A PROPOSAL FOR
INVESTMENT OF CAP-AND-TRADE AUCTION REVENUES
IN THE
STATE WATER PROJECT
TO
REDUCE GREENHOUSE GAS EMSSIONS
&
RELIABLY INTEGRATE RENEWABLE RESOURCES

Prepared for California Department of Finance & Air Resources Board

March 8, 2013

Submitted by the State Water Contractors

1. ISSUE

The State Water Contractors support the Governor's priorities for the use of Cap-and-Trade auction revenues as set forth in the January 10 Proposed Budget. The Water Sector is responsible for 19% of the electric energy consumed in California with the State Water Project being the single largest end user of the California Independent System Operator controlled grid. That perhaps explains why the SWP was included in the Energy Sector of the California Air Resources Board Cap-and-Trade regulations. But the ARB treated the SWP customers differently than the customers of the electric utilities. That inequity led to the August 27, 2012 letter from Mary Nichols expressing her intent to address our concerns as part of the Water Sector in the Investment Plan. This proposal for the investment of Cap-and-Trade auction revenues in the State Water Project provides a means to address the inequitable treatment of the State Water Project while furthering the State's greenhouse gas emission goals. Water supply projects are an important means of achieving these goals given the significant energy use in the water sector. State Water Project investments will reduce Greenhouse Gas emissions with the additional statewide benefit of facilitating the integration of renewable power into the power grid. We are prepared to assist the California Department of Finance and Air Resources Board to include this proposal into the Governor's Investment Plan.

2. GUIDING PRINCIPLES AND PROPOSAL

2.1 Guiding Principles: The SWC recommend the Investment Plan apply the following principles to guide investment of auction revenues:

- Projects funded by the Investment Plan should be consistent with the Governor's priorities as set forth in the budget proposal for the next three years, including for the Water Sector.
- Priority should be given to entities covered under the Cap-and-Trade Program but not allocated free allowances.
- The Investment Plan should include a mechanism for funding multi-year projects, such as an escrow account concept. GHG reduction projects within the State Water Project require large investments that occur over several years.
- Investment from the Plan should be made to programs and activities that have a proven track record of reducing GHG.
- Investments from the Plan should leave a lasting legacy. Looking back in 50 years it should be evident by the big, resilient programs that the Plan invests in why the state undertook Cap-and-Trade.

2.2 Proposal

2.2.1: General Concept: Funds allocated to the Water Agencies shall further the regulatory purposes of AB 32 and will be consistent with applicable laws on usage of the funds. According to AB 1532, "Moneys appropriated from the fund may be allocated…for the purpose of reducing GHG emissions in the state

through investment that may include…Funding to reduce GHG emissions associated with water use and supply…". The funds provide for investments in energy and water efficiency, and conservation; renewable energy projects; and other related programs that result in the reduction of GHG emissions. Sample projects may include: solar and other renewable projects; refurbishment and replacement of pumps and generators to improve energy efficiency; and implementation of water resource programs, such as recycled water, water conservation, and urban storm water capture and use. Funds allocated can be used for multi-year, longer-term projects and do not have to be utilized at the year of allocation; the escrow account concept. Under this proposal, funds allocated to the State Water Project will be used by DWR for programs and improvements to the SWP.

2.2.2 Refurbishment and Replacement of State Water Project Pump and Generation Equipment

DWR previously completed the replacement of four of the 14 pumps at the Edmonston Pumping Plant. Each Edmonston pump draws 60 MW of power at full load to move water over the Tehachapi Mountains. This is equivalent to a power demand of 30,000 households with a 2 kW load. DWR spent $42 million to replace the four Edmonston Plants. It is estimated that the new pumps increased the pumping efficiency from 89.5% to 93.3%. These efficiency improvements have resulted in an annual savings of 58,700 MWh of energy and 17,322 $mtCO_2$.

DWR also realized significant energy efficiency savings when it completed the refurbishment of the six Hyatt hydroelectric generating units at Oroville. The increased efficient allows the Oroville complex to generation more clean hydroelectric energy from the same amount of flow. The Hyatt efficiency improvements have resulted in an annual GHG emission reduction of 39,100 $mtCO_2$.

DWR is investigating the costs and benefits of replacing the remaining ten Edmonston pumps. DWR also has opportunities to refurbish or replace pumps and generating units at their other facilities. Use of Cap-and-Trade allowance funds may make the replacement of the remaining Edmonston pumps economically viable and will allow DWR to potentially move forward on replacing or refurbishing pumps and generating units at their other facilities.

2.2.2 Procurement of Renewable Resources

Investment funds could be directed to financing DWR's procurement of renewable energy resources. The renewable energy would be used for conveying water through the State Water Project and displace GHG sources tied to energy the SWP currently obtains from the California market. Presently, DWR has a goal to procure an additional 360,000 MWh of renewable energy by 2020. This is based on a target of obtaining the equivalent of 36,000 MWh per year from 2011 through 2020. Then beginning in 2021, DWR plans to double the annual procurement to 72,000 MWh each year for the following ten years. Use of Cap-and-Trade allowance funds would enable DWR to finance this procurement and avoid adversely affecting the increased cost of delivering water that will result from the market imbedding CO_2 allowance costs into future energy pricing. Renewable resource investments will result in a reduction of GHG emissions from the State Water Project while promoting jobs and benefits to California's economy.

2.2.3 Study for Improving Pump-Back Capabilities for the Hyatt-Thermalito Complex

Critical infrastructure issues and water temperature requirements have rendered it extremely difficult to use the State Water Project facilities in Oroville in pump-back, or what is also termed pumped-storage, operations. Cold water is needed in the Feather River below the Oroville facilities to protect endangered salmon habitat. Investment funds could be allocated for a study to analyze how the Oroville complex can be "re-plumbed" to overcome water warming issues when water is pumped back at the Lake Oroville facilities. Enabling pump-back operations provides several benefits:

- Provides additional electricity from a clean generation source during heavy load hours.
- Pump-back could utilize excess wind capacity at night to move water back into the reservoir when minimum load issues on the grid could require the curtailment of renewable generation.
- Provide flexible generation during the day to help integrate intermittent renewable resources into California’s electrical grid. This could increase the level of intermittent renewable generation the CAISO can safely integrate into California's generation fleet.

3. DWR's Track Record of Success in reducing GHG: In its May 2012 Climate Action Plan[1], DWR established aggressive near-term and long-term GHG emission goals. DWR's near-term goal is to reduce GHG emissions by 50% below 1990 levels by 2020 while the long-term goal is to reduce GHG emissions by 80% below 1990 levels by 2050.

3.1 Substantial Progress is Underway

On the SWP operations side, DWR has already taken significant steps to meet its GHG emission reduction goals.

3.1.1 Removing Reid Gardner as an Energy Source

DWR is terminating its interest in Unit #4 of the Reid Gardner Power Station. Reid Gardner is a coal-fired power plant in Nevada that currently supplies up to 235 MW of capacity to the SWP. Electricity from the plant produces disproportionally high amounts of greenhouse gases as compared to other SWP electric energy sources. DWR has committed to cease receiving electricity from Reid Gardner in July 2013. This will result in an annual GHG emission reduction of 882,700 $mtCO_2$.

3.1.2 Increasing Efficiency of Pumps and Hydroelectric Generation

The energy efficiency improvements completed at Oroville's Hyatt Power Plant and the A.D. Edmonston Pumping Plant provide an annual GHG emission reduction of 56,400 $mtCO_2$.

For the January 2010 legislative report, DWR updated its calculations for the CO_2 emissions reductions associated with the SWP Energy Efficiency programs at Hyatt and Edmonston from 2003 through 2020 by using the average of its annual CCAR emissions rates calculated from January 2007 through September 2009.[2]

[1] Climate Action Plan, Phase 1: Greenhouse Gas Emission Reduction Plan, California Department of Water Resources, May 2012

[2] DWR's 2007 CCAR emissions calculations were also updated to reflect the emissions rates for counterparties whose emissions rates for 2007 were not available at the time DWR submitted its 2007 report to the CCAR.

Table 1. SWP Energy Efficiency Savings and Resulting CO_2

Emissions Reductions Years 2003 – 2020

Energy Efficiency Program	Cumulative Energy Savings (megawatt hours)		Cumulative Emissions Reductions (metric tons CO_2)		Equivalent Emissions Savings[3]
Years	Hyatt Generation	Edmonston Pumping	Hyatt Generation	Edmonston Pumping	Automobile Equivalents
2003-2007	306,949	5,951	90,590	1,756	16,852
2008-2020	1,721,443	763,000	508,053	225,186	133,803
Total by Plant	**2,028,392**	**768,951**	**598,643**	**226,942**	**150,654**
CUMULATIVE TOTAL	**2,797 million megawatt hours**		**0.83 million metric tons CO_2**		**150,654 autos**

[3] 5.48 metric tons CO_2e for an average passenger vehicle (http://www.epa.gov/OMS/climate/420f05004.htm)

3.1.3 Increasing Reliance on High-Efficiency Gas-Fired Power Plants

DWR owns a 33.5% interest in the recently completed Lodi Energy Center. The Lodi Energy Center is a high-efficiency, combined cycle, gas-fired power plant. This high-efficiency plant emits less CO_2 than unspecified electricity purchased in the California market. The fast ramp-up and ramp-down capabilities will also allow the plant to support and back-up intermittent renewable energy sources on the California grid, such as wind and solar. The plant's lower GHG emission rate will reduce the SWP's GHG emissions by 23,180 $mtCO_2$ annually.

3.1.4 Increasing Reliance on Renewable Energy Sources to Power the Pumps

DWR has a Renewable Energy Procurement Plan in place that will increase the SWP renewable energy supply by 360 GWh by 2020. This will reduce the GHG emissions for operating the SWP pumps by 157,320 $mtCO_2$. DWR's renewable procurement plan will result in GHG emission reductions of 471,960 $mtCO_2$ by 2030, 943,920 $mtCO_2$ by 2040 and 1,573,200 $mtCO_2$ by 2050. The procurement plan is well underway.

3.2 Historical and Projected GHG Reductions of the SWP (General Statement)

The combined actions of DWR terminating its interest in Reid Gardner Unit #4, increasing the efficiency of Hyatt generation units and Edmonston pumping units and participating as a partial owner of the Lodi Energy Center will reduced the SWP GHG emissions by nearly 1 million $mtCO_2$ per year.

3.2.1 Additional Renewable Energy Procurement

DWR is continuing its efforts to continually reduce GHG emissions in the future. A key element of the plan is the Renewable Energy Procurement strategy laid out in the Climate Action Plan. The strategy calls for an increasing reliance on renewable energy to power the SWP pumps moving forward. The following table provides an overview of DWR's GHG reduction targets through 2050.

Table 2. Future Greenhouse Gas Emission Reductions from Renewable Procurements

Period	Annual Increase in Renewable Energy Procurement Rate	End of Period Portfolio Target	Annual GHG Emission Reduction by End of Period
By 2020	--	360 GWh	157,320 $mtCO_2$
2021-2030	72 GWh/year	1,080 GWh	471,960 $mtCO_2$
2031-2040	108 GWh/year	2,160 GWh	943,920 $mtCO_2$
2041-2050	144 GWh/year	3,600 GWh	1,573,200 $mtCO_2$

3.2.2 Increasing Energy Efficiency in SWP Operations

The SWP's hydroelectric power generation allows for reduced reliance on thermal generation. Consistent with the spirit of AB 32 and DWR's mission to enhance California's natural and human environments, DWR conducts multi-faceted engineering studies and programs to improve water-to-energy conversion of all SWP equipment and facilities. DWR's improvement programs include pump and turbine replacements and refurbishments, to ensure that the SWP's hydroelectric units perform at the highest levels of energy efficiency. Major energy efficiency projects have been undertaken at the A.D. Edmonston Pumping and the Edward Hyatt Power plants, resulting in state-of-the-art performance levels exceeding 90 percent efficiency.

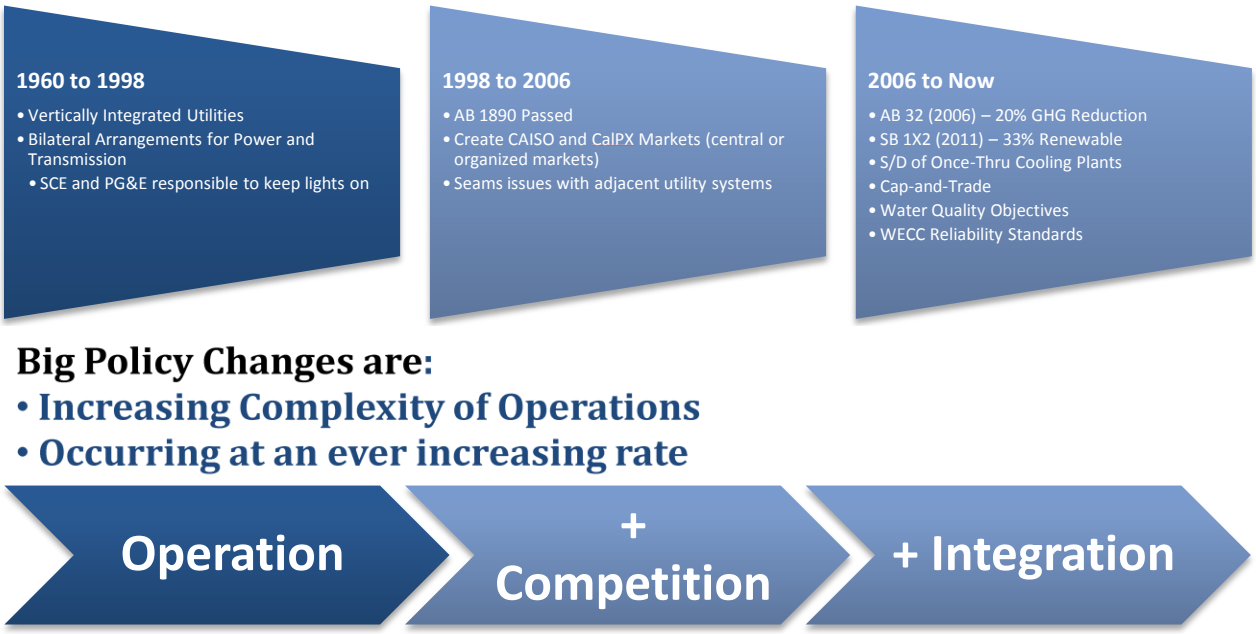
These efficiency improvements to the SWP pumping and generation units illustrate the level of GHG emission reductions that can potentially be achieved at the remaining Edmonston pumping units and in other SWP pumping and generation plants.

4. SWP Role In Achieving California Energy Policy Objectives

4.1 California Industry and Energy Policy Is In Transition

The California Energy Policy is to reduce greenhouse gas emissions, create jobs and contain costs. State energy and environmental agencies are joining with the California Independent System Operator Corporation (CAISO) to achieve these objectives. The new policy requires new investments in transmission, energy efficiency, smart grid applications, and increased use of renewable resources. Easing the transition are the California Air Resources Board, California Public Utilities Commission, California Energy Commission and California Environmental Protection Agency.

Though the policy is set forth in law and regulations, the industry remains in transition. One reason is the pace of change. The other is the magnitude of the change as the flowchart below shows.



For decades the California electric industry and infrastructure was based on vertically integrated utilities that owned generation, transmitted the power over their high voltage transmission lines and distributed the power to their customers. Restructuring legislation passed in 1996. It applied to investor owned utilities and allowed public owned utilities to opt in. The legislation was intended to create a competitive electric energy market in California. Fundamental to the change was a breakup of the vertically integrated utilities. The legislation created (1) the California Independent System Operator (CAISO) to operate the transmission grid and generally ensure system reliability and (2) the California Power Exchange (CALPX) as a central marketplace to conduct energy auctions that established energy prices and schedules on both a day-ahead and an hour-ahead basis. The restructured California electric industry began operation on April 1, 1998.

Under the new market structure California experienced the 2000-2001 energy crisis during which energy prices soared and blackouts cut power to millions of customers in California. By the time state and federal regulators stepped in, considerable damage had occurred. The Pacific Gas and Electric Company was forced to declare bankruptcy, the California Power Exchange was forced out of business, families and businesses in San Diego were hammered by dysfunctional market prices and the state found itself spending an estimated $40 billion on power on behalf of the IOUs.

In 2006, the Legislature passed and Governor Schwarzenegger signed AB 32, the Global Warming Solutions Act of 2006. The law requires that California reduce greenhouse gas emissions (GHG) to 1990 levels by the year 2020, and ultimately achieve an 80% reduction from 1990 levels by 2050. In passing the legislation, the Legislature found and declared:

> "Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California. The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems. "

and

> "Global warming will have detrimental effects on some of California's largest industries, including agriculture, wine, tourism, skiing, recreational and commercial fishing, and forestry. It will also increase the strain on electricity supplies necessary to meet the demand for summer air-conditioning in the hottest parts of the state."

A consequence of the legislation is the utility industry is required to integrate significant amounts of renewable power and participate in the California Cap-and-Trade program while continuing the recovery from the energy crisis. AB 32 requires California electric utilities to supply 20% of their customer needs with renewable power by 2020. In 2011 Governor Brown signed SB 2(1x) (Simitian) into law. This bill revises the Renewable Energy Resources Program to require an increase in the amount of electricity generated from eligible renewable energy resources per year, to at least 33% of total retail sales of electricity in California per year by December 31, 2020.

4.1.1 Reduce Greenhouse Gas Emissions

The California carbon reduction requirement is to achieve 1990 level of emissions by 2020. AB 32 designates the California Air Resources Board as responsible for monitoring and regulating GHG emissions in order to achieve reduction obligations. After extensive stakeholder input, the CARB adopted the Cap-and-Trade regulations on in October 2011. In the process of adopting the regulations the CARB conducted an extensive CEQA review including the finding that Cap-and-Trade is the least cost alternative to fulfilling its AB32 obligations. The regulations went into effect on January 1, 2012.

A cap and trade system is a means by which reductions in greenhouse gas (GHG) emissions can be implemented. It involves creating a market where GHG emission allowances can be bought and sold by entities. Setting a cap for GHG emissions is fundamental to the to the program's function. The California cap and trade system sets targets for emissions which are gradually reduced each year.

The ARB has regulated the electricity sector in the initial stage of the program. The cap for electric sector emissions is 97.7 million metric tons (MMt). Each year beginning in 2013 through 2020, the electric sector emission cap must be reduced by approximately 2%.[4]

4.1.2 Renewable Energy

Serving California businesses and families with renewable power is the other relevant component to California's carbon reduction policy. Over a period of nearly a decade, the California legislature has progressively increased the amount of renewable power that utilities must use to serve their customers. Those amounts were initially established in 2002 under Senate Bill 1078, accelerated in 2006 under Senate Bill 107/Assembly Bill 32 and expanded in 2011 under Senate Bill 2(1X). The result is California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources to 33% of total procurement by 2020.[5]

SB 2 (1X) institutes three compliance periods that require the utilities use increasing amounts of renewable power to supply customers. The California Public Utilities Commission (CPUC) is responsible to establish the quantity of electricity products from eligible resources to be procured by each retail seller for each compliance period. The first compliance period requires procurement from eligible renewable resources that averages 20% of retail sales over the period between January 1, 2011 and December 31, 2013. After 2013, quantities must reflect reasonable progress in each of the intervening years sufficient to ensure eligible renewable resource procurement achieves 25% of retail sales by December 31, 2016; 33% of retail sales by December 31, 2020; and not less than 33% thereafter.

[4] http://www.arb.ca.gov/newsrel/2011/cap_trade_overview.pdf
[5] http://www.cpuc.ca.gov/NR/rdonlyres/3B3FE98B-D833-428A-B606-47C9B64B7A89/0/Q4RPSReporttotheLegislatureFINAL3.pdf

Variable energy resources, primarily wind and solar are seen as the resources most likely to fulfill the RPS requirements. There are two key characteristics of wind and solar that present challenges in integrating their output into California's existing generation fleet; specifically, high forecast errors and the inherent variability of energy production by these resources. Figure 2 illustrates the variation in total wind output in the CAISO service area during April, 2006. The variation is continuous and occurs from second to second, minute to minute and hour to hour. The CAISO has observed that "The integration of variable energy resources will require increased operational flexibility—notably capability to provide load-following and regulation in wider operating ranges and at ramp rates that are faster and of longer sustained duration than are currently experienced.[6]" Unlike water systems where the pressure sometimes drops due to demand outpacing supply, the power system must continuously balance generation supply to load demand. If load and generation are not balanced automatic schemes kick in to shed load in order to prevent equipment damage that could lead to major system wide blackouts.

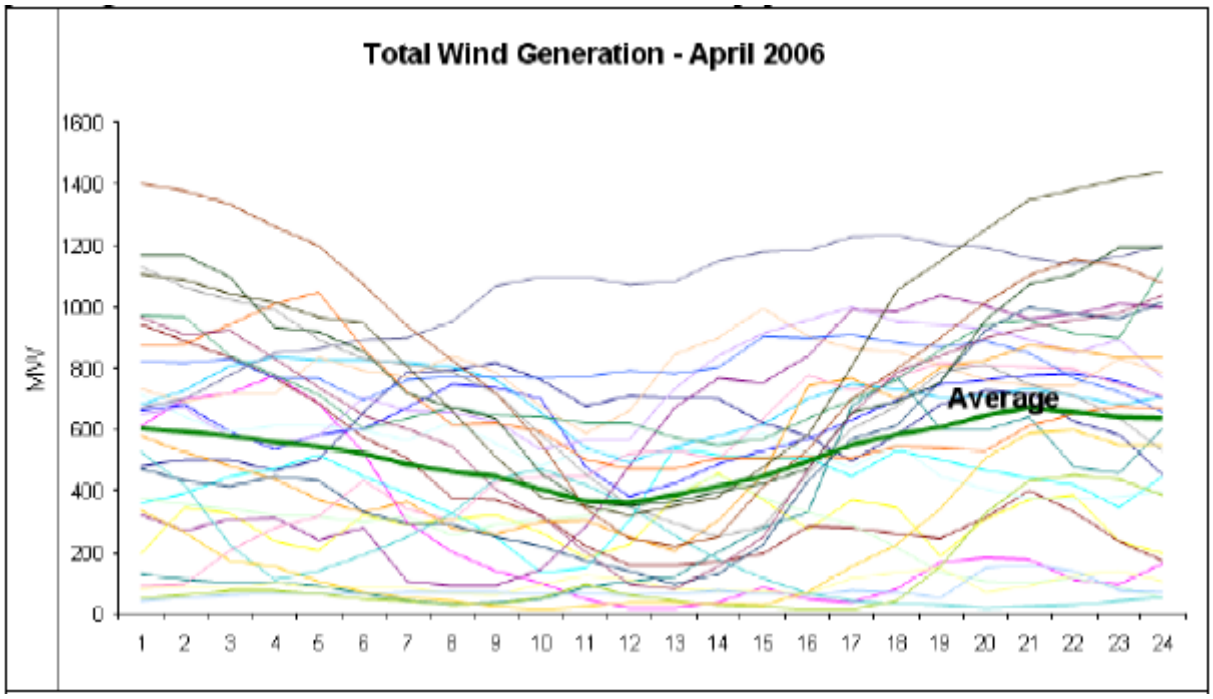


Figure 2

4.2 Water Quality Objectives

The State Water Board is considering changes to the 2006 Water Quality Control Plan for the Bay-Delta. The State Water Board has set a series of workshops to consider information that has been developed since it completed the review of the 2006 Bay-Delta Plan and since it released the 2010 Flow Criteria Report. The changes to the Water Quality Control Plan may include flow criteria that shifts releases of

[6] CAISO, *Integration of Renewable Resources, Operational Requirements and Generation Fleet Capability at 20% RPS, August 31, 2010*, page iii

water from the Lake Oroville reservoir and limit the amount of water exported from the by the SWP. As described below, the SWP hydropower production is a function of water releases from Lake Oroville and water delivered south of the Tehachapi Mountains. A flow criteria that shifts power production from the summer months into the spring and fall could have a broad array of impacts on SWP power production and consumption as well as the impacts on the California power grid.

4.3 The State Water Project

The State Water Project is the largest State-built, multipurpose water project in the United States. A primary purpose of the Project is to store and deliver water to its customers, the State Water Project Contractors. The service areas of the SWP Contractors are found throughout Northern California, the San Francisco Bay area, the San Joaquin Valley, the Central Coast and Southern California. The scope of the State Water Project is evident in Figure 2.

The SWP's system contains 1,750 MW of hydropower capacity with the capability to produce and average annual generation of 4,300 GWh of energy when operating under the existing Biological Opinions (the 2008 Fish and Wildlife Service Biological Opinions for Coordinated Operations and the 2009 National Marine Fisheries Service Biological Opinion for OCAP). The SWP provides about 12.5 percent of the hydropower capacity in California. Annually the SWP pumps consume 7,750 GWh of energy on average when the SWP is operated to meet the requirements of the existing Biological Opinions. The remaining energy not supplied by the SWP hydropower is obtained from a number of sources, including contracted purchases of hydroelectric and renewable energy, the SWP's ownership portion of the Lodi Energy Center power plant, and mid-term and short-term purchases from California's power market.

4.3.1 Built in Operational Flexibility

Flexibility for managing pumping needs and power generation was built in as the Project was constructed. The Project designers recognized the advantages of pumping mainly during off-peak hours and generating mainly during on-peak hours. Excess pumping capability was installed in many of the pumping plants, generation plants were sized to increase peaking capacity and storage was incorporated at strategic locations, solely to increase operational flexibility. In the electric utility business, the ability to control the pattern of generation is called “shaping.” The shaping of both load and generation is a feature unique to the Project. As an additional reliability measure, an extra unit was installed in many of the pumping plants so that standard maintenance outages would not reduce a plant’s pumping capability.

Today, the SWP continues to take advantage of the Project’s built-in operational flexibility by minimizing pumping and maximizing project generation during on-peak hours when energy costs are highest. Ideally, the maximum Project pumping is scheduled during the off-peak hours. Conversely, maximum Project generation is scheduled during the peak hours. While the Project moves as much water as possible during the off-peak hours, delivery levels, storage availability and regulatory restrictions often

create a need to pump water outside of the off-peak hours. This operating scheme helps support the California grid operations by supplying spare energy to the grid during on-peak hours and providing a valuable sink for off-peak generation.

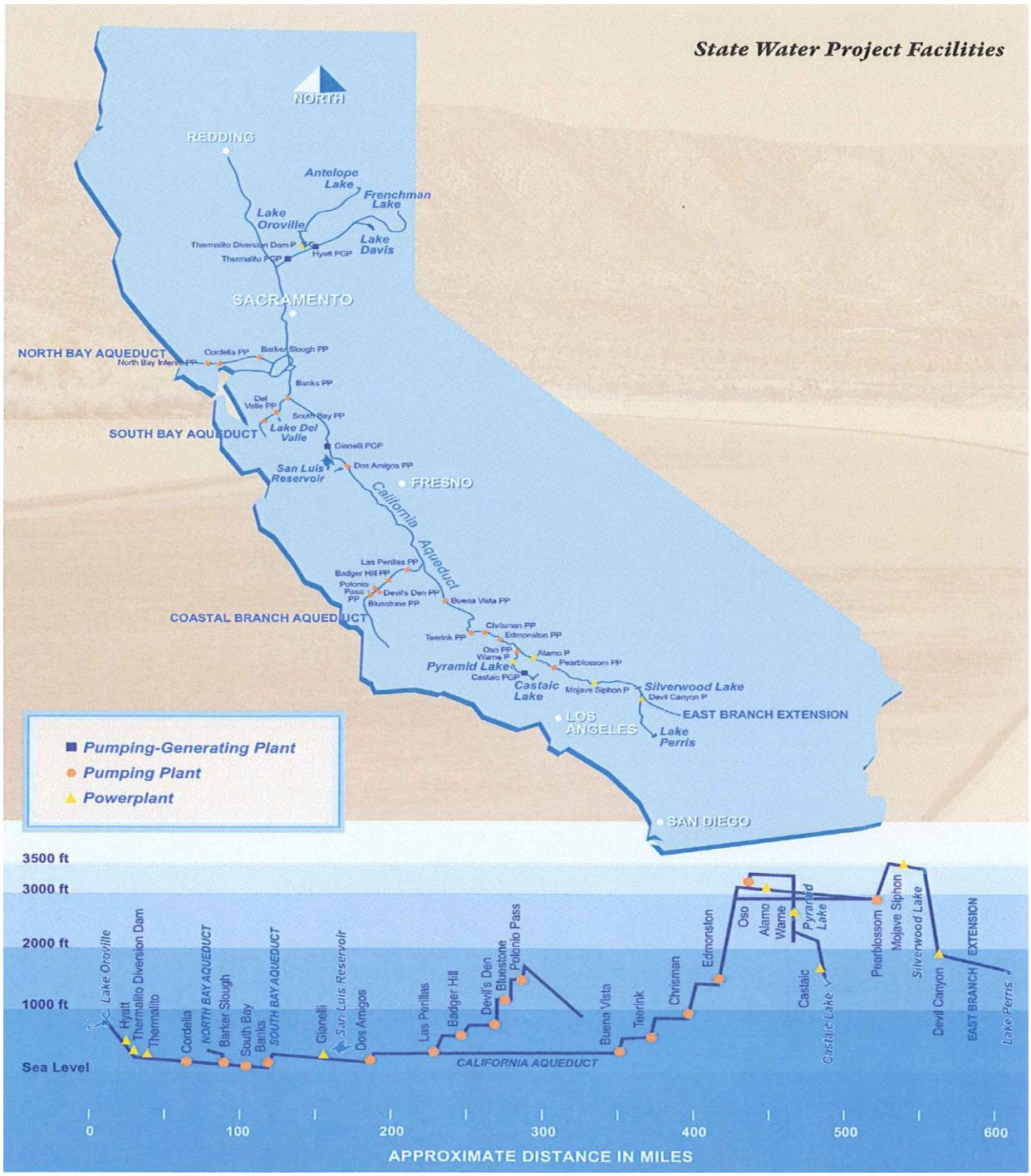

State Water Project Facilities
NORTH
REDDING
Antelope Lake
Frenchman Lake
Lake Oroville
Thermalito Diversion Dam P
Thermalito PGP
Hyatt PGP
Lake Davis
SACRAMENTO
NORTH BAY AQUEDUCT
North Bay Inferm PP
Cordelia PP
Barker Slough PP
Banks PP
Del Valle PP
South Bay PP
SOUTH BAY AQUEDUCT
Lake Del Valle
Gianelli PGP
San Luis Reservoir
Dos Amigos PP
FRESNO
California Aqueduct
Las Perillas PP
Badger Hill PP
Polonio Pass PP
Devil's Den PP
Bluestone PP
Buena Vista PP
COASTAL BRANCH AQUEDUCT
Chrisman PP
Edmonston PP
Teerink PP
Oso PP
Warne P
Alamo P
Pearblossom PP
Pyramid Lake
Castaic PGP
Castaic Lake
Mojave Siphon P
Silverwood Lake
Devil Canyon P
EAST BRANCH EXTENSION
LOS ANGELES
Lake Perris
SAN DIEGO
Pumping-Generating Plant
Pumping Plant
Powerplant
3500 ft
3000 ft
2000 ft
1000 ft
Sea Level
Lake Oroville
Hyatt
Thermalito Diversion Dam
Thermalito
Cordelia
NORTH BAY AQUEDUCT
Barker Slough
South Bay
Banks
SOUTH BAY AQUEDUCT
Gianelli
San Luis Reservoir
Dos Amigos
Las Perillas
Badger Hill
Devil's Den
Bluestone
Polonio Pass
CALIFORNIA AQUEDUCT
Buena Vista
Teerink
Chrisman
Edmonston
Oso
Alamo
Warne
Pyramid Lake
Castaic
Castaic Lake
Pearblossom
Mojave Siphon
Silverwood Lake
Devil Canyon
EAST BRANCH EXTENSION
Lake Perris
0
100
200
300
400
500
600
APPROXIMATE DISTANCE IN MILES

Figure 2

4.3.2 SWP Energy Sources

Figure 3 provides a simplified depiction of the energy sources that could be used to supply the SWP pumping loads in 2020. The graphic illustrates the energy sources required to serve the average annual pumping load without the complication of capturing the SWP's practice of supporting the California grid operations by generating surplus energy in the on-peak and scheduling the maximum amount of pumping in the off-peak. The SWP relies on market purchases to supply much of its off-peak pumping needs. The graphic shows only the simple energy balance required for the SWP to supply just its pumping needs. In recent years, the SWP sells into the market have ranged between 1,000 GWh and 2,000 GWh per year. The additional on-peak sale and off-peak purchases are not captured in the graph.

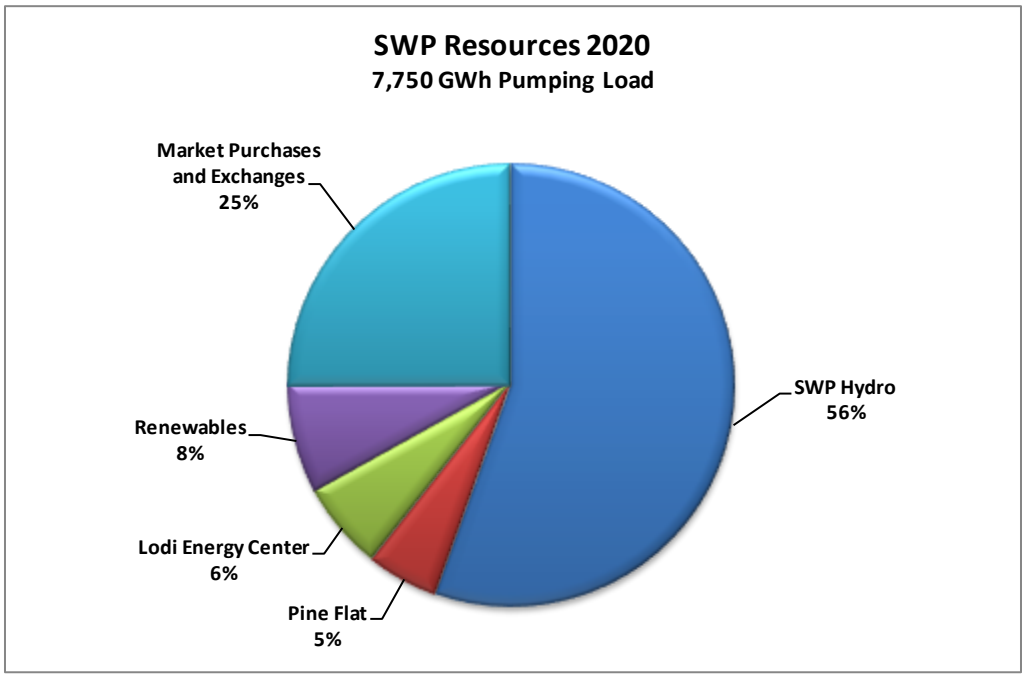


Figure 3

4.3.3 SWP Generation and Pump Load Shaping

Especially during the high-load summer months, the California market has produced two pricing segments for the traditional 16-hour on-peak period; an 8-hour super-peak and an 8-hour partial-peak. Prices are generally significantly higher in the super-peak. When not all of the pumping can be accomplished in the off-peak, it is first shaped into the partial-peak and then into the super-peak. Occasionally, some pumping is required in the super-peak. The SWP energy limited hydroelectric generation is shaped to maximize output during the super-peak, with any additional generation scheduled first into the partial-peak and finally into the off-peak.

Some of the Project features that allow the shaping of pumping loads and generation are apparent while others are more subtle. Storage was incorporated in the Project at locations where it provided operational advantages. An example is the Oroville power facilities. Additional storage was added to the Thermalito Afterbay in order to increase the peaking operation of the Hyatt and Thermalito power

plants. The Thermalito Afterbay allows water released from Lake Oroville during peak hours to be stored and released back into the Feather River at a steady rate.

San Luis Reservoir, O'Neill Forebay and Silverwood Lake provide major facilities for regulation of water en route through the main aqueduct. However, it is the nearly simultaneous operation of the hydraulically interdependent pumping plants, coupled with the extra pumping capability built into the plants, that allows heavy off-peak pumping. These unique design considerations minimized the need for off-stream storage in the original project design, while still allowing the Project to shape the water pumping as if additional storage was available.

DWR continues to construct cost-effective Project additions that reduce energy costs. The recently completed Tehachapi Afterbay provides increased flexibility for using off-peak pumping at the Edmonston Pumping Plant.

4.3.4 SWP Ancillary Services

The Project features that allow shaping of pumping loads and generation also allow the Project to effectively participate in California's ancillary services market. The ancillary services market ensures that capacity is on hand to adjust the flow of electricity when the unexpected happens, such as power plant failure or a sharp rise in the demand for power. Four types of operating reserves are included in the ancillary services market:

- **Regulation –** Generation that is already up and running and can be increased or decreased almost instantly to keep energy supply and energy use in balance.
- **Spinning Reserves –** Generation that is running at less than full output, with additional capacity that can be increased within minutes.
- **Non-Spinning Reserves –** Generation that is not running, but can be brought up to speed within ten minutes. Pump-drop that can be reduced within ten minutes can also supply non-spinning reserve.
- **Replacement Reserves –** Generation that can begin contributing to the grid within an hour.

At times there is an economic advantage for the Project to participate in the ancillary services market over simply producing energy. The Project's generation can be used to supply all four operating reserve categories. However, because of the ability of both the SWP hydroelectric generators and pumps to meet the 10-minute response requirement, the SWP does not participate in the Replacement Reserve market designed for slower responding generation. Hydroelectric generation is especially suited for providing regulation because of its ability to quickly change energy output. The Project often uses pump-drop to participate in the non-spinning reserve market.

4.3.5 Special Protection System provided by State Water Project

Owners of transmission that are connected to the CAISO controlled grid are obligated to comply with reliability standards as set forth by the Western Electricity Coordinating Council (WECC). A System Protection System is an automatic protection system designed to detect abnormal system conditions and take corrective actions. Such an action may include changes in demand or generation.

These standards have directly led to the SWP delivering a unique and valuable service to a large transmission owner and consequently the statewide power grid. The protection system was agreed to by DWR and the transmission owner in lieu of constructing reinforcements between two major substations in California.

This protection system was triggered in September 2010 and June 2012. During each event the SWP curtailed about 1,000 MW of generation and pump load in order to maintain the reliability of the power grid. This is equivalent to being able to turn off power to 1/3 of Sacramento. There are few, if any, comparable sources of such special protection connected to the California power grid.

5. CHALLENGES OF ACHIEVING CALIFORNIA ENERGY POLICIES - COSTS, SYSTEM RELIABILITY AND CARBON REDUCTION

Achieving the state energy policy objectives will be a tall order. Steve Berberich, president of Cal-ISO, acknowledged the need for thousands of megawatts of flexible generation in California as more renewables come on line. At the same CAISO symposium, the president of the CPUC, Michael Peevey, stated that as renewable-energy penetration grows we "especially need coordination and collaboration among various state agencies."[7] The CAISO and the CPUC have each opened proceedings to meet the challenges. Their focus is maintaining the reliability of the power grid while keeping costs down. The CAISO anticipates an increased need for load following and regulation ancillary services as additional renewable generation in integrated into the existing generation fleet. Its initial findings disclose that the existing generation fleet may not be sufficient to provide the flexible generation that the intermittent renewable generation requires.

5.1 Reliability of the Power Grid

The ISO's studies show that reliably operating the grid with a 33 percent Renewable Portfolio Standard (RPS), the potential retirement of 12,079 megawatts of once-through-cooled generation units, and the potential addition of 12,000 megawatts of distributed resources requires California to maintain a fleet of sufficient flexible and local capacity resources both now and into the future. The need for flexible

[7] Keith Casey, "Briefing on Renewable Integration – Market Vision and Roadmap," Briefing prepared for CAISO Board, October 20, 2011.

capacity resources increases with the level of intermittent resources typically used to meet the state's renewable portfolio requirements.

Since 2007 the CAISO has held workshops, conducted studies and published studies that report on the challenges of integrating renewable resources into the grid. For example, CAISO completed a study in 2010 on the operational requirements for integrating renewable resources (*Integration of Renewable Resources, Operational Requirements and Generation Fleet Capability at 20% RPS, August 31, 2010*). It followed-up in October 2011 reporting that its studies "reveal that the integration of intermittent renewable resources will require resources that can flexibly and accurately respond to dispatch signals and can quickly ramp to new operating levels." The CAISO has developed a roadmap of the scope and timing of activities that will lead to the re-tooling the transmission grid and making extensive modifications to its power markets. Of interest to the State Water Board is that the CAISO finds deficiencies in flexible generation that is necessary for the integration of intermittent renewable generation. Water Quality Objectives that impacts on flexible SWP hydropower production will require additional flexible generation be developed.

5.1.1 A Changing Net Load Shape

A reason for the concern is the dramatic change in the shape of the power demand that the CAISO must ensure is met. Historically the shape of the power demand appeared as shown in Figure 4. On a typical day the demand followed a fairly predictable shape. The figure shows how the customer demand varies throughout the day. In this case it shows a demand of about 30,000 MW at midnight. The demand continues to drop slightly until around 5:00 am when the day begins. That is followed by a steady rise until around 5:00 pm when businesses go through the daily cycle. The demand continues its steady decline as the day comes to an end.

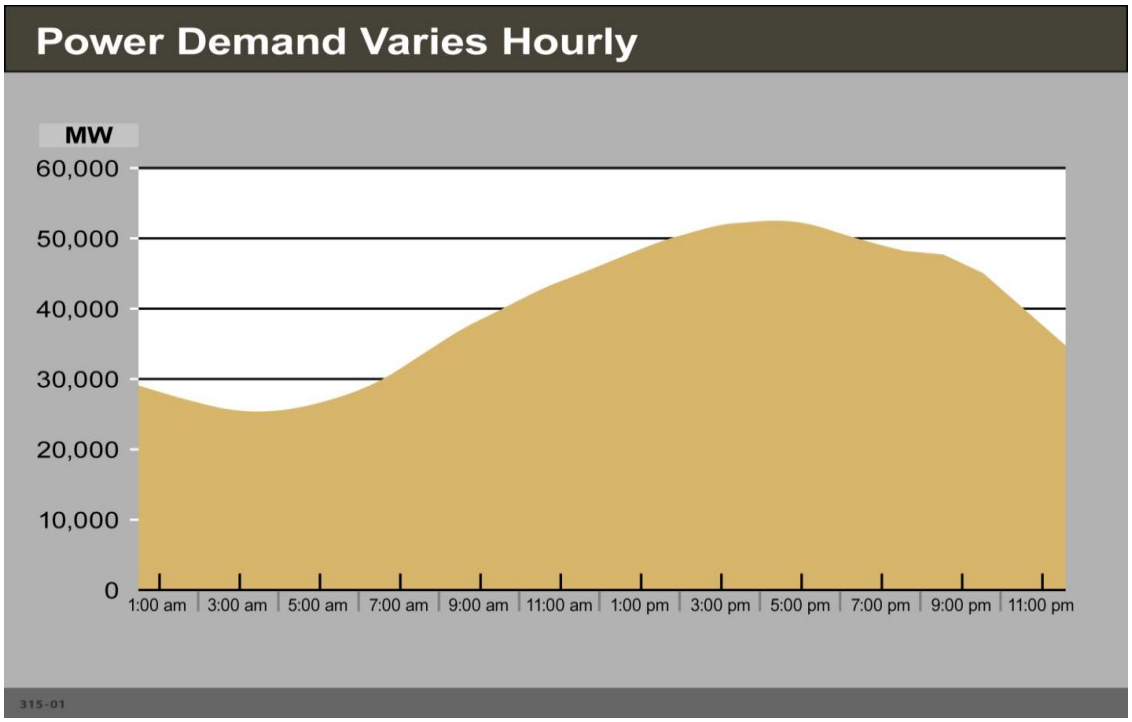


Figure 4

One of the primary CAISO responsibilities is to continuously, and almost instantaneously, balance generation to load. One of the issues the CAISO faces is the change in load following requirements as California moves to meeting the 33 percent RPS. Before the heavy penetration of variable output renewables, the intra-hour and inter-hourly variation in load was due solely to variations on the demand side. Flexible output "load following" generation was used to keep generation and load in balance. With the heavy penetration of variable output resources, the CAISO will have to supply load following to dampen both the variation in load and the variation in the output from variable output resources. This change will increase the need for flexible output resources, such as conventional hydropower generation.

Figure 5 illustrates the change in load following requirements that are expected when renewables are incorporated into the generation portfolio. Figure 5 shows the highly variable load shape that will be served by flexible output generation in the future. Flexible output resources will see a load pattern in Figure 5.that is net of energy generation from variable output resources. This net load demand curve (shown in Figure 5) illustrates a significant increase in the load following burden that will be the responsibility of the flexible output resources. The Cal-ISO has stated that by 2020, with the amount of renewables coming on line, the grid could see ramps approaching 13,500 MW in two hours. The increased load following requirement could necessitate the development of new flexible output resources.

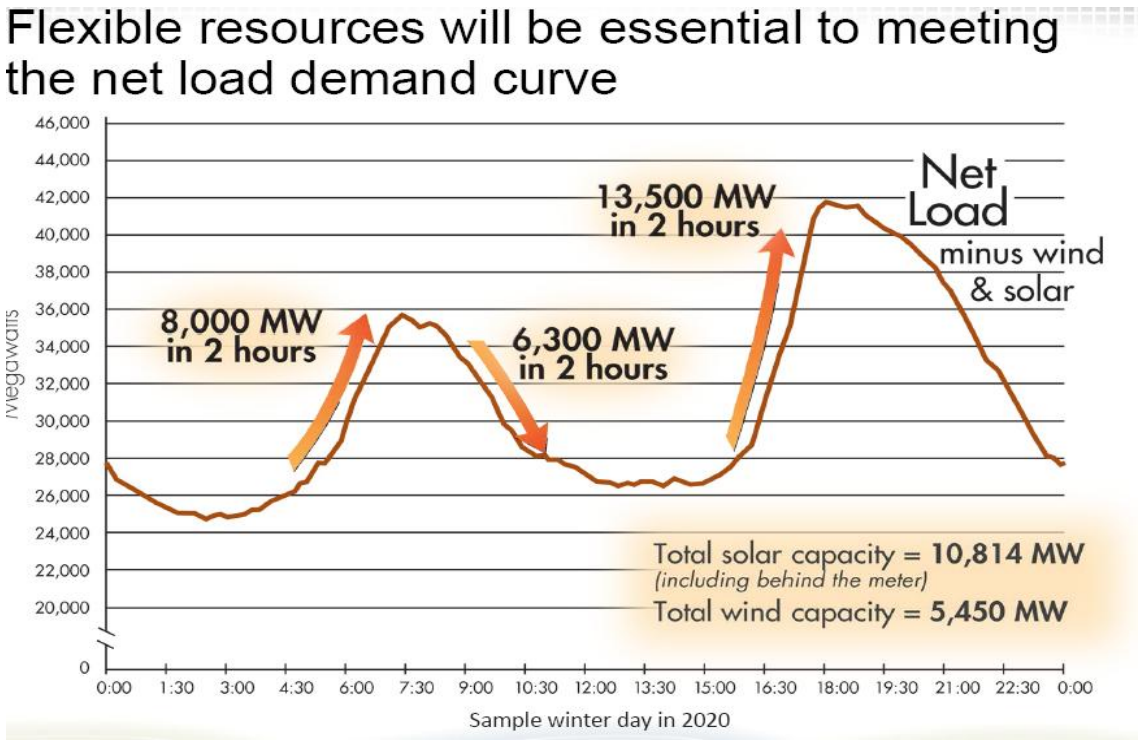


Figure 5

Integrating a 33 percent RPS, maintaining local reliability, and meeting other state energy policy goals such as the once-through-cooling mandate creates several operational challenges for the ISO. Among these challenges is ensuring that the ISO has sufficient flexible capacity to address the added variability and unpredictability created by variable energy resources. This challenge is magnified even further with the prospect of losing over 12,000 MW of flexible capacity resources to once-through-cooling mandates established by the State Water Resources Control Board.[8]

5.1.2 Depressed Energy Market Prices

Another situation that the CAISO has identified is that production of significant amounts of renewable energy will depress energy market prices and undermine the commercial viability of needed flexible generation. This has led to the CAISO seeking unprecedented authority from FERC to contract with owners of flexible generation in order to assure grid reliability. Concerned that natural gas power plants with the ability to integrate renewables could retire in coming years for lack of sufficient revenue, Cal-ISO approved a backstop payment mechanism. Under a new risk-of-retirement provision, CISO will now offer payments to plants that are at risk of retirement and that CISO sees as necessary for system flexibility or local reliability within a two- to five-year time frame. This new market mechanism was partly spurred by controversy over the 578 MW Sutter Energy Center, a natural gas plant that was on the verge of retiring—and never returning, according to plant owner Calpine—until the CPUC directed

[8] same

investor-owned-utilities to negotiate a resource-adequacy contract with the plant. CISO said Sutter was needed in 2017 to integrate renewables.[9]

The CAISO studies also point out that over-generation conditions during the spring months will likely increase as solar and wind resources are added to meet the increased RPS requirements. Over-generation simply means that there is more power being produced than customers are consuming. Such a situation typically occurs during the spring when demands are low and hydropower production is high. The addition of significant amounts of renewable generation will increase the frequency of CAISO managing a potential over-generation condition. A delta flow regime that requires more reservoir releases during the spring will compound the problem.

5.2 Cost of Implementing Energy Policies

The CPUC is the principal agency responsible for implementing the RPS program. It has several proceedings underway which are in total or part intended to address challenges the RPS presents. On May 5, 2011, the Commission adopted the Order Instituting Rulemaking (R.) 11-05-005 to open a new proceeding for the implementation and administration of the 33% RPS Program. Currently, the California Public Utilities Commission (CPUC) is considering modifications to its Resource Adequacy (RA) program to incorporate flexible capacity procurement requirements and the ISO is conducting local reliability studies as part of the CPUC's 2012 LTPP proceeding.[10]

The CPUC developed this report in order to provide new, in-depth analysis on the cost, risk, and timing of meeting a 33% RPS. As identified in the report, the cost to achieve the RPS will be significant. It estimates the major new transmission lines that are needed alone will cost more than $15 billion. It also confirms that the cost of the energy supply will be higher under the RPS.

[9] Chris Raphael, "Need for Flexible Power, Cooperation Heard at Cal-ISO Symposium," California Energy Markets, Vol. No. 1197, (September 7, 2012): 9

[10] CAISO report "Flexible Capacity Procurement Phase 1: Risk of Retirement," http://www.caiso.com/Documents/SecondRevisedDraftFinalProposal-FlexibleCapacityProcurement.pdf, September 15, 2012

6. CONCLUSION AND RECOMMENDATION

Under this proposal, funds allocated to the State Water Project will be used by DWR for programs and improvements to the SWP. Water use and supply projects are specifically identified as an eligible investment in the Draft Concept Paper for the Cap-and-Trade Auction Proceeds Investment Plan (February 15, 2013). Opportunities exist within the SWP that meet the investment principles outlined in the Concept Paper and will directly help in meeting the state's GHG reduction targets. These opportunities include enhancing pumping plant and generation plant efficiencies, adding renewable energy sources to help power the SWP pumps, and removing barriers to pump-back operation at the Oroville hydropower facility.

Our proposal builds on the goals of the investment plan. Our proposal also helps the SWP avoid adverse impacts to the SWP water contractors and their water customers by mitigating the increased cost of delivered water that will result from the energy market imbedding CO_2 allowance cost into future energy pricing.

Providing for the establishment of escrow-type accounts for multi-year projects will encourage implementation of the larger projects the SWP can undertake. This is an important enhancement to the investment plan.

We are prepared to assist the California Department of Finance and Air Resources Board to include this proposal into the Governor’s Investment Plan.