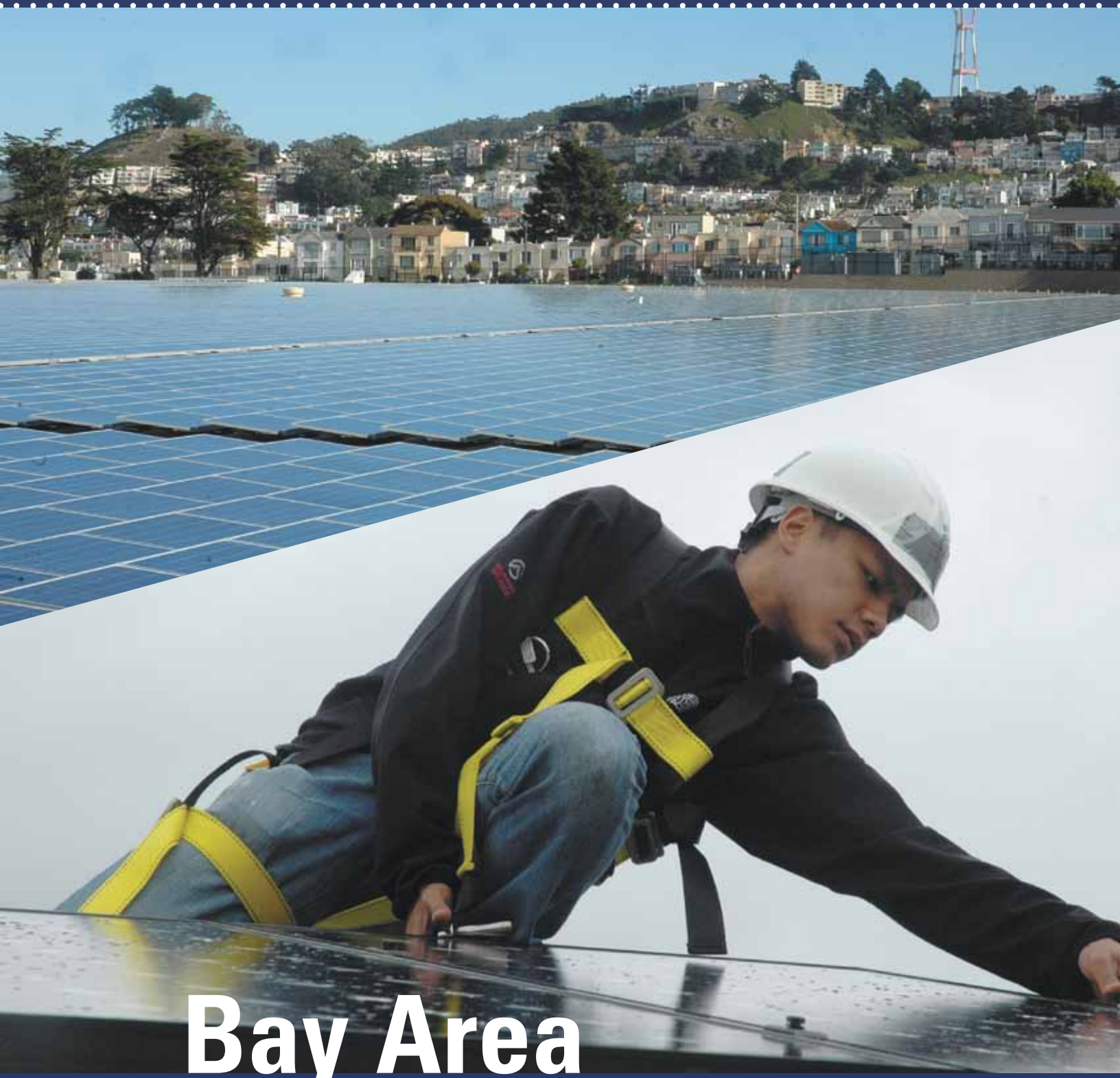

Bay Area Smart Energy 2020

Executive Summary

By Bill Powers, P.E.
Powers Engineering

March, 2012

Download the entire report at www.PacificEnvironment.org/BASE2020

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Executive Summary

By Bill Powers, P.E.
Powers Engineering,
San Diego, California

March, 2012
Executive editor:
Rory Cox
Dedicated to the memory of Charles McGlashan

We would like to thank the following for the donations that made this possible: Jessica Aiona, Deborah Behles, Krista Brown, Allan Dahlquist, Linda Dardarian and Terry Carroll, Barbara Hanscome and Matthew Mumper, Ed Mainland, Shani Kleinhaus, John Schulteis/Renewable Operations, Kirsten Schwind, Toni Smith, Elizabeth Stampe, and Al Weinrub.

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Forward

THE WINDOW OF OPPORTUNITY TO BUILD the energy future of California is wide open. In 2011, Governor Jerry Brown called for a 33 percent renewable portfolio standard by 2020, AND for over half of that generation to come from locally generated, "distributed" power sources. As this is an unprecedented goal in the US, the Governor is seeking advice. And that is why *Bay Area Smart Energy 2020* is needed now.

Bay Area Smart Energy 2020 is a roadmap to rapid, cost-effective conversion to clean energy that relies on local resources. Our region is the right place to build the grid of the future. The San Francisco Bay Area is one of the world's leading centers of clean energy innovation and environmental awareness. The region has a long tradition of environmental leadership dating back to John Muir, and the Bay Area is host to technology leaders, progressive venture capitalists, effective government, environmentally-oriented labor leadership, and hundreds of leading environmental and social justice organizations.

Silicon Valley is a lightning rod for clean energy innovation, hosting countless companies that are developing cutting edge technologies in solar, wind, and energy efficiency, along with the software and integration technology to make it all work. Many of these successful and promising companies were jumpstarted with billions of dollars from local venture capitalists.

Regional academic institutions like UC Berkeley, Lawrence Berkeley National Lab and Stanford are leading the way in clean energy research, while our elected leaders regularly support laws and programs to incentivize a cleaner, greener environment. The concept of "green collar jobs" has caught fire in the Bay Area, thanks to the vision of groups like the Oakland-based Ella Baker Center and local leaders like Van Jones. Progressive labor leaders have strongly supported California's landmark climate change laws, understanding that clean energy is the growth industry of the 21st century.

Despite these promising Bay Area conditions, however, less than 20 percent of our region's electric power today comes from truly clean sources. Amazingly, clean energy is too often under attack, with many politicians across the US working to undermine clean energy incentive programs, while offering no solutions to solve climate change or put people back to work.

If we build it, we will win. As this report demonstrates so well, the tools and technology already exist and are becoming more efficient, sophisticated and cost-effective. By developing local, clean energy projects and production, we will put people to work, reinvigorate our regional economy, and build a truly healthy and sustainable energy future.

Let's get going!

Francesca Vietor

Environment Program Officer, San Francisco Foundation and Commissioner, San Francisco Public Utilities Commission

1. Executive Summary

BAY AREA SMART ENERGY 2020 (BASE 2020) is a distributed generation strategy for minimizing greenhouse gas (GHG) emissions from electricity usage in the nine counties surrounding San Francisco Bay. BASE 2020 prioritizes energy efficiency, rooftop and distributed solar photovoltaics (PV) of all types, and local combined heat and power plants to meet the Bay Area's electricity needs. BASE 2020 is to a large degree the application of California's strategic energy vision, embodied in the *California Energy Action Plan* and the *California Energy Efficiency Strategic Plan*, to the Bay Area.

A framework objective of BASE 2020 is to convert existing homes and businesses to zero net energy buildings. This is a core strategy of the *Energy Efficiency Strategic Plan*, which was co-authored by Pacific Gas & Electric (PG&E), the Bay Area's investor-owned (private) utility. The concept of "zero net energy" is to develop or retrofit buildings so they produce at least as much electricity on site as they use. A combination of energy efficiency measures and rooftop PV are used to achieve zero net energy. Following a similar timeline to that established in the *Energy Efficiency Strategic Plan,* BASE 2020 envisions the conversion of 25 percent of existing Bay Area homes and commercial buildings to zero net energy buildings by 2020. All new homes and businesses will be built as zero net energy structures from 2015 onward.

BASE 2020 will achieve a Bay Area GHG reduction from electricity usage of more than 60 percent, compared to a 2008 baseline year, relying on proven off-the-shelf technologies and policies. At the same time, BASE 2020 will lower utility costs for Bay Area businesses and residents over a "business as usual" case, in large part due to: 1) emphasis on cost-effective energy efficiency measures and 2) the ongoing, spectacular drop in PV system prices.

The peak demand met by Bay Area utilities will decline by more than 50 percent, from approximately 14,000 megawatts (MW) today to 6,500 MW in 2020, as energy efficiency, state-of-the-art air conditioning and commercial building chiller systems, local PV, combined heat and power, and battery storage displace grid power. This will substantially reduce air pollution in Bay Area communities adjacent to large existing natural gas-fired peaker plants that will operate much less frequently on hot summer days.

BASE 2020 at a Glance

- **Solar PV:** Nearly 4,000 MW of local PV will be installed in the Bay Area by 2020 to achieve zero net energy targets. The inflow of this local PV on hot summer days will reduce natural gas-fired peaker plant air pollution, relieve grid congestion, and reduce wear-and-tear on grid equipment in the Bay Area.
- **Energy Efficiency:** Efficiency measures will reduce Bay Area electricity demand from approximately 58,000 gigawatt-hours per year to about 42,000 gigawatt-hours per year. This represents an average energy efficiency reduction, compared to a 2008 baseline, of 25 to 30 percent in Bay Area residential, commercial, and industrial buildings, and agricultural operations.
- **Air Conditioning:** Electricity consumption by air conditioning units, the primary cause of high summertime peak loads, will be reduced 50 percent by 2020 – consistent with the *Energy Efficiency Strategic Plan* – by methodical phase-in of high efficiency replacement units and on/off cycling of most units on hot days.
- **Combined Heat and Power:** 840 megawatts of new combined heat and power will also be added in the Bay Area, using a fuel mix consisting of at least 50 percent biomethane or biogas.

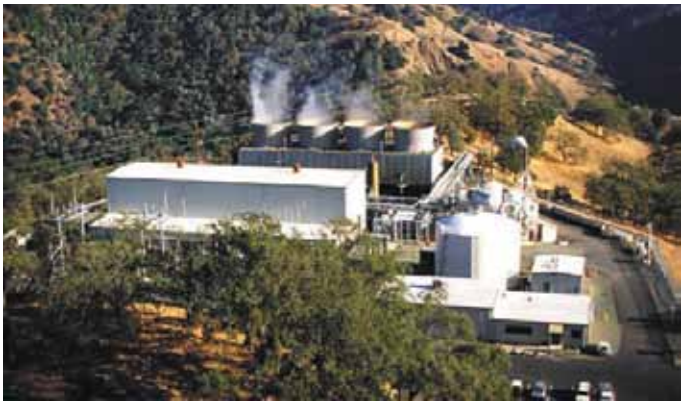
- **Geothermal:** Up to 300 megawatts of additional geothermal capacity will be added at the The Geysers in Sonoma County through cooling system upgrades to existing geothermal units.
- **Wind:** 300 megawatts of planned and under construction wind additions in Solano County are incorporated into BASE 2020.
- **Energy Storage:** 400 megawatts of battery storage will be integrated with the Solano County wind production area to convert Solano County wind power into a round-the-clock baseload resource. 200 megawatts of distributed battery storage, which can be expanded over time, will be integrated with residential and commercial PV systems to serve as peaking capacity and to provide the structure for community-scale microgrids.
- **Financing and Policy Tools:** The primary vehicles to achieve the reduction in GHG emissions will be 1) Property Assessed Clean Energy (PACE); 2) clean energy payments – also known as feed-in tariffs – to incentivize maximum local PV development; and 3) the expansion of Community Choice Aggregation. PACE is a financing mechanism pioneered in Berkeley and refined in Sonoma County that allows home and business owners to invest in energy efficiency and rooftop PV with no up-front expense. Repayment is realized as an assessment added to property taxes. Carefully calibrated clean energy payments in Germany have led to very high PV installation rates, approximately 7,000 megawatts per year, with average PV system installed costs that are much lower than those in California. Community Choice Aggregation allows local communities to form a public energy authority separate from PG&E to select the sources of electricity supply and the quantity of green power provided to customers. Community Choice Aggregation was successfully launched in Marin County in 2010, is in the process of being launched in San Francisco, and is under consideration in Sonoma County.

1.1 – The Policy Context

For BASE 2020 to drive the Bay Area to a robust clean energy economy based on zero net energy buildings, utility actions must be brought into alignment with the state's *Energy Efficiency Strategic Plan*. One example is PG&E's ability to purchase renewable energy credits from rooftop PV system operators to help the company meet its 2020 RPS target of 33 percent. This provides a mechanism to enhance the economics of rooftop PV while reducing overall RPS costs to ratepayers.

California's *Energy Action Plan* prioritizes energy efficiency over all other methods for addressing electricity demand. State policy views rooftop PV as integral to achieving the energy efficiency ideal – zero net energy buildings. California's *Energy Efficiency Strategic Plan* and BASE 2020 rely on local distributed PV to achieve zero net energy buildings.

Yet state policy has not yet directly addressed the fundamental conflict between a state strategy that is built around zero net energy buildings, which will substantially reduce demand for utility-supplied electricity, and the traditional investor-owned utility revenue model that is dependent on ever-expanding demand for utility-supplied electricity. Investor-owned utilities increase revenue by building more transmission lines, distribution substations, power plants, and meters, and passing along the cost of this infrastructure to ratepayers at a guaranteed rate-of-return. This model must change.



One of the geothermal power plants at The Geysers.

1.2 BASE 2020 Sources of Energy

1.2.1 Solar PV

The Bay Area will displace nearly 8,000 gigawatt-hours per year of electricity purchases through the installation of nearly 4,000 megawatts of rooftop PV. The addition of this amount of PV represents the quantity necessary for 25 percent of existing Bay Area residential and commercial buildings to achieve zero net energy by 2020.[1]

Solar electricity generated on the distribution grid at or near the point-of-use has an "avoided cost" (meaning the cost that would be borne by the utility to produce and deliver the same electricity from new conventional sources) of over $0.22 per kilowatt-hour without including the renewable energy value of the solar electricity. As a result, an equitable payment for this solar electricity, in the range of $0.20 per kilowatt-hour, would place no additional financial burden on utility customers without rooftop PV systems. Any distributed PV program payment structure that fairly accounts for rooftop PV value will result in rapid growth in rooftop PV installations.

The state's "Million Solar Roofs" program, which includes the *California Solar Initiative,* will add 3,000 megawatts of primarily rooftop PV by the end of 2016. About 550 megawatts of this capacity will be added in the Bay Area. This is a "net metering" program, meaning the solar generators swap electricity with PG&E at retail electricity rates. The solar generator can be credited with up to 100 percent of the building's annual electricity demand. Net metering at retail electricity rates is a core financial element in the cost-effectiveness of zero net energy building retrofits.

Currently PV installed under net metering does not count directly toward the utility's 33 percent RPS target. However, the green attribute of net-metered solar electricity, the renewable energy credit, may now be purchased by PG&E to count toward the 33 percent RPS target as a result of California Public Utility Commission (CPUC) regulatory action in 2010. These renewable energy credit payments, currently capped at $50 per megawatt-hour through 2013, have the potential to shift the renewable energy playing field in favor of rooftop PV.

Net metering does not shift costs to customers without rooftop PV when all relevant costs and benefits of net-metered PV systems are evaluated together. Net metering does accelerate California's shift to green energy. However, the current cap on net-metered PV capacity, five percent of peak utility demand, will become an obstacle in the near-term to zero net energy building retrofits if this cap is not revised upward or removed entirely.

Rooftop PV is cost-effective. Commercial rooftop PV systems are being built in California with contract prices of $0.14 per kilowatt-hour. This compares to utility-scale PV and solar thermal contracts approved by the CPUC in 2011 ranging from $0.15 to 0.18 per kilowatt-hour. Residential systems have been installed in California for as little as $4.40 per watt, equivalent to about $0.20 per kilowatt-hour. Germany has the highest PV installation rate in the world at over 7,000 megawatts per year, and is installing residential rooftop PV at an average of $3 per watt and small commercial rooftop PV at $2.70 per watt. These PV capital costs are equivalent to $0.14 per kilowatt-hour and less than $0.10 per kilowatt-hour, respectively.[2] The German labor market is more expensive than the California market.

One reason for the lower installed cost of German PV systems is standardized permitting. The Department of Energy is funding the development of a scalable standard template for solar PV permitting, inspection and interconnection by states, utilities and local jurisdictions. The Bay Area will be a pilot site for establishing a regional standardized solar permitting process under the Department of Energy program.

Germany has achieved its high rooftop PV installation rate using a simple clean energy payment sys-

tem (or feed-in tariff) that provides PV generators some income above the cost of production. The payments are revised on a six-month basis to assure that clean energy payment pricing reflects current PV market costs. It is reasonable to assume that at high volume under a similar clean energy payment program, the California rooftop PV market would reflect the same PV cost efficiencies being realized in the German market.

PV panels equipped with integrated microinverters that convert direct current electricity to alternating current at the panel are reducing cost and simplifying installation. The lowest published cost to date for residential PV systems in California, $4.40 per watt, is being offered by Open Neighborhoods in Los Angeles for a 2 kilowatt system using microinverters. In general, PV system prices are anticipated to continue falling at a rate of about 15 percent per year for at least the next few years.

California's utility-scale RPS program is producing some results, but at great cost to ratepayers. According to the CPUC's Division of Ratepayer Advocates, the renewable energy contracts signed by PG&E and California's other investor-owned utilities through the summer of 2010 will incur $6 billion in additional costs above the baseline market reference price if they are built. Many more high-priced contracts have been signed since 2010. For example, the dissenting commissioner on the November 2011 CPUC vote to approve a long-term contract for the 250 megawatt Mojave solar thermal project objected to ratepayers paying $1.25 billion over market price for this one project, stating that ratepayers should be getting double the renewable energy for the cost of the contract.

Contract terms between utilities and generators for renewable energy of all types and natural gas-fired turbines are confidential. This confidentiality is controversial. Legislation signed into law in 2011, SB 836, is beginning to shed light on the cost of specific RPS contracts. Greater contract transparency would draw attention early to high-priced contract proposals and should lower the cost of future long-term utility-scale contracts entered into by PG&E.

In addition, remote utility-scale projects generally require new transmission capacity to reach demand centers. Transmission is expensive. The cost of new transmission lines to reach remote solar and wind sites could exceed $15 billion statewide if the investor-owned utility RPS compliance strategy is followed. Upgrading the existing transmission system to accommodate these new power flows will add billions more in cost. As a result, a large ground-mounted PV array in the Mojave or Colorado Desert produces electricity at an all-in cost, including the cost of new transmission, as much as 50 percent greater than the cost-of-electricity produced by a 500 kilowatt PV array on a big box retail outlet or similar large commercial building in Oakland.

The Vaca Dixon solar project. Photo: Next 100.com

Conclusions/Recommendations:

- Nearly 4,000 megawatts of rooftop PV will need to be online in the Bay Area by 2020 to meet the BASE 2020 rooftop PV target.
- The avoided cost to PG&E of rooftop PV systems in the Bay Area is at least $0.22 per kilowatt-hour without considering the value of the renewable energy credits.
- Any price paid for rooftop PV below $0.22 per kilowatt-hour would benefit all ratepayers by providing electricity at a lower cost than PG&E would charge if it were supplying the same electricity from new conventional sources, after time-of-delivery cost, line losses, and transmission and distribution costs are accounted for.
- New commercial rooftop PV systems in California can deliver electricity at contract prices in the range of $0.14 per kilowatt-hour without state PV incentives.
- Lowest-cost residential PV systems can deliver electricity at $0.20 per kilowatt-hour without state PV incentives.
- Rapid price declines continue in both the commercial and residential rooftop PV markets.
- The renewable energy credits associated with net-metered rooftop PV can be sold as tradable renewable energy credits to assist PG&E reach its RPS target.
- Both net-metering and clean energy payment PV programs will make substantial contributions to meeting the BASE 2020 rooftop PV target.
- Equitable net metering must be preserved and existing net metering caps lifted for zero net energy programs like PACE to function to their potential.
- Equitable clean energy payments that closely track real-time PV price reductions are a proven mechanism for rapidly expanding rooftop PV installations at lowest cost.
- An equitable clean energy payments program in California would provide a mechanism for the state to replicate the rapid rooftop PV growth rate in Germany.

1.2.2 Combined Heat and Power

Combined heat and power refers to facilities that use a small gas turbine, engine, or fuel cell to generate both electricity and useful heat. Combined heat and power facilities are commonly found at college campuses, hospitals, and commercial and industrial complexes.

BASE 2020 incorporates the AB 32 *Global Warming Solutions Act Scoping Plan* target of 4,000 megawatts of new combined heat and power by 2020. A primary role of the new combined heat and power will be to displace coal power purchases by PG&E, purchases made either directly from in-state coal generators or as a component of wholesale power market purchases. This will result in approximately 840 megawatts of new combined heat and power in the Bay Area by 2020.

The avoided cost to PG&E of combined heat and power in the Bay Area is about $0.18 per kilowatt-hour. Combined heat and power projects can cost-effectively deliver electricity at contract prices as low as $0.12 per kilowatt-hour. The fuel composition target for combined heat and power in BASE 2020 is 50 percent biogas or biomethane, combined with natural gas, to reduce the GHG footprint of new combined heat and power to approximately 300 pounds of CO_2 per megawatt-hour. This is less than half the GHG footprint of a state-of-the-art base load combined cycle plant.

Conclusions/Recommendations:

- Any fixed payment paid to combined heat and power operators below $0.18 per kilowatt-hour would benefit all PG&E ratepayers.
- Establish a fixed payment for combined heat and power of at least $0.12 per kilowatt-hour to assure that combined heat and power projects are built.

1.2.3 Geothermal

The conversion of the existing geothermal plants at The Geysers to parallel wet-dry cooling systems, which should reduce evaporative water loss by 80 to 90 percent over current practice, could increase sustainable output from The Geysers by as much as 300 megawatts. Total installed capacity at the The Geysers reached nearly 2,000 megawatts during the geothermal plant building boom of the 1980s. Production from The Geysers dropped dramatically in the late 1980s due to too much geothermal reservoir steam/water being evaporated in the wet cooling towers used on all of the nearly 20 geothermal plants located there. The construction of a treated wastewater and freshwater pipeline to The Geysers in the late 1990s, to inject 8 million gallons per day into the geothermal reservoir, stabilized output at around 900 megawatts.

The incremental production from parallel wet-dry cooling retrofits could potentially produce the lowest cost renewable energy in the state and would improve the sustainability of the geothermal resource. However, given that all of the geothermal plants are using the same extended geothermal reservoir, a comprehensive conversion of all the existing geothermal plants would be necessary to realize the full benefit of the wet-dry cooling conversions.

Conclusions/Recommendations:

- The California Energy Commission should conduct a comprehensive evaluation of the cost and benefits of retrofitting existing geothermal plants at The Geysers with parallel wet-dry cooling systems to increase sustainable output at The Geysers by up to 300 megawatts.
- The conclusions of this study, if favorable, would serve as the basis for initiating necessary regulatory steps to retrofit the existing geothermal plants at The Geysers to parallel wet-dry cooling.

1.2.4 Wind

300 megawatts of new wind projects already planned or under construction in Solano County are incorporated into BASE 2020.

1.2.5 Energy Storage

400 megawatts of battery storage will be integrated to the Solano County wind production area to provide 400 megawatts of peaking power and to smooth output from the wind generators. 200 megawatts of battery storage will also be added to residential and commercial Bay Area buildings to absorb mid-day PV output, provide peaking capacity, address the intermittency of solar electricity production, and serve as the foundation of community-scale microgrids that can operate around-the-clock on electricity supplied by rooftop PV. Pilot community energy storage projects are underway at various utilities. The cost of this battery capacity, in 2012 prices, is less than the expected capacity payments for new peaking gas turbines.

Conclusions/Recommendations:

- Energy storage is a good match for the high summertime output of Solano County wind farms. The California Energy Commission should conduct a study of the economic and grid reliability benefits of integrating 400 megawatts of battery storage with the Solano County wind farms.
- If the study results are favorable, the state should move forward with the regulatory steps necessary to bring the 400 megawatt battery storage facility online prior to 2020.
- 200 megawatts of distributed battery storage should be added at the neighborhood level. Community energy storage systems are a green substitute for conventional peaking gas turbine resources and an essential building block in eventual community-level microgrids.

1.2.6 Solar Hot Water

Solar hot water heating is a cost-effective and relatively untapped option for reducing natural gas demand. An analysis conducted of solar water heating natural gas savings potential in California determined a potential reduction of approximately 120 billion cubic feet of natural gas per year, about 20 days of natural gas supply. This is about 5 percent of the yearly statewide consumption of natural gas.

The *Solar Hot Water and Efficiency Act of 2007* authorized a ten-year incentive program for solar water heaters with a goal of promoting the installation of 200,000 systems in California by 2017. This is an average installation rate statewide of 20,000 systems per year. Germany has installed as many as 200,000 solar hot water systems in one year. PG&E has over 5 million residential and commercial customers. An installation rate of 200,000 systems per year is a realistic and achievable goal in PG&E territory.

Conclusions/Recommendations:

- The state's current solar hot water program must grow to hundreds of thousands of installations per year over the next decade if solar hot water systems are to put significant downward pressure on residential and commercial natural gas consumption.
- The 2020 solar hot water target for PG&E should be about 1.5 million systems, equal to about 25 percent of PG&E's customers. This is consistent with the target of retrofitting 25 percent of PG&E homes and businesses with rooftop PV by 2020. Over half of these retrofits would occur in the Bay Area. A second target is to reach and sustain a solar hot water retrofit rate of 200,000 per year by 2020 in PG&E territory.

170,735-sq.-ft. net zero emissions office building prototype in St. Louis, Mo. Illustration: Hellmuth, Obata and Kassabaum.

1.3 Energy Efficiency and Peak Demand Reduction

1.3.1 Energy Efficiency

The *Energy Efficiency Strategic Plan* calls for 25 percent of residences to reach 70 percent reduction in electricity usage by 2020. Rooftop PV must be added to reach a 70 percent reduction. Adding a number of additional PV panels to a planned residential rooftop PV system to reach 100 percent reduction – zero net energy – is straightforward and cost-effective. For this reason, the *Energy Efficiency Strategic Plan* goal is modified in BASE 2020 to a target of 25 percent of residences achieving 100 percent reduction in net electricity usage by 2020. The remaining 75 percent of existing homes will reduce electricity demand by 30 percent through energy efficiency measures by 2020. Multi-family residences will reduce grid demand by 40 percent by 2020, using a combination of energy efficiency and rooftop PV.

BASE 2020 establishes a target of 25 percent of commercial buildings reaching zero net energy by 2020. This is in essence a mid-point target to the *Energy Efficiency Strategic Plan* goal of 50 percent of existing commercial buildings reaching zero net energy by 2030. 75 percent of existing commercial buildings will reduce electricity usage by 30 percent by 2020 using energy efficiency measures. The net effect of achieving these energy efficiency targets will be a reduction of about 30 percent in grid-supplied electricity to homes and commercial buildings in the Bay Area in 2020 compared to the baseline year of 2008.

BASE 2020 also establishes a uniform goal of 2015 for all new homes and commercial buildings to be zero net energy. This uniform goal compares to the *Energy Efficiency Strategic Plan* targets of zero net energy for all new homes by 2020 and for all new commercial buildings by 2030. The BASE 2020 goal is consistent with the goal established by Austin, Texas in 2007, which requires all new homes to be zero net energy capable by 2015.

Industrial plants and agricultural operations would reduce electricity consumption by 25 percent and 15 percent respectively by 2020, consistent with the goals in the *Energy Efficiency Strategic Plan*.

1.3.2 Air Conditioning

Air conditioning is a major source of peak energy demand in the Bay Area. The CPUC estimates air conditioning loads are responsible for more than 30 percent of the total load on hot summer days. BASE 2020 adopts the *Energy Efficiency Strategic Plan* target of a 50 percent reduction in air conditioning loads by 2020. Achieving this peak demand reduction target will reduce Bay Area peak load by over 2,000 megawatts.

Central air conditioning units have an average useful service life of 10 to 14 years. As a result, well over 50 percent of operating central air conditioning units in the Bay Area will be due for replacement by 2020 through normal attrition. Cost-effective state-of-the-art central air conditioning units have less than one-half the electricity demand of typical older operating units. New state-of-the-art units have a much lower electricity demand than new units meeting only the federal minimum efficiency standard.

Incentive funds should be paid at the contractor level to cover the cost difference between a new minimum efficiency unit and a state-of-the-art unit. This would mean that the net price of the most efficient unit offered by heating and ventilation contractors to consumers in the Bay Area is the same as less efficient units. This will ensure that all new units are high efficiency units. Assuming each replacement on average reduces unit electricity consumption by 50 percent, and half the existing units are replaced due to natural attrition in 10 years, the electricity consumption of the entire population of central air conditioning units in the Bay Area will drop about 25 percent over the next decade.

Electronic on/off cycling controls are inexpensive and simple to install. PG&E has a program to install these on/off controls on 25 percent of existing central air conditioning units. Adding cycling controls to all existing and new central air conditioning units will provide the capability to reduce the instantaneous electricity demand from the entire air conditioner population by an additional 30 to 40 percent, as half these units would be in off mode at any given time while the other half are operational.

Conclusions/Recommendations:

- Achieving the energy efficiency targets in BASE 2020 will reduce electricity demand in the Bay Area by approximately 25 to 30 percent in 2020 compared to a 2008 baseline year.
- Air conditioning loads are responsible for at least 30 percent of summer peak loads.
- Incentive funds should be used to cover the cost difference between a minimum efficiency central air conditioning unit and a state-of-the-art unit at the contractor level. This will ensure that all new replacement units are high efficiency units, reducing demand in the units that are replaced by about 50 percent on average.
- Adding cycling capability to all existing and new central air conditioning units will provide the capability to reduce the instantaneous air conditioner electricity demand by an additional 30 to 40 percent.

Sunset Reservoir solar project. Photo: San Francisco Public Utilities Commission

1.4 Independent Clean Energy Alternatives to Achieve BASE 2020

PG&E'S ENERGY EFFICIENCY PROGRAM is not meeting minimum targets established by the CPUC. PG&E is not the ideal entity to lead the effort to achieve the ambitious zero net energy goals in the *Energy Efficiency Strategic Plan* and BASE 2020. In contrast, an independent non-profit organization, the Energy Trust of Oregon, controls public goods funds collected by the Oregon investor-owned utilities for electricity and natural gas efficiency measures and administers programs intended to maximize efficiency gains and rooftop PV. The Energy Trust of Oregon is well regarded by Oregon stakeholders as effective.

The administration of public goods funds by third parties to maximize energy efficiency is a proven concept, as demonstrated by the Energy Trust of Oregon. California also has off-the-shelf regulatory and legislative options that provide for independent pursuit of maximum energy efficiency and rooftop PV. These include Property Assessed Clean Energy (PACE) and Community Choice Aggregation.

1.4.1 – Property Assessed Clean Energy

Berkeley pioneered an innovative, no upfront cost funding mechanism where the city or private investors provide low-interest financing to property owners to pay for energy efficiency improvements and rooftop PV installations. The financing is repaid as property assessments semi-annually with property tax payments. California PACE legislation, AB 811, was passed into law in 2008. Sonoma County has continuously operated a successful residential and commercial PACE program since 2009, the *Sonoma County Energy Independence Program*. This program serves as the model for the privately-financed, $100 million commercial PACE program launched in Sacramento in September 2011. San Francisco launched its commercial PACE program, *GreenFinanceSF-Commercial* in October 2011.

Federal housing corporations Fannie Mae and Freddie Mac indicated in July 2010 that they would not purchase mortgages on properties with PACE assessments. This suspended development of PACE programs, especially residential PACE, in most parts of California and across the country. Lawsuits have resulted in a formal comment procedure at the Federal Housing and Finance Authority, the federal agency that oversees Fannie Mae and Freddie Mac, that may lead to resolution of this controversy. Federal legislation has been proposed to resolve this issue as well. Commercial buildings and homes with no mortgage, which account for about one-third of residential housing stock, are unaffected by the Fannie Mae/Freddie Mac position on PACE assessments.

PACE programs offer a financially manageable mechanism for homeowners and business owners to achieve zero net energy in existing residential and commercial buildings. PACE is independent of utility-funded energy efficiency programs. PG&E does offer a limited on-bill financing program for commercial customers that mirrors the PACE program in numerous respects. A new program, on-bill repayment, is under study. The on-bill repayment program would allow private investors to collect for energy efficiency improvements through PG&E's existing billing process.

1.4.2 – Community Choice Aggregation

California law allows local government to purchase electricity on behalf of their residents and businesses through a mechanism known as Community Choice Aggregation (CCA). A CCA is a public energy authority. CCAs allow more local control of electricity supply, increased renewable energy, and increased local economic benefits from local renewable energy development. The investor-owned utility (PG&E, in the

case of the Bay Area) continues to provide transmission and distribution service to CCA customers. Large CCAs serving hundreds of thousands of customers in Ohio and Massachusetts have been operating for a number of years. The Marin Energy Authority launched its CCA program, *Marin Clean Energy*, in May 2010. *Marin Clean Energy* is the state's first operational CCA.

Marin Clean Energy is in the process of expanding its customer base from 14,000 customers to approximately 100,000 customers, as all Marin County residents will have the opportunity to participate in mid-2012. The San Francisco Public Utilities Commission is in the process of launching its CCA program, *CleanEnergySF*, with an initial participation target of 75,000 customers. Sonoma County is considering the formation of a CCA.

CCAs provide some of the services of a public utility. The Bay Area has a number of small public electric utilities. The cost of electric service provided by Bay Area public utilities is consistently 10 to 20 percent or more lower than equivalent service from PG&E. Some of the Bay Area public utilities, most notably Alameda Municipal Power, are achieving substantially higher levels of renewable energy sales than PG&E. Two of the public utilities, Silicon Valley Power and Palo Alto Utilities, offer customers 100 percent renewable energy service at less cost than the standard PG&E tariff for equivalent service. *Marin Clean Energy* now offers its customers options with varying renewable energy content: 25 percent, 50 percent, or 100 percent.

Recent changes to CCA legislation allow the CCA to administer public goods funds collected from CCA customers. These funds have historically been controlled by the investor-owned utility. The CCA can now independently determine how these funds will be used to maximize energy efficiency reductions in the CCA jurisdiction.

1.4.3 – Clean Energy Payments

California has the authority to designate a state agency to establish and administer a clean energy payment program (also known as "feed-in tariff" program), buy the energy at the set payment rates, and require the investor-owned utilities to purchase a specific amount of the electricity generated. The Federal Energy Regulatory Commission (FERC) has acknowledged that a state requirement that investor-owned utilities purchase electricity from a state-owned corporation at specified rates would not be preempted by FERC's authority over wholesale power sales. The state could adopt this approach as an alternative to the CPUC's complex clean energy payment proceedings. CPUC clean energy payment proceedings have consistently resulted in rates that are too low to get either rooftop PV or combined heat and power projects built in quantity.

Conclusions/Recommendations:

- Revival of PACE programs in the Bay Area is necessary to create a dynamic alternative for achieving the goals of BASE 2020. PACE requires little intervention by local or state government to make rapid strides in energy efficiency and rooftop PV.
- CCA offers a viable alternative to Bay Area cities and counties currently served by PG&E to increase local control of electricity supply and increase the contribution of local renewable energy.
- California's Department of General Services has contract expertise and administers the state's revolving loan program under the Energy Efficient State Property Revolving Fund. General Services could serve as the state government entity that sets clean energy payment rates for rooftop PV and combined heat and power, purchases the energy at the set rates, and requires each investor-owned utility to purchase a specific amount of these resources.

1.5 – Rethinking the Grid

1.5.1 – Grid Upgrades

The existing Bay Area distribution grid, without substantial modification, can already absorb the electricity flow from nearly 4,000 megawatts of new local PV that will be added under BASE 2020. Electricity flows in one direction in a conventional grid operation. Safety devices, like circuit breakers, will open if flow is reversed. The cost to retrofit a large distribution substation with smart two-way microprocessor-controlled circuit breakers is low, on the order of several hundred thousand dollars. To realize the full local PV and combined heat and power potential of the distribution grid, two-way flow is necessary.

The California Energy Commission has been advocating that California utilities be required to incorporate smart grid features, including full two-way flow, since 2007. According to its *Smart Grid Deployment Plan 2011-2020,* PG&E is making progress on the necessary grid upgrades. It has installed circuit breakers with full automatic control on over 50 percent of its substations, with a goal of 100 percent conversion by 2015. PG&E is also making other upgrades, such as adding voltage optimization controls on distribution feeders to support high levels of PV generation. With these upgrades, PG&E is largely resolving technical barriers to the rapid development of the Bay Area's full local power potential.

1.5.2 – Fair Financing of Distributed Generation

Local PV systems produce and deliver electricity where it is needed, during high demand daylight hours. As a result, this solar electricity reduces rates to all customers by displacing high cost peaking power, relieving congestion on the electrical grid, reducing wear-and-tear on grid hardware like transformers, and by delaying or eliminating the need to expand the grid.

Achieving the targets in BASE 2020 and the *Energy Efficiency Strategic Plan* will result in nearly a million new solar generators in the Bay Area by 2020. These new generators, who do not currently pay fees to export to the grid, will reduce PG&E grid costs and reduce the need for new distribution grid capital expenditures. Distribution grid costs will drop overall. These cost reductions may equal or exceed the rate that customers with rooftop PV reduce their grid power purchases. In this scenario grid costs will not be shifted to customers without PV, as this smaller group of customers will share a smaller cost.

A fair grid cost sharing system is necessary. Historically, financing the building and maintenance of the grid was simple – costs were spread out among all residential, commercial, and industrial customers, and generators paid nothing beyond the initial cost of interconnecting to the grid.

If a thorough and fair review indicates that generators should pay a fee to export electricity to the grid to finance grid costs, then all generators, including large generators that currently pay nothing to export to the grid, should be charged the same fee per kilowatt-hour of exported electricity. Otherwise, utility-scale generators that exclusively export electricity, whether conventional or renewable, would obtain a *de facto* economic advantage over rooftop PV generators while contributing to the grid congestion problem that rooftop PV systems relieve.

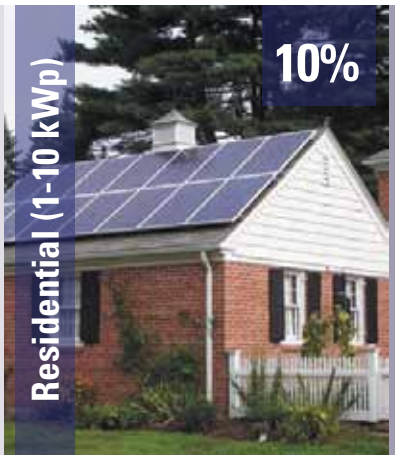
1.5.3 – Monitoring Distributed PV

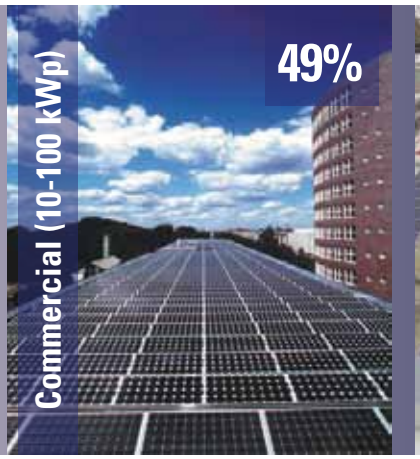
There has been no significant utility effort to date in California to monitor or control the dispatch of non-utility owned rooftop PV on distribution circuits. The monitoring and dispatch control of commercial-scale rooftop PV is considered essential to reliable grid operation in Germany, where approximately 25,000 megawatts of distributed PV is online as of the beginning of 2012 (see graphic, next page). This unnecessary "blindness" can lead to grid reliability issues during certain weather and load conditions. One simple step that needs to be taken by PG&E and other California utilities is to monitor and control the dispatch of commercial-scale rooftop PV owned by third parties.

Solar Market Segments, Germany, 2010

BUILDING-INTEGRATED PV

ROOFTOP





GROUND-MOUNTED

Photos: National Renewable Energy Laboratory, Photographic Information eXchange
Source: Statistics of the Federal Network Agency, BSW-Solar Estimates Shares according to installed capacity.

1.6 Displacement of Fossil Fuel Generation by BASE 2020

A SIGNIFICANT SOURCE OF PG&E'S GHG EMISSIONS is from power purchased on the wholesale power market and identified as "unspecified" in the 2009 PG&E power mix. These power purchases include coal. BASE 2020 will displace all coal usage over the next decade with baseload combined heat and power, increased geothermal output from existing plants at The Geysers, and the integration of battery storage with existing wind power in Solano County.

The second source of PG&E coal power purchases is long-term contracts with a few California coal-fired co-generation plants. BASE 2020 will displace these sources over the next decade, and replace them with the same clean baseload resources to be used to displace PG&E imported coal power purchases.

PG&E is proposing to contract for over 2,000 MW of new natural gas-fired gas turbine plants to be built in the Bay Area over the next few years. The expense of having this new gas turbine capacity available will be on the order of $600 million per year for 20 years. This is despite high electricity reserve margins in the range of 30 to 40 percent, that assure grid reliability on hot days when electricity use is highest. Actual reserves margins are much higher than the required 15 to 17 percent, and indicate that PG&E already has an excess of generation available to meet any reasonably foreseeable demand without new gas-fired plants. There has been no growth in peak demand in recent years that would justify adding more peaking capacity.

A primary justification for these new turbines, offered by PG&E and the California Independent System Operator, is the need to back-up solar and wind resources. Solar PV is completely reliable on hot summer afternoons when peak loads occur in the Bay Area. There is no significant cloud cover during the hottest hours of the summer when the highest electricity demand occurs.

A second justification offered is the need to retire once-through cooled steam boiler plants in the Bay Area due to their impact on marine life. PG&E has identified only two once-through cooled steam boiler units in its service territory, located in Pittsburg, as necessary for Bay Area grid reliability. It would be much cheaper and more efficient to retrofit these existing boiler plants to cooling towers and use them as a back-up peak power supply for another decade or two, than to build new gas turbine plants that will be in operation for 50 years.

Conclusions/Recommendations:

- BASE 2020 will rapidly drive down demand for grid power, obviate the need for any new utility-scale natural gas plants, and end any reliance on coal power.
- Actual PG&E reserve margins are considerably higher than necessary to assure grid reliability on hot days. Peak demand has been static or declining in recent years. Peak loads will steadily decline if BASE 2020 is implemented.
- Solar PV is completely reliable on hot summer afternoons when peak loads occur in the Bay Area. There is no significant cloud cover during these periods. There is no reliability need to build peaking gas turbines to back-up PV in anticipation of significant cloud cover on the hottest days.
- The cost of retrofitting wet cooling towers at the power plant in Pittsburg to eliminate the marine impacts of once-through cooling would be much lower than building new gas turbine peaking capacity to replace these units.
- The $600 million per year of PG&E ratepayers will pay for four new gas turbine power plants in the Bay Area would be sufficient to pay for more than half of the nearly 4,000 MW of new local PV, at 2012 PV prices, that will be added in the Bay Area under BASE 2020.

1.7 Ratepayer Benefits from BASE 2020

THE REDUCTION OF DEMAND FOR PG&E-SUPPLIED electricity and natural gas, achieved through energy efficiency measures, PV, combined heat and power, geothermal, wind, and solar hot water, also reduces the price of electricity and natural gas in wholesale energy markets. This is known as the "merit order effect." It reduces the cost of electricity and natural gas for all ratepayers.

The merit order effect of distributed generation in Germany, an electricity market two times the size of the California market, reduced the wholesale electricity price to German customers by approximately $5 billion in 2009.

PG&E buys a significant amount of electricity and natural gas from wholesale markets. The market price benefits of reduced demand caused by energy efficiency measures and local clean energy will substantially outweigh the transaction costs, especially interconnection costs, that currently hamper or prevent the deployment of local PV and combined heat and power projects.

Conclusions/Recommendations:

- The merit order benefit of distributed PV and combined heat and power on wholesale electricity prices is substantially greater than the transaction costs, especially interconnection costs, imposed by PG&E on distributed PV and combined heat and power developers. These transaction costs should be absorbed by PG&E as the net economic benefit to all PG&E customers of having these PV and combined heat and power systems online substantially outweighs the transaction costs.
- This same merit order benefit applies to natural gas demand reduction realized by use of combined heat and power, solar hot water heating, and substitution of biomethane or biogas for pipeline natural gas. Payments for these technologies and fuels must incorporate the value of the merit order benefit to assure that the deployment of technologies and fuels that are bringing net price benefits to all natural gas consumers are not inappropriately constrained by inadequate incentive budgets.
- The California Energy Commission should verify the merit order effect of the energy efficiency and distributed generation targets in BASE 2020 on the wholesale market price of electricity. The results of this verification would serve as the basis for increasing funding for energy efficiency and demand response programs and for shifting all distributed generation transaction costs, including interconnection costs, to PG&E ratepayers.
- The California Energy Commission should conduct a similar verification of the merit order effect of the BASE 2020 targets for combined heat and power, solar hot water heating, and natural gas substitution with biogas and biomethane on the wholesale market price of natural gas. The results would serve as the basis for increasing incentives for solar hot water systems and biogas and biomethane fuel production.

1.8 GHG Reductions Achieved by BASE 2020

ACHIEVING BASE 2020 TARGETS WILL RESULT IN A reduction of more than 60 percent in Bay Area GHG emissions from electricity usage by 2020. Peak demand on the grid will decline by more than 50 percent.

Table 1-1 summarizes estimated 2008 GHG emissions from electricity usage in the Bay Area. The term GHG is used interchangeably with carbon dioxide (CO_2) in BASE 2020.

Table 1-1. Total Bay Area GHG Emissions from Electricity Consumption in 2008

Source	GWh[3]	CO_2 emission factor (tons/MWh)	2008 CO_2 emissions (million tons)	Bay Area fraction	2008 Bay Area CO_2 emissions (million tons)
PG&E bundled customers	81,983	0.32	26.2	0.6	15.7
PG&E Direct Access customers	6,376	0.48	3.1	0.6	1.8
Bay Area public utilities	5,327	0.32	1.7	1.0	1.7
				Bay Area total	**19.2**

Table 1-2. CO2 Reduction Achieved by Implementing BASE 2020

Source of CO_2 reduction	Quantity of reduction (GWh)	CO_2 emissions (million tons)	Fuel type displaced	Avoided CO_2 emissions (million tons)	Net CO_2 reduction (million tons)
Energy efficiency	15,448	0	natural gas	4.9	4.9
Rooftop PV	6,799	0	natural gas	3.4	3.4
Combined Heat and Power	6,770	1	imported	3.2	2.2
New geothermal	2,234	0	imported	1.1	1.1
New wind with energy storage	867	0	imported	0.4	0.4
Total reduction					**12.0**

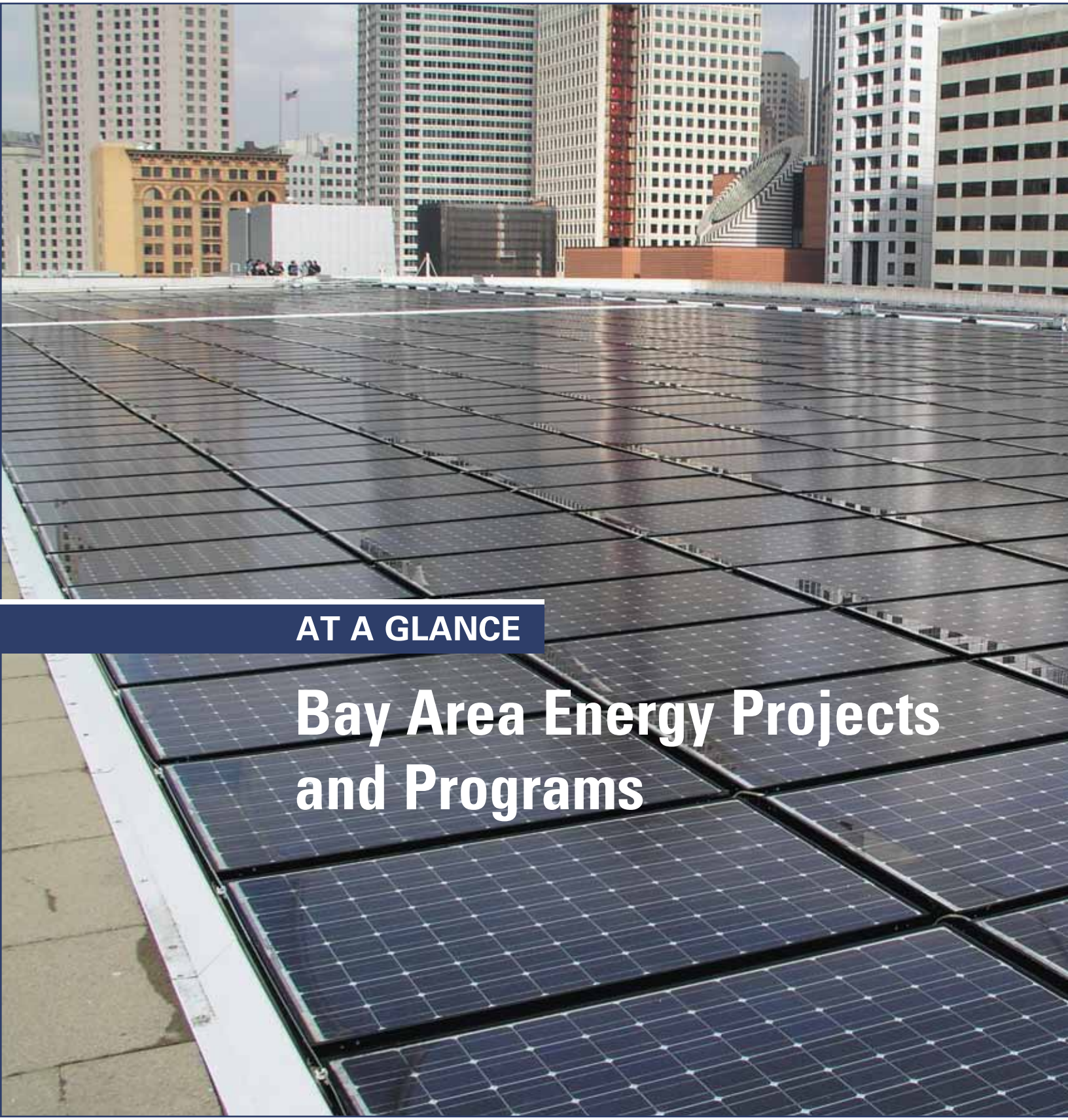
Table 1-2 summarizes the actions to be taken in BASE 2020 to reduce GHG emissions and the GHG reductions achieved. Net GHG emissions from electricity usage would decline from 19 million tons per year in 2008 to 7 million tons per year in 2020, a reduction of more than 60 percent.

The Bay Area peak load reductions on PG&E and Bay Area public utility systems that would occur as a result of BASE 2020 are shown in Table 1-3. Electricity purchased from Bay Area utilities would decline at peak from about 14,000 megawatts in 2008 to approximately 6,500 megawatts in 2020.

This is more than a 50 percent reduction in the peak demand met with grid power. The majority of the reduction in peak demand for utility-supplied grid power will come from energy efficiency measures in general, as well as from more efficient central air conditioners and commercial building chiller plants.[3] The remaining peak demand reduction on the grid will be demand displacement by rooftop PV, combined heat and power, and battery storage.

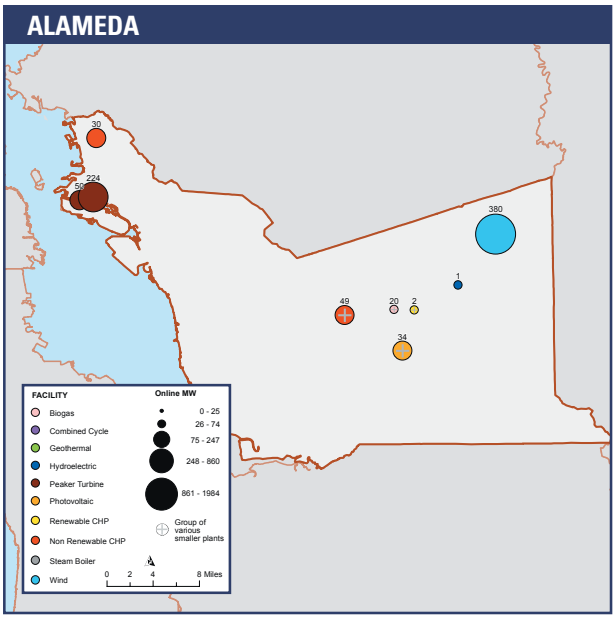
Table 1-3. Bay Area Peak Load Reduction Achieved by Implementing BASE 2020

Source of reduction	Basis of reduction (MW)	Peak load reduction (MW)
Energy efficiency	25 percent reduction in demand on average from energy efficiency measures	2,500
Air conditioner/ chiller plant efficiency improvement	Cooling load represents about 30 percent of peak load. Highest efficiency central air conditioning (CAC) units replace worn-out units, 50 percent reduction. 50 percent reduction targeted for commercial building chiller plants. Cycling capability built into new CAC units to allow 50 percent online, 50 percent offline at peak. A 50 percent turnover in CAC population is assumed.	2,100
Rooftop PV	3,800 MWac of rooftop PV added by 2020. 50 percent of this capability, 1,900 MWac, is available at peak.	1,900
Battery storage associated with rooftop PV	200 megawatts of battery storage will be added to residential and commercial Bay Area buildings to absorb mid-day PV output, provide peaking capacity, address the intermittency of solar electricity production, and serve as the foundation of community-scale microgrids that can operate around-the-clock on electricity supplied by rooftop PV.	200
Combined heat and power	840 MW of combined heat and power is added to Bay Area, removing equivalent amount of load from utility demand at peak.	840
	Total Bay Area peak load reduction	**7,540**



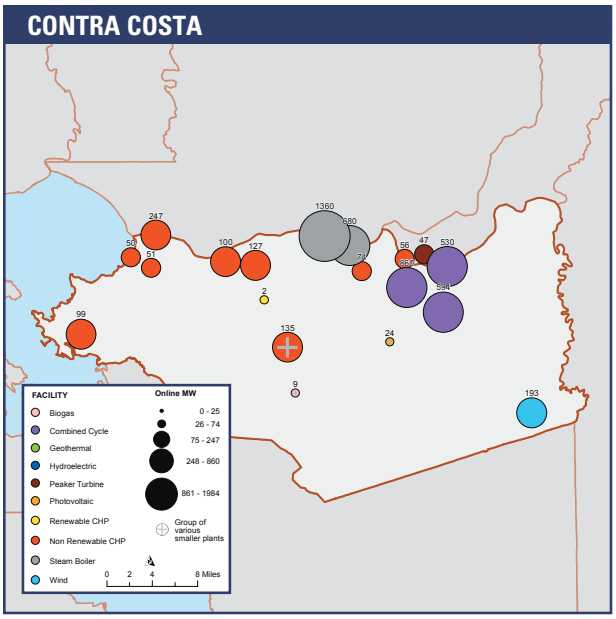
AT A GLANCE

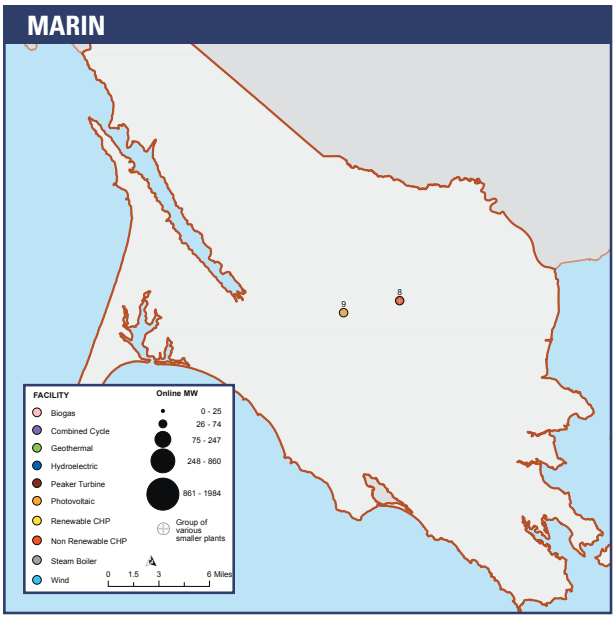
Bay Area Energy Projects and Programs



ALAMEDA COUNTY

- City of Berkeley pioneered the Property Assessed Clean Energy (PACE) program for residential buildings.
- Alameda Municipal Power offers a high volume of renewable energy to their customers at significantly lower rates than PG&E. Landfill biogas-fueled electricity is a significant percentage of the Alameda Municipal Power electricity supply.
- Altamont, one of the US' first major wind farms, is controversial due to a high volume of avian deaths.
- Russell City and Mariposa natural gas power plants proposed for the region would add 800 MW's of natural gas capacity, if built.
- Climate Action Plans passed in Albany, Berkeley, Emeryville, Oakland, Hayward, and Alameda with reduction targets ranging from 25 to 80 percent reduction by 2020.
- Combined heat and power facilities provide power at UC Berkeley campus, among other places.
- Distributed PV potential is 3,764 MW.





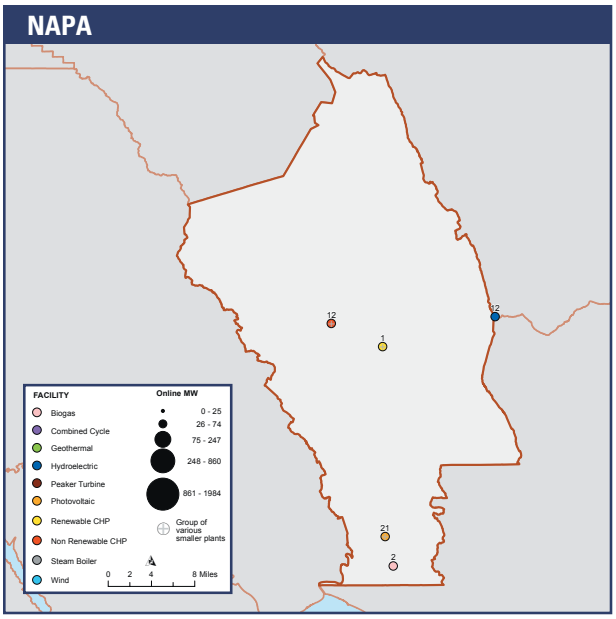
CONTRA COSTA COUNTY

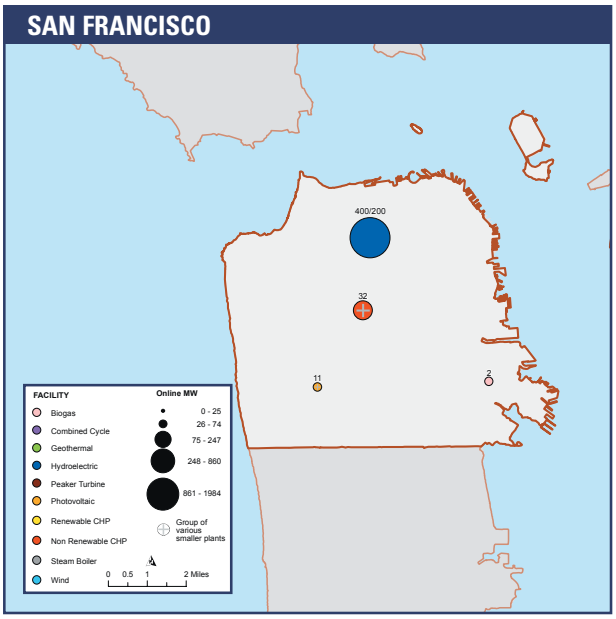
- Hosts over 50 percent of the Bay Area's emissions from fossil fuel power plants.
- Home to the Bay Area's remaining "once-through cooling" power plants, Contra Costa and Pittsburg.
- Martinez Climate Action Plan targets a 25 percent reduction in GHG emissions by 2020.
- Distributed PV potential is 2,264 MW.

MARIN COUNTY

- The Marin Energy Authority is California's first energy purchasing program under the state's Community Choice law.
- Marin County Climate Action Plan targets 15 percent GHG reduction below 1990 levels by 2015. San Rafael has a 25 percent reduction target by 2020.
- Distributed PV potential is 551 MW.

Gateway and Contra Costa power plants, Antioch. Photo: Pacific Environment





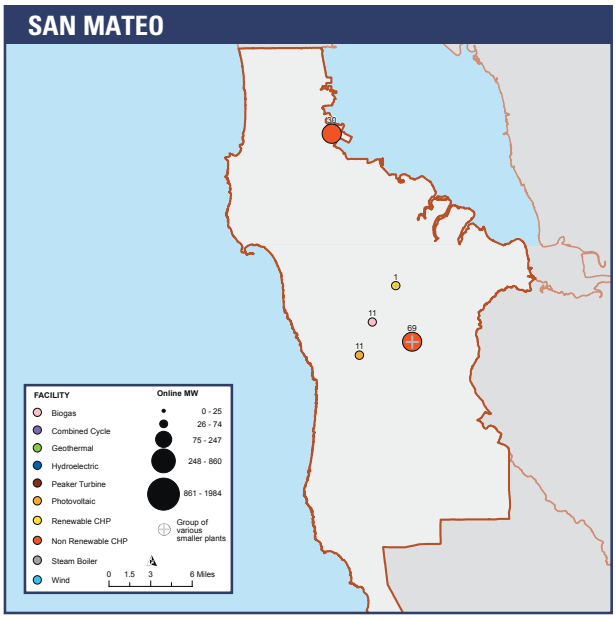
NAPA COUNTY

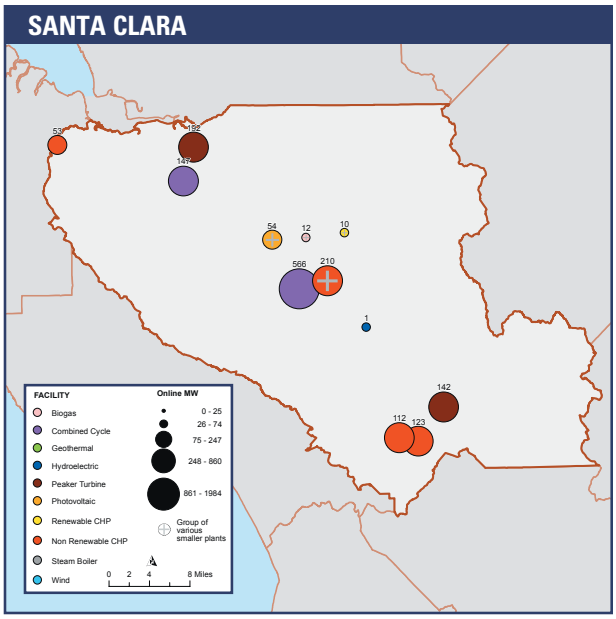
- Distributed PV potential is 318 MW
- Numerous wineries and farms have taken advantage of state and federal incentives to install solar on their properties.

Combined heat and power unit at UC San Francisco. Photo by Susan Merrell/UCSF.

SAN FRANCISCO CITY AND COUNTY

- Sunset Reservoir, a 5 MW solar project developed by the SF Public Utilities Commission, became operational in 2010.
- Combined heat and power facilities provide efficient power at San Francisco State University, UC San Francisco, and other locations.
- Biogas from wastewater powers combined heat and power units at two treatment plants.
- SF Public Utilities Commission operates Hetch Hetchy Reservoir.
- SF imports natural gas-derived electricity from Contra Costa County through the new Transbay Cable. Potrero and Hunters Point power plants have gone off-line in recent years.
- San Francisco Climate Action Plan targets 20 percent GHG reduction by 2020.
- Distributed PV potential is 1,923 MW.
- The SFPUC is moving ahead with their Community Choice program, CleanPowerSF, the second in the state.





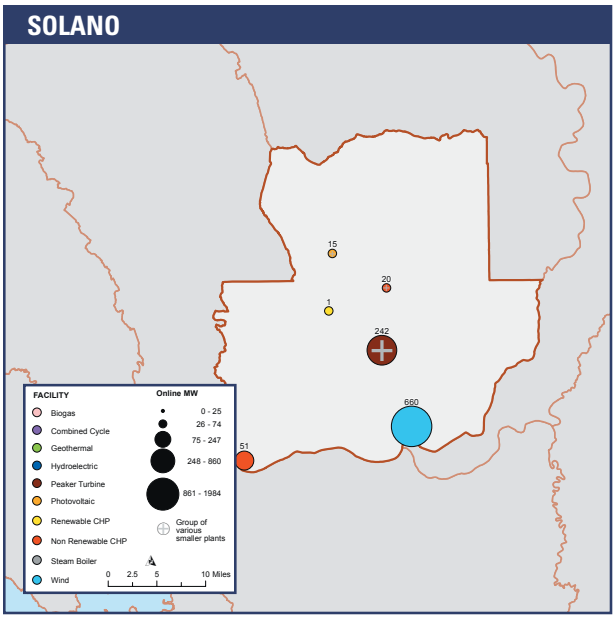
SAN MATEO COUNTY

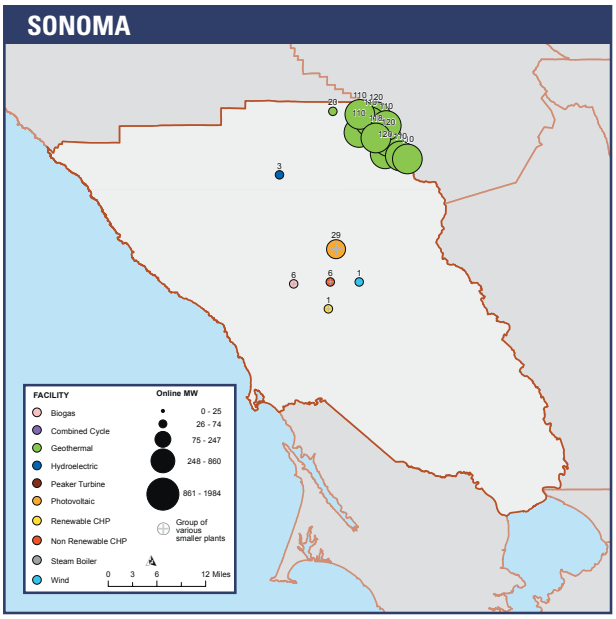
- A combined heat and power facility provides power to the San Francisco Airport.
- Climate Action Plans in Burlingame, Menlo Park and San Mateo target 15 to 20 percent reduction in emissions by 2020.
- Distributed PV potential is 1,631 MW.

Milpitas High School solar project, Milpitas. Photo: New York Times

SANTA CLARA COUNTY

- City of Palo Alto has a public utility that offers power that is 24 percent renewable at rates lower than PG&E. Their "Palo Alto Green" program offers 100 percent renewable power, which 21 percent of their customers pay a premium for.
- Silicon Valley Power is a public power agency providing power to residents of Santa Clara. It operates a 6 MW CHP facility, and a 147 MW natural gas power plant. It offers customers the option to purchase renewable energy.
- Google, Cal-tech and other campuses use fuel-cell powered generators called Bloom Boxes.
- The "Google-plex" has a 1.6 MW solar array which generates 30 percent of Google's peak electricity needs.
- Santa Clara County targets a 15 percent reduction in GHG emissions by 2020.
- Distributed PV potential is 4,232 MW.





SOLANO COUNTY

- A complex of wind projects near Rio Vista has a capacity of 660 MW.
- Vaca Dixon solar project has a capacity of 2 MW.
- Benicia Climate Action Plan targets a 10 percent reduction of GHGs below 1990 levels by 2020.
- Distributed PV potential is 946 MW.

SONOMA COUNTY

- The Geysers is US' first major geothermal project. Its complex of 18 power plants has a total combined capacity of 900 MW.
- City of Healdsburg runs its own public power agency.
- Sonoma County Energy Independence Program offers PACE financing for homeowners.
- Sonoma County Climate Action Plan targets 25 percent reduction in GHG's below 1990 levels by 2015.
- Distributed PV potential is 1,090 MW.

Solano County wind farm. Photo: Pacific Environment.

BILL POWERS, P.E.

Mr. Powers is a registered professional mechanical engineer in California with over 25 years of experience in the energy and environmental fields. He is the author of the 2007 strategic energy plan, "San Diego Smart Energy 2020," for the San Diego region. The plan uses California's Energy Action Plan as the template for accelerated introduction of local distributed renewable and combined heat and power resources to reduce greenhouse gas emissions from power generation in the San Diego region by 50 percent by 2020. Mr. Powers served as an expert witness in a landmark California Energy Commission proceeding where the Commission determined urban solar photovoltaics could potentially serve as a cost-effective alternative to conventional gas turbine peaking power. He has written numerous articles on the strategic cost and reliability advantages of local renewable energy over large-scale, remote, transmission-dependent renewable resources.

Mr. Powers began his career converting Navy and Marine Corps shore installation power plants from oil-firing to domestic waste, including woodwaste, municipal solid waste, and coal, in response to concerns over the availability of imported oil following the Arab oil embargo. He has permitted numerous peaking gas turbine, microturbine, and internal combustion engine cogeneration plants in California. Mr. Powers organized the first U.S. conference focused exclusively on dry cooling systems for power plants in 2002. Mr. Powers currently serves on the San Diego Environmental and Economic Sustainability Task Force. The mission of the task force is to produce a Climate Mitigation and Adaptation Plan for San Diego. Mr. Powers has a B.S. in mechanical engineering from Duke University and an M.P.H. in environmental sciences from the University of North Carolina—Chapel Hill.

(Endnotes)

1 The California *Energy Efficiency Strategic Plan* target of 25 percent of residences reaching 70 percent reduction in electricity usage by 2020, compared to a 2008 baseline, is modified in BASE 2020 to 25 percent of residences achieving 100 percent reduction in electricity usage by 2020. The *Energy Efficiency Strategic Plan* target of 50 percent of existing commercial buildings reaching net zero energy by 2030 is expanded in BASE 2020 to establish a target of 25 percent of commercial buildings reaching net zero energy by 2020.

2 Commercial PV is eligible for accelerated depreciation.

3 "Management" in this case refers to widespread adoption of air conditioner cycling as a peak load reduction measure

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Download the entire report at
www.PacificEnvironment.org/BASE2020

100% Recycled, 100% Post-Consumer Waste, Processed Chlorine Free