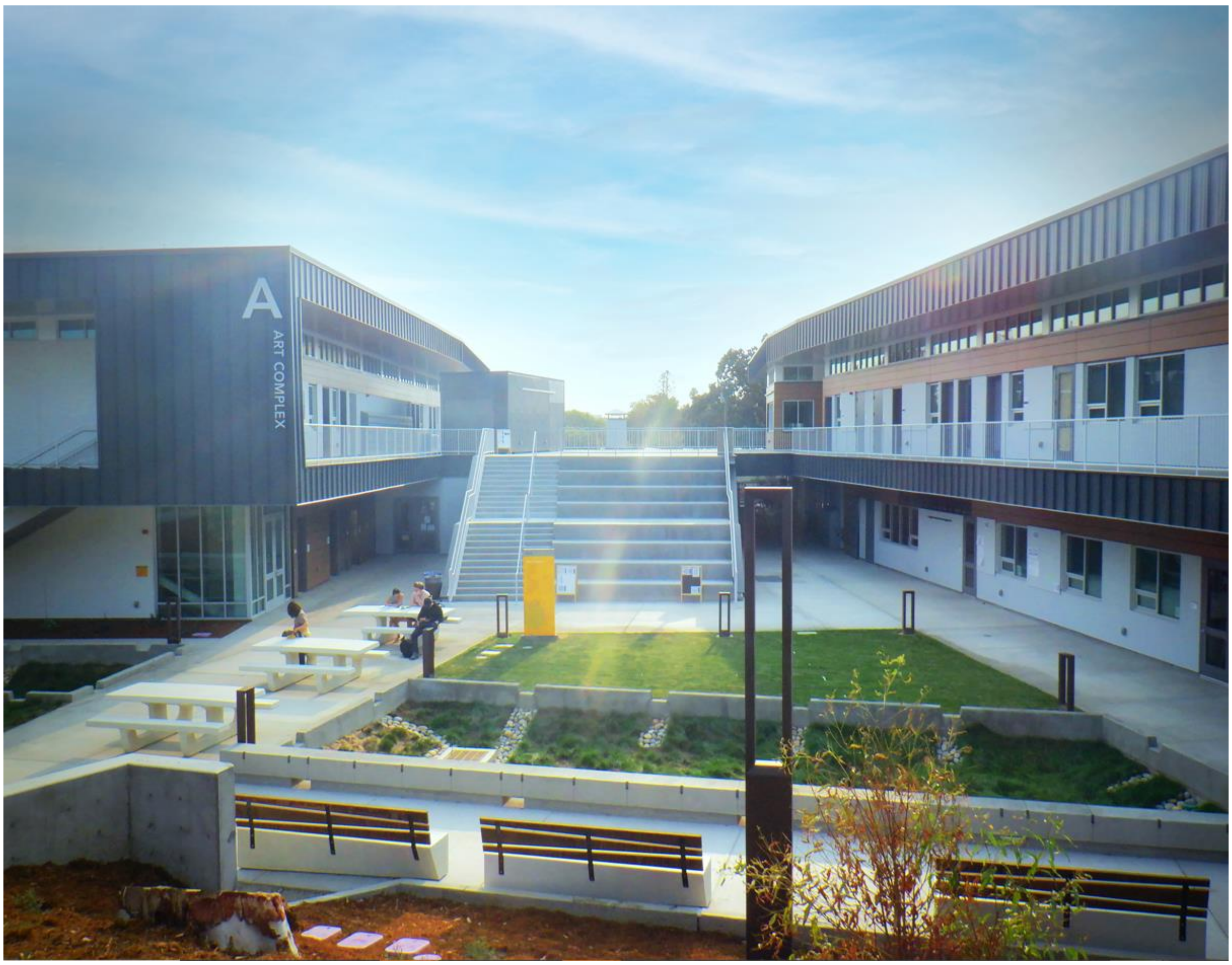
Case Study:
All-Electric Central Utility Plant

Contra Costa Community College District,
Diablo Valley College – Pleasant Hill Campus



April 2023

Compiled by the [Empower Procurement Program] implemented by [Prospect Silicon Valley], with funding from the California Energy Commission. Send questions or comments to e-buildings@prospectsv.org.

Executive Summary

In 2015, the Contra Costa Community College District (4CD) began planning several new buildings and upgrades at the Pleasant Hill campus of Diablo Valley College. Two major capital projects were the new Physical Education/Kinesiology (PE/K) and Art Complexes. From the beginning, the District Facilities Planning Team committed to making them ZNE-ready, creating a valuable example of low-carbon procurement for large local government projects.

The single biggest contributor to achieving ZNE-readiness was the all-electric central utility plant (CUP). Building the CUP had all the common barriers faced by low-carbon procurement, including higher up-front costs and the need for the District Facilities Planning Team and the campus Operations and Maintenance (O&M) team to study the technology to assess its likely operating costs. Some of the Project Team's key procurement strategies, that may be valuable to other teams planning complex electrification projects, include:

1. Make a clear commitment to low-carbon goals from the beginning, including when selecting architectural and engineering partners.
2. Anticipate what knowledge the O&M team will need to support the project, and help engineering teams communicate complex technical elements. Maintain open dialogue and engagement with all stakeholders.
3. Allocate adequate time to thoroughly review the project scope and work with design and engineering teams to understand all relevant scenarios.
4. Plan for possible commissioning and warranty challenges.

The Empower Procurement Program, executed by Prospect Silicon Valley under a grant from the California Energy Commission, worked with 4CD to create this case study. Prospect Silicon Valley will use this case study and others to highlight building-specific procurement barriers to electrification and make recommendations for reducing these to the California Energy Commission.

Background

Building electrification is one of the largest sources of potential greenhouse gas (GHG) reductions in California. Local governments and public institutions can help lead this market shift by setting an example with their own buildings. Many of the challenges they face are not technical but procurement issues, such as getting approvals to adopt less familiar technology and using total cost of ownership to weigh purchase options.

To study building-specific procurement challenges, the Empower Procurement Program formed an E-Buildings team that worked with local government facilities and sustainability managers on specific projects. Using case studies, they documented the procurement challenges and how they were overcome, and summarized key learnings. Of the four case studies, three covered projects the E-buildings team helped execute. This fourth case study presents the history and key learnings of a much larger and more complex project. It is hoped the four case studies together will provide useful examples to local governments to help them more clearly see their own barriers to low-carbon procurement and create strategies to overcome them.

Prospect Silicon Valley will summarize the barriers identified through this research in a report to the California Energy Commission, with recommendations for overcoming them. It will also provide estimates of potential impacts if those recommendations were implemented.

The E-buildings team can be reached at E-Buildings@prospectsv.org.

Project Description

Contra Costa Community College District includes three public community colleges: Contra Costa Community College, Los Medanos College, and Diablo Valley College (DVC). DVC, where this project took place, is located in Pleasant Hill about 20 miles northeast of Oakland.

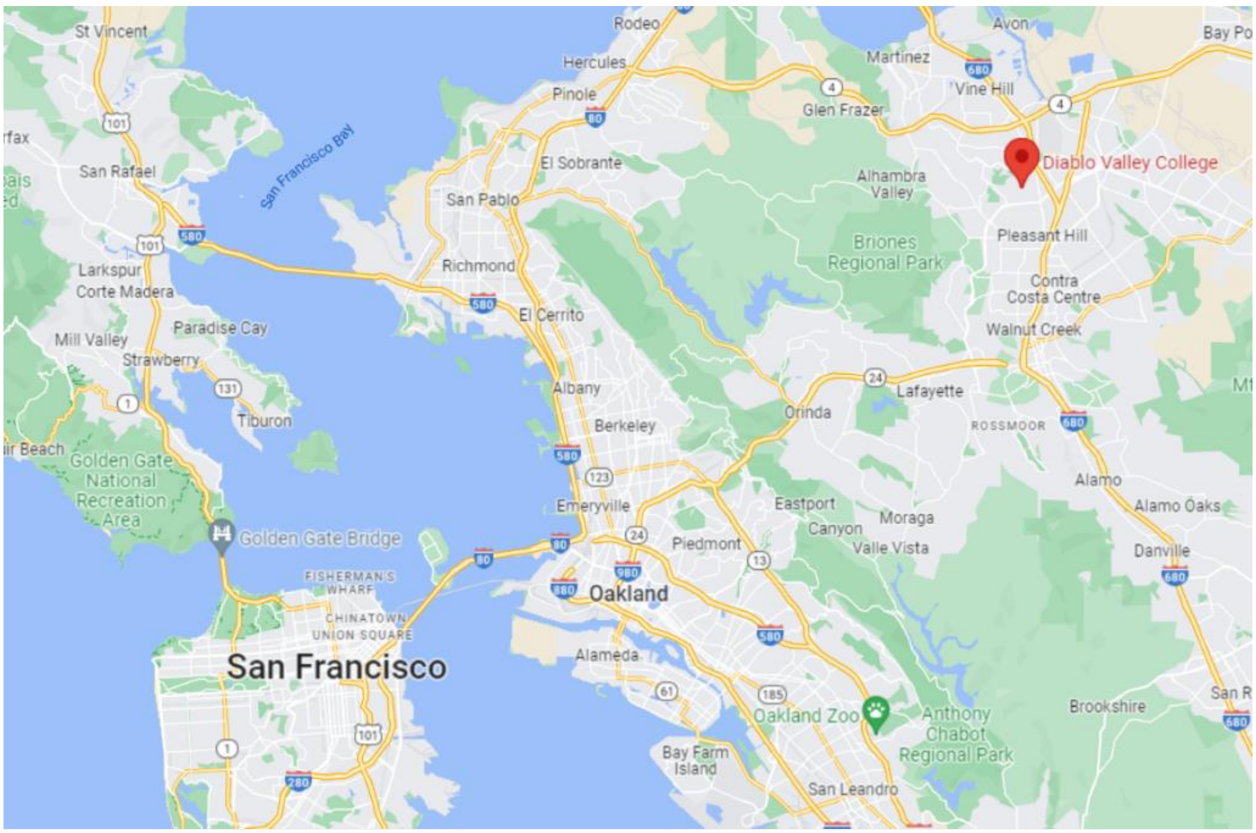


Figure 1: Diablo Valley College is located in the San Francisco Bay Area and has a student body over 20,000.

To develop this case study, the E-Buildings team worked closely with Tracy Marcial, Energy & Sustainability Manager, and Ines Zildzic, Vice Chancellor, Facilities Planning and Construction at 4CD. Both played key roles in the project since it began in 2015, representing 4CD within the broader Project Team, which included various stakeholders from the District and the DVC Campus. They were invaluable to help the E-Buildings team understand the project's phases, opportunities and challenges.

Project Background

In 2015, 4CD began planning a new Physical Education/Kinesiology (PE/K) Complex and a new Art Complex at the DVC, Pleasant Hill campus. Both facilities were funded by local 2014 Measure E bonds, and the PE/K Complex also received funding through 2006 Measure A. The PE/K Complex consists of three new buildings: a 17,250 ft^2 fieldhouse, a 5,100 ft^2 faculty office building, and a 7,500 ft^2 aquatics and classroom building. The project also included renovating the existing 17,000 ft2 gymnasium and the existing 9-lane, 50m competition swimming pool. The Art Complex is a 33,100 ft^2, two story new building.

Very early, the 4CD Facilities Planning Team recommended that the new buildings be ZNE-ready. While this was not a District standard at the time, there were already several State level policies in place with future ZNE building mandates. Executive Order B-18-12 for Existing Buildings stated that 50% of State buildings be retrofitted to ZNE by 2025, and 100% by 2030. In addition, Title 24, the California Building Code, was expected to require all commercial construction to be ZNE by 2030. In practice, ZNE-ready at DVC means all-electric. Existing on-site solar resources will allow specific buildings to achieve ZNE certification. For the entire campus to reach ZNE, meaning on-site renewables production would offset the annual usage of electricity and gas, more solar will be needed. The District's sustainability goals were drafted to reduce natural gas usage 30% by 2030, and 75% by 2035 to be consistent with State policies and mandates and incoming Tile 24 code changes.

Most importantly, the Facilities Planning Team knew it would be more cost effective to make new buildings all-electric from the beginning, rather than retrofit them in the future. It was clear that to responsibly utilize bond funds and consider the total cost of ownership of these new facilities, the buildings had to be all-electric and as efficient as possible. See Figure 2: Map of project's new and renovated buildings and affected exiting buildings.

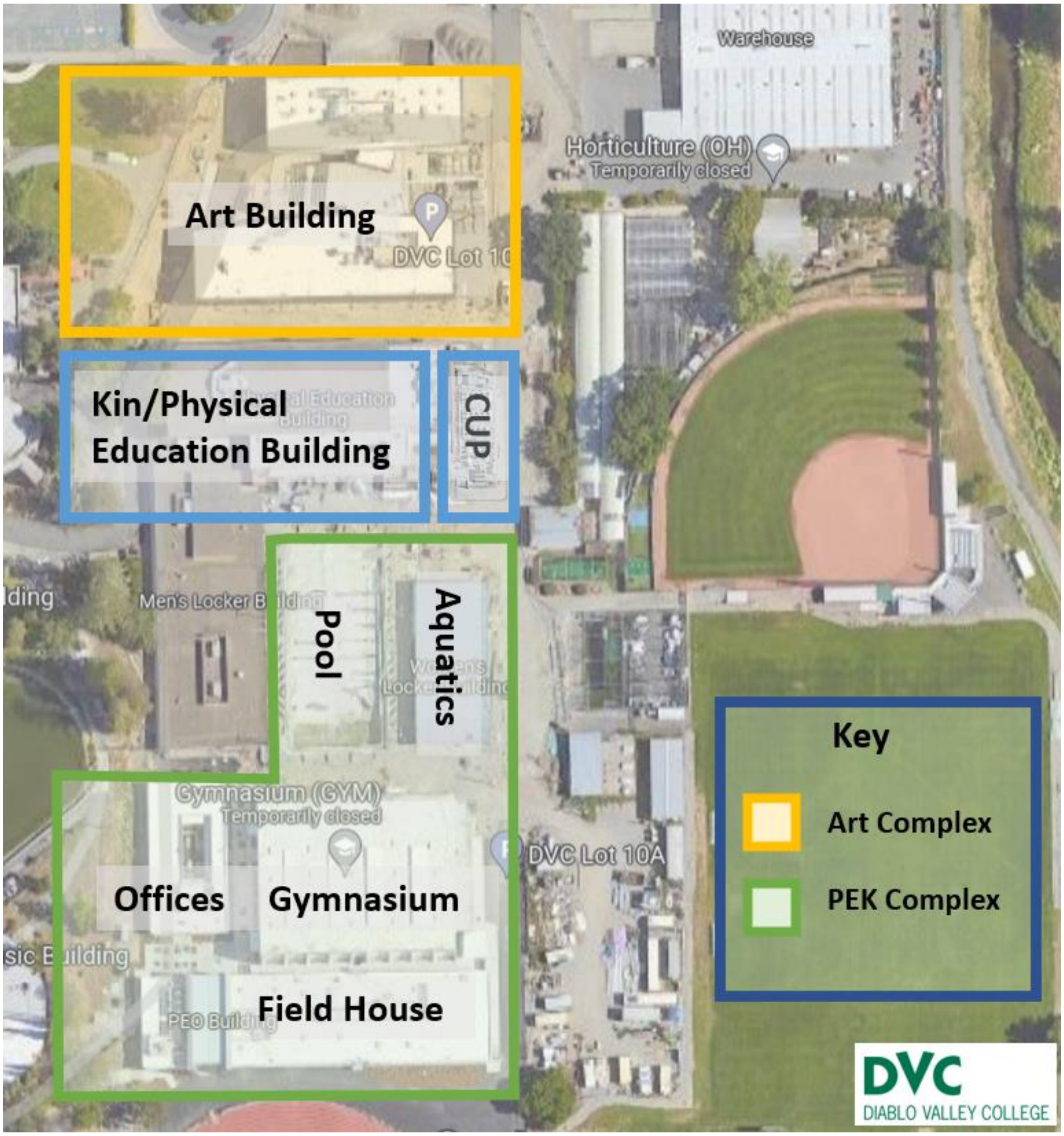


Figure 2: Map of project's new and renovated buildings

Timeline

The timeline in Table 1 below illustrates how decisions related to the CUP were made over time. It was decided to use a CUP for the new buildings in 2017, and in 2018 the cooling loads from the existing Physical Education/Kinesiology building(now referred to as FTX) were added, followed separately by the heating loads. Because the construction of the PEK and Art Complexes was phased, initially the CUP had to work at partial load to serve just one building. Because the FTX building had an existing chiller that was well past its useful life and required repeated repairs, the DVC O&M teams had to keep that chiller going until the CUP was built and connected. All of these decisions required a high degree of communication between stakeholders, especially because the District Facilities Planning team manages capital projects, while the campus manages the Operations and Maintenance of the buildings.

Table 1: Project Timeline

Date	Project Milestone	Rationale/Details
2015	Decision to build new Arts and Physical Education/Kinesiology (PE/K) complexes	New buildings to be ZNE-ready.
2016	Assessment of HVAC equipment in the existing FTX building	Team determined the chiller and boiler in the existing FTX building must be replaced, and began planning as a separate Design-Build Mechanical Project.
2017	Start of design for Arts and PE/K complexes	Team decided to provide HVAC for the new buildings with a Central Utility Plant (CUP). Team considered expanding the CUP to also serve the existing FTX building nearby.
2018	Removed FTX building boiler from the Design-Build Mechanical Project scoped in 2016.	Removed because of insufficient budget. The cost of the HVAC upgrades was found to be significantly higher than estimated by the 2016 assessment.
2018	Moved chiller and boiler loads for the FTX building to the CUP.	It was more cost effective to add these loads to the new CUP than to build dedicated systems.
2018	Start of CUP construction	Because of the project's phased structure, utilities for the new buildings were installed during this time, several years before all of the buildings were scheduled to be completed.
2020	Decision to start using the CUP for FTX building chilled water .	The chiller was past its expected life. To keep it running until the CUP came online required careful coordination between the District Facilities Planning and DVC O&M Departments.
2021	Start of CUP operation	For FTX building chilled water.
2022	CUP reaches "Substantial Completion", triggering start of installation labor warranty.	As defined by contract, Substantial Completion depended upon completion of the Art building.
2023	Final buildings added to the CUP	As the CUP load approached 100%, warranty issues occurred. For phased projects, it is important to negotiate the start of the warranty period to still have coverage when 100% load is reached.

Progress Towards Sustainability Goals

Out of the District's nine sustainability goal categories, formally adopted in November 2022, this project made substantial progress in four categories, as shown in Table 2.

Table 2: Summary of Project's Progress Towards Sustainability Goals

Category	Goals by 2030	Contributions from this Project
#1: GHG reduction	Reduce GHG by 75% below the baseline.	GHG reductions significantly reduced by going all-electric.
#2 Renewable energy usage	• Decrease Energy Usage Intensity (EUI) by 25%. • Produce or procure 75% of electrical consumption using renewable energy.	Low EUI of new buildings help make better use of existing renewable energy.
#3 Promote Green Building and ZNE	• All new buildings LEED or WELL Gold. • Reduce natural gas usage by 30%.	• Both complexes expect to receive LEED v4 Gold certification. • ZNE buildings will be essential to meet natural gas reduction target.
#5 Zero Waste	• Achieve zero waste to landfill. • Reduce material consumption by 10%.	New buildings specifically designed to help achieve the Zero Waste initiative.

Table 3 illustrates the expected performance of the new complexes relative to baseline code minimum performance.

Table 3: Estimated Project Savings

Energy Use and Expected Savings	PE/K Complex	Art Complex
Similar Building Benchmark Electric Energy Use Intensity (for Climate and Building Type)	72.5 kBtu/sf/yr	79.4 kBtu/sf/yr
Estimated Building Electric Energy Use Intensity	31.5 kBtu/sf/yr	50 kBtu/sf/yr
Expected Energy Cost Savings (Compared to a Baseline T24 Building)	~40%	~36%
Expected Energy Savings (Compared to a Baseline T24 Building)	25 kW, 41,999 kWh (~18%)	24.3 kW, 43,477 kWh (~12.6%)

Barriers To Low-Carbon Procurement, And How They Were Addressed

Challenges in maintaining alignment on procurement decisions

Because of the project's size, procurement decisions were inherently difficult and time-consuming. Decision making required input from multiple departments from both the campus and district office. The architectural design teams included a large group of consultants and engineers and the contractor team included a large group of subcontractors. Project reviews involved various levels of stakeholders, including User Groups, a Steering Committee, and an Executive Steering Committee. One stakeholder commented, "Everyone had a say in everything".

The District Facilities Planning Team understood that maintaining ZNE objectives could increase decision making time. It focused on clearly communicating its sustainability and energy management goals over the course of the project, and encouraging data-driven multiple scenario analysis. It also made the process as inclusive as possible. Whether to build an all-electric CUP was a prime example of a difficult low-carbon decision. There was early agreement it would help achieve ZNE-readiness because of its high efficiency. However, it took time for the O&M Team to get an understanding of what maintenance and operation of an all-electric CUP would entail.

The District Facilities Planning Team's inclusive approach, while taking more time and effort, was a key reason it was able to maintain the support of key stakeholders for low-carbon procurement throughout the project's eight-year duration.

Challenges estimating costs, and justifying higher first costs

Since the project was bid out using a traditional design-bid-build model, the Project Team did not have access to subcontractor costs at bid time. This made it more difficult to see certain details, potential costs, and possible tradeoffs in the early stages of reviewing bids to ensure the alignment with the cost estimates of those specific line items. While the total construction bid was relatively within the construction budget, the delivery method of the project had constraints on the project team as far as visibility into individual trades' costs. Therefore, the Project Team worked hard to allocate adequate time to review project scope at each phase of the design. To the extent practical, it also waited to make decisions until it had as much information as possible.

During the design phase, the Project Team also had to justify higher first time equipment costs for low-carbon solutions. To do this, the District used Life Cycle Cost Analysis (LCCA). LCCA considers first cost, annual energy costs, and annual maintenance costs over the life of the equipment as well as disposal cost. Using this methodology, the life cycle costs of all-electric and traditional gas equipment were more comparable. The District did not formally include the financial, health, and broader social benefits of reduced carbon emissions and air pollution. However, such tools could be useful in other projects, adding further support for all-electric buildings with renewable energy.

Dealing with More Complex Commissioning and Warranty Issues

Although the Project Team had used much consideration when selecting professional service providers for this project, it realized that commissioning would be more complex than anticipated and would require a particularly high level of experience and attention. The decision was made to augment and replace the initial commissioning firm with another that had more experience. This decisive action proved to be a huge benefit to the project.

As shown in Table 1, it became necessary to use the CUP for existing buildings before the new buildings were completed. Warranty periods often begin once the equipment becomes operational, shortly after startup. However, for this project, the CUP warranty was negotiated to begin after substantial completion of the Art building, when the CUP would be operating at ~90% of peak design load. The final PE/K building will also be completed and connected prior to the end of the CUP warranty period. It is important to ensure procurement documents cover such warranty details, especially for large, complicated systems like the CUP and for phased projects.

Key Learnings

This case study is only focused on the procurement of an all-electric CUP, which was just one area of this complex project. However, the following key learnings should be valuable to other project teams planning their own electrification projects:

1. Make a clear commitment to low-carbon goals from the beginning, including when selecting architectural and engineering partners.
2. Anticipate what knowledge the O&M team will need to support the project, and help engineering teams communicate complex technical elements. Maintain open dialogue and engagement with all stakeholders.
3. Allocate adequate time to thoroughly review the project scope and work with design and engineering teams to understand all relevant scenarios.
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