EN1: Decarbonize Electricity Generation

Brief Summary:
This measure would focus on lowering carbon emissions by switching the fuel sources used in electricity generation. The measure would promote and expedite a transition away from fossil fuels used in electricity generation (i.e., natural gas) to a greater reliance on renewable energy sources (e.g., wind, solar). In addition, this measure would promote an increase in cogeneration, which results in useful heat in addition to electricity generation from a single fuel source.

Purpose:
The purpose of this control measure is to reduce emissions of criteria pollutants, toxic air contaminants and greenhouse gases (GHGs) in the generation of electricity.

Source Category:
This measure affects electricity-generating power plants in the Bay Area.

Regulatory Context & Background:
Power plants generate electricity via a variety of fuel sources – fossil fuels (most commonly coal or natural gas), renewables (e.g., solar and wind) or other sources (e.g., nuclear). In addition, cogeneration, also referred to as combined heat and power (CHP), is the simultaneous generation of useful heat and electricity from a single fuel source. As such, CHP systems result in more "use" from a fuel source than non-CHP systems and thus increase the total efficiency of the fuel source.

As shown in Table 1, as of April 2016, nearly 85 percent of the electricity generation capacity in the Bay Area is from fossil-fueled power plants, all from natural-gas plants (CEC 2016).[1] Renewable fuel sources account for the remaining capacity (over 15 percent), with the majority of this capacity coming from wind power (nearly 13 percent). While renewable plants contribute a modest portion of the energy-generation capacity in the Bay Area, plants fueled by renewable sources account for the majority of physical electricity-generating facilities in the Bay Area (nearly 72 percent). Lastly, while nearly 64 percent of natural-gas plants in the Bay Area are CHP facilities (28 of 44), the electricity-generation capacity of these CHP plants represents less than 16 percent of the total capacity of these plants (1,011 MW of 6,351 MW).

[1] There are also ten peaker plants in the Bay Area, only used for power generation when there is high demand. These plants, all fueled by natural gas, have a total capacity of just over 775 MW.

Table 1. Electricity Generation Capacity in the Bay Area by Fuel Source

Fuel Source	Capacity (1) *MW (%)*	Plants	
		# (%)	**CHP facilities** (MW/#)
Fossil Fuels			
Natural gas	*6,351 (84.8%)*	*44 (28.4%)*	*1,011/28*
Fossil Fuels Sub-total	**6,351 (84.8%)**	**44 (28.4%)**	**1,011/28**
Renewables			
Wind	*954 (12.7%)*	*25 (16.1%)*	*-/-*
Solar	*109 (1.5%)*	*68 (43.9%)*	*-/-*
Digester or Landfill Gas	*65 (0.9%)*	*13 (8.4%)*	*13/3*
Hydroelectric	*15 (0.2%)*	*5 (3.2%)*	*-/-*
Renewables Sub-total	**1,143 (15.2%)**	**111 (71.6%)**	**13/3**
TOTALS			
	7,494	**155**	**1,024 /31**

Note:

1. Capacity total is 100.1 percent due to rounding.

As the regional agency responsible for protecting air quality in the Bay Area, the Air District has the authority to adopt regulations and rules to limit air emissions from stationary sources. As such, power plants must request and be granted an authority to construct and a permit to operate from the Air District that outlines the operating conditions of and emission limits at each facility. Among the permit requirements required by the Air District is the condition that combustion equipment – such as gas turbines and heat recovery boilers – use the Best Available Control Technology (BACT) to minimize emissions. In addition, projects may be subject to emission offset requirements, Prevention of Significant Deterioration (PSD) analysis requirements, and health risk screening analysis (HRSA) requirements.

Electricity is delivered to residential and commercial customers in the Bay Area via a mix of investor-owned utilities (IOU), publically-owned utilities (POU) and community choice aggregators (CCA). The dominant electricity provider in the Bay Area is the IOU Pacific Gas and Electric (PG&E). Two examples of POUs are the municipal electric utilities Alameda Municipal Power, which provides electricity to residents and businesses in the city of Alameda, and Silicon Valley Power, which provides electricity to residents and large corporations such as Yahoo in the city of Santa Clara. CCAs are growing in popularity. A CCA is a system that allows cities and counties to aggregate the buying power of individual customers within a defined jurisdiction in order to secure alternative energy supply contracts on a community-wide basis. As of mid-2016, the three operational CCAs in the Bay Area are Marin Clean Energy (MCE), serving Marin County, unincorporated Napa County and the cities of Benicia, El Cerrito, Richmond and San Pablo, Sonoma Clean Power (SCP), serving a number of cities in and unincorporated areas of Sonoma County, and CleanPowerSF, serving San Francisco City and County.

California, with its abundant natural resources, has a long history of supporting the development and utilization of renewable energy. For example, following deregulation of the electric utilities in California in 1998, the California Energy Commission (CEC) was placed in charge of a new Renewable Energy Program to help increase total renewable electricity production statewide. Among the various elements of the program, market-based incentives were provided for new and existing utility-scale facilities powered by renewable energy. In 2002, California established its Renewables Portfolio Standard (RPS) Program. This program, jointly implemented by the California Public Utilities Commission (CPUC) and the CEC, is one of the most ambitious renewable energy standards in the country. The RPS program required that all electricity retailers in California (including IOUs, POUs, and CCAs) increase procurement from eligible renewable energy resources to 20 percent by the end of 2013, then to further increase renewable procurement to 25 percent by the end of 2016, and 33 percent of total procurement by 2020. Passage of Senate Bill (SB) 350 in September 2015 increased and extended the required procurement from renewable sources to 50 percent by 2030.

Electricity providers in the Bay Area are on track to meet, and in some cases have already exceeded, these RPS goals. For example, PG&E served 29.5 percent of its retail electricity sales with renewable power in 2015, placing it ahead of the 2016 requirement, and has stated that it is well ahead of schedule in meeting the 2020 goal (PG&E 2016a). In addition, PG&E's Solar Choice Program allows customers to purchase 50 to 100 percent of their electricity needs from solar projects created for this program in PG&E's service territory (PG&E 2016b). The CCAs in the Bay Area have exceeded these goals, providing customers electricity generated with 33 percent (SCP), 35 percent (CleanPowerSF) and 50 percent (MCE), or offering for a premium 100 percent renewable energy (all three Bay Area CCAs). Similarly, Silicon Valley Power and Alameda Municipal Power offer customers the option to buy electricity generated by 100 percent renewable sources.

In addition, there are numerous efforts at the State level to promote the development of CHP. For example, ARB's Initial Scoping Plan (2008) outlines a target of 4,000 MW of additional CHP capacity, and an associated reduction of 6.7 MMT CO_2e, by 2020. Similarly, AB 1613, the *Waste Heat and Carbon Emissions Reduction Act*, created a feed-in tariff to incentivize the development of small CHP (no larger than 20 MW). In addition, in 2010, Governor Brown called for an additional 6,500 MW of new CHP capacity by 2030 in his Clean Energy Jobs Plan.

Implementation Actions:

The Air District will:

- Engage with PG&E, municipal electric utilities and CCAs to maximize the amount of renewable energy contributing to the production of electricity within the Bay Area as well as of electricity imported into the region.
- Work with CCA networks (such as LEAN Energy) to explore options for supporting the formation of new CCAs, such as providing start-up funding or credit guarantees.
- Support the development of bioenergy to displace electricity generated from fossil fuels. Track and participate in the state's Bioenergy Interagency Working Group. Engage with stakeholders including dairy farms, forest managers, water treatment facilities, food

processors, public works agencies and waste management to increase use of biomass in electricity production. The Air District's role may be to facilitate pilot testing of new technologies and applications, expedite Air District permitting of biofuel facilities, provide technical analysis, etc.
- Expedite Air District permitting for new, large-scale renewable energy generation facilities, biofuel facilities, and high-efficiency CHP facilities.
- Explore developing grant and/or incentive programs to facilitate, promote and pilot test new renewable energy-based electricity technologies and applications, such as energy storage technology.

Emission Reductions:
Emission reduction estimates are not available.

Emission Reduction Methodology:
N/A

Exposure Reduction:
The decarbonizing of fuel sources used to generate electricity in the Bay Area would result in fewer GHG and criteria pollutant emissions. In addition, as generation of electricity shifts away from fossil-fueled power plants to plants fueled by renewable sources (either because plants are converted or production at these plants is lowered), communities located near fossil-fueled power plants would be exposed to lower levels of criteria pollutants and toxic air contaminants. Moreover, increased efficiencies with CHP would reduce fuel consumption which in turn lowers GHG and criteria pollutant emissions.

Emission Reduction Trade-Offs:
None anticipated.

Cost:
To shift electricity generation at power plants in the Bay Area away from fossil fuels to renewable sources, existing plants would need to be modified and/or new (renewable) plants would need to be constructed. This effort would require considerable upfront capital investment. At the same time, renewable power plants (particularly solar and wind) have considerably lower operational costs than traditional fossil-fuel plants – in part because the "fuel" used is essentially free – such that this initial investment would be returned on a shorter term.

Co-Benefits:
In addition to the emission reduction benefits of decarbonizing electricity generation, a greater reliance on renewable fuel sources has these additional benefits:
- There is an essentially endless supply of many of these resources (e.g., wind and solar), some are generated as byproducts of other industries (i.e., biomass) and others are replenished over time (i.e., hydro).

- Once fully developed, these facilities are much more cost-effective as the fuel source is far cheaper than coal and/or natural gas.
- Power generation from these sources (esp. wind and solar) are isolated from fluctuations in economic markets and are not affected by international political instability.
- There are economic benefits associated with manufacturing and maintaining renewable power plants, keeping businesses and jobs in California.

Additional benefits from CHP include:

- Reduced electricity losses from transmission and distribution along power lines due to electricity and heat being generated on-site.
- Increased reliability for critical facilities, such as hospitals, data centers, prisons, and wastewater treatment plants.

Issues/Impediments:

Fossil-fuel power plants typically generate greater quantities of electricity than renewable plants (e.g., solar and wind farms need substantial amounts of land), so there is the challenge of generating enough electricity to meet demand via renewable sources. In addition, renewable energy sources have issues with the reliability, predictability and consistency of the supply since renewable energy often relies on the weather for its source of power. For example, hydro generators need rain to fill dams to supply flowing water, wind turbines need wind to turn the blades, and solar collectors need clear skies and sunshine to collect heat and make electricity. When these resources are unavailable, so is the capacity to make energy from them. Similarly, the intermittent nature of many renewables renders them non-dispatchable and thus ineffective at responding to changing demand, especially meeting peak demand. As such, developing systems to cost-effectively store this energy for later use is key to improving the viability of renewable energy. Lastly, there are issues with grid reliability and integration associated with the intermittent nature of power generated by way of renewable resources (especially wind and solar).

Sources:

1. California Air Resource Board, *Climate Change Scoping Plan – a framework for change*, December 2008.
2. California Energy Commission, *California Electricity Data, Facts, & Statistics*, California Power Plant Database (Excel File), created on April 12, 2016, website accessed at http://energyalmanac.ca.gov/electricity/ on July 13, 2016.
3. CEC, *California Electricity Producers*, http://energyalmanac.ca.gov/electricity/overview.html.
4. CEC, *California Renewable Energy Overview and Programs*, http://www.energy.ca.gov/renewables/.
5. CEC, *Combined Heat and Power*, http://www.energy.ca.gov/chp/.
6. California Public Utilities Commission, California Renewables Portfolio Standard (RPS), http://www.cpuc.ca.gov/PUC/energy/Renewables/.

7. PG&E, 2016a, *PG&E Achieves Major Renewable Energy Milestone*, http://www.pgecurrents.com/2016/02/25/pge-achieves-major-renewable-energy-milestone/, posted February 25, 2016.
8. PG&E, 2016b, *PG&E's Solar Choice Program*, http://www.pge.com/en/myhome/saveenergymoney/solar/choice/index.page.

EN2: Decrease Energy Use

Brief Summary:
This measure focuses on decreasing energy use in the Bay Area by (1) increasing consumer awareness about energy efficiency through education and outreach and (2) tracking electricity use.

Purpose:
The purpose of this control measure is to decrease the amount of energy consumed in the Bay Area through increased efficiency and conservation. With decreased energy use, less electricity generation is required, and thus there would be a reduction in the emissions of greenhouse gases (GHGs), criteria pollutants and toxic air contaminants (TACs).

Source Category:
This measure affects electricity-generating power plants.

Regulatory Context & Background:
Table 1 indicates the electricity usage in the nine-county Bay Area for the last ten years broken down by non-residential and residential users (CEC 2016). After a sharp increase in electricity usage from non-residential users in 2007 and 2008, non-residential usage fell in 2009 and has gradually climbed since to just under 40 million megawatt hours (MWh) annually in 2014. Residential electricity usage has followed a slightly different pattern, with a one-year peak in 2006 followed by lower usage that gradually increased through 2009, and then slowly declined in the last five years, capped by a sharper drop to under 16 million MWh annually in 2014. Overall, since climbing until a peak in 2008, total electricity usage in the nine-county Bay Area has averaged just over 55 million MWh annually. In addition, over this ten-year period, the split between annual non-residential and residential usage has remained quite constant, with non-residential users accounting for approximately 71 percent of electricity consumption annually and residential users some 29 percent.

Table 1. Electricity Consumption in the nine-county Bay Area (in million MWh)

	2005	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***
Non-Residential	37.4	37.9	40.1	40.4	38.8	38.7	39.3	38.9	39.3	39.7
Residential	15.9	16.5	16.0	16.2	16.3	16.2	16.3	16.2	16.1	15.7
Total	**53.3**	**54.4**	**56.1**	**56.6**	**55.1**	**54.9**	**55.6**	**55.1**	**55.4**	**55.4**

Projections of electricity consumption over the next decade indicate that demand for electricity will increase over this time period as a result of economic and demographic growth (Kavalec 2015).[1] Specifically, in the Bay Area, electricity consumption is expected to increase 0.98 percent annually under a low-energy demand scenario to as much as 1.66 percent annually

[1] This study also considered the effect of other factors – such as electricity rates and the effects of efficiency programs and on-site electricity production - on electricity demand.

under a high-energy demand scenario each year between 2013 and 2025.[2] Statewide, the majority of this annual increased demand would be attributed mostly to growing demand in the residential sector (1.44 to 2.29 percent), more moderate demand growth in the commercial sector (0.97 to 1.79 percent) and limited demand growth (or even decrease) in the industrial sector (-0.42 to 0.44 percent). It is reasonable to expect that demand will continue to increase beyond 2025 along with expected increases in both the population and job numbers in the Bay Area, as shown in Table 2 (ABAG 2013).

Table 2. Total Population and Jobs in the Bay Area: 2005 through 2040.

	2005	***2010***	***2015***	***2020***	***2025***	***2030***	***2035***	***2040***
Population	7,096,500	7,150,739	7,461,400	7,786,800	8,134,000	8,496,800	8,889,000	9,299,100
Jobs	3,449,740	3,385,300	3,669,990	3,987,150	4,089,320	4,196,580	4,346,820	4,505,230

Sources: Numbers from ABAG 2013.

It is important to note that demand for electricity would also grow as a result of increased electrification across sectors (i.e., switching from fossil fuels to electricity as a fuel source), a key component of the Air District's regional GHG-reduction efforts. For example, control measure BL2: Decarbonize Buildings calls for replacing furnaces, water heaters and other appliances in buildings currently powered by fossil fuels with low- and zero-carbon alternatives, including electric-powered options. Similarly, control measure TR14: Cars & Light Trucks promotes the replacement of fossil-fueled vehicles with electric vehicles. While these efforts to increase electrification would result in an overall decrease in GHG emissions, they would also put upward pressure on electricity demand.

At the same time that electricity consumption is expected to increase in the future, emissions of GHGs from electricity generation are actually expected to decrease over this time period.[3] This decline in emissions is largely the result of implemented policies that serve to lower GHG emissions from this sector by increasing reliance on renewable sources to generate electricity, such as the Renewable Portfolio Standard.

This control measure serves to strengthen another important factor in lowering GHG emissions from this sector - reducing energy use. Much of this effort to date has taken the form of energy-efficiency programs, which originated during the energy crisis of the 1970s with the emergence of the concept of "energy conservation" as a means for customers to cope with soaring energy prices (ACEEE 2015). Since that time, despite a decline in energy efficiency programs with utility deregulation in the 1990s, these programs have expanded and are widely regarded as an integral and highly valuable element of utility investments and operations that provide significant energy and economic benefits to both the utility and ratepayers, while also

[2] This forecast is for the Pacific Gas and Electric Company (PG&E) planning area, which extends beyond the Bay Area into more northern, southern and eastern portions of the state. PG&E is the principal electricity provider in the Bay Area.

[3] GHG emissions from the energy sector include emissions from electricity generated and used within the Bay Area, and electricity generated outside the Bay Area that is imported into and used within the region (BAAQMD 2015).

generating jobs and reducing emissions of air pollutants. California's investment in energy efficiency programs has resulted in per capita energy use in California remaining essentially flat since the 1970s, while per capita consumption in the rest of the United States has increased by about 33 percent (CPUC 2015).

Energy efficiency programs in California either focus on achieving in-the-moment demand reductions, or on longer-horizon energy consumption reductions. For example, Flex Alerts, issued by the California Independent Systems Operator (ISO), are urgent, voluntary calls to conserve electricity and shift demand by using major appliances after 6 pm. This program decreases not only energy consumption but also the reliance on peaker plants, which generate electricity only when there is high demand and generally emit more criteria pollutants and GHGs than facilities that run consistently. Longer-horizon programs include Energy Upgrade California, a state initiative to help Californians make investments to save energy and conserve natural resources, help reduce demand on the electricity grid, and make informed energy management choices at home and at work. Regionally, the Bay Area Regional Energy Network (BayREN), a collaboration of the nine Bay Area counties led by the Association of Bay Area Governments, implements a series of initiatives that deliver energy savings such as providing technical assistance to consumers and contractors to retrofit housing units, offering energy-saving rebates for the housing sector, and offering multiple financing options to assist diverse consumers in undertaking energy projects. Locally, cities and counties across the Bay Area have adopted a wide range of policies, including measures in their climate action plans, aimed at increasing energy efficiency such as facilitating energy audits of buildings and promoting energy-efficiency retrofits of existing homes and commercial buildings.

As noted in ARB's 2008 Climate Change Scoping Plan, one of the challenges to fully implementing energy efficiency programs and actions is lack of access by the public, residents and business to information about these programs, their benefits, and how to participate in them. Therefore, while California has a long history of success in implementing regulations and programs to encourage energy efficiency, additional efforts are needed to overcome the information barriers to provide the benefits of increased efficiency to more Californians and, in doing so, help meet California's GHG emission goals. This control measure serves to overcome these challenges.

Implementation Actions:

The Air District will:

- Provide education and outreach about energy-efficiency programs and financing available to local governments, residents, and businesses in the Bay Area.
- Increase consumer awareness about energy efficiency benefits by incorporating this message into existing outreach programs such as Spare the Air, outreach to Bay Area schools, community engagement campaigns, etc.
- Work with partners such as PG&E, municipal utilities and community choice aggregators to develop messaging to decrease electricity demand during peak times.
- Distribute information on state and local energy-efficiency programs to permitted sources.

- Work with local governments to adopt additional energy-efficiency policies and programs, including within climate action plans and other local plans, and to identify resources for tracking building stock information (e.g., square footage, age of buildings) to inform future policy-making.

Emission Reductions:
Due to the uncertain nature of the implementation actions, emission reductions cannot be quantified.

Emission Reduction Methodology:
NA

Exposure Reduction:
Reducing energy use would reduce the need to generate electricity in or import electricity into the Bay Area. As electricity generation drops, communities located near fossil-fueled power plants would be exposed to lower levels of criteria pollutants and TACs.

Emission Reduction Trade-Offs:
This control measure is designed purely to reduce energy consumption, so there would be no direct emission trade-offs. There may be indirect emissions associated with the production and delivery of some energy-efficient technologies.

Cost:
NA

Co-Benefits:
In addition to a reduction in emissions of GHGs, criteria pollutants and TACs, there are a number of co-benefits associated with reducing demand for electricity:
- Improved air quality near power plants (due to reduced production);
- Increased reliability of power supply and cost; and
- Financial savings through reduced energy usage.

Issues/Impediments:
No significant issues or impediments are anticipated due to the voluntary nature of this control measure.

Sources:
1. American Council for an Energy-Efficient Economy, *Energy Efficiency Programs*, http://aceee.org/portal/programs, accessed on September 28, 2015.
2. Association of Bay Area Governments, *ABAG Projections 2009: Regional Projections*, http://www.abag.ca.gov/planning/currentfcst/regional.html.
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4. BAAQMD, 2015, *Bay Area Emissions Inventory Summary Report: Greenhouse Gases Base Year 2011*.
5. Bay Area Regional Energy Network, https://www.bayren.org/.
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7. California Energy Commission, *Energy Consumption Data Management System – Electricity Consumption by County*, http://www.ecdms.energy.ca.gov/elecbycounty.aspx, accessed on January 13, 2016.
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9. Kavalec, Chris, 2015. *California Energy Demand Updated Forecast, 2015*-2025. California Energy Commission, Electricity Supply Analysis Division. Publication Number: CEC-200-2014-009-CMF.