Long-Term Operation – Final Environmental Impact Statement

Appendix U – Power Technical Appendix

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Appendix U Power Technical Appendix

U.1 Background Information

U.1.1 Central Valley Project and State Water Project Energy Generation and Usage

This appendix describes the hydroelectric generation facilities and power demands for the Central Valley Project (CVP) and State Water Project (SWP) related to changes that could occur as a result of implementing the alternatives evaluated in this environmental impact statement. Implementation of the alternatives could affect CVP and SWP power generation and energy demands through potential changes in operation of the CVP and SWP facilities. Changes in CVP and SWP operations are described in more detail in Appendix H, *Water Supply Technical Appendix*.

Potential actions that could be implemented under the alternatives evaluated in this environmental impact statement could affect CVP/SWP hydroelectric generation and electricity use. The changes in power production and energy use would need to be compliant with appropriate federal and state agency policies and regulations.

Most of the CVP and SWP dams have associated hydroelectric facilities. As water is released from the CVP and SWP reservoirs, the generation facilities produce power that is used by the CVP and SWP pumping plants, respectively, and by other users. The study focuses on CVP and SWP hydroelectric generation facilities at CVP and SWP reservoirs, CVP and SWP energy use to move water, and transmission activities of the net generated electricity for other users throughout California. These CVP/SWP energy generation facilities are in the Trinity River and Central Valley regions. CVP and SWP energy use to move water primarily occurs in the Central Valley, San Francisco Bay Area, Central Coast, and Southern California regions, as defined in this appendix.

Power generation capacity provided by large hydropower facilities fluctuates year to year dependent on water supply conditions. Power generation from small hydropower facilities is a small and decreasing percentage of California’s renewable energy portfolio as other renewable resources have increased in capacity. The increase in other renewable sources allows hydropower to serve as a peaking resource on high energy demand days (California Energy Commission 2023a). Approximately 1,762 megawatts (MW) of the state's capacity are from in-state small hydropower facilities certified under the Renewable Portfolio Standard Program. Large in-state hydropower facilities total approximately 12,281 MW of capacity (California Energy Commission 2023b).

Hydropower is an important renewable energy and generally supplies between 7% and 22% of electricity generated in California depending upon the water year type (California Energy Commission 2022). In 2017, one of the wettest years on record, hydropower provided approximately 21% of electricity generated in California. In 2021, during a drought cycle, both

small and large hydropower facilities provided approximately 7% of the electricity generated in California (California Energy Commission 2023b).

California first established a state Renewables Portfolio Standard (RPS) in 2002 under Senate Bill (SB) 1078, when it set a RPS standard of 20% before the year 2017 for investor-owned utilities. California later accelerated this RPS requirement in 2006 under SB 107, when it moved the date up to the year 2010. In 2011, California expanded this requirement to include publicly owned municipal power and increased the RPS requirement to 33% by the year 2020 (e.g., Sacramento Municipal Utility District) under SB X1-2. In 2015, passage of the Clean Energy and Pollution Reduction Act (SB 350) created a 50% RPS requirement by the year 2030. During the 2017 legislative session, SB 100 was enacted and established a 60% RPS requirement by 2030 and established a state policy requirement of 100% carbon free by the year 2045 (California Energy Commission 2023c). This was also captured in Governor Brown's Gubernatorial Executive Order B-55-18 on carbon neutrality.

The RPS program's current targets and compliance periods for California load-serving entities to procure electricity from eligible renewables are 20% by the end of 2020, 44% by the end of 2024, 52% by the end of 2027, and 60% by the end of 2030. Load-serving entities include publicly owned utilities, investor-owned utilities, electrical service providers, and community choice aggregators (California Energy Commission 2023d).

For purposes of the state's RPS requirements, renewable energy resources do not include hydropower facilities over 30 MW, in accordance with the California Public Utilities Code Section 399.12(e) and California Public Resources Code Section 25741 (California Legislative Information 2017). However, large hydropower generation by the CVP is not precluded from counting toward the state's carbon-free policy.

As described in Section 25741 (a) (1) of the Public Resources Code, a California renewable electrical generation facility means a facility that meets all of the following criteria: *the facility uses biomass, solar thermal, photovoltaic, wind, geothermal, fuel cells using renewable fuels, small hydroelectric generation of 30 MW or less, digester gas, municipal solid waste conversion, landfill gas, ocean wave, ocean thermal, or tidal current, and any additions or enhancements to the facility using that technology* (California Legislative Information 2024). Section 399.12(e) of the Public Utilities Code, as amended, states that an existing conduit hydroelectric facility of 30 MW or less shall be an eligible renewable energy resource. A new conduit hydroelectric facility of 30 MW or less shall be an eligible renewable energy resource so long as it does not require a new or increased appropriation or diversion of water from a watercourse.

While the CPUC only lists small hydroelectric generation of 30 MW or less as a California renewable electrical generation facility under the RPS, the U.S. Department of Energy does not distinguish between large and small hydropower facilities as a renewable energy source (U.S. Department of Energy 2024). The United States Department of the Interior, Bureau of Reclamation's (Reclamation) hydropower operations in California are not affected by the state's RPS and not subject to regulation by the CPUC or other state utility regulations.

U.1.2 Central Valley Project Power and Energy Resources

Power generated by the CVP is marketed and transmitted by the Western Area Power Administration (WAPA) Sierra Nevada Region. CVP facilities generally use around 25% to 30% of the power generated by the CVP. WAPA is allowed to market the remaining power under existing laws including the Reclamation Project Act, Hoover Power Plant Act, Energy Policy Act, and reporting policies under WAPA/Power Marketing Department Order, U.S. Department of Energy Order RA6120-2 Section 5.0: Power Marketing Administration Financial Reporting, RA 6120.2. WAPA under the 2025 Power Marketing Program for the Sierra Nevada provides allocations to wholesale customers in northern and central California and portions of Nevada (Western Area Power Administration 2023). Five customers are listed as first preference in the Fiscal Year 2024 Rates. First preference power customers are Calaveras Public Power Agency, Chicken Rancheria, California Department of Corrections Sierra Conservation Center, Trinity Public Utilities District, and Tuolumne Public Power Agency (Western Area Power Administration 2024). Additional customers include Native American tribes, Reclamation customers, military agencies, cities, Bay Area Rapid Transit District, rural electric cooperatives, public utilities and irrigation districts, and federal and state agencies (Western Area Power Administration 2020).

CVP plant-in-service costs for all CVP and WAPA facilities are assigned to water users and power customers for repayment in accordance with their benefits resulting from Reclamation's cost allocation study. WAPA is responsible for recovering costs from its power customers. Reclamation's customers requested a final CVP cost allocation, and Reclamation completed the cost allocation study in 2020 (Bureau of Reclamation 2020a). In accordance with Reclamation's most recent plant-in-service cost allocation study, 17.9% of CVP plant-in-service costs, excluding Central Valley Project Improvement Act costs, are allocated to commercial power customers, and are repaid annually through the power revenue requirement methodology established by WAPA. Power customers pay their percentage share of total WAPA and Reclamation's costs (including the power allocation of CVP plant-in-service, annual costs, and interest) for the right to receive a percentage share of the daily net (of project use) CVP power generation.

Consequently, as CVP annual and plant-in-service power costs increase (including Central Valley Project Improvement Act Environmental Restoration Funds), and available energy for sale decreases, the net unit cost of CVP power will increase. Market prices for power have increased since 2019 due to the inability of the system to store excess solar and wind renewables.

On December 31, 2024, all the WAPA's Sierra Nevada Region's long-term power sales contracts will expire. These include all the contracts outside of project loads. WAPA finalized the 2025 Power Marketing Plan for the Sierra Nevada Region (82 *Federal Register* 156), which was applicable beginning September 14, 2017, to allocate power and complete other processes, to provide services beginning on January 1, 2025, for 30 years. Power customers had an opportunity to cancel their contracts as part of the rate filing/rate adjustment before September 31, 2019, and before the services are provided under the new 2025 Power Marketing Plan. With the establishment of carbon-free resource requirements by the state, large hydropower is becoming more desirable, as energy utilities are required to have increasing percentages of their portfolios from renewable sources. CVP power customers will have another opportunity to

choose not to renew power sales contracts in 2024. WAPA Sierra Nevada together with the Balancing Area of Northern California joined California Independent System Operator's (CAISO) Western Energy Imbalance Market in March of 2021 (U.S. Department of Energy 2019). WAPA Sierra Nevada will be ensured "reliable delivery of hydropower during adjustment to the change to renewable energy mix" (Western Area Power Administration 2021). Participants in the Western Energy Imbalance Market are able to purchase and sell power at a reduced cost in real-time, which improves the balance of supply and demand. The benefits to the CVP power facilities and other Western Energy Imbalance Market participants include the following (Western Energy Imbalance Market 2024).

- Costs are reduced with more efficient transmission through the regional transmission system and the need to carry reserve utilities is reduced
- Carbon emissions are reduced with more efficient use and integration of renewable energy
- Increased operational visibility among other electricity grids enhances reliability and improves transmission line congestion management

Currently, there is uncertainty regarding the timing and extent of negative pricing in power markets. Factors such as the ongoing integration of renewables, expansion of energy storage, carbon pricing, and the development of regionalized energy markets contribute to the unpredictability of seasonal energy values. This high level of uncertainty, combined with the flexibility of hydro facilities to mitigate negative pricing, makes it challenging to accurately assess whether future generation shifted to the indicated seasons results in a loss or benefit.

The CVP power facilities include 11 hydroelectric powerplants and have a total maximum generating capacity of 2,103 MW, as shown in Table U-1. Water releases as part of water operations determine the amount of power that will be produced at an individual plant. Hydrology can vary substantially from year to year, which then affects the hydropower production. Typically, in an average water year, approximately 4,500 gigawatt-hours (GWh) of energy is produced (Bureau of Reclamation 2021a). During power emergencies water may be released to provide power generation for a specific purpose. The power generated from CVP powerplants is prioritized to: (1) meet project use loads; (2) first preference power customers; (3) sub balancing authority requirements; (4) ancillary services; and (5) base resource energy which is marketed to other preference customers.

Table U-1. Central Valley Project Hydroelectric Powerplants

Facility	Installed Capacity (MW)
Trinity Powerplant	140
Lewiston Powerplant	0.3
Judge Francis Carr Powerplant	154
Shasta Powerplant	714
Spring Creek Powerplant	180

Facility	Installed Capacity (MW)
Keswick Powerplant	117
Folsom Powerplant	207
Nimbus Powerplant	13
New Melones Powerplant	380
O'Neill Pump-Generating Plant	14.4
San Luis Powerplant (CVP portion of the San Luis (William R. Gianelli) Pump-Generating Plant)	202
Total	**2,121.7**

Source: Bureau of Reclamation 2021a.
MW = megawatt; CVP = Central Valley Project

Power generation at CVP and SWP hydropower facilities fluctuates in response to reservoir releases and conveyance flows. Reservoir releases are affected by hydrologic conditions, minimum streamflow requirements, flow fluctuation restrictions, water quality requirements, non-CVP and non-SWP water rights, CVP water service contractors, and SWP entitlement holders.

The CVP power generation facilities were developed to meet CVP energy use loads. Most of the energy used by the CVP is needed for pumping plants in the Sacramento–San Joaquin Delta (Delta), at San Luis Reservoir, and along the Delta-Mendota Canal and San Luis Canal portion of the California Aqueduct. Table U-2 shows the pump load for each CVP pumping plant.

Table U-2. Central Valley Project Facility Pumping Loads

Facility	Pumping Load (MW)
C.W. "Bill" Jones Pumping Plant	101
O'Neil Pumping-Generating Plant	27
San Luis (William R. Gianelli) Pumping-Generating Plant (CVP share)	215
Dos Amigos Pumping Plant	216

Source: Bureau of Reclamation 2016a; California Department of Water Resources 2022.
MW = megawatt

Table U-3 presents historical average annual CVP hydropower generation and use. Monthly power generation patterns follow seasonal reservoir releases, with peaks during the irrigation season. Hydropower generation between January and June decreases after 2007 because the potential to convey CVP water across the Delta, given limits that were put in place to reduce reverse flows in the Old and Middle River, by implementation of the 2008 and 2009 Biological Opinions. These same limits are carried forward in the 2020 Record of Decision.

Table U-3. Hydropower Generation and Energy Use by Central Valley Project

Calendar Year	Water Year Type [a]	Net CVP Hydropower Generation (GWh) [b]	CVP Facility Energy Used (GWh)
2000	Above normal	5,701	–
2001	Dry	4,169	957
2002	Dry	4,378	1,090
2003	Above normal	5,484	1,170
2004	Below normal	5,187	1,172
2005	Above normal	4,599	1,150
2006	Wet	7,285	1,037
2007	Dry	4,276	1,064
2008	Critically dry	3,673	923
2009	Dry	3,392	803
2010	Below normal	4,118	1,001
2011	Wet	5,629	1,276
2012	Below normal	4,423	990
2013 [c]	Dry	4,314	NA
2014	Critically dry	2,751	NA
2015	Critically dry	2,471	NA
2016	Below normal	3,605	NA
2017A	Wet	6,253	NA
2018	Below Normal	3,939	NA
2019	Wet	5,248	NA
2020	Dry	4,147	NA
2021	Critically dry	2,794	NA

Sources: Bureau of Reclamation 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016b, 2017, 2018, 2019, 2020b, 2021b.

[a] Water year types are based on Sacramento Valley 40-30-30 Index, as described in Appendix H.

[b] After station service. Includes federal share of San Luis.

[C] CVP facility energy use not available from 2013 on.

GWh = gigawatt-hour; NA = not available

The California Public Utilities Commission created a Water-Energy Calculator 2.0 as a tool to estimate the "energy intensity" of several water system components (California Public Utilities Commission 2022). The energy intensity is the average amount of energy required to extract and convey and/or treat water on a unit basis, such as per one acre-foot. Substantial quantities of energy are required by the CVP pumping plants to convey large amounts of water over long distances with significant changes in elevation. The *Water-Energy Calculator 2.0 Project Report*

indicated that the energy intensity of CVP conveyance delivered to users downstream of San Luis Reservoir ranged from 0.225 megawatt-hours (MWh) per acre-foot for users in the South Coast region to 0.327 MWh per acre-foot for users in the San Joaquin region, to 0.696 MWh per acre-foot in the Central Coast region (California Public Utilities Commission 2022).

U.1.2.1 Trinity River

The Trinity Powerplant is on the Trinity River (Bureau of Reclamation 2023a). Primary releases from Trinity Dam are made through the powerplant. Trinity County has first preference to the power from this plant. When connections to the wider power grid are interrupted the Trinity Powerplant supplies power to Trinity County for maintenance of the system and during emergencies, such as the recent Carr Fire.

The Lewiston Powerplant is at the Lewiston Dam along the Trinity River (Bureau of Reclamation 2023b). It is operated in conjunction with the spillway gates to maintain the minimum flow in the Trinity River downstream. Because the turbine capacity is less than the Trinity River minimum flow criteria, the turbine is usually set at maximum output with the spillway gates adjusted to regulate river flow. The Lewiston Powerplant provides power to the adjacent fish hatchery. Adjacent to Lewiston Dam is an intake to the Clear Creek Tunnel, which diverts Trinity River water to Carr Powerplant, where it discharges into Whiskeytown Reservoir.

U.1.2.2 Sacramento River

The Shasta Powerplant is a peaking powerplant located downstream of Shasta Dam along the Sacramento River (Bureau of Reclamation 2023d). Until the early 1990s, concerns with downstream water temperatures resulted in the bypasses of outflows around the powerplant and lost hydropower generation. Installation of the Shasta Temperature Control Device enabled operators to decide the depth of the reservoir from which the water feeding into the penstocks originates. The system has shown success in controlling the water temperature of powerplant releases through Shasta Dam. The Shasta Powerplant also provides water supply for the Livingston Stone National Fish Hatchery.

The Spring Creek Powerplant is a peaking plant along Spring Creek (Bureau of Reclamation 2023e). Water discharged via the Judge Francis Carr Powerplant flows into the Whiskeytown Reservoir and then provides the source of water for the Spring Creek Powerplant generation. Trinity County has first preference to the power benefits from Spring Creek Powerplant. Water from the Spring Creek Powerplant is discharged into Keswick Reservoir.

The Keswick Powerplant is located at Keswick Dam along the Sacramento River downstream of Shasta Dam. The powerplant regulates the flows into the Sacramento River from both Shasta Lake and Spring Creek releases. With minimal storage capacity, Keswick Dam is operated to allow for peaking operations at Shasta Dam and the Spring Creek powerhouse while maintaining relatively consistent flows to the Sacramento River below Keswick Dam (Bureau of Reclamation 2023f).

The Keswick and Shasta Powerplants support voltage regulation for the Sacramento region during heavy summer load times and during periods of very light load when transmission line voltages can become too high.

U.1.2.3 Clear Creek

The Judge Francis Carr Powerplant is a peaking powerplant located on the Clear Creek Tunnel (Bureau of Reclamation 2023c). It generates power from water exported from the Trinity River Basin via the intake to the Clear Creek Tunnel adjacent to Lewiston Dam. The plant discharges into Whiskeytown Reservoir. Similar to Trinity Powerplant, Trinity County has first preference to the power benefit from this facility.

U.1.2.4 American River

The Folsom Powerplant is a peaking powerplant at Folsom Dam along the American River (Bureau of Reclamation 2023g). The Folsom Powerplant is operated in an integrated manner with flood control and storage management operations at Folsom Reservoir. One of the integrated operations is related to coordinating early flood control releases with power generation. It also provides power for the pumping plant that supplies multiple local municipal water systems. Folsom Powerplant supports voltage regulation for the Sacramento region during heavy summer load times. Folsom Powerplant is also identified as a required Blackstart Resource in WAPA's System Restoration Operating Procedure.

The Nimbus Powerplant is located at Nimbus Dam along the American River, downstream of Folsom Dam (Bureau of Reclamation 2023h). The Nimbus Powerplant regulates releases from Folsom Dam into the American River and can be considered a run-of-the-river powerplant.

U.1.2.5 Stanislaus River

The New Melones Powerplant is a peaking powerplant located along the Stanislaus River (Bureau of Reclamation 2023i). Primary reservoir releases are made through the powerplant. This plant provides substantial voltage support to the Pacific Gas and Electric Company (PG&E) system during summer heavy load periods.

U.1.2.6 San Joaquin River

This analysis does not include powerplants along the San Joaquin River. Their operations would be expected to be consistent between all action alternatives.

U.1.3 State Water Project Power and Energy Resources

The SWP also generates hydroelectricity along the California Aqueduct at energy recovery plants (California Department of Water Resources 2022). Power generated by the SWP is transmitted by PG&E, Southern California Edison, and CAISO through other facilities (California Department of Water Resources 2022). The SWP also markets energy in excess of the SWP demands to a utility and members of the Western Systems Power Pool (WSPP).

The SWP power facilities are operated primarily to provide power for the SWP facilities (California Department of Water Resources 2022). Table U-4 summarizes the SWP power facilities and capacities. The SWP has power contracts with electric utilities and the CAISO that act as exchange agreements with utility companies for transmission and power sales and purchases. Each year, the SWP must purchase additional power to meet pumping requirements.

Table U-4. State Water Project Hydroelectric Powerplants

Facility	Installed Capacity (MW)
Hyatt Pumping-Generating Plant (Oroville)	645
Thermalito Diversion Dam Powerplant (Oroville)	3
Thermalito Pumping-Generating Plant (Oroville)	114
San Luis (William R. Gianelli) Pumping-Generating Plant (SWP share)	225
Alamo Powerplant	17
Mojave Siphon Powerplant	30
Devil Canyon Powerplant	276
Warne Powerplant	74
Total	**1,384**

Source: California Department of Water Resources 2017.
MW = megawatt; SWP = State Water Project

The SWP power generation facilities were developed to meet SWP energy use loads. Most of the energy used by the SWP is needed for pumping plants located in the Delta, at the San Luis Reservoir, and along the California Aqueduct. Table U-5 shows the 2018 total energy used at pumping plants and powerplants (California Department of Water Resources 2022).

Table U-5. State Water Project Pumping Plant Total Energy Used in 2018

Facility	At Plant (MWh)
Hyatt Pumping-Generating Plant (Oroville)	100
Barker Slough Pumping Plant	9,182
Cordelia Pumping Plant	11,102
South Bay Pumping Plant	109,558
Del Valle Pumping Plant	1,182
Harvey O. Banks Pumping Plant	571,838
San Luis (William R. Gianelli) Pump-Generating Plant	242,058
Dos Amigos Pumping Plant	243,724
Buena Vista Pumping Plant	310,192
John R. Teerink Pumping Plant	319,931
Ira J. Chrisman Pumping Plant	705,343
A.D. Edmonston Pumping Plant	2,510,631
Oso Pumping Plant	105,608
Alamo Pumping Plant	248

Facility	At Plant (MWh)
Pearblossom Pumping Plant	439,504
Las Perillas Pumping Plant	9,907
Badger Hill Pumping Plant	24,853
Devil's Den Pumping Plant	21,280
Bluestone Pumping Plant	19,853
Polonio Pass Pumping Plant	21,406
Greenspot Pump Station	695
Crafton Hills Pump Station	19,704
Cherry Valley Pump Station	984
Total	**5,698,883**

Source: California Department of Water Resources 2022.
MWh = megawatt hour

Table U-6 presents historical average annual SWP hydropower generation and use for the period 2001 through 2021. Monthly power generation patterns follow seasonal reservoir releases, with peaks during the irrigation season. SWP power use and generation values indicate the SWP generates approximately 63% of the energy needed for deliveries (California Department of Water Resources 2002, 2004a, 2004b, 2005, 2006, 2007, 2008, 2012a, 2012b, 2013a, 2013b, 2014, 2015a, 2015b, 2016, 2017, 2019, 2021a, 2022). Energy generation and purchases and energy use decrease after 2007 because the potential to convey SWP water across the Delta was reduced in accordance with legal decisions and subsequently through implementation of the 2008 and 2009 Biological Opinions and carried forward in the 2020 Record of Decision. Each year the associated energy use and hydropower generation is forecasted based on the previous year's energy use and hydropower generation. Operational studies over the long-term are based on median-year water supply conditions and reservoir storage conditions that are optimal. The actual SWP power requirements may vary from the forecasted amount due to water available and delivered in a given year. Long-term purchase agreements are based on forecasted power requirements. and as a result, the SWP may acquire more energy than needed in a year (California Department of Water Resources 2022).

Table U-6. Hydropower Generation and Energy Use by the State Water Project

Calendar Year	Water Year Type [a]	State Water Project Hydropower Generation (GWh)	Energy Acquired through Long-Term Agreements and Purchases (GWh)	Energy Used by State Water Project Facilities (GWh)
2000	Above normal	6,372	5,741	9,190
2001	Dry	4,295	4,660	6,656
2002	Dry	4,953	4,610	8,394
2003	Above normal	5,511	4,668	9,175
2004	Below normal	6,056	4,429	9,860
2005	Above normal	5,151	5,367	8,308
2006	Wet	7,056	5,811	9,158
2007	Dry	5,577	6,642	9,773
2008	Critically dry	3,541	4,603	5,745
2009	Dry	4,650	3,970	6,089
2010	Below normal	3,920	5,081	7,187
2011	Wet	4,846	4,895	8,549
2012	Below normal	4,198	3,741	7,406
2013	Dry	3,069	3,604	5,736
2014	Critically dry	1,133	1,691	2,791
2015	Critically dry	1,275	2,781	3,488
2016	Below normal	3,075	4,108	6,604
2017	Wet	4,519	5,385	9,660
2018	Below Normal	2,552	3,646	5,727
2019	Wet	NA	NA	NA
2020	Dry	NA	NA	NA
2021	Critical	NA	NA	NA

Sources: California Department of Water Resources 2002, 2004a, 2004b, 2005, 2006, 2007, 2008, 2012a, 2012b, 2013a, 2013b, 2014, 2015a, 2015b, 2016, 2017, 2019, 2021a, 2022.
a Water year types are based on Sacramento Valley 40-30-30 Index, as described in Appendix H.
GWh = gigawatt-hour; NA = Not Available

The *Water-Energy Calculator 2.0 Project Report* indicated that the energy intensity of SWP conveyance delivered to water users downstream of San Luis Reservoir ranged from 0.527 MWh per acre-foot for users in the San Joaquin region to 2.056 MWh per acre-foot for users in the Central Coast region, to 3.306 MWh per acre-foot in the South Coast region (California Public Utilities Commission 2022).

U.1.4 Central Valley Project and State Water Project Service Areas (South to Diamond Valley)

U.1.4.1 San Luis Reservoir Powerplants (Federal Share)

The O'Neill Pump-Generating Plant is on a channel that conveys water between the Delta-Mendota Canal and the O'Neill Forebay (Bureau of Reclamation 2023j). This pump-generating plant only generates power when water is released from the O'Neill Reservoir to the Delta-Mendota Canal. When water is conveyed from the Delta-Mendota Canal to O'Neill Forebay, the units serve as pumps, not hydroelectric generators. The generated power is used to support CVP pumping and irrigation actions of the CVP.

The San Luis (William R. Gianelli) Pump-Generating Plant is along the western boundary of the O'Neill Forebay at the San Luis Dam (Bureau of Reclamation 2023k). This pump-generating plant is owned by the federal government but is operated as a joint federal-state facility that is shared by the CVP and SWP. Energy is generated when water is needed to be conveyed from San Luis Reservoir back into O'Neill Forebay for continued conveyance to the Delta-Mendota Canal or conveyance to federal water users downstream of Dos Amigos pumping plant on the California Aqueduct. The plant is operated in pumping mode when water is moved from O'Neill Forebay to San Luis Reservoir for storage until heavier water demands develop. The generated power is used to offset CVP and SWP pumping loads. The powerplant can generate up to 424 MW, with the CVP share of the total capacity being 202 MW. This facility is operated and maintained by the State of California under an operation and maintenance agreement with Reclamation.

U.1.4.2 San Luis Reservoir Powerplant (State Share)

As described above, the San Luis (William R. Gianelli) Pump-Generating Plant is owned by the federal government and is operated as a joint federal-state facility shared by the CVP and SWP. The SWP water flows from the California Aqueduct into O'Neill Forebay downstream of the CVP's O'Neill Pump-Generating Plant The pump-generating plant is located along the western boundary of the O'Neill Forebay at the San Luis Dam (California Department of Water Resources 2022). Electricity is generated when water is transferred from San Luis Reservoir back to O'Neill Forebay for continued conveyance in the California Aqueduct. The plant acts as a pumping plant when water is transferred from O'Neill Forebay to San Luis Reservoir. The generated power is used to offset CVP and SWP pumping loads. The powerplant can generate up to 424 MW, with the SWP share of the total capacity being 225 MW. This facility is operated and maintained by the State of California under an operation and maintenance agreement with Reclamation.

U.1.4.3 East Branch and West Branch Powerplants

Downstream of the Antelope Valley, the California Aqueduct divides into the East Branch and West Branch. The Alamo Powerplant, Mojave Powerplant, and Devil Canyon Powerplant are located along the East Branch, which conveys water into San Bernardino County (California Department of Water Resources 2022). The Warne Powerplant is located along the West Branch, which conveys water into Los Angeles County. The generation rates vary at these powerplants depending upon the amount of water conveyed.

U.1.4.4 Other Energy Resources for the State Water Project

Other energy supplies have been obtained by the California Department of Water Resources (DWR) from other utilities and energy marketers under agreements that allow DWR to buy, sell, or exchange energy on a short-term hourly basis or a long-term multiyear basis (California Department of Water Resources 2022).

For example, DWR jointly developed the 1,254 MW Castaic Powerplant on the West Branch with the Los Angeles Department of Water and Power (California Department of Water Resources 2022). The power is available to DWR at the Sylmar Substation.

DWR has entered into many long-term purchase agreements since 1979 beginning with a long-term purchase agreement with the Kings River Conservation District for the approximately 400 million kilowatt-hours of energy from the 165 MW hydroelectric Pine Flat Powerplant (California Department of Water Resources 2022). DWR also purchases energy from five hydroelectric plants with a total output of 30 MW that are owned and operated by Metropolitan Water District of Southern California. DWR, the U.S. Department Energy, WAPA, and Reclamation entered into a 50-year agreement in 2017, and under the agreement, DWR receives a maximum of 6,500 MWh from the Boulder Canyon Project at Hoover Dam, There are also other long-term purchase agreements with other public agencies for energy (California Department of Water Resources 2022).

DWR also purchases energy under short-term purchase agreements from utilities and energy marketers of the WSPP (California Department of Water Resources 2022).

U.1.5 Other Hydroelectric Generation Facilities

Hydroelectric facilities in addition to CVP and SWP hydroelectric facilities in the study area are owned by investor-owned utility companies, such as PG&E and Southern California Edison; municipal agencies, such as the Sacramento Municipal Utility District; and by local and regional water agencies. Some of the larger facilities outside the CVP and SWP systems and within or adjacent to the study area are included in the subsequent list (California Energy Commission 2023e).

- PG&E
    - Helms Pumped Storage (1,212 MW capacity) in Fresno County
    - Pit System (579 MW) in Shasta County
    - Upper North Fork Feather River System (351 MW) in Plumas County
- Sacramento Municipal Utility District American River Project System (708 MW) in El Dorado County
- City and County of San Francisco Hetch Hetchy Power System (286 MW) in Tuolumne County
- Southern California Edison

    - Big Creek System and Eastwood Pump Storage (590 MW) in Fresno and Madera counties
    - Mammoth Pool Project (187 MW) in Fresno and Madera counties
- Turlock Irrigation District and Modesto Irrigation District Don Pedro Project (203 MW) in Tuolumne County
- Yuba Water Agency Yuba River Development Project (364 MW) in Yuba County

U.1.6 Energy Demands for Groundwater Pumping

Between 2002 and 2016, groundwater provided approximately 41% of the state's annual water supply on average, and up to 58% of total annual water supply during critically dry years (California Department of Water Resources 2021b). The use of groundwater varies regionally throughout the state.

The energy intensity to extract and convey groundwater is based on values presented in hydrologic region reports between 2005 and 2017. The California Public Utilities Commission estimated the total electric energy intensity for groundwater pumping and the state's major inter-basin water transfers, including the SWP and CVP, in the Water-Energy Calculator 2.0. The total energy intensity for brackish desalination groundwater pumping, groundwater pumping, and recycled water groundwater pumping are the same; values range from 0.307 in the San Joaquin region, 0.491 in the San Francisco Bay region, to 0.697 in the South Coast region. In all regions, the energy intensity to pump groundwater is substantially less than the total energy intensity for SWP conveyance. Compared with the CVP conveyance energy intensity, the energy intensity for groundwater pumping is higher than CVP conveyance in the South Coast, San Francisco Bay, and Tulare Lake regions, and less in the Central Coast and San Joaquin regions (California Public Utilities Commission 2022). Some wells use natural gas for individual engines instead of electricity. Between 2002 and 2016, average groundwater use in the state was approximately 17.6 million acre-feet, or 41% of total water supply (California Department of Water Resources 2021b).

U.2 Evaluation of Alternatives

U.2.1 Methods and Tools

The impact assessment considers changes in power generation and energy demands related to changes in CVP and SWP operations under the alternatives as compared with the No Action Alternative. This section details methods and tools used to evaluate those impacts. Alternative 2 consists of four phases that could be utilized under its implementation. All four phases are considered in the assessment of Alternative 2 to bracket the range of potential impacts.

Energy generation is limited on a monthly basis by the average power capacity of each generation facility based upon reservoir elevations and water release patterns. The majority of the CVP and SWP energy use is for the conveyance facilities located in the Delta and south of the Delta. Energy use would change with changes in CVP and SWP deliveries.

Reservoir elevations and flow patterns through pumping facilities output from the CalSim 3 model (Appendix F, *Model Documentation*) is used with Long-Term Generation (LTGen) and SWP power tools, as described in Attachment 1, *Power Model Documentation*. These tools estimate average annual peaking power capacity, energy use, and energy generation at CVP and SWP facilities, respectively. The tools estimate average monthly and annual energy generation and use and net generation. Net generation is the difference between energy generation and use; a negative net generation means more energy is used than generated. When net generation values are negative, the CVP or SWP would purchase power from other generation facilities. Because California's energy system must always be balanced, purchasing power from other generation facilities would imply that additional generation is needed. This additional generation could come from reduced curtailments of renewable generation, existing thermal generation, or increased import of energy from out of state (primarily from the Pacific Northwest or from Arizona and Nevada). When net generation values are positive, power would be available for use by both CVP power customers (for available CVP power) and non-CVP and SWP electricity users for available SWP power and would allow for either less generation from thermal generating plants, or less imported power from outside the state.

While LTGen estimates average monthly and annual energy generation, energy use, and net generation, a potential refined methodology was considered and is described in Appendix M, *Greenhouse Gas Emissions*. The refined method estimates hourly generation to optimize the generation for economic value. It was used to look at the CO_2 offset by the Gross CVP Generation and was compared with the current method. That comparison showed that the refined method does not provide substantial differences in energy generation between the two methods (monthly vs. hourly) and is consistent between the alternatives.

When CVP and SWP water deliveries change, water users are anticipated to change their use of groundwater, recycled water, and/or desalinated water, as described in Appendix H and Appendix I, *Groundwater Technical Appendix*. Specific responses by water users to changes in CVP and SWP water deliveries are not known; therefore, energy use for the alternate water supplies cannot be quantified in this analysis. It is not known whether the net change in energy use for the CVP and SWP would or would not be similar to the net change in energy use for alternate water supplies (e.g., groundwater pumping, water treatment, water conveyance).

U.2.2 No Action Alternative

Under the No Action Alternative, Reclamation would continue with current operation of the CVP, as described in the 2020 Record of Decision and subject to the 2019 Biological Opinions. The 2020 Record of Decision for the CVP and the 2020 Incidental Take Permit for the SWP represent current management direction or intensity pursuant to 43 Code of Federal Regulations § 46.30.

The No Action Alternative is based on 2040 conditions. Changes that would occur over that time frame without implementation of the action alternatives are not analyzed in this technical appendix. However, the changes to power that are assumed to occur by 2040 under the No Action Alternative are summarized in this section.

Conditions in 2040 would be different from existing conditions because of the following factors:

- Climate change and sea-level rise
- General plan development throughout California, including increased water demands in portions of the Sacramento Valley

By the end of September, the surface water elevations at CVP reservoirs generally decline, and power generation decreases. It is anticipated that climate change would result in more short-duration high-rainfall events and less snowpack in the winter and early spring months. The reservoirs would be full more frequently by the end of April or May by 2040 than in recent historical conditions, potentially resulting in increased generation in the spring if water is released. However, as the water is released in the spring, there would be less snowpack to refill the reservoirs. This condition would reduce reservoir storage, thereby resulting in decreased generation sooner than the end of September.

Under the No Action Alternative, land uses in 2040 would occur in accordance with adopted general plans. Development under the general plans could affect power with increased water demand resulting in increased power generation if storage is available, and increased power use to move water to satisfy demand. Infill projects where areas are already developed could increase density but would be done in compliance with applicable zoning and general plan policies around power. Development in non-urbanized areas could convert natural or rural areas to developed areas, resulting in impacts on power use to deliver water.

Because of climate change and increased water demands in the Sacramento Valley, CVP and SWP energy generation may be less in the summer months, and therefore less generation would be available for sale to CVP first preference power customers, when energy demand is high for water conveyance and air-conditioning equipment throughout the state. Water deliveries could also change in the future, which could result in less energy use for CVP and SWP water conveyance facilities.

Under the No Action Alternative, Reclamation and DWR would operate the dams to provide water temperature management while minimizing impacts on power generation.

The No Action Alternative would also rely upon increased use of Livingston-Stone National Fish Hatchery during droughts to increase production of winter-run Chinook salmon. However, this component requires no physical changes to the facility nor operational changes related to power supply.

U.2.3 Alternative 1

Alternative 1 is compared with the No Action Alternative to evaluate changes in both CVP and SWP net generation.

U.2.3.1 Potential Changes in Central Valley Project Net Generation

Changes in CVP operations under Alternative 1 compared with the No Action Alternative would result in a change in CVP water deliveries to areas located south of the Delta; therefore, annual energy use would result in changes in CVP energy resources, as summarized in Table U-7. Under Alternative 1, compared with the No Action Alternative, annual CVP energy generation would be higher for both the long-term average and for dry and critically dry years, but the energy required to move the water would also be higher for both the long-term average and for dry and critically dry years. The CVP net generation over the long-term would be slightly lower by 4% and slightly lower by 2% for dry and critically dry years under Alternative 1 compared with the No Action Alternative. The net generation under both water year types would be positive. Therefore, Alternative 1 would not require alternative sources of energy to be purchased from other sources.

Table U-7. Simulated Annual Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 1 (Compared with the No Action Alternative

Water Year	Use/Generation	Alternative 1	NAA	Change between Alternative 1 and NAA (% change) [b]
Long-Term Average	Energy Use	1,725	1,535	190 (12%)
	Generation	4,553	4,478	75 (1%)
	Net Generation	2,828	2,943	-115 (-4%)
Dry and Critically Dry Water Years [a]	Energy Use	1,100	956	144 (15%)
	Generation	3,213	3,113	100 (3%)
	Net Generation	2,113	2,158	-45 (-2%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921–September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 1 value. Percent change is the change divided by the No Action Alternative value.
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-8 shows the breakdown of the CVP facilities monthly energy use, generation, and net generation by long-term average and for dry and critically dry years. The model output shows that there would be a decrease in monthly average net generation under Alternative 1 compared with the No Action Alternative in October, December through April, and July through September for all years, and a decrease in monthly average net generation in October, December through March, and August for dry and critically dry years. The decreases in monthly average net generation tend to be a result of increases in energy use and smaller increases or decreases in generation during those months.

Table U-8. Simulated Monthly Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 1 Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	101	134	129	127	138	129	98	117	132	150	151	128
		Generation	263	215	270	325	339	335	320	466	486	629	493	337
		Net Generation	162	80	141	197	202	206	222	350	354	479	342	209
	Alt 1	Energy Use	129	123	146	156	163	152	109	129	147	165	157	151
		Generation	260	210	283	336	351	337	329	482	524	636	484	320
		Net Generation	131	88	138	180	188	185	220	353	377	471	326	169
	Change from NAA (percent change) [b]	Energy Use	28	-12	17	28	25	22	10	12	15	16	6	23
		Generation	-3	-4	14	11	12	2	9	16	38	8	-10	-17
		Net Generation	-31 (-19%)	7 (9%)	-3 (-2%)	-17 (-9%)	-13 (-7%)	-20 (-10%)	-1 (-1%)	3 (1%)	23 (7%)	-8 (-2%)	-16 (-5%)	-39 (-19%)
Dry and Critically Dry Years [a]	NAA	Energy Use	85	110	97	93	113	102	51	58	74	100	87	88
		Generation	231	189	142	152	153	172	248	366	451	515	389	222
		Net Generation	146	78	46	59	40	71	197	309	377	415	301	134
	Alt 1	Energy Use	106	98	116	111	136	108	60	68	86	119	98	86

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
		Generation	226	177	144	155	155	176	272	383	475	544	393	221
		Net Generation	120	80	28	44	19	68	212	315	389	425	295	134
	Change from NAA (percent change) [b]	Energy Use	20	-13	19	18	23	6	10	10	12	19	11	-1
		Generation	-6	-11	2	3	2	3	24	16	24	29	5	-1
		Net Generation	-26 (-18%)	2 (2%)	-17 (-38%)	-15 (-25%)	-21 (-52%)	-3 (-4%)	14 (7%)	6 (2%)	12 (3%)	10 (2%)	-6 (-2%)	0 (0%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting No Action Alternative value from Alternative 1 value. Percent change is the change divided by No Action Alternative value.
GWh = Gigawatt-hour; NAA = No Action Alternative; Alt 1 = Alternative 1

Under Alternative 1, the CVP would expect increased monthly average generation in all years compared with the No Action Alternative in most months except in October, November, August, and September, and would expect relatively larger increases in monthly energy use in most months except in November. Decreases in average monthly net generation would be relatively small in all years (10% or less) with larger reductions experienced in October and September by 19%. Decreases in monthly net generation in dry and critically dry years would be highest in December through February, ranging between 25% and 52%, and smaller reductions in October, March, and August.

There would be monthly reductions in CVP net generation under Alternative 1 compared with the No Action Alternative. However, the CVP would not require alternative sources of energy because the monthly net generation would still be positive.

U.2.3.2 Potential Changes in State Water Project Net Generation

Changes in SWP operations under Alternative 1 compared with the No Action Alternative would result in increased SWP water deliveries to areas located south of the Delta; therefore, annual energy use would result in changes in SWP energy resources, as summarized in Table U-9. Under Alternative 1 compared with the No Action Alternative, SWP annual energy generation would be higher for the long-term average and annual energy generation would be higher for dry and critically dry years, but the energy required to move the water would also be higher for both long-term average and in dry and critically dry years resulting in a reduction in average net generation for both year types. The SWP net generation over the long-term would be lower by 42% and the annual net generation would be lower by 72% for dry and critically dry years under Alternative 1 compared with the No Action Alternative. Alternative sources of energy would be required from other sources under Alternative 1 because net generation would be negative under both water year types.

Table U-9. Simulated Annual State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 1 Compared with the No Action Alternative

Water Year	Use/Generation	Alternative 1	NAA	Change between Alternative 1 and NAA (percent change) [b]
Long-Term Average	Energy Use	9,044	7,202	1,842 (25%)
	Generation	4,131	3,744	387 (10%)
	Net Generation	-4,912	-3,458	-1,454 (-42%)
Dry and Critically Dry Water Years [a]	Energy Use	5,508	3,756	1,752 (47%)
	Generation	2,433	1,972	461 (43%)
	Net Generation	-3,075	-1,785	-1,290 (-72%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921–September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 1 value. Percent change is the change divided by the No Action Alternative value.
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-10 shows the monthly energy use, generation, and resulting net generation for SWP facilities for the No Action Alternative and Alternative 1, both as a long-term average of all years and as an average for dry and critically dry years. Simulated SWP monthly net generation would be decreased in all months for both the average of all years and for dry and critically dry years. For both timeframes, the decrease in monthly net generation is a result of increased energy use. The monthly average generation in all years and dry and critically dry years would also increase, but not by as much as energy use.

Under Alternative 1, the SWP would expect increased monthly average generation compared with the No Action Alternative for all years including dry and critically dry years; however, there would also be greater increases in monthly energy use resulting in decreased monthly net energy generation in all months for both water year types. The average monthly net generation would be decreased for all years by between 6% and 113%, and the average monthly net generation would be decreased for dry and critically dry years by between 10% and 327% compared with the No Action Alternative. Alternative sources of energy would be needed for operations in response to the decreased net generation in all months in addition to those already required under the No Action Alternative.

Table U-10. Simulated Monthly State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 1 Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	561	532	480	439	435	480	509	536	575	656	641	570
		Generation	263	216	223	240	272	322	297	341	408	503	399	260
		Net Generation	-298	-316	-257	-199	-163	-158	-212	-195	-168	-153	-242	-310
	Alt 1	Energy Use	629	570	594	667	635	723	599	661	690	764	751	674
		Generation	273	234	248	288	322	387	321	371	464	530	426	267
		Net Generation	-355	-336	-346	-380	-312	-336	-277	-291	-227	-235	-324	-407
	Change from NAA (percent change) [b]	Energy Use	67	37	114	228	200	243	90	125	115	108	110	104
		Generation	10	18	25	48	50	65	24	30	56	27	27	7
		Net Generation	-57 (-19%)	-19 (-6%)	-89 (-35%)	-180 (-91%)	-150 (-92%)	-178 (-113%)	-65 (-31%)	-95 (-49%)	-59 (-35%)	-81 (-53%)	-83 (-34%)	-97 (-31%)
Dry and Critically Dry Years [a]	NAA	Energy Use	458	425	434	238	185	232	276	296	342	326	330	305
		Generation	223	183	162	99	69	95	157	219	310	299	220	124
		Net Generation	-235	-242	-272	-139	-116	-137	-119	-78	-32	-27	-110	-181
	Alt 1	Energy Use	538	464	470	406	316	337	366	419	470	456	465	405
		Generation	242	197	169	129	98	126	201	265	363	339	261	164
		Net Generation	-296	-267	-301	-277	-218	-212	-165	-154	-107	-117	-204	-241
	Change from NAA	Energy Use	79	39	37	169	131	105	90	123	128	129	135	99
		Generation	19	14	8	30	29	31	44	47	53	40	41	40

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	(percent change) [b]	Net Generation	-61 (-26%)	-25 (-10%)	-29 (-11%)	-138 (-100%)	-102 (-88%)	-75 (-55%)	-46 (-39%)	-76 (-98%)	-75 (-233%)	-90 (-327%)	-94 (-86%)	-60 (-33%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 1 value. Percent change is the change divided by the No Action Alternative value.
GWh = Gigawatt-hour; NAA = No Action Alternative; Alt 1 = Alternative 1

U.2.4 Alternative 2

Alternative 2, Multi-Agency Consensus, provides for governance decisions that would be made at certain junctures over time, which are described as four different phases. The modeling results of each phase are compared with the No Action Alternative to evaluate changes in both CVP and SWP net generation.

The first 2 years of implementation under Alternative 2 would include the Alternative 2 Without Temporary Urgency Change Petition (TUCP) Delta Voluntary Agreements (VA) phase. At the end of 2 years, Alternative 2 could transition to either the Alternative 2 Without TUCP and Without VA phase, Alternative 2 Without TUCP Systemwide VA phase, or Alternative 2 With TUCP Without VA phase. The Alternative 2 With TUCP Without VA phase would only be implemented as a backstop during drought.

U.2.4.1 Potential Changes in Central Valley Project Net Generation

Changes in CVP operations under the Alternative 2 Without TUCP Delta VA compared with the No Action Alternative would result in changes in CVP water deliveries to areas located south of the Delta; therefore, annual energy use would result in changes in CVP energy resources, as summarized in Table U-11. Under Alternative 2 Without TUCP Delta VA compared with the No Action Alternative, CVP annual energy generation would be slightly higher for both the long-term average and for dry and critically dry years, and the energy required to move the water would be lower for both the long-term average and for dry and critically dry years. This lower requirement would result in a slight increase in annual net generation for the average of all years and for dry and critically dry years. The CVP annual net generation over the long-term conditions under Alternative 2 Without TUCP Delta VA compared with the No Action Alternative would be slightly higher by 2%, and slightly higher by 1% for dry and critically dry years. Under Alternative 2 Without TUCP Delta VA, net generation for both water year types would be positive and the CVP would not require alternative sources of energy to be purchased from other sources.

Table U-11. Simulated Annual Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPDeltaVA Compared with the No Action Alternative

Water Year	Use/Generation	Alt2woTUCPDeltaVA	NAA	Change between Alt2woTUCPDeltaVA and NAA (percent change) [b]
Long-Term Average	Energy Use	1,501	1,535	-34 (-2%)
	Generation	4,493	4,478	15 (0%)
	Net Generation	2,992	2,943	49 (2%)
Dry and Critically Dry Water Years [a]	Energy Use	929	956	-27 (-3%)
	Generation	3,121	3,113	8 (0%)
	Net Generation	2,192	2,158	34 (1%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPDeltaVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPDeltaVA = Alternative 2 Without Temporary Urgency Change Petition and With Delta Voluntary Agreements; GWh = Gigawatt-hour; NAA = No Action Alternative; < = less than

Table U-12 shows the breakdown of the monthly energy use, generation, and net generation by long-term average and for dry and critically dry years for the CVP facilities. The model output shows that there would be a decrease in monthly average net generation under Alternative 2 Without TUCP Delta VA compared with the No Action Alternative in December, January, and May for all years and no change in July; a decrease in monthly average net generation in December, January, May, August, and September; and no change in February for dry and critically dry years. The decreases in net generation tend to be a result of both increases in energy use and decreases in generation in some of those months, or the increase in energy use outweighs the increase in generation.

Under Alternative 2 Without TUCP Delta VA, the CVP would expect increased monthly average generation or no change in all years compared with the No Action Alternative in most months and would expect a reduction in energy use or no change in most months except in October, December, January, August, and September. Decreases in average monthly net generation would occasionally be relatively small in all years (2% in net generation). Decreases in monthly net generation in dry and critically dry years in December, January, May, August, and September would be 6% or less.

There would be some monthly reductions in CVP net generation compared with the No Action Alternative. However, the CVP would not require alternative sources of energy because the monthly net generation would still be positive.

Table U-12. Simulated Monthly Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPDeltaVA Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	101	134	129	127	138	129	98	117	132	150	151	128
		Generation	263	215	270	325	339	335	320	466	486	629	493	337
		Net Generation	162	80	141	197	202	206	222	350	354	479	342	209
	Alt2woTUCPDeltaVA	Energy Use	102	134	135	128	137	106	83	116	128	148	153	130
		Generation	268	221	272	322	339	338	320	464	487	628	498	335
		Net Generation	166	87	137	194	202	232	237	348	359	479	345	205
	Change from NAA (percent change) [b]	Energy Use	1	0	6	1	-1	-23	-15	-1	-4	-1	2	2
		Generation	5	6	3	-2	0	3	0	-3	1	-1	4	-2
		Net Generation	4 (3%)	7 (8%)	-3 (-2%)	-3 (-2%)	1 (0%)	26 (13%)	15 (7%)	-2 (0%)	5 (1%)	0 (0%)	3 (1%)	4 (-2%)
Dry and Critically Dry Years [a]	NAA	Energy Use	85	110	97	93	113	102	51	58	74	100	87	88
		Generation	231	189	142	152	153	172	248	366	451	515	389	222
		Net Generation	146	78	46	59	40	71	197	309	377	415	301	134
	Alt2woTUCPDeltaVA	Energy Use	88	107	101	94	105	780	48	54	70	98	86	90
		Generation	242	194	146	151	145	186	261	352	447	515	379	217
		Net Generation	154	87	45	57	40	105	213	398	378	417	293	127
	Change from NAA (percent change) [b]	Energy Use	2	-3	5	1	-8	-21	-3	-4	-4	-2	-1	4
		Generation	11	5	34	-2	-8	13	13	-15	-4	0	-9	-5

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
		Net Generation	8 (6%)	9 (11%)	-1 (-2%)	-2 (-4%)	0 (0%)	35 (49%)	16 (8%)	-11 (-4%)	1 (0%)	2 (1%)	-8 (-3%)	-7 (-6%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPDeltaVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPDeltaVA = Alternative 2 Without Temporary Urgency Change Petition Delta Voluntary Agreements;
GWh = Gigawatt-hour: NAA = No Action Alternative

Under Alternative 2 Without TUCP Without VA, CVP water deliveries would change to areas located south of the Delta as compared with the No Action Alternative. Therefore, annual energy use would result in changes in CVP energy resources, as summarized in Table U-13. Under Alternative 2 Without TUCP Without VA compared with the No Action Alternative, CVP annual energy generation would be slightly higher for both long-term average and for dry and critically dry years, but the energy required to move the water would be slightly higher for the long-term average and slightly lower for dry and critically dry years. This change in water deliveries would result in no change in annual net generation for the average of all years and a slight increase for dry and critically dry years. Under Alternative 2 Without TUCP Without VA compared with the No Action Alternative, the CVP annual net generation over the long-term conditions would not change and be slightly higher by 1% and in the dry and critically dry years. Under Alternative 2 Without TUCP Without VA, net generation for both water year types would be positive and the CVP would not require alternative sources of energy to be purchased from other sources.

Table U-13. Simulated Annual Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPwoVA Compared with the No Action Alternative

Water Year	Use/Generation	Alt2woTUCPwoVA	NAA	Change between Alt2woTUCPwoVA and NAA (percent change) [b]
Long-Term Average	Energy Use	1,551	1,535	16 (1%)
	Generation	4,494	4,478	16 (0%)
	Net Generation	2,943	2,943	0 (0%)
Dry and Critically Dry Water Years [a]	Energy Use	934	956	-22 (-2%)
	Generation	3,119	3,113	6 (0%)
	Net Generation	2,185	2,158	27 (1%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPwoVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPwoVA = Alternative 2 Without TUCP Delta and Without VA: GWh = Gigawatt-hour
NAA = No Action Alternative

Table U-14 shows the breakdown of the monthly energy use, generation, and net generation for the CVP facilities by long-term average and for dry and critically dry years. The model output shows that there would be a decrease in monthly average net generation under Alternative 2 Without TUCP Without VA compared with the No Action Alternative in March, April, May, July, and September for all years, and in May, July, August and September for dry and critically dry years. The decreased net generation tends to be a result of increased energy use and/or decreased generation in some of those months and/or the increased energy use outweighs the increased generation.

Under Alternative 2 Without TUCP Without VA, the CVP would expect increased monthly average generation in all years compared with the No Action Alternative in most months except in May, July and September, and would expect decreased energy use in February, and June. Decreases in average monthly net generation would occasionally be relatively small in all years (2% or less). Decreases in monthly net generation in dry and critically dry years would also be small (6% or less) with the largest reduction (6%) in September.

There would be some monthly reductions in CVP net generation compared with the No Action Alternative. However, the CVP would not require alternative sources of energy because the monthly net generation would still be positive.

Table U-14. Simulated Monthly Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPwoVA Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	101	134	129	127	138	129	98	117	132	150	151	128
		Generation	263	215	270	325	339	335	320	466	486	629	493	337
		Net Generation	162	80	141	197	202	206	222	350	354	479	342	209
	Alt2woTUCPwoVA	Energy Use	101	137	133	127	136	134	103	118	128	150	151	131
		Generation	267	221	274	325	342	336	321	465	488	625	495	335
		Net Generation	166	83	141	198	206	202	218	346	360	475	344	204
	Change from NAA (percent change) [b]	Energy Use	0	3	4	0	-1	4	5	2	-4	0	0	3
		Generation	4	6	4	1	3	1	2	-2	2	-4	1	-2
		Net Generation	4 (2%)	3 (4%)	0 (0%)	1 (0%)	4 (2%)	-3 (-2%)	-4 (-2%)	-3 (-1%)	6 (2%)	-4 (-1%)	2 (1%)	-5 (-2%)
Dry and Critically Dry Years [a]	NAA	Energy Use	85	110	97	93	113	102	51	58	74	100	87	88
		Generation	231	189	142	152	153	172	248	366	451	515	389	222
		Net Generation	146	78	46	59	40	71	197	309	377	415	301	134
	Alt2woTUCPwoVA	Energy Use	87	110	99	92	105	94	52	56	68	96	84	90
		Generation	240	192	146	154	154	183	263	353	445	508	376	217
		Net Generation	154	83	47	62	49	88	212	298	377	412	292	127
		Energy Use	1	-1	2	-1	-8	-7	1	-2	-6	-4	-3	2

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Change from NAA (percent change) [b]	Generation	9	4	4	2	1	10	15	-13	-6	-7	-12	-5
		Net Generation	8 (5%)	5 (6%)	1 (3%)	3 (4%)	9 (22%)	17 (25%)	14 (7%)	-11 (-4%)	0 (0%)	-3 (-1%)	-10 (-3%)	-7 (-6%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPwoVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPwoVA = Alternative 2 Without TUCP Without VA; GWh = Gigawatt-hour; NAA = No Action Alternative

Under Alternative 2 Without TUCP Systemwide VA, CVP water deliveries would change to areas located south of the Delta as compared with the No Action Alternative. Therefore, annual energy use would result in a change in CVP energy resources, as summarized in Table U-15. Under Alternative 2 Without TUCP Systemwide VA compared with the No Action Alternative, CVP facilities annual energy generation would be higher for the long-term average and slightly lower for dry and critically dry years, but the energy required to move the water would be slightly lower for the long-term average and for dry and critically dry years. This would result in slightly increased annual net generation for the average of all years and for dry and critically dry years. Under Alternative 2 Without TUCP Systemwide VA compared with the No Action Alternative, the CVP annual net generation over the long-term conditions would be slightly higher by 1%, and higher by 1% for dry and critically dry years. Under Alternative 2 Without TUCP Systemwide VA, net generation for both water year types would be positive and the CVP would not require alternative sources of energy to be purchased from other sources.

Table U-15. Simulated Annual Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPAllVA Compared with the No Action Alternative

Water Year	Use/Generation	Alt2woTUCPAllVA	NAA	Change between Alt2woTUCPAllVA and NAA (percent change) [b]
Long-Term Average	Energy Use	1,503	1,535	-32 (-2%)
	Generation	4,490	4,478	12 (0%)
	Net Generation	2,987	2,943	44 (1%)
Dry and Critically Dry Water Years [a]	Energy Use	929	956	-27 (-3%)
	Generation	3,109	3,113	-4 (0%)
	Net Generation	2,180	2,158	22 (1%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPAllVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPAllVA = Alternative 2 Without Temporary Urgency Change Petition Systemwide Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-16 shows the breakdown of the monthly energy use, generation, and net generation for the CVP facilities by long-term average and for dry and critically dry years. The model output shows that there would be a decrease in monthly average net generation under Alternative 2 Without TUCP Systemwide VA compared with the No Action Alternative in December, June, July, and September for all years, and in December and May through September for dry and critically dry years. The decreases in net generation tend to be a result of increased energy use and/or decreased generation in some of those months that is greater than decreases in energy use, or the change in energy use outweighs the change in generation.

Under Alternative 2 Without TUCP Systemwide VA, the CVP would expect increased monthly average generation in all years compared with the No Action Alternative in most months except in May, June, July, and September, and would expect decreased energy use in March, April, June and July. Decreases in average monthly net generation would occasionally be relatively small in all years (3% or less). Decreases in monthly net generation in dry and critically dry years would also be small (8% or less) with the largest reduction (8%) in December.

There would be some monthly reductions in CVP net generation compared with the No Action Alternative. However, the CVP would not require alternative sources of energy because the monthly net generation would still be positive.

Table U-16. Simulated Monthly Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPAllVA Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	101	134	129	127	138	129	98	117	132	150	151	128
		Generation	263	215	270	325	339	335	320	466	486	629	493	337
		Net Generation	162	80	141	197	202	206	222	350	354	479	342	209
	Alt2woTUCPAllVA	Energy Use	102	135	135	128	137	106	83	116	128	149	153	131
		Generation	267	222	273	325	344	337	329	466	476	621	495	334
		Net Generation	165	87	138	197	207	232	246	349	348	472	342	203
	Change from NAA (percent change) [b]	Energy Use	1	0	6	1	0	-24	-15	0	-4	-1	2	3
		Generation	4	7	3	0	4	2	9	-1	-9	-8	2	-3
		Net Generation	3 (2%)	7 (9%)	-2 (-2%)	0 (0%)	5 (2%)	25 (13%)	24 (11%)	0 (0%)	-5 (-2%)	-7 (-2%)	0 (0%)	-5 (-3%)
Dry and Critically Dry Years [a]	NAA	Energy Use	85	110	97	93	113	102	51	58	74	100	87	88
		Generation	231	189	142	152	153	172	248	366	451	515	389	222
		Net Generation	146	78	46	59	40	71	197	309	377	415	301	134
	Alt2woTUCPAllVA	Energy Use	89	107	101	95	106	78	48	54	69	98	86	90
		Generation	241	191	144	154	156	185	264	350	436	503	379	215
		Net Generation	152	84	42	59	49	107	216	296	367	405	292	125
	Change from NAA (percent change) [b]	Energy Use	4	-3	5	1	-7	-24	-3	-4	-5	-3	-1	2
		Generation	9	3	1	1	2	12	15	-17	-15	-12	-10	-7

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
		Net Generation	6 (4%)	6 (7%)	-4 (-8%)	0 (0%)	9 (22%)	36 (51%)	18 (9%)	-13 (-4%)	-10 (-3%)	-10 (-2%)	-9 (-3%)	-9 (-7%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPAllVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPAllVA = Alternative 2 Without Temporary Urgency Change Petition Systemwide Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Under Alternative 2 With TUCP Without VA, CVP water deliveries would change in areas located south of the Delta as compared with the No Action Alternative. Therefore, annual energy use would result in a change in CVP energy resources, as summarized in Table U-17. Under Alternative 2 With TUCP Without VA compared with the No Action Alternative, CVP facilities annual energy generation would be slightly higher for both long-term average and for dry and critically dry years, but the energy required to move the water would also be slightly higher for the long-term average and lower for dry and critically dry years. This would result in slightly increased annual net generation for the average of all years and for dry and critically dry years. Under Alternative 2 With TUCP Without VA compared with the No Action Alternative, the CVP annual net generation over the long-term conditions would be slightly higher by less than 1% and higher by 2% in dry and critically dry years. Under Alternative 2 With TUCP Without VA, net generation for both water year types would be positive and the CVP would not require alternative sources of energy to be purchased from other sources.

Table U-17. Simulated Annual Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2wTUCPwoVA Compared with the No Action Alternative

Water Year	Use/Generation	Alt2wTUCPwoVA	NAA	Change between Alt2wTUCPwoVA and NAA (percent change) [b]
Long-Term Average	Energy Use	1,552	1,535	17 (1%)
	Generation	4,508	4,478	30 (0%)
	Net Generation	2,956	2,943	13 (0%)
Dry and Critically Dry Water Years [a]	Energy Use	924	956	-32 (-3%)
	Generation	3,123	3,113	10 (0%)
	Net Generation	2,199	2,158	41 (2%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2wTUCPwoVA value. Percent change is the change divided by the No Action Alternative value.
Alt2wTUCPwoVA = Alternative 2 With Temporary Urgency Change Petition Without Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-18 shows the breakdown of the monthly energy use, generation, and net generation, by long-term average and for dry and critically dry years, for the CVP facilities. The model output shows that there would be a decrease in monthly average net generation under Alternative 2 With TUCP Without VA compared with the No Action Alternative in March, April, May, and July for all years, and decreased average net generation in April, May, and August for dry and critically dry years. The decreased net generation tends to be a result of both increased energy use and decreased generation for all years and for dry and critically dry years.

Under Alternative 2 With TUCP Without VA, the CVP would expect increased monthly average generation in all years compared with the No Action Alternative in most months except in March, April, May, and July and would expect decreased energy use in January, February, and

June. Decreases in average monthly net generation would occasionally be relatively small in all years (4% or less). Decreases in monthly net generation in dry and critically dry years would also be small (3% or less).

There would be some monthly reductions in CVP net generation compared with the No Action Alternative. However, the CVP would not require alternative sources of energy because the monthly net generation would still be positive.

Table U-18. Simulated Monthly Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2wTUCPwoVA Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	101	134	129	127	138	129	98	117	132	150	151	128
		Generation	263	215	270	325	339	335	320	466	486	629	493	337
		Net Generation	162	80	141	197	202	206	222	350	354	479	342	209
	Alt2wTUCPwoVA	Energy Use	103	138	133	126	136	135	102	119	128	149	152	130
		Generation	270	223	276	328	344	334	315	466	488	626	498	339
		Net Generation	168	85	143	201	209	199	212	347	360	477	346	209
	Change from NAA (percent change) [b]	Energy Use	1	4	4	-1	-2	5	4	3	-4	0	1	2
		Generation	7	8	7	3	5	-1	-5	0	2	-3	4	2
		Net Generation	6 (4%)	5 (6%)	3 (2%)	4 (2%)	7 (3%)	-6 (-3%)	-9 (-4%)	-3 (-1%)	6 (2%)	-3 (-1%)	4 (1%)	0 (0%)
Dry and Critically Dry Years [a]	NAA	Energy Use	85	110	97	93	113	102	51	58	74	100	87	88
		Generation	231	189	142	152	153	172	248	366	451	515	389	222
		Net Generation	146	78	46	59	40	71	197	309	377	415	301	134
	Alt2wTUCPwoVA	Energy Use	88	112	100	89	102	98	50	56	67	92	83	86
		Generation	242	194	152	153	157	173	242	355	443	506	380	227
		Net Generation	154	82	52	64	55	75	192	299	376	414	297	141
		Energy Use	2	2	4	-4	-10	-3	0	-2	-7	-8	-4	-2
		Generation	11	6	10	0	4	0	-6	-11	-8	-10	-9	5

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Change from NAA (percent change) [b]	Net Generation	8 (6%)	4 (6%)	6 (13%)	5 (8%)	14 (35%)	4 (6%)	-6 (-3%)	-10 (-3%)	-1 (0%)	-1 (0%)	-4 (-1%)	6 (5%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2wTUCPwoVA value. Percent change is the change divided by the No Action Alternative value.
Alt2wTUCPwoVA = Alternative 2 With Temporary Urgency Change Petition Without Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-19 compares annual energy use, generation, and net generation for the long-term average and for dry and critically dry water years for all phases of Alternative 2. The first 2 years of implementation of Alternative 2 would be under the Alternative 2 Without TUCP Delta VA phase. CVP long-term annual average net generation would be increased slightly by 2% compared with the No Action Alternative and would be increased slightly in dry and critically dry years by 1%.

Table U-19. Simulated Annual Central Valley Project Energy Net Generation (GWh) under Alternative 2 Compared with the No Action Alternative

Water Year	Use/ Generation	Change between Alt2woTUCPDeltaVA and NAA (percent change) [b]	Change between Alt2woTUCPwoVA and NAA (percent change) [b]	Change between Alt2woTUCPAllVA and NAA (percent change) [b]	Change between Alt2wTUCPwoVA and NAA (percent change) [b]
Long-Term Average	Energy Use	-34 (-2%)	16 (1%)	-32 (-2%)	17 (1%)
	Generation	15 (0%)	16 (0%)	12 (0%)	30 (0%)
	Net Generation	49 (2%)	0 (0%)	44 (1%)	13 (0%)
Dry and Critically Dry Water Years [a]	Energy Use	-27 (-3%)	-22 (-2%)	-27 (-3%)	-32 (-3%)
	Generation	8 (0%)	6 (0%)	-4 (0%)	10 (0%)
	Net Generation	34 (1%)	27 (1%)	22 (1%)	41 (2%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2wTUCPwoVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPDeltaVA = Alternative 2 Without Temporary Urgency Change Petition Delta Voluntary Agreements
Alt2woTUCPwoVA = Alternative 2 Without Temporary Urgency Change Petition Without Voluntary Agreements
Alt2woTUCPAllVA = Alternative 2 Without Temporary Urgency Change Petition Systemwide Voluntary Agreements
Alt2wTUCPwoVA = Alternative 2 With Temporary Urgency Change Petition Without Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative; < = less than

CVP long-term annual average net generation would not change compared with the No Action Alternative and would be increased by 1% in dry and critically dry years under Alternative 2 Without TUCP Without VA. CVP long-term annual average net generation would increase slightly by less than 1% and increase by 2% in dry and critically dry years under Alternative 2 With TUCP Without VA phases. CVP long-term annual average net generation would be increased by 1% compared with the No Action Alternative and would be increased by 1% in dry and critically dry years under the Alternative 2 Without TUCP and All VA phase. Overall, there would be only slight changes in annual net generation or no change when comparing all Alternative 2 phases.

Table U-20 shows the number of months and percent range of changes (increases and decreases) in net generation for CVP facilities under Alternative 2 phases compared with the No Action

Alternative. The first 2 years of implementation of Alternative 2 would be under the Alternative 2 Without TUCP Delta VA phase. During the first 2 years, CVP monthly average net generation in all years would be increased in 9 months (between 0% and 13%) and would be decreased in 3 months (between 0% and 2%) compared with the No Action Alternative. CVP monthly average net generation in dry, and critically dry years would be increased in 7 months (between 0% and 49%) and decreased in 5 months (between 2% and 6%) in the first 2 years of implementation of Alternative 2 compared with the No Action Alternative.

CVP monthly average net generation changes under all other phases of Alternative 2 would be similar to the Alternative 2 Without TUCP Delta VA phase relative to the number of months and percent ranges of increased and decreased monthly net generation.

Table U-20. Simulated Monthly Central Valley Project Energy Net Generation (GWh) under Alternative 2 Compared with the No Action Alternative

Water Year	Use/ Generation	Change between Alt2woTUCPDeltaVA and NAA (percent change range) [b]		Change between Alt2woTUCPwoVA and NAA (percent change) [b]		Change between Alt2woTUCPAllVA and NAA (percent change) [b]		Change between Alt2wTUCPwoVA and NAA (percent change) [b]	
		INCREASE/ NO CHANGE	***DECREASE***	***INCREASE/ NO CHANGE***	***DECREASE***	***INCREASE/ NO CHANGE***	***DECREASE***	***INCREASE/ NO CHANGE***	***DECREASE***
Average All Years	Number of Months	9	3	7	5	8	4	8	4
	Net Generation Change	0%–13%	0%–2%	0%–4%	1%–2%	0%–13%	2%–3%	0%–6%	1%—4%
Dry and Critically Dry Water Years [a]	Number of Months	7	5	8	4	6	6	7	5
	Net Generation Change	0%–49%	2%–6%	0%–25%	1%–6%	0%–51%	2%–8%	5%–35%	0%–3%

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921 and September 30, 2021.
[b] Change from No Action Alternative is the number of months and range of the percent change of increases and decreases in monthly net generation for each Alternative 2 phase.
Alt2woTUCPDeltaVA = Alternative 2 Without Temporary Urgency Change Petition Delta Voluntary Agreements
Alt2woTUCPwoVA = Alternative 2 Without Temporary Urgency Change Petition Without Voluntary Agreements
Alt2woTUCPAllVA = Alternative 2 Without Temporary Urgency Change Petition Systemwide Voluntary Agreements
Alt2wTUCPwoVA = Alternative 2 With Temporary Urgency Change Petition Without Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

U.2.4.2 Potential Changes in State Water Project Net Generation

Under Alternative 2 Without TUCP Delta VA changes in SWP operations compared with the No Action Alternative would result in a change in SWP water deliveries to areas located south of the Delta. Therefore, annual energy use would change resulting in changes in SWP energy resources, as summarized in Table U 21. Under Alternative 2 Without TUCP Delta VA, SWP annual energy generation would be slightly higher for the long-term average and slightly lower in dry and critically dry years compared with the No Action Alternative, but the energy required to move the water would be higher for both the long-term average and in dry and critically dry years. This change in water deliveries would result in a slight decrease in annual net generation for all years and for dry and critically dry years. The SWP annual net generation over the long-term under Alternative 2 Without TUCP Delta VA compared with the No Action Alternative would be 5% lower and would be 4% lower for dry and critically dry years. Annual negative net generation under Alternative 2 Without TUCP Delta VA for all water year types would require alternative sources of energy to be purchased from other sources.

Table U-21. Simulated Annual State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPDeltaVA Compared with the No Action Alternative

Water Year	Use/Generation	Alt2woTUCPDeltaVA	NAA	Change between Alt2woTUCPDeltaVA and NAA (percent change) [b]
Long-Term Average	Energy Use	7,398	7,202	196 (3%)
	Generation	3,752	3,744	8 (0%)
	Net Generation	-3,645	-3,458	-187 (-5%)
Dry and Critically Dry Water Years [a]	Energy Use	3,812	3,756	56 (1%)
	Generation	1,959	1,972	-13 (1%)
	Net Generation	-1,854	-1,785	-69 (-4%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPDeltaVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPDeltaVA = Alternative 2 Without Temporary Urgency Change Petition Delta Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-22 shows the monthly energy use, generation, and resulting net generation for SWP facilities for the No Action Alternative and Alternative 2 Without TUCP Delta VA, both as long-term average of all years and as an average for dry and critically dry years. The model output shows that there would be a decrease in monthly average net generation in all months except for December and June for all years, and a decrease in monthly average net generation in all months except in December, March, April, and June for dry and critically dry years. The decrease in net generation is a result of increased energy use; the average generation of all years and dry and critically dry years would decrease or increase but not by as much.

Under Alternative 2 Without TUCP Delta VA, SWP would expect increased monthly average generation in all years compared with the No Action Alternative in most months and would expect greater increases in energy use in all months except December. Decreases in average monthly net generation would vary in all years ranging between 2% and 22%, with the highest reductions in February (19%) and in May (22%). Decreases in average monthly net generation would vary in dry and critically dry years between 5% and 53%, with the highest reductions in February (14%), July (53%), and August (14%).

Alternative sources of energy would be needed for operations in response to the decreased net generation in some months in addition to those already required under the No Action Alternative.

Table U-22. Simulated Monthly State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPDeltaVA Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years		NAA	Energy Use	561	532	480	439	435	480	509	536	575	656	641	570
			Generation	263	216	223	240	272	322	297	341	408	503	399	260
			Net Generation	-298	-316	-257	-199	-163	-158	-212	-195	-168	-153	-242	-310
		Alt2woTUCPDeltaVA	Energy Use	579	541	467	462	473	492	512	568	577	669	666	583
			Generation	265	215	217	247	279	326	294	329	411	501	403	265
			Net Generation	-314	-326	-251	-215	-194	-167	-218	-239	-166	-168	-263	-318
		Change from NAA (percent change) [b]	Energy Use	18	9	-12	23	38	12	3	31	2	13	25	13
			Generation	2	-1	-6	7	7	3	-3	-12	4	-2	4	5
			Net Generation	-16 (-5%)	-10 (-3%)	6 (2%)	-16 (-8%)	-31 (-19%)	-9 (-5%)	-6 (-3%)	-44 (-22%)	2 (1%)	-14 (-9%)	-21 (-9%)	-8 (-2%)
Dry and Critically Dry Years [a]		NAA	Energy Use	458	425	434	238	185	232	276	296	342	326	330	305
			Generation	223	183	162	99	69	95	157	219	310	299	220	124
			Net Generation	-235	-242	-272	-139	-116	-137	-119	-78	-32	-27	-110	-181
		Alt2woTUCPDeltaVA	Energy Use	485	442	388	260	205	230	276	292	338	338	344	314
			Generation	225	183	150	105	72	102	163	210	306	296	218	126
			Net Generation	-260	-259	-239	-155	-132	-128	-112	-82	-32	-42	-125	-188
		Change from NAA (percent change) [b]	Energy Use	27	17	-46	22	20	-2	0	-4	-4	11	14	9
			Generation	1	0	-12	6	4	7	6	-8	-4	-3	-1	2

Year Type	Alternative	Use/ Generation		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
			Net Generation	-25 (-11%)	-17 (-7%)	34 (12%)	-17 (-12%)	-16 (-14%)	9 (7%)	6 (5%)	-4 (-5%)	0 (0%)	-15 (-53%)	-15 (-14%)	-7 (-4%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPDeltaVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPDeltaVA = Alternative 2 Without Temporary Urgency Change Petition Delta Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Under Alternative 2 Without TUCP Without VA, operations would result in a change in SWP water deliveries to areas located south of the Delta compared with the No Action Alternative. Therefore, annual energy use would result in changes in SWP energy resources, as summarized in Table U-23. Under Alternative 2 Without TUCP Without VA compared with the No Action Alternative, annual energy generation would be about the same for the long-term average and slightly lower for dry and critically dry years, but the energy required by the SWP to move the water would be slightly higher for the long-term average and slightly lower for dry and critically dry years. The changes to SWP annual net generation would be slightly lower under Alternative 2 Without TUCP Without VA compared with the No Action Alternative; long-term average net generation would decrease by 5%, and dry and critically dry year annual net generation would increase by 1%. Annual negative net generation under Alternative 2 Without TUCP Without VA for all water year types would require alternative sources of energy to be purchased.

Table U-23. Simulated Annual State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPwoVA Compared with the No Action Alternative

Water Year	Use/Generation	Alt2woTUCPwoVA	NAA	Change between Alt2woTUCPwoVA and NAA (percent change) [b]
Long-Term Average	Energy Use	7,387	7,202	185 (2%)
	Generation	3,754	3,744	10 (0%)
	Net Generation	-3,632	-3,458	-174 (-5%)
Dry and Critically Dry Water Years [a]	Energy Use	3,724	3,756	-32 (-1%)
	Generation	1,951	1,972	-21 (-1%)
	Net Generation	-1,774	-1,785	11 (1%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPwoVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPwoVA = Alternative 2 Without Temporary Urgency Change Petition Without Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-24 shows the monthly energy use, generation, and resulting net generation for SWP facilities for the No Action Alternative and Alternative 2 Without TUCP Without VA, both as long-term average of all years and as an average for dry and critically dry years. The model output shows that there would be a decrease in monthly average net generation in most months except in December for all years, and a decrease in monthly average net generation except in November, December, March, April, May, and June for dry and critically dry years. The decreased net generation is a result of increased energy use or decreased energy use with greater decreases in generation; the average generation of all years and dry and critically dry years would be decreased or increased but not by as much.

Table U-24. Simulated Monthly State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPwoVA Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	561	532	480	439	435	480	509	536	575	656	641	570
		Generation	263	216	223	240	272	322	297	341	408	503	399	260
		Net Generation	-298	-316	-257	-199	-163	-158	-212	-195	-168	-153	-242	-310
	Alt2woTUCPwoVA	Energy Use	562	536	475	471	460	495	535	567	584	665	652	580
		Generation	263	215	221	252	278	326	295	330	415	499	399	263
		Net Generation	-299	-321	-254	-219	-181	-169	-240	-237	-169	-166	-253	-317
	Change from NAA (percent change) [b]	Energy Use	1	4	-4	32	25	15	26	31	8	9	11	10
		Generation	0	-1	-2	12	6	4	-2	-11	7	-4	0	3
		Net Generation	-1 (0%)	-4 (-1%)	2 (1%)	-20 (-10%)	-19 (-12%)	-11 (-7%)	-28 (-13%)	-42 (-21%)	-1 (-1%)	-13 (-8%)	-12 (-5%)	-7 (-2%)
Dry and Critically Dry Years [a]	NAA	Energy Use	458	425	434	238	185	232	276	296	342	326	330	305
		Generation	223	183	162	99	69	95	157	219	310	299	220	124
		Net Generation	-235	-242	-272	-139	-116	-137	-119	-78	-32	-27	-110	-181
	Alt2woTUCPwoVA	Energy Use	481	412	400	260	196	225	272	287	332	322	327	308
		Generation	225	179	154	108	73	98	162	209	308	288	211	124
		Net Generation	-256	-233	-246	-152	-123	-127	-110	-78	-24	-34	-116	-184
	Change from NAA (percent change) [b]	Energy Use	23	-14	-34	23	11	-7	-4	-9	-10	-5	-3	3
		Generation	2	-4	-7	9	5	3	5	-9	-2	-11	-8	0

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
		Net Generation	-21 (-9%)	9 (4%)	26 (10%)	-13 (-10%)	-6 (-5%)	10 (8%)	8 (7%)	0 (0%)	8 (25%)	-6 (-23%)	-5 (-5%)	-3 (-1%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2v1woTUCP value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPwoVA = Alternative 2 Without Temporary Urgency Change Petition Without Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Under Alternative 2 Without TUCP Without VA, SWP would expect not change or slightly increased monthly average generation for the average in all years compared with the No Action Alternative in October, January through March, June, August, and September, and increased energy use in most months except December. Decreases in average monthly net generation for all years would vary ranging between less than 1% and 21%, with the highest reductions in January (10%), February (12%), April (13%), and May (21%). Decreases in average monthly net generation would vary in dry and critically dry years between 1% and 23%, with the highest reduction in July (23%).

Alternative sources of energy would be needed for operations in response to the decreased net generation in some months in addition to those already required under the No Action Alternative.

Under Alternative 2 Without TUCP Systemwide VA, operations would result in a change in SWP water deliveries to areas located south of the Delta compared with the No Action Alternative. Therefore, annual energy use would result in changes in SWP energy resources, as summarized in Table U-25. Under Alternative 2 Without TUCP Systemwide VA compared with the No Action Alternative, annual energy generation would be slightly higher for the long-term average and would be slightly lower for dry and critically dry years, but the energy required by the SWP to move the water would be higher for both the long-term average and for dry and critically dry years. This change in water deliveries would result in a slight decrease in annual net generation for all years and for dry and critically dry years. The SWP annual net generation over the long-term conditions under Alternative 2 Without TUCP Systemwide VA compared with the No Action Alternative would be 5% lower and would be 3% lower for dry and critically dry years. Alternative sources of energy would be required from other sources under Alternative 2 Without TUCP Systemwide VA because net generation would be negative under both water year types.

Table U-25. Simulated Annual State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPAllVA Compared with the No Action Alternative

Water Year	Use/Generation	Alt2woTUCPAllVA (GWh)	NAA (GWh)	Change between Alt2woTUCPAllVA and NAA (percent change) [b] (GWh)
Long-Term Average	Energy Use	7,373	7,202	171 (2%)
	Generation	3,747	3,744	3 (0%)
	Net Generation	-3,626	-3,458	-168 (-5%)
Dry and Critically Dry Water Years [a]	Energy Use	3,787	3,756	31 (1%)
	Generation	1,953	1,972	-19 (-1%)
	Net Generation	-1,834	-1,785	-49 (-3%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPAllVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPAllVA = Alternative 2 Without Temporary Urgency Change Petition Systemwide Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-26 shows the monthly energy use, generation, and resulting net generation for SWP facilities for No Action Alternative and Alternative 2 Without TUCP Systemwide VA, both as long-term average of all years and as an average for dry and critically dry years. The model output shows that there would be a decrease in monthly average net generation in most months except in December and April for all years, and a decrease in monthly average net generation in most months except in December, March, and April for dry and critically dry years. The decreased net generation is a result of increased energy use, and the average generation of all years and dry and critically dry years would be decreased or increased but not by as much as the increased energy use.

Under Alternative 2 Without TUCP Systemwide VA, SWP would expect increased monthly average generation in all years compared with the No Action Alternative in most months and would expect greater increases in energy use in most months except in December and June. Decreases in average monthly net generation would vary in all years ranging between 1% and 19%, with the highest reductions in February (18%) and in May (19%). Decreases in average monthly net generation would vary in dry and critically dry years ranging between 2% and 56%, with the highest reductions in October (11%). December (12%), February (12%), July (56%), and August (13%).

Alternative sources of energy would be needed for operations in response to the decreased net generation in some months in addition to those already required under the No Action Alternative.

Table U-26. Simulated Monthly State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2woTUCPAllVA Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	561	532	480	439	435	480	509	536	575	656	641	570
		Generation	263	216	223	240	272	322	297	341	408	503	399	260
		Net Generation	-298	-316	-257	-199	-163	-158	-212	-195	-168	-153	-242	-310
	Alt2woTUCPAllVA	Energy Use	580	538	467	460	472	491	511	565	573	666	665	581
		Generation	264	214	215	248	281	323	303	333	404	497	402	263
		Net Generation	-316	-324	-251	-213	-192	-168	-208	-232	-170	-170	-263	-317
	Change from NAA (percent change) [b]	Energy Use	19	5	-13	21	38	11	2	29	-2	10	23	10
		Generation	1	-2	-7	8	9	1	6	-8	-4	-6	2	3
		Net Generation	-18 (-6%)	-7 (-2%)	6 (2%)	-14 (-7%)	-29 (-18%)	-10 (-6%)	4 (2%)	-37 (-19%)	-2 (-1%)	-16 (-11%)	-21 (-9%)	-7 (-2%)
Dry and Critically Dry Years [a]	NAA	Energy Use	458	425	434	238	185	232	276	296	342	326	330	305
		Generation	223	183	162	99	69	95	157	219	310	299	220	124
		Net Generation	-235	-242	-272	-139	-116	-137	-119	-78	-32	-27	-110	-181
	Alt2woTUCPAllVA	Energy Use	484	433	391	258	207	230	277	293	337	333	339	310
		Generation	223	180	150	106	76	102	171	214	302	290	214	124
		Net Generation	-262	-253	-241	-153	-131	-128	-106	-79	-34	-43	-125	-186
		Energy Use	26	7	-43	20	22	-2	1	-3	-6	7	9	5
		Generation	0	-3	-12	6	7	7	14	-4	-8	-9	-6	0

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Change from NAA (percent change) [b]	Net Generation	-27 (-11%)	-11 (-4%)	31 (12%)	-14 (-10%)	-14 (-12%)	9 (6%)	13 (11%)	-1 (-2%)	-2 (-7%)	-15 (-56%)	-15 (-13%)	-4 (-2%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2woTUCPAllVA value. Percent change is the change divided by the No Action Alternative value.
Alt2woTUCPAllVA = Alternative 2 Without Temporary Urgency Change Petition Systemwide Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Under Alternative 2 With TUCP Without VA, operations would result in a change in SWP water deliveries to areas located south of the Delta compared with the No Action Alternative. Therefore, annual energy use would result in changes in SWP energy resources, as summarized in Table U-27. Under Alternative 2 With TUCP Without VA compared with the No Action Alternative, annual energy generation would be slightly higher for both long-term average and for dry and critically dry years, but the energy required by the SWP to move the water would also be higher for both long-term average and in dry and critically dry years. The changes to SWP net generation would be slightly lower under Alternative 2 With TUCP Without VA compared with the No Action Alternative; long-term average net generation would be 6% lower, and dry and critically dry year net generation would be 4% lower. Alternative sources of energy would be required from other sources under Alternative 2 With TUCP Without VA because net generation would be negative under both water year types.

Table U-27. Simulated Annual State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2wTUCPwoVA Compared with the No Action Alternative

Water Year	Use/Generation	Alt2wTUCPwoVA	NAA	Change between Alt2wTUCPwoVA and NAA (percent change) [b]
Long-Term Average	Energy Use	7,450	7,202	248 (3%)
	Generation	3,778	3,744	34 (1%)
	Net Generation	-3,672	-3,458	-214 (-6%)
Dry and Critically Dry Water Years [a]	Energy Use	3,833	3,756	77 (2%)
	Generation	1,978	1,972	6 (0%)
	Net Generation	-1,855	-1,785	-70 (-4%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2wTUCPwoVA value. Percent change is the change divided by the No Action Alternative value.
Alt2wTUCPwoVA = Alternative 2 With Temporary Urgency Change Petition Without Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-28 shows the monthly energy use, generation, and resulting net generation for SWP facilities for No Action Alternative and Alternative 2 With TUCP Without VA, both as long-term average of all years and as an average for dry and critically dry years. The model output shows that there would be a decrease in monthly average net generation in all months for all years, and a decrease or no change in monthly average net generation in most months except in November, December, March, and September for dry and critically dry years. The decreased net generation would be a result of increased energy use; the average generation of all years and dry and critically dry years would be decreased or increased but not by as much as the increased energy use.

Table U-28. Simulated Monthly State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alt2wTUCPwoVA Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	561	532	480	439	435	480	509	536	575	656	641	570
		Generation	263	216	223	240	272	322	297	341	408	503	399	260
		Net Generation	-298	-316	-257	-199	-163	-158	-212	-195	-168	-153	-242	-310
	Alt2wTUCPwoVA	Energy Use	572	542	482	470	462	498	541	570	587	671	661	582
		Generation	266	218	223	252	280	326	296	331	415	502	404	265
		Net Generation	-306	-325	-258	-218	-182	-172	-245	-239	-172	-169	-257	-317
	Change from NAA (percent change) [b]	Energy Use	11	10	2	31	27	18	32	34	12	15	20	12
		Generation	4	2	0	12	8	4	-1	-10	7	0	5	4
		Net Generation	-7 (-2%)	-8 (-3%)	-2 (-1%)	-19 (-9%)	-20 (-12%)	-14 (-9%)	-33 (-16%)	-44 (-22%)	-4 (-3%)	-15 (-10%)	-15 (-6%)	-7 (-2%)
Dry and Critically Dry Years [a]	NAA	Energy Use	458	425	434	238	185	232	276	296	342	326	330	305
		Generation	223	183	162	99	69	95	157	219	310	299	220	124
		Net Generation	-235	-242	-272	-139	-116	-137	-119	-78	-32	-27	-110	-181
	Alt2wTUCPwoVA	Energy Use	490	421	425	269	201	230	282	294	341	330	336	306
		Generation	231	182	162	109	75	94	158	212	308	291	218	127
		Net Generation	-260	-239	-264	-160	-126	-136	-123	-82	-32	-39	-118	-180
		Energy Use	32	-4	-9	31	16	-2	6	-2	-1	4	7	1
		Generation	7	-1	0	10	6	-1	1	-6	-1	-8	-2	3

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Change from NAA (percent change) [b]	Net Generation	-24 (-10%)	3 (1%)	9 (3%)	-21 (-15%)	-10 (-8%)	1 (1%)	-4 (-4%)	-4 (-6%)	0 (0%)	-11 (-41%)	-8 (-8%)	2 (1%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alt2wTUCPwoVA value. Percent change is the change divided by the No Action Alternative value.
Alt2wTUCPwoVA = Alternative 2 With Temporary Urgency Change Petition Without Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

Under Alternative 2 With TUCP Without VA, SWP would expect increased monthly average generation or no change for the average in all years compared with the No Action Alternative in most months except in April and May, and increased energy use in all months. Decreases in average monthly net generation for all years would vary ranging between less than 2% and 22%, with the highest reductions in April (16%) and May (22%). Decreases in average monthly net generation would vary in dry and critically dry years ranging between 1% and 41%, with the highest reductions October (10%), January (15%), and July (41%).

Alternative sources of energy would be needed for operations in response to the decreased net generation in some months in addition to those already required under the No Action Alternative.

Table U-29 compares annual energy use, generation, and net generation for the long-term average and for dry and critically dry water years for all phases of Alternative 2. The first two years of implementation of Alternative 2 would be under the Alternative 2 Without TUCP Delta VA phase. SWP long-term annual average net generation would be decreased by 5% compared with the No Action Alternative and would be decreased by 4% in dry and critically dry years.

Table U-29. Simulated Annual State Water Project Energy Net Generation (GWh) under Alternative 2 Compared with the No Action Alternative

Water Year	Use/ Generation	Change between Alt2woTUCPDeltaVA and NAA (percent change) [b]	Change between Alt2woTUCPwoVA and NAA (percent change) [b]	Change between Alt2woTUCPAllVA and NAA (percent change) [b]	Change between Alt2wTUCPwoVA and NAA (percent change) [b]
Long-Term Average	Energy Use	196 (3%)	185 (2%)	171 (2%)	248 (3%)
	Generation	8 (0%)	10 (0%)	3 (0%)	34 (1%)
	Net Generation	-187 (-5%)	-174 (-5%)	-168 (-5%)	-214 (-6%)
Dry and Critically Dry Water Years [a]	Energy Use	56 (1%)	-32 (-1%)	31 (1%)	77 (2%)
	Generation	-13 (-1%)	-21 (-1%)	-19 (-1%)	6 (0%)
	Net Generation	-69 (-4%)	11 (1%)	-49 (-3%)	-70 (-4%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative is the number of months and range of the percent change of increases and decreases in monthly net generation for each Alternative 2 phase.
Alt2woTUCPDeltaVA = Alternative 2 Without Temporary Urgency Change Petition Delta Voluntary Agreements
Alt2woTUCPwoVA = Alternative 2 Without TUCP Without VA
Alt2woTUCPAllVA = Alternative 2 Without Temporary Urgency Change Petition Systemwide Voluntary Agreements
Alt2wTUCPwoVA = Alternative 2 With Temporary Urgency Change Petition Without Voluntary Agreements
GWh = Gigawatt-hour; NAA = No Action Alternative

After two years, agencies would have the flexibility to choose one of the other three phases depending on conditions. SWP long-term annual average net generation would be decreased by 5% compared with the No Action Alternative under both the Alternative 2 Without TUCP Without VA and Alternative 2 Without TUCP Systemwide VA phases and would be decreased by 6% under Alternative 2 With TUCP Without VA phase. In dry and critically dry years, the SWP annual average net generation would be increased slightly by 1% compared with the No Action Alternative under the Alternative 2 Without TUCP and Without VA phase, would be decreased by 3% under Alternative 2 Without TUCP Systemwide VA, and would be decreased by 4% under Alternative 2 With TUCP Without VA phase. Overall, there would be only slight differences in changes to annual net generation compared with the No Action Alternative when comparing all Alternative 2 phases.

Table U-30 shows the number of months and percent range of changes (increases and decreases) in net generation for SWP facilities under all Alternative 2 phases compared with the No Action Alternative. The first two years of implementation of Alternative 2 would be under the Alternative 2 Without TUCP Delta VA phase. During the first two years, SWP monthly average net generation in all years would be increased in two months between 1% and 2% and decreased in 10 months between 2% and 22% compared with the No Action Alternative. SWP monthly average net generation in dry and crucially dry years would not change or be increased in four months (between 0% and 12%) and would be decreased in eight months (between 4% and 53%) compared with the No Action Alternative.

Under Alternative 2 Without TUCP Systemwide VA compared with the No Action Alternative, SWP changes to the monthly average net generation for the average of all years would be increased in two months by 2% and decreased in 10 months between 1% and 19%. Under the other two phases of Alternative 2, there would be fewer months that would experience increased monthly net generation for the average of all years, and the range of percent decreased net generation would be similar to the first phase of Alternative 2. In dry and critically dry years, Alternative 2 Without TUCP Systemwide VA and Alternative 2 With TUCP Without VA would be similar to monthly increased or decreased net generation compared with the first phase of Alternative 2. In dry and critically dry years, under Alternative 2 Without TUCP Without VA, there would be more months (+2) with increased monthly net generation and fewer months (-2) with decreased monthly net generation compared with the first phase of Alternative 2. Overall, there would be changes in monthly net generation when comparing all Alternative 2 phases, although some months could see greater changes for certain Alternative 2 phases compared with the No Action Alternative.

Table U-30. Simulated Monthly State Water Project Energy Net Generation (GWh) under Alternative 2 Compared with the No Action Alternative

Water Year	Use/ Generation	Change between Alt2woTUCPDeltaVA and NAA (percent change range) [b]		Change between Alt2woTUCPwoVA and NAA (percent change) [b]		Change between Alt2woTUCPAllVA and NAA (percent change) [b]		Change between Alt2wTUCPwoVA and NAA (percent change) [b]	
		INCREASE/ NO CHANGE	***DECREASE***	***INCREASE/ NO CHANGE***	***DECREASE***	***INCREASE/ NO CHANGE***	***DECREASE***	***INCREASE/ NO CHANGE***	***DECREASE***
Average All Years	Number of Months	2	10	1	11	2	10	0	12
	Net Generation Change	1%–2%	2%–22%	1%	0%–21%	2%	1%–19%	NA	1%–22%
Dry and Critically Dry Water Years [a]	Number of Months	4	8	6	6	3	9	4	8
	Net Generation Change	0%–12%	4%–53%	0%–25%	1%–23%	6%–12%	2%–56%	0%—3%	4%–44%

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative is the number of months and range of the percent change of increases and decreases in monthly net generation for each Alternative 2 phase.
Alt2woTUCPDeltaVA = Alternative 2 Without Temporary Urgency Change Petition Delta Voluntary Agreements
Alt2woTUCPwoVA = Alternative 2 Without TUCP Without VA
Alt2woTUCPAllVA = Alternative 2 Without Temporary Urgency Change Petition Systemwide Voluntary Agreements
Alt2wTUCPwoVA = Alternative 2 With Temporary Urgency Change Petition Without Voluntary Agreements
GWh = Gigawatt-hour ; NAA = No Action Alternative

U.2.5 Alternative 3

Alternative 3 is compared with the No Action Alternative to evaluate changes in both CVP and SWP net generation.

U.2.5.1 Potential Changes in Central Valley Project Net Generation

Changes in CVP operations under Alternative 3 compared with the No Action Alternative would result in a change in CVP water deliveries to areas located south of the Delta; therefore, annual energy use would result in changes in CVP energy resources, as summarized in Table U-31. Under Alternative 3 compared with the No Action Alternative, annual CVP energy generation would be higher for both long-term average and in dry and critically dry years, and the energy required by CVP to move the water would be lower for both long-term average and for dry and critically dry years. The CVP annual net generation over the long-term conditions would be increased by 21%, and annual net generation would be increased by 16% in the dry and critically dry years under Alternative 3 compared with the No Action Alternative. The net generation under both water year types is positive and annual net generation would increase compared with the No Action Alternative. Therefore, Alternative 3 would not require alternative sources of energy to be purchased from other sources.

Table U-31. Simulated Annual Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 3 Compared with the No Action Alternative

Water Year	Use/Generation	Alternative 3	NAA	Change between Alternative 3 and NAA (percent change) [b]
Long-Term Average	Energy Use	933	1,535	-602 (-39%)
	Generation	4,500	4,478	22 (0%)
	Net Generation	3,567	2,943	624 (21%)
Dry and Critically Dry Water Years [a]	Energy Use	662	956	-294 (-31%)
	Generation	3,165	3,113	52 (2%)
	Net Generation	2,503	2,158	345 (16%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 3 value. Percent change is the change divided by the No Action Alternative value.
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-32 shows the breakdown of the monthly energy use, generation, and net generation, by long-term average and for dry and critically dry years for the CVP facilities. The model output shows that there would be an increase in monthly average net generation under Alternative 3 compared with the No Action Alternative for all months except in June (1% decrease) for all years, and there would be an increase in monthly average net generation for dry and critically dry years. The increased net generation tends to be a result of both decreased energy use and increased generation during most months.

Under Alternative 3, CVP would expect increased monthly average generation in most months except in June, July, and September in all years, and increased monthly average generation in most months except in April through July and in October for dry and critically dry years. CVP would expect greater decreases compared with the No Action Alternative in monthly energy use to move the water in all year types, resulting in increases in monthly average net generation in almost all months for both year types compared with the No Action Alternative.

The monthly net generation under both water year types would be positive and would increase compared with the No Action Alternative in almost all months for both water year types. Therefore, Alternative 3 would not require alternative sources of energy to be purchased from other sources.

Table U-32. Simulated Monthly Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 3 Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	101	134	129	127	138	129	98	117	132	150	151	128
		Generation	263	215	270	325	339	335	320	466	486	629	493	337
		Net Generation	162	80	141	197	202	206	222	350	354	479	342	209
	Alt 3	Energy Use	76	81	71	90	89	81	38	42	84	89	102	90
		Generation	270	214	288	335	353	348	339	498	436	585	502	332
		Net Generation	194	133	217	245	264	266	301	456	352	495	400	242
	Change from NAA (percent change) [b]	Energy Use	-25	-53	-58	-38	-49	-48	-60	-75	-48	-60	-49	-39
		Generation	7	0	18	10	14	13	19	31	-50	-44	9	-5
		Net Generation	32 (20%)	53 (66%)	76 (54%)	48 (24%)	62 (31%)	61 (30%)	79 (36%)	106 (30%)	-2 (-1%)	16 (3%)	58 (17%)	33 (16%)
Dry and Critically Dry Years [a]	NAA	Energy Use	85	110	97	93	113	102	51	58	74	100	87	88
		Generation	231	189	142	152	153	172	248	366	451	515	389	222
		Net Generation	146	78	46	59	40	71	197	309	377	415	301	134
	Alt 3	Energy Use	63	59	55	74	80	69	24	27	39	68	78	67
		Generation	235	183	152	159	164	178	236	346	420	506	422	229
		Net Generation	172	125	97	85	84	109	213	319	381	438	345	162
	Change from NAA	Energy Use	-22	-52	-42	-19	-32	-32	-27	-31	-35	-32	-10	-20
		Generation	3	-5	10	7	11	6	-12	-20	-31	-9	34	7

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	(percent change) [b]	Net Generation	26 (18%)	47 (60%)	52 (113%)	26 (44%)	44 (108%)	38 (54%)	15 (8%)	10 (3%)	4 (1%)	23 (6%)	43 (14%)	28 (21%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 3 value. Percent change is the change divided by the No Action Alternative value.
Alt 3 = Alternative 3; GWh = Gigawatt-hour; NAA = No Action Alternative

U.2.5.2 Potential Changes in State Water Project Net Generation

Changes in SWP operations under Alternative 3 compared with the No Action Alternative would result in a change in SWP water deliveries to areas located south of the Delta; therefore, annual energy use would result in changes in SWP energy resources, as summarized in Table U-33. Under Alternative 3 compared with the No Action Alternative, SWP annual energy generation would be lower for both the long-term average and for dry and critically dry years, but the energy required by the SWP to move the water would also be lower for both the long-term average and for dry and critically dry years. The SWP net generation would be increased under Alternative 3 relative to the No Action Alternative. Under Alternative 3 compared with the No Action Alternative, the long-term average net generation would be 77% higher, and the average net generation would be 88% higher for dry and critically dry years. Under Alternative 3, energy use would still exceed generation, resulting in negative net generation for the long-term average and for dry and critically dry years but there would be less of a reduction in net generation compared with the No Action Alternative. Alternative sources of energy would be required from other sources under Alternative 3 because net generation would be negative under both water year types.

Table U-33. Simulated Annual State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 3 Compared with the No Action Alternative

Water Year	Use/Generation	Alternative 3	NAA	Change between Alternative 3 and NAA (percent change) [b]
Long-Term Average	Energy Use	3,823	7,202	-3,379 (-47%)
	Generation	3,035	3,744	-709 (-19%)
	Net Generation	-788	-3,458	2,670 (77%)
Dry and Critically Dry Water Years [a]	Energy Use	1,919	3,756	-1,837 (-49%)
	Generation	1,720	1,972	-252 (-13%)
	Net Generation	-199	-1,785	1,586 (88%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 3 value. Percent change is the change divided by the No Action Alternative value.
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-34 shows the monthly energy use, generation, and resulting net generation for SWP facilities under the No Action Alternative and Alternative 3, both as the long-term average of all years and as an average for dry and critically dry years. Simulated SWP monthly net generation would be increased in all months for both the average of all years and for dry and critically dry years compared with the No Action Alternative; however, monthly net generation would still be a negative number in most months for both year types. For both timeframes, negative net generation is a result of higher energy use needed to transport water than average monthly power generation.

Under Alternative 3, SWP would expect decreased average monthly generation under Alternative 3 compared with the No Action Alternative in most months except in December for the average of all years and decreased average monthly generation in most months except in February and March for dry and critically dry years. Under Alternative 3, there would be large decreases in monthly energy use for all months, resulting in increased monthly net generation for all months for all years and for dry and critically dry years. However, energy used to move water would still exceed generation, resulting in negative net generation in most months except in January through May for the long-term average, and in May through August for the dry and critically dry years.

Table U-34. Simulated Monthly State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 3 Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	561	532	480	439	435	480	509	536	575	656	641	570
		Generation	263	216	223	240	272	322	297	341	408	503	399	260
		Net Generation	-298	-316	-257	-199	-163	-158	-212	-195	-168	-153	-242	-310
	Alt 3	Energy Use	309	304	270	195	191	231	276	314	349	313	285	362
		Generation	194	172	248	233	249	309	290	329	288	300	244	181
		Net Generation	-116	-132	-22	38	57	79	14	15	-61	-14	-41	-181
	Change from NAA (percent change) [b]	Energy Use	-252	-228	-209	-244	-243	-250	-234	-222	-226	-343	-356	-208
		Generation	-70	-44	26	-7	-24	-13	-7	-12	-120	-203	-155	-79
		Net Generation	182 (61%)	184 (58%)	235 (91%)	237 (119%)	220 (135%)	237 (150%)	226 (107%)	210 (108%)	107 (64%)	140 (91%)	201 (83%)	129 (42%)
Dry and Critically Dry Years [a]	NAA	Energy Use	458	425	434	238	185	232	276	296	342	326	330	305
		Generation	223	183	162	99	69	95	157	219	310	299	220	124
		Net Generation	-235	-242	-272	-139	-116	-137	-119	-78	-32	-27	-110	-181
	Alt 3	Energy Use	216	221	210	143	104	153	167	150	167	151	101	175
		Generation	153	134	140	93	73	117	151	181	251	241	189	95
		Net Generation	-64	-87	-70	-50	-32	-37	-16	31	84	91	88	-80
	Change from NAA	Energy Use	-242	-205	-223	-94	-81	-79	-109	-146	-175	-176	-229	-130
		Generation	-71	-49	-21	-6	4	21	-7	-38	-59	-57	-31	-29

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	(percent change) [b]	Net Generation	171 (73%)	155 (64%)	202 (74%)	88 (64%)	85 (73%)	100 (73%)	102 (86%)	108 (140%)	116 (359%)	118 (432%)	198 (180%)	101 (56%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 3 value. Percent change is the change divided by the No Action Alternative value.
Alt 3 = Alternative 3; GWh = Gigawatt-hour; NAA = No Action Alternative

Monthly SWP net generation under Alternative 3 would require alternative sources of energy in months that show negative net generation for both water year types. Positive net generation in one month would not necessarily benefit a month with a negative net generation because no opportunities for large-scale energy storage are available.

U.2.6 Alternative 4

Alternative 4 is compared with the No Action Alternative to evaluate changes in both CVP and SWP net generation.

U.2.6.1 Potential Changes in Central Valley Project Net Generation

Changes in CVP operations under Alternative 4 compared with the No Action Alternative would result in a change in CVP water deliveries to areas located south of the Delta; therefore, annual energy use would result in changes in CVP energy resources, as summarized in Table U-35. Under Alternative 4 compared with the No Action Alternative, annual CVP energy generation would be slightly higher for long-term average and for dry and critically dry years, but the energy required to move the water would also be slightly higher for the long-term average and for dry and critically dry years. The changes would result in slightly decreased annual net generation for the long-term average and slightly increased annual net generation for dry and critically dry years. Under Alternative 4 compared with the No Action Alternative, the CVP annual net generation over the long-term conditions would be slightly lower by less than 1%, and there would be a 1% increase in net generation in dry and critically dry years. Net generation would be positive under Alternative 4 for both water year types and annual increases in net generation would not require alternative sources of energy to be purchased from other sources.

Table U-35. Simulated Annual Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 4 Compared with the No Action Alternative

Water Year	Use/Generation	Alternative 4	NAA	Change between Alternative 4 and NAA (percent change) [b]
Long-Term Average	Energy Use	1,579	1,535	44 (3%)
	Generation	4,499	4,478	21 (0%)
	Net Generation	2,920	2,943	-23 (-1%)
Dry and Critically Dry Water Years [a]	Energy Use	961	956	5 (0%)
	Generation	3,146	3,113	33 (1%)
	Net Generation	2,186	2,158	28 (1%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 4 value. Percent change is the change divided by the No Action Alternative value.
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-36 shows the breakdown of the monthly CVP facilities' energy use, generation, and net generation for the long-term average and for dry and critically dry years. The model output shows that there would be slight decreases in net generation under Alternative 4 compared with the No Action Alternative in October, March, April, May, July, August, and September for the average of all years (10% or less), and slight decreases in net generation in October, April, May, July, and August (3% or less) for dry and critically dry years.

Under Alternative 4, CVP would expect increased generation in six months for the long-term average and in eight months for dry and critically dry years compared with the No Action Alternative, but would also expect slight increases or no change in energy use in most months. Occasional decreased monthly net generation would be relatively small (1% to 10% for all years and 1% to 3% for dry and critically dry years).

CVP net generation under Alternative 4 for both water year types would be positive and alternative sources of energy would not be required.

Table U-36. Simulated Monthly Central Valley Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 4 Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	101	134	129	127	138	129	98	117	132	150	151	128
		Generation	263	215	270	325	339	335	320	466	486	629	493	337
		Net Generation	162	80	141	197	202	206	222	350	354	479	342	209
	Alt 4	Energy Use	108	139	122	129	142	139	106	121	131	152	156	135
		Generation	252	228	283	329	347	337	319	464	492	628	486	322
		Net Generation	155	90	161	200	206	198	213	342	361	475	330	188
	Change from NAA (percent change) [b]	Energy Use	6	4	-7	2	4	9	7	5	-1	3	5	6
		Generation	-1	14	14	5	8	2	-1	-3	6	-1	-7	-14
		Net Generation	-7 (-4%)	10 (12%)	20 (14%)	3 (2%)	4 (2%)	-8 (-4%)	-9 (-4%)	-7 (-2%)	7 2%)	-4 (-1%)	-12 (-4%)	-21 (-10%)
Dry and Critically Dry Years [a]	NAA	Energy Use	85	110	97	93	113	102	51	58	74	100	87	88
		Generation	231	189	142	152	153	172	248	366	451	515	389	222
		Net Generation	146	78	46	59	40	71	197	309	377	415	301	134
	Alt 4	Energy Use	91	115	87	94	113	102	52	58	71	97	86	90
		Generation	235	202	147	159	160	174	244	358	452	508	379	229
		Net Generation	144	88	60	64	48	72	192	300	381	411	293	139
	Change from NAA	Energy Use	5	4	-9	1	0	0	2	0	-3	-4	-1	2
		Generation	4	14	5	6	7	1	-4	-8	1	-7	-10	7

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	(percent change) [b]	Net Generation	-2 (-1%)	10 (12%)	14 (31%)	5 (9%)	7 (18%)	1 (2%)	-6 (-3%)	-8 (-3%)	4 (1%)	-4 (-1%)	-8 (-3%)	5 (4%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 4 value. Percent change is the change divided by the No Action Alternative value.
Alt 4 = Alternative 4; GWh = Gigawatt-hour; NAA = No Action Alternative

U.2.6.2 Potential Changes in State Water Project Net Generation

Changes in SWP operations under Alternative 4 compared with the No Action Alternative would result in a change in SWP water deliveries to areas south of the Delta, resulting in changes to SWP power and energy resources, as summarized in Table U-37. Under Alternative 4 compared with the No Action Alternative, annual SWP energy generation would be slightly higher for both long-term average and for dry and critically dry years, however, the energy required by SWP to move the water would be slightly higher than the increases in generation for both long-term average and for dry and critically dry years. The SWP annual net generation would be decreased under Alternative 4 relative to the No Action Alternative; long-term average net generation would be decreased by 10%, and net generation would be decreased by 16% for dry and critically dry years. Annual reductions in net generation would require alternative sources of energy to be purchased from other sources in addition to those already required under the No Action Alternative.

Table U-37. Simulated Annual State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 4 Compared with the No Action Alternative

Water Year	Use/Generation	Alternative 4	NAA	Change between Alternative 4 and NAA (percent change) [b]
Long-Term Average	Energy Use	7,626	7,202	424 (6%)
	Generation	3,822	3,744	78 (2%)
	Net Generation	-3,804	-3,458	-346 (-10%)
Dry and Critically Dry Water Years [a]	Energy Use	4,174	3,756	418 (11%)
	Generation	2,094	1,972	122 (6%)
	Net Generation	-2,079	-1,785	-294 (-16%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 4 value. Percent change is the change divided by the No Action Alternative value.
GWh = Gigawatt-hour; NAA = No Action Alternative

Table U-38 shows the monthly energy use, generation, and resulting net generation for SWP facilities under the No Action Alternative and Alternative 4, both as long-term average of all years and as an average for dry and critically dry years. Simulated SWP monthly net generation under Alternative 4 would be decreased in October, November, January through May, and July through September for all years, and monthly net generation would decrease in October, and January through September for dry and critically dry years. Monthly net generation under Alternative 4 would increase slightly in two months as compared with the No Action Alternative. Decreased net generation would result from increases in energy use needed to move water being greater than increases in generation.

Under Alternative 4, SWP would expect slightly increased generation under Alternative 4 compared with the No Action Alternative in most months except in May and September for the average of all years, and in all months for the average of dry and critically dry years. However, the increases in energy use would be greater than increases in generation, resulting in decreased net generation for most months for both year types.

Alternative sources of energy would be needed for operations under Alternative 4 in response to the decreased net generation in all months in addition to those already required under the No Action Alternative.

Table U-38. Simulated Monthly State Water Project Energy Generation, Energy Use, and Net Generation (GWh) under Alternative 4 Compared with the No Action Alternative

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average All Years	NAA	Energy Use	561	532	480	439	435	480	509	536	575	656	641	570
		Generation	263	216	223	240	272	322	297	341	408	503	399	260
		Net Generation	-298	-316	-257	-199	-163	-158	-212	-195	-168	-153	-242	-310
	Alt 4	Energy Use	597	553	479	481	484	513	544	579	596	691	678	599
		Generation	265	223	234	260	288	335	298	334	420	514	403	248
		Net Generation	-332	-330	-246	-221	-196	-177	-246	-244	-177	-178	-275	-351
	Change from NAA (percent change) [b]	Energy Use	36	21	0	42	50	32	35	43	21	35	37	28
		Generation	2	7	11	20	16	13	1	-7	12	11	3	-12
		Net Generation	-34 (-11%)	-14 (-4%)	11 (4%)	-22 (-11%)	-33 (-21%)	-19 (-12%)	-34 (-16%)	-49 (-25%)	7 (5%)	-24 (-16%)	-33 (-14%)	-40 (-13%)
Dry and Critically Dry Years [a]	NAA	Energy Use	458	425	434	238	185	232	276	296	342	326	330	305
		Generation	223	183	162	99	69	95	157	219	310	299	220	124
		Net Generation	-235	-242	-272	-139	-116	-137	-119	-78	-32	-27	-110	-181
	Alt 4	Energy Use	507	426	437	292	219	243	302	320	370	366	372	328
		Generation	232	185	168	114	76	99	167	223	320	313	233	136
		Net Generation	-275	-241	-270	-178	-143	-144	-135	-97	-50	-53	-139	-193
	Change from NAA	Energy Use	49	0	3	54	34	11	26	24	28	40	42	23
		Generation	9	2	6	15	7	4	10	5	10	14	13	12

Year Type	Alternative	Use/ Generation	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	(percent change) [b]	Net Generation	-39 (-17%)	1 (1%)	2 (1%)	-39 (-28%)	-27 (-23%)	-7 (-5%)	-16 (-13%)	-19 (-25%)	-18 (-54%)	-26 (-95%)	-29 (-26%)	-11 (-6%)

[a] Dry and Critically Dry Water Years is the average of all Dry and Critically Dry water years between October 31, 1921, and September 30, 2021.
[b] Change from No Action Alternative was computed by subtracting the No Action Alternative value from the Alternative 4 value. Percent change is the change divided by the No Action Alternative value.
Alt 4 = Alternative 4; GWh = Gigawatt-hour; NAA = No Action Alternative

U.2.7 Mitigation Measures

No avoidance and minimization measures or mitigation measures have been identified. Mitigation measures to avoid, minimize, rectify, reduce, eliminate, or compensate for adverse environmental effects of Alternatives 1 through 4 are compared with the No Action Alternative in this section.

Changes under Alternatives 1 through 4 compared with the No Action Alternative would result in decreased annual and/or monthly net energy generation and increased potential energy use by CVP and SWP water users for alternate water supplies. Therefore, there could be adverse impacts on energy resources compared with the No Action Alternative, and mitigation measures could be applicable. There are several opportunities to reduce the effect of the action alternatives on net generation. If generating plants' efficiencies were improved, additional generation could be made at each of the plants. Similarly, improvements to the CVP and SWP pumping plants' efficiencies would reduce the energy needed to move water throughout the state. However, as the CVP and SWP plants' equipment is replaced through normal operations and maintenance, improvements in performance and efficiency are a primary consideration. The capital expense associated with making performance upgrades outside of normal operations and maintenance would make the upgrades infeasible.

There may be some opportunities for the CVP and SWP to increase generation through operational modifications, such as reducing the bypass of powerplants for fall temperature management. However, these modifications would not be of sufficient magnitude to address all of the potential effects on net generation associated with Alternatives 1 through 4, as indicated by the modeling. As described above in Section U.2.1, Methods and Tools, changes in timing of the CVP generation, from monthly to hourly, were modeled using a refined methodology and the differences between the two methods were not substantial.

Unlike the SWP, which requires significantly more power generation than the SWP generates, CVP generation is sold to CVP first preference power customers only after project use needs are met (approximately 25%). As CVP use needs increase from the No Action Alternative, CVP first preference power customers receive less generation at a higher cost. CVP first preference power customers incur additional costs from: (1) the cost of replacement generation; and (2) if replacement generation has a difference emission factor, an emission charge.

Additionally, CVP first preference power's effective rate also increases not only due to less generation but also because Reclamation requires that the CVPIA power restoration fund charges be paid by first preference power customers and not project use power. It will be important to recognize and monitor the change in project use consumption as a share of the CVP resource when allocating CVP capital and annual costs.

U.2.8 Summary of Impacts

The results of the environmental effects of implementation of Alternatives 1 through 4 compared with the No Action Alternative are presented in Table U-39. Due to the limitations and uncertainty in the CalSim 3 monthly model and other analytical tools, monthly incremental differences of less than 5% between action alternatives and the No Action Alternative are considered to be similar.

There may be inherent overestimation bias for monthly power generation release in the CalSim modeling output. As the monthly power generation releases are different across the alternatives, there may be differences in overestimation bias between the alternatives. In CalSim, the power generation releases are assumed constant through each month. However, there can be significant releases during flood and temperature control operations within the month. The assumption of monthly averaged releases in CalSim may result in unaccounted for power bypass from flood and temperature control in the model which in turn may result in bias in power generation release outputs.

Due to the comparative manner that the output data is used, the overestimation bias may be considered to not be a concern. However, to evaluate the alternatives, the gross differences in outputs between the alternatives may not be able to be used on their own because there are differences in bias of CalSim modeled power generation release between alternatives. These differences could be attributed to differences in elevations of the CVP reservoirs between alternatives (along with other criteria), which in turn could lead to varying amounts of bypass from flood and water temperature control being unaccounted for in each of the alternatives, and therefore could result in varying amounts of bias between the alternatives with respect to generation.

Table U-39. Comparison of Alternatives 1 through 4 to No Action Alternative

Impact	Alternative	Magnitude and Direction of Impacts [a]	Potential Mitigation Measures
Potential changes in Central Valley Project net generation	No Action Alternative	Potential for less energy available for CVP operation based on 2040 conditions which would be different from existing conditions. [b] Climate change would result in less storage due to decreases in snowpack in the spring and winter months. Increases in water demand would increase power generation but also result in increased power use by the CVP for the movement of water affecting net generation of power. Although new water storage projects may increase power generation; this increase could be offset by water supply actions which consume large amounts of power such as desalination.	--
	Alternative 1	4% reduction in annual net generation for the average of all years for CVP facilities and a 2% reduction in net generation in dry and critically dry years would occur. At a monthly level, reductions of greater than 5% in average CVP net generation would occur in October (19%), January (9%), February (7%), March (10%), June (7%), August (5%), and September (19%). In dry and critically dry years, there would be monthly average reductions greater than 5% in net CVP generation in October (18%), December (38%), January (25%), February (52%), and April (7%).	--
	Alternative 2	Under Alternative 2 Without TUCP Delta VA, a 2% increase in average annual net generation for all years, and a 1% increase in net generation in dry and critically dry years would occur. A range of the other 3 phases of Alternative 2 of no change to 1% increase in annual net generation for the average of all years for CVP facilities, and a range of 1% to 2% increase in dry and critically dry years average annual net generation would occur. Under Alternative 2 Without TUCP Delta VA, reductions in monthly average CVP net generation in all years greater than 5% would not occur; and in dry and critically dry years, there would be monthly average reductions greater than 5% in September (6%). At a monthly level for the other three phases reductions in average CVP net generation in all years greater than 5% would not occur. In dry and critically dry years monthly reductions greater than 5% would occur in September (6%) under Alternative 2 Without TUCP Without VA; in December (8%), and September (7%) under Alternative 2 Without TUCP Systemwide VA.	--

Impact	Alternative	Magnitude and Direction of Impacts [a]	Potential Mitigation Measures
	Alternative 3	A 21% increase in annual net generation for the average of all years and 16% increase in annual net generation for dry and critically dry years for CVP facilities would occur. At a monthly level, reductions in average CVP net generation greater than 5% would not occur for the average of all years and for dry and critically dry years.	--
	Alternative 4	A 1% decrease in annual net generation for the average of all years and 1% increase for dry and critically dry years for CVP facilities would occur. At a monthly level, reductions in average CVP net generation greater than 5% would occur in September (10%) for all years. In dry and critically dry years, there would be no monthly average reductions greater than 5%..	--
Potential changes in State Water Project net generation	No Action Alternative	Potential for less energy available for SWP operation based on 2040 conditions which would be different from existing conditions. Climate change would result in less storage due to decreases in snowpack in the spring and winter months. Increases in water demand would increase power generation but also result in increased power use by the SWP for the movement of water affecting net generation of power. Although new water storage projects may increase power generation; this increase could be offset by water supply actions which consume large amounts of power such as desalination.	--
	Alternative 1	A 42% reduction in annual net generation for the average of all years and 72% reduction annual net generation in dry and critically dry years for SWP facilities would occur. Average monthly SWP monthly net generation would be reduced for the average of all years from 6% in November to 113% in March, and dry and critically dry years from 10% in November to 327% in July.	--

Impact	Alternative	Magnitude and Direction of Impacts [a]	Potential Mitigation Measures
	Alternative 2	Under Alternative 2 Without TUCP Delta VA, a 5% decrease in average annual net generation for all years, and a 4% decrease in net generation in dry and critically dry years would occur. Under the other three phases of Alternative 2, a range of 5% to 6% decrease in annual net generation for the average of all years for SWP facilities, and a range of less than 3% to 4% decrease and 1% increase in dry and critically dry years average annual net generation would occur. At a monthly level reductions in average SWP net generation in all years greater than 5% would occur under Alternative 2 Without TUCP Delta VA from 8% in January to 22% in May; under Alternative 2 Without TUCP Without VA from 7% in March to 21% in May; under Alternative 2 Without TUCP Systemwide VA from 6% in October and March to 19% in May; and under Alternative 2 With TUCP Without VA from 6% in August to 22% in May. In dry and critically dry years monthly reductions greater than 5% would occur under Alternative 2 Without TUCP Delta VA from 7% in November to 53% in July; under Alternative 2 Without TUCP Without VA from 9% in October to 23% in July; under Alternative 2 Without TUCP Systemwide VA from 7% in June to 56% in July; and under Alternative 2 With TUCP Without VA from 6% in May to 41% in July.	--
	Alternative 3	A 77% increase in annual net generation would occur for the average of all years and an 88% increase in net generation for dry and critically dry years for SWP facilities. Average monthly SWP net generation would be increased in all months for the average of all years, and in all months for dry and critically dry years.	--
	Alternative 4	A 10% reduction in annual net generation for the average of all years and 16% reduction annual net generation in dry and critically dry years for SWP facilities would occur. Average monthly SWP monthly net generation would be reduced by more than 5% for the average of all years in October (11%), January (11%), February (21%), March (12%), April (16%), and May (25%), July (16%), August (14%), and September (13%); and in dry and critically dry years in October (17%), January (28%), February (23%), April (13%), May (25%), June (54), July (95%), August (26%), and September (6%).	--

[a] For the evaluation of alternatives, operation of the action alternatives are compared with the No Action Alternative.

[b] Under the No Action Alternative, Reclamation would operate the CVP consistent with the 2020 Record of Decision implementing the Proposed Action consulted upon for the 2019 Biological Opinions and the reasonable and prudent measures in the incidental take statements. DWR would operate the SWP consistent with

the 2020 Record of Decision and the 2020 Incidental Take Permit for the SWP. Reclamation and DWR would operate consistent with authorizing legislation, water rights, contracts, and agreements as described by common components. The evaluation under the No Action Alternative is compared with existing conditions.

U.3 Cumulative Impacts

Past, present, and reasonably foreseeable projects, described in Appendix Y, *Cumulative Impacts Technical Appendix*, may have cumulative effects on power resources, to the extent that they could change net power generation for the Central Valley Project and State Water Project.

Past and present actions contribute to the existing condition of the affected environment in the project area while reasonably foreseeable actions are those that are likely to occur in the future that are not speculative. Past, present, and reasonably foreseeable projects include actions to develop water storage capacity, water conveyance infrastructure, water recycling capacity, the reoperation of existing water supply infrastructure, including surface water reservoirs and conveyance infrastructure, and habitat restoration actions. The projects identified in Appendix Y that have the most potential to contribute to cumulative impact on power resources are:

- Delta Conveyance Project
- Sites Reservoir
- Maxwell Intertie Project
- Alternative Intake Project
- Freeport Regional Water Project
- El Dorado Water and Power Authority Supplemental Water Rights Project
- Eastern San Joaquin Integrated Conjunctive Use Program
- Pacheco Reservoir / San Luis Reservoir Low Point Improvement Project
- Future groundwater storage and recovery projects
- Voluntary Agreements
- Bay-Delta Water Quality Control Plan Update
- Los Vaqueros Reservoir Expansion Phase 2

The No Action Alternative would continue with the current operation of the CVP and may result in changes to power resources in the Central Valley Project and State Water Project. These changes may potentially contribute to cumulative impacts and were described and considered in the 2020 Record of Decision.

Appendix Y lists past, present, and reasonably foreseeable projects that have or may potentially improve water supplies in California and reduce impacts generated by climate change, sea-level rise, increased water allocated to improve habitat conditions, and future growth. If CVP and SWP water supply reliability increase, energy used to support the conveyance of CVP and SWP water supplies would also increase. Some of the projects listed in Appendix Y are also anticipated to potentially reduce CVP and SWP water supply reliability (e.g., Water Quality

Control Plan Update). If CVP and SWP water supply reliability decreases, energy used to support the conveyance of CVP and SWP water supplies also would also decrease.

Each of the action alternatives would result in minor increases in long-term average CVP net generation rates, with the exception of Alternative 1 which would result in minor decreases in net generation. On a monthly basis, minor decreases in net generation would occur in some months under all of the alternatives compared to the No Action Alternative. None of the reductions in CVP monthly or annual net generation would require the procurement of additional power given that net generation would remain positive for all of the alternatives on an annual and monthly basis. All of the action alternatives would result in minor decreases in long-term average net generation for the SWP except for Alternative 3 which would result in increased net generation. However, similar to the existing conditions and No Action Alternative, negative long-term average and monthly SWP net generation levels would continue to occur. The minor reductions in SWP net generation would require the procurement of additional generation elsewhere within the California energy system similar to existing conditions. Given these minor changes in long-term average CVP and SWP net generation rates, contributions to cumulative impacts from power resources would be the same under all alternatives and would be anticipated to be minimal.

U.4 References

Bureau of Reclamation. 2001. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/vungvari/pom_monsum_2001.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2002. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2002.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2003. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2003.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2004. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2004.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2005. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2005.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2006. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2006.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2007. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2007.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2008. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2008.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2009. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2009.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2010. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2010.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2011. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2011.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2012. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2012.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2013. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/data/pom_monsum_2013.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2014. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/vungvari/pom_monsum_2014.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2015. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/vungvari/pom_monsum_2015.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2016a. *Jones Pumping Plant Fact Sheet*. Available: https://www.usbr.gov/mp/mpr-news/docs/factsheets/jones-pumping-plant.pdf. Accessed: April 29, 2019.

Bureau of Reclamation. 2016b. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/vungvari/pom_monsum_2016.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2017. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/vungvari/pom_monsum_2017.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2018. *Central Valley Project-California Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/vungvari/pom_monsum_2018.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2019. *Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/vungvari/pom_monsum_2019.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2020a. *Central Valley Project Final Cost Allocation Study*. Available: https://www.usbr.gov/mp/cvp/docs/cvp-final-cost-allocation-study-2020.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2020b. *Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/vungvari/pom_monsum_2020.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2021a. *Hydropower Program, Hydroelectric Powerplants Listed by Capacity*. August 2021.

Bureau of Reclamation. 2021b. *Annual Power System Generation Summary*. Available: https://www.usbr.gov/mp/cvo/vungvari/pom_monsum_2021.pdf. Accessed: March 1, 2023.

Bureau of Reclamation. 2023a. *Trinity Powerplant*. Available: https://www.usbr.gov/projects/index.php?id=562. Accessed: March 21, 2019.

Bureau of Reclamation. 2023b. *Lewiston Powerplant*. Available: https://www.usbr.gov/projects/index.php?id=557. Accessed: March 21, 2019.

Bureau of Reclamation. 2023c. *Judge Francis Carr Powerplant*. Available: https://www.usbr.gov/projects/index.php?id=532. Accessed: March 21, 2019.

Bureau of Reclamation. 2023d. *Shasta Powerplant*. Available: https://www.usbr.gov/mp/mpr-news/docs/factsheets/shasta-dam.pdf. Accessed: April 29, 2019.

Bureau of Reclamation. 2023e. *Spring Creek Powerplant*. Available: https://www.usbr.gov/projects/index.php?id=556. Accessed: March 21, 2019.

Bureau of Reclamation. 2023f. *Keswick Powerplant*. Available: https://www.usbr.gov/projects/index.php?id=579. Accessed: March 21, 2019.

Bureau of Reclamation. 2023g. *Folsom Powerplant*. Available: https://www.usbr.gov/projects/index.php?id=547. Accessed: March 5, 2023.

Bureau of Reclamation. 2023h. *Nimbus Powerplant*. Available: https://www.usbr.gov/projects/index.php?id=570. Accessed: March 5, 2023.

Bureau of Reclamation. 2023i. *New Melones Powerplant*. Available: https://www.usbr.gov/projects/index.php?id=569. Accessed: March 5, 2023.

Bureau of Reclamation. 2023j. *O'Neill Powerplant*. Available: https://www.usbr.gov/projects/index.php?id=571. Accessed: March 5, 2023.

Bureau of Reclamation. 2023k. *San Luis (William R. Gianelli) Powerplant*. Available: https://www.usbr.gov/projects/index.php?id=577. Accessed: March 21, 2019.

California Department of Water Resources. 2002. *Management of the California State Water Project. Bulletin 132-01*. December.

California Department of Water Resources. 2004a. *Management of the California State Water Project. Bulletin 132-02*. January.

California Department of Water Resources. 2004b. *Management of the California State Water Project. Bulletin 132-03*. December.

California Department of Water Resources. 2005. *Management of the California State Water Project. Bulletin 132-04*. September.

California Department of Water Resources. 2006. *Management of the California State Water Project. Bulletin 132-05*. December.

California Department of Water Resources. 2007. *Management of the California State Water Project. Bulletin 132-06*. December.

California Department of Water Resources. 2008. *Management of the California State Water Project. Bulletin 132-07*. December.

California Department of Water Resources. 2012a. *Management of the California State Water Project. Bulletin 132-08*. June.

California Department of Water Resources. 2012b. *Management of the California State Water Project. Bulletin 132-09*. December.

California Department of Water Resources. 2013a. *Management of the California State Water Project. Bulletin 132-10*. June.

California Department of Water Resources. 2013b. *Management of the California State Water Project. Bulletin 132-11*. Available: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Bulletin-132/Bulletin-132/Files/Bulletin_132-11_final_100223.pdf. December.

California Department of Water Resources. 2014. *Management of the California State Water Project. Bulletin 132-12*. August.

California Department of Water Resources. 2015a. *Management of the California State Water Project. Bulletin 132-13*. Available: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Bulletin-132/Bulletin-132/Files/Bulletin-132-13-r.pdf. April.

California Department of Water Resources. 2015b. *Management of the California State Water Project. Bulletin 132-14*. Available: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Bulletin-132/Bulletin-132/Files/Bulletin-132-14-r.pdf. November.

California Department of Water Resources. 2016. *Management of the California State Water Project. Bulletin 132-15*. Available: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Bulletin-132/Bulletin-132/Files/Bulletin-132-15-r.pdf. July.

California Department of Water Resources. 2017. *Management of the California State Water Project. Bulletin 132-16*. Available: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Bulletin-132/Bulletin-132/Files/Bulletin-132-16-r.pdf. June.

California Department of Water Resources. 2019. *Management of the California State Water Project. Bulletin 132-17*. Available: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Bulletin-132/Bulletin-132/Files/Bulletin-132-17-r.pdf. January.

California Department of Water Resources. 2021a. *Management of the California State Water Project. Bulletin 132-2018*. Available: https://water.ca.gov/-/media/dwr-website/web-pages/programs/state-water-project/management/bulletin-132/bulletin-132/files/bulletin132-18.pdf. January.

California Department of Water Resources. 2021b. *California's Groundwater Update 2020 Highlights, Bulletin 118*. Available: https://data.cnra.ca.gov/dataset/calgw_update 2020/resource/88dbb333-90c3-48f2-a247-7a4f84fce56d. Accessed: March 5, 2023.

California Department of Water Resources. 2022. *Management of the California State Water Project Bulletin 132-2019*. Available: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Bulletin-132/Bulletin-132/Files/Bulletin-132-19-020323.pdf. December.

California Energy Commission. 2022. *California Electrical Energy Generation 2001 to Current, Total Production, by Resource Type*. Available: https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/california-electrical-energy-generation. Accessed: March 22, 2023.

California Energy Commission. 2023a. *Saving Hydropower for a (Not So) Rainy Day*. Available: https://www.energy.ca.gov/data-reports/energy-insights/saving-hydropower-not-so-rainy-day. Accessed: March 7, 2023.

California Energy Commission. 2023b. *2021 Total System Electric Generation*. Available: https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2021-total-system-electric-generation. Accessed: February 28, 2023.

California Energy Commission. 2023c *Clean Energy and Pollution Reduction Act – SB350*. Available: https://www.energy.ca.gov/rules-and-regulations/energy-suppliers-reporting/clean-energy-and-pollution-reduction-act-sb-350. Accessed: February 28, 2023.

California Energy Commission. 2023d. *Renewables Portfolio Standard – Verification and Compliance*. Available: https://www.energy.ca.gov/programs-and-topics/programs/renewables-portfolio-standard/renewables-portfolio-standard. Accessed: February 28, 2023.

California Energy Commission. 2023e. *Data on Renewable Energy Markets and Resources, Hydroelectricity, List of Hydroelectric Power Plants in California*. Available: https://www.energy.ca.gov/media/180. Accessed: March 22, 2023.

California Legislative Information. 2017. Article 16. California Renewables Portfolio Standard program [399.11–399.33], Section 299.12.

California Legislative Information. 2024. Public Resources Code Division 15. Energy Conservation and Development, Chapter 8.6. Renewable Energy Resources Program, 25741(a)(1). Available: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?sectionNum=25741&lawCode=PRC. Accessed: February 15, 2024.

California Public Utilities Commission. 2022. *Water-Energy Calculator 2.0 Project Report*. Available: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/water-energy-nexus/we-calc20-project-report.pdf. Accessed: March 20, 2023.

Federal Register/Volume 82, Number 156. 2017. *Department of the Energy Western Area Power Administration 2025 Power Marketing*. Available: https://www.govinfo.gov/content/pkg/FR-2017-08-15/pdf/2017-17210.pdf. Accessed: March 20, 2023.

U.S. Department of Energy. 2019. *Western Area Power Administration Memorandum: Recommendation to Participate in the California Independent System Operator Corporation's Energy Imbalance Market*. Available: https://www.wapa.gov/regions/SN/Power Marketing/Documents/sn-eim-recommendation-memo.pdf. Accessed: March 20. 2023.

U.S. Department of Energy. 2024. Renewable Energy website. Available: Renewable Energy | Department of Energy. Accessed March 11, 2024.

Western Area Power Administration. 2020. *2025 Base Resource Allocations*. Updated September 12, 2020. Available: https://www.wapa.gov/wp-content/uploads/2023/04/2025-BR-Allocations.pdf. Accessed: February 15, 2024.

Western Area Power Administration. 2021. SN Energy Imbalance Market Activities. Available: https://www.wapa.gov/about-wapa/regions/sn/sn-power-marketing/western-eim/. Accessed: February 15, 2024.

Western Area Power Administration. 2023. *About Sierra Nevada*. Available: https://www.wapa.gov/project/sierra-nevada-region/. Accessed: February 15, 2024.

Western Area Power Administration. 2024. Sierra Nevada Region Fiscal year 2024 Rates. Available: https://www.wapa.gov/wp-content/uploads/2023/09/current-rates.pdf. Accessed: March 11, 2024.

Western Energy Imbalance Market. 2024. Western Energy Imbalance Market, How it Works. Available: https://www.westerneim.com/Pages/About/HowItWorks.aspx. Accessed: March 11, 2024.