

Clean Energy Opportunities in California's Water Sector

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April 2015

Introduction

California's water sector consumes nearly 20 percent of the state's electricity, and its needs are growing. The water sector uses electricity to pump, treat, transport, deliver, and heat water (CEC 2006). And expected increases in groundwater pumping, water treatment, and water recycling mean the energy intensity of water will grow. While there is growing recognition that increased water efficiency is one of the fastest and cheapest ways to conserve electricity, less attention has been paid to the sources of electricity powering the water sector. This report focuses on opportunities for water and wastewater utilities to invest in clean, renewable energy, as well as on the barriers that have prevented these opportunities from being fully realized. These potential investments offer benefits to water utilities, their customers, and the state's effort to provide sufficient supplies of reliable, cost-effective electricity and water while reducing global warming pollution. For California to meet its climate goals, we need to rethink the role that water plays as a significant electricity consumer and producer.



In 2010, the San Francisco Public Utilities Commission completed construction of a 5 MW solar photovoltaic installation on the roof of Sunset Reservoir.

Among our key findings:

- **Regulatory misalignment hinders integrated planning for a clean water and energy future.** Although there are clear opportunities and benefits for water and wastewater utilities to participate in the clean energy transition, there is no systematic strategy to remove a range of institutional, financial, regulatory, and informational barriers. These barriers must be addressed in order to unlock the water sector's potential to contribute to California's climate goals.
- **Consistent baseline information, needed to evaluate the ways that water utilities can contribute to California's clean energy transition and reduce global warming pollution, is lacking.** Improved information from water and wastewater utilities regarding their electricity use and sourcing practices can help illuminate the water sector's role in generating clean electricity and providing grid services that will help bring more clean energy onto the grid.
- **New revenue sources are available to water and wastewater utilities that participate in California's clean energy transition.** Participating in the clean energy transition can open up new revenue sources for the water sector, including the sale of excess renewable electricity or receipt of renewable energy credits, cap-and-trade proceeds, payments for providing grid services, and fees for accepting organic wastes for renewable energy generation.

AT A CROSSROADS: PART OF THE PROBLEM OR PART OF THE SOLUTION?

The water sector is at a crossroads. Its electricity requirements are growing in California due to increased or more complex water treatment, a greater reliance on groundwater, and pumping from greater depths as groundwater levels decline. At the same time, the electricity sector is undergoing a major transformation in an effort to reduce power demand and to rely on larger amounts of renewable energy, which generates little or no global warming emissions. Water and wastewater utilities access electricity by purchasing it from an electric utility or the wholesale market, by signing a contract with an independent generator, or by generating it themselves. Although the electricity purchased from electric utilities is governed by California's Renewables Portfolio Standard (RPS) and must become cleaner over time, the electricity that water and wastewater utilities directly purchase or generate is not typically addressed by California's climate and renewable energy policies. Therefore, the water sector and its growing electricity needs could contribute to greater global

The water sector's growing energy needs could contribute to greater global warming emissions, at odds with California's efforts to lower emissions associated with electricity.

warming emissions, at odds with California's efforts to lower emissions associated with electricity consumed within the state.

OPPORTUNITIES ABOUND

Conversely, the water sector is poised to become a greater part of the energy and climate solution. Because many water and wastewater utilities have a significant amount of electricity purchasing power and own assets and infrastructure that could host renewable generation facilities or provide flexibility for the electricity grid, they are in a unique position to take advantage of the benefits associated with clean energy investments and to play a more proactive role in helping the state meet its clean energy goals. This opportunity is especially timely given that California is mapping out a plan for deeper emissions reductions and Governor Brown has made a commitment to increase the electricity derived from renewable sources to 50 percent by 2030.

Numerous studies and real-world experiences have found that many water and wastewater utilities can rely primarily on renewable sources of electricity. One example is the Sonoma County Water Agency's (SCWA) policy to reduce the global warming emissions associated with its water services in order to achieve "carbon-free water" by 2015 (see Box 1).¹ If 25 percent of the electricity used by water and wastewater utilities came from renewables or was offset by energy efficiency, it would contribute 1,000 MW to California's electricity supply (Park and Croyle 2012).

MISSING INFORMATION AND REGULATORY BARRIERS HINDER PROGRESS

Electric utilities are required by state law to disclose the sources of the electricity they sell. This disclosure requirement does not extend to most water and wastewater utilities, hindering the state's ability to understand and track electricity generation, use, and related emissions.² This missing data also makes it much more difficult for water utilities themselves

to identify clean energy opportunities that may help them save money and protect their ratepayers from uncertainty due to climate change or fossil fuel price volatility. Although they are not required to, some water and waste-water utilities independently report their sources of electricity, but the information is not compiled in a standardized format or updated on a regular schedule. If the water sector is to take advantage of opportunities to save electricity and money—and transition to cleaner and more sustainable forms of electricity—water and wastewater utilities will need to provide information

that will allow the state to identify opportunities and track progress.

Along with missing information, a number of other barriers hinder progress. Some of these barriers are structural and are therefore particularly difficult to change, such as the heterogeneity and fragmentation of the water sector. The different institutional cultures of water utilities and energy utilities are also a barrier. However, some of the financial and regulatory barriers could be tackled. A combination of smart leadership within utilities and relevant state agencies

BOX 1.

Sonoma County Water Agency's Energy Policy, Establishing Its Goal to Provide "Carbon-Free" Water

In 2011, the Sonoma County Water Agency adopted an energy policy pledging to develop renewable energy sources, conserve water, and improve system efficiency to work towards a goal of carbon-free water in 2015. The policy reads:

The Water Agency has a special interest in energy matters that arises from a unique set of circumstances:

The Water Agency is a large energy consumer. The Water Agency is among the region's largest users of electricity. The pumping and distribution of potable water to more than 600,000 Sonoma and Marin County residents takes large amounts of electrical power, as does treatment processes in the Water Agency's sanitation facilities.

The Water Agency is an electricity producer. The Water Agency's enabling statute allows it to produce electrical power. The Water Agency owns hydroelectric and solar facilities, which provides it with renewable, carbon-free electricity.

The Water Agency is a leader in climate mitigation activities. The Water Agency is a leader in developing projects and programs to reduce the risk of climate change through innovative projects and programs. In addition to investigating alternative renewable power sources, such as biogas, fuel cells, wind, wave, and geothermal energy projects, the Water Agency has supported the deployment of energy-conserving measures such as plug-in hybrid vehicles and LED lighting.

While it will always be a major consumer of energy, the Agency is committed to developing sources of power that balance its responsibilities to its customers and to the

environment. It is the Agency's policy to meet this commitment through:

Carbon Free Water—Recognizing the threat to economic security and public safety posed by climate change, the Agency will continue to implement programs that reduce the Agency's greenhouse gas production, with the goal of achieving a net carbon neutral energy supply by 2015. These programs include:

Develop Renewable Energy Sources—The Water Agency will continue to develop projects that reduce the carbon intensity of its power supply. Projects could include solar, wind, wave, geothermal, anaerobic digestion, or pyrolysis energy systems.

Water Conservation—Conserving water means conserving power. The Water Agency will continue to promote cost-effective water conservation measures.

System Efficiency—The Water Agency will implement cost-effective energy conservation measures wherever possible, saving ratepayers' money and reducing environmental impacts.

Projects of Regional Benefit—The Agency will continue to seek and develop more reliable sources of electricity for the region, including participating in local energy projects and programs that promote self-sufficiency and make North Bay residents less dependent on outside energy sources subject to market fluctuations, natural disasters, and transmission system failures. To accomplish this, the Agency will seek to work with partners, such as the County of Sonoma and other local jurisdictions (SCWA 2011).

plus thoughtful legislation aimed at collecting the needed information, developing a roadmap of opportunities, and creating incentives (or reducing disincentives) could maximize the water sector's contribution to the state's effort to reduce global warming emissions associated with electricity.

Background

Over the last several years, there has been an increasing focus on the water-energy nexus as awareness grows that we need better understanding of both the water demands of the power sector (for power plant cooling, for example)³ and the energy demands of the water sector. This report looks at the latter issue—the energy demands related to providing water services. While this report focuses on California, many of the opportunities it identifies are present in other areas of the country as well. Electric utilities, water utilities, and wastewater utilities dramatically improved the quality of life over the twentieth century, yet many of their systems were designed and operated with an assumption that water and electricity would continue to be inexpensive and plentiful. Moreover, like other sectors of society, utilities did not anticipate limits on global warming emissions (Johnson Foundation 2014). These conditions have changed, and utilities are changing as well. There is a growing interest in defining the “utility of the future” as one that optimizes and integrates water and energy resources (WEF 2012).

THE ELECTRICITY IN OUR WATER

The treatment and transport of water in California represents a large share of electricity consumption in the state. The California Energy Commission (CEC) estimates that the water sector accounts for nearly 20 percent of the state's electricity demand (CEC 2006). This number includes two categories of use: (1) the electricity used by water and wastewater utilities to capture, treat, and pump water to customers and (2) the electricity used by end users, for instance when pumping water from private groundwater wells.⁴

Here, we focus on the first category of use (see Box 2). We use the term *water and wastewater utilities* to include the variety of institutional structures used to deliver and treat water, such as wholesale water suppliers, retail water suppliers, irrigation districts, flood control districts, reclamation districts, joint powers authorities, special districts, mutual water companies, investor-owned water companies, community service districts, wastewater treatment providers, and publicly owned treatment works. The most recent analyses suggest that the amount of electricity used by water and wastewater utilities alone accounts for about half of the total electricity

requirements of the water sector, or around 10 percent of California's electricity use (CPUC 2010a).⁵

Historically, global warming emissions associated with the electric sector have comprised a significant portion of California's total emissions; in 2012, they represented one-fifth of total reported emissions (ARB 2014). Reducing California's electricity consumption by means of energy efficiency investments and bringing on additional clean, renewable electricity generation will help the state reduce its reliance on fossil-fuel-based energy and achieve its climate goals (see Box 3). To date, there has been a limited understanding of the water sector's—and specifically water and wastewater utilities'—role in meeting the state's climate goals.

ELECTRICITY DEMAND IS PROJECTED TO INCREASE

As water and wastewater utilities pump more groundwater due to drought, comply with increasingly stringent federal

BOX 2.

Energy Used in the Water Sector

The water sector uses energy in a variety of ways to treat, convey, distribute, and heat water. But water utilities, wastewater utilities, and water users all use energy differently. This report addresses only water and wastewater utilities' energy use.

WATER UTILITIES

Create Supply

- Collect surface water
- Pump groundwater
- Desalinate water

Treat Water

- Filtration
- Disinfection
- Advanced Treatment

Convey Water

- Transport wholesale water
- Distribute treated water to end users

WASTEWATER UTILITIES

Treat Wastewater

- Filtration
- Disinfection
- Advanced Treatment

Dispose of or Reuse Treated Water



The water sector's electricity needs are growing due to drought, increasingly stringent federal water quality standards, and more energy-intensive water supplies such as recycled water. Recycled water is delivered through the purple pipes seen here.

water quality standards, and pursue more energy-intensive water supplies such as recycled water (see Figure 2, p. 6), their electricity demand will increase. For example, groundwater accounts for about 40 percent of the water used in California in normal years and up to 60 percent of the water used during droughts (California Water Foundation 2014). Increased groundwater pumping has contributed to the widespread lowering of groundwater tables (Famiglietti et al. 2011). More pumping and pumping from greater depths has led water agencies to use more electricity.

In addition, many water and wastewater utilities are planning to increase water recycling to provide a “drought-proof” water supply. Indeed, the State Water Resources Control Board (SWRCB) has a goal of increasing the use of recycled water by at least 1 million acre-feet per year by 2020 and by at least 2 million acre-feet per year by 2030 over 2002 levels (Recycled Water Policy, adopted by the SWRCB in 2009). Although recycled water will undoubtedly be an important part of California’s future water supply, recycling water often requires more energy than treating water taken

from surface or underground sources. The WaterReuse Foundation (Raucher and Tchobanoglous 2014) estimates that it would require an additional 1,215 GWh per year to recycle about 1 million acre-feet of water to potable standards. Moreover, to reach the SWRCB’s 2030 goal, the water sector’s energy requirements would grow by around 2,430 GWh per year (based on estimates from Raucher and Tchobanoglous 2014).

Finally, several water utilities are looking to seawater for another “drought-proof” water supply—two desalination plants are being built in Cambria and Carlsbad, and there are currently plans to build 17 more desalination plants in California. Desalination is energy intensive. If all these plants are built and brought online, they would increase electricity use by about 2,800 GWh per year (Cooley and Heberger 2013). The amount of electricity demanded by 19 desalination plants plus increased water recycling (around 5,230 GWh per year) is equivalent to the electricity consumed by 756,078 average California households (EIA 2012), or to one coal-fired thermoelectric plant.

In summary, the water sector is poised to become an even larger energy consumer, surpassing 20 percent of the state’s total electricity requirements. However, many water and wastewater utilities could also become clean energy leaders, as we will describe in more detail.

ELECTRICITY SOURCES ARE UNCLEAR

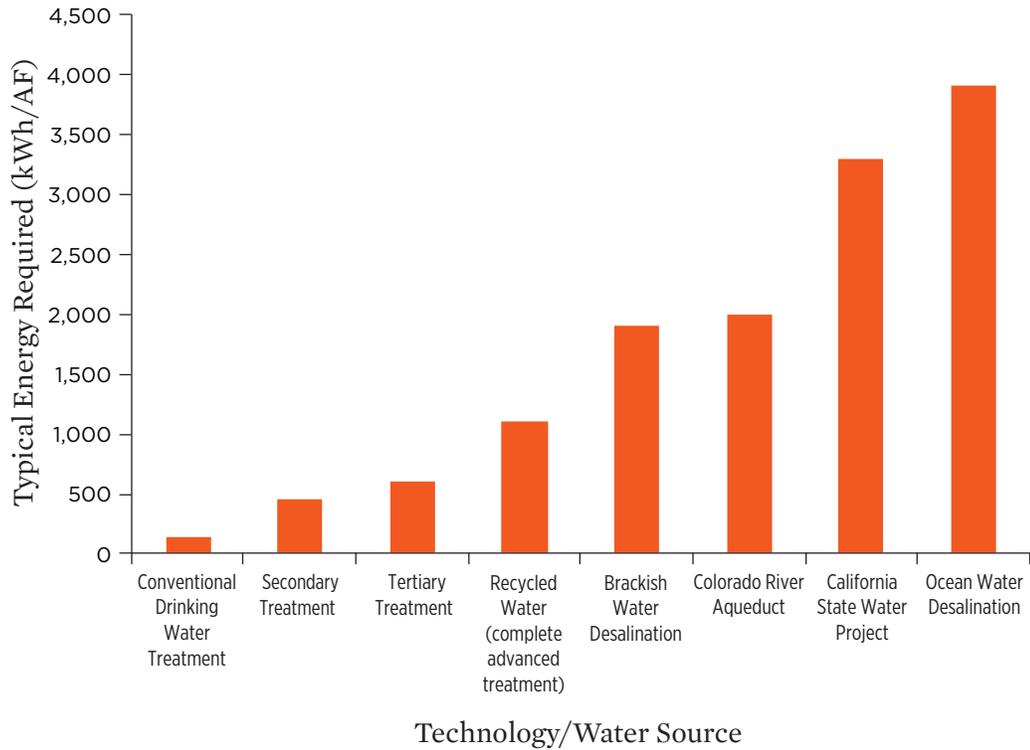
While state law requires electric utilities to disclose the sources of the electricity they sell⁶ (see Box 4, p. 7), this

BOX 3.

California Assembly Bill 32: The Global Warming Solutions Act

This law, often referred to as AB32, requires California to reduce global warming emissions to 1990 levels by 2020. To fulfill this mandate, the state has adopted a suite of policies and programs, including emissions standards for new vehicles and vehicle fuels; energy efficiency standards for appliances, buildings, and industrial processes; a cap-and-trade program covering large emitters; and policies that encourage renewable energy investments. In addition, an executive order signed in 2005 establishes the goal of reducing California’s global warming pollution to 80 percent below 1990 levels by 2050.

FIGURE 1. Electricity Requirements for Different Water Treatment Processes



The energy footprint of water supplies can vary greatly. A key consideration for new water supply alternatives is the amount of energy required to obtain, treat, and deliver potable water. In California, the most energy-intensive water supplies include large interbasin water transfers through the Colorado River Aqueduct and State Water Project and ocean water desalination.

SOURCE: RAUCHER AND TCHOBANOGLIOUS 2014.

disclosure law does not extend to water utilities that are not retail electricity providers. Some water and wastewater utilities independently report the sources of their electricity, but the information is not compiled in a standardized format or updated on a regular schedule across the water sector. Even in cases in which water utilities are required to submit power source disclosure forms, these forms lump together electricity that is self-consumed with electricity that is sold to other electricity providers. It therefore remains difficult to get a clear picture of how much, and what kinds of, electricity California’s water and wastewater utilities rely on to power their services. This incomplete picture of the sources of electricity used by water and wastewater utilities makes it difficult to understand how their electricity choices impact global warming emissions and the state’s efforts to decarbonize the electricity sector.

Water and wastewater utilities access electricity by purchasing it from an electric utility or the wholesale market,

It remains difficult to get a clear picture of how much, and what kinds of, electricity California’s water and wastewater utilities use.

by signing a contract with an independent generator, or by generating it themselves. If they purchase electricity from another utility or the market, they generally have less control over sources because they purchase a mix of whatever is generated on the grid. But if the utility signs a contract with a specific generator or owns its own generation resources, it clearly has choices about the source of that electricity.

A 2010 study of nine large water utilities concluded that the majority of the electricity used was generated by the water utilities themselves (CPUC 2010a).

California has several policies that are designed to hasten the transition from fossil-fuel-based electricity to increased use of renewables. The state’s largest renewable energy program—the RPS—currently requires all electric utilities to source 33 percent of their retail electricity sales from renewables by 2020. But only a fraction of the more than 7,000 water and wastewater utilities are directly subject to the RPS requirements.⁷ For example, the Colorado River Aqueduct is not required to participate in the clean energy transition.

Clean Energy Opportunities and Benefits for Water and Wastewater Utilities

Many water and wastewater utilities have a significant amount of electricity purchasing power, often have experience generating their own electricity, and own assets and infrastructure that could host renewable generation facilities and provide flexibility for the electricity grid. They are therefore in a unique position to benefit from clean energy investments and as well as to play a more proactive role in helping the state lower global warming pollution associated with electricity generation.

BOX 4.

Electricity Source Reporting

Retail electricity providers are required to submit power source disclosure forms each year to the CEC. These forms provide information about the amount and sources of electricity consumed and sold to retail and wholesale customers. Providers are also required to disclose this information publicly in the form of a Power Content Label, similar to the nutrition label found on many foods. The standardized format of the Power Content Label makes it easy for electricity customers to understand the sources of their provider’s power and to compare one provider’s power mix to another’s. Twenty-two water utilities are classified as retail electricity providers in California and thus are required to submit power source disclosure forms.

The Imperial Irrigation District (IID) is a publicly owned electric utility as well as a water utility; it is therefore required to submit a power source disclosure form and to comply with the RPS. The table to the right shows the district’s 2013 Power Content Label, which compares its electricity sources to the average total electric system power mix in California. While the district initially lagged behind other publicly owned electric utilities in terms of renewable energy investments (Wisland and Haya 2012), it has made significant efforts over the past three years to bring more clean energy online. In 2013, the IID was powered by 34 percent renewable sources (exceeding the RPS requirement of 33 percent by 2020). The district has scaled up its investment in renewables, primarily by taking advantage of resources in its own backyard, including biomass, solar, and geothermal resources. In particular, the IID has chosen to enter into several long-term⁸ power purchase agreements for solar power produced in California. In addition, the district has signed several short-term⁹ power purchase agreements for biomass, biogas, and geothermal power.

Power Content Label from the Imperial Irrigation District, 2013

Energy Resources	2013 IID Power Mix (Actual)	2013 CA Power Mix**
Eligible Renewable	34%	19%
<i>Biomass & Waste</i>	11%	3%
<i>Geothermal</i>	6%	4%
<i>Small Hydroelectric</i>	8%	1%
<i>Solar</i>	5%	2%
<i>Wind</i>	4%	9%
Coal	12%	8%
Large Hydroelectric	4%	8%
Natural Gas	35%	44%
Nuclear	3%	9%
Other	0%	0%
Unspecified Sources of Power*	12%	13%
Total	100%	100%

In 2013, the Imperial Irrigation District sourced 34 percent of its power from renewable energy sources, exceeding California’s RPS. The district also sourced power cleaner than that provided by the California grid, which averaged 19 percent renewable energy.

* “Unspecified sources of power” means electricity from transactions that are not traceable to specific generation sources.

** Percentages are estimated annually by the CEC based on the electricity sold to California consumers during the previous year.

SOURCE: CALIFORNIA ENERGY COMMISSION. WWW.ENERGY.CA.GOV/SB1305/LABELS/INDEX.HTML

PROTECTING CUSTOMERS FROM ELECTRICITY PRICE VOLATILITY

In most cases, electricity is one of the largest costs for water and wastewater utilities, and these costs are reflected in the prices customers pay for their services. Fossil fuel prices have historically been volatile (EIA 2007); when water utilities purchase electricity generated by burning fossil fuels, they (and their customers) are exposed to that price volatility. When water utilities directly invest in renewable energy generation, either by owning a facility or buying the output from a facility, the price of the electricity is locked in, providing the utility with valuable price stability. These stable electricity prices can be built into the rate base, avoiding sudden rate changes that can be controversial and costly.

For example, the Inland Empire Utilities Agency (IEUA) responded to the electricity price spikes following energy deregulation by making a commitment to “go gridless by 2020.” This commitment to proactively managing their energy uses and sources has gone hand-in-hand with a commitment to a cleaner energy future. The IEUA currently uses approximately 75 GWh of electricity annually at its regional water recycling plants and other facilities (IEUA 2014a). More than 20 percent comes from renewables, primarily biogas produced at its wastewater treatment plants. The IEUA’s Energy Management Plan has a specific focus on scaling up renewables to satisfy all of the agency’s electricity requirements during the peak energy pricing period (IEUA 2014b).

INCREASING RESILIENCE TO CLIMATE IMPACTS

Relying on non-hydropower renewables to meet a larger portion of electricity demand can also help the water sector adapt to climate change by diversifying its energy sources. During the 2007 to 2009 California drought, hydropower generation was roughly halved and energy utilities were forced to substitute with other energy sources, including more expensive natural gas. This substitution led to increased costs for electricity ratepayers, totaling roughly \$2 billion over the three-year period (Christian-Smith, Levy, and Gleick 2014).

As large electricity users, water and wastewater utilities are vulnerable to changes in energy availability and prices. Moreover, if they rely on their own generation of hydropower or purchases of hydropower-dominated supplies—for example, from the Western Area Power Administration (WAPA)—they are especially vulnerable to changes in the timing and availability of water. Climate change is expected to increase the frequency and severity of droughts in California (IPCC 2013; Karl, Melillo, and Peterson 2009; Sheffield and Wood 2008). Non-hydropower renewable energy generation therefore becomes not only an important step in combating climate change, but also a smart way to reduce business risk.

PROVIDING NEW REVENUE STREAMS

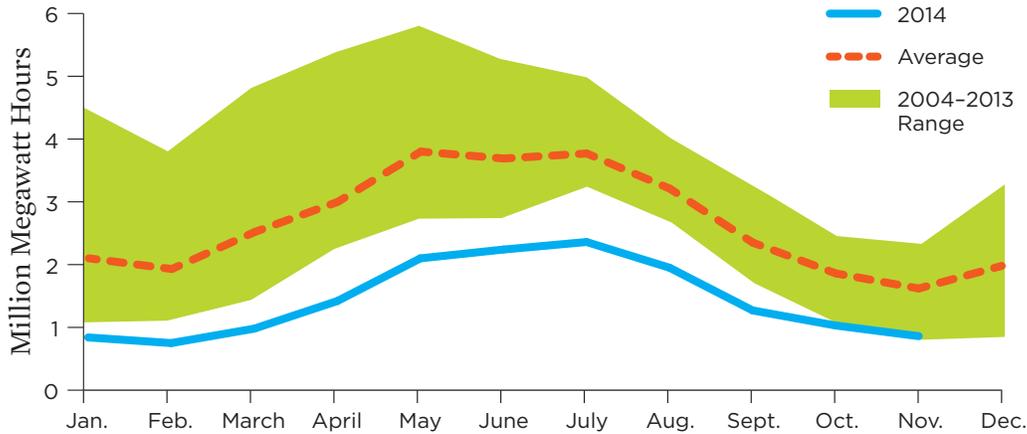
If water and wastewater utilities generate or purchase more renewable electricity than they need, they can sell the electricity, the renewable energy credits (RECs) or “green attributes” associated with that electricity, or both to an electric utility that must comply with the RPS program. For example, the East Bay Municipal Utility District’s (EBMUD) wastewater treatment plant is a net producer of renewable energy (producing 55 GWh of RPS-eligible electricity each year). It sells the RECs associated with this clean energy to Pacific Gas and Electric Company (PG&E), which buys them to comply with state climate laws (EBMUD 2014). Moreover, EBMUD sells its excess power to the Port of Oakland and also receives revenue from tipping fees it charges for accepting organic waste, which it uses to help fuel co-digestion.¹⁰

Water and wastewater utilities can increase revenues in two other ways. Both were made possible in 2014, when cap-and-trade revenues became available to the water sector through the Water-Energy Grant Program. This program provides funds to implement water efficiency programs or other water projects that reduce global warming emissions and reduce water and energy use. First, water utilities that are electric utility customers can take advantage of “demand response” programs that help reduce their electricity bills by shifting their electricity use to times of day when rates are lower. Second, there are growing opportunities for water and wastewater utilities to get paid for dynamically ramping up or down their energy-consuming devices, an activity called fast acting grid services or ancillary services. These slight changes in power demand give electricity grid operators tools for managing the power system in real time, particularly



The East Bay Municipal Utility District's wastewater treatment plant in Oakland is a net producer of electricity.

FIGURE 2. Hydropower Generation in California, 2003 through 2014



Hydropower generation varies by month and year, and that variance may grow due to climate change. To protect against growing drought risk, California water utilities that rely on hydropower should invest in alternative, clean sources of generation to meet future electricity needs.

SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION, ELECTRIC POWER MONTHLY. [HTTP://WWW.EIA.GOV/ELECTRICITY/MONTHLY](http://www.eia.gov/electricity/monthly).

as we shift to more intermittent electricity sources such as solar and wind power.

RENEWABLE ENERGY INVESTMENT STRATEGIES

UTILITY-OWNED GENERATION

The most direct way for a water utility to invest in renewable energy is to build and operate a renewable energy project on its land or infrastructure. Most water and wastewater utilities own assets that position them well to invest directly in clean energy. These assets include reservoirs and ponds that can host floating solar panels, canals and pipelines that can provide small conduit and in-conduit hydropower, water and wastewater treatment facilities that can generate biogas, and land that can be used for wind, solar, biomass, and geothermal energy generation. These investments can be sized to meet the utility's on-site electricity needs,¹¹ or the utility can invest in a larger facility and work with the local electric utility or power scheduling coordinator to sell electricity to the grid.

California water utilities already own a fair amount of hydropower generation. Although overreliance on hydropower is unwise due to more frequent drought, it is still an important resource for the state. Only small-scale existing hydropower is considered renewable under the state's RPS program, but all hydropower in California emits very low or negligible amounts of global warming pollution.¹² A number of water-storage facilities owned by water utilities host

hydropower generation that was installed decades ago. For instance, in 2011 the State Water Project, operated by the Department of Water Resources, supplied nearly all of its electricity needs from a combination of its own hydroelectric facilities¹³ and purchases of hydropower from other water utilities, including the Kings River Conservation District and the Metropolitan Water Agency (DWR 2012).

Even though the opportunities to build additional hydropower projects in California that require water diversions and impoundments are fairly limited, water utilities own infrastructure—such as canals and pipelines—that could host small turbines to capture the kinetic energy in flowing water (small conduit or in-conduit hydropower). For example, San Diego County Water Authority (SDCWA) installed 4.5 megawatts (MW) of in-conduit hydropower generation in their water delivery infrastructure in 2007 as part of a larger effort to upgrade their system. Electricity from the project qualifies as renewable under the RPS and is sold to San Diego Gas and Electric Company. According to its own initial analysis, the SDCWA could generate up to 63.7 GWh of additional renewable electricity by installing in-conduit hydro in six more locations, all of which have payback periods of 10 years or less (SDCWA 2014).

Water and wastewater utilities can also install renewable generation facilities on their buildings and lands. The SCWA owns three small-scale solar photovoltaic facilities on its agency headquarters, carport, and two water treatment

facilities. These facilities meet about 5 percent of the agency's total electricity needs. In 2013, the SCWA also installed a wind turbine at their Geyserville wastewater treatment plant that powers approximately 7 percent of that facility's electricity needs (SCWA 2015).

Wastewater utilities process large amounts of organic wastes. As these wastes break down, they produce biogas, a powerful global warming pollutant that can be captured and used to generate renewable electricity. The energy contained in wastewater is greater than the energy required for treatment. In many cases, wastewater utilities have the potential to generate all the electricity they need to operate their systems and, in some cases, even to sell excess electricity. As previously noted, EBMUD's wastewater treatment plant is a net energy producer, selling excess electricity to the Port of Oakland. Other utilities are not far behind. For example, the Fresno-Clovis Wastewater Treatment Plant can generate approximately 3.3 MW of renewable electricity from its biogas and co-digestion facilities, which currently provide approximately 75 percent of the total electricity required for wastewater treatment (City of Fresno 2014). In addition, the City of Fresno is currently seeking out additional organic wastes from the surrounding agricultural area to increase the energy generated by co-digestion (Hogg 2014).

POWER PURCHASE AGREEMENTS

Power purchase agreements (PPAs) are contracts between an individual or group of electricity purchasers and an independent electricity generator. PPAs allow water utilities to make direct investments in renewable energy projects without having to finance, build, own, or operate the projects. The electricity generated by these projects can be consumed on-site or sold back into the electricity grid.

In many cases, water and wastewater utilities may want to invest in a generation facility or enter into a PPA jointly with other electricity users to lower transaction costs and allow parties to pool assets to invest in larger projects. For example, the state helped launch the Solar Energy and Economic Development (SEED) fund. The SEED fund is a revolving loan tool that allows cities and municipal agencies (including public water and wastewater utilities) to participate in a collaborative solar procurement without spending money upfront on reviewing sites, preparing competitive bid documents, or negotiating contracts. Solar projects built with SEED funds return a portion of project costs to the revolving loan program to provide the funds for new projects (Solar Roadmap 2015).

Publicly owned water and wastewater utilities can also participate in collaborative electricity purchases through a joint powers authority (JPA). This can help with clean energy

investments because a JPA can act as the entity that schedules the electricity supply, a step needed to sell power to the grid. For example, the Power and Water Resources Pooling Authority (PWRPA) is a JPA composed of 15 water and irrigation districts.¹⁴ The PWRPA allows its members to make joint electricity purchases and aggregate their allocations of

Power purchase agreements allow water utilities to make direct investments in renewable energy projects without having to build, own, or operate the projects.

low-cost electricity generated at federal dams throughout the western United States. The PWRPA allows any of this power that cannot be used by one member to be returned to the pool for use by other members. The PWRPA also provides a means for its members to pay wholesale power transmission rates rather than retail rates, significantly reducing the overall cost of power to members.

PARTNERSHIP WITH LOCAL ELECTRIC SERVICE PROVIDERS

Finally, even if water and wastewater utilities do not need or want renewable energy to power their own services, they may be able to host clean generation facilities that will generate electricity to be sold to the local electricity provider. The SCWA signed an agreement to lease the surface area of some of its storage ponds to Pristine Sun, which will install 12.5 MW of floating solar panels (Pyper 2015). The electricity will be sold by Pristine Sun to the local electricity provider—Sonoma Clean Power—which will then sell the electricity to its retail customers.

PROVIDING GRID FLEXIBILITY

As the state transitions to a greater reliance on renewables to meet its electricity needs, grid operations must become more flexible in order to take advantage of renewable power when it is generated, for instance when the sun is shining or the wind is blowing. Among ways to help increase the amount of renewable energy used on the grid is to shift electricity consumption to times of day when renewable sources are most active and to operate electricity-consuming devices in accordance



Installing PV panels on-site can allow utilities to generate their own electricity or even sell excess electricity.

with grid needs rather than purely at will. Given the amount of electricity used by water utilities, they may be able to play a significant role in providing future grid flexibility.

DEMAND RESPONSE

Traditionally, demand response programs have focused on shifting electricity loads to off-peak periods and reducing load during critical peak times, when the grid is most challenged. This helps avoid the use of older, less efficient power plants, which emit additional global warming pollution. In addition, as California brings more renewables online, demand response has allowed the absorption into the grid of larger quantities of renewables whose power production varies by time of day and time of year.

Shifting electricity demand to off-peak times of day saves water and wastewater utilities' money because they are charged a lower rate and can avoid extra charges for using electricity during peak demand times. The savings are calculated as kilowatts (kW) of demand shifted. PG&E, for example, offers water and wastewater utilities that participate in demand response net savings from \$0.50 to \$1.05 per kW of demand shifted.¹⁵ When electric utilities forecast that the grid will be stressed, they will pay water and wastewater utilities for reducing electricity demand with advance notice.

Water and wastewater utilities can participate in demand response programs without disrupting water supply or treatment processes. Examples of participation include temporary pump shutdown, reducing the number of booster pumps

Shifting electricity demand to off-peak times of day saves water and wastewater utilities' money.

operating by adjusting pressure-reducing valves, changing the rate of pumping, turning off or slowing down treatment or filtration plants, and temporary substitution of gravity-fed water supplies. Demand response can be manual or automated, and all of the investor-owned electric utilities in California offer financial incentives for upgrading to the equipment required to participate in demand response programs. PG&E offers up to \$200 per kW of demand shifted. Water utilities can work directly with their electricity providers to explore demand response opportunities that lower electricity bills, or they can work with a third-party aggregator that serves as a go-between for electricity utilities and a group of demand response providers.

Some water utilities are already large providers of demand response. For example, the State Water Project uses pumps to move water from northern to southern California. The pumps make it one of the largest consumers of electricity in the state. But they also allow it to respond to high grid demand: it can curtail pumping in order to make the electricity

it would have used available to other parts of the state when the grid is stressed (DWR 2012). In addition, the Orange County Water District has a contract to provide demand response to Southern California Edison. Finally, water and wastewater utilities can also band together to provide demand response. The City of Fresno is one of nearly 100 water and wastewater utilities that have contracts with EnerNOC,¹⁶ one of several companies that aggregate the demand response capability of many power users, to shift demand during peak power events.

Finally, water utilities that own pumped hydropower assets or are considering these investments could also provide valuable load shifting on the grid. Pumped hydropower facilities use electricity to pump water from a lower elevation reservoir to an upper reservoir. They then generate hydropower by releasing the water from the upper reservoir. Pumped hydropower acts as an energy storage device because it can pump water uphill when the grid has excess electricity and prices are relatively cheap, store the water in the upper reservoir, and generate electricity when the grid needs it.

FAST-ACTING GRID RELIABILITY

Water and wastewater utilities may also be able to change the way they operate electricity-consuming devices, such as pumps, to provide real-time grid services that maintain the efficiency of the transmission network and ensure reliability if a major power plant or transmission line unexpectedly goes offline. Fossil-fueled power plants have traditionally supplied these reliability services. However, as the state seeks to reduce its reliance on fossil fuels, the ability of electricity-consuming devices to respond quickly to signals from the grid will become more valuable and may offer additional sources of revenue to water and wastewater utilities. For a water or wastewater utility to deliver fast-acting grid services, it needs automated systems that are connected to local electric utilities, balancing authorities, or the California Independent Systems Operator and able to respond in real time to grid signals such as load shedding.

Looking Forward: Capturing the Potential

Water and wastewater agencies, collectively, are significant consumers and generators of electricity in California. As their energy requirements grow over the coming decades, they could be an important part of achieving the state's climate goals. Clean energy investments will help the water sector achieve greater control over its electricity supplies, will provide protection from fossil fuel price volatility, and could provide new revenue streams from renewable electricity

or REC sales, cap-and-trade funds, tipping fees, demand response savings, and payments for providing fast-acting grid services. It is clear that there are many advantages to partnering with the water sector in achieving California's climate goals. However, to unlock this potential, it will be necessary to remove barriers and create incentives for progress. Below, we describe some of the key barriers water and wastewater utilities currently face, and we provide several recommendations for moving forward.

Clean energy investments will help the water sector achieve greater control over its electricity supplies, will provide protection from fossil fuel price volatility, and could provide new revenue streams from renewable electricity sales.

KEY BARRIERS

INFORMATIONAL

- **Lack of data about electricity consumption.** In many cases, it is not clear or easy to understand how much electricity a utility uses to extract, treat, and transport water in California. This makes it difficult for entrepreneurs to help utilities find ways to benefit from clean energy investments or load-shifting techniques, for policy makers to understand the big-picture opportunities, or for utilities to learn from each other. Numerous studies have recommended that the state collect better data about water-related electricity requirements (CPUC 2010a; CPUC 2010b; CEC 2006).
- **Lack of data about electricity sources.** Even as the state makes progress in understanding the total electricity needs of the water sector and the embedded energy in water, it can be difficult to find information about electricity sources. Although a few water utilities are required to provide power source disclosure forms, there is no standardized required reporting for the vast majority of water and wastewater utilities. Standardized reporting

would make it easy to compare one utility to another and to compare each utility to itself over time.

- **Lack of data about electricity demand flexibility.** In the past, it has been difficult for some water and wastewater utilities to understand their energy demand load profile. As smart meters become more widespread, they will make it much easier to understand almost-instantaneous load profiles. Water and wastewater utilities will need tools to understand where they have flexibility in those loads and how they may be able to provide valuable grid services.
- **Lack of information about how to provide grid services.** It can be difficult for water and wastewater utilities to learn about the cost savings and financial incentives associated with existing demand response programs.

REGULATORY

- **No big-picture road map.** Currently, there is no agency officially tasked with looking across the water sector to determine the most cost-effective and beneficial ways to reduce global warming emissions and rely on cleaner sources of electricity. This is unlike the energy sector, for which the CEC releases the Integrated Energy Policy report every two years. This report assesses major challenges and opportunities facing the sector and provides policy recommendations aimed at conserving resources and protecting the environment and public safety.
- **Interconnection hurdles.** If a utility wishes to invest in its own energy generation facility, it must navigate an application process to gain permission to connect to the grid. While the electric utilities and state and federal agencies in charge of interconnection have been working to streamline this permitting process, it is still lengthy and confusing to newcomers. Interconnection processes can be especially challenging for water and wastewater utilities because they may lack flexibility in terms of the size and location of the facility they wish to connect to the grid. In addition, the costs of gaining access to the grid may act as a barrier to entry for some water and wastewater utilities.
- **Policy uncertainty for renewable energy incentives.** The state's current RPS program extends only through 2020. The electric utilities are already close to meeting the program's requirements, so they may be less willing to consider purchasing excess renewable generation or unbundled RECs¹⁷ from the water sector without further policy signals. In addition, even if electric utilities are still willing to procure additional renewables, they may

be able to find cheaper offers from other market providers. There is also uncertainty around policies that define the opportunities for small-scale investments. The state is currently undergoing a process to determine how excess generation from net-metered facilities will be priced, which creates uncertainty for would-be investors in the meantime.

FINANCIAL

- **Lack of capital.** It is often difficult for water and wastewater utilities to spend money on investments that do not fall within the scope of traditional water service provisions or regulatory compliance obligations. Furthermore, many utilities struggle to obtain the upfront capital needed. Proposition 218, in particular, requires that water and wastewater utilities go through a cumbersome notification process each time they need to alter rates. This can serve as a significant barrier to new capital projects, including renewable energy investments.
- **Price of renewable energy vs. fossil fuel energy.** Historically, electricity from renewable energy generation facilities has been more expensive than electricity generated from fossil fuels, which may have made it more difficult for water utilities to justify purchases. However, renewable energy prices have plummeted and become much more competitive in the past decade.

STRUCTURAL

- **Fragmentation of the water sector.** Water and wastewater services are provided by more than 7,000 utilities, the majority of which are public and, therefore, governed by local boards. This fragmentation suggests that there may not be a one-size-fits-all solution. It also complicates statewide efforts to encourage conservation, efficiency, or clean energy choices. However, no matter the local circumstances, consistent energy data reporting is important so that a comprehensive and reliable evaluation of water utilities' energy use can be undertaken.
- **Clean energy investment is not clearly articulated as being within the purview of water and wastewater utilities.** The achievement of California's clean energy and climate goals is not currently considered part of most water and wastewater utilities' core responsibilities. Therefore, it is difficult for all but the most motivated water utilities to seek out clean energy opportunities that reduce global warming pollution and provide more cost-effective and reliable services for their customers. A similar situation existed several decades ago when water conservation and efficiency were not considered within utilities' scope of work; changes in law have encouraged

the integration of conservation managers into many water utilities' organizational structures. In many cases, investing in renewables or providing grid services require water and wastewater utilities to expand the ways they think about how to provide services for customers. They may also have to develop in-house expertise to take advantage of these opportunities.

- **Publicly elected boards often fear voter backlash for projects that will not pay off during their terms of office.** The majority of water and wastewater utilities are publicly owned and governed by elected boards whose members are often risk averse. They are often unwilling to invest in innovative ideas that take time to provide a return on investment, even if the future return is large.

RECOMMENDATIONS

In order for the state to make significant reductions in global warming pollution, the water sector must be empowered to take advantage of the benefits that clean energy can provide and to play a more prominent role in the state's efforts to reduce emissions. We recommend a variety of ways to unlock the water sector's potential as a partner in California's clean energy transition.

The Air Resources Board should update the AB32 scoping plan such that better information about the water sector is collected. While the AB32 scoping plan recognizes the water sector as a significant energy consumer and source of global warming emissions, it does not provide sufficient policy guidance to ensure that the water sector will be part of the climate solution. Data are needed to understand where opportunities lie for the water sector to contribute to California's climate goals. Updates to the scoping plan should identify actions needed to collect comprehensive data from the water sector. Most water and wastewater utilities are not required to report publicly the sources and amounts of electricity used in a standardized format that would enhance the state's understanding of opportunities for the water sector to be part of the climate solution.

The state should ensure that state dollars lower overall emissions. Any water or wastewater utility that receives state funding from the 2014 water bond, Department of Water Resources grants, or cap-and-trade revenues should be required to prove that its overall utility-wide emissions have decreased; currently, utilities can receive funds because they have achieved emissions reductions in one area of services even if they have allowed emissions to increase in another.

The CEC and CPUC should assess the potential for water and wastewater utilities to provide grid flexibility. Before programs are developed specifically to enhance the ability of the water sector to provide demand response and other grid services, water and wastewater utilities must know how much flexibility they have within their system to adjust operations and the financial incentives for doing so. This information should be compiled so that market innovators and third-party aggregators can come up with new ways to participate.

Data are needed to understand where opportunities lie for the water sector to contribute to California's climate goals.

The state should provide incentives to lower the cost of renewable generation investments. A range of incentives could be provided to encourage the water sector to make investments in renewable energy. The state should continue to support programs like the self-generation incentive program, feed-in tariff, and SEED fund, which help lower the costs and facilitate sharing best practices that lead to the most cost-effective of these investments.

Reduce the hurdles for clean energy investments. A number of laws and regulations unnecessarily hinder the ability of water utilities to make clean energy investments. For example, the process leading to connecting generation to the grid is cumbersome and should be streamlined. In addition, laws, such as Proposition 218, that restrict the ability of water utilities to generate capital for clean energy investments should be reformed.

Expand markets for renewable energy. Increasing the RPS or enacting another policy that would require electric utilities to make additional renewable energy investments could expand opportunities for water utilities to sell renewable electricity.

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ACKNOWLEDGMENTS

This report was made possible in part through generous support from the Energy Foundation and UCS members. We would like to thank the following individuals for their insightful comments and expert review: Debbie Franco, Max Gomberg, Fran Spivey-Weber, and Cynthia Truelove. In addition, we would like to thank UCS staff who provided helpful feedback, including John Rogers, Adrienne Alvord, and Angela Anderson. We would also like to thank the individuals at water and wastewater utilities who reviewed sections of the report and provided valuable information about local efforts, including Carolyn Glanton, Dale Roberts, Anisa Devine, and Bertha Ramos. Finally, we thank our editor, Leslie Brunetta, for making the report more readable, Bryan Wadsworth for overseeing the production process, and Cynthia DeRocco for formatting and layout.

ENDNOTES

- 1 In 2013, the SCWA used slightly more than 48.2 gigawatt-hours (GWh) of electricity to pump, treat, and transport water to its customers. Ninety-seven percent of this electricity was generated from renewable resources, including biogas resources, primarily from biogas collected at the Sonoma County landfill, a small hydropower generator at Warm Springs Dam, and small amounts from solar, geothermal, and wind resources.
- 2 Water utilities that are also retail sellers of electricity are required to report the quantity and sources of the electricity delivered to their customers as well as the quantity and sources of the electricity used for their own purposes or resold.
- 3 The Energy and Water in a Warming World initiative (EW3) launched by the Union of Concerned Scientists (UCS) has brought together a team of more than a dozen independent experts to assess the water demands of energy production in the context of climate variability and change, both at present (Averyt et al. 2011) and over the next several decades (Rogers et al. 2013).
- 4 We do not consider water heating here because it primarily uses natural gas, not electricity.
- 5 The California Public Utilities Commission (CPUC) found that the nine largest wholesale water utilities alone account for 8 percent of the state's electricity requirements. These utilities are the State Water Project, Central Valley Project, Colorado River Aqueduct, Metropolitan Water District of Southern California, Los Angeles Department of Water and Power, San Francisco Public Utilities Commission, Modesto Irrigation District, San Diego County Water Authority, and Santa Clara Valley Water District (CPUC 2010b).
- 6 Assembly Bill 162 (enacted in 2009) and Senate Bill 1305 (enacted in 1997) established the requirement for retail electricity suppliers to disclose information about the energy resources used to generate the electricity sold to retail customers.
- 7 Just 22 water utilities of the more than 7,000 California water and wastewater utilities are classified as retail energy providers: San Francisco Public Utilities Commission, Los Angeles Department of Water and Power, Modesto Irrigation District, Merced Irrigation District, Turlock Irrigation District, Imperial Irrigation District, Pasadena Water and Power, Burbank Water and Power, Glendale Water and Power, Anaheim Public Utilities, Riverside Public Utilities, Kirkwood Meadows Public Utility, Corona Department of Water and Power, City of Palo Alto, City of Banning, City of Needles, Azusa Light and Water, City of Lompoc, Biggs Municipal Services, City of Shasta Lake, City of Vernon, and City of Cerritos.
- 8 Long-term is defined as 20 years or longer.
- 9 Short-term is defined as 10 years or shorter.
- 10 Co-digestion involves adding organic materials, such as food waste, that are rich in energy to wastewater digesters to increase biogas production.
- 11 Forty-three states, including California, have policies that allow electricity customers to install small-scale photovoltaic systems on the rooftops of homes and businesses. Any electricity they generate for on-site use will be credited against their electricity bills, and any excess can be sold back to the grid. This is often called net metering.
- 12 The definition of RPS-eligible hydropower can be found in California Public Utilities Code Section 399.12 and California Public Resources Code 25741.
- 13 The Hyatt-Thermalito power complex generated 2,210 GWh and the aqueduct recovery plants generated 1,790 GWh in 2011. In addition, the State Water Project purchased 795.5 GWh from hydroelectric facilities at Pine Flat Dam, operated by Kings River Conservation District, and 146.7 GWh of small hydropower from the Metropolitan Water District (DWR 2012).

- 14 PWRPA members: Banta-Carbona Irrigation District, Byron-Bethany Irrigation District, Glenn-Colusa Irrigation District, James Irrigation District, Lower Tule River Irrigation District, Princeton-Codora-Glenn Irrigation District, Provident Irrigation District, West Side Irrigation District, West Stanislaus Irrigation District, Arvin-Edison Water Storage District, Cawelo Water District, SCWA, Reclamation District 108, Santa Clara Valley Water District, and Westlands Water District.
- 15 See PG&E's Automated Demand Response Program web page (pge-adr.com) for more specific information.
- 16 EnerNOC has or had contracts with 87 water and wastewater utilities in California, including Adelanto Water Department, Camrosa Water District, City of Beaumont, City of Blythe, City of Buena Park, City of Covina, City of Fresno, City of Hemet, City of Loma Linda, City of Monterey Park, City of Oceanside, City of San Jacinto, City of Santa Rosa, City of South San Francisco Water, County of Los Angeles, Eastern Municipal Water District, Laguna County Sanitation District, City of La Habra, Little Rock Creek Irrigation District, Lost Hills Water District, Mesa Consolidated Water District, Novato Sanitary District, Olivenhain Municipal Water District, Padre Dam Municipal Water District, Rosamond Community Services District, Rowland Water District, San Diego County Water Authority, Santa Fe Irrigation District, Valley Center Municipal Water District, Walnut Valley Water District, and Yuima Municipal Water District (EnerNOC 2013).
- 17 An unbundled REC is the green attribute that has been separated from the underlying renewable electricity.

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