AMERICAN PUBLIC POWER ASSOCIATION

80 Years of Powering Strong Communities

SMART DECARBONIZATION

PUBLIC POWER'S CASE FOR GENERATING DIVERSITY AND AFFORDABILITY

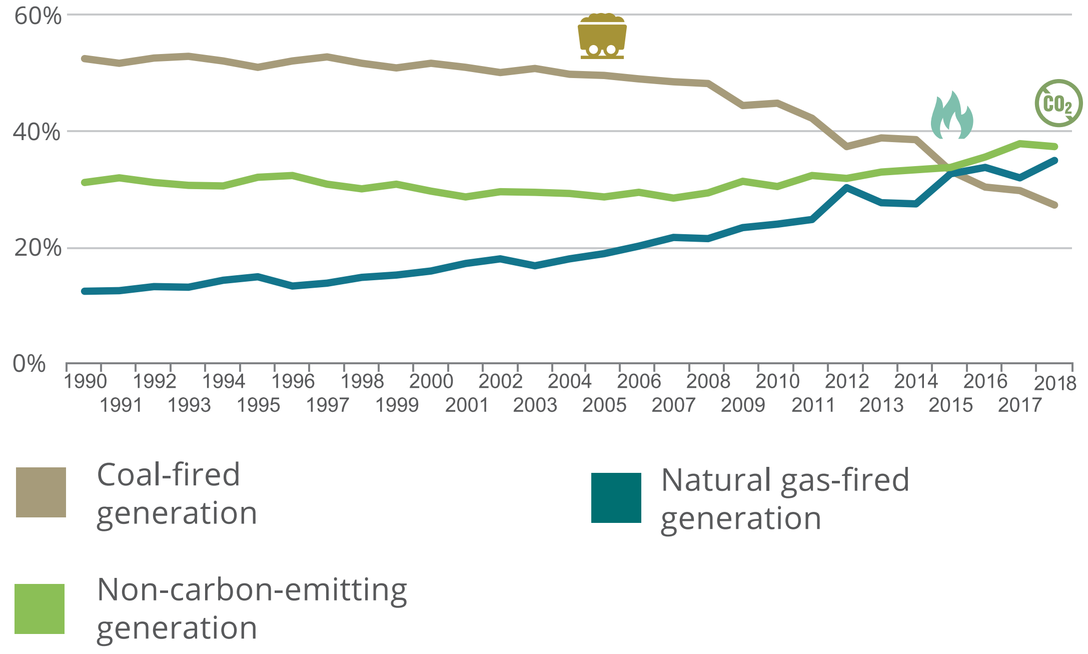
Electric utilities are reducing CO2 emissions

Between 2005 and 2018, total electric generation increased by **4%** and electric sector-related CO_2 emissions declined **25%**

According to the Energy Information Administration, much of this decline can be attributed to the industry's shift from coal to natural gas and other low- or zero-emitting resources.

Click on the icons below for more detail

PERCENT OF TOTAL ELECTRICITY GENERATION



Sources: U.S. Energy Information Administration, *Monthly Energy Review,* October 2019 Table 7.2a, Electricity Net Generation: Total (All Sectors) and Table 10.6, Solar Electricity Net Generation.

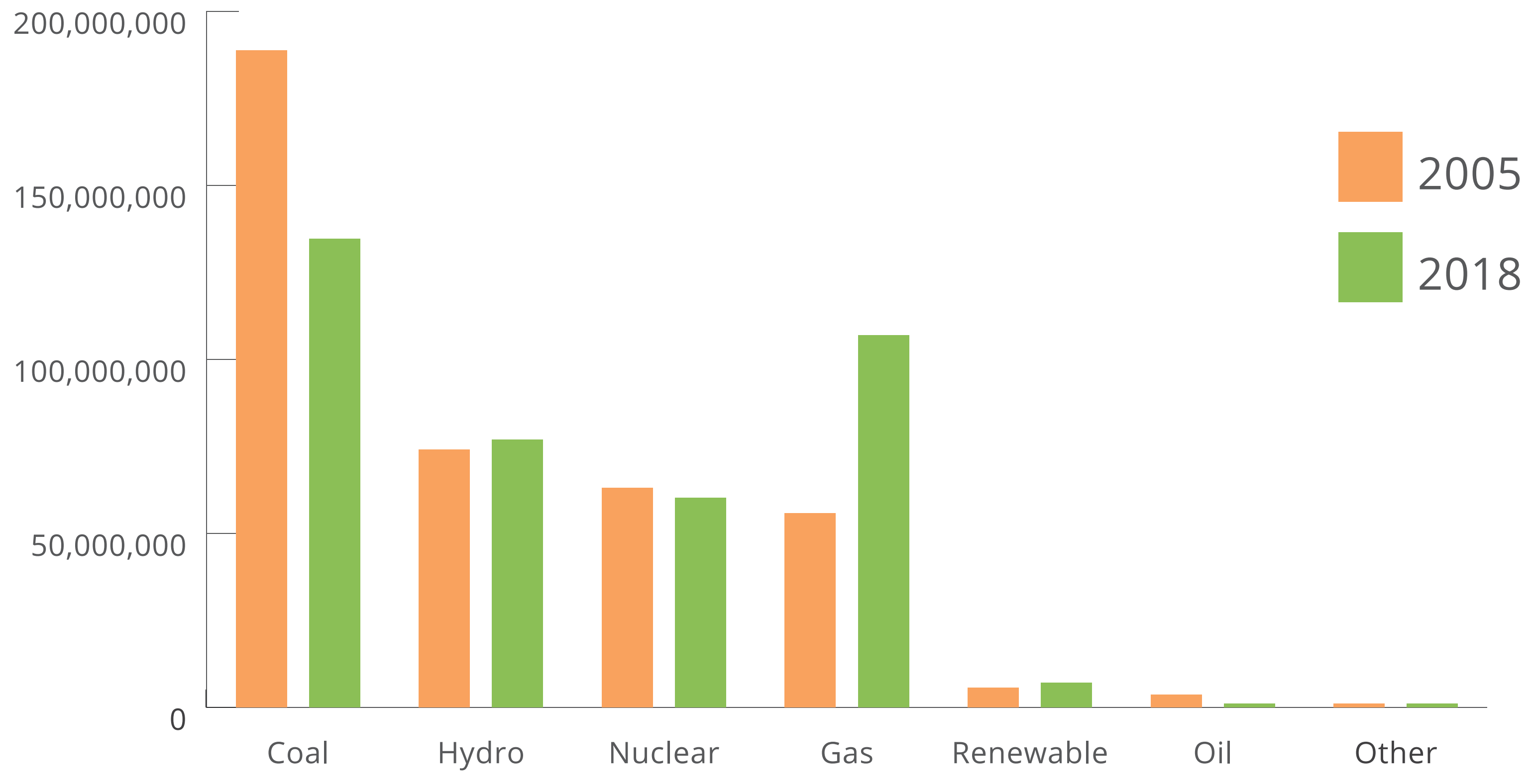
"CO_2 emissions reductions attributable specifically to shifts from coal to natural gas and to non-carbon generation totaled 4,621 [million metric tons] MMmt. Of this total, 2,823 MMmt resulted from decreased use of coal and increased use of natural gas. 1,799 MMmt resulted from decreased use of coal and increased use of non-carbon generation sources."[1]

Public power's generation is also changing

Like the rest of the industry, public power utilities have reduced their emissions. Similar to the industry overall, the primary reason for public power's decline in CO_2 emissions is from switching fuel from coal to natural gas. Public power utilities' generation from coal declined by 40% from 2005 to 2018 (188.8 million megawatt-hours to 134.7 million MWh).

Generation from natural gas for public power has nearly doubled — from 55.8 million MWh in 2005 to 106.8 million MWh in 2018, accounting for more than 27% of all public power generation.

PUBLIC POWER GENERATION (MWH) BY FUEL SOURCE, 2005 VS 2018

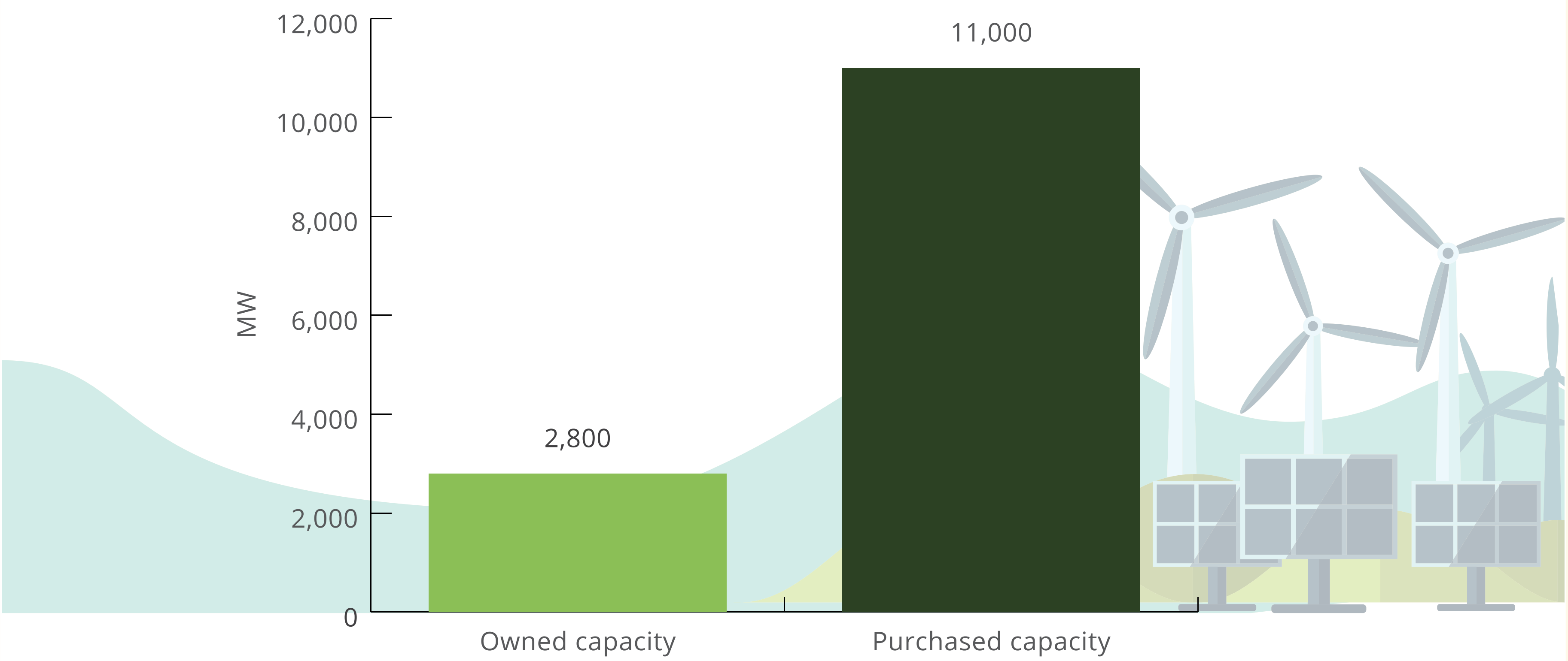


Source: ABB Velocity Suite

Public power's generation mix is only one part of the story

Because public power utilities are exempt from federal taxation, they are unable to take advantage of the solar investment tax credit and wind production tax credit. Therefore, most public power utilities enter into power purchase agreements (PPAs) to take advantage of these robust energy tax incentives, even if they would prefer to directly build, own, and operate their own renewable generation capacity.

PUBLIC POWER'S NON-HYDRO RENEWABLE CAPACITY, 2019

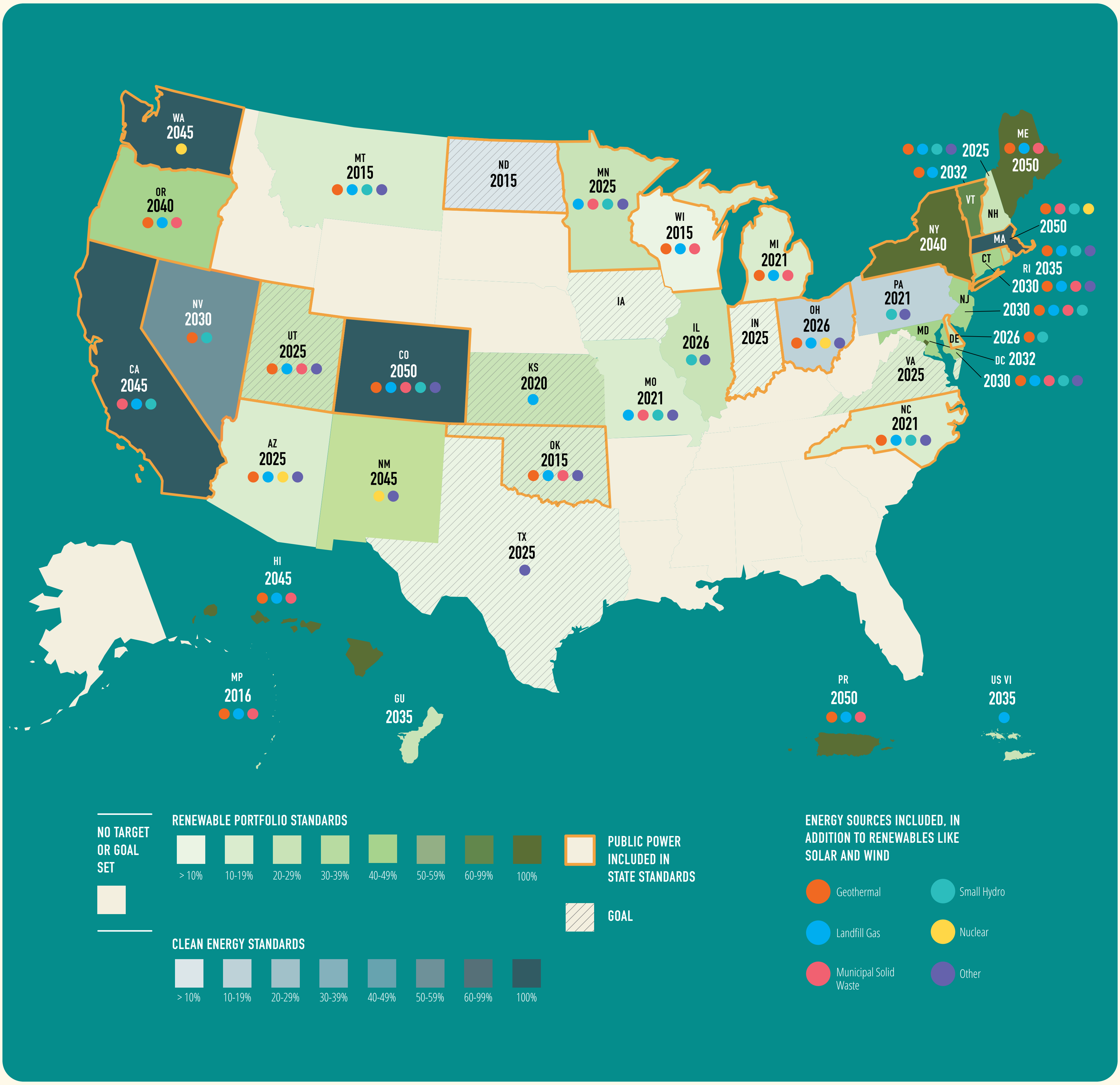


Source: American Public Power Association member survey

Additionally, public power utilities plan to add more than 6,000 MW of renewable capacity either through PPAs or direct ownership over the next five years. About 75% of this capacity will be solar generation.

State and territory targets vary widely

Twenty-nine states plus the District of Columbia have instituted renewable portfolio standards, and another five have developed renewable or clean energy goals. This map shows which resources are included in the targets, the timeline for achieving the target, and which states include public power in the requirements or goals.



The map conveys the variability of these standards and goals, especially in terms of resources allowed. For example, while most states include hydropower as an accepted technology within their mandates, many place limits on its capacity. States also differ on how they treat other types of generation, such as landfill gas.

Among states that have adopted 100% clean energy targets, different fuel resources will be accepted. For example, under Massachusetts' clean energy standard, nuclear and hydroelectric developed after 2010 count toward achieving 100% carbon-free energy by 2050. Nuclear is also included under Nevada's 100% clean energy standard. Almost every other state either excludes nuclear in its clean energy and zero emissions targets, or it is unclear if it will accept the resource.

Some public power utilities and wholesale power providers (e.g., joint action agencies) voluntarily comply with state mandates or established their own goals due to community interest.

What’s included in the resource mix makes a big difference

The three maps below (click the title in the margin to view each) show generation in each state in 2018 (excluding imports and exports). The maps only include utility-scale generation, and do not include distributed generation. These maps help illustrate the progress certain states have made toward achieving theoretical 100% clean energy goals, when different resources are included.

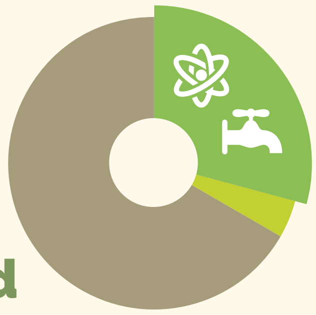
Share of renewable generation, excluding hydropower

Share of renewable generation, including hydropower

Share of non-carbon emitting generation

These maps show how important it is to clarify which technologies qualify in meeting goals or mandates. If hydro and nuclear are excluded, then states will have a lot further to go to achieve their clean energy goals or requirements.

Excluding sources costs more



Achieving deep carbon reductions will be difficult if certain technologies are excluded. About **one-third** of all generation in the United States in 2018 came from a non-carbon emitting fuel source, and **72%** of this generation was produced from nuclear and hydro sources.

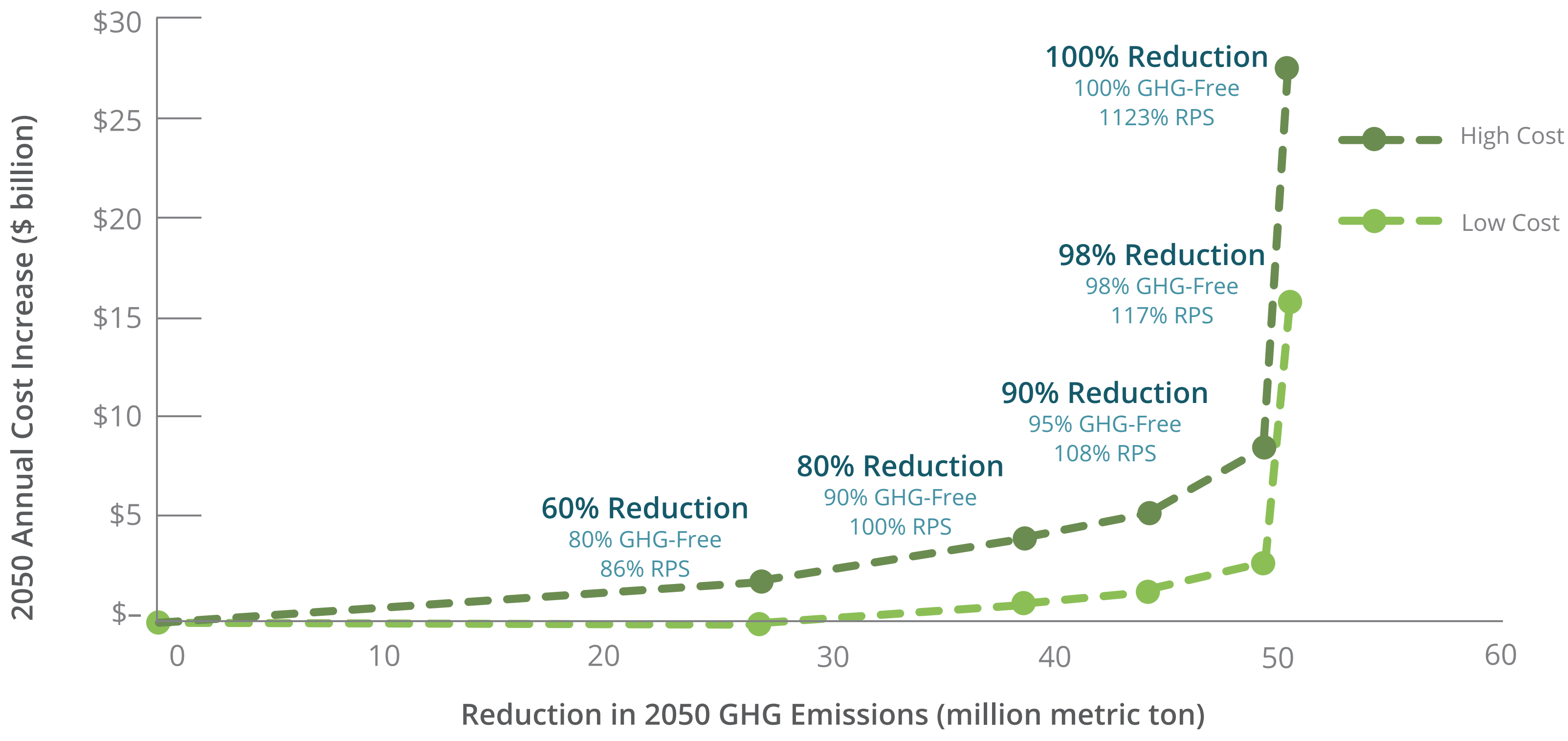
A study conducted in the Pacific Northwest shows how difficult it will be to achieve 100% carbon-free goals without nuclear, hydro, and other options.

> Deep decarbonization of the Northwest grid is feasible without sacrificing reliable electric load service. But this study also finds that, absent technological breakthroughs, achieving 100% GHG reductions using *only* wind, solar, hydro, and energy storage is both impractical and prohibitively expensive. [2]

How expensive? The study projected costs for different carbon reduction scenarios: [3]

Carbon reduction, 1990–2050	Added annual costs	Increase to electric bill
80%	$1–$4 billion	3–14%
98%	$3–$9 billion	10–28%
100% (zero carbon)	$16–$28 billion	100%

Plus, the zero carbon scenario would require an additional upfront investment of $100–$170 billion to build the wind, solar, and storage capacity necessary to replace the last trace of GHG-emitting resources.



Source: *Resource Adequacy in the Pacific Northwest,* March 2019. Energy and Environmental Economics Inc.

The study emphasized the continued need for firm capacity, including natural gas, which would only be called up during reliability events. Other types of zero or low-carbon firm capacity could include new nuclear, fossil fuel-powered plants with carbon capture utilization and sequestration (CCUS), ultra-long duration electricity storage, and carbon-neutral hydrogen or biogas.[4]

The Energy Futures Initiative stressed the need for multiple pathways for decarbonization solutions, noting there is no “silver bullet” technological fix.[5]

Today’s available technologies are insufficient to reach deep decarbonization across all sectors in the long term. Decarbonization policy must support innovation on dual tracks: incremental improvements in existing technologies to meet 2030 targets, and technology innovations with breakthrough potential needed to meet midcentury goals.[6]

EFI also stated that decarbonization, at least in California, cannot be achieved without large scale carbon management. This means CO_2 is "removed from dilute sources (e.g., the atmosphere and oceans) or concentrated sources (e.g., emissions from power plants and industrial facilities) and is then either used for commercial products or stored in geologic formations."[7] The report discussed the potential benefits of CCUS, and noted that the amount of energy needed to capture carbon makes this option very costly.[8]

As challenges of integrating more renewables into the grid increase, so do costs. A different study of the Pacific Northwest noted that while RPS have driven investments in renewables, the focus on renewables excluded other abatement measures, such as energy efficiency and switching fuel from coal to natural gas.[9] Renewable generation also often necessitates building more transmission because renewable capacity is not usually located near load centers.[10] Achieving 80% renewables would require a 56 — 105% increase in long-distance transmission capacity.[11]

Adding capacity has waste and cost implications

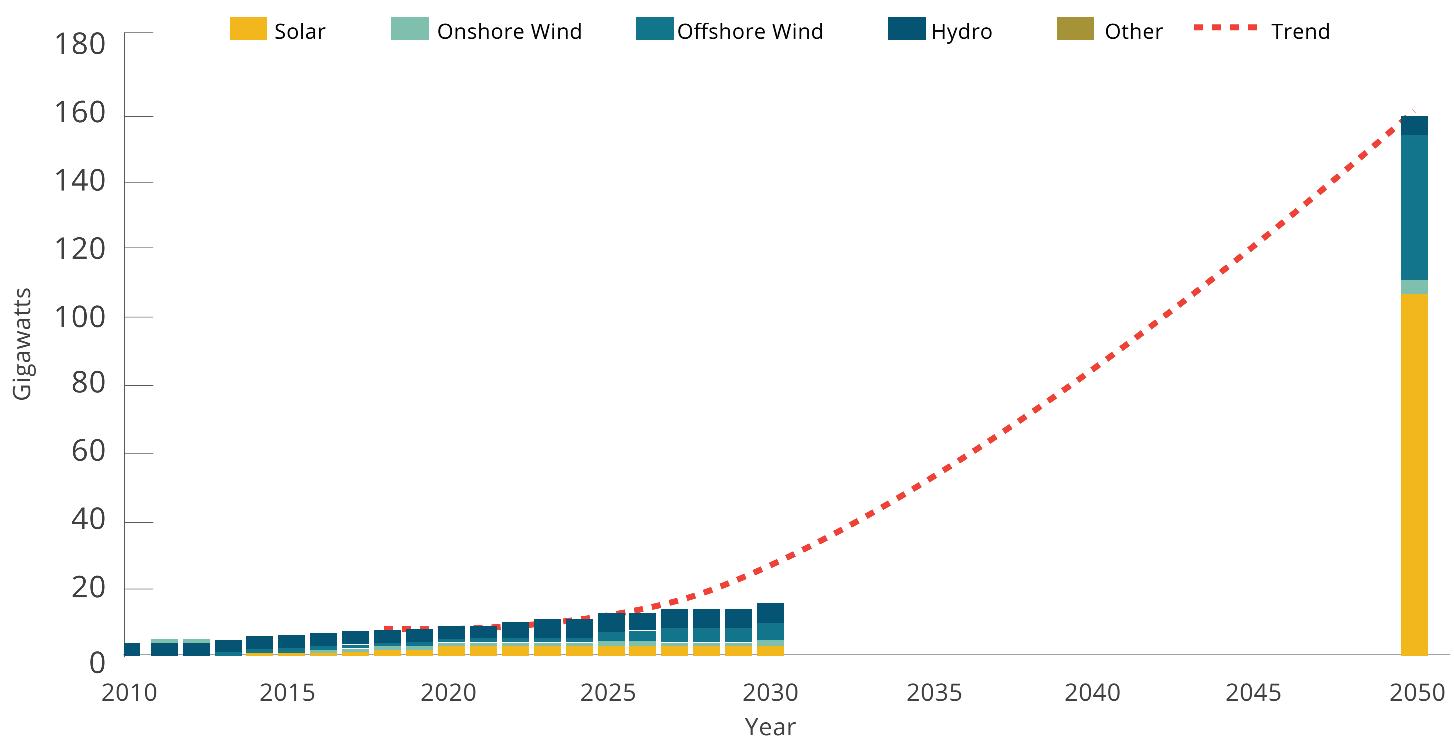
Renewables that produce more energy than can be used also affect costs. Oversupply from ample wind and hydro generation can occur at certain times of the day or even for several days at a time — leading to curtailment of these resources. In an RPS setting, this leads to market distortions and increased prices because curtailing a unit requires the utility to find a replacement to meet its quota. This leads to a resource portfolio that has more renewable generation than is needed.[12]

EFI notes that, assuming demand grows as anticipated (1.27% a year through 2030), meeting California's 60% RPS "will result in 2.8 terawatt-hours of surplus generation over the course of a year."[13] One review of decarbonization studies notes that at 100% renewables, curtailment wastes the equivalent of 40% of current annual U.S. electricity demand.[14]

Conversely, renewable generation is often unavailable when it is needed most. Solar is unavailable during evenings and on cloudy and rainy days, and wind is highly variable. Though energy storage can alleviate many of these concerns, many regions experience lengthy periods when renewable generation is unavailable.

This mismatch between capacity (MW) and generation (MWh) means that significantly more wind and solar capacity has to be constructed than for other forms of generation with higher capacity factors. This will require significant investment, as the following example from New England shows.

CUMULATIVE ADDITIONS OF RENEWABLE POWER IN NEW ENGLAND



Source: *Achieving 80% GHG Reduction in New England by 2050,* September 2019. The Brattle Group.

Additional considerations for public power

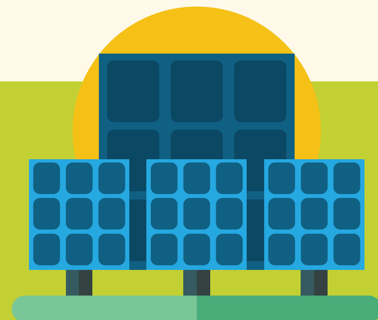
Public power utilities may face challenges — and opportunities — separate from those mentioned above in meeting or setting clean energy goals.

Factors affecting public power goals might include:

- Whether public power utilities are given comparable incentives to the wind PTC and solar ITC
- Finding the right partner to acquire renewable generation via PPA
- If public power utilities have full requirements contracts that stipulate they purchase all generation from a specific entity (which would mean they are unable to enter into renewable PPAs even if they wish to)
- How the costs of transitioning to carbon-free technologies would impact customers, particularly those from disadvantaged communities
- A timeline that would avoid or minimize stranding assets with remaining useful life or that have debt still to be repaid

Examples of public power clean energy strategies

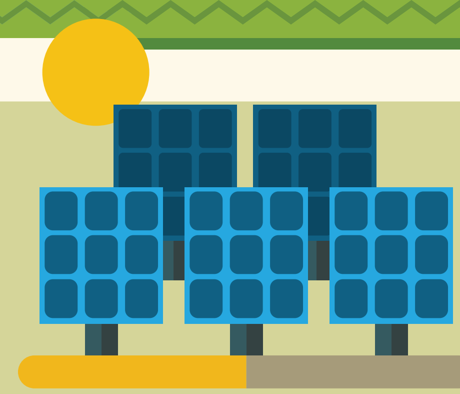
Despite these considerations, many public power utilities have developed strategies to increase their clean energy portfolio.



GOOGLE is purchasing the output of new solar farms in **TVA** service territory totaling 300 MW.

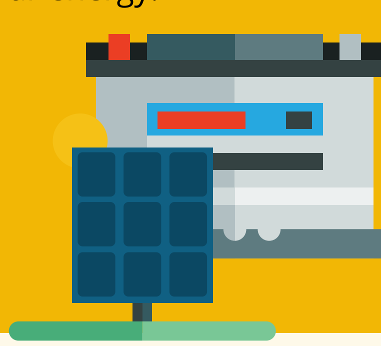
GOOGLE receives 140 MW from a 300 MW wind farm through an agreement with the **GRAND RIVER DAM AUTHORITY**

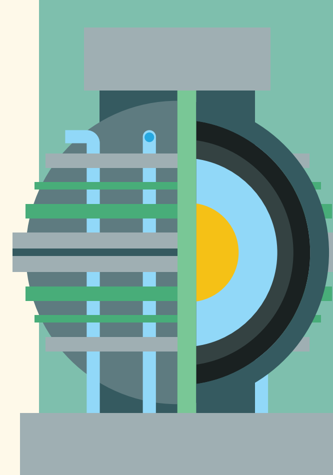
The **OMAHA PUBLIC POWER DISTRICT** developed Rate 261M (high voltage rate) to help **FACEBOOK** acquire 200 MW from a wind project.



SALT RIVER PROJECT and **APPLE** forged a partnership where SRP purchases power generated from a 50 MW solar facility developed by Apple. This power feeds directly into SRP's grid, which also serves Apple.

SRP has also worked with **INTEL** to deliver 100 MW of solar energy.



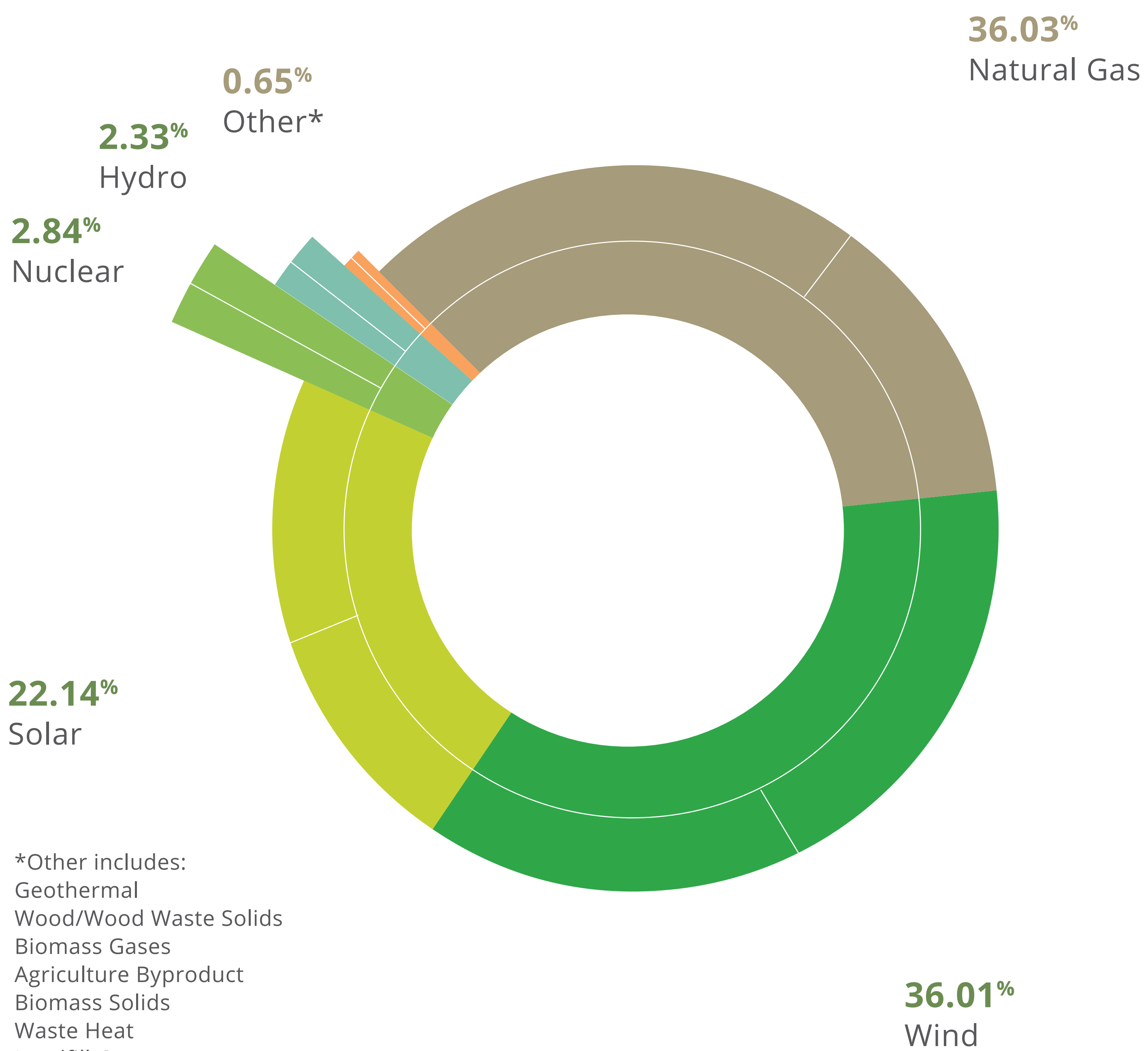


UTAH ASSOCIATED MUNICIPAL POWER SYSTEMS is investigating the feasibility of constructing small modular reactors, a new type of nuclear generation that has a much smaller footprint and allows for greater flexibility.

Electricity is already on a cleaner path

The electric industry is heading toward a future that is less reliant on fossil fuels. While natural gas has the most capacity under construction, more than 60% of capacity under construction or that is permitted to begin construction is zero-emitting.

PERMITTED PLANTS AND PLANTS UNDER CONSTRUCTION, BY FUEL TYPE

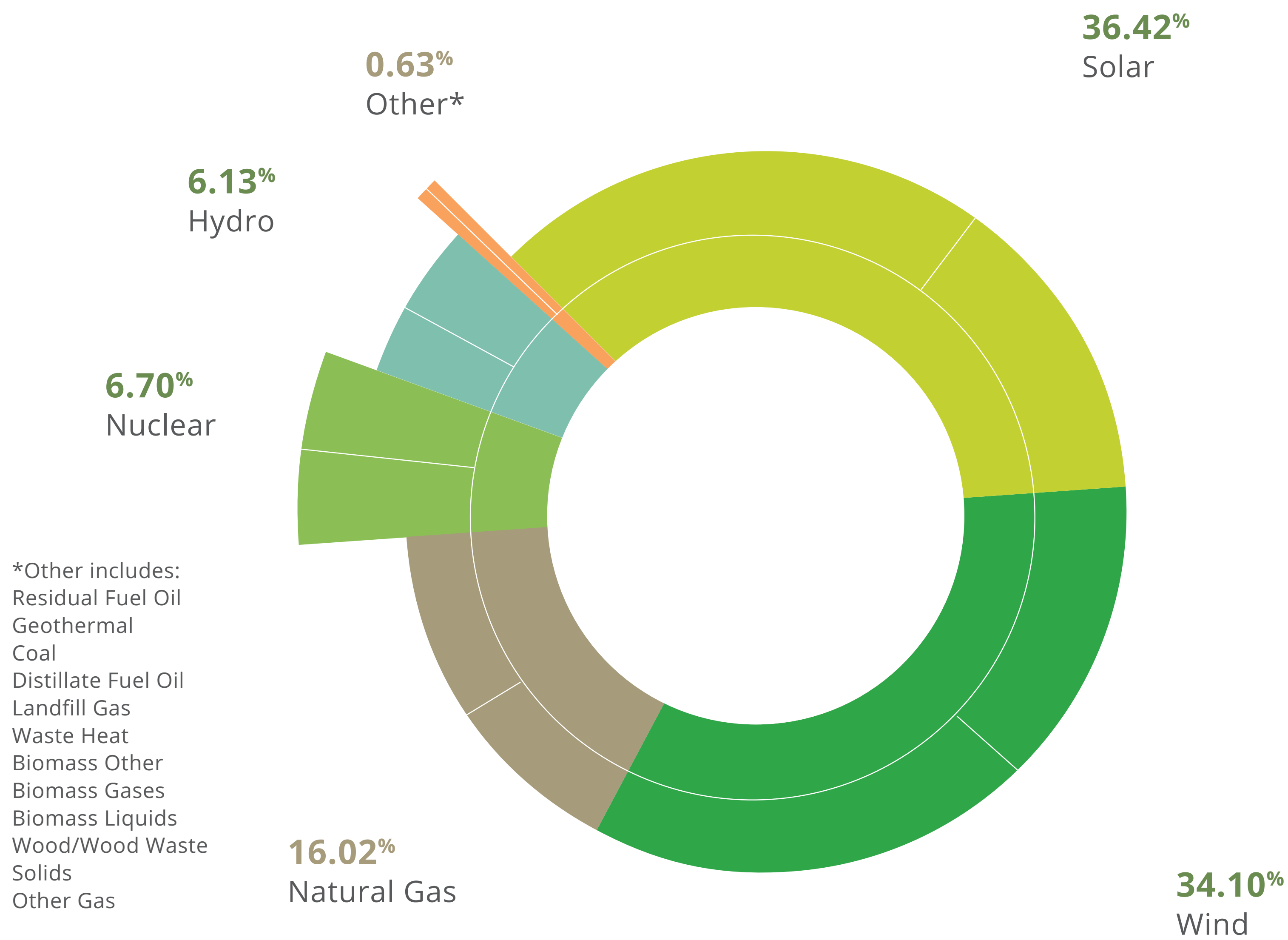


*Other includes:
Geothermal
Wood/Wood Waste Solids
Biomass Gases
Agriculture Byproduct
Biomass Solids
Waste Heat
Landfill Gas
Waste
Distillate Fuel Oil

Source: ABB Velocity Suite

Planned generating capacity is even less reliant on fossil fuels. More than 80% of capacity that has been proposed or is pending application is from non-carbon emitting sources.

PLANTS PENDING APPLICATION AND PROPOSED, BY FUEL TYPE



Source: ABB Velocity Suite

THE ELECTRIC INDUSTRY'S EFFORTS ARE ONLY ONE PIECE OF DECARBONIZATION.
Electricity accounts for 28% of end-use energy in the U.S. Other sectors, especially the industrial and agricultural sectors, will be even more difficult and expensive to fully decarbonize.

Six Considerations for Decarbonization

As communities move along a path to decarbonization, here are some key considerations.

THERE IS A BALANCE BETWEEN DECARBONIZATION AND COST. Higher rates of decarbonized electricity carry increased costs. Utilities and decision-making bodies need to carefully weigh the desire for a carbon-free portfolio with potential increased costs.

CLEAN ENERGY TARGETS THAT EXCLUDE NUCLEAR AND HYDRO ARE NOT REALISTIC. Mandates that exclude these non-emitting fuel resources would make it more difficult to achieve clean energy targets. Intermittent resources cannot be counted on at all times, and so firm resources, including nuclear and, to a lesser extent hydro, will be a necessary component of any clean future.

THE GOAL SHOULD BE EMISSIONS REDUCTIONS, NOT A SPECIFIC RESOURCE MIX. Combating climate change necessitates removing CO_2 from the generation mix as much as possible. Policy decisions should be technology-neutral so that utilities can select from a wide array of options than can achieve emissions reductions.

SOME AREAS OF THE COUNTRY MAY NEED A LONGER GLIDE PATH TO A CLEANER ENERGY FUTURE. Not every state or region is in as strong a position to develop clean energy resources. Economics are also different across the country. Each locality should be able to select the path appropriate to reduce its CO_2 emissions.

DECARBONIZATION SHOULD BE ECONOMY-WIDE, NOT JUST FOR ELECTRICITY GENERATION. The electric sector might be viewed as the "low-hanging fruit" in decarbonization, but 72% of emissions are contributed by other sectors, and decision-makers need to keep this fact in mind as they attempt to achieve emissions reductions.

ELECTRIFICATION CAN PLAY A ROLE IN DECARBONIZATION. As the electric industry continues to move away from fossil fuels, the more sources that are able to move to electricity, the deeper the potential for CO_2 emissions reductions for the entire economy.

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