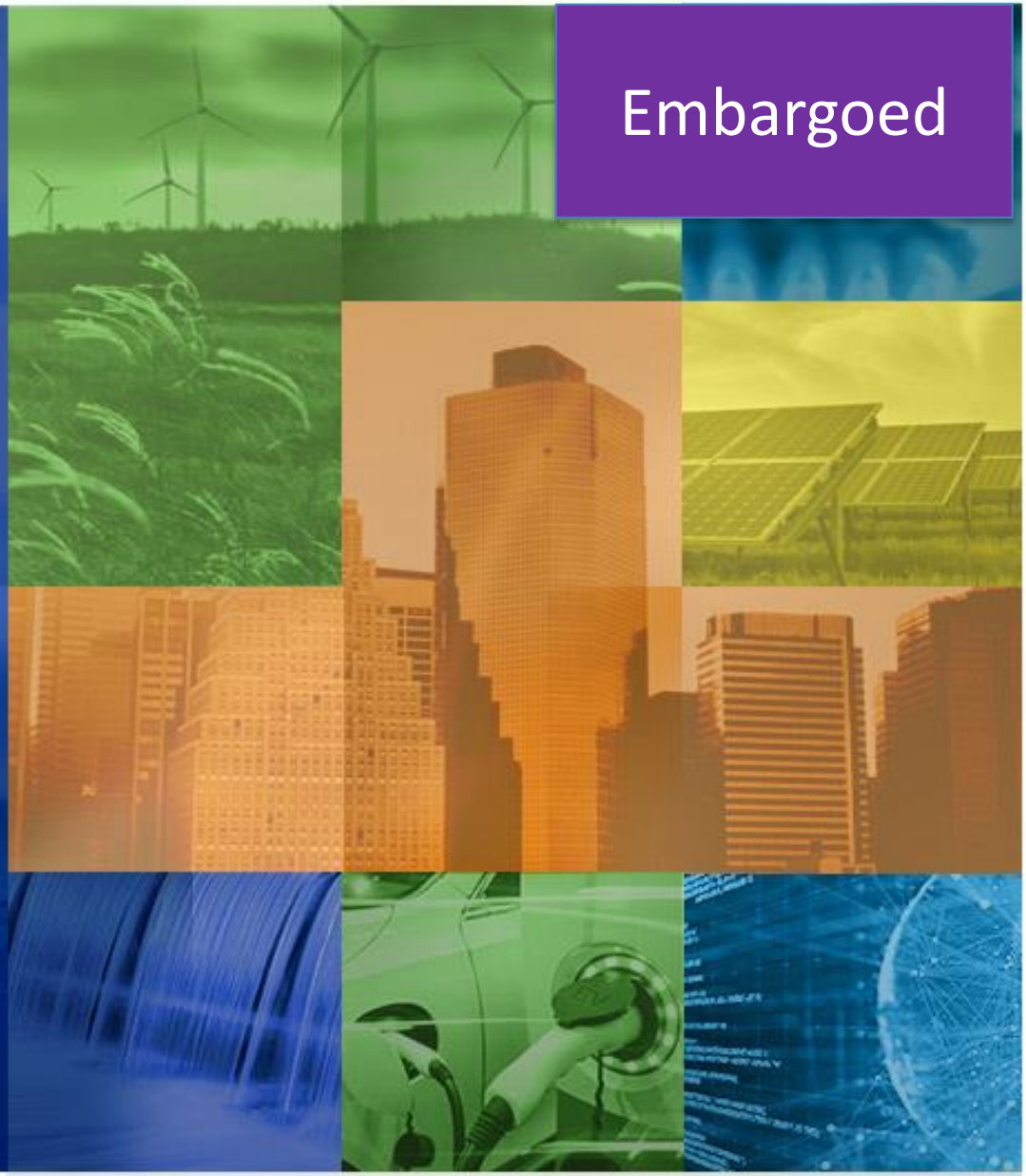
2019

Sustainable Energy in America

Factbook

GROWTH SECTORS OF THE U.S. ENERGY ECONOMY



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About the Factbook: The sub-sections within each sector

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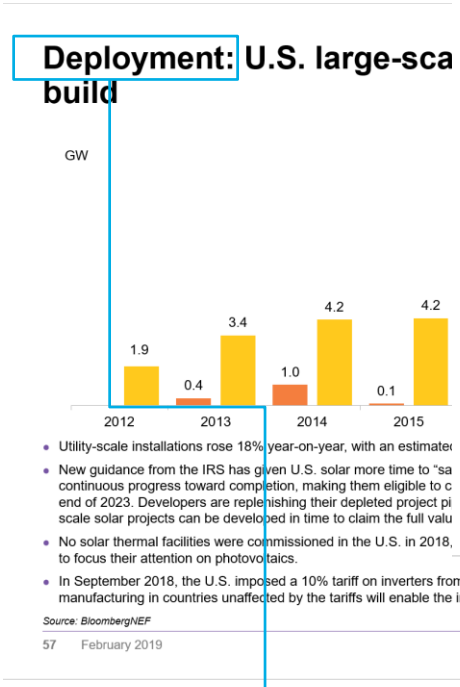
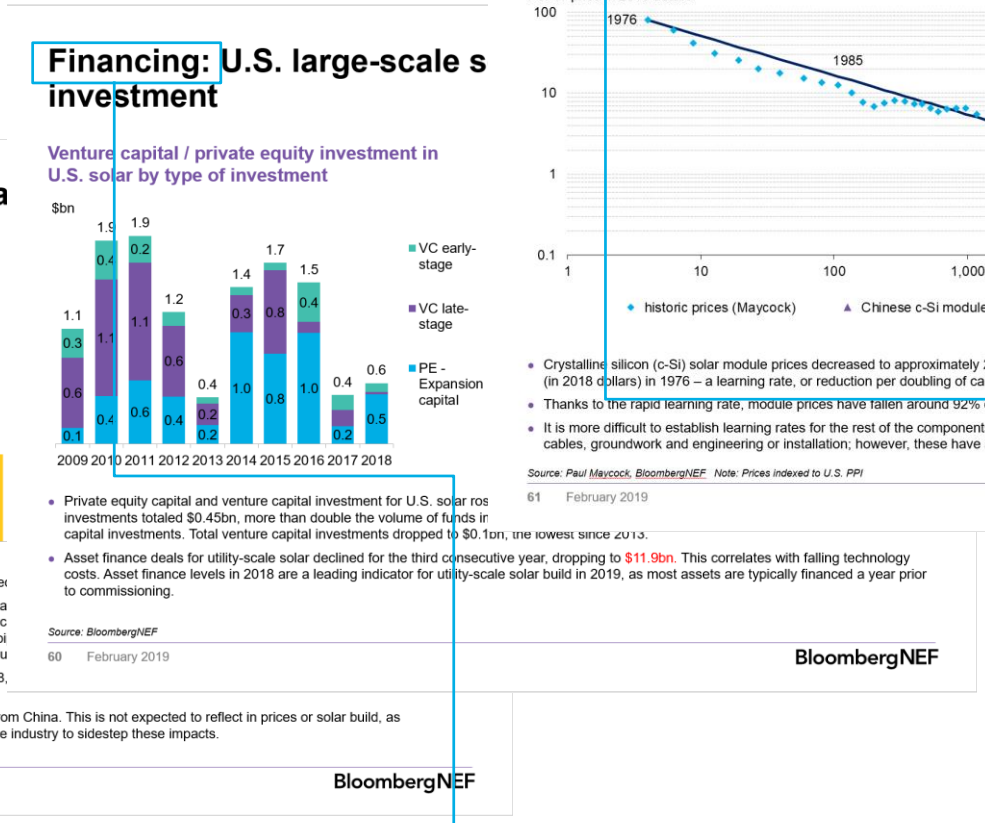
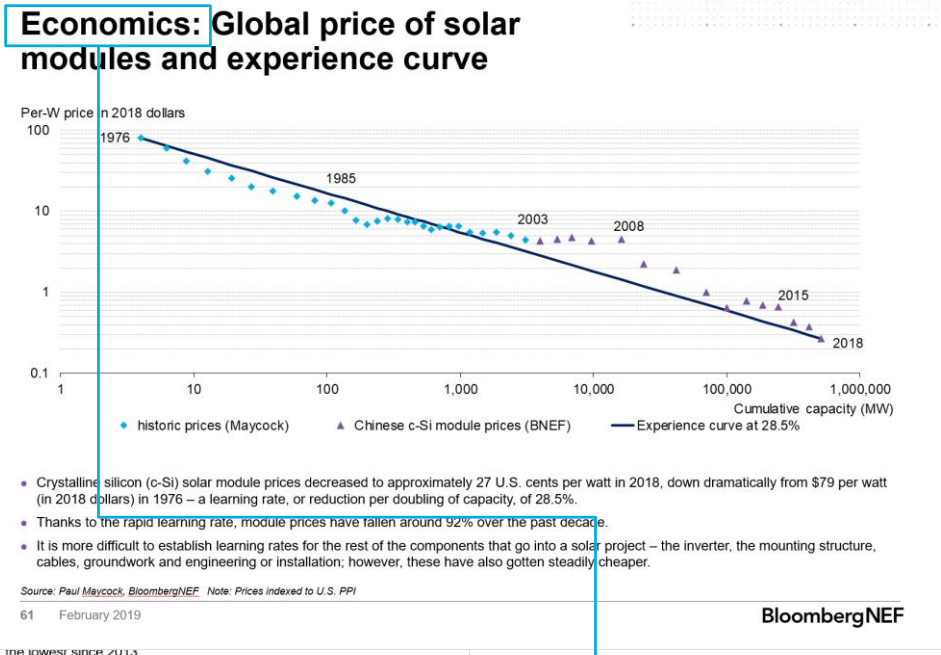
For each sector, the report shows data pertaining to three types of metrics (sometimes multiple charts for each type of metric)







Deployment: captures how much activity is happening in the sector, typically in terms of new build or supply and demand

Financing: captures the amount of investment entering the sector

Economics: captures the costs of implementing projects or adopting technologies in the sector

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The Business Council for Sustainable Energy (BCSE) is a coalition of companies and trade associations from the energy efficiency, natural gas and renewable energy sectors. It includes independent electric power producers, investor-owned utilities, public power, manufacturers, commercial end users and service providers in energy and environmental markets. Founded in 1992, the coalition's diverse business membership is united around the continued revitalization of the economy and the creation of a secure and reliable energy future in America. The Factbook is also supported by the following sponsors: Ameresco, the American Gas Association, the American Wind Energy Association, Capital Power, The Christian Coalition, The Copper Development Association, The Corn Refiners Association, Covanta, CRES Forum, Enel Green Power North America, First Solar, Inc., Ingersoll Rand, Johnson Controls, JP Morgan Chase & Co., Jupiter Oxygen Corporation, McKnight Foundation, National Grid, The National Hydropower Association, The Polyisocyanurate Insulation Manufacturers Association, Sacramento Municipal Utility District, Schneider Electric, Sempra Energy, The Solar Energy Industries Association, U.S. Green Building Council, Young Conservatives for Energy Reform.

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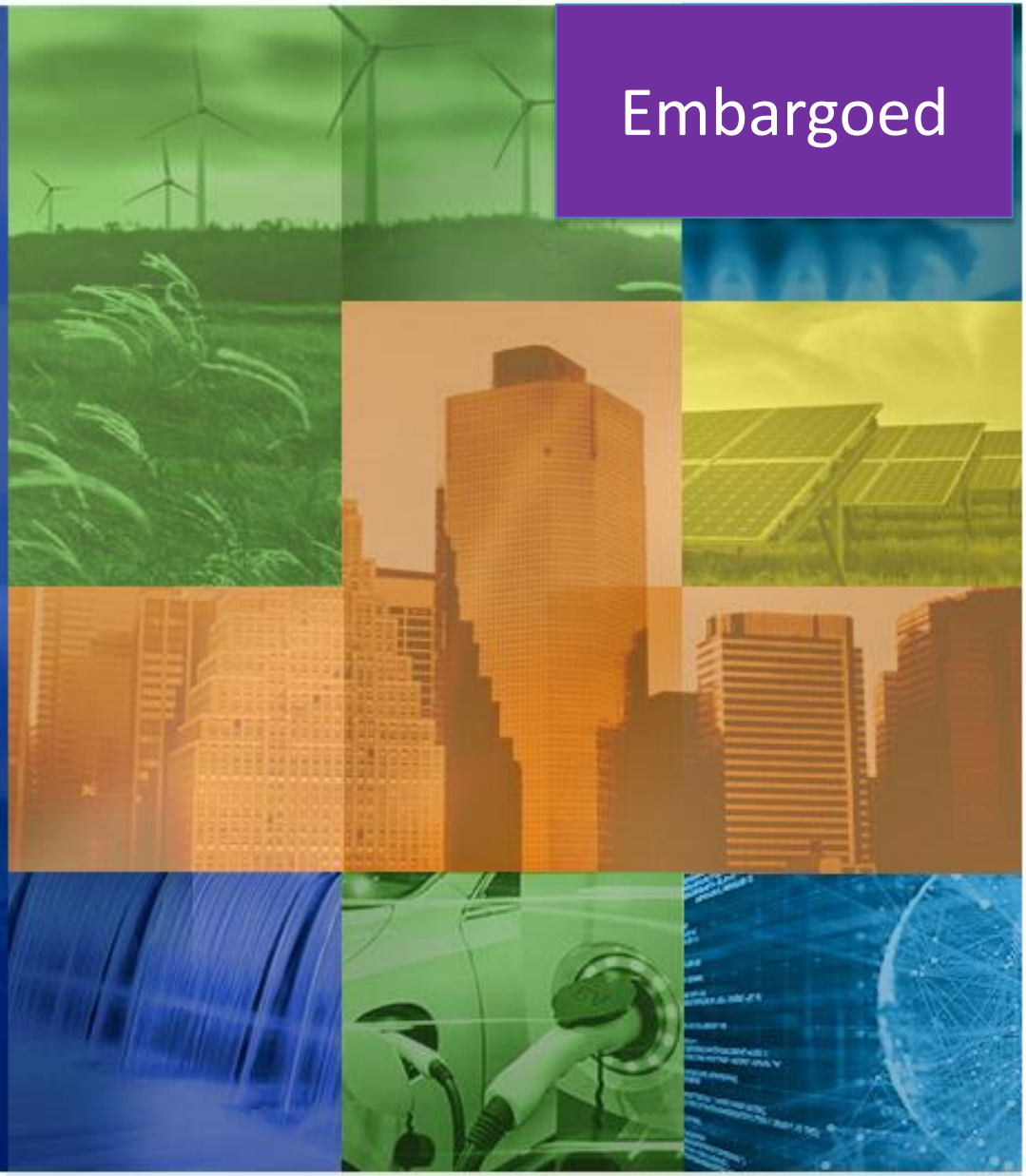

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U.S. energy overview: Greenhouse gas (GHG) emissions

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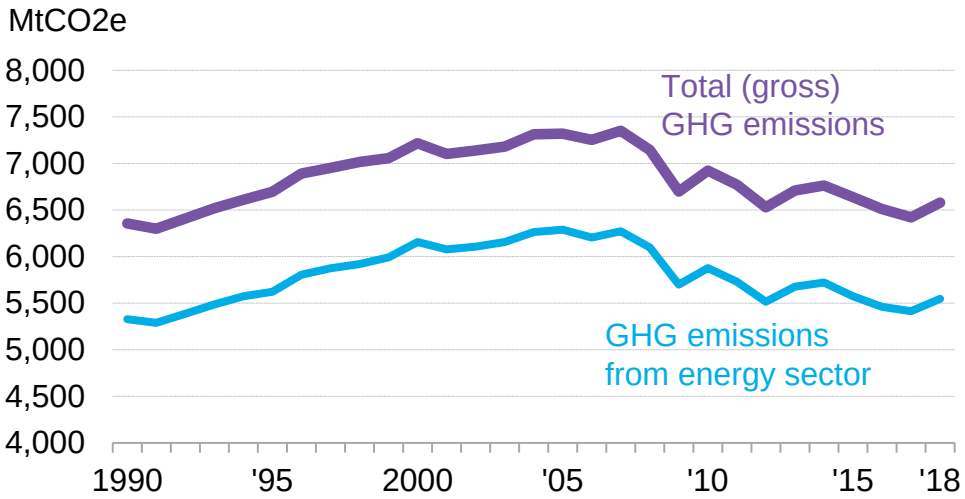
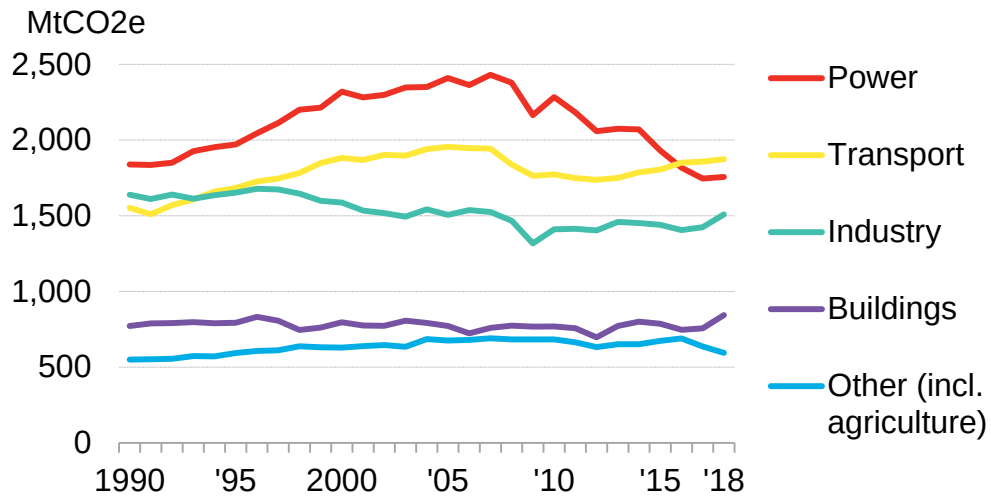
Economy-wide and energy sector emissions



Emissions by sector



- U.S. GHG emissions rose for the first time in several years, increasing by a projected 2.5% as energy demand escalated in the buildings and industrial sectors and, to a lesser extent, in power and transport. Total gross greenhouse gas emissions now sit at roughly 6,574Mt or approximately 10% below 2005 levels. This represents roughly two-fifths of the way to the U.S's abandoned Paris Agreement target of 26% below 2005 levels by 2025.
- A cleaner electricity mix mitigated a rise in power-sector demand, with power-sector emissions climbing only 0.6% despite a 3.3% increase in primary energy consumption by power plants. The U.S. grew its production from natural gas and wind and solar as higher-emitting coal-fired power plants retired in near-record numbers.
- Transport emissions rose 1% year-on-year, as gasoline consumption grew modestly. The transportation sector remained the largest single source of climate-warming emissions for the third consecutive year, widening its gap with the power sector to 128Mt.
- Federal progress on climate change took another step back in 2018, as the Trump Administration reiterated its intent to withdraw from the Paris Agreement and announced weaker efficiency standards for vehicles and emissions standards for new coal-fired power plants.

Source: BloombergNEF, EIA, EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016 Notes: "Sinks" refer to forests and green areas which absorb carbon dioxide. Values for 2018 are projected, accounting for seasonality, based on monthly values from EIA available through September 2018.

Deployment: U.S. natural gas residential customers vs. consumption

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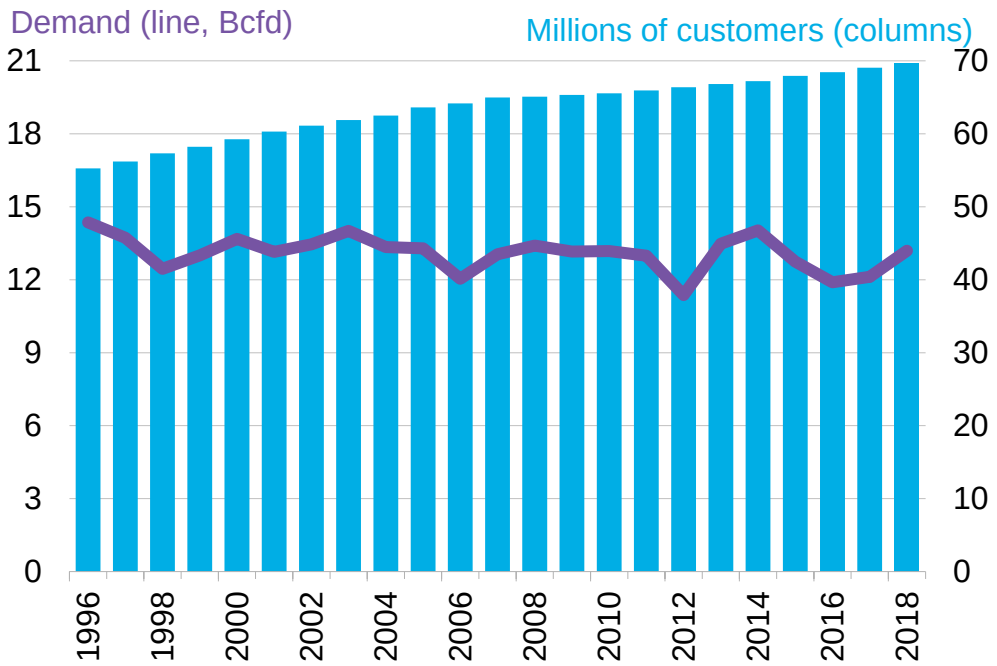
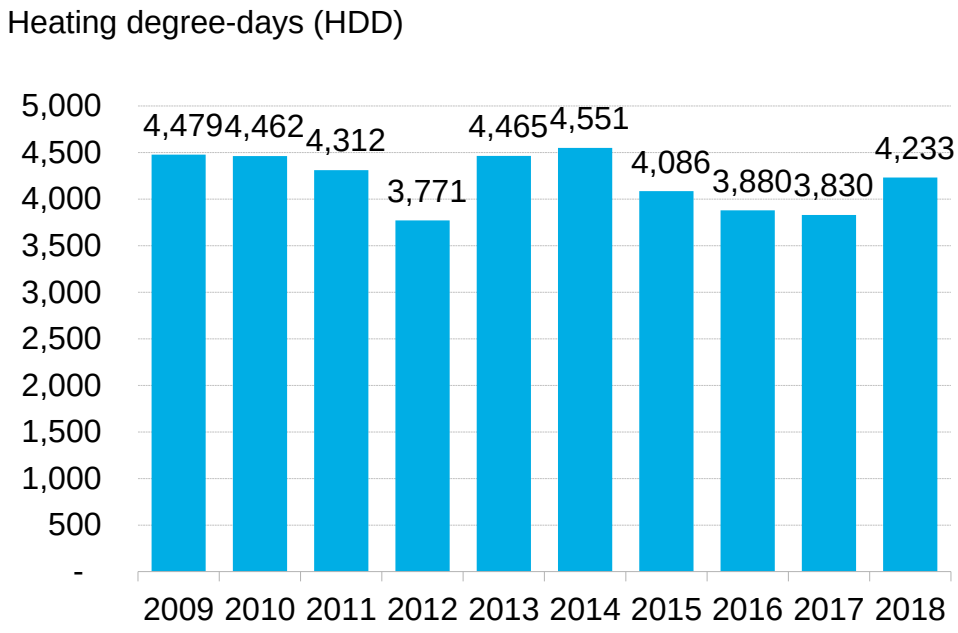
Residential demand vs. consumption



Heating degree-days



- Due to energy efficiency efforts, residential gas consumption expanded at a slower rate than the number of customers. The customer base for residential gas expanded by 12.7 million, or 22%, over the past 20 years. Meanwhile, residential consumption has remained largely flat over the same time period.
- Residential gas consumption is volatile year-to-year as it's driven by weather patterns. Consumption dropped during the abnormally mild winter of 2012, which saw a 13% decrease in the number of heating degree days from the previous winter. It then jumped during the polar vortices of 2013 and 2014. Year-on-year, 2018 will see a 9% rise in demand, partly due to colder weather early on in the year.

Source: BloombergNEF, EIA Notes: Values for 2018 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2018). Heating degree-days are through mid-December 2018.

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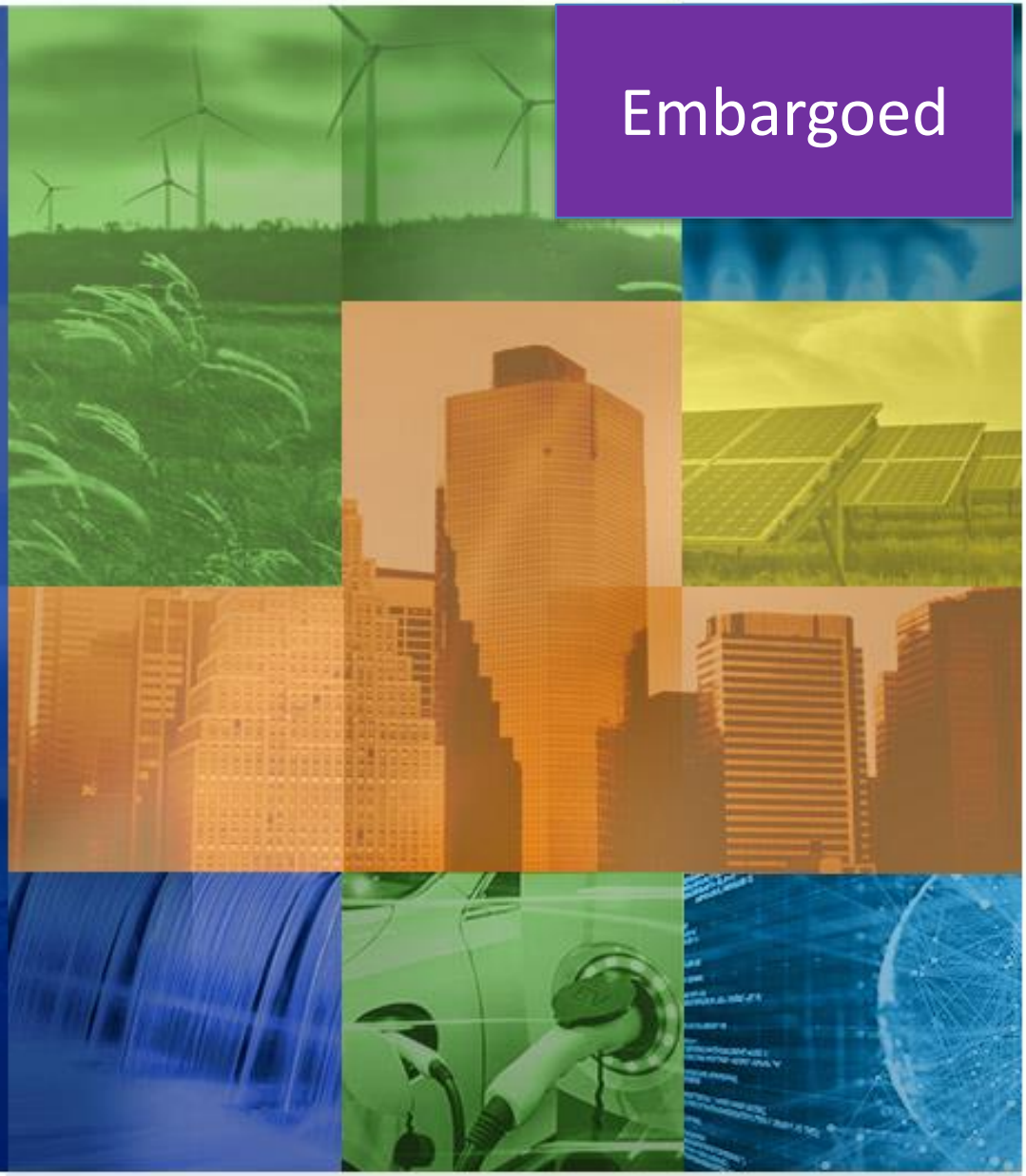

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Deployment: U.S. natural gas demand by end use

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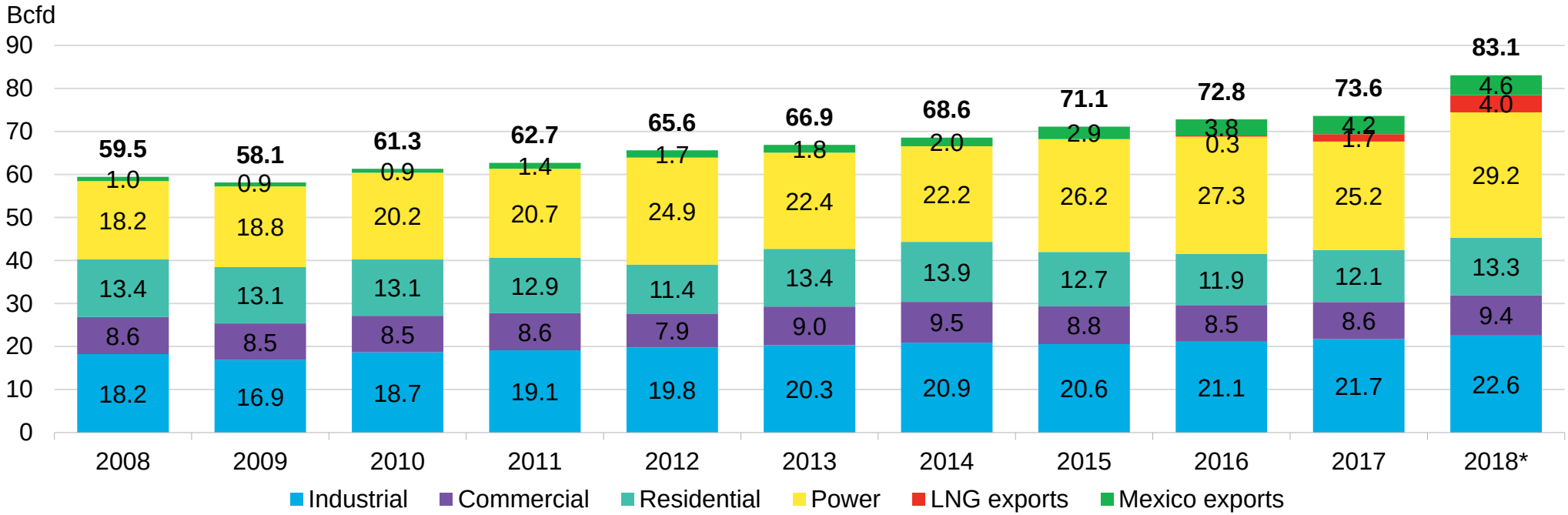

- Total U.S. annual gas demand has grown 40% over the past decade and spiked 13% from 2017 to 2018 to hit a new record of 83.1Bcfd.
- The growth was primarily driven by power sector demand, which increased by 4Bcfd (16%) from 2017, but all sectors saw growth in gas consumption. Power-sector gas consumption resumed its growth trend after a 8% dip in 2017 due to strong production from competing large hydro power projects.
- Refinery expansions along the Gulf Coast as well as new chemical facilities – mainly in Appalachia – led to the uptick in industrial demand.
- Residential and commercial consumption increased with cooler temperatures in the winter, reaching levels not seen since 2014.
- LNG exports grew by 2.3Bcfd (up 135% year-on-year) as Sabine Pass expanded its export capacity and two new terminals, Cove Point and Corpus Christi, began operations in 2018. Pipeline flows to Mexico and Canada also grew as new export capacity additions came into service.

Source: BloombergNEF, EIA. Note: Values for 2018 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2018).

Deployment: industrial gas demand by region

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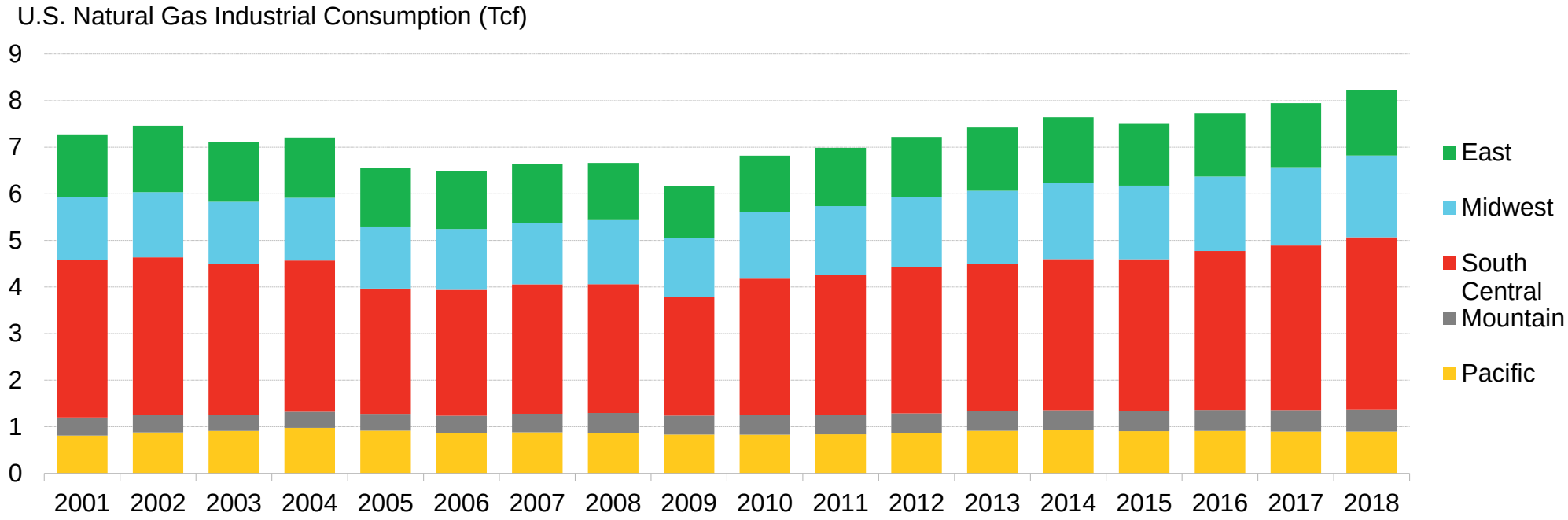

- In the past decade, overall natural gas consumption has increased 23% from 2008 levels, helped by lower natural gas prices. The majority of industrial consumption continues to come from facilities in the South Central region, where natural gas is readily available.
- Industrial sector gas consumption totaled 8.2Tcf in 2018, of which 3.7Tcf was consumed in the South Central region, 1.7Tcf in the Midwest, 0.5Tcf in the Mountain region, 0.9Tcf in the Pacific and 1.4Tcf in the East.
- Industrial gas consumption rose 3.5% in 2018 from the year prior. Consumption increased in most regions, but by varying amounts: the East was up by 2%, the Mountain region by 2%, the Midwest by 4% and the South Central by 5%. Consumption in the Pacific did not change.
- There has been a long-term decrease in gas consumption in the Pacific region, where demand peaked in 2014 at 0.92Tcf and has declined nearly every year since.

Source: BloombergNEF, EIA; Note: Values for 2018 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2018). 2017 industrial consumption numbers were used as proxies for missing monthly values for a number of states.

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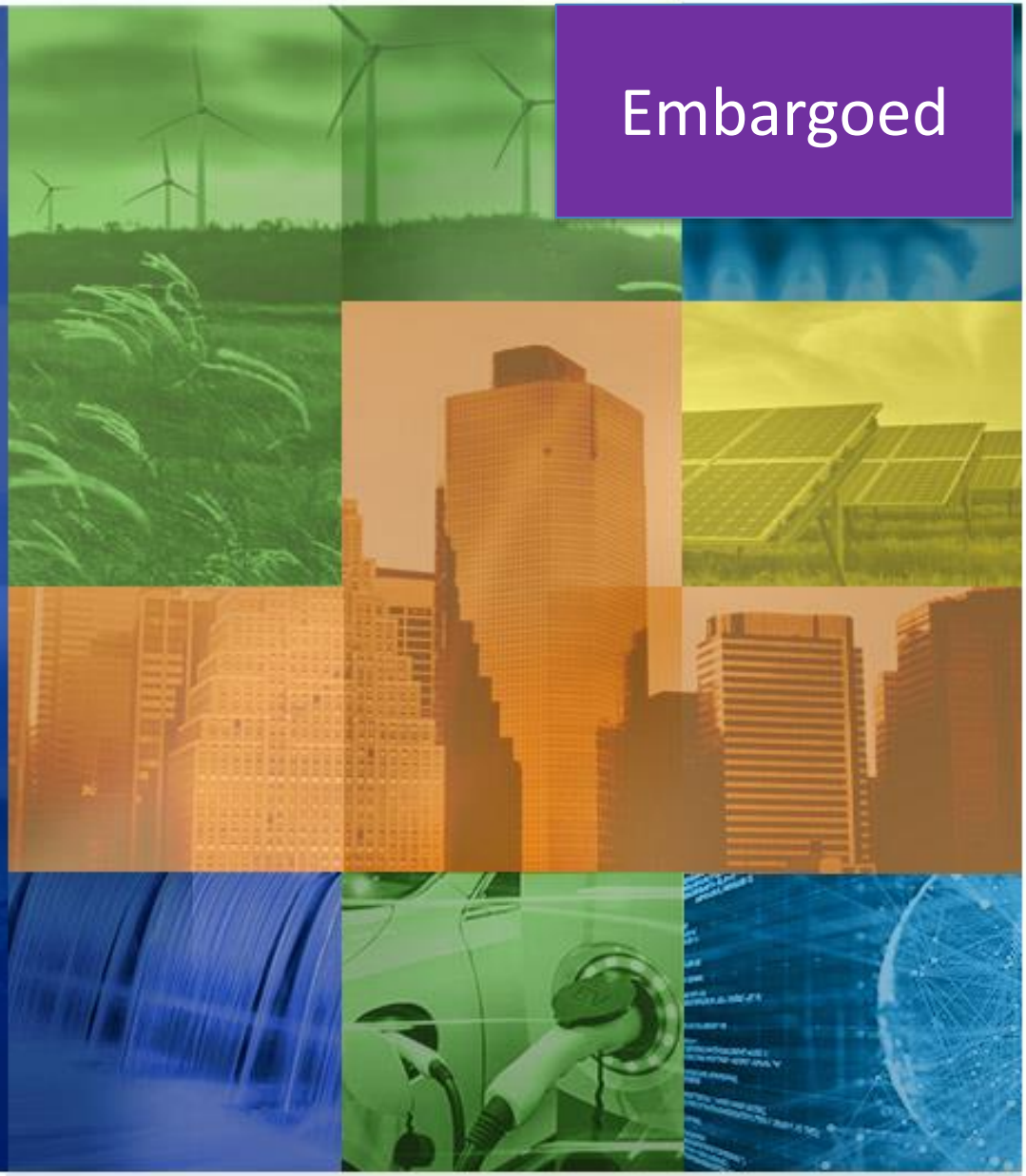

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Deployment: U.S. stationary fuel cell build

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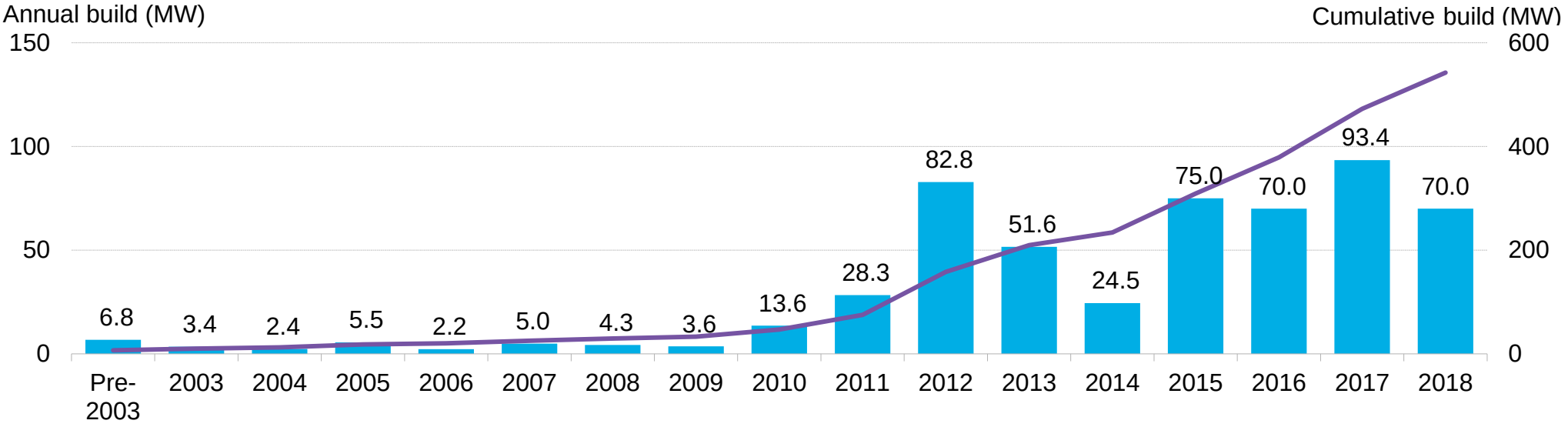

- The stationary fuel cell industry installed 70MW of systems in the U.S. in 2018, according to a survey conducted by the Fuel Cell and Hydrogen Energy Association of its members. This was down from 93.4MW in 2017.
- The U.S. is home to the world's largest manufacturers of stationary fuel cells. Despite lower deployment in the U.S in 2018, the industry saw significant exports of its products overseas. The industry also expanded its order backlog with projects and awards announced in 2018 that will enable future growth and deployment.
- In 2017, a federal Investment Tax Credit supporting the industry lapsed. The credit was then reinstated in February 2018, retroactive for 2017.

Source: E4tech Fuel Cell Industry Review 2017, Fuel Cell and Hydrogen Energy Association, SGIP, Bloom Energy, FuelCell Energy, BloombergNEF Notes: Fuel cells installed before 2003 are excluded due to the expected 10-year lifetime of these installations.

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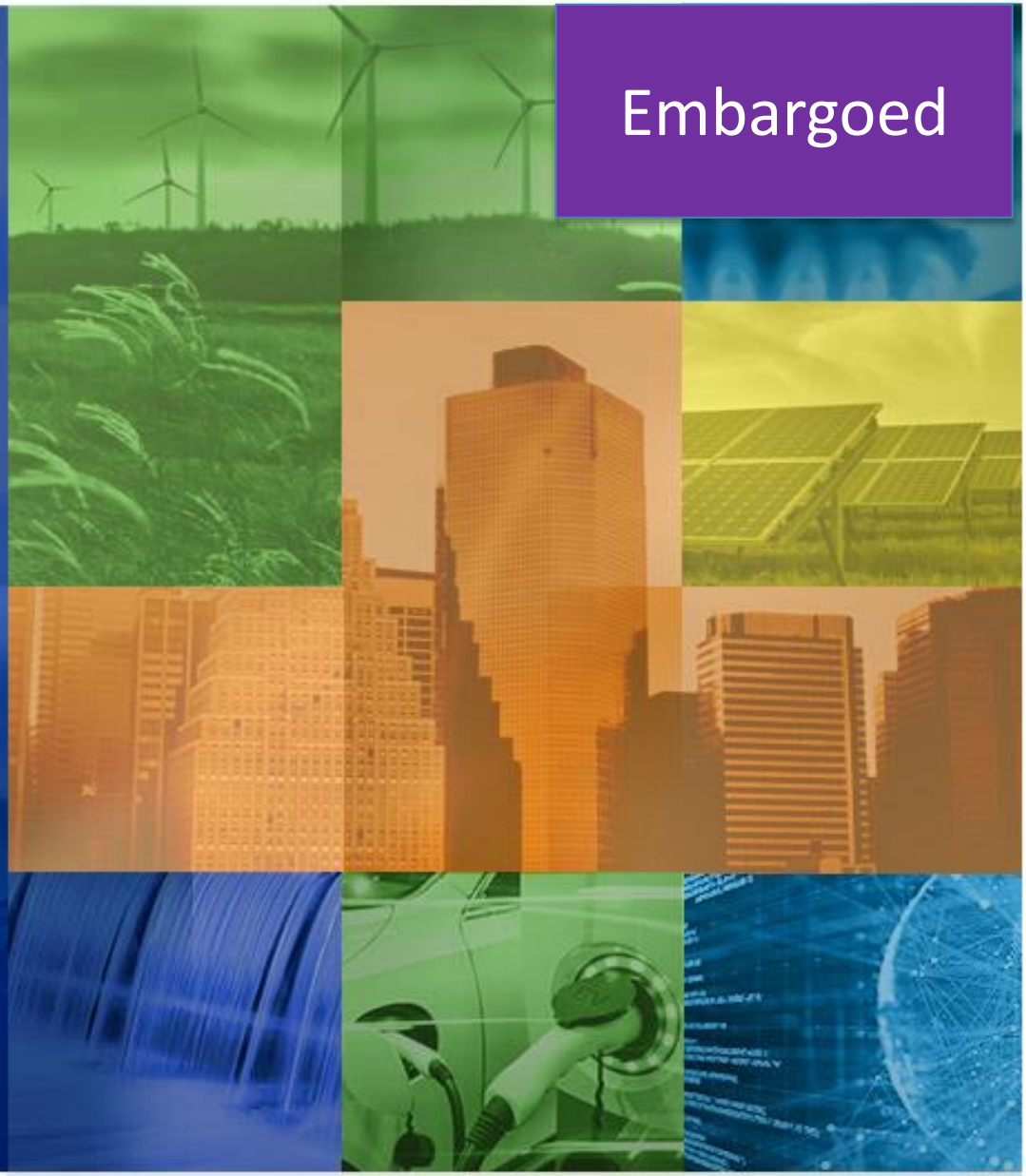

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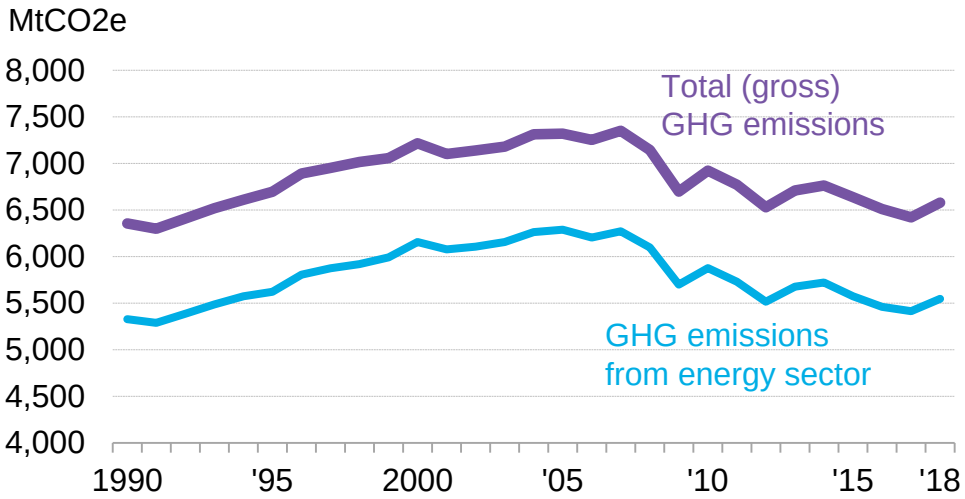
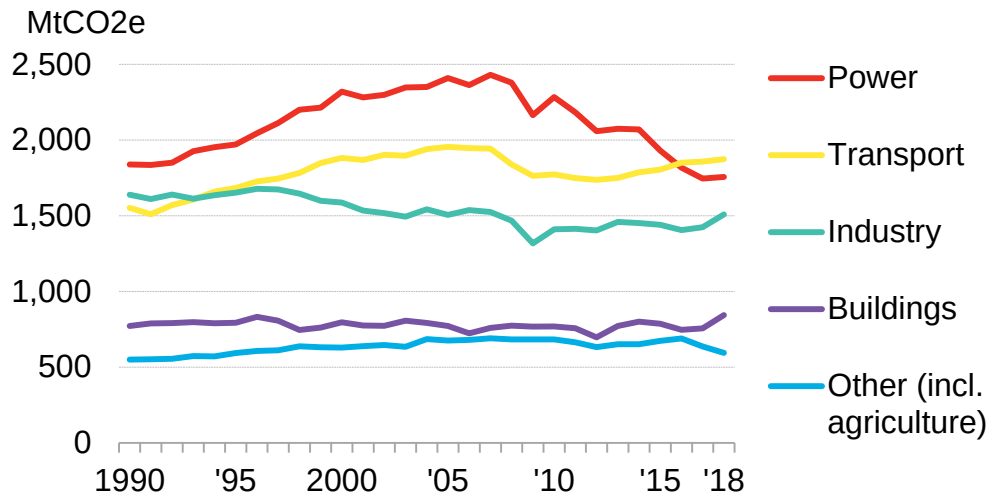


Emissions by sector



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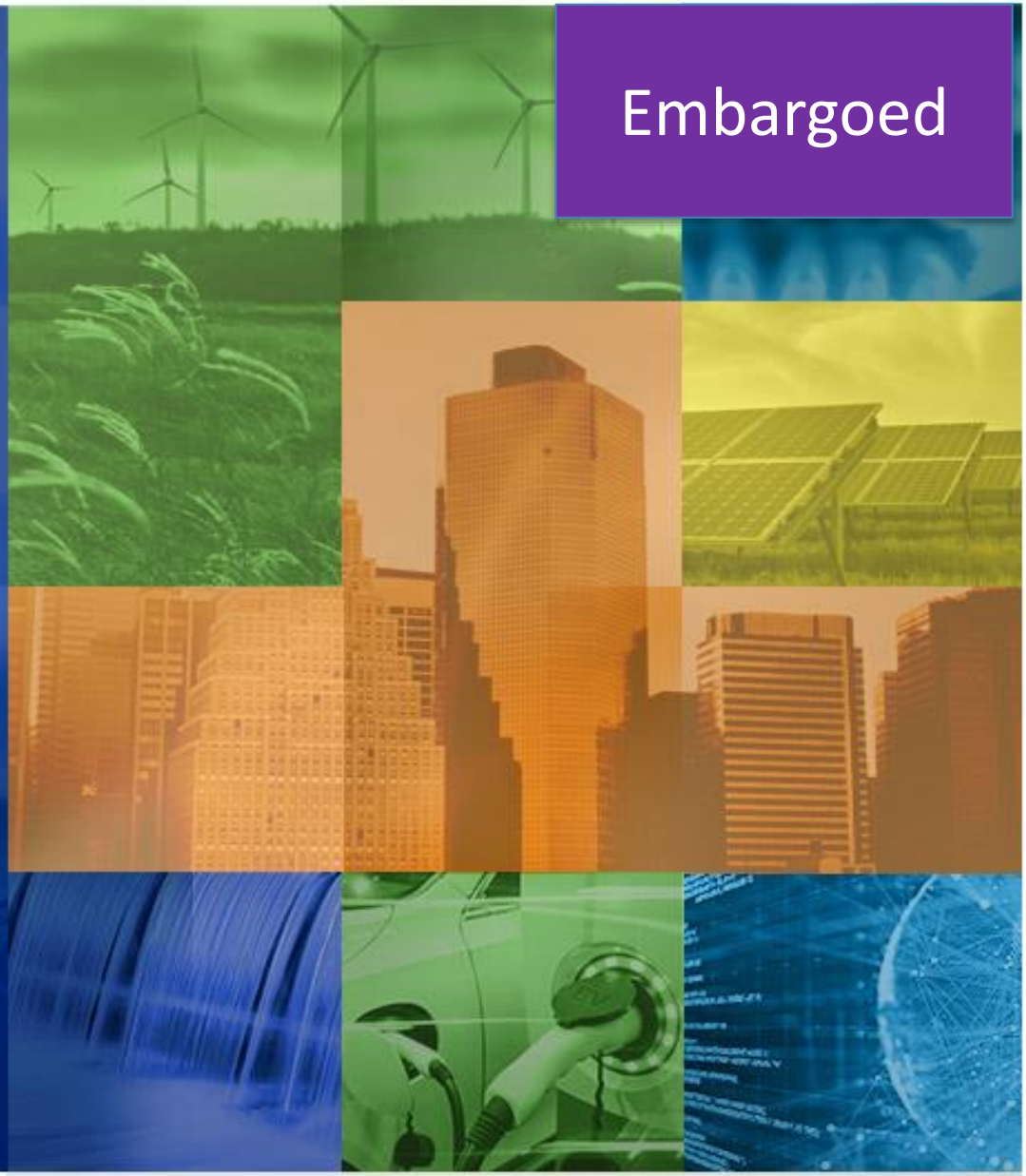

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U.S. energy overview: Renewable energy capacity build by technology

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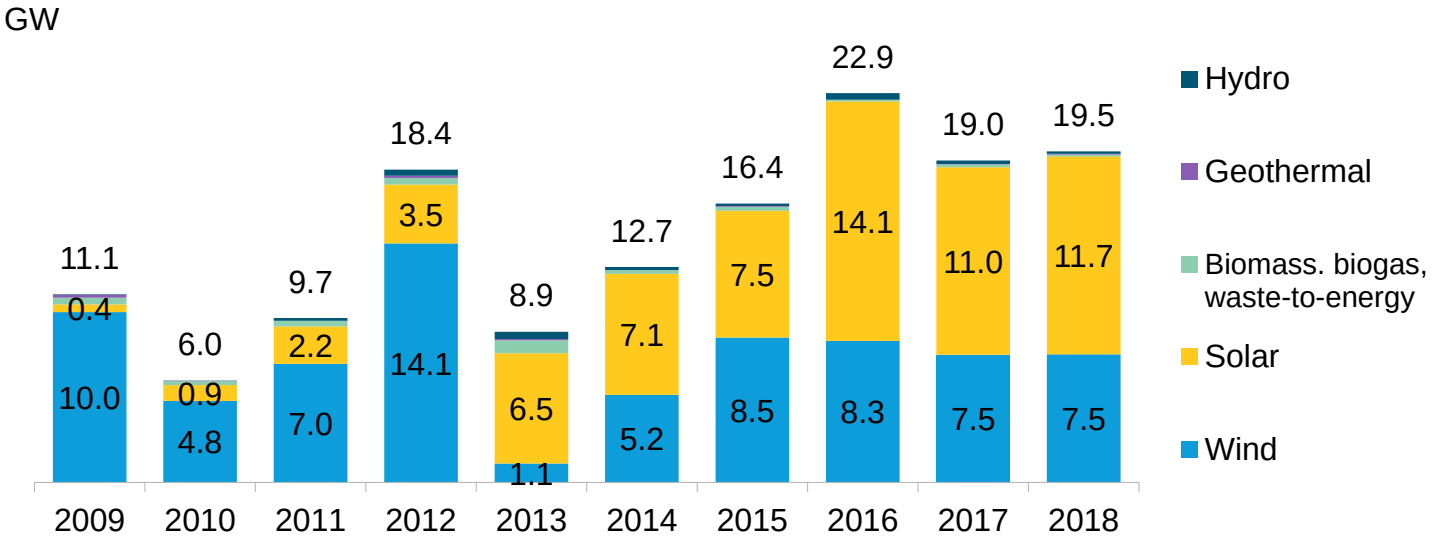

- The U.S. installed an estimated 19.5GW of renewables and hydroelectric capacity in 2018, a moderate uptick from 2017 and the second-highest year on record. The increase came amid uncertainty surrounding the impact of corporate tax reform, solar and metals tariffs, and a generally deteriorating trade relationship with China.
- Wind build maintained 2017 levels as developers rushed to monetize the federal Production Tax Credit (PTC). Meanwhile, several Northeastern states held requests for proposals (RFPs) for offshore wind projects, a first for an industry that has seen significant levels of build in Europe but relatively little activity in the U.S. so far.
- The solar industry rebounded after 2017's down year, despite continued uncertainty over solar and metals tariffs weighing on purchasing decisions. Like their counterparts in wind, solar developers are replenishing project pipelines before the step down of their key tax credit, the federal 30% Investment Tax Credit (ITC). However, the ITC's step-down begins after the PTC's, lending less urgency to the solar sector.
- Build was muted in other sectors: hydro added 142MW, biomass and waste-to-energy added 103MW, and geothermal added 53MW. Policy support for these sectors has been shorter term and less consistent, in general, than for the wind and solar industries.

Source: BloombergNEF, EIA Notes: All values are shown in AC except solar, which is included as DC capacity. Numbers include utility-scale (>1MW) projects of all types, rooftop solar, and small- and medium-sized wind. Includes installations or planned installations reported to the EIA through October 2018, as well as BNEF projections.

Economics: U.S. levelized costs of electricity (unsubsidized for new build, 2H 2018)

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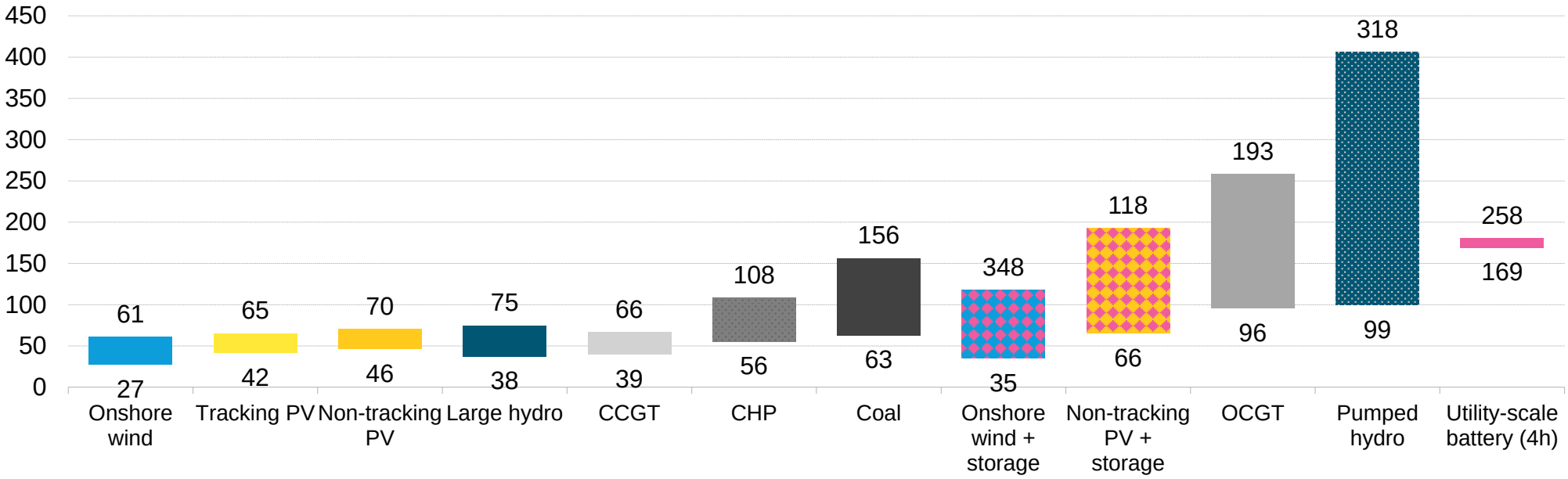
$/MWh (nominal)



- Levelized cost of electricity (LCOE) is a metric for comparing the relative costs of different generating technologies. It measures the all-in, lifetime costs of operating a plant, accounting for upfront costs as well as anticipated ongoing expenses.
- At $27-$61/MWh *without accounting for tax credits*, the LCOE for onshore wind is lower than for new gas-fired plants for bulk electricity generation in many areas of the U.S. Meanwhile, combined-cycle gas turbines (CCGTs) offer the lowest cost *dispatchable* power in the U.S., with an LCOE of $39-$66/MWh.
- Photovoltaic (PV) systems outfitted with mechanisms to track the sun's progress across the sky offer an LCOE of $42-$65/MWh and are nearly at parity with new CCGTs. PV without tracking is getting cheaper, with an LCOE of $46-$70/MWh.
- The levelized cost of paired onshore wind-plus-battery (with four hours of storage) systems ranges from $36-$118/MWh, while solar-plus-battery (four hours) is $57-$169/MWh.

Source: BloombergNEF. Note: LCOE range represents a range of costs and capacity factors. Battery storage systems (co-located and stand-alone) presented here have four-hour storage. In the case of solar- and wind-plus-battery systems, the range is a combination of capacity factors and size of the battery relative to the power generating asset (25-100% of total installed capacity). All LCOE calculations are unsubsidized. Categorization of technologies is based on their primary use case. Nuclear not included due to insufficient data and lack of project development. Large hydro projects are those greater than 50MW of capacity.

Finance: Corporate procurement of clean energy in the U.S.

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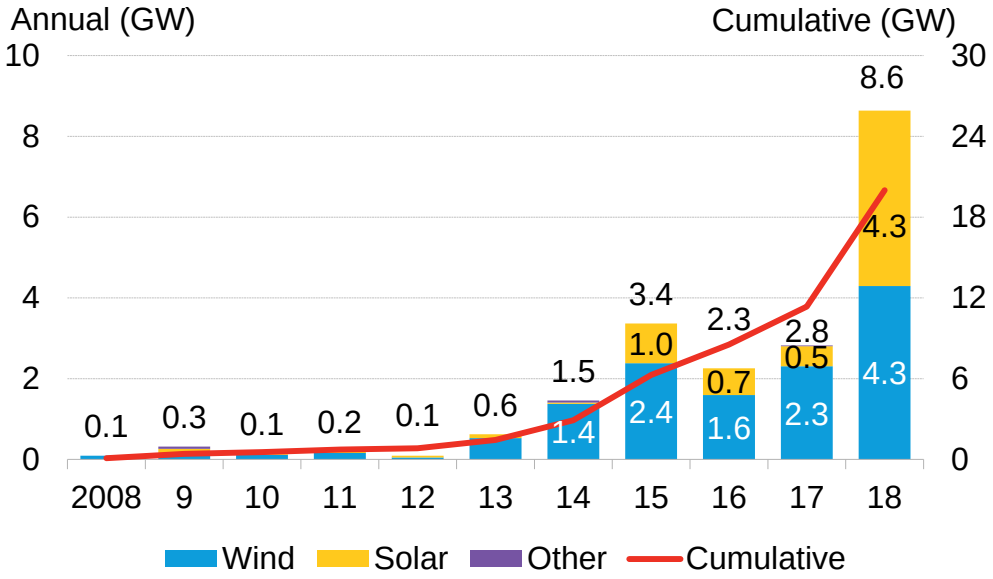
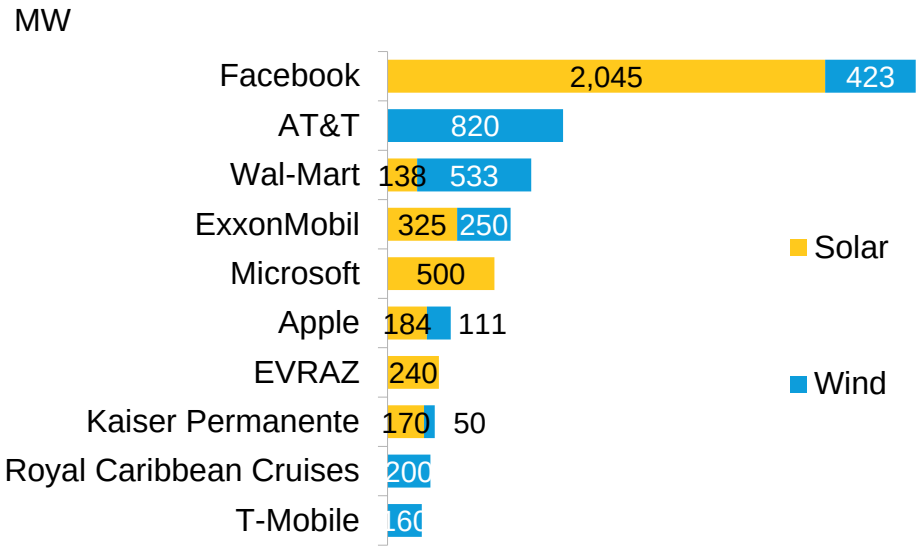
Renewable capacity contracted by corporations, by technology



Largest corporate offtakers, 2018



- New power purchase agreements (PPAs) signed between buyers of clean energy and generators spiked to a new record of 8.6GW in 2018, up from 2.8GW in 2017. Facebook contracted nearly 2.5GW of U.S. clean energy in 2018, more than any other corporation. It has worked closely with regulated utilities such as Pacific Power and PNM Resources through green tariff programs. ExxonMobil is the first oil and gas major to lock into a long-term clean energy contract to power its own operations. It signed two deals to purchase 575MW of solar and wind from Orsted.
- Some buyers that previously signed contracts are feeling remorse as wholesale prices have remained low. As a result, corporations seeking new PPAs are now asking for shorter terms on their deals. Average corporate wind PPA lengths dropped from 17 years in 2014 to 14 years in 2018.
- Smaller companies are increasingly aggregating their load to take advantage of the economies of scale of larger clean energy projects. This has opened the door for companies such as Akamai, Adobe and Etsy to sign long-term contracts. Roughly 4.5GW of corporate PPAs signed since 2014 have come through aggregated purchasing.

Source: BloombergNEF Note: Charts show offsite PPAs only

Deployment: U.S. announced and commissioned energy storage projects

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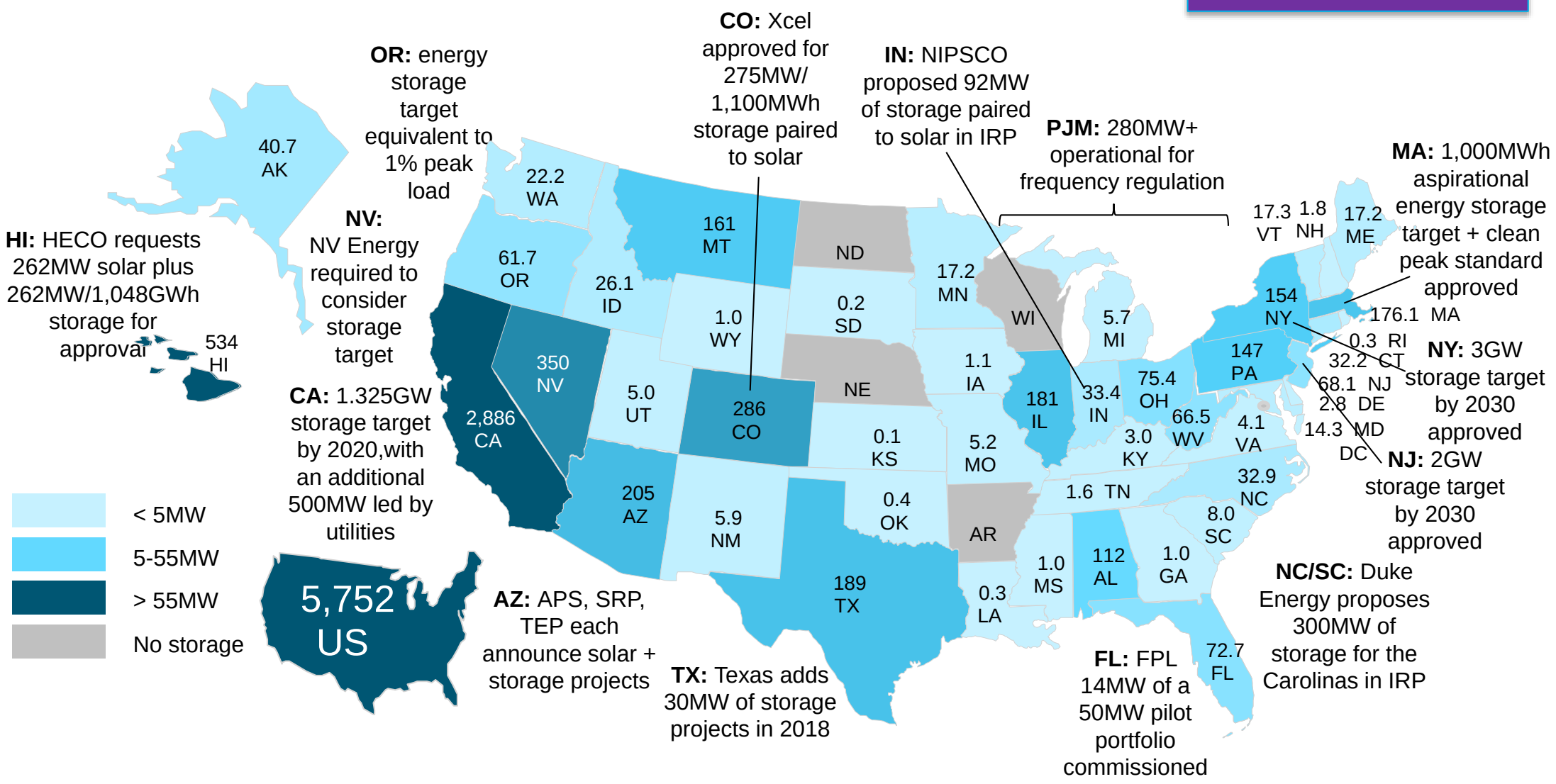

HI: HECO requests 262MW solar plus 262MW/1,048GWh storage for approval

OR: energy storage target equivalent to 1% peak load

NV: NV Energy required to consider storage target

CA: 1.325GW storage target by 2020,with an additional 500MW led by utilities

CO: Xcel approved for 275MW/ 1,100MWh storage paired to solar

IN: NIPSCO proposed 92MW of storage paired to solar in IRP

PJM: 280MW+ operational for frequency regulation

MA: 1,000MWh aspirational energy storage target + clean peak standard approved

NY: 3GW storage target by 2030 approved

NJ: 2GW storage target by 2030 approved

NC/SC: Duke Energy proposes 300MW of storage for the Carolinas in IRP

AZ: APS, SRP, TEP each announce solar + storage projects

TX: Texas adds 30MW of storage projects in 2018

FL: FPL 14MW of a 50MW pilot portfolio commissioned

Source: BloombergNEF Note: Includes projects that are larger than 500kW/500kWh, have announced a specific location, and has been confirmed by the relevant company through public data. Indiana NIPSCO capacity not included in state capacity because individual project capacity is not yet disclosed.

Deployment: U.S. non-hydropower commissioned energy storage capacity

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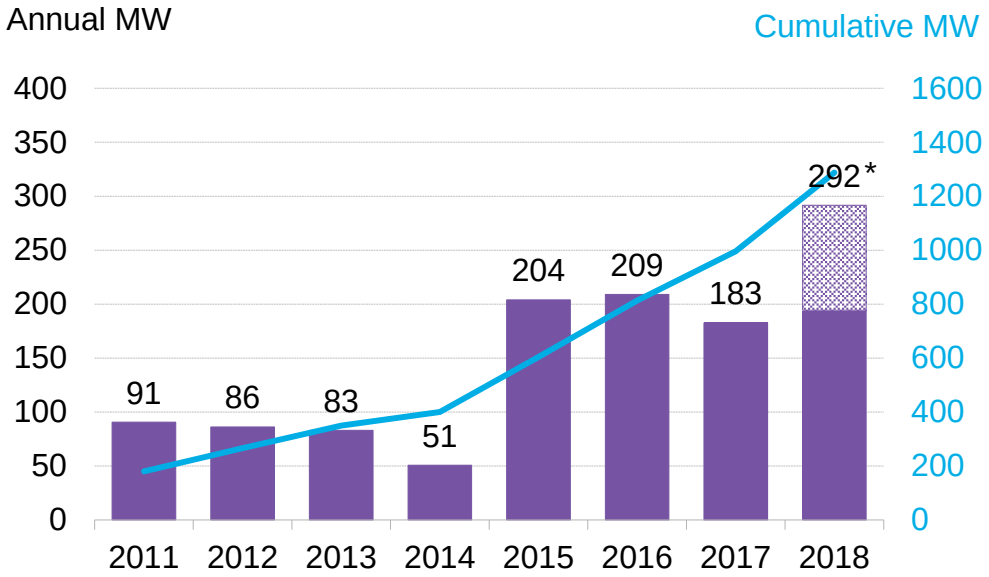
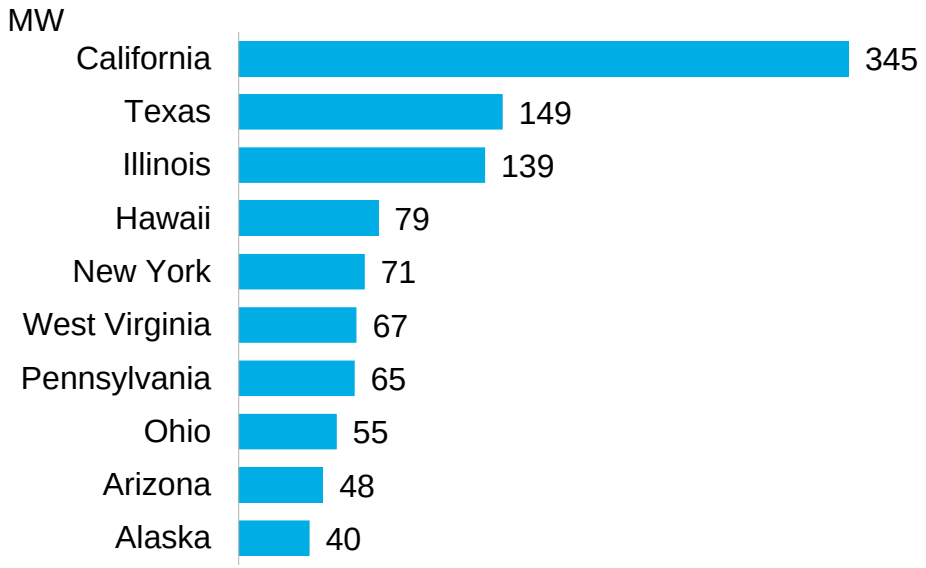
Commissioned capacity



Installations by state (top 10 states in 2018)



- Annual energy storage installations have increased significantly since 2014. Build ramped up in 2015 from projects seeking to participate in the PJM frequency regulation market – these assets represent most of the capacity in Illinois, West Virginia, Ohio and Pennsylvania.
- While PJM states are still, in aggregate, the biggest energy storage market in terms of commissioned capacity in the U.S., California is the largest single state market. California build surged in 2016 and early 2017 in response to emergency gas supply shortages expected from the Aliso Canyon gas storage facility leak-mitigation efforts.
- In 2018, markets began to expand beyond PJM and California. New Jersey, Texas, North Carolina, Illinois and Massachusetts each added more than 20MW of capacity.
- Falling lithium-ion battery pack prices have helped to lower costs for new stationary storage applications.

*Source: BloombergNEF Notes: *2018 includes expected but unconfirmed capacity as of December 5, 2018. Unconfirmed capacity is marked in white. Does not include underground compressed air energy storage or flooded lead-acid batteries. Minimum project size for inclusion in this analysis is 500kW or 500kWh. Cumulative capacity subtracts capacity that was decommissioned.*

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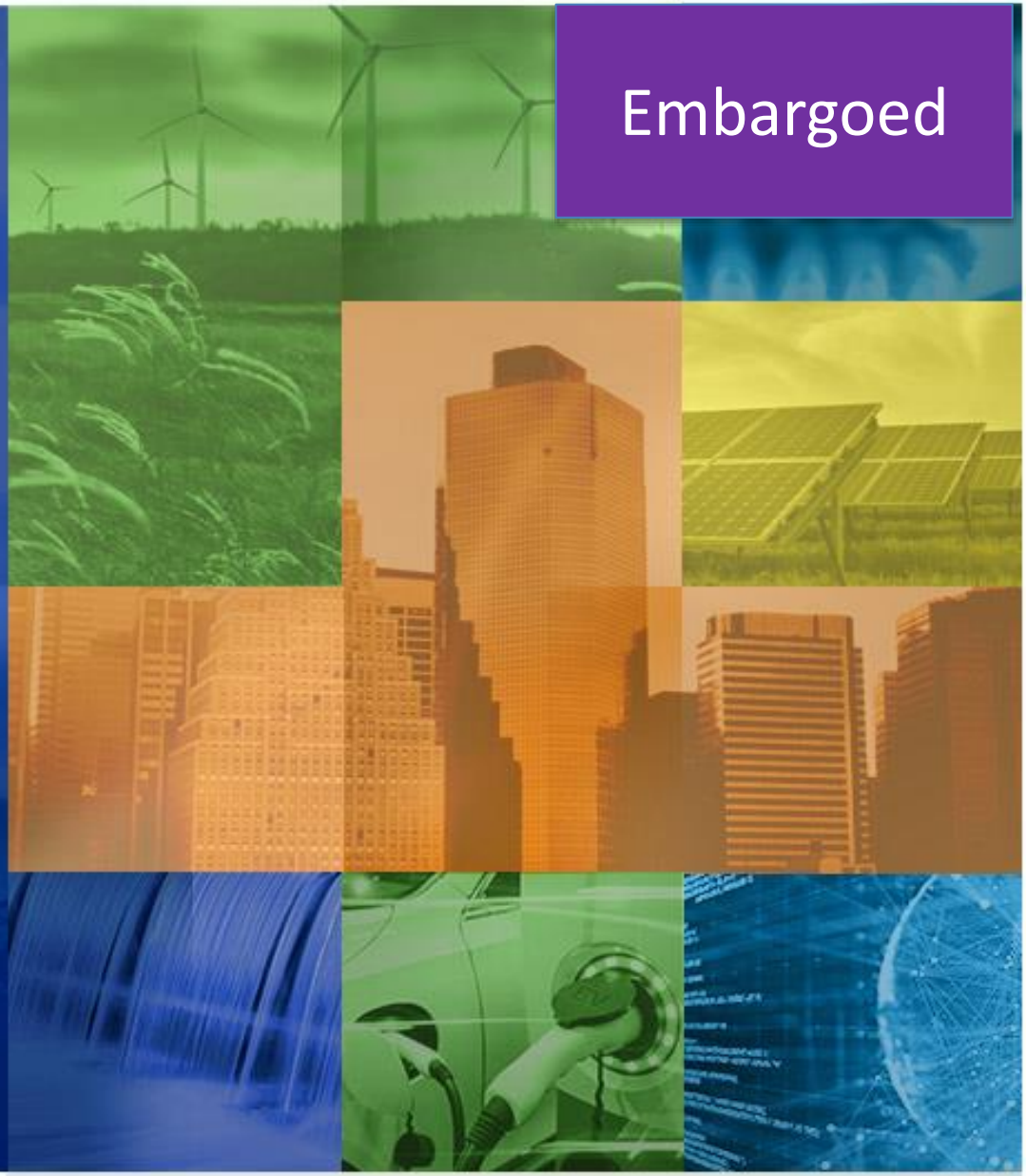

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