Sempra Energy®

SHAPING THE FUTURE

A SUPPLEMENT TO OUR 2019 CORPORATE SUSTAINABILITY REPORT

Natural gas and the energy transition

Introduction

Every day, Sempra enables the delivery of energy to over 35 million consumers, and we understand the critical role our infrastructure will play as we transition to an energy system that is lower carbon. The development of a lower-carbon energy system will result in dramatic changes in that system over the next 30 years. Those changes will likely include:

- Shifting to natural gas from coal;
- Enabling and maximizing wind and solar energy;
- Adding hydrogen from renewable resources to the energy mix;
- Using waste to generate energy; and
- Deploying new and emerging technologies, such as carbon capture, utilization and storage.

Natural gas and its infrastructure will play a continuing role in enabling the energy transition and creating a more circular economy[1]. According to many recent studies, optionality and flexibility will be needed for economy-wide decarbonization[2,3]. This includes resources that can be used on demand when seasonal wind and solar power is unavailable. Natural gas is available, affordable and well-positioned to meet this need.

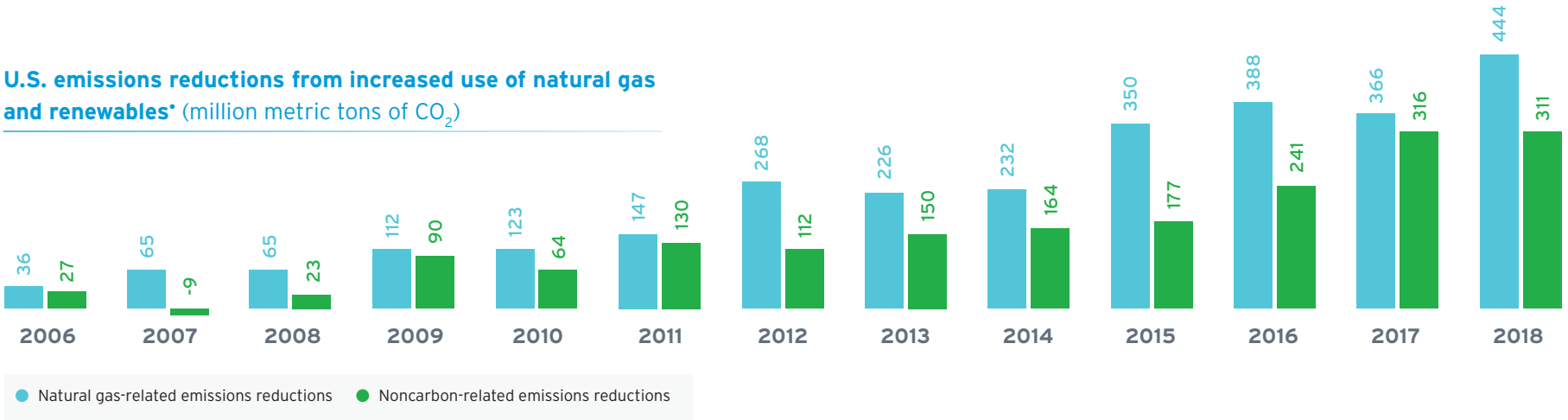
Shifting to natural gas from coal

Coal-to-gas switching in the power sector was the largest driver of the sector's emissions reductions in 2016, accounting for 33% of the reductions[4]. This will continue to reduce emissions in the future.

According to the U.S. Energy Information Agency (EIA), 23% of U.S. electric generation is still produced from coal; a switch from coal to clean burning natural gas can help further drive down emissions within the electric sector.

Coal-to-gas switching in the power sector was the largest driver of the sector's emissions reductions in 2016, accounting for 33% of the reductions[4]. This will continue to reduce emissions in the future.

U.S. emissions reductions from increased use of natural gas and renewables* (million metric tons of CO_2)

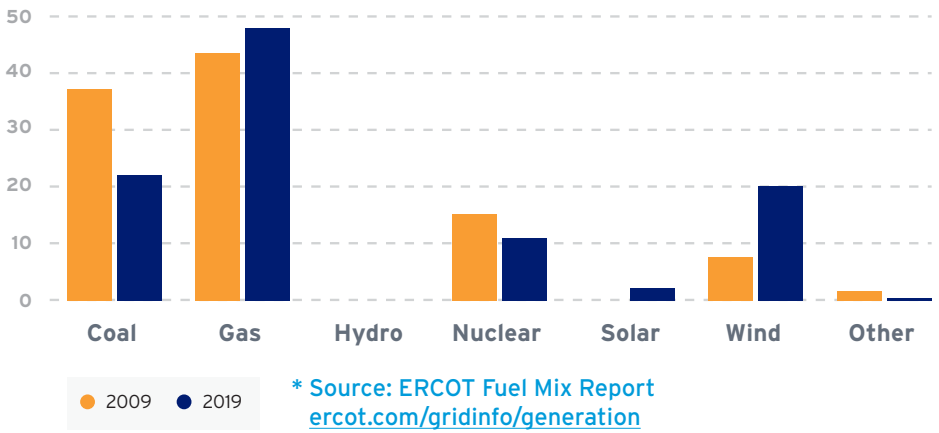


U.S. power sector emissions reductions. Note that natural gas has had a greater impact than renewables in reducing these emissions.
* Source: U.S. Energy Information Administration's Monthly Energy Review, October 2019 *eia.gov/totalenergy/data/monthly/archive/00351910.pdf*

Enabling and maximizing wind and solar energy

Natural gas has and will continue to play an important role in the increased use of solar and wind energy. These renewable energy resources are intermittent – they must be used when the sun is shining or the wind is blowing. Once the sun begins to set or the wind dies down, solar and wind production decreases and natural gas fills the gap. Additionally, natural gas generation provides the majority of California's nighttime load, critical when high temperatures cause customers to use energy-intensive air conditioning units. Natural gas supports renewables by providing the flexibility for intermittent wind and solar resources to be seamlessly added to the grid without service interruptions to customers. Texas provides a strong example of this relationship: the state is now number one in the U.S. for wind power – an achievement made possible, in part, by the availability and growth of natural gas generation: Natural gas fills the gap when renewable resources are not available.

Electric Reliability Council of Texas (ERCOT), percent of fuel mix*



* Source: ERCOT Fuel Mix Report
ercot.com/gridinfo/generation

Data from the California Public Utilities Commission (CPUC) provides another example. It shows that as Californians use more renewable electricity, the state will actually need more gas, not less, to serve as backup[5]. In other words, even though Californians are using less natural gas overall, when renewables aren't available, they need significant amounts of gas to quickly fill that gap when it occurs.

There are also times when demand for electricity is lower than the amount being produced by wind and solar resources. When this happens, the wind or solar resources must be curtailed or sold to neighboring states to avoid damaging the grid. This overgeneration of wind and solar resources can happen during the day or seasonally. During spring and fall when temperatures are mild, production of renewable energy often exceeds the demand.

California provides a good example of this. In 2019 in California, nearly one million megawatt hours (MWh) of solar and wind energy were curtailed – enough to power 84,000 homes for one year. During the first two months of 2020, the amount of curtailed electricity increased by 100,000 MWh per month[6]. To avoid damaging the grid, California either pays other states to take its excess wind and solar electricity or curtails generation, stopping production exactly when it is most available.

In 2019 in California, nearly one million megawatt hours (MWh) of solar and wind energy were curtailed – enough to power 84,000 homes for one year.

Adding hydrogen from renewable resources to the energy mix

Because of the importance of wind and solar energy resources to a lower-carbon energy system, we need to find ways to store the energy so that it can be used when needed. Battery storage is often thought of as the solution, and it will certainly play an important role. But even with advances in battery technology, batteries alone cannot replace the need for long-duration renewable energy storage solutions. This is where existing gas infrastructure can serve an important role.

A technology known as Power-to-gas (P2G) is being deployed throughout the world as a complimentary storage solution to batteries. P2G works by taking the electricity generated from solar and wind, combining it with a small amount of water and running it through electrolysis. This process converts the electrical energy into chemical energy, splitting the water molecule into pure hydrogen and oxygen. The hydrogen can either be used as a fuel or it can be blended with natural gas and delivered to customers through the natural gas system.

In its pure form, hydrogen is a zero-emissions fuel. When blended with natural gas, it reduces the carbon content of the natural gas supply. The expanded use of this technology, used in concert with the existing natural gas distribution system, has the potential to boost the use of wind and solar power both nationally and globally. Working with researchers at the University of California, Irvine, SoCalGas has demonstrated the fraction of renewable power used by the campus microgrid could increase tenfold, from 3.5 percent to 35 percent, by using a P2G strategy.

P2G is a proven technology. At the end of 2019, 64 P2G projects were in operation including a 6 MW project in Germany[7]. In August 2020, Siemens launched a 1 MW green hydrogen production project in China[8].

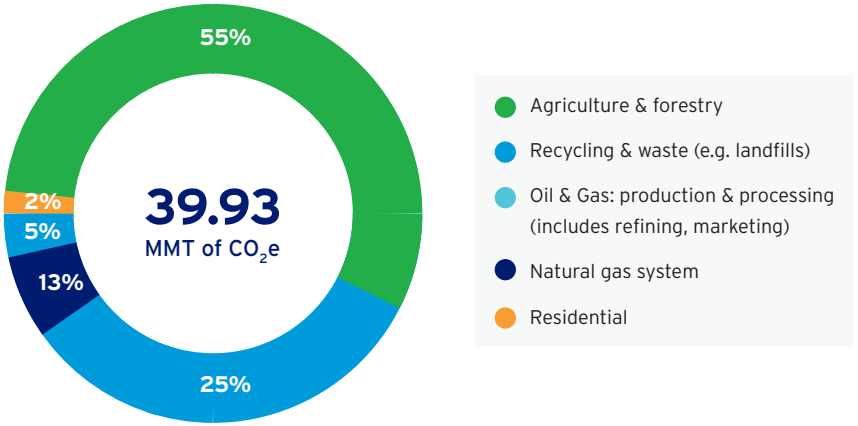
This July, the European Commission released a report titled "A hydrogen strategy for a climate-neutral Europe" in which they outline their strategy around the use of hydrogen as a key priority to achieve the European Green Deal and Europe's clean energy transition. The report lays out key targets, including a 40GW target for the deployment of P2G capacity in the EU by 2030[9].

Using waste to generate energy

The natural gas system can also play an important role in supporting the more continuous use of resources and the elimination of waste by reducing the release of methane emissions from the decomposition of organic matter in our waste streams. With 21 times more global warming potential than carbon dioxide, methane is a potent greenhouse gas. It is being released directly into the atmosphere in large and increasing quantities, with agriculture and waste contributing 56% of anthropogenic (caused by human activity) emissions[10]. In California alone, these sectors were responsible for over 75% of the methane emissions in the state, or approximately 30 million tonnes of CO_2e in 2017[11].

This methane can be used to generate energy as renewable natural gas or RNG. Once processed to pipeline quality, the emissions from our waste streams can be used exactly as conventional natural gas and distributed using the existing natural gas distribution pipeline system. At scale, this would prevent the release of hundreds of millions of tons of methane emissions.

California Air Resources Board 2017 Methane Inventory*



* Source: CARB's greenhouse gas emission inventory, arb.ca.gov/app/ghg/2000_2017/ghg_sector_data.php

RNG is playing an increasingly important role in the energy transition. In California, a 2016 law (SB 1383) requires a 40% reduction in methane emissions below 2013 levels from waste sources such as landfills and dairies, with provisions to deliver that energy to consumers. Also in California, SB 1440, passed in 2018, requires the CPUC to consider adopting RNG targets or goals for natural gas utilities. Oregon recently enacted legislation allowing its natural gas utilities to purchase RNG on behalf it its customers, with the goal of replacing 15% of traditional natural gas with RNG by 2030. And Colorado and Hawaii are also considering legislation to reduce carbon emissions through the use of RNG.

In just 20 years, there could be enough RNG available in the U.S. to replace up to 90% of the nation's current residential natural gas consumption, according to a recent American Gas Institute study conducted by ICF[12]. Additionally, a January 2020 study by the Lawrence Livermore National Laboratory identified capturing and converting the methane emissions from waste biomass as part of the RNG process as one of three pathways that could allow California to physically remove 125 $MMtCO_2$ from the atmosphere per year. This is the amount that must be removed to achieve the state's goal of carbon neutrality by 2045[13].

Companies including UPS, Frito-Lay, Smithfield Foods, and Williams Companies as well as the University of California and other educational institutions have also announced the use of the fuel to help achieve their carbon reduction goals. Industry group The Coalition for RNG lists 130 operational projects in the U.S., with 110 additional projects either under construction or substantial development[14]. The public health and environmental benefits of replacing diesel with RNG as a transportation fuel are quite significant.

SoCalGas is focused on becoming the cleanest gas utility in North America and committed to replacing 20% of the traditional natural gas delivered to its core customers* with renewable natural gas by 2030.

** Core customers are residential customers, vehicle fueling stations, and certain nonresidential business customers as described in Rule 23. Requires CPUC approval.*

Deploying new and emerging technologies, such as carbon capture, utilization and storage

Beyond these significant benefits, new and emerging technologies such as carbon capture, utilization and storage (CCUS) can provide further benefits by substantially reducing greenhouse gas emissions from major industrial operations like power plants or factories. CCUS involves the capture of carbon dioxide (CO_2) from fuel combustion or industrial processes. The CO_2 can be used as a resource to create valuable products or services or can be permanently stored underground.

The U.S. Department of Energy (DOE) recently announced approximately $110 million in federal funding for cost-shared research and development (R&D) projects related to CCUS[15]. SoCalGas is involved in 21 CCUS research, design and development (RD&D) projects, including geological sequestration and direct air capture projects. One project uses methane pyrolysis technologies (the use of high temperatures to change the chemical composition of methane) to produce carbon nanomaterials from natural gas. These nanomaterials can be used in a variety of biomedical applications and can be valued at up to $600.00 per gram, depending on application.

In conclusion, natural gas will continue to play an important role in driving the energy transition as we reshape the energy system to lower carbon emissions and achieve carbon-neutral objectives.

[1] As defined by the World Economic Forum, a circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models.

[2,3] Studies conducted by Energy Futures Initiative, Inc, and led by Dr. Ernest Moniz, former Secretary of Energy under the Obama Administration
news.mit.edu/2018/adding-power-choices-reduces-cost-risk-carbon-free-electricity-0906
static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/5cd04bf2104c7b911cec485b/1557154802835/EFI_CA_Decarbonization_FactSheet.pdf

[4] carbonbrief.org/analysis-why-us-carbon-emissions-have-fallen-14-since-2005
pv-magazine-australia.com/2020/03/20/two-solar-and-one-wind-farm-in-north-queensland-could-be-curtailed-to-zero/

[5] cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/News_Room/NewsUpdates/2020/Session%204%20Hydraulic%20Modeling%20Updates%202020%20Workshop%203-slide%20deck-final.pdf

[6] caiso.com/informed/Pages/ManagingOversupply.aspx
sempra.com/renewable-natural-gas-now-flowing-socalgas-pipelines-calgren-dairy-digester-pipeline-cluster

[7] powermag.com/why- P2G-may-flourish-in-a-renewables-heavy-world/

[8] worldoil.com/news/2020/8/19/siemens-energy-launches-its-first-megawatt-green-hydrogen-production-project-in-china

[9] ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf (Page 2)

[10] The Global Methane Budget 2000-2017 - essd.copernicus.org/articles/12/1561/2020/

[11] arb.ca.gov/cc/inventory/background/ch4.htm

[12] gasfoundation.org/2019/12/18/renewable-sources-of-natural-gas/

[13] climatechangenews.com/2019/06/14/countries-net-zero-climate-goal/
livermorelabfoundation.org/2019/12/19/getting-to-neutral/

[14] rngcoalition.com/rng-production-facilities

[15] energy.gov/articles/us-department-energy-announces-110m-carbon-capture-utilization-and-storage

For more information on Sempra Energy's sustainability efforts, please visit www.sempra.com/sustainability or email us at sustainability@sempra.com.

Sempra Energy®