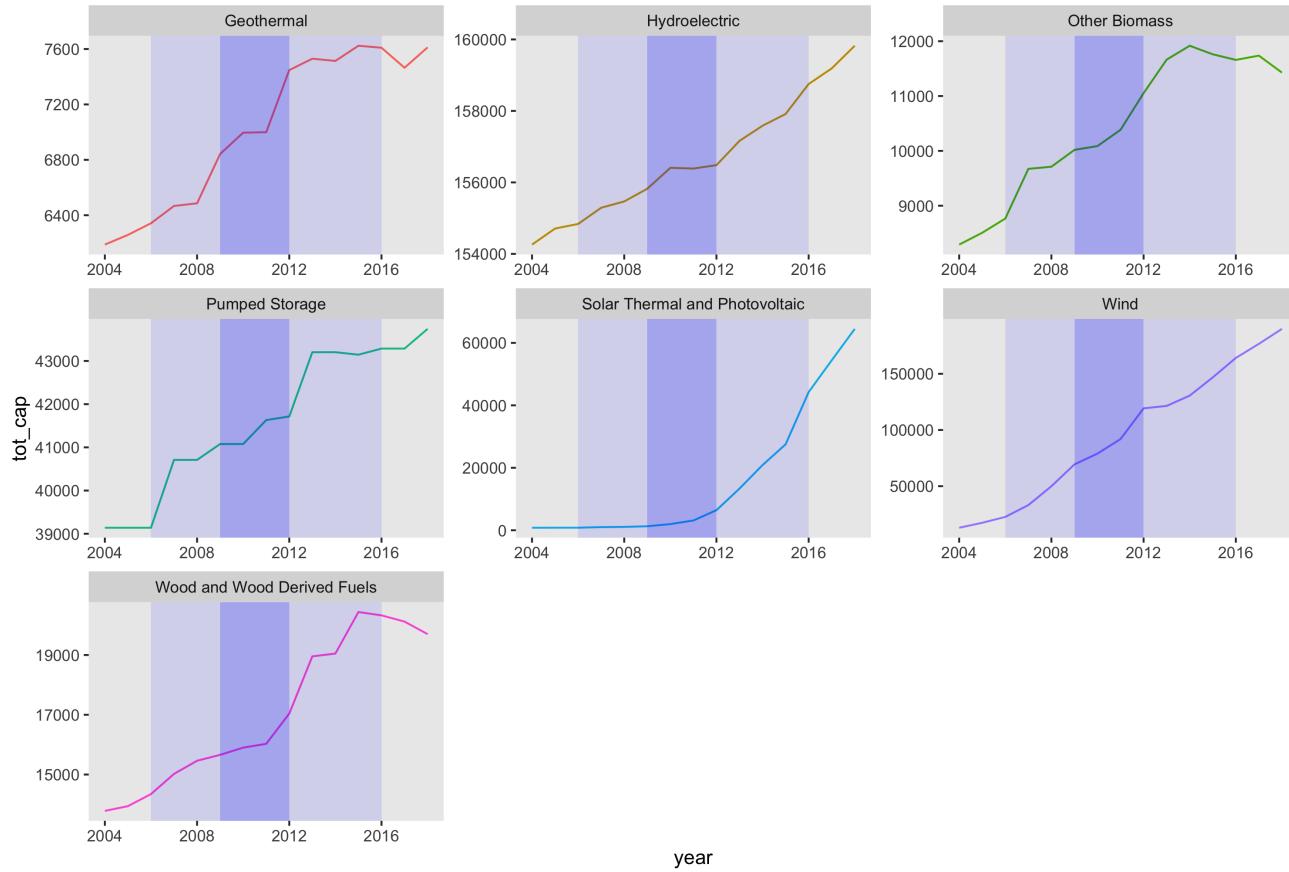
Annual Capacity Growth by Technology



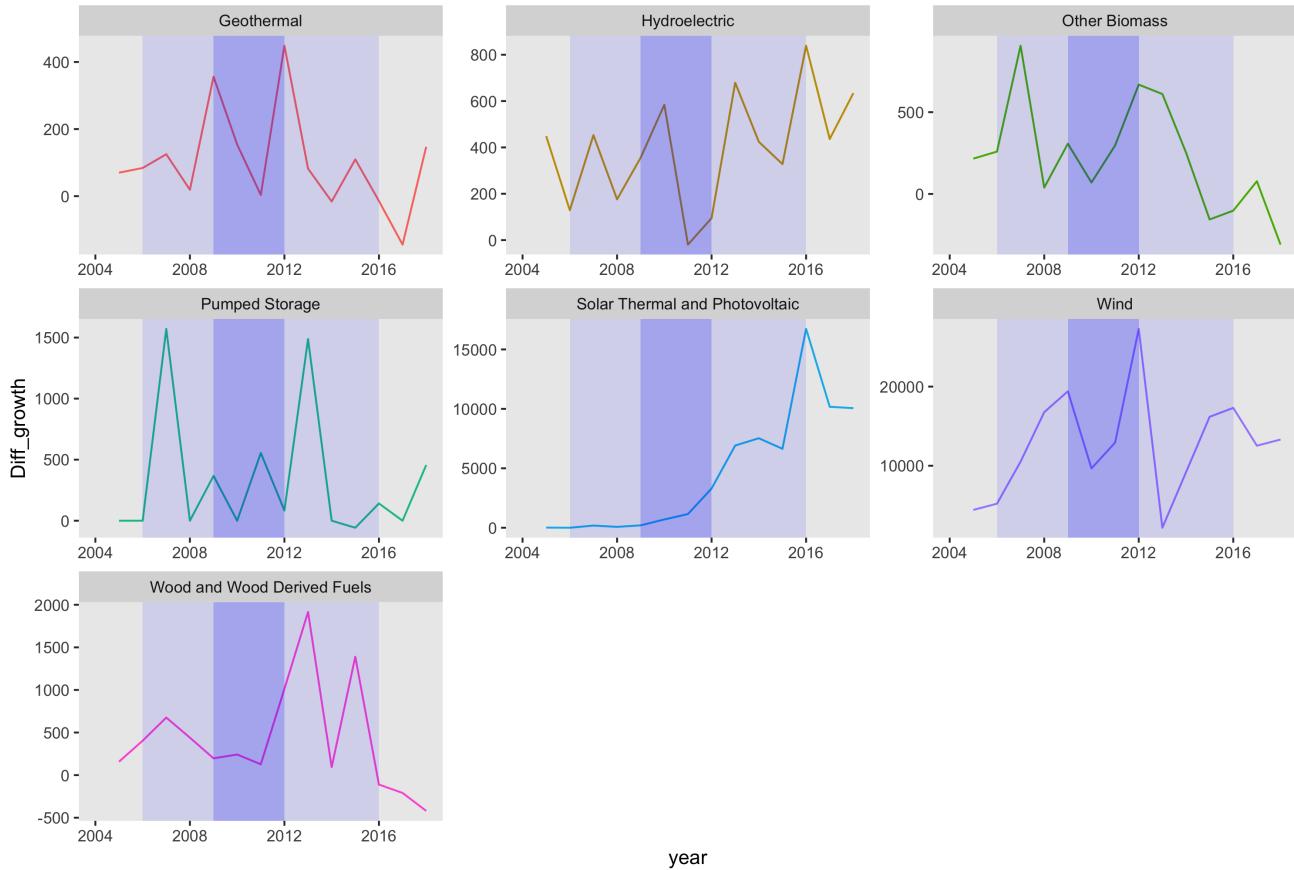
Annual Capacity Additions by Technology



U.S. Renewable Energy Capacity (MW), 2005-2018



Annual Capacity Additions (MW), 2005-2018



8 To Do with capacity data

1. Renewable capacity in regulated vs. non-regulated... (I started but need to weight appropriately)
2. Find out details about placed in service requirements for tax credits
3. Calculate variable = tax credit rate for each technology + RPS variables

9 Proposed generator data

9.1 Wind and solar projects only

Table 1: Location of proposed solar projects, 2008-2018

region	Capacity (MW)	# Projects	Avg. Build Time	Number of Utilities	% Capacity
Southeast	559836	918	1.4226580	534	0.41
CAISO	271653	1069	1.6753976	298	0.20
MISO	105541	476	1.1365546	190	0.08
Northwest	101204	208	1.7211538	111	0.07
PJM	79088	204	1.3333333	99	0.06
ISO-NE	74815	208	1.1442308	108	0.05
Southwest	70118	195	1.4564103	96	0.05
ERCOT	34071	94	1.6170213	52	0.03
NYISO	46931	138	1.2681159	43	0.03
Hawaii	14967	42	2.0476190	25	0.01
District of Columbia	854	2	1.0000000	2	0.00
SPP	2627	9	1.4444444	8	0.00
Total	1361705	3563	17.2669391	1566	0.99

Table 2: Location of proposed wind projects, 2008-2018

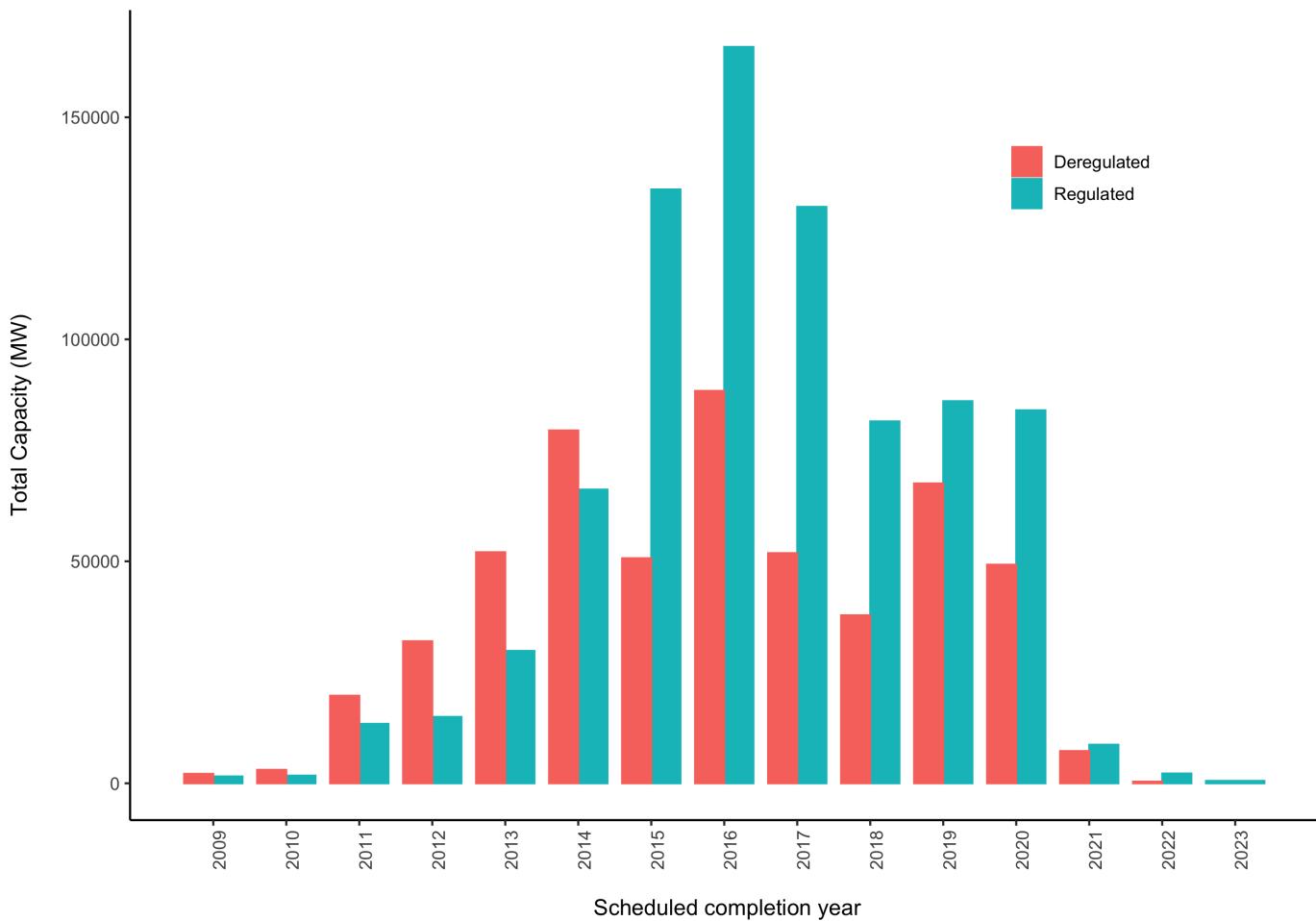
region	Capacity (MW)	# Projects	Avg. Build Time	Number of Utilities	% Capacity
MISO	133636	289	1.5986159	162	0.25
Northwest	89201	182	1.9450549	90	0.16
ERCOT	84168	193	1.6217617	98	0.15
SPP	72664	139	1.5539568	90	0.13
PJM	49854	103	1.8834951	56	0.09
ISO-NE	33450	68	1.8382353	47	0.06
NYISO	25072	45	2.0000000	27	0.05
Southwest	27901	55	1.6363636	34	0.05
CAISO	24049	81	1.5432099	40	0.04
Hawaii	2948	5	1.8000000	5	0.01
Alaska	487	2	1.0000000	2	0.00
Southeast	790	2	2.0000000	2	0.00
Total	544220	1164	20.4206933	653	0.99

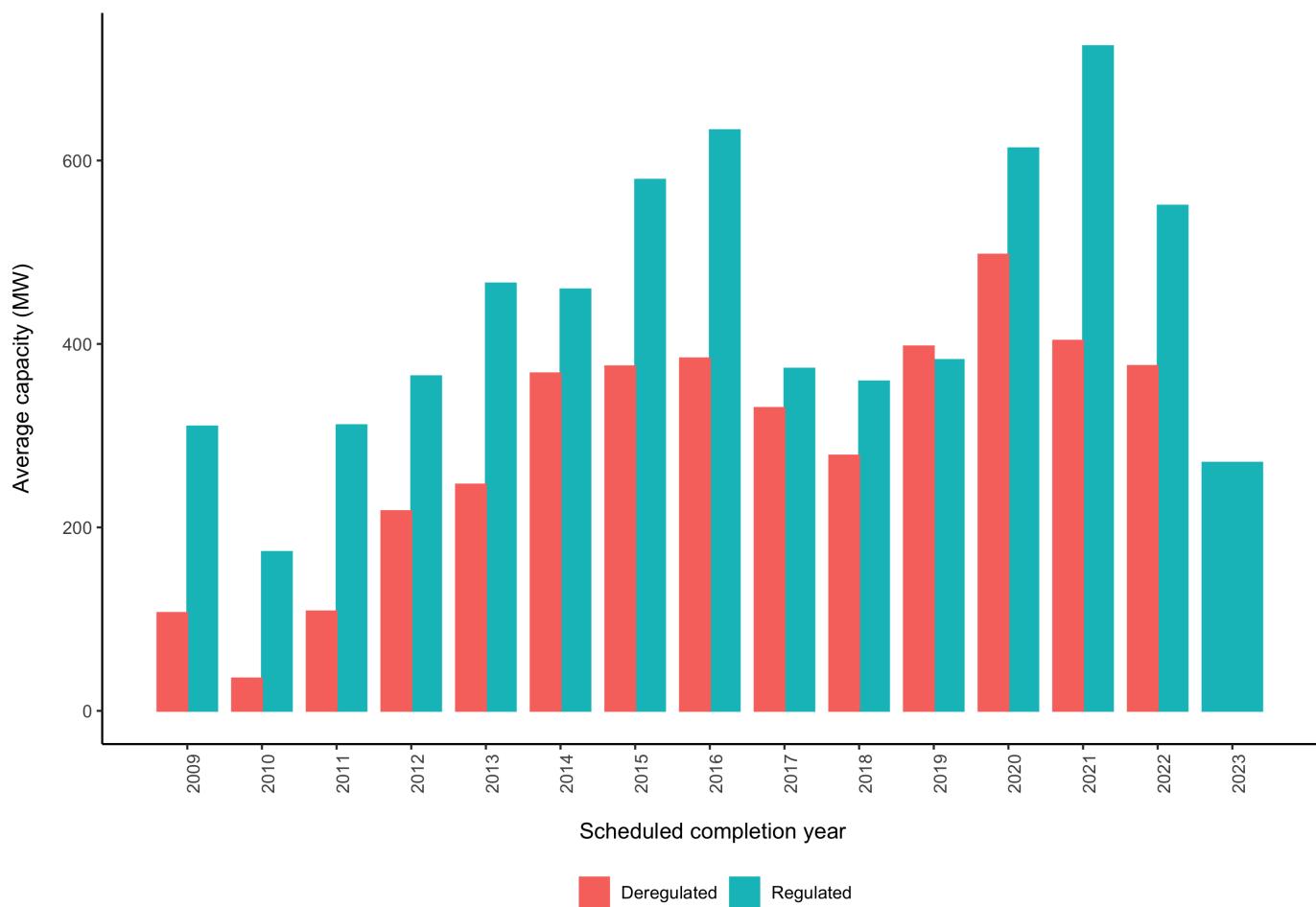
Table 3: Location of proposed solar projects, 2008-2018

regulated	Capacity (MW)	# Projects	Avg. Build Time	Number of Utilities	% Capacity
Regulated	820078	1755	1.3937322	878	0.6
Deregulated	541627	1808	1.5331858	598	0.4
Total	1361705	3563	2.9269180	1476	1.0

Table 4: Location of proposed wind projects, 2008-2018

regulated	Capacity (MW)	# Projects	Avg. Build Time	Number of Utilities	% Capacity
Regulated	275301	556	1.6852518	280	0.51
Deregulated	268919	608	1.7220395	303	0.49
Total	544220	1164	3.4072913	583	1.00





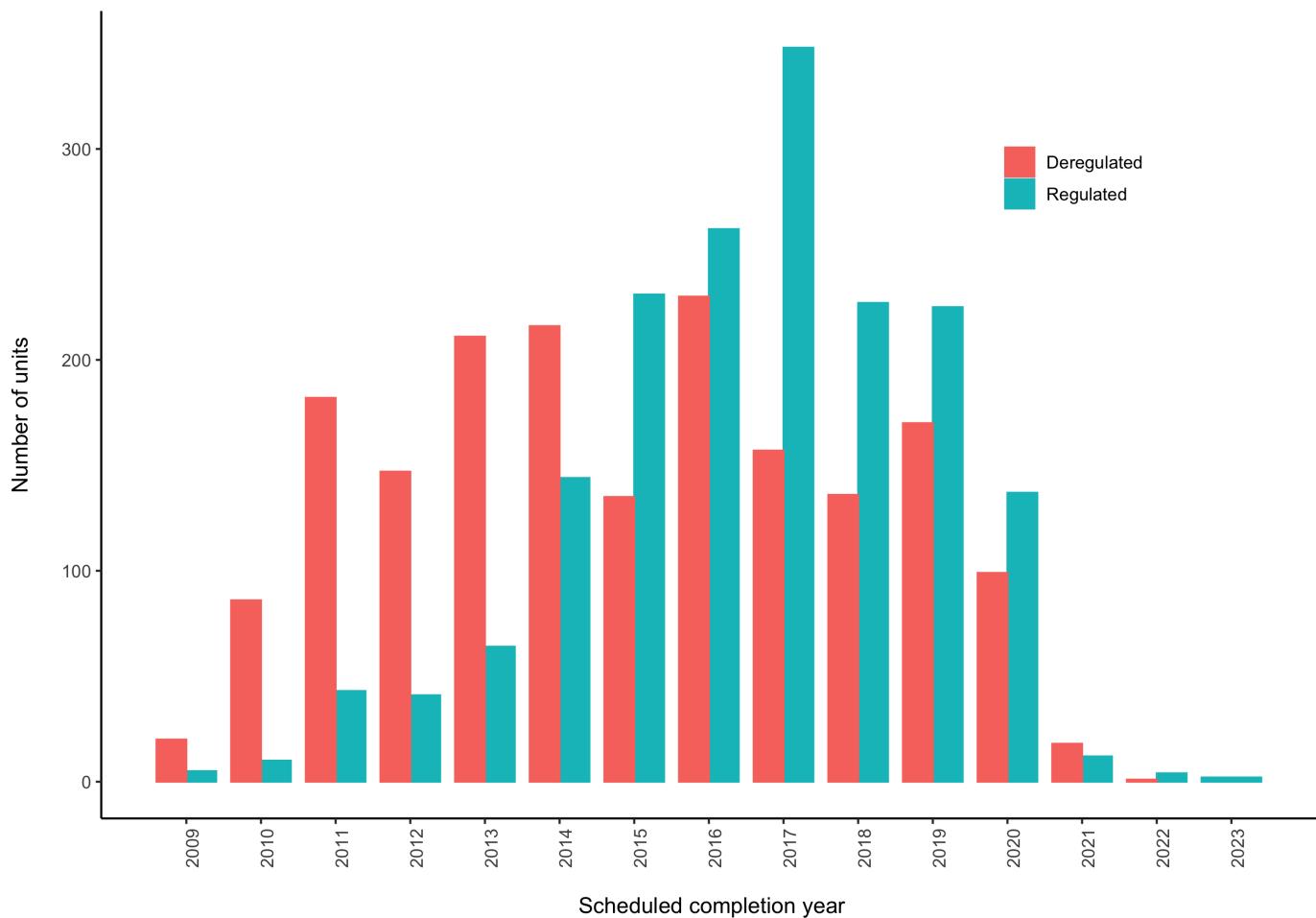
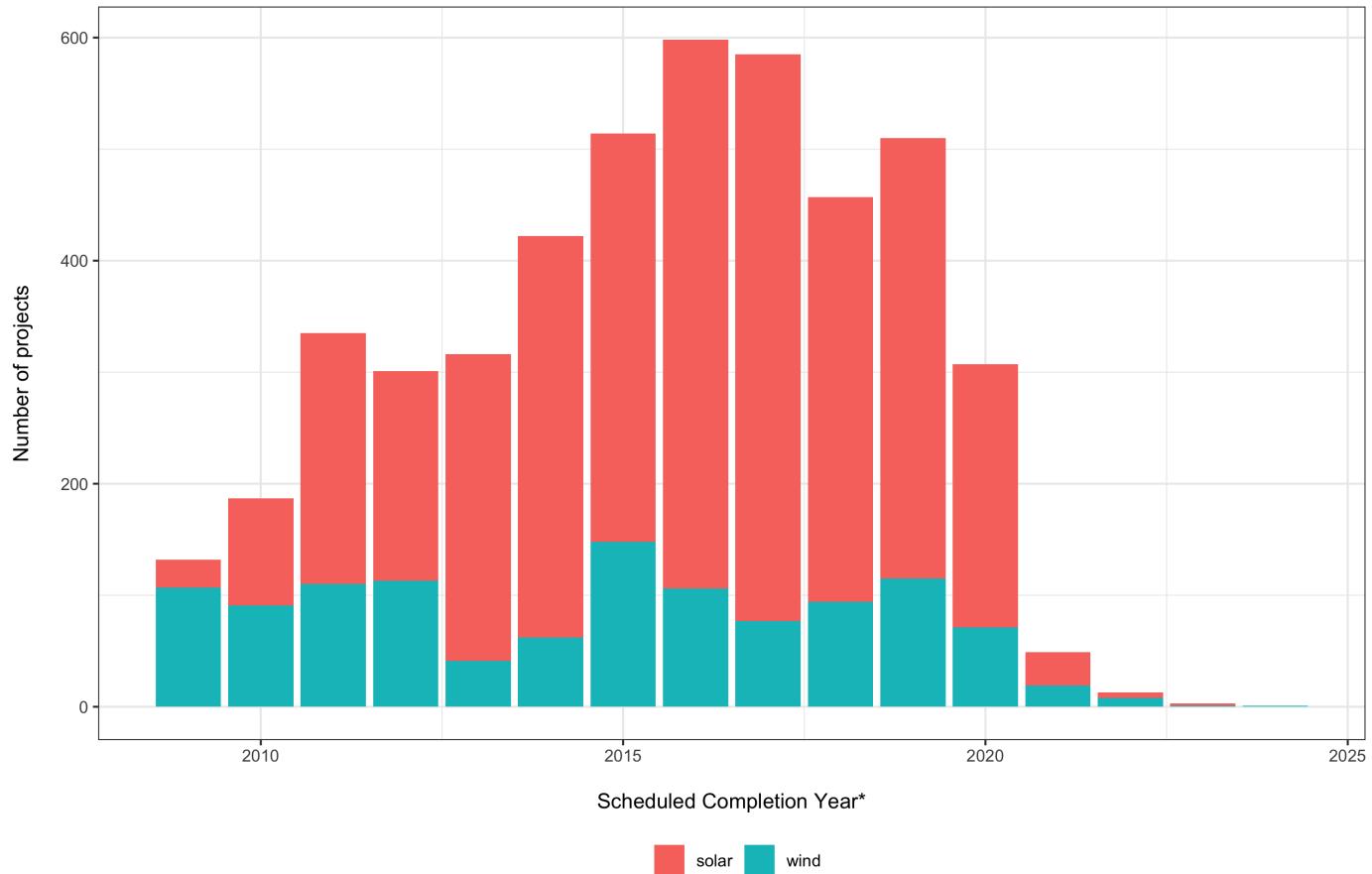
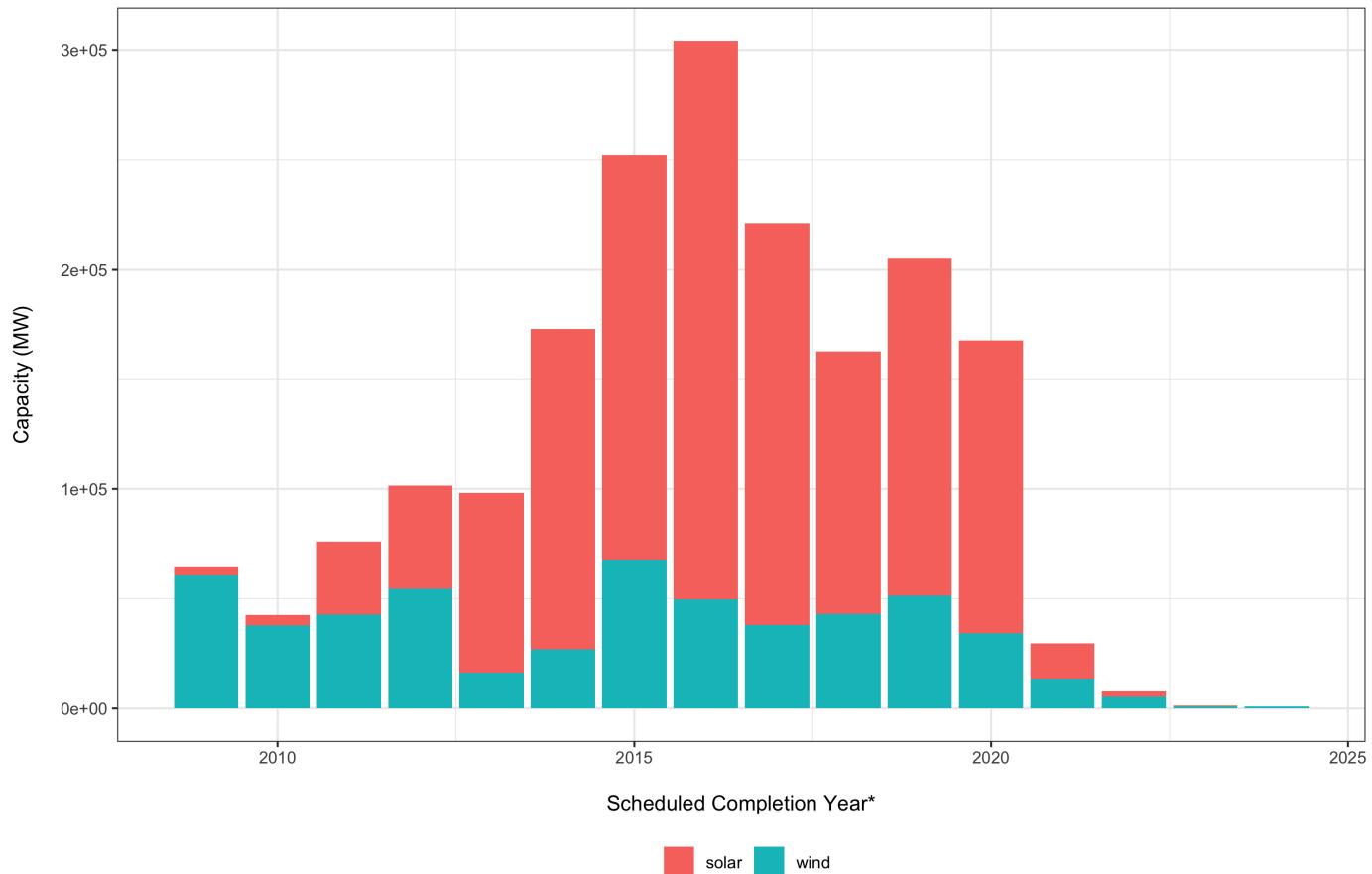


Figure 5: this is a caption
 Number of proposed generators by technology



*Indicates initial scheduled completion date

Total proposed capacity by completion year



*Indicates initial scheduled completion date

Figure 6: this is a caption

