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The Business Council for Sustainable Energy®

2019 Sustainable Energy in America Factbook

March 5, 2019

About the BCSE

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.

The Council advocates for policies at state, national and international levels that:

- Increase the use of commercially-available clean energy technologies, products and services;
- Support an affordable, reliable power system; and
- Reduce air pollution & greenhouse gas emissions.

2019
Sustainable Energy in America
FACTBOOK

The Business Council for Sustainable Energy®

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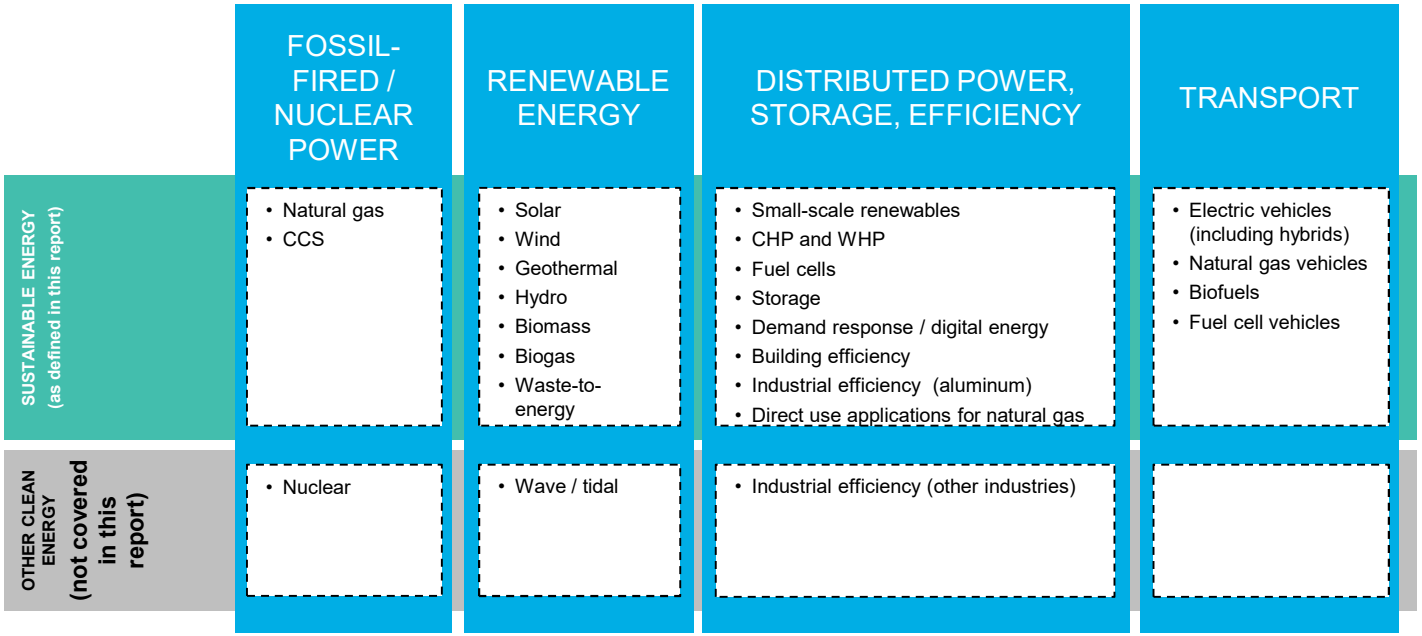
Faces Behind the Facts
Success Stories of the 2019 Sustainable Energy in America Factbook
Get the Facts: bcse.org | See the Faces: cebn.org
Optimized Thermal SYSTEMS
Clean energy and energy efficiency supported
OVER 3 MILLION JOBS
in 2017.
2019 Sustainable Energy in America Factbook
Clean energy in the U.S. attracted
$64 BILLION IN INVESTMENT
in 2018—up 11% since 2017.
2019 Sustainable Energy in America Factbook
THERM

About the Factbook: terminology



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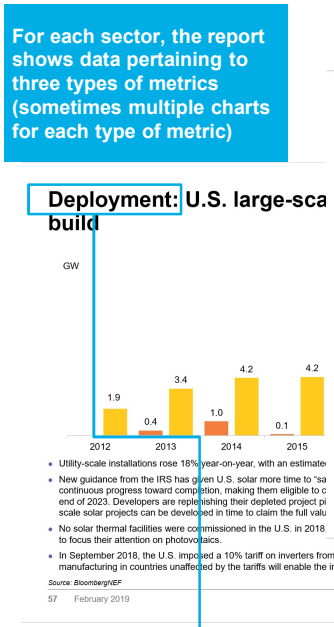
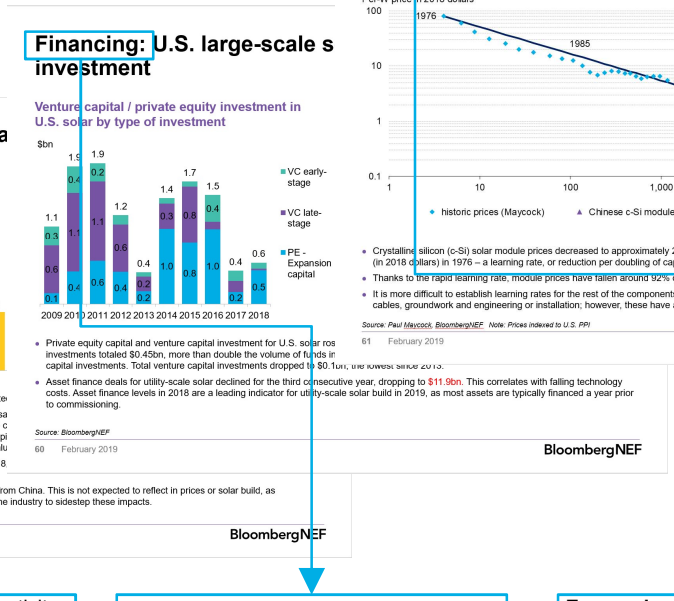
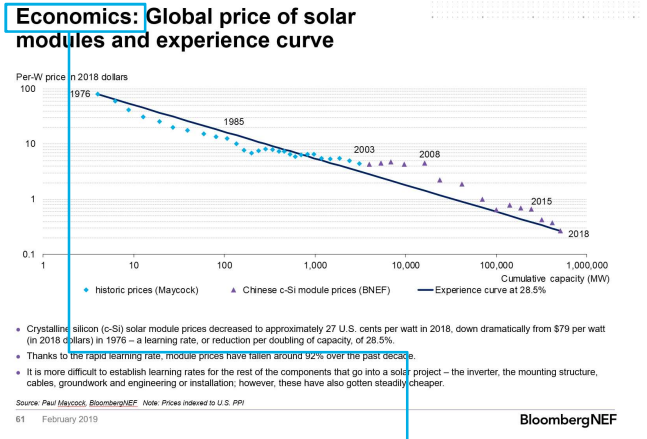
About the Factbook: sector sub-sections

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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Factbook key findings

- U.S. power continued de-carbonizing thanks to natural gas, efficiency and renewables growth, with coal retirements.
- Employment grew.
- Energy remained affordable by historical standards to consumers.
- Electric vehicle sales gained traction.

But…

- Energy productivity improvements stalled.
- Energy consumption overall went up.
- CO2 emissions rose.

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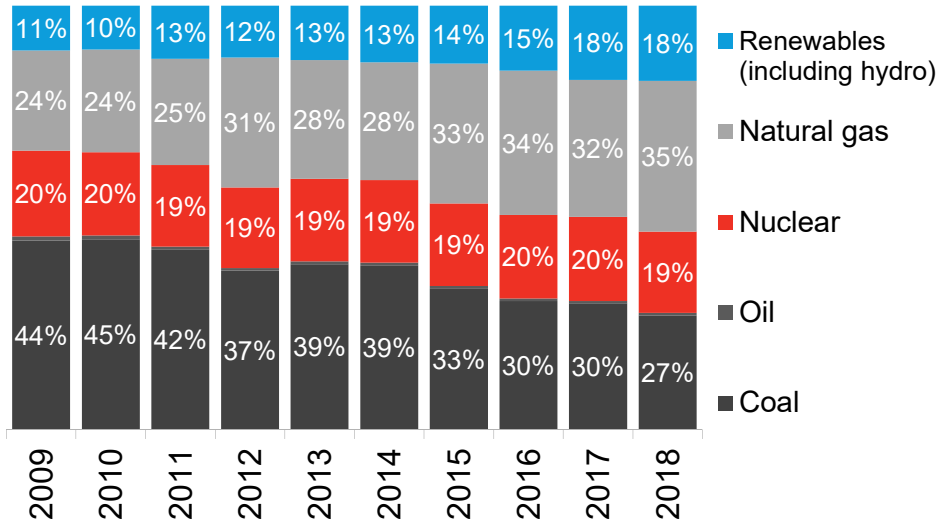
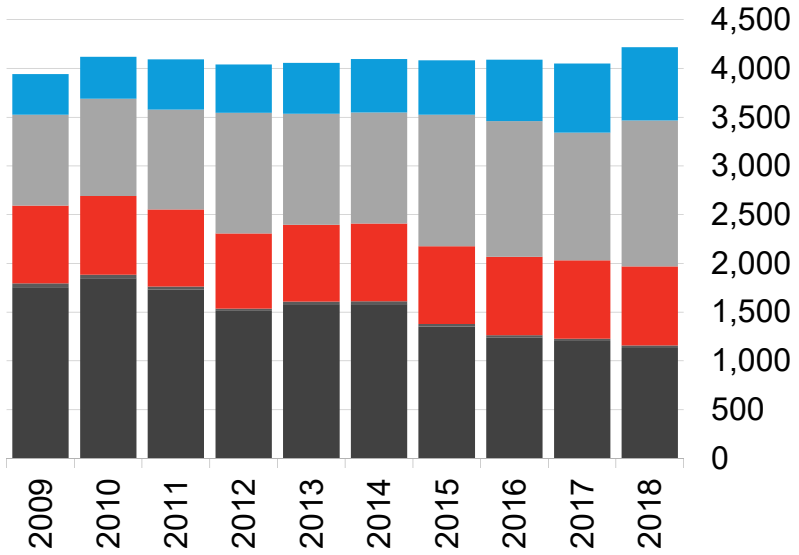
U.S. energy overview: Electricity generation mix

U.S. electricity generation by fuel type (%)



U.S. electricity generation by fuel type (TWh)



Source: U.S. Energy Information Administration, BloombergNEF

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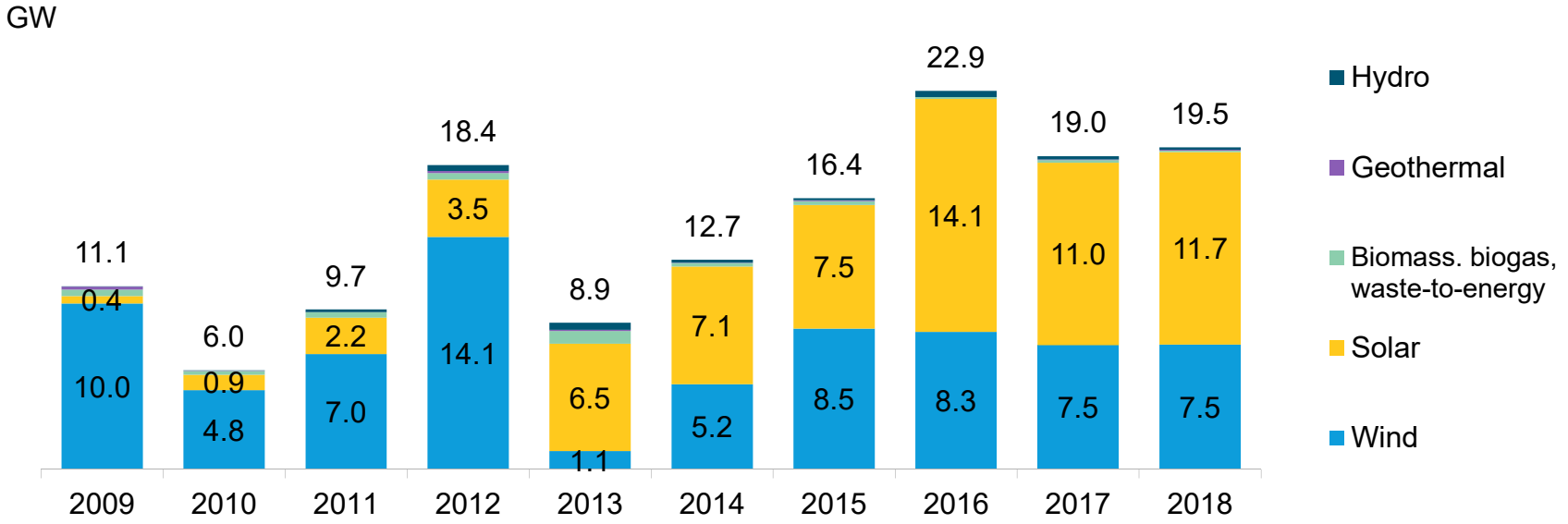
U.S. energy overview: Renewable energy capacity build by technology



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.

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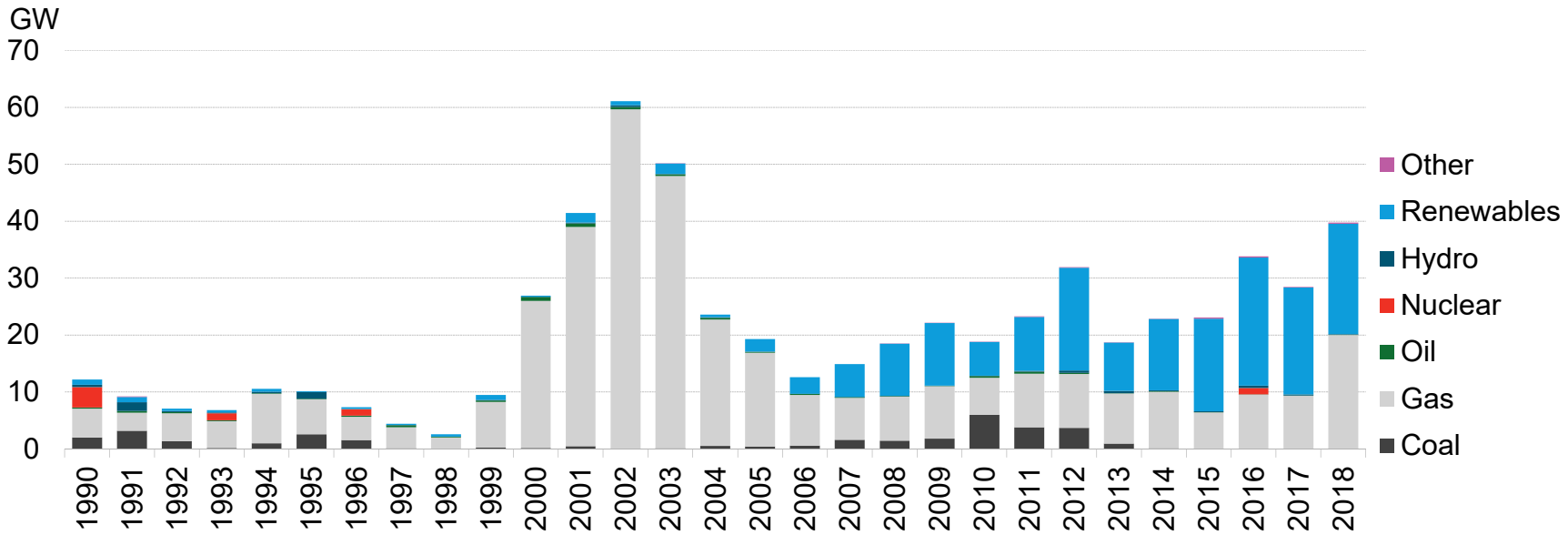
U.S. energy overview: Electric generating capacity build by fuel type



Source: EIA, BloombergNEF Note: All values are shown in AC except solar, which is included as DC capacity. "Renewables" here does not include hydro, which is shown separately. All capacity figures represent summer generating capacity. Includes installations or planned installations reported to the EIA through October 2018, as well as BNEF projections.

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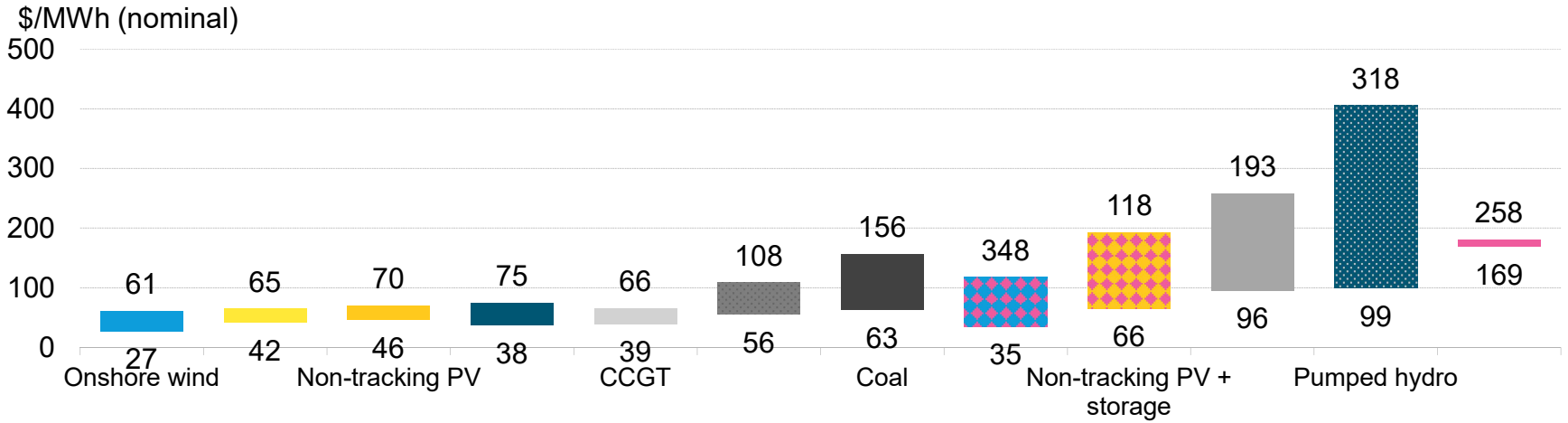
Economics: U.S. levelized costs of electricity (unsubsidized for new build, 2H 2018)

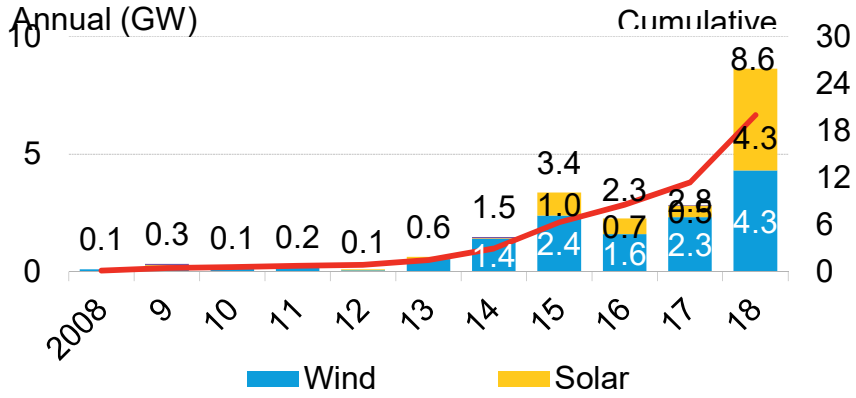


- Levelized cost of electricity (LCOE) is a metric for comparing the relative costs of different generating technologies. It measures the all-in, lifetime costs of operating a plant, accounting for upfront costs as well as anticipated ongoing expenses.
- At $27-$61/MWh *without accounting for tax credits*, 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.

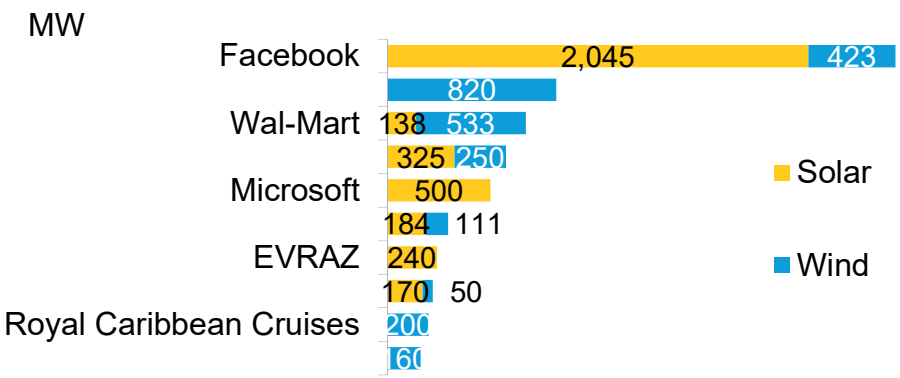
Source: BloombergNEF. Note: LCOE range represents a range of costs and capacity factors. Battery storage systems (co-located and stand-alone) presented here have four-hour storage. In the case of solar- and wind-plus-battery systems, the range is a combination of capacity factors and size of the battery 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.

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

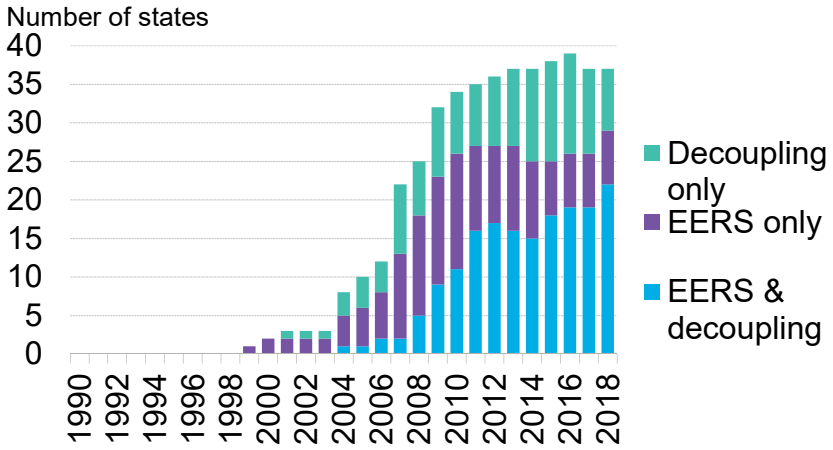
Finance: Corporate procurement of clean energy and energy efficiency

- Corporations continue to establish targets to purchase clean energy. Through 2018, 158 companies have pledged to source 100% of their energy consumption from renewables by signing onto the "RE100" initiative; 32% of these firms are domiciled in the U.S. Financial, consumer staples and technology companies are the most common signees. 40 companies from 13 countries joined the RE100 in 2018.
- Through 2018, 37 companies have joined The Climate Group's EP100 campaign, up from 13 companies in 2017. Signatories pledge to double their energy productivity by 2030, while also cutting energy waste and owning and operating energy-smart buildings. Salesforce, Hilton and Schneider Electric are notable members to join the initiative in 2018.
- The Climate Group's EV100 campaign is also gaining momentum. Companies make a public commitment to integrate electric vehicles (EV) into their fleet or support EV charging infrastructure at their operations by 2030. IKEA, HP and Unilever spearhead a group of 31 companies that have joined the campaign through 2018.

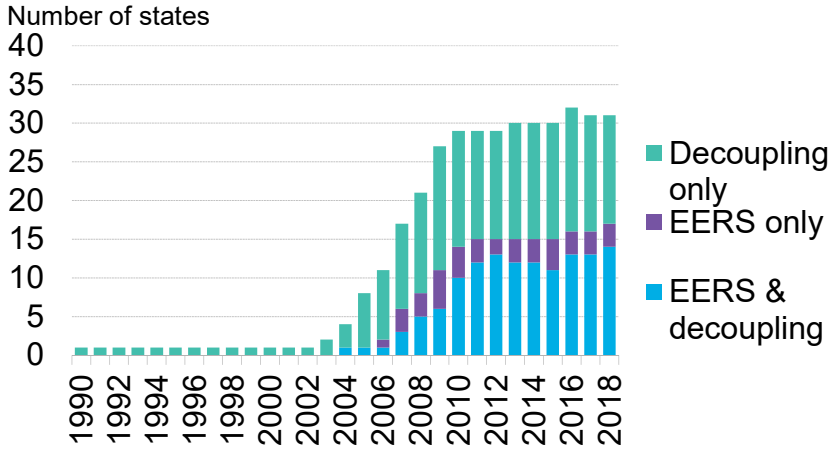
Source: BloombergNEF, The Climate Group, company announcements, DOE

Policy: U.S. states with EERS and decoupling for electricity and natural gas

Electricity



Natural gas

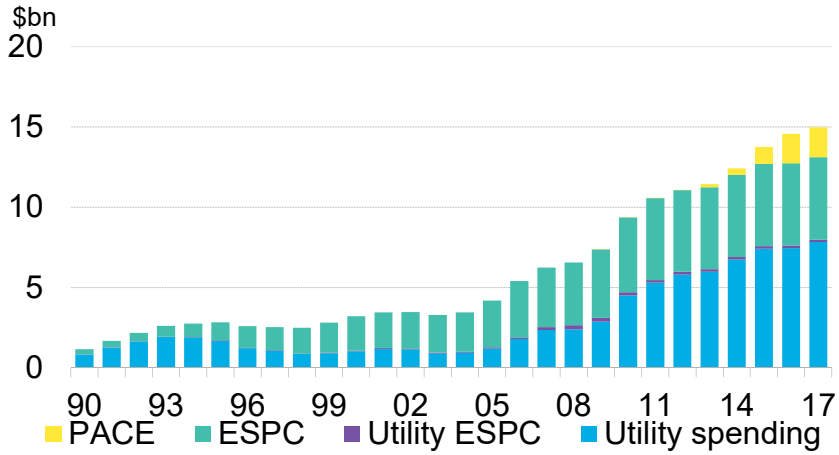


- Energy efficiency resource standards (EERS) are state-level policies that require utilities to invest in measures that improve end-user efficiency in order to meet energy-savings goals set by the government. Decoupling is a regulatory framework in which utilities' revenues are based on the reliable provision of energy but not on the volume sold. Decoupling removes the disincentive for utilities to invest in efficiency. Utilities are most likely to invest in energy efficiency in states with both EERS and revenue decoupling.
- The uptake of decoupling and EERS among states grew substantially from 2006 to 2010, accompanied by a dramatic increase in utility spending on end-user efficiency from $1.9bn to $4.7bn during that period. Although the number of states adopting legislation has slowed, spending has continued to rise as EERS targets have become more stringent.

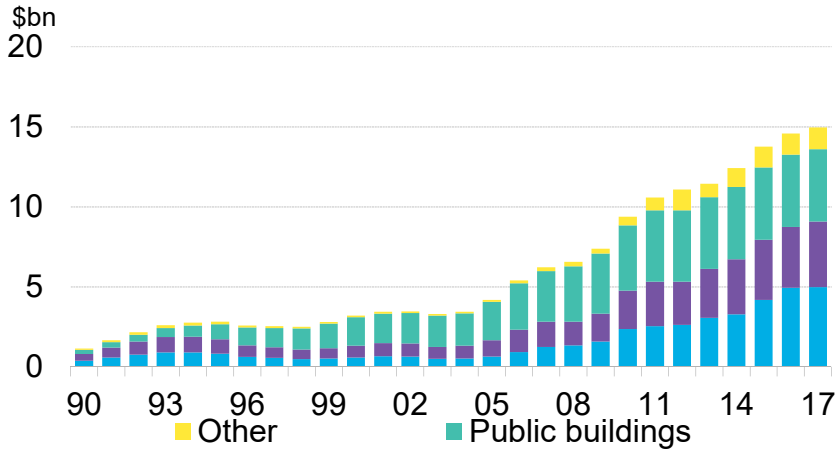
Source: ACEEE, BloombergNEF Notes: Decoupling includes all lost revenue adjustment mechanisms, but no longer includes pending policies as per a methodology change in ACEEE reporting.

Financing: U.S. estimated investment in energy efficiency through formal frameworks

By framework



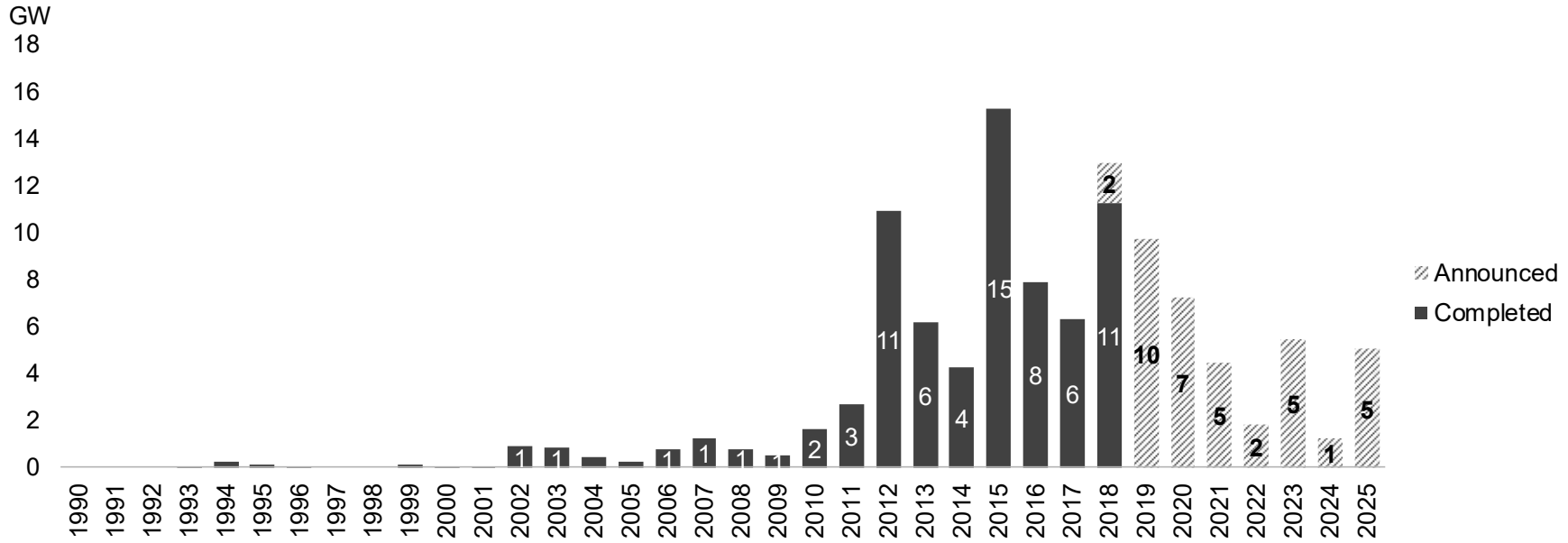
By sector



- Total U.S. spending on energy efficiency through formal frameworks climbed to an estimated record level of $15bn in 2017.
- Utility spending and ESPCs remain the most important frameworks. While the PACE financing framework was the fastest source of growth in 2016, particularly in the residential sector, 2017 was more muted. Instead, a boost in utility spending on energy efficiency accounts for over 90% of the estimated increase in energy efficiency investment. As discussed on the previous slide, most of this money was channeled through electricity energy efficiency programs.
- While our estimate for ESPC investment has leveled off in recent years, there is a certain amount of extrapolation involved due to the lack of detailed data on the market. The picture may change when new data becomes available.

Source: ACEEE, NAESCO, LBNL, CEE, IAEE, PACENation, BloombergNEF Notes: The values for the 2015-17 ESPC market size shown here are estimates. The most recent data from LBNL reports revenues of $5.3bn in 2014. The 2015-17 estimates are based on a continuation of 2011-14 growth rates.

U.S. energy overview: Completed and announced coal-fired plant retirements



Source: EIA, company announcements, BloombergNEF Notes: "Retirements" does not include conversions from coal to natural gas or biomass; includes retirements or announced retirements reported to the EIA through October 2018. All capacity figures represent summer generating capacity.

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Factbook key findings

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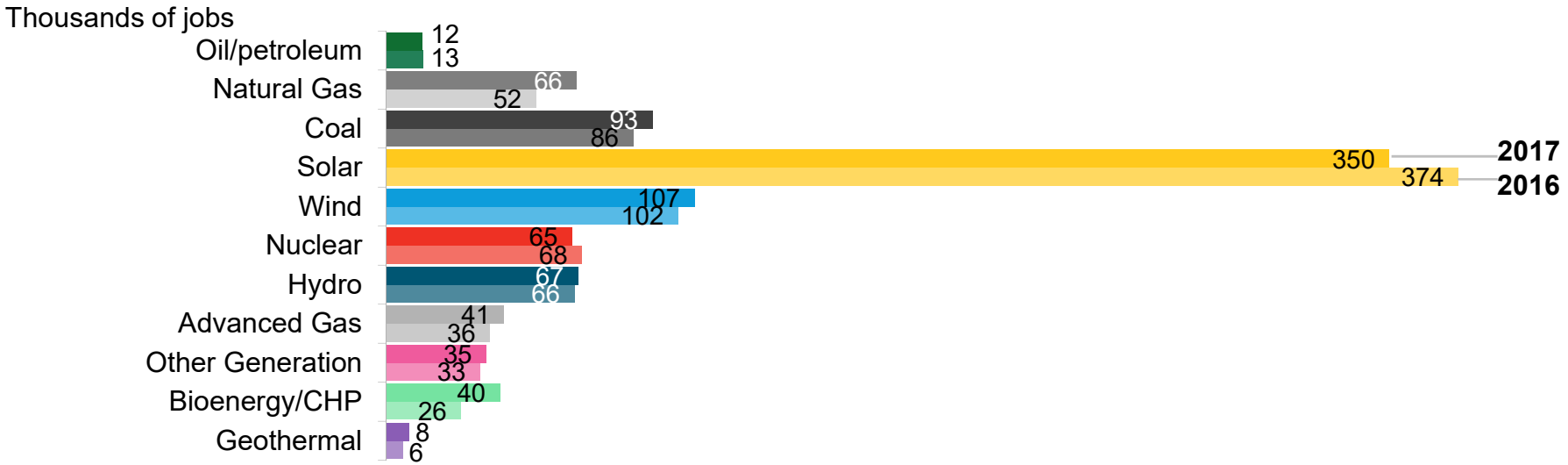
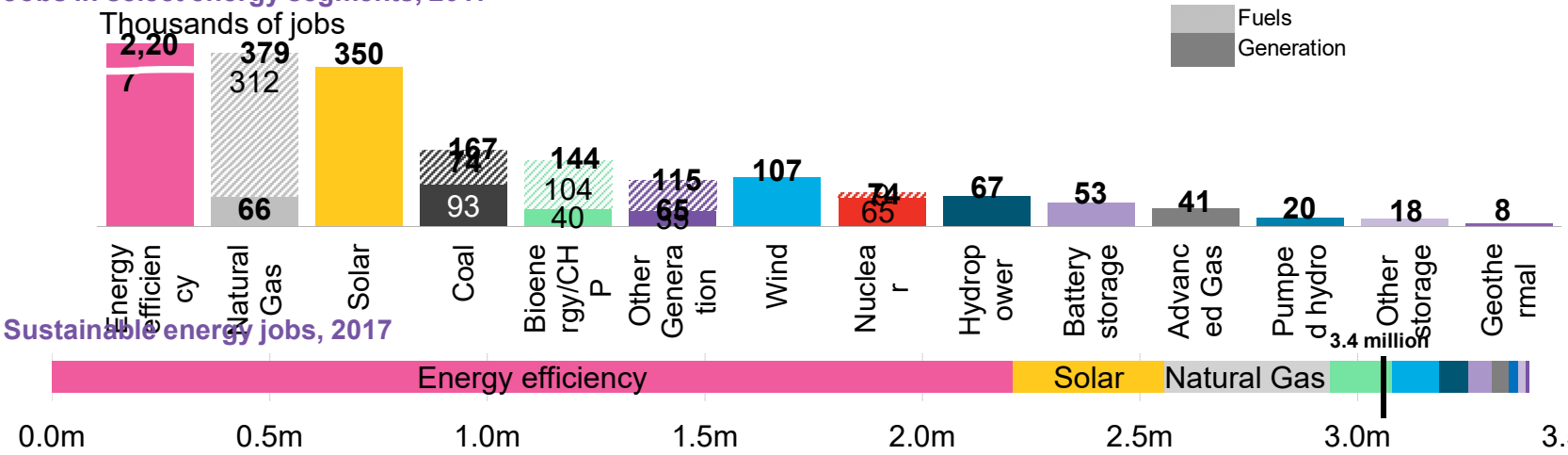
U.S. energy overview: Jobs in electricity generation



Source: The U.S. Energy Employment Report, NASEO and EFI. Notes: 2016 data is from Q1 2016, 2017 data is from 2Q 2017. "Advanced gas" uses a variety of technologies including high efficiency compressor systems, advanced low NOx combustion technology, first application of closed loop steam cooling in an industrial gas turbine, advanced turbine blade and vane materials, high temperature tbc and abradable coatings, advanced row 4 turbine blades, 3-d aero technology, or advanced brush seal.

U.S. energy overview: Jobs in select segments of the energy sector

Jobs in select energy segments, 2017



Sustainable energy jobs, 2017

- The renewable, energy efficiency, and natural gas sectors employed an estimated 3.4 million Americans in 2017, according to the U.S. Energy and Employment Report. This number increased from approximately 3.3 million in 2016. Energy efficiency alone supported 2.2 million jobs, while natural gas supported roughly 379,000 jobs and solar 350,000 jobs.
- While renewable sectors like solar, wind, hydropower and geothermal do not require upstream processing or extraction of a fuel, fossil-fired generation does. Adding in fuel-related jobs notably boosts the total employment by fossil-fired generation and bioenergy. As of 4Q 2017, 74% of the jobs associated with the natural gas sector came from fuel supply. Coal employed 167,000, with 44% in coal production and supply.
- Energy efficiency jobs related to construction often hire people who also work on other types of construction tasks (20% of the 1.3 million employees in this category spend only the minority of their time on efficiency).

Source: The U.S. Energy Employment Report, NASEO and EFI. Notes: The data provided relies on thousands of data points provided via survey. Transmission, distribution, and oil/petroleum jobs not included as available data does not break out the portion of those jobs relevant to the electricity sector. See footnote on next slide for details on the definition for "Advanced Gas."

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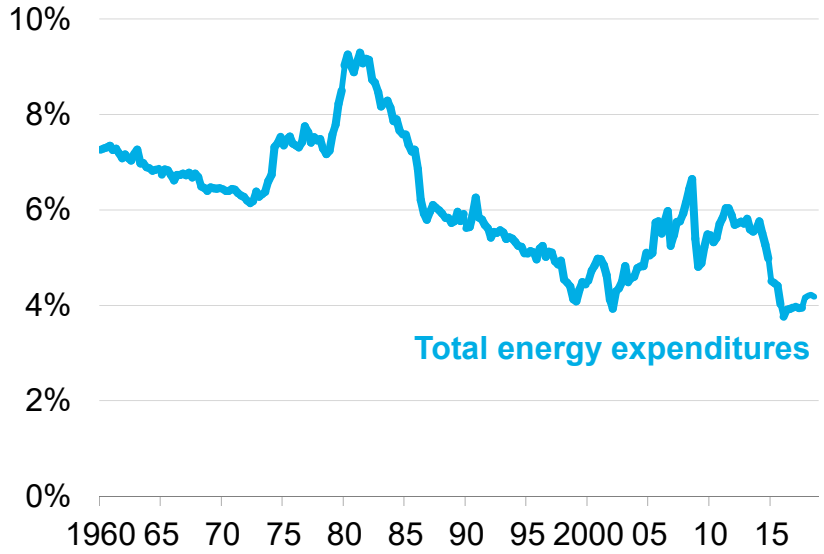
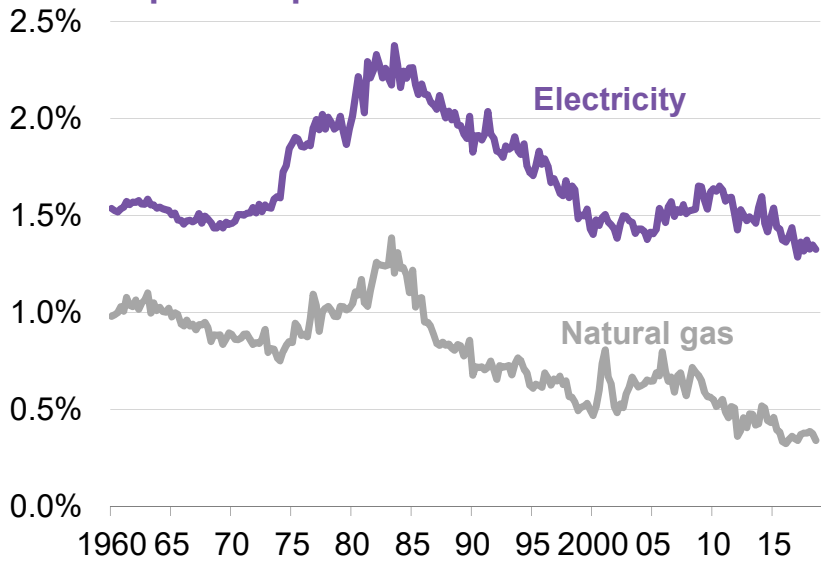
U.S. energy overview: Energy as a share of personal consumption expenditures

Total energy goods and services as share of total consumption expenditure



Electricity and natural gas as share of total consumption expenditure



Source: Bureau of Economic Analysis, BNEF

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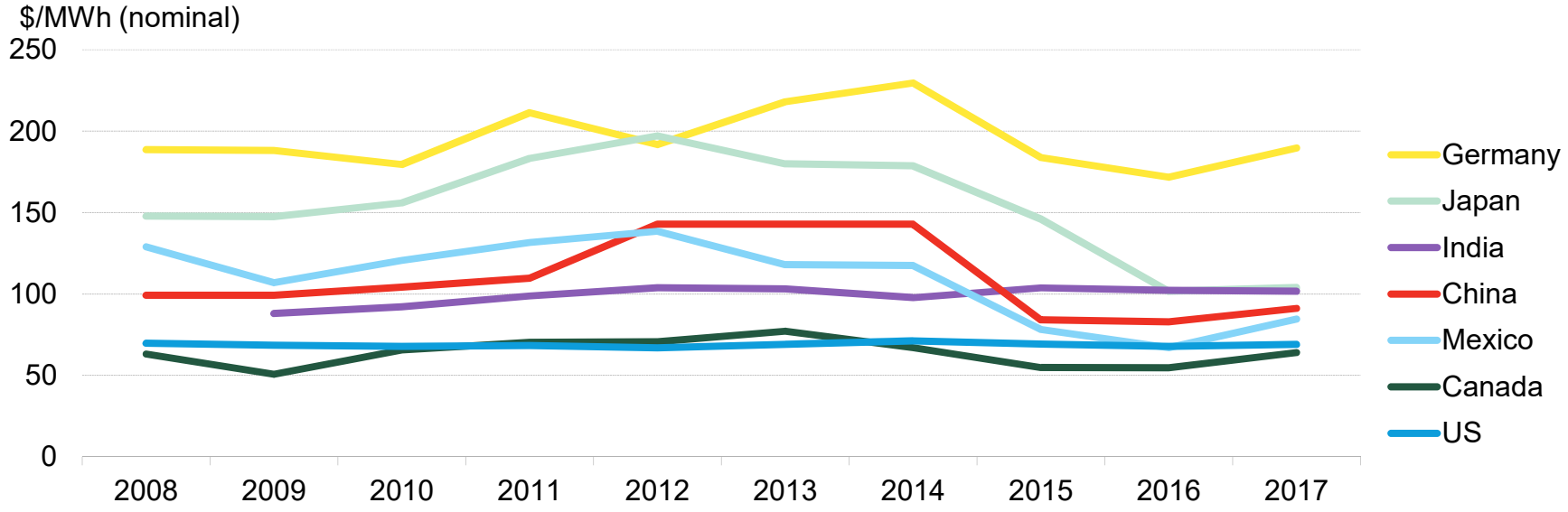
U.S. energy overview: Average electricity rates for industry by country



Source: BloombergNEF, government sources (EIA for the U.S.) Notes: Prices are averages (and in most cases, weighted averages) across all regions within the country. Japanese data is for the C&I segment and 2016 figures come from a different source than preceding years.

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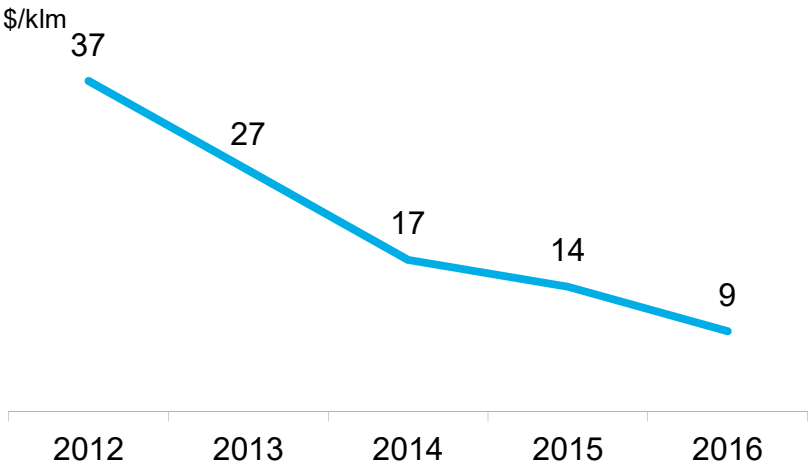
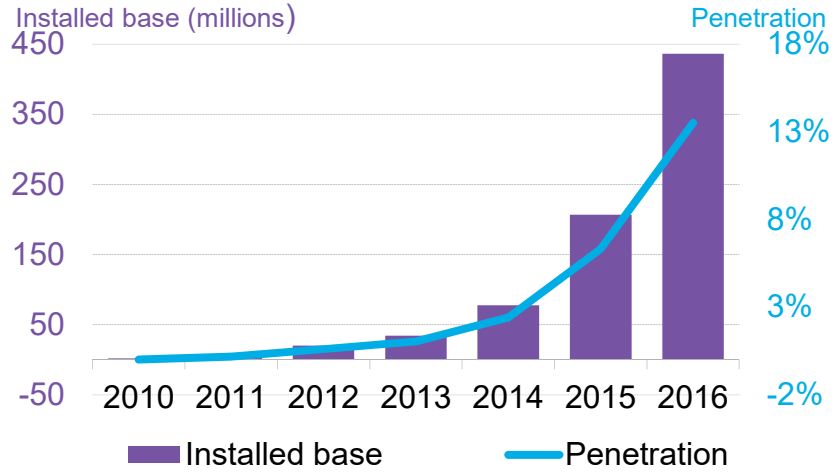
Deployment: Light-emitting diodes (LED)

LED price, A-type lamps



LED installed base and penetration, A-type lamps

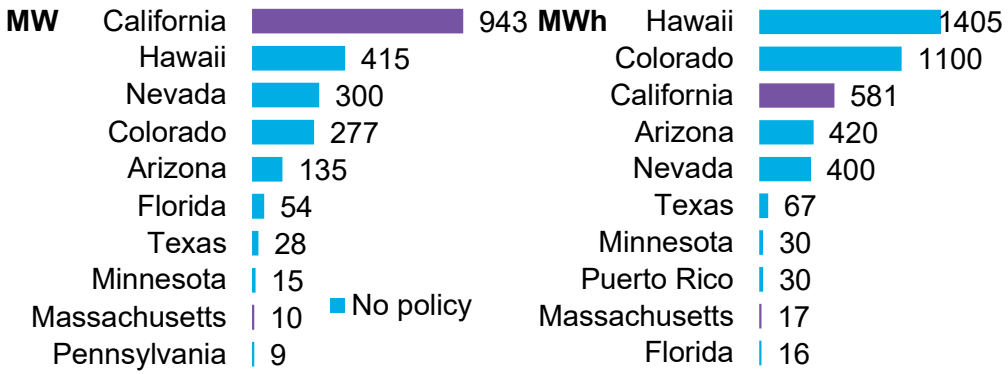


- The light-emitting diode (LED) is a technology that displaces traditional incandescent bulbs, while providing longer lifetimes and significant energy savings for consumers. The A-type lamp is the classic light bulb used in most household applications.
- The installed base of LEDs has accelerated rapidly in recent years, climbing to 436 million A-type units at the end of 2016, the latest year for which data are available. With an estimated 3.3 billion A-type bulbs installed in the U.S., this represents a 13.5% penetration. Annual savings of 99 trillion Btu are a fraction of the estimated 469 trillion Btu saved by all LEDs across the U.S.
- As deployment has picked up, costs have fallen dramatically. Costs per kilo-lumen (klm) have fallen 75% since 2012, to only $9/klm in 2016.
- Federal efficiency policies and utility energy efficiency programs (many, in turn, promoted by state policy) have helped spark LED uptake.
- LEDs also offer efficiency enhancement for connected and networked devices and “smart” buildings.

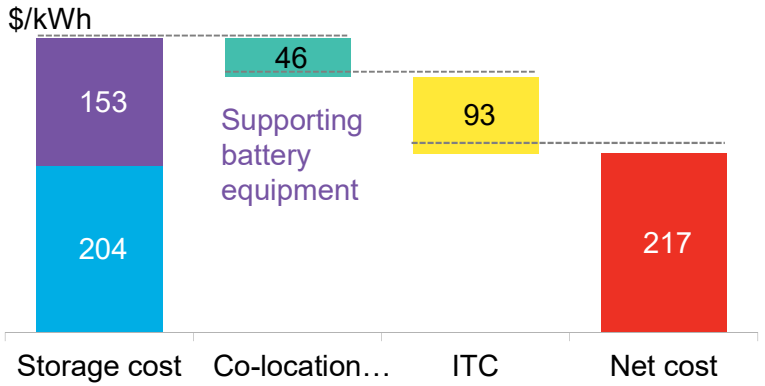
Source: Department of Energy. Note: Luminous flux differs from power (radiant flux) in that radiant flux includes all electromagnetic waves emitted, while luminous flux is weighted according to a model (a "luminosity function") of the human eye's sensitivity to various wavelengths.

Deployment: Solar + storage

Co-located solar and storage projects announced and commissioned, by state



Cost advantage to co-locating storage with solar



- Co-located photovoltaics and storage (PV+S) development activity jumped in 2018. California and Hawaii led the nation with total planned and commissioned projects of 943MW/581MWh and 415MW/1405MWh, respectively. Colorado recently issued a solicitation; BNEF estimates it will seek 1,100MWh through 275MW of storage co-sited with solar.
- The Southwest saw a surge in large-scale PV+S announcements, led by solar developers bidding into utility solicitations at prices that undercut other firm generation sources, including natural gas. Developers with solar-storage offerings have expanded opportunities compared to those that only have solar products, as solicitations that explicitly call for firm resources or electricity delivery after sunset are now open to them as well.
- Battery storage systems that function as supporting equipment to solar projects, through co-location, are eligible for the ITC worth 30% of their upfront capital cost. Co-located systems are also able to share interconnection, hardware and operation costs. Together, these cost savings are worth nearly 40% of the cost of a standalone system.

Source: BloombergNEF. Note: Storage capacity uses two metrics: MW which signifies power output (based on the inverter capacity) and the MWh which specifies the energy storage capacity and relates to the duration the input/output can be sustained for (ie, a 10MW/40MWh system can sustain 10MW for 4 hours). The ITC is the federal investment tax credit.

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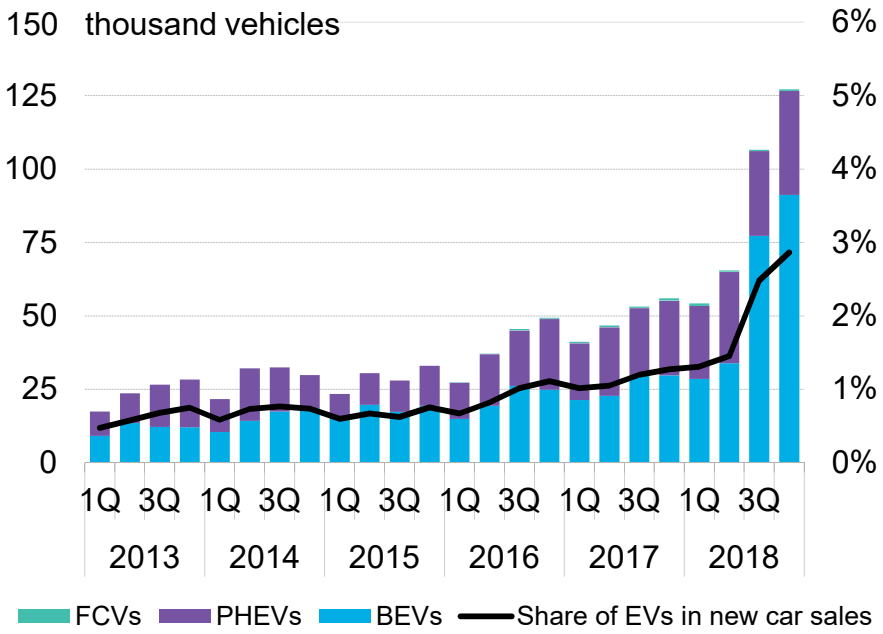
Deployment: Electric vehicle and hybrid electric vehicle sales in the U.S.

U.S. EV and FCV sales



Source: BloombergNEF, Bloomberg Terminal, Marklines, California Fuel Cell Partnership. Note: PHEV stands for plug-in hybrid electric vehicle, BEV stands for battery electric vehicle, HEV stands for hybrid electric vehicle and FCV stands for fuel cell vehicle. EVs includes BEVs and PHEVs. FCV sales data not available prior to 2016. FCV sales numbers too low to be visible.

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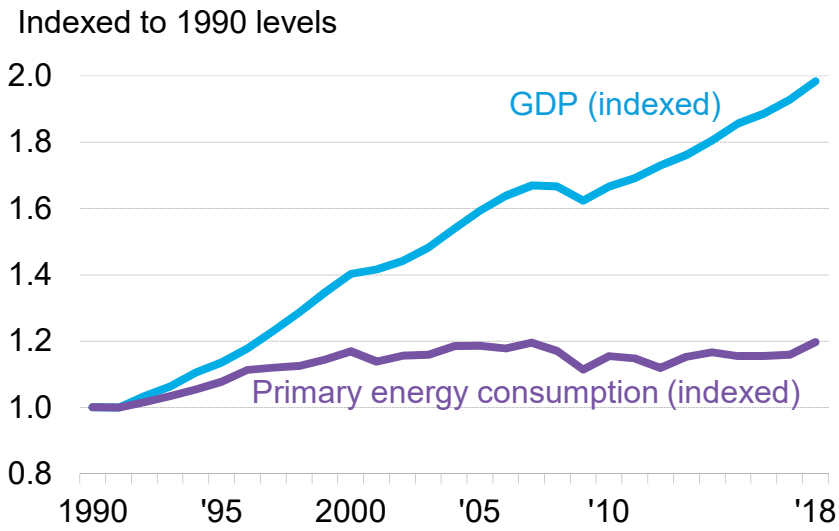
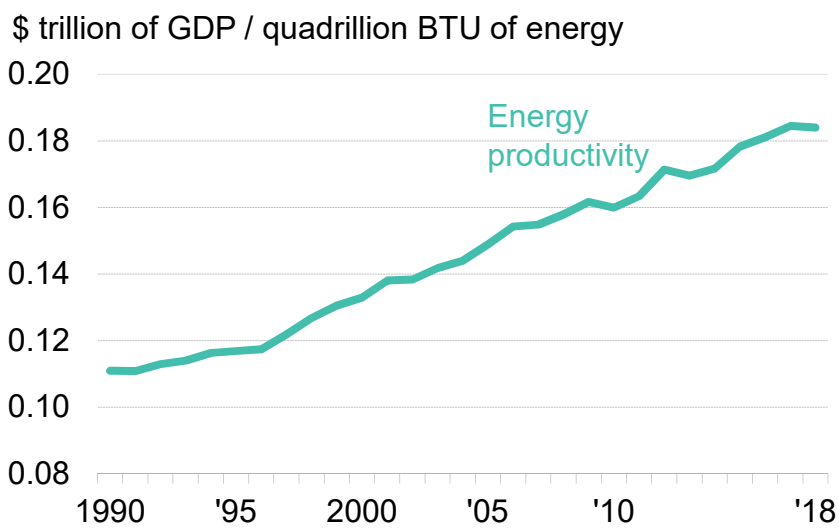
U.S. energy overview: Economy's energy productivity

U.S. GDP and primary energy consumption



U.S. energy productivity



Source: Bureau of Economic Analysis, EIA, Lawrence Berkeley National Laboratory, BNEF Notes: Values for 2018 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2018). 2018 GDP estimate is a projection from economists compiled at ECFC <GO> on the Bloomberg Terminal.

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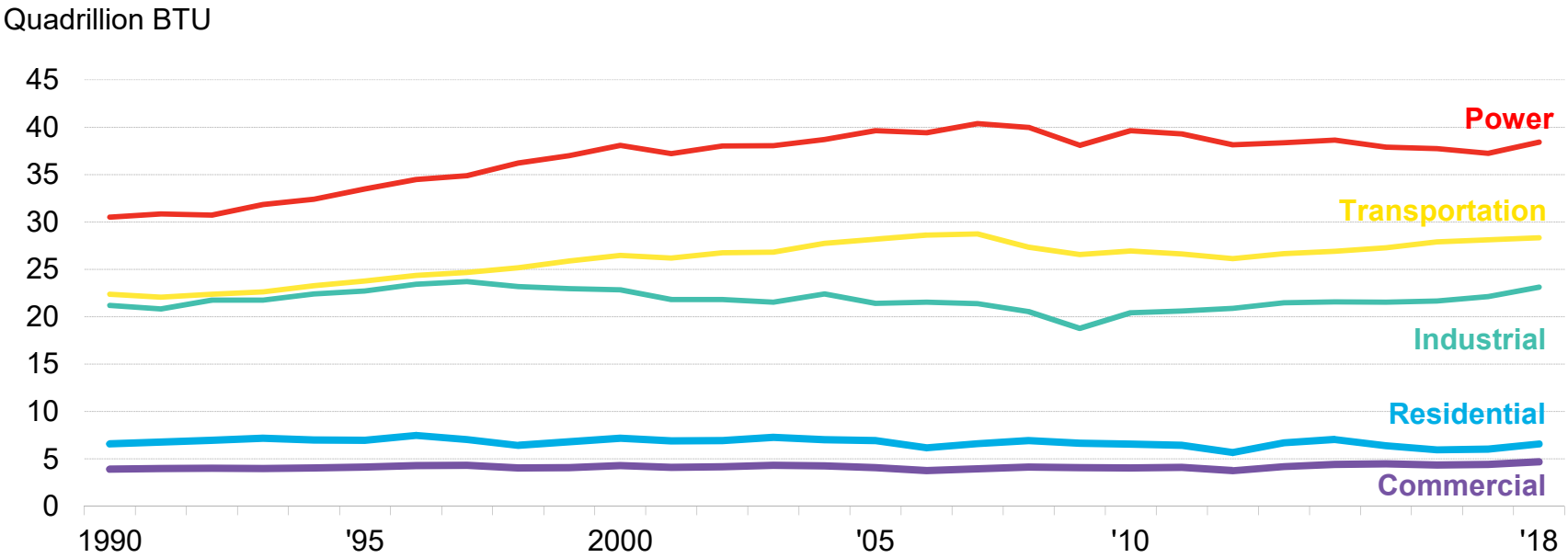
Factbook key findings

- U.S. power continued de-carbonizing thanks to natural gas, efficiency and renewables growth, with coal retirements.
- Employment grew.
- Energy remained affordable by historical standards to consumers.
- Electric vehicle sales gained traction.

But…

- Energy productivity improvements stalled.
- **Energy consumption overall went up.**
- CO2 emissions rose.

U.S. energy overview: Primary energy consumption by sector



Source: EIA, BNEF Notes: Values for 2018 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through September 2018)

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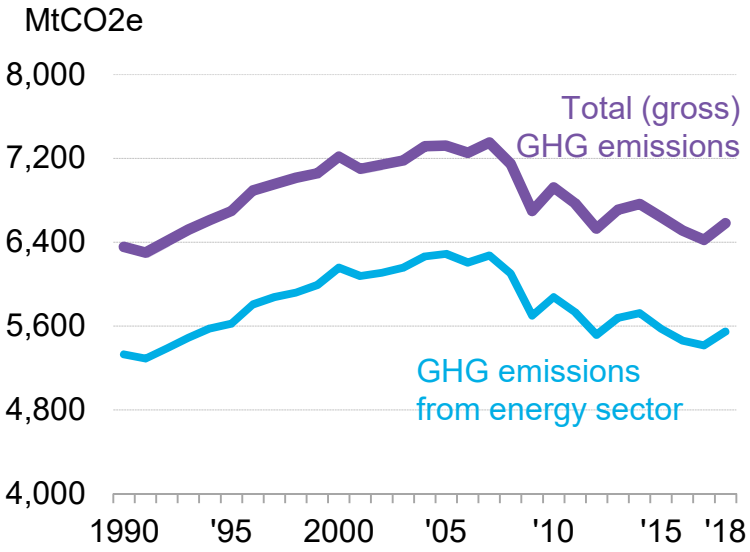
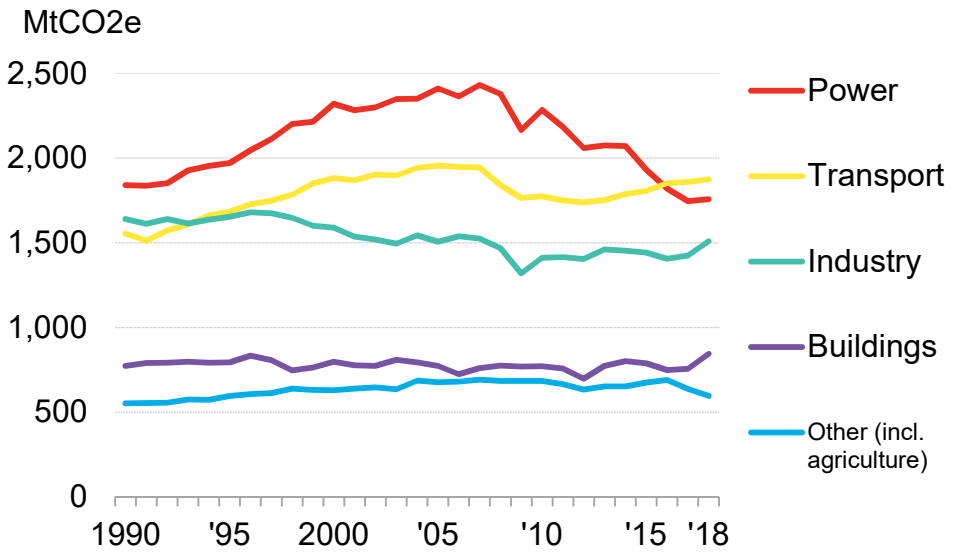
U.S. energy overview: Greenhouse gas (GHG) emissions

Economy-wide and energy sector emissions



Emissions by sector



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.

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2019

Sustainable Energy in America

Factbook

GROWTH SECTORS OF THE U.S. ENERGY ECONOMY

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