

Background

The Central Plant is a key State asset that provides chilled water for cooling, steam for heating and compressed air for controls to approximately four million square feet of 23 existing State-owned buildings in the downtown Sacramento Capitol campus, including the State Capitol.

The equipment in the original central plant, built in 1968, had reached the end of useful life. The original plant lacked sufficient capacity for future growth, and the emergency back-up necessary for the high pressure steam boilers during periods of high demand. California's goal was to impart a facility to provide safer and more reliable heating and cooling to the Capitol campus, expand capacity, improve energy efficiency and environmental sustainability.

The original central plant remained fully operational during construction and was demolished once the new plant was operational. The new Central Plant was built to LEED (Leadership in Energy and Environmental Design) Gold certification and contains state-of-the-art equipment that has enhanced efficiency, reliability and capacity, resulting in reduced energy costs, greenhouse gas emissions and wastewater discharge.

The 1960s era plant was replaced by a modern design, which was intended to complement the surrounding architecture and enhance the aesthetic attractiveness of the site. The design minimized the height of plant structures and arranged tall edifices, such as the TES tank, to reduce the scale of the plant and the shading of surrounding buildings. Planter boxes and canopies on the mezzanine level also help to reduce the scale of the plant.



Sustainable Sites

The best strategy for sustainable site development is to choose a site that has been previously developed. The Central Plant site was first developed over 150 years ago and provided substantial opportunities for sustainability. Further, the urban environment provided already established infrastructure and services; eliminating the need for new services and increasing the community connectivity.

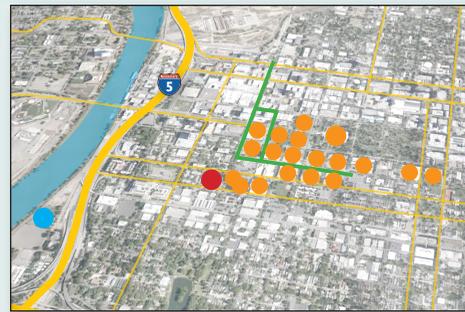
The facility offers on-site bicycle storage and changing rooms with showers to encourage cycling and preferential parking is provided for fuel efficient and low emission vehicles. Automobiles in the United States emit more than 333 million tons of carbon dioxide each year— more than one-fifth of our total carbon dioxide emissions (Source: Environmental Defense Fund). The Central Plant reduces the impact of automobile use by providing the opportunity and incentive to use alternative modes of transportation. Numerous bus stops and a light rail station are located within a quarter of a mile of the plant.

Urban sites tend to create heat islands; so the Central Plant was developed to include techniques such as the use of pervious vegetative surfaces and higher reflective hard surfaces to mitigate the increase in absorbed heat within the site. Heat islands are metropolitan areas

where the temperature is higher than the annual average temperature. Onsite paving was completed with a surface that reflects light and heat, instead of absorbing like black asphalt. Additionally, trees and other plantings are maximized to minimize the amount of heat absorbed by the hard surfaces.

Materials & Resources

The use of recycled materials decreases the use of virgin raw materials and the volume of solid waste in landfills. Much of the recycled content comes from the use of steel and the use of fly ash replacing cement in the concrete.



ABOVE:

The Central Plant (red) provides heating and cooling services to 23 State owned buildings (orange) in the downtown Sacramento area. The light blue circle represents the site of the former rainy well. Light rail lines are represented by green lines.

THE DEPARTMENT OF GENERAL SERVICES CENTRAL PLANT





Central Plant Renovation

CALIFORNIA DEPARTMENT OF GENERAL SERVICES

SUSTAINABILITY FEATURES

Sustainable Site

- 1 Cooling Tower uses environmentally friendly water treatment
- 2 White 'Cool' roof
- 3 Stepped-back facade for neighborhood scale
- 4 Bicycle storage
- 5 Staff shower and locker facilities
- 6 Creating Magnolia Park for neighbors to enjoy
- 7 Rain garden for runoff
- 8 High albedo concrete to reduce heat island effect
- 9 No new parking

Water Efficiency

- 1 Reclaimed cooling tower water for landscape irrigation
- 2 Reclaimed water for toilet fixtures

Energy and Atmosphere

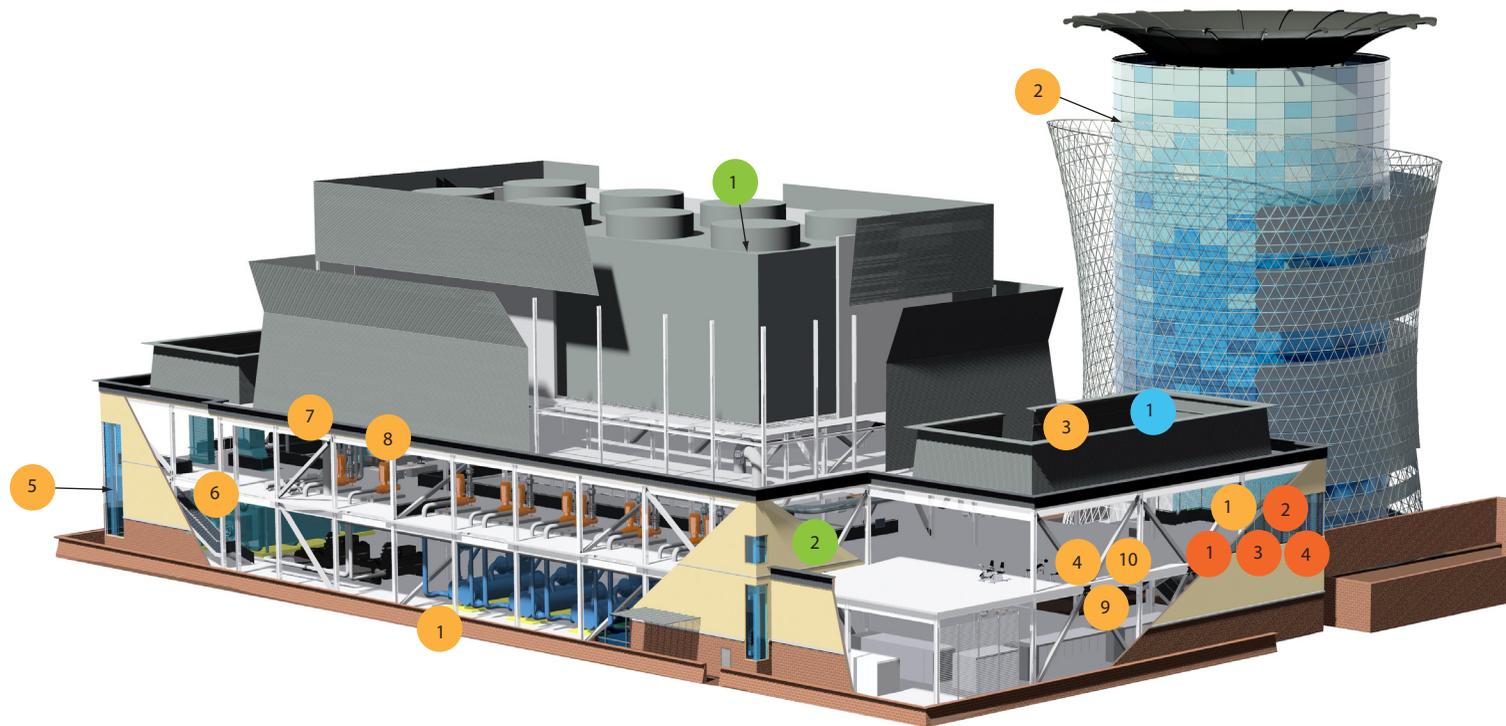
- 1 Ultra-high efficient all-variable speed chiller plant
- 2 Chilled water thermal storage system to provide cooling for State buildings during high electrical rate period
- 3 Non-ozone depleting refrigerant
- 4 Energy efficient evaporative cooling
- 5 Steam powered electric generator to provide emergency cooling and load leveling during energy emergency conditions
- 6 Solar heating for domestic and space heating hot water
- 7 Advance M-Cycle evaporative air systems for office spaces to reduce energy use by effectively applying psychometric energy from the atmosphere
- 8 High-performance, low-E glass
- 9 New steam heating plant that will increase the overall heating system operating efficiency
- 10 Plant controls based on the engineering principle that provides energy optimization of all systems
- 11 Overall monitoring of system performance
- 12 Photovoltaic panels will provide electrical power for office support areas
- 13 Radiant heating and cooling system for thermal comfort in support areas
- 14 Post occupancy monitoring of system performance
- 15 Enhanced Commissioning
- 16 City trees retained for shading
- 17 Energy efficient integrated occupancy control of lighting, conditioning and ventilation

Materials and Resources

- 1 Recycling of demolished materials
- 2 Selection of materials with high-recycled content
- 3 Slabs with 30% fly ash

Indoor Environmental Quality

- 1 CO2 monitored throughout office area and demand based ventilation control will provide excellent Indoor Air Quality.
- 2 Maximize the use of day lighting with automatic light fixture dimming control
- 3 Low energy direct-indirect lighting fixtures
- 4 Lab tested no or low VOC finishes
- 5 Operable windows for natural ventilation



PLANT FEATURES:

Chiller Plant

The goal of the Central Plant is to maintain maximum energy efficiency at all operational periods. All the equipment that provides chilled water and cooling tower fans are equipped with variable frequency drives (VFD's) which minimize energy use and overall life cycle costs.

VFD's operate on demand-based controls that constantly match the power consumption with the most efficient plant operation, making it possible for this chiller plant to operate at 0.5kw/ton which is about half of the energy of a traditional chiller plant.

Generation of monthly system performance assurance reports ensure the energy efficiency goals are being achieved, and assist in the overall operations by detecting early abnormal function.

The plant has zero use of CFC (chlorofluorocarbon)-based refrigerants, reducing the impact on global warming and ozone depletion.

The Thermal Energy Storage (TES) tank stores 4.25 million gallons of chilled water to meet the day time cooling requirements by supplying chilled water to the 23 State buildings in downtown Sacramento. The TES tank reduces energy demand by reducing chiller operation during day time peak conditions. This allows the chillers to generate low cost chilled water during night time hours. The stored chilled water will be used during the heat of the day.

HVAC System

Displacement Ventilation vs. Conventional Mixing System

- Low Noise (very low velocity)
- Less Fan Energy (less airflow at central air handler, low pressure drop)
- Higher Chiller Efficiency / Smaller Required Chiller Capacity
- More fresh air in occupied zone
- Increased thermal comfort for occupant (higher temperature, lower velocity, less "draft")

Active Chilled Beam HVAC System:

- Low sound, low velocity
- No moving parts!
- Less Fan Energy (less airflow at central air handler)
- Increased thermal comfort for occupant
- Smaller Required Chiller Capacity

In addition, the use of occupancy sensors in the occupied, administrative areas of the plant allow the HVAC system and lighting controls serving those spaces to go into standby mode when the space is unoccupied.

Solar Hot Water

In lieu of domestic hot water heaters, 82% of the domestic water heating load can be obtained from a solar hot water system, installed on the roof. The solar thermal system is also designed to heat the HVAC hot water when a lot of solar thermal energy is available.

High Quality Indoor Environment

The office space is equipped with CO₂ monitoring and demand based ventilation control systems to ensure excellent indoor air quality. Non-toxic and low VOC (Volatile Organic Compound) substances, were also used to avoid indoor air pollution. Large windows and glazed façades maximize indoor day lighting for plant employees and visitors, and sunshades prevent glare from the sun.

Commissioning

Commissioning is a systematic process of ensuring that the building's energy related systems are installed, calibrated and perform according to the project requirements; design to construction and into occupancy, resulting in reduced energy use and lower operating costs. The plant utilized enhanced commissioning, where the commissioning process was begun early during the design of the new plant, and continue until after occupancy of the plant.

On-site Renewable Energy

The plant utilizes on-site renewable energy, including photovoltaic arrays mounted in the parking area that generate power for the facility's office and support areas, as well as domestic hot water, reducing the environmental and economic impacts associated with fossil fuel energy use.



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