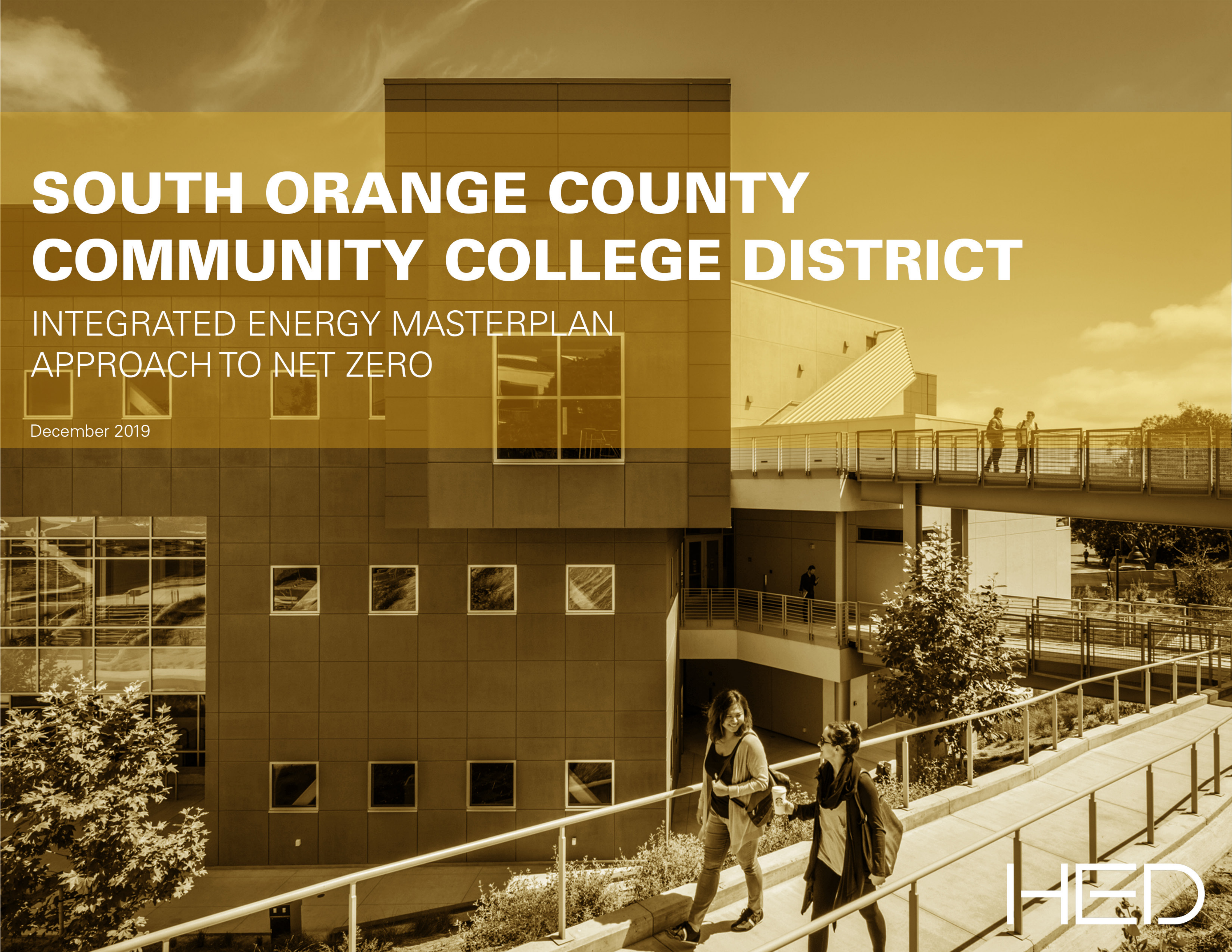
SOUTH ORANGE COUNTY COMMUNITY COLLEGE DISTRICT

INTEGRATED ENERGY MASTERPLAN
APPROACH TO NET ZERO

December 2019



HED

South Orange County Community College District
1967

Saddleback College

Irvine Valley College

ATEP
Advanced Technology & Education Park | Tustin, CA

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Presented to:

ACKNOWLEDGMENTS

SOUTH ORANGE COUNTY COMMUNITY COLLEGE DISTRICT

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EXECUTIVE SUMMARY

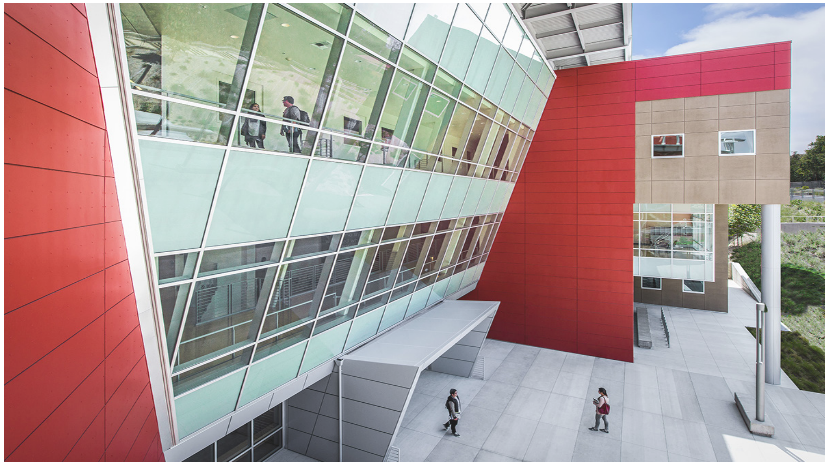
The California Community Colleges mission is to provide students the knowledge and background necessary to compete in today's and future economy. It is the largest higher education system in the United States with over 2.1 million students enrolled annually. It is comprised of 115 colleges with 73 self-governing districts. The South Orange County Community College District (SOCCCD) is a public comprehensive community college district which began providing service in 1967 and today has strong ties to the 26 communities that exist within its service area and beyond. The multi-campus district is comprised of Saddleback College in the City of Mission Viejo (1967), Irvine Valley College in the City of Irvine (1985) and Advanced Technology Education Park (2007) in the City of Tustin. 42,500 registered students are served by 931,467 assignable square feet and 1.3 million gross square feet of facilities.

As a leading employer and well respected public agency, SOCCCD understands it has a deep responsibility to its local communities and society-at-large to operate its facilities in ways that are efficient, sustainable and cost-effective—with the least possible impact on the environment. Reducing energy consumption is good for the environment and any generated cost savings can be utilized to better serve students and all communities, locally and globally. Consistent with these perspectives, the students, faculty, staff, administrators and Board of Trustees of the College have consistently pursued and implemented a wide range of sustainability efforts over many years, including energy efficiency improvement, recycling, LEED certification, green transportation and procurement practices, water conservation and more.

The SOCCCD Integrated Energy Master Plan (IEMP) is the most recent undertaking in a series of longstanding campus efforts that continue to positively contribute to society's need to reduce energy usage, while building upon the institution's growing culture of sustainability.

The IEMP addresses the following information:

- Driving factors for the Integrated Energy Master Plan (IEMP)
- Interpretations of Executive Orders for application at District and campus level
- Current campus energy consumption
- Energy Use Intensity (EUI) metrics establishment
- Building-by-building energy goals compared to external benchmarks
- Long-term and near-term goals with energy and greenhouse gas emissions targets
- Implementation of energy related projects and methodologies to achieve Net Zero Energy
- Incentives and Rebates



Saddleback College Sciences Building (LEED Gold Certified)

HOW TO USE THIS DOCUMENT

The information contained in this document has been organized in sections that enable readers to become familiar with how the overarching energy policies of the State of California, the California Community Colleges and South Orange County Community College District advance effective energy management. Moreover, this report provides the key data for understanding the existing and projected energy consumption of Irvine Valley College, IDEA building at ATEP campus and Saddleback College as well as the available options to achieve the objectives of this Integrated Energy Master Plan. The report's sections are as follows:

PROJECT BACKGROUND AND GUIDING ENERGY POLICY

This section provides an overview of key energy policies of the State of California and, relatedly, the California Community Colleges. Within this overview is a summary of the important role of Government Partnerships Energy Efficiency Programs and the benefits they provide to colleges. The section concludes with a discussion about how South Orange County Community College District and other agencies can utilize these foundational policies to manage energy costs.

PROJECT APPROACH

This section describes the methodologies that were used to create the IEMP. A hallmark of this plan is its innovative perspective and distinctive emphasis on the integration of varied energy solutions that synergistically address the College's present state and projected future condition.

Sections most recommended for Sustainability / Energy Managers

ENERGY ANALYSIS AND STRATEGIES FOR MODERNIZATION

This section identifies specific strategies that are most appropriate for each phase of campus development as outlined in the Facilities Master Plan.

STRATEGIES

This section provides a broad framework for implementing energy solutions that deliver maximum savings and operating cost efficiencies, in alignment with institutional needs and California's loading order.

Sections most recommended for Facilities Managers / Design Professionals

Sections most recommended for Business / Financial Officers

Irvine Valley College- Quad Landscape

PROJECT BACKGROUND AND GUIDING ENERGY POLICY

[OVERVIEW]

The intent of the Integrated Energy Master Plan (IEMP) is to provide practical, real-world energy solutions that take into consideration the impact of synergies between various cost effective strategies including energy efficiency, energy conservation and on-site renewable energy generation. A key goal for the project was to create a comprehensive plan of holistic energy solutions across a wide spectrum of applications. The plan would be designed to meet the needs of South Orange County Community College District through a deliberate alignment with the College's present state and projected future condition. In parallel, the plan would provide a strategic road map of recommended energy solutions that could be followed by any of the 115 California Community Colleges or other interested agencies. By understanding the synergistic outcomes between programs and projects, whether these are competing or complementary, the IEMP provides strategies the College and other agencies can utilize to proactively manage energy costs.

This Section Includes:

16 California's Energy Environment

22 The California Community Colleges

25 Focus on SOCCCD

29 Call to Action

[CALIFORNIA'S ENERGY ENVIRONMENT]

In 2019, California current-dollar GDP was $2.9 trillion and ranked 1st in the United States. California's economic prosperity and quality of life substantially rely on dependable, high quality and reasonably priced energy. As the nation's exemplar for promoting matters of environmental sustainability, the Golden State has been long recognized for introducing groundbreaking public policy. In California and throughout the world, there is a great public awareness and interest concerning energy related matters such as maintaining an effective and stable energy grid, the importance of energy security, mitigation of sometimes rapid fluctuations and volatility in the price of energy, and the need to consider climate change. Importantly, California's energy and environmental policies have, over time, taken a whole systems approach with a strategic focus on key priority areas for achieving meaningful objectives.

Environmental law involves legal standards written to protect and improve the natural environment. The California Environmental Protection Agency (CalEPA) was established in 1991 combining numerous activities in one cabinet level agency. They are comprised of one office, two boards and three departments. Their mission is:

> "to restore, protect and enhance the environment, to ensure public health, environmental quality and economic vitality."

California Regulatory Drivers include aggressive policies for reducing greenhouse gas (GHG) emissions, passing legislation, developing incentives and encouraging voluntary actions. The following list illustrates several of these policies the college must consider in its planning.

- Air Quality Management Districts and California Air Pollution Controls Act 194
- California Air Resources Board (CARB) established in 1967
- California Environmental Quality Act (CEQA) 1970
- Senate Bill 20 Electronic Waste Recycling Act (EWRA) 2003
- California Executive Order S-3-05 (2005) established the California Environmental Protection Agency (Cal/EPA)
- Senate Bill 97 (2010) CEQA set guidelines for land-use planning and GHG emissions
- Assembly Bill 32 (2006) Global Warming Solutions Act
- Executive Order S-01-07 (2007) set the Low Carbon Fuel Standard
- Executive Order S-14-08 (2008) California Renewable Portfolio Standard set utilities target of 33% of electricity generated from renewable resources
- Executive Order B-18-12 Green Building Action Plan
- Senate Bill 375 (2008) requires Planning Organizations to work with CARB to reduce GHG emission

- California Community Colleges Board of Governors (2008) adopted an Energy and Sustainability Policy. The policy was updated in 2019
- Pavley Bill (AB 1493) (2009) authorizes Cal Air Resources Board regulations on GHG emission
- Assembly Bill 341 establishes a statewide solid waste diversion goal with the intention of encouraging innovation in technology in recovery of recyclables in waste and requiring the Department of Resources and Recycling Recovery to submit reports on Legislature strategies necessary to accomplish the state goal. 2011-2012
- Executive Order B-16-12 ZEV Regulations
- Senate Bill 535 (2012) – requires 25% of state cap-and-trade revenues to go to projects that benefit disadvantaged communities
- Executive Order B-48-18 ZEV & infrastructure deployment
- Senate Bill 350 (2015) - mandates an increase of California's renewable energy use to 50% by 2030 and a doubling of energy efficiency
- Senate Bill 32-15 (2016) – expands AB32 and requires a reduction in GHG emissions to 40% below 1990 levels
- Assembly Bill 758 -- doubles building energy savings (17% reduction in building energy use by 2030)
- Senate Bill 49 (2017) California Environmental, Public Health, and Workers Defense Act
- Assembly Bill 398 Extends cap-and-trade program to 2030
- Senate Bill 50 Public Lands Protection Act 2017
- Executive Order B-55-18 (2018) - By 2045, achieve statewide carbon neutrality
- Senate Bill 100 (2018)- 60% of all electricity from renewable sources by 2030 and 100% from carbon-free sources by 2045; double the energy efficiency of existing buildings; and allow greater electric utility investment in electric vehicle charging infrastructure
- AB 3232 (2018) Requires the Energy Commission to assess how to achieve a 40 percent GHG reduction in the building sector by 2030 to below 1990 levels
- Senate Bill 1477, also signed in September 2018, will allocate $50 million annually in incentives for very low emissions new buildings
- The recently passed AB 3232 law sets a tentative target of 40 percent GHG emissions reduction in California's buildings below 1990 levels by 2030 (to align with the state's overall GHG emission goals) and directs the Energy Commission to assess how to achieve it in a manner that is beneficial for consumers and the grid

Integrated Energy Policy Report

In the aftermath of the 2001 electricity crisis, the California Energy Commission (CEC) collaborated with key stakeholders in 2002 to develop and establish a biennial Integrated Energy Policy Report (IEPR). The purpose of the IEPR is to assess major energy trends and issues facing the state's electricity, natural gas, and transportation fuel sectors and to provide policy recommendations to conserve resources; protect the environment; ensure reliable, secure, and diverse energy supplies; enhance the state's economy; and protect public health and safety. Each new edition of the IEPR includes these assessments and associated policy recommendations. The IEPR is published every two years, with updates in alternate years. Preparation of the IEPR involves close collaboration with federal, state, and local agencies, as well as a wide variety of stakeholders to identify critical energy issues and develop strategies to address those issues.

Energy Action Plan

In an unprecedented collaborative effort, the California Energy Commission, the California Public Utilities Commission, and the California Power Authority jointly adopted in 2003 an Energy Action Plan (EAP) that was, in essence, a post-energy-crisis call-to-action that articulated a single, unified approach to meeting California's electricity and natural gas needs. The EAP was updated in 2005 and again in 2008, and today is widely recognized and respected for its formative policy, both nationally and internationally. The cornerstone of the EAP was that it articulated for the first time California's "loading order" for addressing the state's future energy needs. As depicted below, the loading order is a priority list establishing that the state, in meeting its energy needs, would invest first in energy efficiency and demand response, followed by renewable generation, and then distributed generation.

1. Energy Efficiency / Energy Conservation
2. Demand Response
3. Renewable Generation
4. Distributed Generation

From another perspective, the EAP established the overarching pillars of the state's sustainable energy policy. First, energy efficiency was identified as the state's top priority procurement objective; hence, all energy providing utilities operating within the state have been required to invest in energy efficiency, whenever it is cost effective, reliable and feasible. Second, the EAP recognizes the need for new generation of energy and promulgates that new energy must be produced initially through renewable energy resources and then by distributed generation.

Global Warming Solutions Act

California set the stage for its transition to a sustainable, low-carbon future by legislating for a sharp reduction of greenhouse gas (GHG) emissions through AB 32, the California Global Warming Solutions Act of 2006. In doing so, California established another watershed policy in its history with the first program in the United States to take a comprehensive, long-term approach to addressing climate change, concurrently aiming to improve the environment and natural resources while maintaining a robust economy.
The Global Warming Solutions Act requires:

- California to reduce its GHG emissions to 1990 levels by 2020
- 40% reduction in GHG emissions below 1990 levels by 2030
- 80% reduction in GHG emissions below 1990 levels by 2050

Full implementation of the Act is intended to help mitigate core risks associated with climate change while improving energy efficiency, reducing waste and expanding the use of renewable energy resources and cleaner transportation.

California considers its energy efficiency standards "the bedrock upon which climate policies are built" and uses renewable energy to fill any remaining energy needs. Compared to the implementation costs of other climate policies, the state finds that "energy efficiency provides substantial emissions reductions and should be an essential element of the Best System of Emissions Reductions (BSER) CO^2e reduction target."

Long Term Energy Efficiency Strategic Plan

Adopted in 2008, California's Long Term Energy Efficiency Strategic Plan serves as a statewide road map for achieving maximum cost-effective energy efficiency and energy savings in California's electricity and natural gas sectors between 2009 and 2020, and beyond. This strategic plan was developed through a collaborative process involving the utilities firms that are regulated by the California Public Utilities Commission—namely, Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), San Diego Gas & Electric Company (SDG&E) and Southern California Gas Company (SoCalGas)—and more than 500 additional stakeholders. The regulated utilities are collectively recognized as Investor-Owned Utilities (IOUs) and play a critical role in furthering the state's goal of attaining energy efficiency as a way of life in California by advancing structural changes in the way Californians use energy.

Previously, with the adoption of California's Energy Action Plan, energy efficiency was identified as the state's top priority resource. The Long Term Energy Efficiency Strategic Plan continues this commitment to energy efficiency as it articulates a long-term vision and goals for each of the state's economic sectors, while also identifying specific near-term, mid-term and long-term strategies to assist in achieving those goals, some of which include:

- All new residential construction in California will be zero net energy by 2020;
- All new commercial construction in California will be zero net energy by 2030;
- Heating, ventilation and air conditioning (HVAC) will be reshaped to ensure optimal performance for California's climate resulting in a 50 percent improvement in efficiency in the HVAC sector by 2020;
- All eligible income-qualified customers will have the opportunity to participate in special energy programs by 2020;
- Energy efficiency will be made available to every Californian.

California Community Colleges, along with all government agencies, are identified in the Long Term Energy Efficiency Strategic Plan as having key roles for increasing energy efficiency, largely due to the presence of commercial buildings that are intense users of energy. In this context, the 5 billion-plus square feet of diverse commercial buildings in the state consume more electricity than any other end-use sector in California, in aggregate accounting for 38 percent of the state's power use and over 25 percent of natural gas consumption.

Energy Management in State Buildings

In 2009, California's Department of General Services (DGS) issued MM 09-04, Procedures for Energy Management in State Buildings during Normal Operations and Electrical Emergencies. The procedures provide information about efficient energy management in state buildings during normal operation and outline actions state agencies should take during electrical emergencies. The energy management practices of all state agencies should conform to these procedures, including the prescribed detailed instructions on controlling energy usage during the following conditions:

Emergency Status Level
No emergency
Stage 1 Electrical Emergency
Stage 2 Electrical Emergency
Stage 3 Electrical Emergency
Rotating Outage or Blackout

As stated previously, the California community colleges are comprised of more than 75.6 million gross square feet of facilities throughout 115 colleges across the state; accordingly, each college has an important role to perform during an emergency electricity event. In this regard, when the California Independent System Operator Corporation (CAISO) declares an electrical emergency, the DGS takes action and notifies all departments, universities and community colleges to take appropriate curtailment measures to reduce electrical load during Stage 1, 2 or 3 electrical emergencies. Federal law requires that CAISO maintain specified levels of energy reserves available to the electrical grid. In addition, CAISO is charged with maintaining a reliable and affordable power supply while minimizing the environmental impacts of conventional generation. CAISO envisions "demand response and energy efficiency becoming integral, dependable and predictable resources that support a reliable and environmentally sustainable electric power system."

Zero-Net-Energy Goal

All Integrated Energy Policy Reports since 2007 have included a key recommendation to create a pathway to zero-net-energy (ZNE) buildings for new construction through the Building Energy Efficiency Standards contained in Title 24. California's Long-term Energy Efficiency Strategic Plan and other related policies and programs also support this approach.

Executive Order B-18-12 & Green Building Action Plan EO B-18-12 establishes:

- 50% of new state buildings to be ZNE* by 2020
- All new state buildings to be ZNE by 2025
- 50% of existing state buildings to be ZNE by 2025

*ZNE Source – Energy Efficient building that produces as much clean renewable energy as it consumes annually, when accounted for at the energy generation source.

A ZNE code building meets an energy use intensity (EUI) value designated in the Building Energy Efficiency Standards by building type and climate zone that reflect best practices for highly efficient buildings.

Making the ZNE definition operational will require ongoing efforts through the 2016 and 2019 code development cycles. To ensure that all buildings have a pathway to compliance, the CEC anticipates establishing reasonable exceptions to account for building and building site limitations, including the need for "development entitlements" for off-site renewable energy resources, such as community based renewable energy generation. Recommendations to ensure success in meeting present ZNE goals include adopting triennial building standards updates that increase the efficiency of new buildings by 20 to 30 percent in each update; tracking market progress on ZNE construction and performance; coordinating with the California Public Utilities Commission (CPUC) on future Investor-Owned Utility new construction-related programs; collaborating with the CPUC and stakeholders to create workforce development programs that provide the skills needed to meet ZNE goals; and including a voluntary energy tier for ZNE in the California Green Building Standards Code.

Renewable Portfolio Standard (RPS) Program

Renewable energy generation is third on the state's loading order of priorities, and critical to the state's energy infrastructure. California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country. Established in 2002, accelerated in 2006, 2011, 2015 and expanded in 2018, the RPS program requires that Investor-Owned Utilities, electric service providers, and community choice aggregators derive 60 percent of the total electricity from renewable power by 2030 and requires all state's electricity to come from carbon-free resources by 2045.

Government Partnerships Energy Efficiency Programs

Government Partnerships are energy efficiency (EE) programs implemented through collaborations between IOUs and local governments, regional governments or state agencies.

The California Energy Commission in September 2015 set out its 10-year roadmap to transform the states existing built environment. The action plan requires industry and government to collaboratively deliver substantial energy savings to help meet the states carbon emissions reductions goal – 80% reduction from today's level by 2050. At the heart of the action plan are robust milestones to double energy savings in existing buildings. Key stakeholders partnering agencies include:

- CA Department of General Services
- Local Government at all levels
- Local Government Associations
- Local Government Partnership Utility and Implementer Leads
- Public K-12 Schools, colleges and universities
- California Division of the State Architect

Saddleback College Observatory

[THE CALIFORNIA COMMUNITY COLLEGES]

The California community colleges (CCC) is the largest system of higher education in the United States, comprised of 115 colleges within 73 self-governing Districts. The colleges provide students with the knowledge and background necessary to compete in today's economy through a wide range of educational offerings that include workforce training, basic courses in English and math, certificate and degree programs and preparation for transfer to four-year institutions. The colleges serve more than two million students annually, or approximately 25 percent of the nation's community college students. Notably, three out of every ten Californians, aged 18 to 24, are enrolled at one of the 115 colleges.

Each community college district is governed locally by a popularly elected Board of Trustees whose role includes being responsive to its community, setting local-level institutional policy and overseeing the operations and budgets of each college within its district. Comparably, the CCC is governed by a Board of Governors (BOG) whose role is to set policy and provide guidance for the 73 districts and 115 colleges that constitute the system. The 17-member board is appointed by the governor and formally interacts with state and federal officials and other organizations. The BOG also selects a chancellor, who provides leadership for the system of colleges through the California Community Colleges Chancellor's Office (CCCCO).

California Community Colleges Board of Governors Climate Change and Sustainability Policy

In 2008, the California Community College Board of Governors (BOG) adopted the Energy and Sustainability Policy for all districts to achieve energy conservation, sustainable building & plant management best practices to reduce energy consumption. Furthermore, the BOG's is committed to a goal of 100% participation in long term sustainability planning, greenhouse gas reduction strategies and programs to prepare students for careers in the Green Economy. In May 2019, the BOG approved and adopted a new Climate Change and Sustainability Policy to better align with the states vision and goals as outlined by California's scoping plan.

Saddleback College Library Building

Reduce Energy Costs

California community colleges receive the majority of their general fund operational dollars from the state. Governor Gavin Newsom has allotted total budget for 2019-20 of $8.7 billion in funding for the CCC. Eighty to ninety percent of these allocated dollars pay for personnel related costs at each campus. In contrast, capital improvement projects are usually financed through General Obligation (GO) bonds that are authorized locally by the electorate of each college district. California Community Colleges' unmet facilities needs are estimated at $42 billion over the next 10 years. A failure to fund these capital projects would likely be considered a missed opportunity to create jobs and to cultivate a skilled and educated workforce throughout the state.

The physical infrastructure of the present day CCC is expansive, with thousands of facilities located in diverse urban, suburban and rural communities across California. The system has 5,281 buildings that consist of 75.6 million gross square feet of facilities space located on 24,279 acres of land. Of significance, the system of 115 colleges annually consumes approximately 706 million kWh of electricity and 26 million therms of natural gas at a total annual operating cost for energy of $6.9 billion and $162 million, respectively. For each college within the CCC system, energy costs represent the one of the largest line item expenses, after faculty and staff salaries and benefits. With these factors in mind, CCC recognizes there are significant opportunities to reduce energy costs and, thereby, district operating costs by following the state's loading order priorities by focusing first on efficiencies and conservation and then potentially through renewable or distributed generation. Through sheer size and its comprehensive efforts for a system-wide deployment of energy optimization strategies, the CCC is strategically positioned to play a major role in meeting California's goal for a more reliable and sustainable power system.

Irvine Valley College Library Building

Table 1 California Community Colleges Goals for Addressing Climate Change and Furthering Environmental Sustainability

Goals by 2025	Goals by 2030	Measurement
1. Reduce GHG emission to 30% below 1990 levels	Reduce GHG emission to 40% below 1990 levels	Existing annual report, modify to extend data back to 1990 and use GHG energy conversion tools from EPA
2. Increase renewable energy consumption to 25%	Increase renewable energy consumption to 50%	Existing annual report, modify to identify renewable consumption
3. 25% of fleet vehicles are zero-emission vehicles	50% of fleet vehicles are zero-emission vehicles	Required survey in 2025 & 2030
4. 50% of all new buildings and major renovations will be constructed as Zero Net Energy	100% of all new buildings and major renovations will be constructed as Zero Net Energy	Required through building code
5. 50% of all new buildings and major renovations will achieve at least a Leadership in Energy and Environmental Design (LEED) "Silver" or equivalent rating	100% of all new buildings and major renovations will achieve at least a Leadership in Energy and Environmental Design (LEED) "Silver" or equivalent rating	Required through building code
6. Increase procurement of sustainable products and services by 20% compared to current levels	Increase procurement of sustainable products and services by 25% compared to current levels	New annual report, tracking procurement of sustainable products and services
7. Reduce municipal solid waste by 25% compared to current levels	Reduce municipal solid waste by 50% compared to current levels	New annual report, tracking municipal solid waste

[FOCUS ON SOCCCD]

SOCCCD STATS AS OF SCHOOL YEAR 2017-2018		
	Saddleback & District Services	IVC & IDEA building at ATEP
College Acreage (acre)	172.54	106
No. of Buildings	40	35
Gross SF of Buildings	816,321	493,502
Staff	1,202	756
Students	26,476	15,162
Electricity (kWh)	3,354,040	6,182,123
Natural Gas (therms)	990,665	83,866
Water (gallons)	62,458,374	45,243,777
Campus Owned Vehicles	97	25
Parking Spaces	4,436	2,262

Note: The campus owned vehicles, which are almost exclusively used on campus, have minimal effect on the carbon emissions and are too small to have an impact on this report. Additionally, electric vehicles do not yet exist for pickup trucks and vans which almost exclusively make up the campus fleet.

The District's vision is to be an educational leader in a changing world. The Board of Trustees adopted Board Policy 3006 Sustainability in May 2009, revised in February 2019. An administrative regulation was passed that focused on energy and sustainability. The regulation dealt with ten major categories:

- Sustainability
- Climate Action Plan
- Energy Conservation and Utility Management
- Water Conservation
- Waste Management
- Physical Plant Management
- Sustainable Building Practices
- Sustainable Procurement
- Sustainable Food Service
- College Operations, Education and Service

The District identified goals and strategies which provided the mechanisms for tracking progress.

SOCCCD Key Drivers:

- CA Legislation
- CA Code of Regulations & Standards
- Gubernatorial Executive Orders
- Reduce energy use, reduce operating costs and reduce emissions
- Utilize IOU's Incentives & Rebates
- Political – State and Federal governmental expectation that public entities will lead by example
- Economic–to build financial resilience to rising utility costs
- Reputational–promoting excellence in education and sustainability

California's leadership in reversing climate change – A multi-sector strategy:

- Limit statewide GHG emissions to 1990 levels by 2020 and at least 40% below 1990 levels by 2030
- SB100 100% Renewable energy by 2045
- Zero Net Energy mandates (EO) B-18-12
- 50% of new major renovations of state buildings will be ZNE by 2025
- IOU's Energy Efficiency Programs
- Natural Gas Efficiency Programs
- Vehicle Emissions Standard stricter than Federal Standard
- Appliance Efficiency Standards
- SB 700 3,000 MW behind the meter storage by 2026
- Statewide cap-and-trade program (pay to produce emissions)

The College upgraded and adopted its Facilities Master Plan to implement this extensive building and modernization program in direct support of the goals of the 2011-2031 Facilities Master Plan, and the 2020 Facilities Master Plan, currently being developed. The 2020 Facilities Master Plan currently in development will include funds for new and continuing efficiency improvements on all of the District's campuses.

Facilities Master Plan (FMP)

The Facilities Master Plan (FMP) provides a long range planning framework to strategize new construction and accommodate changes in existing conditions through the 2031 planning horizon.

The goals of the Facilities Master Plan include:

- To establish clear direction for the colleges by envisioning the future under the changing conditions of internal and external trends and influences.
- To provide a foundation and serve as a primary resource for the development of college planning activities.
- To determine the status of the colleges, the dynamics that may impact the college, and to provide appropriate responses to the situation.
- To serve as the basis for facility decisions regarding expansion and modification of facilities and the implementation of the state bond measure that was provided to improve college facilities.
- To identify the limitations, strengths, and capabilities of the colleges and offer options for the future.
- To stimulate continuing discussion about college programs and their effectiveness.

To this end, the Facilities Master Plan is intended to:

- Establish clear development/modernization direction for the colleges by strategizing future growth relative to changing internal and external trends and influences.
- Provide a foundation for implementation strategies and serve as a primary resource for the development of other college planning activities.
- Support accreditation reviews and demonstrate compliance with accreditation standards.
- Inform the community of the college's present needs and future plans, forging a closer relationship between the colleges and the community.
- Serve as the basis for facility decisions regarding expansion and modification of facilities and the implementation of all funding measures provided to improve college facilities.
- Identify how the campus can serve students by emphasizing the strengths and capabilities of the colleges, and offer an environment supportive of academic and cultural pursuits.
- Stimulate synergies between students and faculty, and promote effectiveness of college programs.
- Increase coordination between master plan development and ongoing facilities maintenance projects.

SOCCCD - 2017 Sustainability & Energy Plan

The Sustainable Master Plan is designed to be a living document subject to ongoing evaluation and improvement. It is expected to evolve with changing circumstances including implementing the articulated sustainability goals on waste, recycling, water conservation, energy efficiency, renewable energy, green buildings, and sustainable transportation. Through the work of the District, five focus areas for sustainable practices were identified:

- Governance & Policies
- Teaching, Learning & Outreach
- Sustainable Transportation Planning
- Waste Reduction, Reuse & Recycling
- Green Buildings & Sustainable Operations

Integrated Energy Master Plan

As the campus building program progressed and energy costs remained as one of the largest operating expenses after personnel expenditures, South Orange Community College District staff identified the need to further maximize operational efficiencies. Further, the Integrated Energy Master Plan (IEMP) provides an opportunity to engage in meaningful discussions with key stakeholders to ensure their needs and concerns are accounted for during the planning phase which ensures successful implementation of actual projects.

The IEMP focuses on deploying facility management practices to reduce overall energy consumption by maximizing energy efficiency in existing buildings. Strategies include:

- Deep energy efficiency lighting upgrades
- HVAC upgrades to highly efficient, right-sized systems with regular scheduled maintenance
    1. Replace chillers, boilers, and water pumps with more efficient options
    2. Install variable air volume (VAV) fans and motors with adjustable speeds.
    3. Install electric sensor water faucets in restrooms.
    4. Replace transformers with new higher efficient electrical transformers.
- Improving thermal performance of building envelope e.g. insulation, glazing, roofing, etc
- Participate in IOU's Demand Response Programs to reduce peak electrical load
- Load reductions by improving efficiency of appliances and equipment
- Energy savings data controls
- Retro-based building commissioning (RCx) & Monitoring-based building commissioning (MBCx)
- Central Plant / Equipment replacement
- Utility incentives & rebates programs (e.g. Savings by Design Programs)
- On-site renewable energy generation

The SOCCCD Integrated Energy Master Plan is a comprehensive strategic plan that identifies various energy related projects and methodologies to be employed by the college in support of the continued progression of the campus building and modernization program. In addition, the SOCCCD IEMP has been concurrently designed as an energy conscious Strategy and Resource Guide to be utilized by any of the 115 colleges within the California Community Colleges as well as other interested colleges, universities or public agencies.

[CALL TO ACTION]

According to the U.S. Department of Energy, America's buildings account for about 40% of the total US primary energy consumption, which is natural gas, gasoline, coal, nuclear energy and renewable energy. Primary energy sources are mainly used to create secondary energy (i.e. electricity) which buildings use over 70%. Buildings also produce 39% of the country's carbon emissions. For community colleges and other governmental agencies, these metrics indicate that significant opportunities exist to reduce the cost of energy and the institution's carbon footprint. In this regard, the State of California has created a policy driven framework that supports a continuous endeavor to increase energy efficiency and conservation, through renewable energy and distributed generation—where feasible and cost effective. This comprehensive framework is supported by the California Community Colleges Board of Governors and Chancellor's Office. Moreover, all industry sectors operating within the state are expected to play a role in reducing the cost of energy to ensure California's economic prosperity and quality of life for all Californians.

Each IEMP provides for a holistic integration of energy use throughout campus, building by building. Notably, the IEMP is also aligned and integrated with California's full complement of guiding energy policies. SOCCCD strives to be a leader in energy conservation within the state as well as the communities served by the District. As an educational institution, the District aims to increase awareness with its constituents and its colleagues to promote sound energy management practices. Readers of this plan, especially those who work in California community colleges, can and should lead by example by providing cost effective solutions (such as those identified in this report) that will increase energy efficiency; create operational savings by reducing the demand for energy; reduce an institution's carbon footprint and deliver stellar stewardship of resources for the betterment of the environment, institution and economy.

Integrated Design, Engineering and Automation (IDEA) Building at ATEP

PROJECT APPROACH

[OVERVIEW]

The South Orange County Community College District Integrated Energy Master Plan intentionally follows California's loading order priorities by striving to increase energy efficiency campus-wide through energy optimization strategies that reduce costs and minimize consumption. The strategies recommended or documented herein for meeting the state's uppermost priorities are augmented by recommendations or strategies that utilize renewable or distributed generation to potentially offset consumption costs or create new revenue streams. The college's need to become more energy efficient in a cost effective manner, where feasible, aligns well with the state's overarching energy policies.

This section provides the varied energy solutions that meet the sustainable goals of the District.

This Section Includes:

32 Methodology Overview

33 Zero Net Energy Approach

35 Energy Design Guidelines

36 Energy Modeling & Data Analyses

37 Benchmarking Standards

38 Energy Strategies for Existing Conditions

[METHODOLOGY OVERVIEW]

A central objective of the IEMP was to develop a phased, holistic approach for meeting the college's energy needs whereby, in alignment with California's loading order priorities, solutions could be applied near-term to existing buildings and in the longer-term to newly constructed or modernized buildings that are delineated in the college's Facilities Master Plan. As described throughout this section, this essential objective was accomplished through the following reproducible methodologies:

1. Based on existing conditions, the energy consumption of each building on campus was modeled, both wholly and by subsets of categories (e.g., lighting load, cooling load, heating load);

2. Energy consumption baseline data were created for each building on campus;

3. Multiple national energy consumption benchmarking standards were identified, compared to campus building-by-building baseline data, then utilized for setting campus building-by-building consumption reduction goals; and

4. In alignment with California's loading order priorities, varied strategies were identified, prioritized, and recommended for the existing conditions of the campus and also for a multi-phased, multi-year approach based on the sequencing schedule of the Facilities Master Plan.

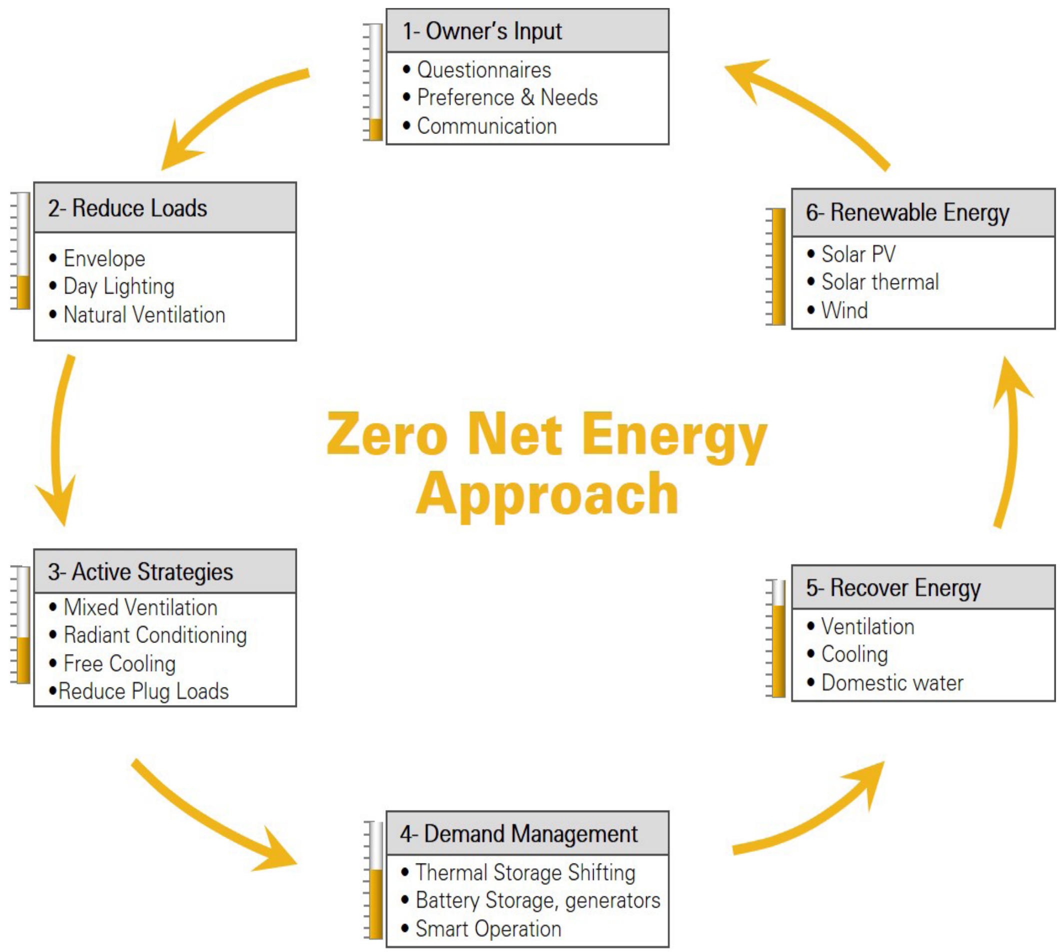
[ZERO NET ENERGY APPROACH]

Given that buildings consume approximately 40% of the total energy consumed in the U.S, recent legislations in California have prioritized energy efficient buildings (approaching zero net energy). A systematic approach with a set of priorities is needed to achieve this goal. These are:

1. Owner's Program Requirements examples include reducing the energy consumption by understanding the existing energy use and planning for future development.

2. Reduce Loads by using passive strategies. These strategies include:
   - building orientation
   - shading
   - thermal mass
   - natural ventilation

3. Energy Efficiency (EE) Measures or Active Strategies. Typical EE measures include:
   - High efficiency lighting (LED)
   - High efficiency air-conditioning units (VRF)
   - Central Plant Systems
   - High efficiency motor variable frequency drives
   - Hybrid ventilation systems
   - Economizer systems
   - Radiant cooling and heating systems



4. Demand Management aims at reducing the cost of energy by shifting energy consumption to off-peak hours of the day to take advantage of lower electrical rates. Some strategies include:
    - Thermal Storage: This technique generates ice from ice making chillers at extra low off-peak tariffs, typically from 12:05 am to 6:00 am. The ice then melts and the chilled water is pumped to the Air Handling Units during the peak load hours (11:00 am to 6:00 pm) without turning on the chillers. This process is repeated every day.
    - Pre-Cooling: This involves having water drip down the condenser coils of rooftop air-conditioning units. This causes the ambient temperature around the condenser coil to drop between 20-30°F and increases the efficiency of the A/C unit.
    - Battery Storage: This works similar to thermal storage. This method uses batteries that are charged during off-peak hours for use during peak hours.
    - Photovoltaic Systems: PV systems generate electricity during the same time when electricity consumption is also at its peak, thereby reducing the peak load.
    - Smart Operation: typically classrooms and offices have a space temperature set-point of 72°F. However, by having a floating set-point which is dependent on outside temperature can reduce energy use and demand. This strategy has been proven to be successful because comfortable temperature for occupants can vary depending on environmental (outdoor temperature, air velocity, humidity, etc) and personal factors (metabolism, clothing, activity level, etc). For example, having a constant set-point of 72°F can be uncomfortable for occupants when the temperature outside is in the 90s. This is especially effective in transient spaces such as corridors or lobbies when having a controlled temperature is not necessary as occupants do not stay in these spaces for long periods.

      Another strategy is to keep transient spaces such as corridors at a higher temperature set-point compared to an occupied space.

5. Recover Energy. The code requires each occupied area to be provided with minimum outside air (OSA) for each occupant. Therefore, the quantity of OSA entering the building must be exhausted to prevent building pressurization. However, the exhaust is already conditioned and therefore, to save energy, it may be possible to use this cool air to precondition the incoming OSA. Another strategy is to use heat recovery chillers that allow the heat rejected from the chillers be used for hot water or heating purposes. This technique is commonly used for cogeneration systems and is used at Saddleback Central Plant for heating, hot water and swimming pools.

6. Renewable Energy or on-site generation. Southern California is one of the best places in the world to generate electricity from PV panels due to the abundant sunlight. It is also an excellent candidate to produce hot water from solar panels. Climate analysis shows that there isn't sufficient wind velocity to drive wind turbines at SOCCCD and therefore should not be considered as a viable source of renewable energy. Fuel cells are another alternative only if bio-gas is used. However, SOCCCD does not have a supply of bio-gas and therefore it should not be considered.

[ENERGY DESIGN GUIDELINES]

The most effective strategy to manage the energy consumption of future facilities is to design and construct buildings that allow flexibility of use, incorporate efficient systems, conserve energy and resources and, under certain circumstances, generate energy. Planning for such wide ranging options requires thoughtful consideration. Developing and utilizing Energy Design Guidelines can be instrumental in delivering the types of holistic energy solutions that are envisioned in this IEMP. Although presently not in widespread use, Energy Design Guidelines for new construction and significant modernization projects have value as an innovative strategy for effectively and proactively managing energy consumption. IEMP Energy Design Guidelines include:

Establishment of target benchmarks for Energy Use Intensity (EUI). It is important to establish an EUI baseline for all new capital projects at inception in order to create an internal benchmark for comparing energy performance. Overall, a lower EUI indicates better building energy performance, but EUI's vary according to building type. Designing to a specific EUI target will provide the colleges with a good indication of the annual operating budget that will be needed to operate the building. Refer to page 37 for the detail EUI definition.

Development of life-cycle cost analyses of energy technologies during the design process that show the relationship between capital and operational costs. Life-cycle cost analyses of energy technologies and strategies can assist in the formation of construction budgets and energy budgets by providing a true cost comparison of different alternatives.

Optimization of building orientation and massing. Both active and passive solar strategies are more effective on buildings that maximize southern exposures while minimizing east and west exposures. Building massing should optimize airflow, by promoting or limiting airflow as needed. Massing should also consider both positive and negative impacts to adjacent structures and open spaces.

Optimization of building envelopes. High performance glazing that minimizes solar heat gains and maximizes visible light transmission is essential for reducing heating and cooling loads, thus energy consumption.

Optimization of shading and daylighting. While shading can reduce solar heat gains, daylighting promotes learning. Shading and daylighting strategies should be paired to maximize the effectiveness of both passive strategies. In addition, adjacent landscape and site structures can provide shading to buildings and should be considered and designed to maximize beneficial impact.

Specification of high efficiency and Energy Star rated equipment. This strategy applies to all energy consuming equipment from HVAC systems to refrigerators. Significant information is available to both engineers and specification writers that allow for identification of appropriate equipment that minimizes energy consumption.

Establishment of energy performance requirements and strategies by building type. This allows performance levels to be applied appropriately to each building in consideration of the specific challenges of each building type.

Establish LEED requirements. The district requires that all new construction and major renovations shall be at least LEED Gold equivalent. Therefore, all college staff should continue to ensure that all relevant new construction meets or exceeds this commitment.

[ENERGY MODELING & DATA ANALYSES]

An initial task was to benchmark the energy consumption of each campus in its existing condition. The Irvine Valley College campus is currently served by two electric meters and the Saddleback campus is served by six (i.e. individual buildings are not independently metered). It was thus necessary to model the entire campus for energy consumption—building-by-building—and further divide the consumption of each building into energy consuming categories such as lighting load, HVAC load, heating load, etc. The data generated for each of the buildings was calibrated using a HED proprietary Excel based engine, thus allowing alignment of the actual consumption from the electrical meters with the predicted consumption from the computer model. Reference data used to provide this level of analysis included:

1. Electricity consumption from one main meter at 15 minute intervals for both kW and kWh for 3 years
2. Fuel usage including gasoline, diesel, propane, etc.
3. Natural gas consumption for 3 years
4. Water consumption
5. Building management systems information
6. Lighting retrofit project scopes and year of completion
7. Computer equipment load demands
8. Building envelope data, determined by referring to code requirements by year of construction
9. Building schedule operation
10. Campus hours of operation
11. Existing Educational Master Plan and Facilities Master Plan

A comprehensive review of all consumption data, including metering data, interval data, data analytics and energy simulation of the entire campus was undertaken to identify energy consumption, building-by-building. All building performance data underwent multiple reviews and data precision tests to ensure the data was within a reasonable accuracy range. This campus-level internal benchmarking established a baseline for energy consumption, building-by-building.

Once the energy consumption data for the campus was modeled, the data was analyzed and considered. The overall analytical results were then graphically presented alongside industry benchmarks so that comparisons between building energy use and industry benchmarks could easily be made, leading to informed decision making for the establishment of specific reduction strategies and goals. The consumption information, related baselines and multiple reduction strategies that were developed from the existing conditions of the campus enable college stakeholders to assess the varied energy savings opportunities with a high degree of accuracy. The data analyses and resultant baselines incorporated estimated energy savings from already completed projects.

The following key activities were conducted during this stage of the project:

1. Create a baseline graph of consumption kWh
2. Create a baseline of demand in kW
3. Assessment of the existing greenhouse emissions of the campus
4. Review of operational practices

[BENCHMARKING STANDARDS]

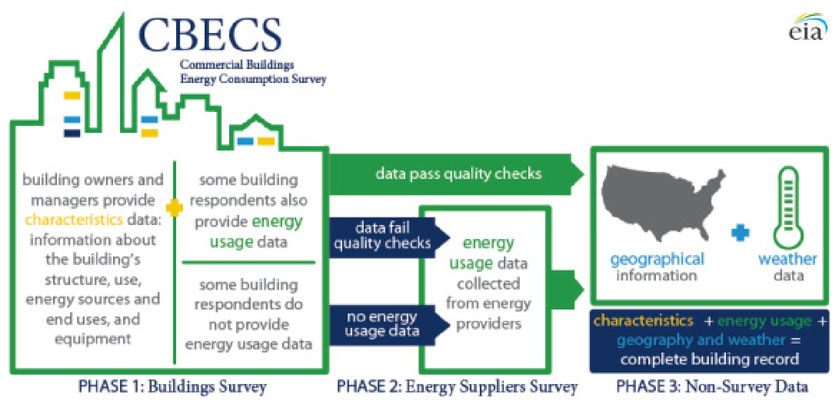
Benchmarking allows SOCCCD to understand the relative energy efficiency of a building and compare its performance to similar types of buildings. Once energy consumption baselines were established for each of the colleges, comparative analyses with multiple national benchmarking standards were conducted to ensure the reasonableness and efficacy of the baseline calculations. The benchmarks that were utilized and approach to the analyses are described below.

The energy consumption of a building is measured in Energy Use Intensity (EUI). EUI is a building's energy use (in kBtu) per square foot per year. EUIs are calculated by totaling the annual energy used by all utilities serving the building, such as electric and natural gas, divided by the building's gross floor area. EUIs are normalized for building size, allowing buildings of various sizes to be compared to each other.

$$Energy\ Use\ Intensity\ (EUI) = \frac{Annual\ Building\ Energy\ (kBtu)}{Building\ Area\ (ft^2)}$$

Higher EUIs show greater energy use, whereas lower EUIs indicate more energy efficient buildings. With this in mind, it is important to note that certain building types will always use more energy than others. For instance, buildings that house information technology servers will account for greater energy usage than buildings that house regular classrooms and/or office space. Similarly, greater energy usage will also occur in buildings that house multiple laboratories; this type of workroom may consume three to four times more energy than regular classrooms. Further, the type of laboratory and the activities conducted in the space will determine the equipment needed for ventilation, lighting, fume-hoods, etc. These factors, combined with a laboratory's hours of operation, will impact its overall energy consumption.

The Commercial Building Energy Consumption Survey (CBECS) is the national dataset upon which ENERGY STAR scores are modeled. To facilitate the establishment of sound energy reduction goals for the College, it was important to compare the overall EUIs (total energy consumption/total square footage) by building type between the CBECS dataset and the college's dataset to ensure that HED's proprietary software produced EUI datasets that were in alignment with, and considered reasonable relative to, CBECS overall EUIs by building type. Following this comparative analysis, a graphical illustration was developed that shows the CBECS EUI and college EUI for each building on campus, in its existing condition. This data served as baselines and benchmarks to establish college EUI reduction goals for each building on campus. The college EUI reduction goals are shown on the illustrative bar chart on the chapters "Energy Analysis and Strategies for Modernization".



[ENERGY STRATEGIES FOR EXISTING CONDITIONS]

The IEMP quantifies and benchmarks energy consumption and demand based on existing college conditions. Further, the plan addresses future needs by taking into account planned-for systems such as an improved energy management system as well as planned-for building activities including demolition, modernization or new construction. The key to implementing successful energy projects is recognizing and taking advantage of synergies, trade-offs, and all available incentives, rebates and grants. Naturally, this entails setting both short-term and long-term goals and also balancing projects with longer payback periods with projects that have quicker payback periods. Doing so in alignment with the Facilities Master Plan will maximize energy savings, reduce CO2 emissions, and provide a comfortable healthy indoor environment that promotes an optimal learning experience.

In developing and highlighting these varied approaches to energy efficiency, conservation, and generation, the following took place:

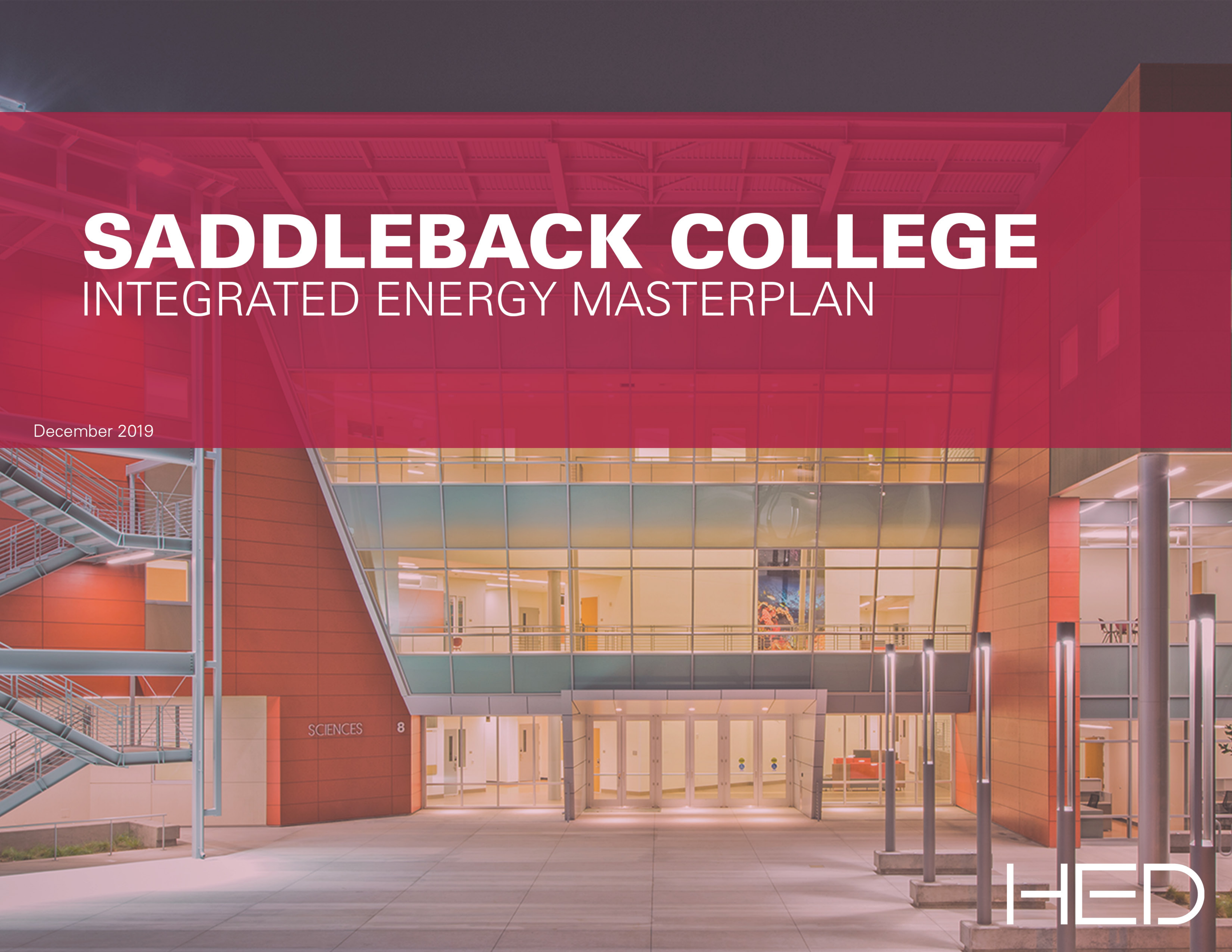
1. Acknowledged the energy savings projects previously completed on the three campuses- refer to the individual college sections
2. Assessed consumption reduction values of multiple improvement strategies
3. Illustrated the estimated reduction in demand, by each major project strategy.
4. Illustrated the importance of an effective Energy Management System
5. Considered demand response to lower consumption at peak times and receive financial incentive for doing so
6. Highlighted consumption reduction and clean power generation through a photovoltaic system
7. Characterized the role of distributed generation
8. Identified synergies between program/project recommendations
9. Ascertained the benefits to students, staff, and faculty of program/project implementation
10. Identified learning opportunities available from the performance of the energy projects

Specific loading order strategies are identified and described in the following sections.

Irvine Valley College Library Building

SADDLEBACK COLLEGE
INTEGRATED ENERGY MASTERPLAN

December 2019



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[EXECUTIVE SUMMARY]

Saddleback College, located in Mission Viejo, was established in 1967 and since then has educated more than 500,000 students. The college has a rich history and diverse student population. The values of the college embrace innovation and sustainability as one of their core principles. Saddleback College is dedicated to reducing its ecological footprint by ensuring its facilities are maintained and operated in a resource efficient and sustainable manner. The college offers various academic courses on the various facets of sustainability and is also committed to teaching by example and showcasing innovation and sustainable technologies through campus projects. It is also imperative to address the financial health of the institution through efficiency and resource management.

Efficient resource management can reduce the college's impact on natural resources such as air, water, energy and other raw materials. The 2011 Facilities Master Plan (the new 2020 Master Plan is currently in development) set goals for upcoming new construction projects and site improvement projects and detailed a 5, 10 and 20 year development plan. These goals were set after considering the existing college goals and objectives. The Integrated Energy Master Plan (IEMP) provides a roadmap for the college to operate its facilities in an efficient, sustainable and cost-effective manner. The IEMP also provides a pathway to achieve the goals set by the Board of Governors of the California Community Colleges in the Resolution on Climate Change and Sustainability Goals and Policy. It provides campus wide and building specific passive and active sustainability measures.

Stakeholder engagement included formal meetings, one-on-one meetings, on site visits for technical briefings to gain relevant data, and answer questions relating to the development and scope of the Integrated Energy Master Plan. The District's objective was to foster discussions with key stakeholders. Stakeholders were integral to the entire process as this is a data driven exercise.

Saddleback College- Sciences Building

ENERGY ANALYSIS AND STRATEGIES FOR MODERNIZATION

[OVERVIEW]

This section examines in detail the existing energy usage and generation as well as the Greenhouse gas (GHG) emissions at Saddleback College. Reduction targets are established relative to the existing Energy Use Intensity (EUI) and to the Commercial Building Energy Consumption Survey (CBECS) benchmarks. Further, this section recommends various energy strategies for implementation at Saddleback College based on climate analysis (See Appendix). The specified strategies were selected from the general menu of strategy options that were described in the Strategies section of this resource guide. The recommendations are aligned with the present state of the campus as well as its future condition. Strategies for two tiers of upgrades were selected to maximize energy savings for the campus while considering the operational logistics of the institution. A range of applicable potential savings for specified strategies are included for reference. The detailed analysis for implementation of solar energy are also provided to reach the goal of net zero energy.

This Section Includes:

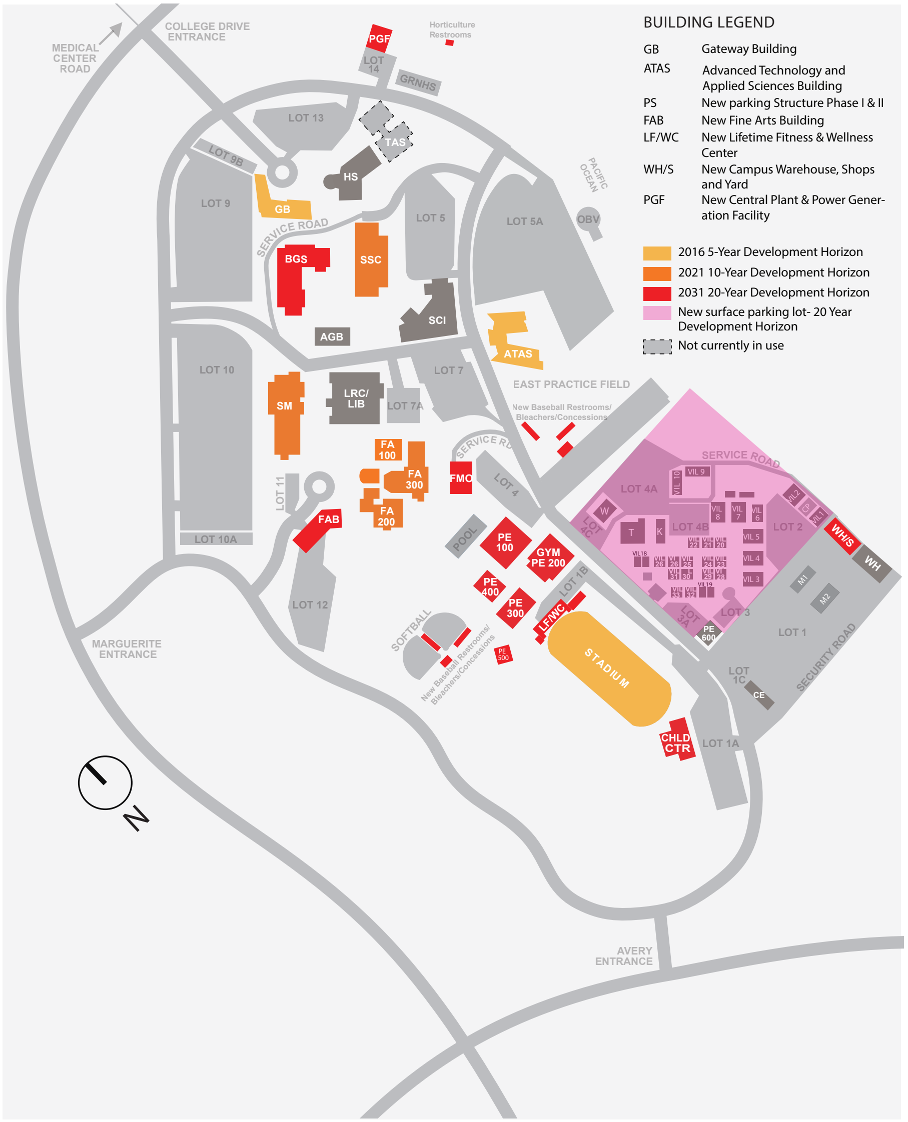
9 Energy Analysis

20 Climate Action Plan

23 Strategies for Modernization

30 Reach to Net Zero Energy

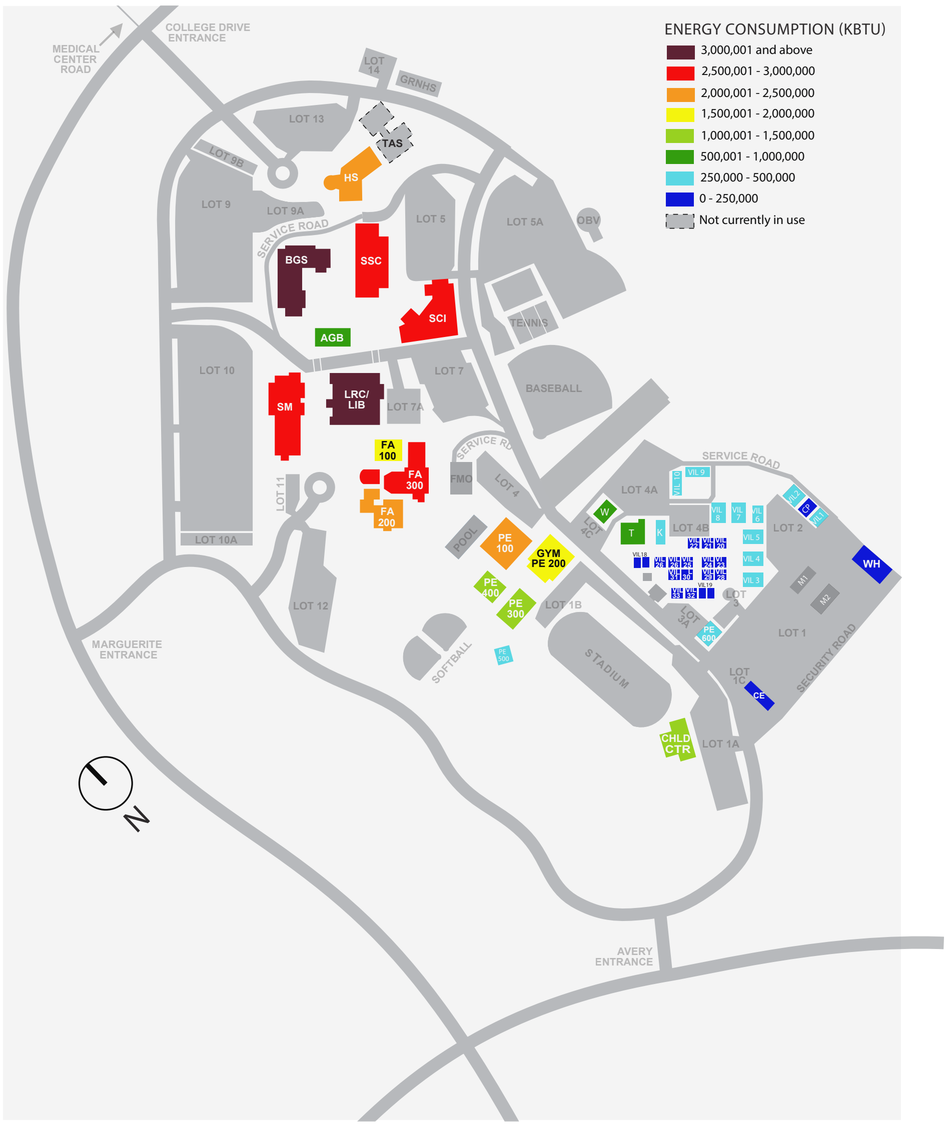
[ENERGY ANALYSIS - FACILITIES MASTER PLAN]



BUILDING KEY

AGB	Administration and Governance Building
BGS	Business/General Studies
CE	Community Education
CHLD CTR	Child Dev. Center
CP	Campus Police
FA	Fine Arts Complex
FMO	Facilities and Maintenance
GRNHS	Horticulture Greenhouse
HS	Health Sciences
LRC	Learning Resouce Center
OBV	Observatory
RO	Representative Offices
PE	Physical Education
SA	Special Annex
SCI	Sciences
SM	Science & Mathematics
SSC	Student Services Center
TAS	Technology and Applied. Sci (Not currently in operation)
VIL	"Village" Classrooms
W	"W" Building (Comm. Arts)
WH	Warehouse

[ENERGY ANALYSIS - EXISTING ENERGY CAMPUS MAP]



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[ENERGY ANALYSIS - EXISTING ENERGY CONSERVATION PROJECTS]

Saddleback College has a long history of implementing energy efficient projects and have been recognized by the community.

- The college was awarded by San Diego Gas & Electric in 1980 and 1991 for their advanced energy efficient technologies.
- The college was nominated to receive the Excellence in Energy Award from the San Diego Business Journal in 2001.

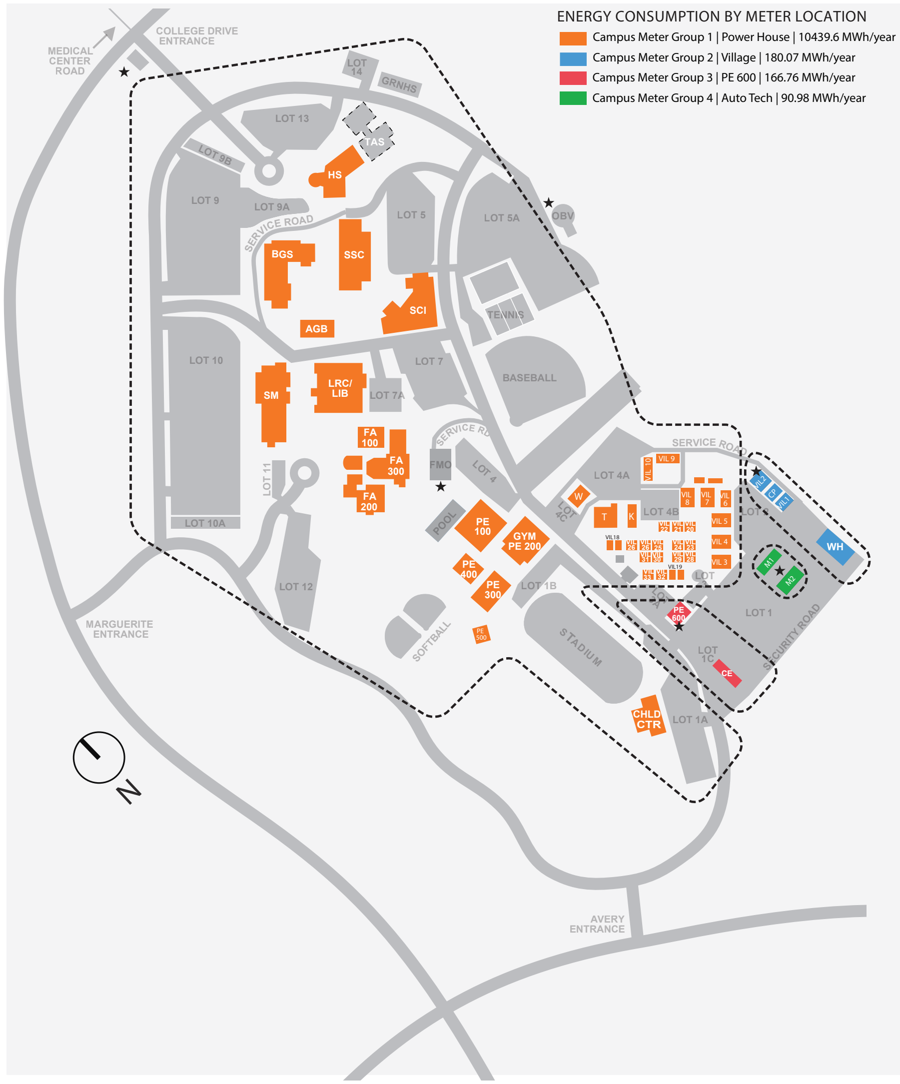
The energy conservation efforts by the college have resulted in energy savings of over 1,000,000 kWh per year. Some of these projects were:

- The installation of a 1.5 MW cogeneration plant that produces over 8,500,000 kWh per year. The heat generated from the plant is used to heat the college's swimming pool and to provide domestic hot water for the buildings. The heat is also converted by the absorption chillers to provide chilled water which is used to air condition the buildings on campus.
- In 2015, the existing central plant and cogeneration facility were upgraded and all the parking lot fixtures were upgraded to LED. This resulted in further reducing the energy consumption by 11%.

Current construction and renovation projects have included various energy conservation efforts such as:

- Sciences Building: Use of high performance windows, LED fixtures, Building Management System, interior and exterior lighting controls and thermostat controlled multiple zones.
- Fine Arts Building HVAC Replacement/Upgrade: Replacement of rooftop HVAC units, improved insulation on roof utility lines, replacement of ducts, displacement ventilation in the performing arts theater, thermostat controlled zones, use of a building management system and a LED system upgrade.

[ENERGY ANALYSIS - ELECTRIC METER GROUPING]



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[ENERGY ANALYSIS - BUILDING CONSUMPTION AND EUI SUMMARY]

Building Information			End Use (kBtu)						Fuel Type (kBtu)		Consumption & EUI	
Building Code	Building	Year	Heating	Water Heating	Cooling	Fans & Pumps	Lights	Equip	Gas	Electricity	Consumption (kBtu)	EUI (kBtu/SF-Year)
T	Transportation	1969	8,352 (0.9%)	48,875 (5.02%)	256,146 (26.03%)	450,350 (46.29%)	114,059 (11.72%)	95,048 (9.8%)	57,227	915,603	972,830	104.8
W	Cinema/TV/ Radio	1976	147,243 (28%)	26,664 (5.07%)	237,752 (45.2%)	0 (0%)	62,224 (11.84%)	51,854 (9.9%)	173,907	351,830	525,737	103.8
FA 100	Fine Arts	1977	54,379 (3.4%)	80,747 (5.1%)	357,857 (22.6%)	744,268 (47.02%)	188,436 (11.91%)	157,030 (9.9%)	135,126	1,447,591	1,582,449	103.2
FA 200	Fine Arts	1977	74,826 (3.5%)	110,401 (5.1%)	588,823 (27.2%)	816,628 (37.75%)	257,639 (11.91%)	314,698 (14.5%)	185,227	1,977,788	2,163,015	103.2
PE 500	PE Classroom	1992	37,986 (9.4%)	63,945 (15.77%)	89,629 (22.1%)	192,258 (47.39%)	17,774 (4.38%)	4,040 (1%)	101,931	303,701	405,574	102.4
K	K Building	1968	8,956 (2.4%)	19,561 (5.15%)	87,668 (23.1%)	180,248 (47.42%)	45,650 (12.01%)	38,042 (10%)	28,517	351,608	380,125	102.3
Village 18-33	Classrooms	2009	193,508 (4.7%)	213,487 (5.15%)	859,013 (20.7%)	1,967,116 (47.44%)	498,206 (12.02%)	415,171 (10%)	406,995	3,739,506	4,146,501	102.3
Village 3-8	Classrooms	2006	73,888 (2.7%)	140,077 (5.17%)	607,424 (22.4%)	1,290,682 (47.6%)	326,891 (12.06%)	272,409 (10%)	213,965	2,497,406	2,711,371	101.9
Village 9	Classrooms	1969	9,713 (2.6%)	19,049 (5.18%)	81,656 (22.2%)	175,526 (47.77%)	44,455 (12.1%)	37,046 (10.1%)	28,762	338,683	367,445	101.6

Building Information			End Use (kBtu)						Fuel Type (kBtu)		Consumption & EUI	
Building Code	Building	Year	Heating	Water Heating	Cooling	Fans & Pumps	Lights	Equip	Gas	Electricity	Consumption (kBtu)	EUI (kBtu/SF-Year)
PE 200	Gymnasium	1976	149,051 (7.6%)	313,923 (15.92%)	460,022 (23.3%)	942,684 (47.77%)	87,256 (4.42%)	19,831 (1%)	462,974	1,509,793	1,972,083	101.4
Village 10	Classrooms	1969	9,430 (2.6%)	19,219 (5.2%)	82,580 (22.4%)	176,000 (47.64%)	44,852 (12.14%)	37,376 (10.1%)	28,649	340,808	369,457	101.2
PE 600	PE Fitness Center	2003	62,106 (29.8%)	58,731 (16.45%)	106,568 (17.4%)	102,981 (28.84%)	16,325 (4.57%)	10,306 (2.9%)	120,837	236,180	357,017	99.0
PE 300	PE Activity	1976	102,048 (9.7%)	173,749 (16.5%)	295,724 (28.1%)	422,684 (40.08%)	48,294 (4.59%)	10,976 (1%)	275,797	777,678	1,052,791	97.8
PE 100	PE Shower Locker	1976	217,135 (9.9%)	370,173 (16.9%)	364,543 (16.6%)	1,112,634 (50.79%)	102,892 (4.7%)	23,385 (1.1%)	587,308	1,603,454	2,190,762	95.5
FA 300	Fine Arts	1977	90,837 (3.4%)	336,458 (12.59%)	605,276 (22.6%)	1,054,325 (39.52%)	318,448 (11.92%)	265,373 (9.9%)	427,295	2,243,422	2,672,392	95.5
AGB	Administration & Governance Building	1981	8,272 (1.2%)	12,877 (1.9%)	248,873 (36.7%)	242,664 (35.78%)	81,944 (9.3%)	102,431 (15.1%)	21,149	675,912	919,370	91.9
PE 400	PE Offices	1976	60,092 (6.3%)	10,543 (1.1%)	127,508 (13.3%)	304,876 (31.69%)	28,225 (2.94%)	428,992 (44.7%)	70,635	889,601	959,360	89.1

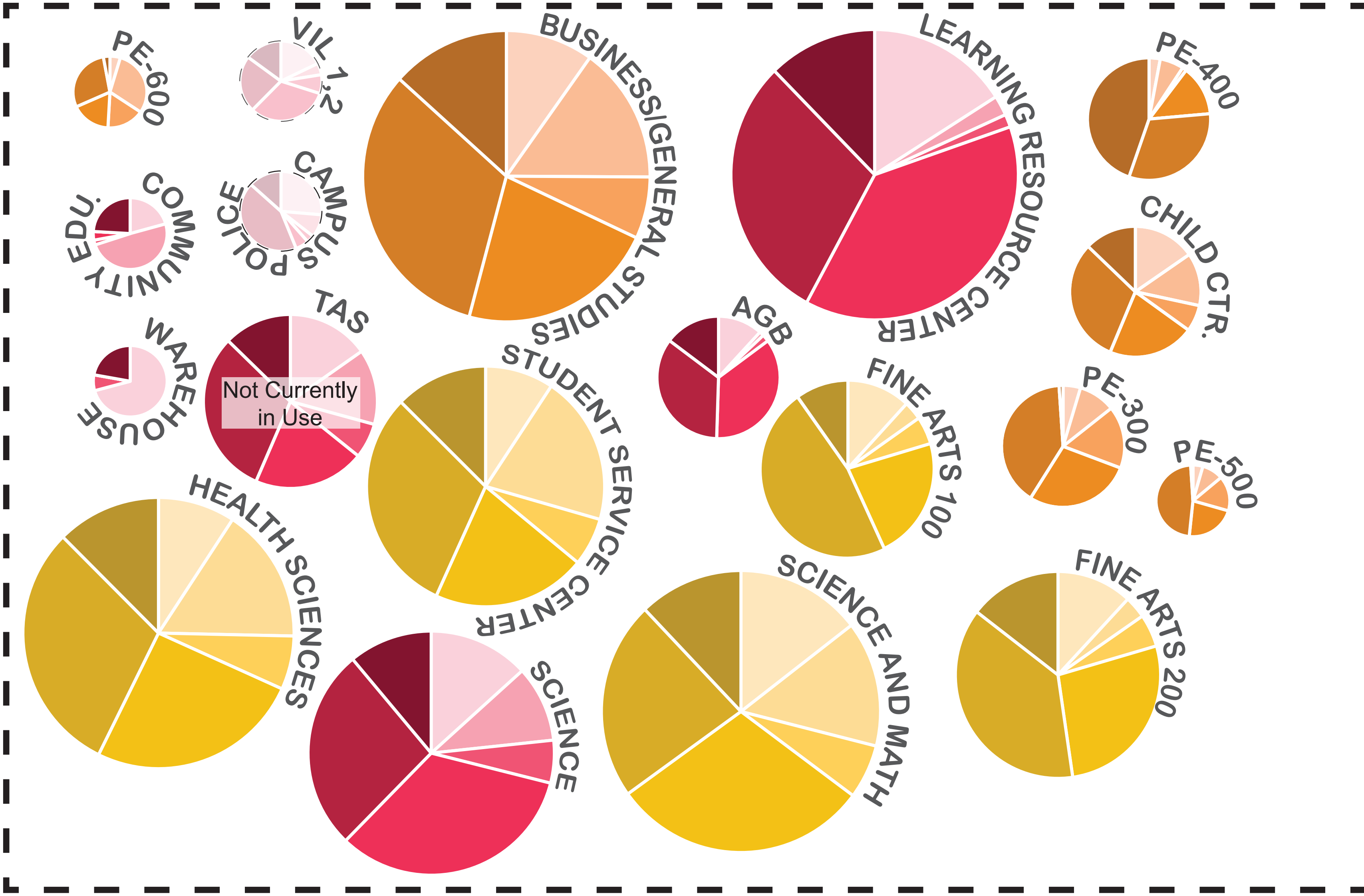
Building Information			End Use (kBtu)						Fuel Type (kBtu)		Consumption & EUI	
Building Code	Building	Year	Heating	Water Heating	Cooling	Fans & Pumps	Lights	Equip	Gas	Electricity	Consumption (kBtu)	EUI (kBtu/SF-Year)
SM	Science & Mathematics	1974	421,621 (14.4%)	181,918 (6.22%)	1,199,341 (29.9%)	937,018 (22.84%)	501,811 (14.52%)	386,009 (12.1%)	114,977	3,024,179	2,923,023	84.6
Child Center	Child Development Center	1991	151,943 (13.1%)	76,507 (6.58%)	247,669 (21.3%)	360,485 (30.94%)	178,542 (15.35%)	148,785 (12.8%)	228,450	935,481	1,163,446	84.2
LRC/LIB	Learning Resource Center	1973	69,965 (2.2%)	45,012 (1.43%)	1,199,341 (38.2%)	937,018 (29.85%)	501,811 (15.99%)	386,009 (12.3%)	114,977	3,024,179	3,139,156	83.3
Campus Police	Campus Police	1980	23,223 (9.3%)	7,407 (2.98%)	13,043 (5.2%)	106,466 (42.84%)	65,590 (26.39%)	32,794 (13.2%)	30,630	217,893	248,523	82.8
HS	Health Sciences	2004	314,666 (16.1%)	124,881 (6.41%)	479,649 (25.5%)	607,525 (30.25%)	179,341 (9.2%)	242,860 (12.5%)	439,547	1,509,375	1,948,921	82.2
BGS	Business/ General Studies	1986	488,604 (15.2%)	220,763 (6.87%)	713,632 (22.2%)	1,342,173 (32.45%)	317,040 (9.87%)	429,322 (13.4%)	709,367	2,802,167	3,511,534	76.6
SSC	Student Services Center	1990	483,232 (20.1%)	155,623 (6.48%)	501,893 (20.9%)	734,653 (30.59%)	223,491 (9.31%)	302,645 (12.6%)	638,855	1,762,682	2,401,536	69.3
CE	Community Education	1983	41,240 (49.3%)	1,808 (2.16%)	3,249 (3.9%)	0 (%)	17,265 (20.63%)	20,142 (24.1%)	43,048	40,656	83,706	66.6
VIL 1, 2	Classrooms	1980	17,845 (4.7%)	29,104 (7.61%)	123,285 (32.2%)	87,896 (22.97%)	67,921 (17.75%)	56,600 (14.8%)	46,949	335,702	382,651	52.3

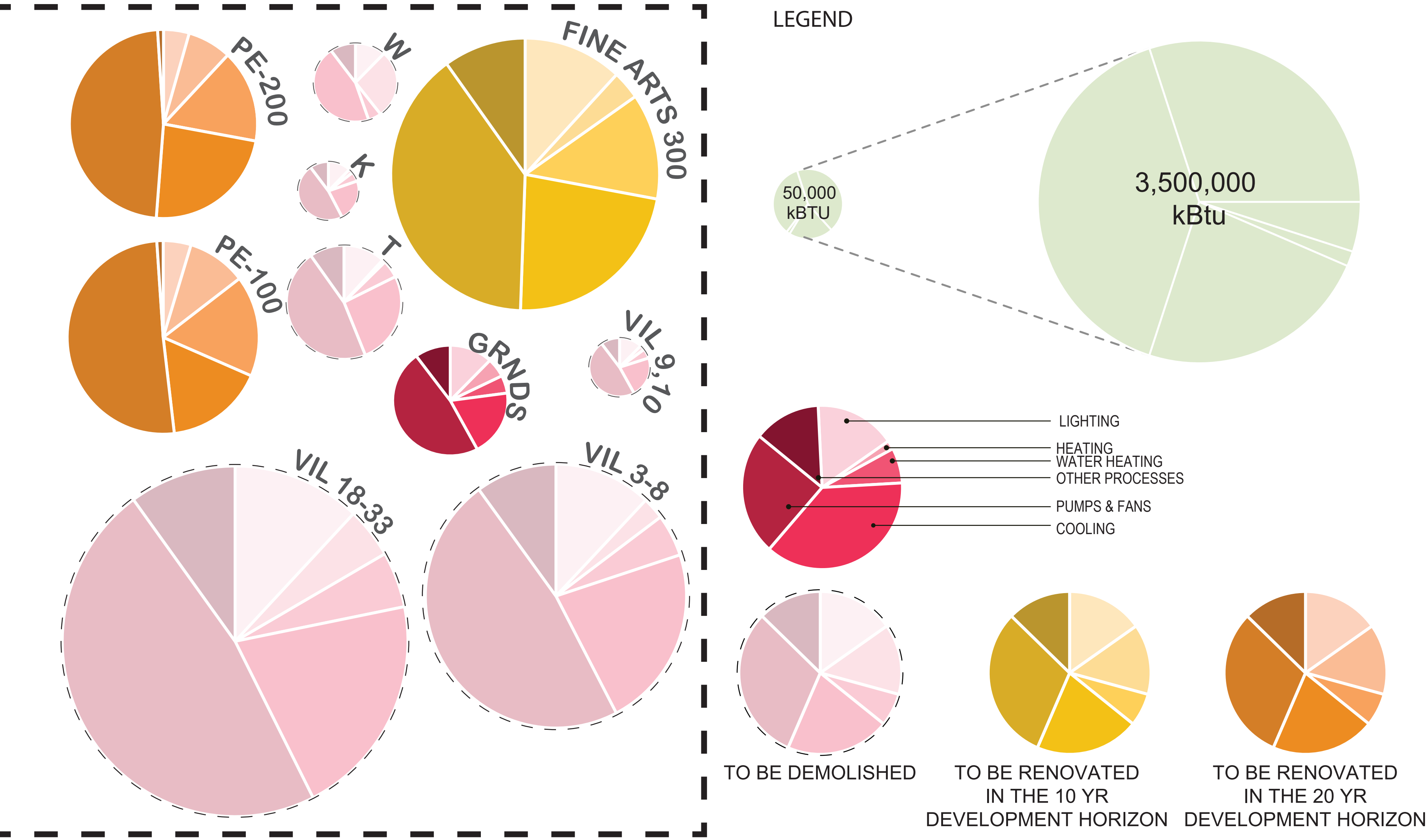
[ENERGY ANALYSIS - ENERGY CONSUMPTION BY BUILDING]

This graphic provides a comparative overview of the energy consumption of all existing buildings at Saddleback College. Each building is represented by a pie chart. The color/ dashed line indicates if the building is scheduled for demolition or planned for future renovation/ expansion.

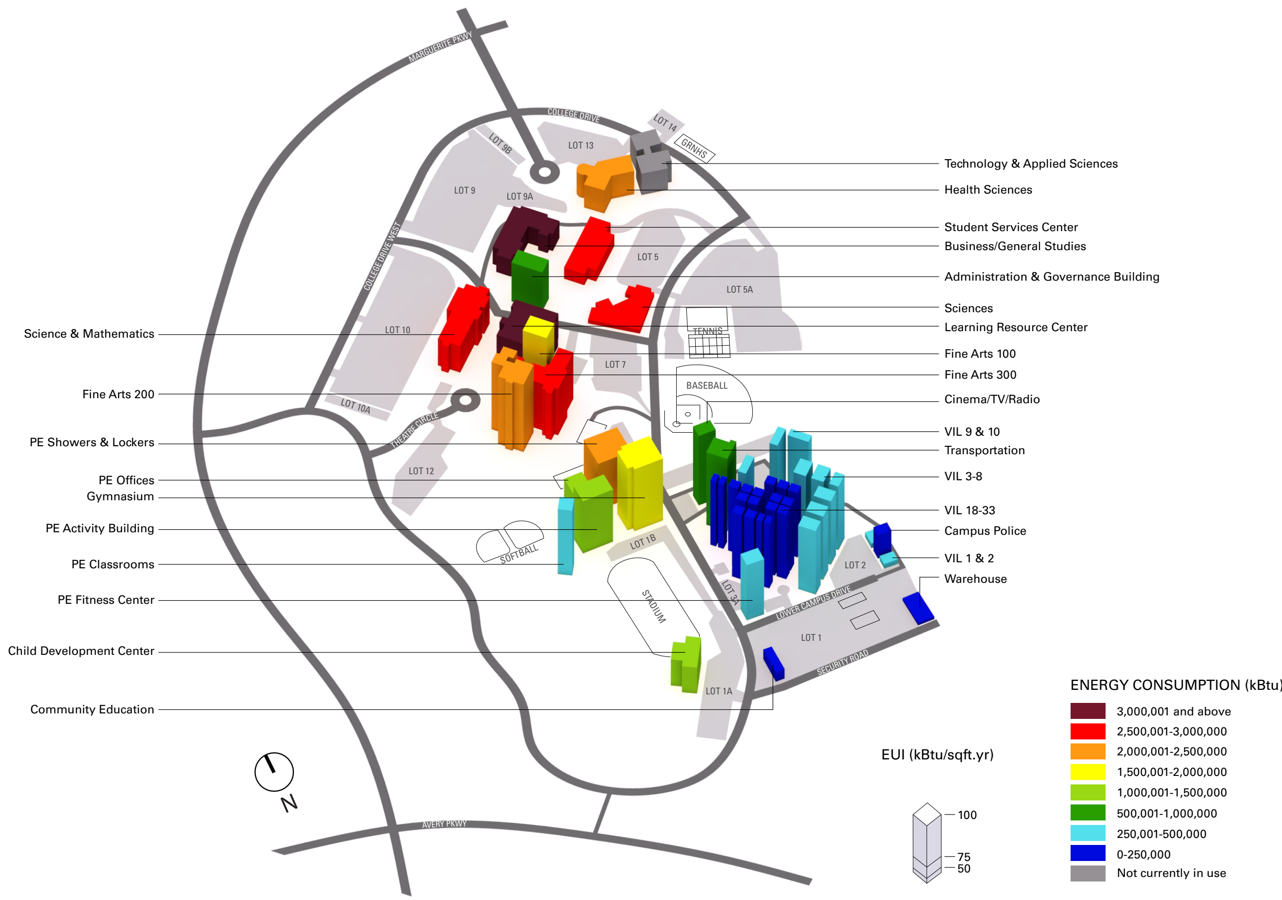
The size of each pie chart represents each building's annual energy consumption. (The larger the pie, the higher the overall energy consumption). Each pie chart is divided into the percentage of energy consumed by each major building system (power, lighting, heating, cooling, process energy, and hot water).

See the Legend on the opposite page for additional information.



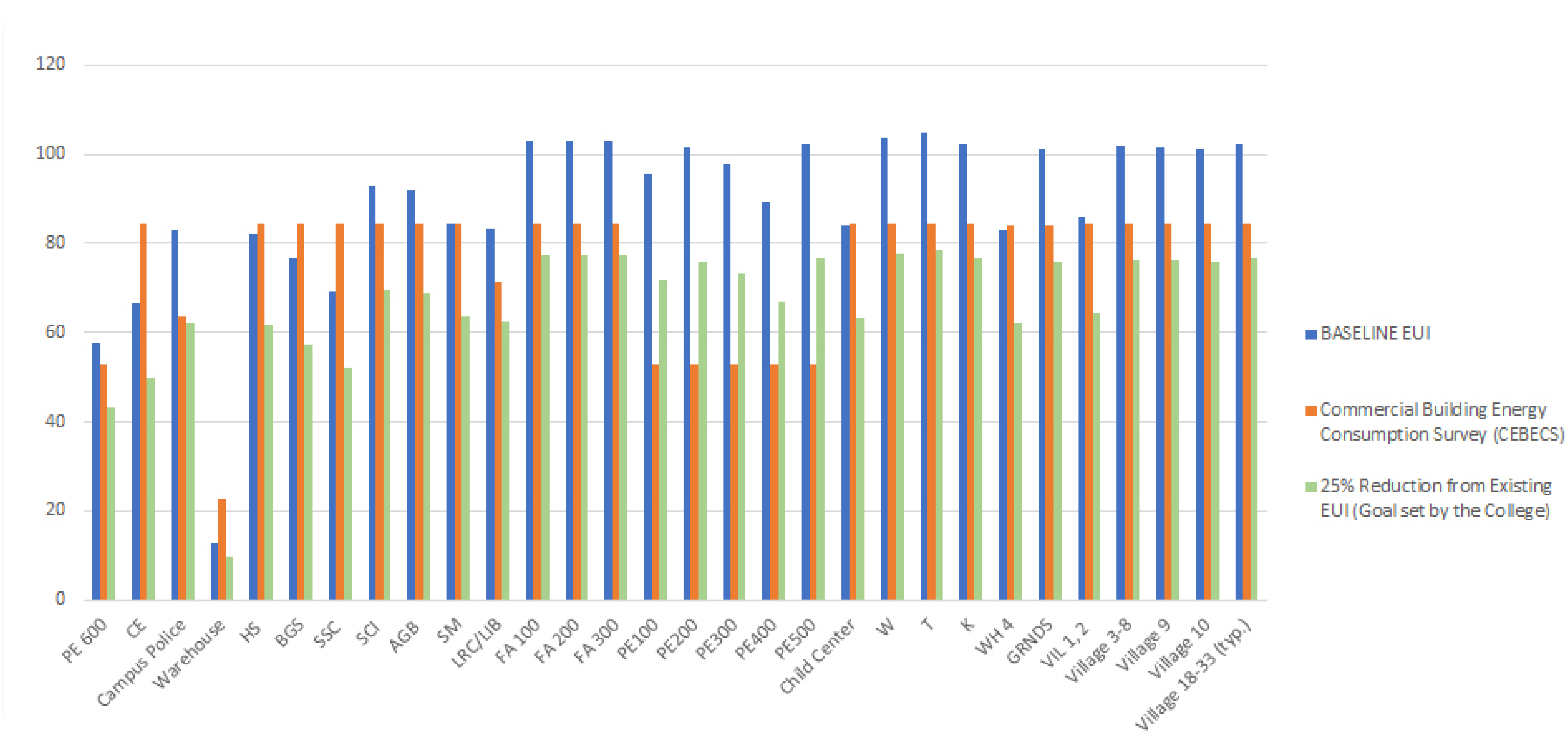

PE-200
W
FINE ARTS 300
K
PE-100
T
GRNDS
VIL 9,10
VIL 18-33
VIL 3-8
LEGEND
50,000
kBTU
3,500,000
kBtu
LIGHTING
HEATING
WATER HEATING
OTHER PROCESSES
PUMPS & FANS
COOLING
TO BE DEMOLISHED
TO BE RENOVATED
IN THE 10 YR
DEVELOPMENT HORIZON
TO BE RENOVATED
IN THE 20 YR
DEVELOPMENT HORIZON

[ENERGY ANALYSIS - EXISTING CAMPUS ENERGY USE INTENSITY]



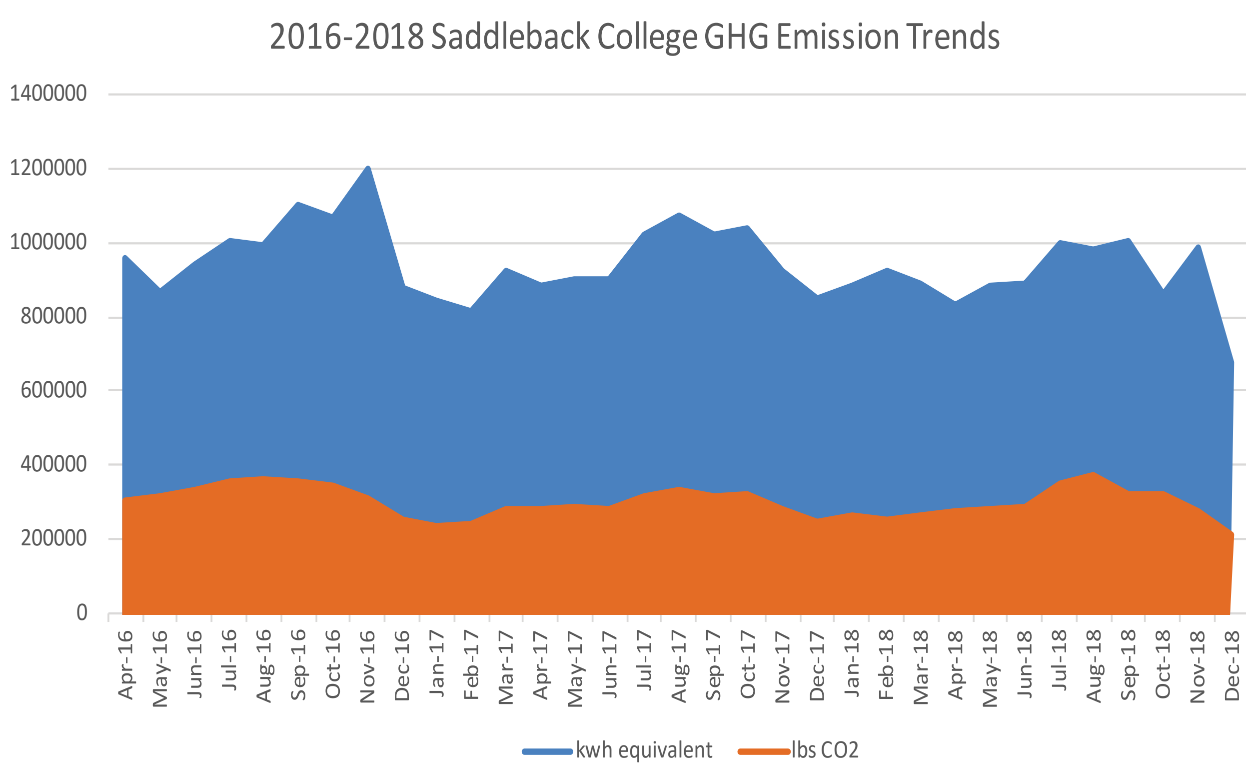
Note: This image shows two distinctive elements for each building. The first uses the color scale to show the actual energy consumption of the building per year (in kBtu). The second uses the height of the buildings to depict the Energy Use Intensity. Since buildings with larger area naturally consume more energy, EUI values provide a method of normalizing the consumption by dividing the energy consumption per year by the area of the building.

[ENERGY ANALYSIS - EUI COMPARISON OF ALL CAMPUS BUILDINGS]



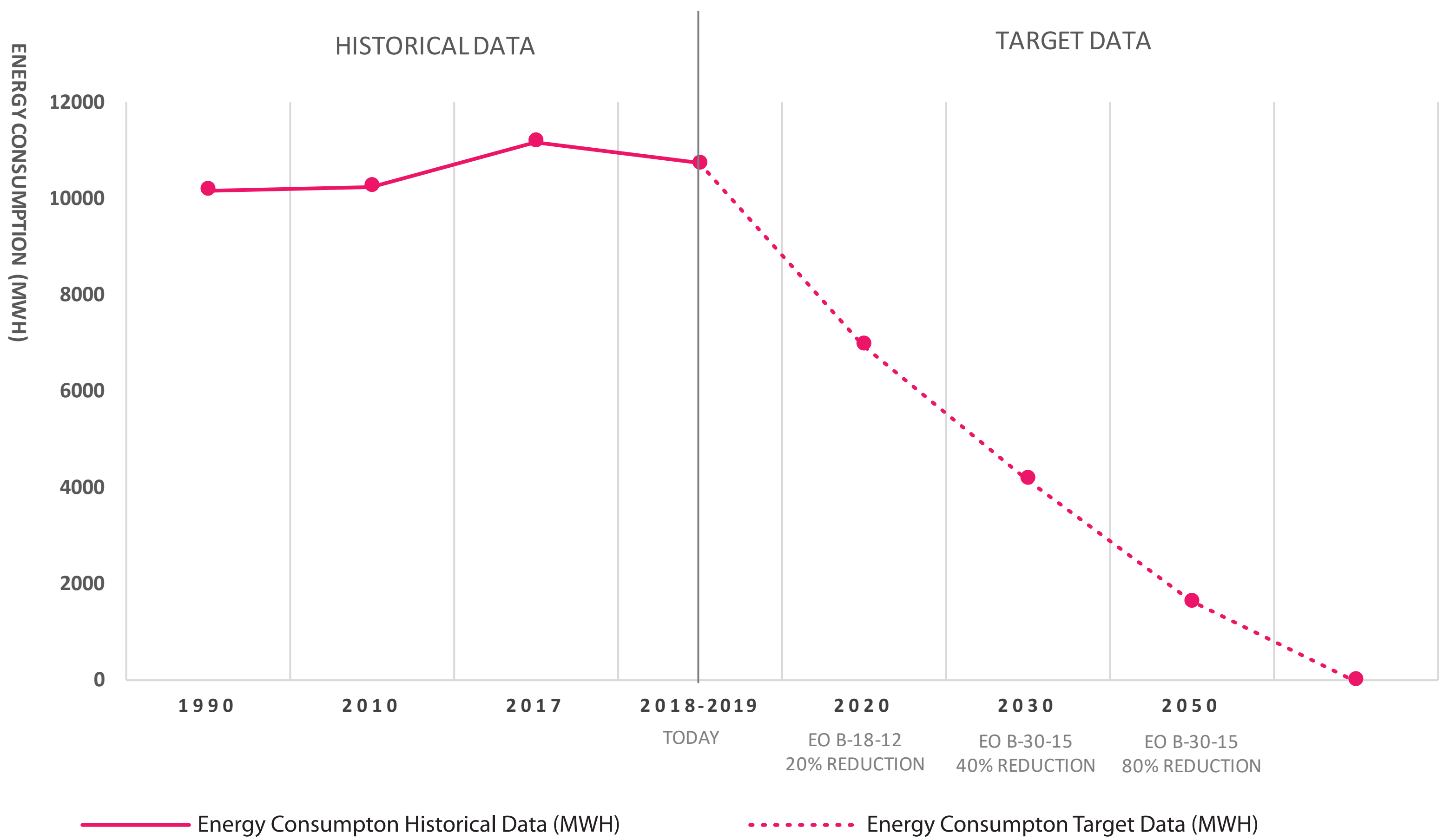
The Commercial Buildings Energy Consumption Survey (CBECS) is a sample survey that collects energy usage information from the existing U.S building stock. The survey provides the average EUI of similar buildings located in the same climate zone and therefore can be used for benchmarking. Currently, approximately 30% of the college's buildings are more efficient than the CBECS benchmark. Should the college achieve their 25% reduction in energy goal, over 80% of the buildings will be more efficient than the CBECS benchmark.

[CLIMATE ACTION PLAN- HISTORICAL MONTHLY GREENHOUSE GAS EMISSION TRENDS]

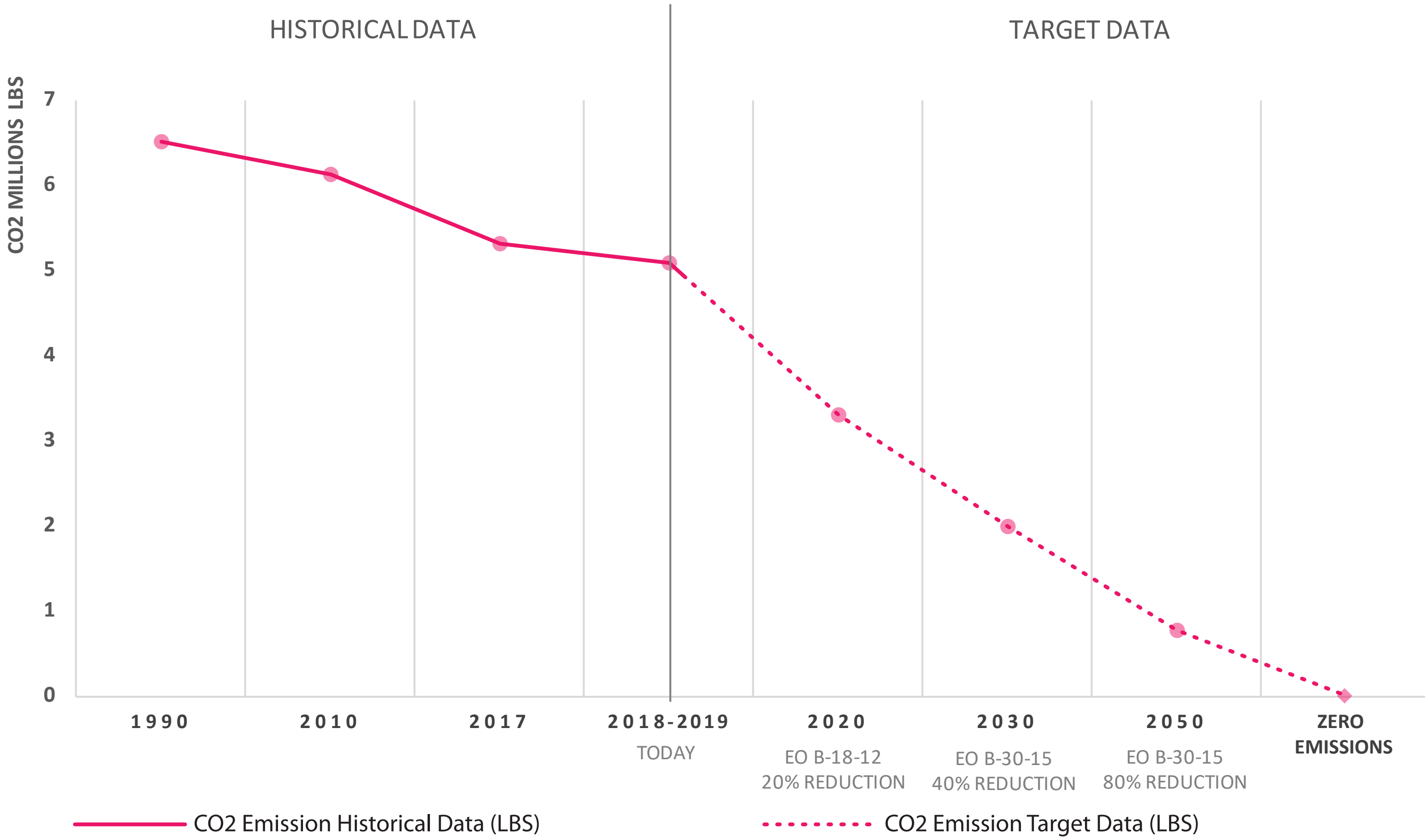


This figure depicts the monthly trend in GHG emissions levels between April 2016 and December 2018 at Saddleback College based on monthly utility consumption. There is a wide variation in GHG emissions from month-to-month. The more in-depth study was conducted to help better understand building-by-building energy consumption. There is a strong correlation between energy use reduction measures and GHG reductions. The goals and strategies outlined in the Plan will support the development of further measures that can be taken and projects that can be implemented to continue the college's effort towards reducing GHG emissions and the eventual goal of carbon neutrality in 40 years.

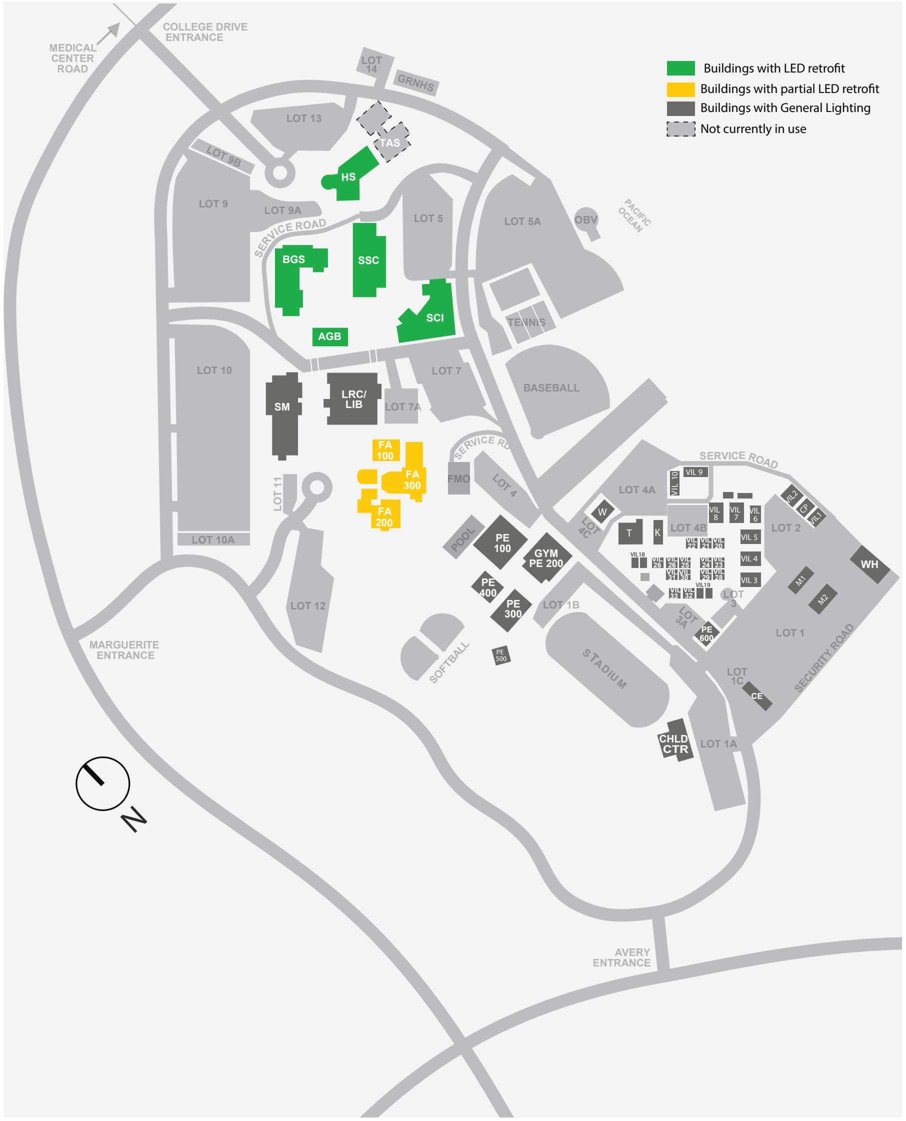
RECORDED AND PROJECTED DATA FOR ENERGY CONSUMPTION



RECORDED AND PROJECTED DATA FOR CO2 EMISSION

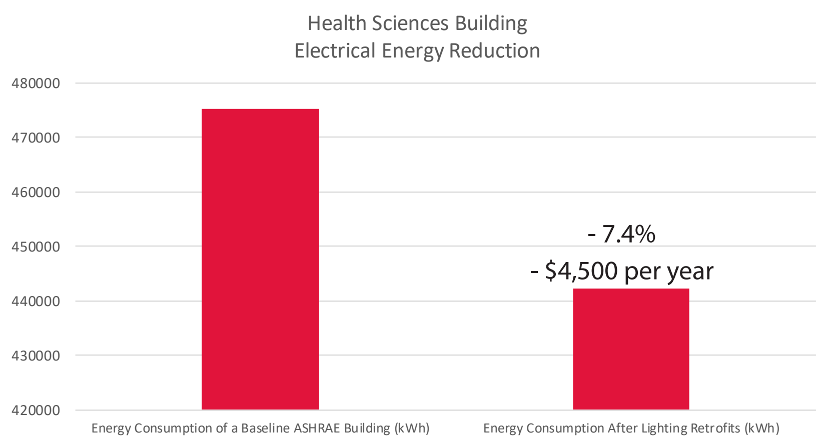


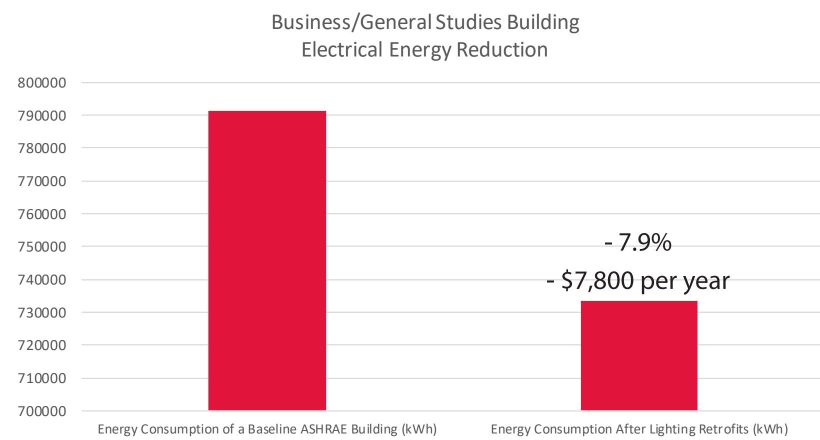
[STRATEGIES FOR MODERNIZATION - LIGHTING RETROFITS]



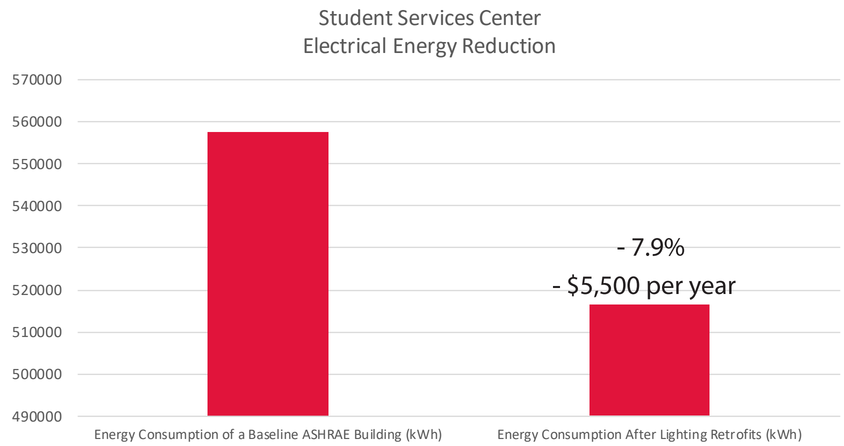
Note: The college has replaced all site lighting with LED fixtures as well. This has resulted in significant savings to the college.

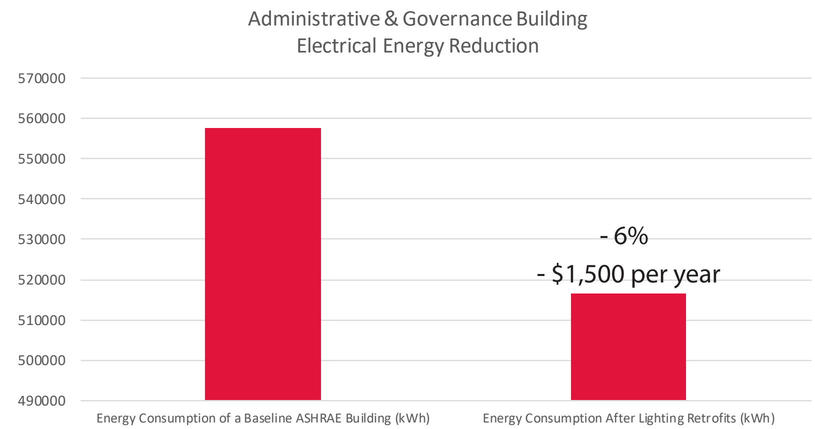
[STRATEGIES FOR MODERNIZATION - COMPLETED LED LIGHTING RETROFIT PROJECTS]



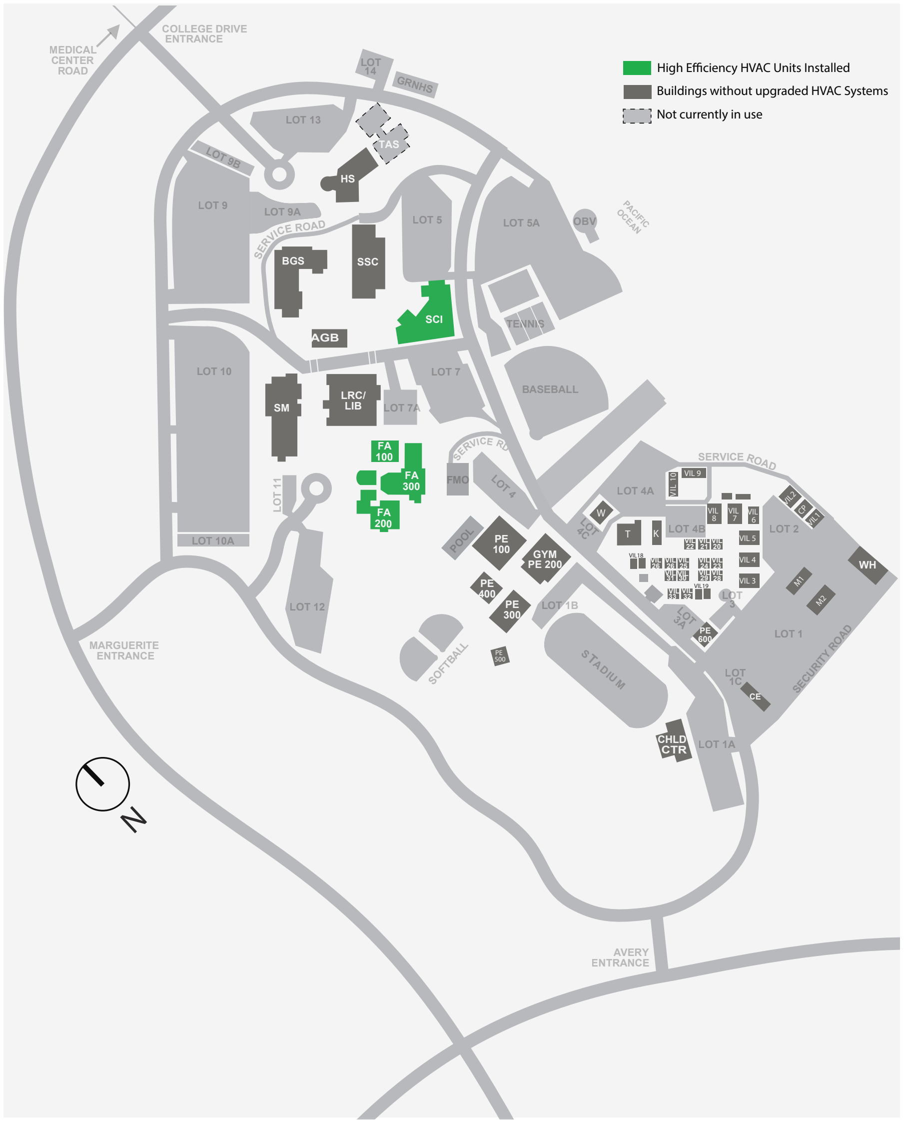


[STRATEGIES FOR MODERNIZATION - COMPLETED LED LIGHTING RETROFIT PROJECTS]

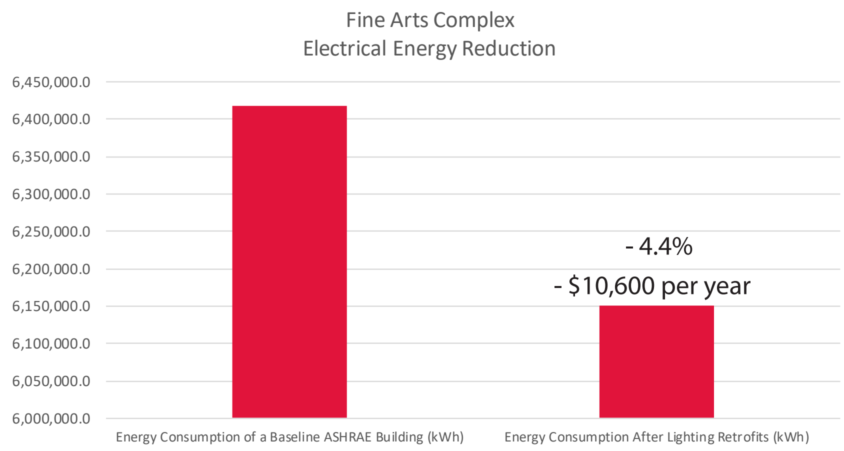


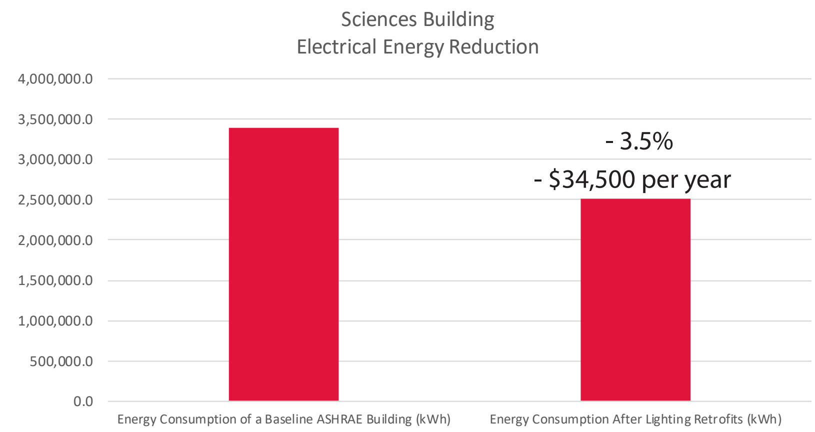


[STRATEGIES FOR MODERNIZATION - HIGH EFFICIENCY HVAC PROJECTS]



[STRATEGIES FOR MODERNIZATION - HIGH EFFICIENCY HVAC PROJECTS]



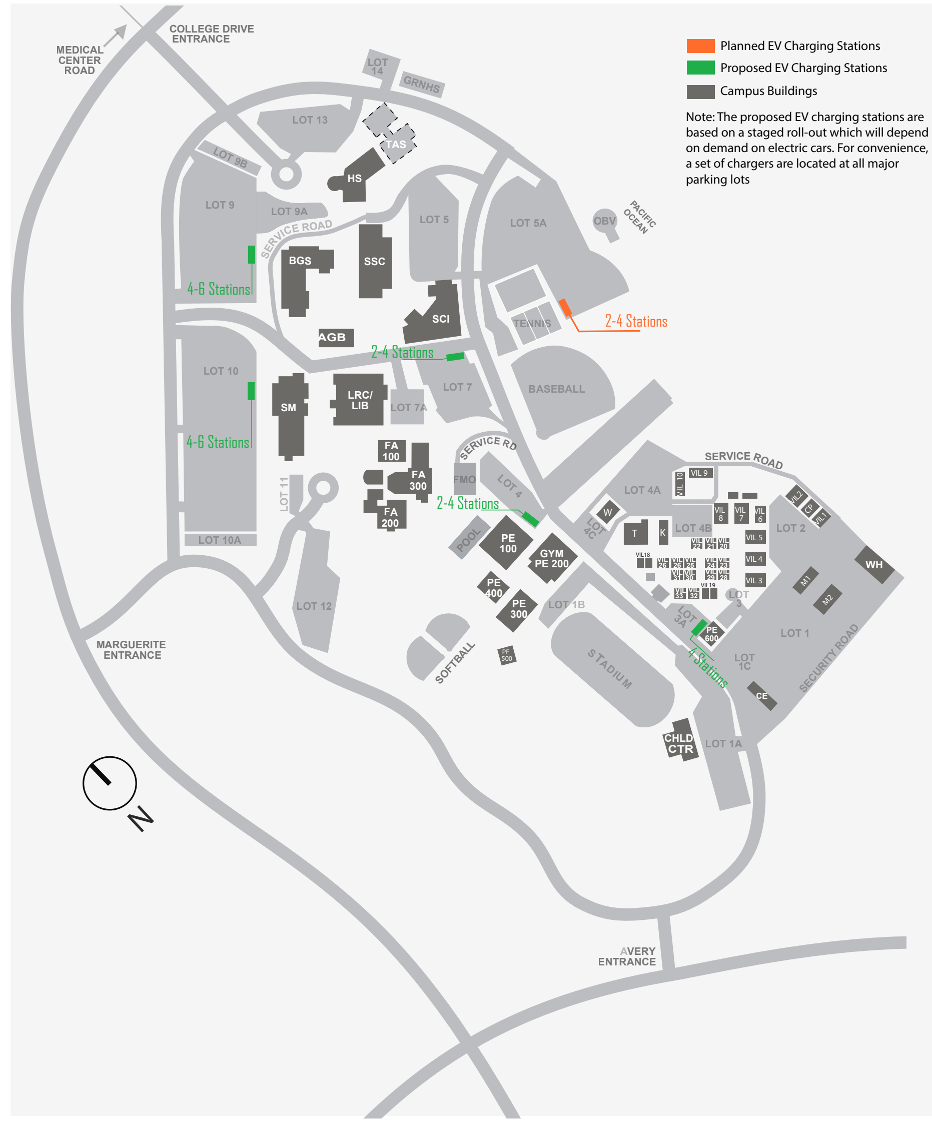


[STRATEGIES FOR MODERNIZATION - BUILDING MANAGEMENT SYSTEM]

The college has a campus-wide Building Management System (BMS). The graphic shows which buildings are connected to the central BMS and those that are not. However, the campus BMS system is undergoing a major upgrade to another system that has an "open" protocol. The benefits of open protocol BMS systems include:

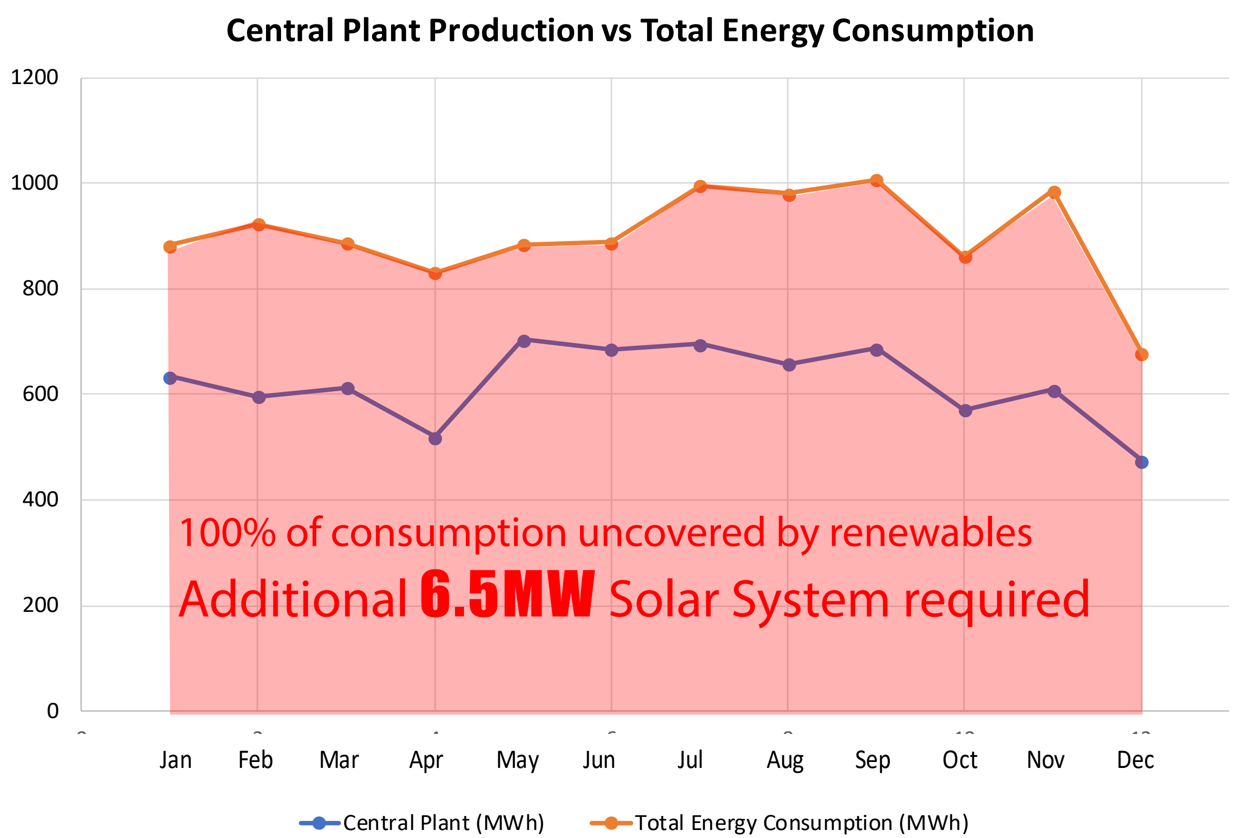
- Low cost of ownership- open protocol means that the owner is not locked into one priority system which requires components and software from only one company for the entire life of the system. This can be very expensive for the owner as there is no choice in both hardware and software and is a monopoly.
- Sensors and equipment can be obtained from a wide selection of manufacturers that specialize in any one component of a BMS. For example, some manufacturers solely focus on actuators while others focus on lighting management systems. Therefore, the owner has the most innovative and energy efficient components for their system.
- Staff require training for only one software and in addition, it makes it easier to hire staff that have had the same training.
- It makes preventative maintenance easy and facility staff can program the software to their exact needs.
- Deploying the same computer graphics for each building across the campus makes it easier for maintenance and can be easily modified without the need for expensive proprietary software modifications.
- It is easy to revise the software if functionality of the space is expanded or changed.

[STRATEGIES FOR MODERNIZATION - EV CHARGING STATION]



Electric charging stations are required by Title 24 Energy Code in all new parking lots. An electrical rate determined by the college will provide constant revenue. Depending on the rate charged to the consumer, the payback is usually less than 2 years and it most importantly encourages the use of clean vehicles, thereby reducing the carbon footprint and providing a positive image of an eco-friendly college. The 4 planned EV stations and the infrastructure and conduits for the 24 proposed EV stations will be installed within the next year.

[REACH TO ZERO NET ENERGY - SOLAR ENERGY DEMAND]



Saddleback College does not have any existing solar systems. The cogeneration plant produces 7,448.35 MWh of electricity, providing 68.9% of the total electricity consumption per year. The central plant system still generates carbon emissions because its primary fuel source is gas. Therefore, to meet the goal of net zero energy*, it requires additional 10,802.39 MWh of electricity to be produced by 6.5MW solar systems in the future planning.

* Zero Net Energy is an energy efficient campus where the annual renewable energy generated on the campus is equal or more than the energy consumed

[REACH TO NET ZERO ENERGY - LIFE CYCLE ANALYSIS]

System Size: 6500 kW
Annual Generation: 10,784,059 kWh/year
Required PV Area: 6500 kW * 100 sqft/kW = 650,000 sf

Initial PV Cost: $ 3180 /kW x 6500 kW = $ 20,670,000
Annual O & M: $ 19 /kW-yr x 6500 kW = $ 123,500
Annual Payback: 10,784,059 kWh/yr x $ 0.12 /kWh = $ 1,294,086

ROI (excluding rebate):
$ 20,670,000 / ($ 1,294,087 - $ 123,500) = 17.6 yrs

RESULTS

10,784,059 kWh/Year*

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	4.43	683,362	82,003
February	5.11	717,828	86,139
March	6.20	940,210	112,825
April	6.72	994,699	119,364
May	7.03	1,068,302	128,196
June	6.96	1,003,212	120,385
July	7.42	1,106,074	132,729
August	7.36	1,079,103	129,492
September	6.81	976,847	117,222
October	5.78	866,624	103,995
November	4.80	705,351	84,642
December	4.09	642,447	77,094
Annual	6.06	10,784,059	$ 1,294,086

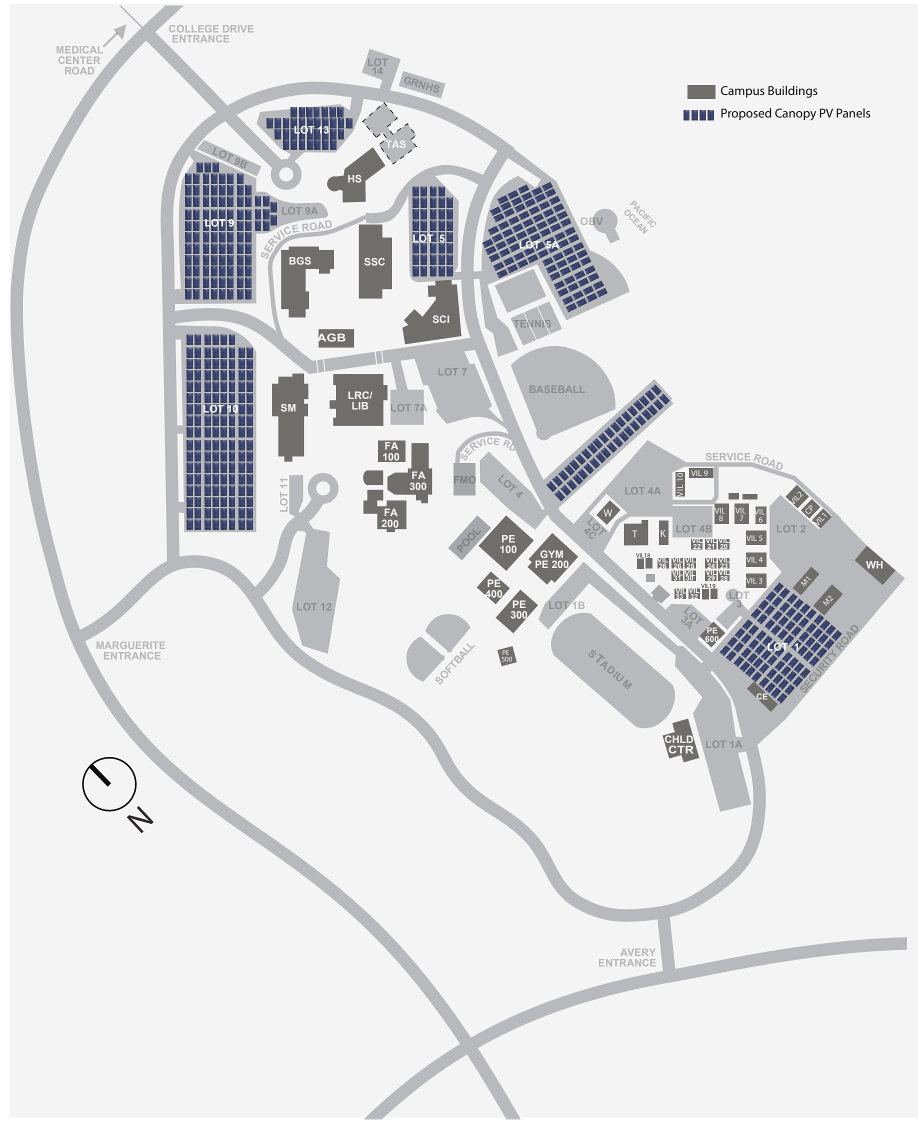
Note: Typically PV panels have a warranty of 25 years and the inverter of 10 years. The panels decrease in efficiency output approximately 1% year per year. Therefore the only regular maintenance required depends on the location of the PV panels, typically PV panels should be hosed down twice a year to remove the dust. The District may finance the PV system from the District Capital Outlay Fund. This would enable the college to gain all the savings from the generation of power.

[REACH TO ZERO NET ENERGY - BENEFITS OF PV SYSTEMS]

Benefits of adding PV panels on site include:

- Renewable Energy Source: Southern California experiences clear skies for most of the year. Solar energy is the most easily accessible source of renewable energy and can be used to offset most of the electrical energy consumption of the campus
- Reduced Electricity Costs: The energy savings translate to significant cost savings and with enough PV panels to enable a net-zero campus, the initial costs will be paid back within approximately 18 years.
- Demand Response: Conventional power plants experience peak demand during approximately 11am to 4pm and from 8pm to 11pm. To manage this demand the price of electricity increases during peak times. Peak solar energy, on the other hand, peak production coincides with the time of peak demand and can further reduce electricity costs. Further, the energy produced by the PV panels can be stored in batteries to further manage demand.
- Resilience: PV panels reduce the dependence on the power grid and increase the security of the campus power grid against fires, overloads and other natural disasters.
- Carbon footprint: Solar PV helps in reducing and/or eliminating the operational carbon footprint.

[REACH TO NET ZERO ENERGY - PROPOSED FUTURE PV LOCATIONS]



PV panels should be part a of car port structure. This provides shading for the cars and can easily be phased as a stand alone project. Placing PV panels on existing roofs is not recommended because it will effect the building structure and will trigger a DSA structural upgrade.

STRATEGIES

This section provides a broad framework for implementing energy solutions that deliver maximum savings and operating cost efficiencies, in alignment with institutional needs and California's loading order. Highlighted are varied technologies that address energy efficiency, energy conservation, renewable energy and renewable energy production across all campus buildings and infrastructure. Additionally, this section presents a holistic approach to energy planning by emphasizing the importance of Energy Design Guidelines for new construction as well as the value of stakeholder engagement as a driving force for positive outcomes.

This Section Includes:

37 Climate Analysis

44 Campus Level Energy Efficiency

47 Building Level Energy Recommendations

49 Lighting Hardware and Controls

50 Demand Response

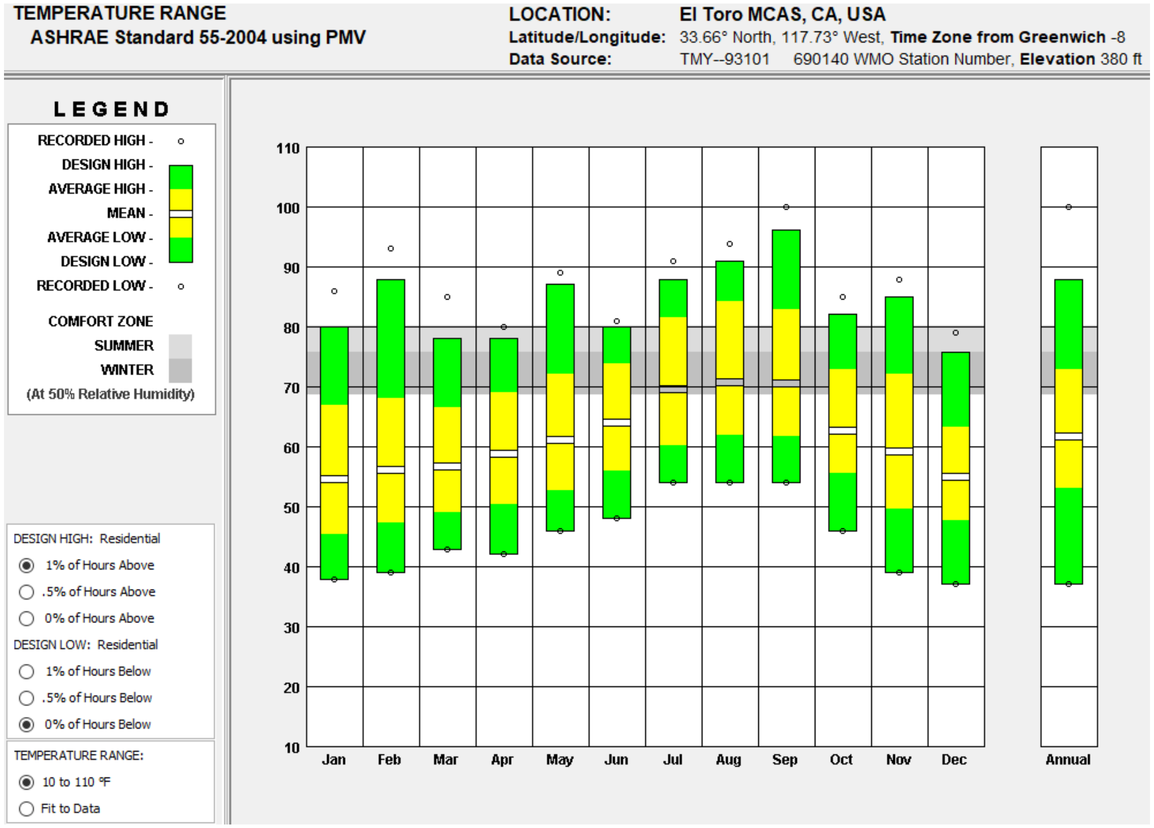
52 Building Management Systems

53 Cogeneration Plant

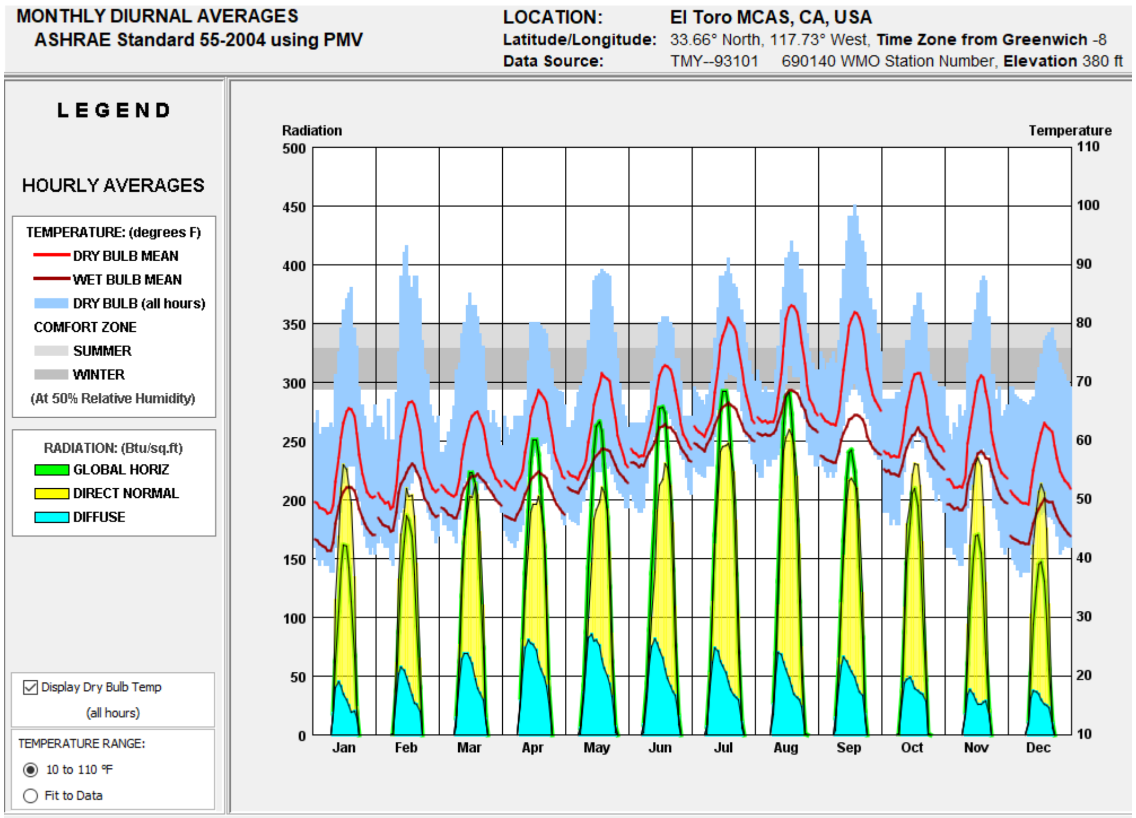
54 Battery Energy Storage

55 Water Conservation Efforts

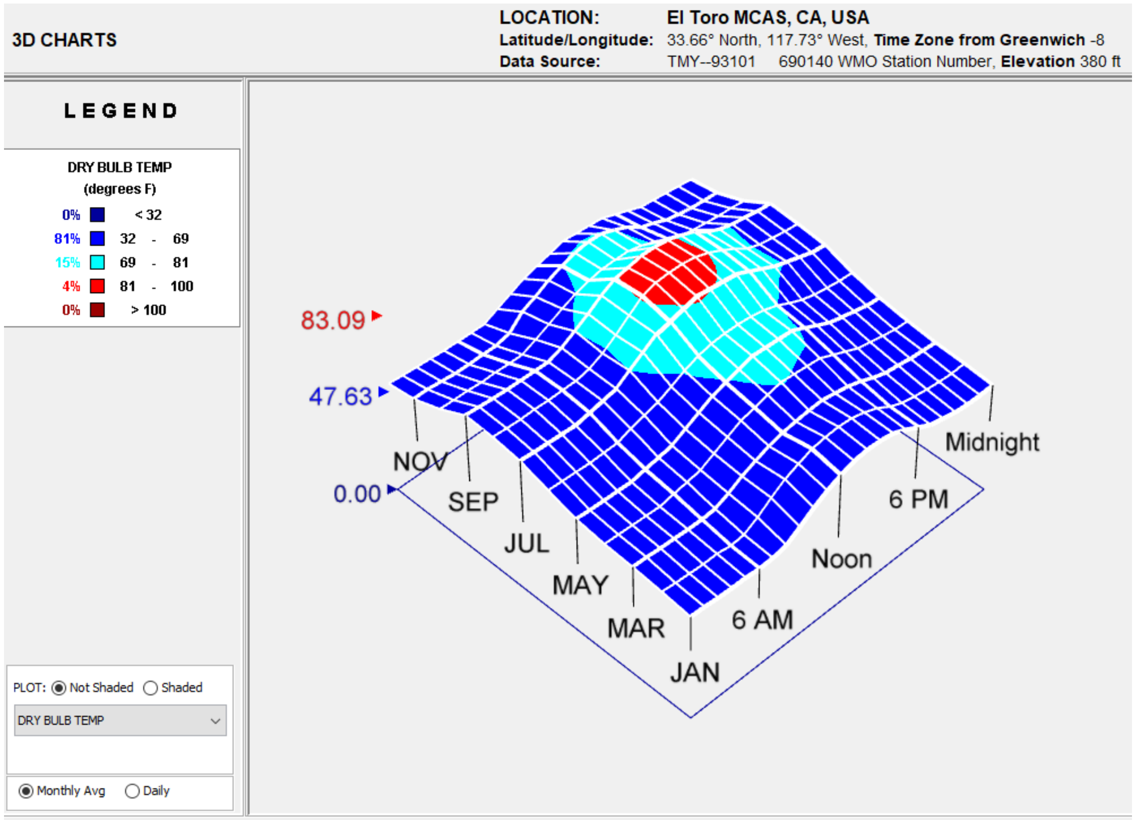
[CLIMATE ANALYSIS]



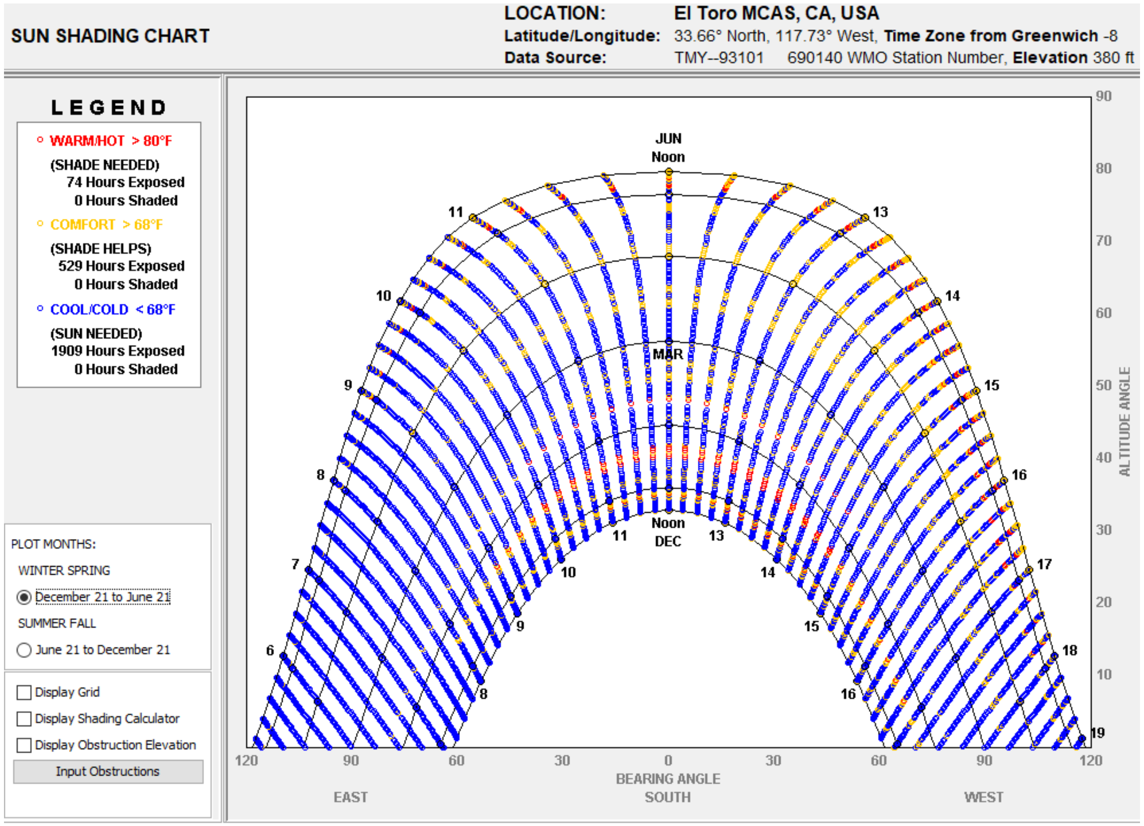
A climate analysis was performed to assess if the climate can be used to reduce the energy needed to cool and heat the buildings. The graph above shows the outdoor temperature against month of the year. The peak temperature can reach as high as 100F when mechanical cooling will be required. During winter the temperature can fall as low as 38F as denoted by the small circle when heating will be required. These are extreme conditions however the average temperature is shown by the white bars with green shade depicting upper and lower limits. Most of the time of the year the climate is moderate so that outside air can be used to cool the building (i.e. economizer mode). There is also a need for heating however this can may be achieved by heat provided by internal gains such as lighting, people etc.



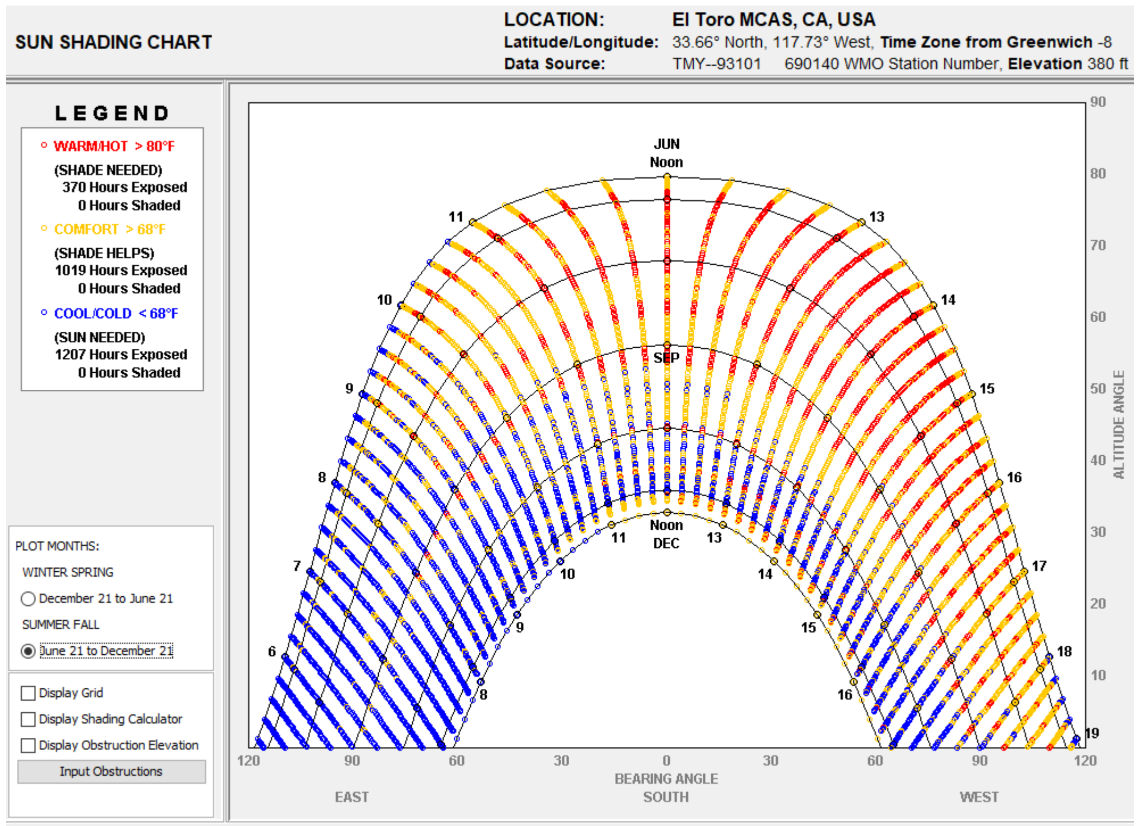
This graph shows the temperature range experienced during the month, this range can be used to justify thermal mass strategies. Thermal mass structures are those that include concrete, masonry, or other thermal mass assemblies which can store solar energy during the day and re-radiate it at night. This averages out the diurnal extremes. The building is cooled during the night when the temperature drops and the cold structure slows the heat from entering the building during the day, thus reducing the energy required to cool the building.



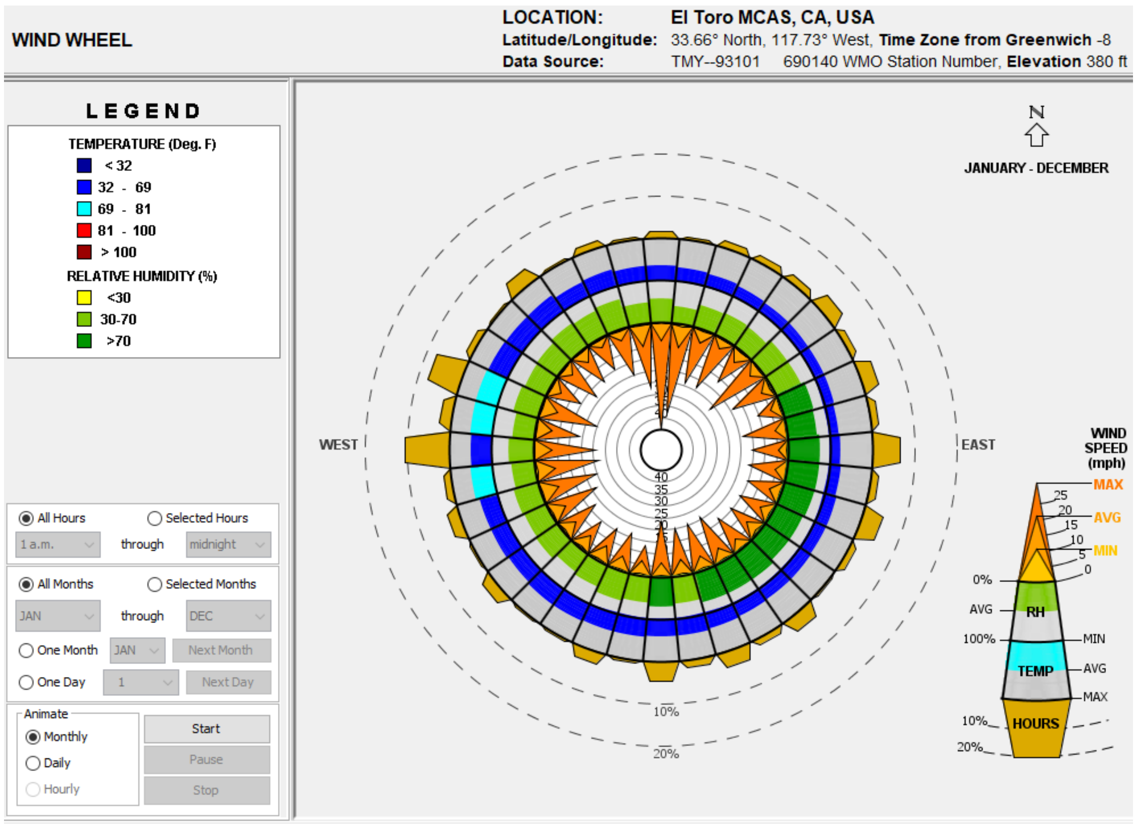
The image above provides a 3-D representation of outside temperature at monthly intervals and time of day. The red circle shows that the temperature can reach between 91F- 100F for only 4% of the time in the year in September during noon and 4:00pm period. This gives an indication on the cooling and heating requirements for the buildings.



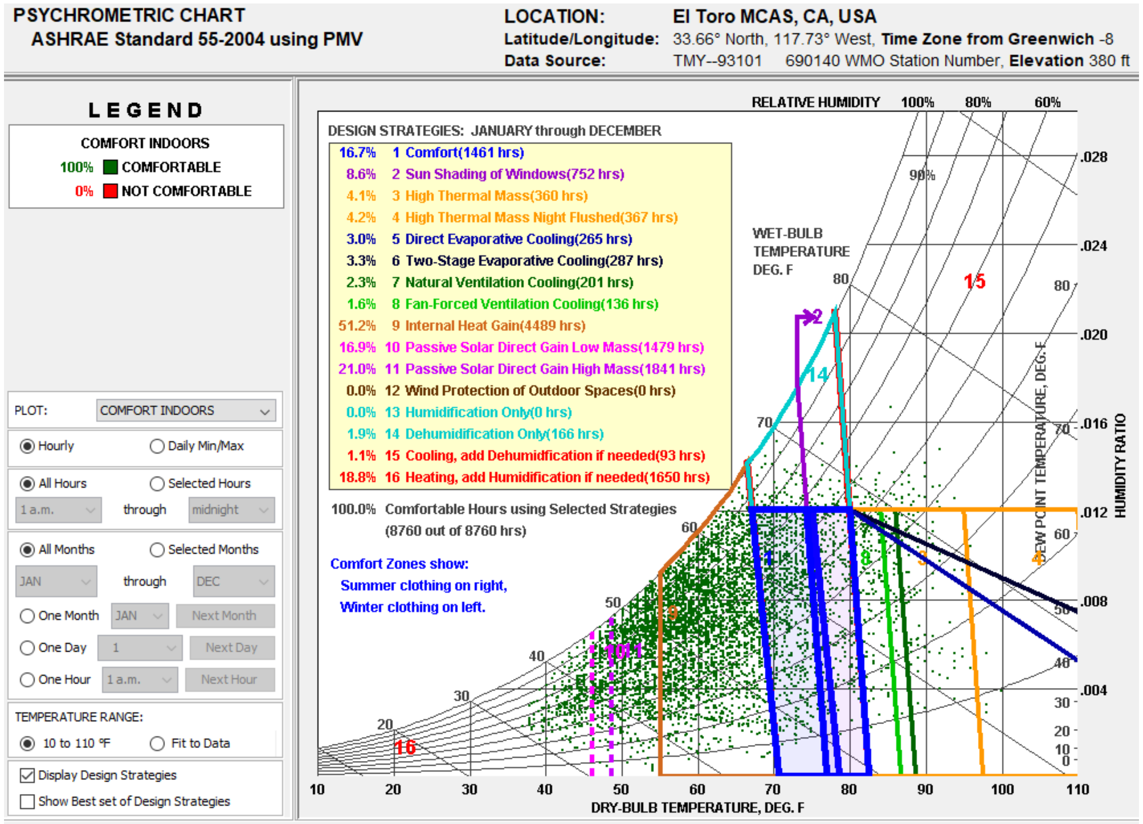
As the sun rises in the east and sets in the west it delivers different levels of sun intensity to the building. This chart plots the path of the sun during December 21st to June 21st and shows the temperature for most of the time is less than 68F. Therefore, shading is not required for that period.



This chart differs from the previous one and is for summer months from June 21st to December 21st. It shows that shading is needed for 370 hrs of the year.



The wind study indicates that there is a breeze of approximately 25 mph for less than 5 % of the year. This is insufficient to drive a wind turbine and therefore this technology should not be considered as a viable option in generating renewable power.



The strategies above show that for approx 17% of the time the outside climate is within the comfort conditions of the inside, so that the windows can be opened or the ventilation fans of the Air Handling Units can be used to bring in cool air without cooling.

It also demonstrates that 37% of the time the building would benefit with thermal mass. Typically high thermal mass construction is concrete, which has the property to slow the heat entering the building, when it does several hours later, it's evening and the windows can be opened to cool the space. If windows are not preferred then a night flushing strategy can be used instead.

[CAMPUS LEVEL ENERGY EFFICIENCY]

As designated in California's loading order, energy efficiency is the state's top priority for meeting its energy needs and for strengthening its notable economic prosperity and quality of life for all Californians. Energy efficiency is recognized for producing substantial savings in relation to implementation costs. In alignment with the loading order priorities and an ongoing desire to reduce energy consumption and costs, the college consistently seeks to identify energy efficiency projects that are scalable, cost-effective and support broader campus efforts toward increased sustainability and improved energy performance. Once identified, these projects are to be strategically implemented in a phased approach making sure to verify planned-for energy efficiency outcomes so that future adjustments can be made as needed.

The first step for identifying viable energy efficiency measures is to conduct a building-by-building analysis across campus, pairing energy modeling for each building with mechanical equipment surveys while also considering building size and age. Small and medium buildings ranging from 10,000 square feet to 25,000 square feet present challenges and potential dollar savings limits because the cost of an energy audit is fixed by the amount of time an auditor needs to survey the building. For buildings of this size, the savings can be more challenging because of a small overall footprint and related low energy usage. To ensure cost effective retrofits for these types of buildings, it is critical to provide streamlined energy surveys to minimize engineering time on site and maximize energy savings on energy projects.

Buildings that are larger than 25,000 square feet will benefit from an ASHRAE Level 2 audit which is likely to yield highly accurate results and recommendations. ASHRAE Level 2 audits should integrate the audit, scope of work, project management commissioning, and measurement and verification (M&V). Based on typical performance, each building larger than 25,000 square feet should benefit by way of a 10 to 20 percent reduction in cooling, heating and domestic hot water energy, upon implementation and commissioning.

Projects Planned for Completion 2019 -2020

Project Name	Budget Amount
Saddleback - ATAS Renovation	$ 64,100,000
Saddleback - PE Renovation	$ 3,188,000
New Stadium	$ 62,230,000
Campus-wide BMS Controls	$ 4,900,000
Total Amount	$ 134,418,000

ASHRAE ENERGY AUDIT

ASHRAE Level 1 Energy Audit

Buildings with smaller square footage with smaller HVAC equipment and lower energy usage have fewer cost effective solutions available to reduce energy consumption. However, substantial results can still be achieved by investigating all rebates and incentives that are available for specified small projects in addition to conducting a complete energy survey through an ASHRAE Level 1 Energy Audit. When conducting such an audit on more than one building it is prudent to aggregate multiple buildings through an identified overall energy efficiency strategy.

ASHRAE Level 2 Energy Audit with Implementation and M&V

An ASHRAE Level 2 Energy Audit is designed to uncover the most cost-effective measures and projects for a particular facility. As a result, this level of audit typically includes recommendations to modify three or more types of equipment for the facility under review. In general, energy projects in buildings that are large enough for ASHRAE Level 2 Energy Audits have included one or more of the following upgrades shown on the right.

Note:
Rebates and Incentives are continuously changing so it is best to check websites
SDGE website: https://www.sdge.com/rebates
California Energy Commission:
https://www.energy.ca.gov/funding-opportunities/funding-resources

- Low pressure drop air filtration
- Supply air temperature reset
- Duct static pressure reset
- Duct sealing
- Automated scheduling
- Demand control ventilation (CO or CO_2 based)
- Optimizing outside air usage
- Repairing economizers
- Non-integrated to integrated economizers
- Allowing outside air to go to 0% during warm up periods
- Outside air based boiler lockout
- Outside air based chiller/ compressor/cooling tower lockout
- Interior lighting retrofit
- Exterior lighting retrofit
- Lighting occupancy controls
- Lighting daylighting controls
- Motor replacement
- VFD installation on supply fans
- VFD installation on return/ exhaust fans
- VFD installation on pumps
- VFD installation on cooling tower fans
- VFD installation on compressors
- Web bulb temperature reset on cooling towers
- Pumping optimization and right sizing
- HVAC equipment retrofits
- Computer server room optimization
- Window films
- Hot water heater replacement
- Electric transformer retrofit
- Duct sealing
- Pneumatic to DDC conversions
- Adjusting zone temperature deadbands
- Installing energy management system
- Repairing/replacing sensors in an existing energy management system
- Repairing compressed air leaks

Conducting an ASHRAE Level 2 Energy Audit will identify the best possible combination of core project opportunities and, additionally, will define a tailored implementation package for each building. The ASHRAE Level 2 process will determine the exact mix of energy efficiency measures best suited for each building. Measures might range from simple lighting retrofits to deeper capital-intensive projects that can have positive implications throughout the campus and within the central plant.

As appropriate, the college should employ an integrated energy firm to install data loggers for each building to monitor energy consumption for a minimum period of 4 - 6 months. Monitoring should be used to confirm appropriate cost-effective strategies that include a payback analysis and deliver guaranteed savings. The vendor shall maximize all rebates, incentives and tax credits. In addition to identifying and implementing project opportunities, a rigorous data intensive commissioning and measurement & verification procedure should be built into the energy audit process for every building. For each building, electric and natural gas meters, as well as chilled water valve sensors should be installed. These meters and sensors should have the ability to communicate with the EMS. Having these technologies in place will assist in tracking usage and trends and will also help identify areas that have the most efficient return on investment strategies.

[BUILDING LEVEL ENERGY RECOMMENDATIONS]

Perform an ASHRAE Audit, Type 2 for all Saddleback buildings. Provide building systems commissioning as described in the Major Renovations checklist.

BUILDINGS WITH EUI OVER 100 KBtu/sqft

T, W, FA 100, FA 200, PE 500, K, Village 18-33, Village 3-8, Village 9- 10 and PE 200

Buildings T, W, PE 500, K and Village buildings 9- 10 have a high EUI but low total energy consumption. Prioritize passive energy efficiency strategies such as passive cooling, daylighting and passive solar design. Buildings built before 1990 (FA100, FA 200, PE 200) might require an envelope retrofit.

- Maximize daylighting and minimize direct sun penetration- solar protected windows, skylights, light shelves (S, SE, SW façades)
- Implement daylighting controls, occupancy sensors and timers
- Upgrade to LED fixtures
- Consider using high-emissivity roofing to reduce heat load on roofs
- Redesign passive shading devices to block solar heat gain while admitting sunlight
- Improve envelope performance:
    - o Increase R-value of walls, roof, windows and floors
    - o Minimize thermal bridging
    - o Improve building airtightness
    - o Use high performance windows
- Consider using high thermal mass to store heat and to drive night flush ventilation
- Specify efficient office equipment and appliances to reduce plug loads and consider establishing a plug load budget
- Consider the use of solar water heating systems

BUILDINGS WITH EUI OVER 50 KBtu/sqft

PE 600, PE 300, PE 100, FA 300, AGB, PE 400, SM, Child Development Center, LRC, Campus Police, HS, BGS, SSC and CE

PE 600 has a high EUI but low total energy consumption. Prioritize passive cooling and daylighting. Buildings built before 1990 (PE 100, PE 100, PE 300, FA 300, AGB, PE 400, SM, LRC, BGS, CE) might require an envelope retrofit.

- Maximize daylighting and minimize direct sun penetration- solar protected windows, skylights, light shelves (S, SE, SW façades)
- Implement daylighting controls, occupancy sensors and timers
- Upgrade to LED fixtures (PE 600, PE 300, PE 100, FA 300, PE 400, SM, Child Center, LRC, Campus Police, TAS, CE)
- Consider using high-emissivity roofing to reduce heat load on roofs
- Redesign passive shading devices to block solar heat gain while admitting sunlight
- Improve envelope performance:
    - o Increase R-value of walls, roof, windows and floors
    - o Minimize thermal bridging
    - o Improve building airtightness
    - o Use high performance windows

BUILDINGS WITH EUI UNDER 50 KBtu/sqft

Village 1-2: Classrooms, SCI: Sciences, WH: Warehouse

Prioritize daylighting. Reduce fan and pump use.

- Maximize daylighting and minimize direct sun penetration- solar protected windows, skylights, light shelves (S, SE, SW façades)
- Implement daylighting controls, occupancy sensors and timers
- Upgrade to LED fixtures
- Consider using high-emissivity roofing to reduce heat load on roofs
- Redesign passive shading devices to block solar heat gain while admitting sunlight

Saddleback College Fine Arts Complex

[LIGHTING HARDWARE AND CONTROLS]

The college could increase energy efficiency through a campus-wide retrofit of interior and exterior advanced lighting hardware and controls. Like most institutions, the college recognizes that lighting retrofits reliably generate strong payback on investment as these projects can often yield energy reductions of up to 30 percent. The college consistently evaluates its existing lighting and controls for retrofit opportunities. Lighting strategies include the following:

- Occupancy sensors: This strategy involves reducing lighting levels or automatically turning lights off in spaces when there is no occupancy. When motion is detected lights turn on automatically; they can also be set to come on partially dimmed. Occupancy sensors are highly suited for parking structures and parking lots, as well as smaller, enclosed spaces that are intermittently occupied such as private offices, classrooms, conference rooms, and restrooms.

- Daylight harvesting: This strategy involves capturing daylight and supplementing it with electric lights to achieve a preset lighting level. For example, placing day light sensors at the perimeter of the buildings allows light levels to be measured so that electric lights automatically turn-on to supplement the daylight if light levels fall below a preset limit in specified spaces.

- Building Management System: It is important to have the lighting system operational only during times of occupancy. To that end the lighting control panel is connected to the Building Management System with a programmed occupancy schedule. This ensures lights are not inadvertently left on during non-occupied periods such as nights and weekend periods. However, there may be occasions when lights are required such as when a cleaning crew is performing work. In these instances, an override switch should be provided locally which allow lights to turn on manually for a preset period.

- LED lights: This technology provides great dimming capabilities, longer life and reduction in operational costs.

Saddleback College Science Building Classroom with LED lighting

[DEMAND RESPONSE PLAN]

Another cost saving plan is to enroll the college on a demand response program with the utility. Demand Response is a strategic and tactical tool used by utilities and grid operators to reduce energy demand across the system in order to prevent power outages from occurring during high stress times on the electricity grid. The periods of acute high demand for electricity are deemed emergency events and typically occur only during a few days each year, with durations usually lasting only for a few hours at a time. Demand Response is primarily called into action during the hottest days of summer, at times of extraordinary load on the system when energy efficiency and such SOCCCD practices are insufficient to curtail electric demand. Institutions who voluntarily participate in the Demand Response program benefit financially by receiving a monetary incentive from the utility provider and also through the utility cost savings derived by a reduction in kWh used. The Board of Governors of the California Community Colleges through its Energy and Sustainability Policy encourages each college to participate in all utility offered Demand Response programs and pursue all possible incentives offered by these programs.

The college is a prime candidate for participation in a utility provided Demand Response program. Based on the institution's current conditions, the campus should employ a combination of manual and semi-automated Demand Response strategies. By doing so, the college will be able to generate exceptional value through this no-cost, no-penalty program with very minimal impact to day-to-day operations. The dollars generated can be allocated to expanding other energy savings initiatives and the energy behavior the program generates is consistent with the college's overall goals.

Plan to Curtail Energy Load

Chiller System – Air / Water Cooled	Elevators
Chiller Water Pump	Personal Computers
Condenser Pump	Kitchen – Dishwasher / Freezer Units
Cooling Tower	Pool Pumps
Rooftop Units	Lighting
Split Units	Exhaust Fans
Packaged Units	Heat Pumps
Air Handling Units	Hot Water Heater Pumps
Fans	Electric Boiler

Additional energy reduction strategies that are commonly employed at college campuses include HVAC, elevator and generator procedures, as detailed below.

Heating, Cooling & Air Conditioning (HVAC)

- Pre-cool each of the areas prior to the event by reducing set point temperatures 5°F to 10°F or as low as 60°F on each of the units. Ten to fifteen minutes prior to the start of the event, turn off the units completely or raise the set points as high as 80°F in order to keep the compressors off as long as possible during the event.

- Similarly with chillers, pre-cool the building prior to the event by reducing chilled water temperatures 5°F to 10°F or as low as 38°F. Ten to fifteen minutes prior to the start of the event, turn off completely or raise the chilled water temperature to 48°F.
- Turn off as many air handling units/fans as possible or cycle them in a constant air volume system. Reduce fan VFD's or DSP (duct static pressure) as much as possible in a variable air volume system. Also reduce VFD's on chilled water pumps, condenser pumps and cooling tower fans to minimize pumping and fan power.
- Turn off as many refrigeration compressors as possible and keep freezer/cooler doors shut for the duration of the event.
- Turn off lighting in offices and all other unoccupied areas, as well as areas with natural lighting.
- For any areas that cannot be shut down fully, try reducing lighting by simply turning "off" every other row. Reduced lighting can assist in maintaining a cooler building temperature.

Elevators

- If there is more than one elevator, post signs in front of extra elevators and ask that they not be used. Only take elevators offline in accordance with building and safety codes, and ADA requirements.

Generator

- If running a generator, make sure to engage it 15 minutes prior to the Demand Response event time and keep it operating 15 minutes after the event time.
- Make sure the generator transfer switch is properly engaged and is fully fueled for a successful Demand Response reduction outcome.

Institutional Actions Required for Participation in Demand Response Program

For participation in a Demand Response program, the college must ensure that proper hardware and software controls are in place to effectively respond to Demand Response protocols from a utility. Moreover, the college must consistently communicate and emphasize to campus stakeholders the effects as well as the benefits of Demand Response to help ensure that the organizational culture accepts participation as a normal way of doing business. Additionally, and importantly, the campus community must understand through ongoing organizational communication and feedback that Demand Response is a strategy embraced by the college and that certain conditions may exist when participating in Demand Response. For example, when an electrical emergency event is declared, authorities will notify the college's contact personnel by 3:00 pm the day prior. Subsequently, all college staff should be notified and encouraged to participate by turning off lights, utilizing pre-cooling strategies and shutting blinds in rooms with southern and western exposures to help mitigate heat gain during hours of reduced air-conditioned loads. All applicable equipment from the following list should be shut down or reduced, if possible.

[BUILDING MANAGEMENT SYSTEMS]

The current Building Management System (BMS) for the campus is Computrols, which controls the co generation central plant, chilled water system, hot water systems, AHU's etc. However the system is proprietary and needs specialized programing knowledge to operate effectively. This has led to inefficiencies and expense to the colleges' operational budget. In order to remedy the situation the District has prepared a RFP to provide a new BMS system throughout the campus and abandon the existing system. HED recommends Niagara Control Systems or a system which includes the following features:

1) BACNet open protocol system
2) Web based system
3) Must interface with the existing college IT system
4) Must be upgradeable

Some of the benefits of a Building Management System include:

- Reduction of operational cost by energy optimization
- Reduction of operational cost through preventative maintenance
- Reduction of service cost through staff productivity
- Campus security such as fire alarms, site lighting, CCTV cameras, safety and security telephones
- Remote alert notifications prior to user complaints

[COGENERATION PLANT]

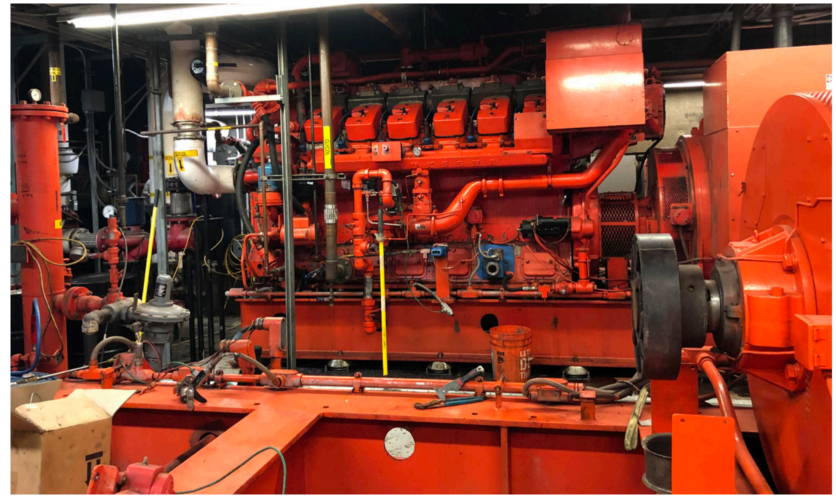
The Saddleback College Central Plant was constructed in 1975, and is one part of the larger Facilities, Maintenance & Operations Department which supports Saddleback College administrators, faculty and staff on the 172 acres of the picturesque rolling hills that are Saddleback College, and its 40 buildings.

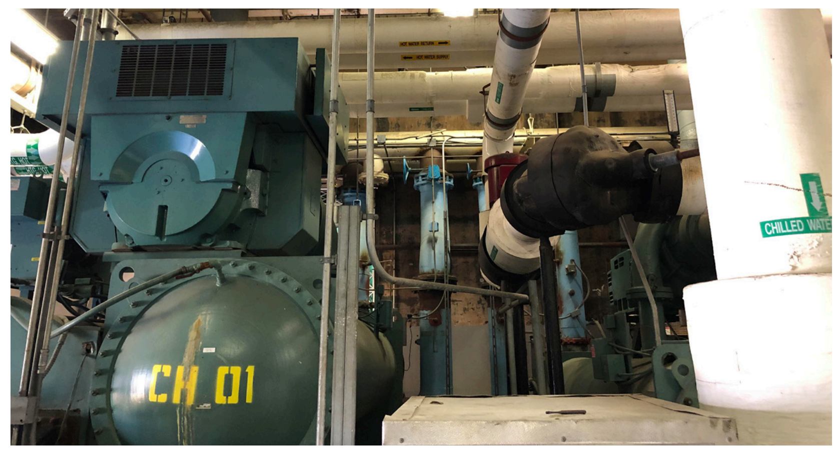
In 1975 the Central Plant was constructed as the source of all the Hydronic Water on campus, and in 2001 the central plant was renovated to include a 1.5 MW cogeneration facility. In 2013, the Central Plant underwent another significant renovation to include a second absorption chiller to support its smaller sister absorption chiller and the 600-ton and 1,000-ton workhouse centrifugal chillers. This renovation also included new hot water pumps and three new cooling towers to support the ever growing needs of the campus community.

Saddleback College is looking forward to the future and anticipating the needs of Saddleback College's new state-of-the-art Stadium, new ATAS Building, New Tennis Courts and future Gateway Building. The Central Plant and facilities will continue to be the source of Saddleback College's Power, and Hydronic water campus-wide.

It is recommended as the maintenance of the plant increases and the cost of clean renewable energy decreases a life cycle study should be conducted in detail that compares the existing system with a v system and Battery Storage. The study should include:

1) Cost of maintenance
2) Operational Cost
3) Maintenance Cost
4) Green House Gas Emissions
5) Standby Charge
6) Salvage Value
7) Future proof
8) Impending legislation that curb Green House Gases
9) Community Engagement.





[BATTERY ENERGY STORAGE]

Battery storage is a new technology that would allow the college to charge the lithium-ion batteries during the night when electricity rates are at very low rates and discharge during peak hours during the day.

This process is to reduce the demand charge and not necessarily to reduce the energy consumption. The demand charge is significant so will reduce the operational cost depending on the size of batteries.

Currently, Saddleback College is generating electricity utilizing a 1.5-megawatt cogeneration plant as described in the previous section. However, the cogeneration plant is on 24 hours a day 7 days a week producing approximately 70% of the needs of the college. The reason for continuous operation is that it takes a long period to go through the process from the cold start to fully operational stage. In addition, the maintenance of stop and starting reciprocating engines dramatically increase. It is recommended to install a battery energy storage system of approximately one megawatt in size along with the PV system previously described on page 31. This would reduce the load on the cogeneration plant and reduce natural gas consumption as well as result in a reduction in maintenance and operational cost of the plant. Additionally, it reduces the carbon emissions of the college.

A battery system of 1MW would cost approximately $2 million and the college would realize operational and utility savings immediately. The size of the battery storage system should be approximately 2 megawatt at an approximately cost of $4 million, pay back would be approximately 10- 13 years.

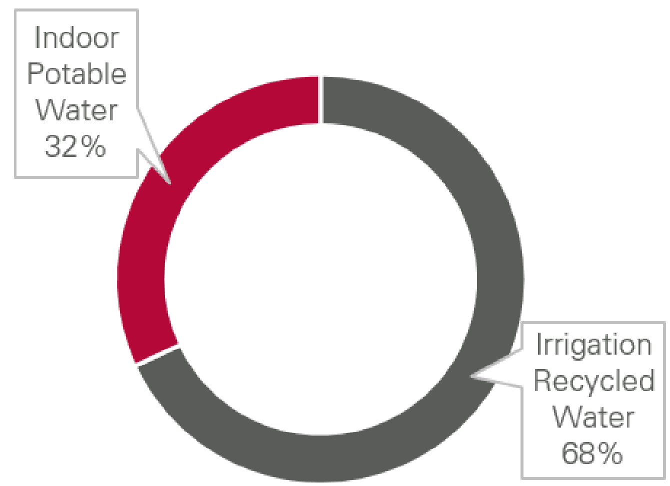
Battery Energy Storage System

[WATER CONSERVATION EFFORTS - EXISTING AND UPCOMING]

Saddleback College has been using reclaimed water (over 265 million gallons) for landscape irrigation since 1995. Reclaimed water accounts for 75% of the college's total water consumption and results in over $75,000 in cost savings. Current water conservation efforts that have already been implemented and are upcoming are:

- Water Efficient Irrigation Controllers: New irrigation controllers were installed in 2014. These controllers are part of a campus-wide computer controlled irrigation system (installed in 2016) which allow increased water efficiency by better management of watering schedules.
- Drought-resistant planting: Drought-resistant and California native plants are used on all new construction and renovation projects (LRC renovation and new Sciences building).
- Reduction in turf areas in all new construction and renovation projects.
- Mulching mowers: Mulching mowers increase the composting materials in sod area and allow for better waste retention and healthier sod.
- Cooling Tower water use: This project intends to eliminate the use of potable water for the central plant cooling towers.
- Reclaimed water for toilets and urinals in new construction projects such as the new Athletics Stadium.

Annual water consumption was calculated using utility bills from calendar years 2015 to 2016. The gross annual water consumption at Saddleback College is 62,458,374 gallons per year, the annual water use intensity is 11.5 gal/sqft per year and the per capita consumption is 2,211 gal/person per year.



Water Consumption Distribution Pie Chart

APPENDIX

This Section Includes:

59 Acronyms

[ACRONYMS]

AB	Assembly Bill
ADR	Automated Demand Response
ANSI	American National Standards Institute
ARB	California Air Resources Board
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BIS	Business Incentives & Services package
CALEPA	California Environmental Protection Agency
CEEP	Commercial Energy Efficiency Program
CHP	Combined Heat and Power
CO_2e	Carbon Dioxide Equivalent
CPAC	Comprehensive Packaged Air Conditioning Systems program
CPUC	California Public Utilities Commission
CSI	California Solar Initiative
DG	Distributed Generation
DOE	U.S. Department of Energy
DSIRE	Database of State Incentives for Renewable Energy
EE	Energy Efficiency
EERS	Energy Efficiency Resource Standard
EO	Executive Order
EM&V	Evaluation, Measurement, and Verification
EPA	Environmental Protection Agency
ESCO	Energy Service Company
Fc	Foot-candles
FiT	Feed in Tariff
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
GW	Gigawatt (1 GW = 1,000 MW)
GWh	Gigawatt-hour (1 GWh =1,00 MW)
HVAC	Heating, Ventilation and Air Conditioning
IDSM	Integrated Demand Side Management
IOU	Investor-Owned Utility
kW	Kilowatt
kWh	Kilowatt-hour
LBNL	Lawrence Berkeley National Laboratory
MW	Megawatt
MWh	Megawatt-hour (1 MWh = 1,000 kWh)
NEM	Net Energy Metering
PEV	Plug-in electric Vehicle
PG&E	Pacific Gas & Electric
PV	Photovoltaic
RCx	Retrocommissioning
REC	Renewable Energy Certificate
RES	Renewable Energy Standard
RPS	Renewable Portfolio Standard
SCE	Southern California Edison
SCG	Southern California Gas Company
SDG&E	San Diego Gas & Electric
SGIP	Self-Generation Incentive Program
SPC	Standard Performance Contract program
TOU	Time-of-Use
ZEV	Zero Emissions Vehicle
ZNE	Zero Net Energy

IRVINE VALLEY COLLEGE &
ADVANCED TECHNOLOGY & EDUCATION PARK
INTEGRATED ENERGY MASTERPLAN

December 2019

HED

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[EXECUTIVE SUMMARY]

The Irvine Valley College (IVC) was established as a satellite campus of the South Orange County Community College District in 1979. It is a public community college which is funded by a combination of state and local tax dollars. IVC is committed to student success, access and equity. An integral part of providing access and equity is sustainability and addressing global climate change. As a leading employer and a well-respected public agency, IVC understands its responsibility to its students and the local community at large that its facilities are operated in an efficient and sustainable manner. Sustainability is interwoven in the fabric of IVC's vision and goals for the future. Student groups and college policies have played an important role in furthering this goal. Additionally, for the long-term financial health of the college in this climate of rising utility costs, increasing maintenance and operational expenditures, it is imperative to address resource effectiveness.

Efficient resource management can reduce the college's impact on natural resources such as air, water, energy and other raw materials. The 2011 Facilities Master Plan set goals for upcoming new construction projects and site improvement projects and detailed a 5, 10 and 20 year development plan. The 2020 Facilities Master Plan is currently in development and will be completed by 2020. These goals were set after considering the existing college goals and objectives. The Integrated Energy Master Plan (IEMP) provides a roadmap for the college to operate its facilities in an efficient, sustainable and cost-effective manner. The IEMP also provides a pathway to achieve the goals set by the Board of Governors of the California Community Colleges in the Resolution on Climate Change and Sustainability Goals and Policy. It provides campus-wide and building specific passive and active sustainability measures.

Stakeholder engagement included formal meetings, one-on-one meetings, on site visits for technical briefings to gain relevant data, and answer questions relating to the development and scope of the Integrated Energy Master Plan.

The District's objective was to foster discussions with key stakeholders. Stakeholders were integral to the entire process as this is a data driven exercise.

Irvine Valley College Chemistry Annex

ENERGY ANALYSIS AND STRATEGIES FOR MODERNIZATION

[OVERVIEW]

This section examines in detail the existing energy usage and generation as well as the Greenhouse Gas (GHG) emissions at Irvine Valley College (IVC). Reduction targets are established relative to the existing Energy Use Intensity (EUI) and to Commercial Buildings Energy Consumption Survey (CBECS) benchmarks. Further, this section recommends various energy strategies for implementation at IVC based on climate analysis (See Appendix). The specified strategies were selected from the general menu of strategy options that were described in the Strategies section of this resource guide. The recommendations are aligned with the present state of the campus as well as its future condition. Strategies for two tiers of upgrades were selected to maximize energy savings for the campus while considering the operational logistics of the institution. A range of applicable potential savings for specified strategies are included for reference. The detailed analysis for implementation of solar energy are also provided to reach the goal of net zero energy.

This Section Includes:

8 Energy Analysis

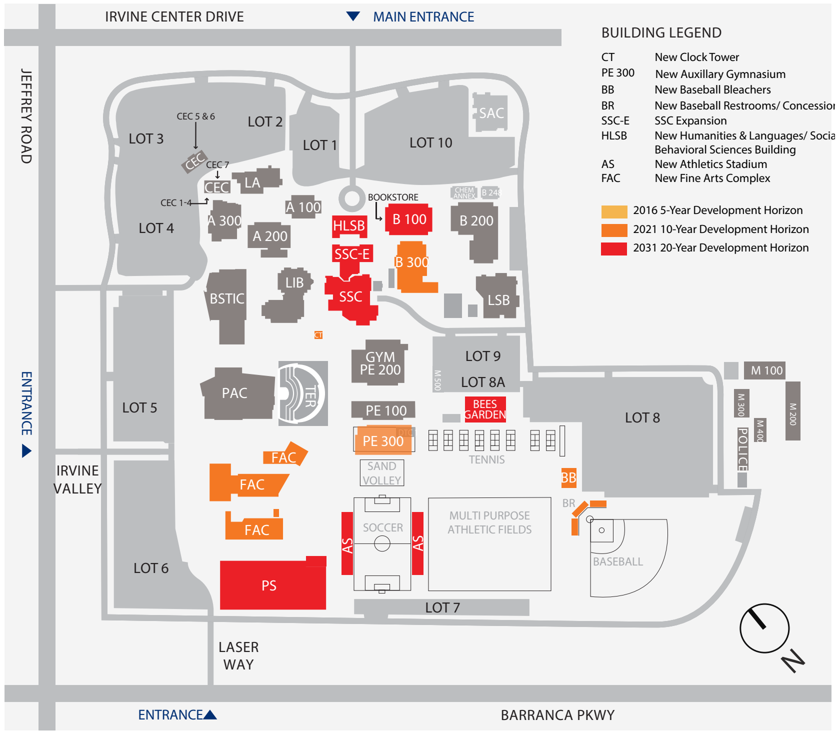
18 Climate Action Plan

21 Strategies for Modernization

27 Reach to Zero Net Energy

[ENERGY ANALYSIS - FACILITIES MASTER PLAN]

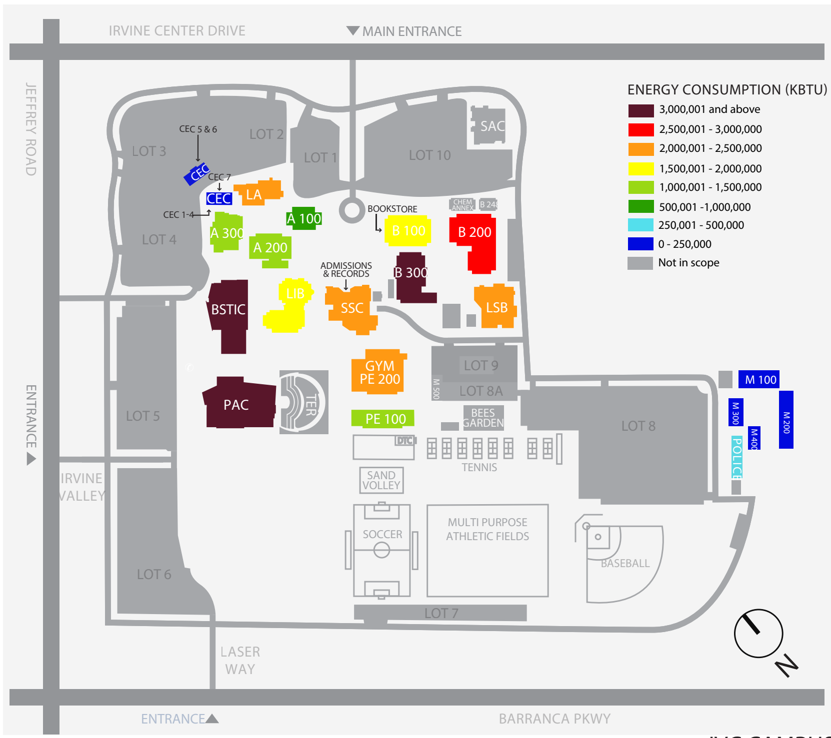
The Facilities Master Plan shown was prepared in 2011. Currently, a new Facilities Master Plan is being prepared and will be completed in 2020



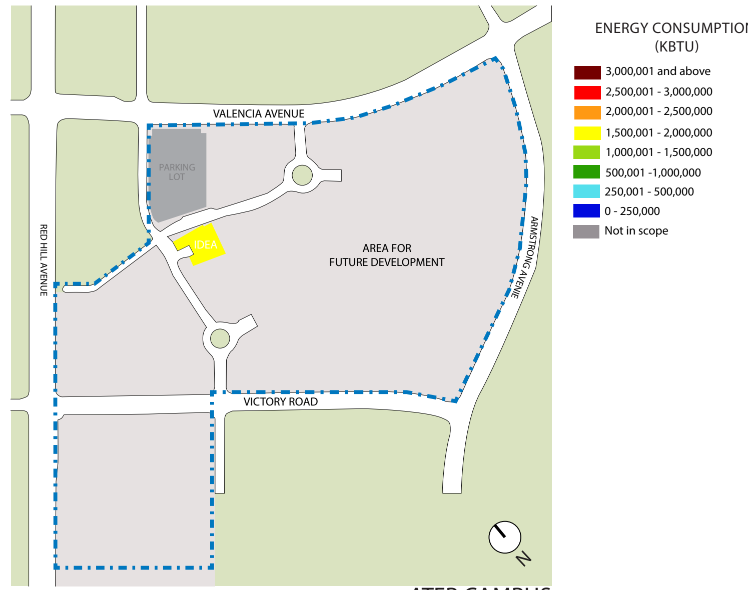
BUILDING LEGEND

A 100	Administration	CEC	Community Education Complex	PAC	Performing Arts Center
A 200	Social Sciences	CEC 1	Outreach and Community Relations	PE 100	Health Fitness Complex
A 300	Humanities, Fine Arts and District HR	CEC 7	International Student Office	PE 200	Hart Gymnasium
B 100	Classrooms, Offices and Bookstore	DTC 1	DSPS Testing Center	POLICE	Campus Police
B 200	Mathematics and Physical Sciences	LA	Liberal Arts	SAC	Student Activities Center
B 300	Classrooms and Labs	LIB	Library	SSC	Student Services Center
BSTIC	Business Sciences and Technology Innovation Center	LSB	Life Sciences Building (B 400)	TER	Live Oak Terraces
		M 100	Facilities Management Office	IDEA	Integrated Design, Engineering and Automation

[ENERGY ANALYSIS - EXISTING ENERGY CAMPUS MAP]



IVC CAMPUS



ATEP CAMPUS

BUILDING LEGEND

A 100	Administration	CEC	Community Education Complex	PAC	Performing Arts Center
A 200	Social Sciences	CEC 1	Outreach and Community Relations	PE 100	Health Fitness Complex
A 300	Humanities, Fine Arts and District HR	CEC 7	International Student Office	PE 200	Hart Gymnasium
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BSTIC	Business Sciences and Technology Innovation Center	LSB	Life Sciences Building (B 400)	TER	Live Oak Terraces
		M 100	Facilities Management Office	IDEA	Integrated Design, Engineering and Automation

[ENERGY ANALYSIS - EXISTING ENERGY CONSERVATION PROJECTS]

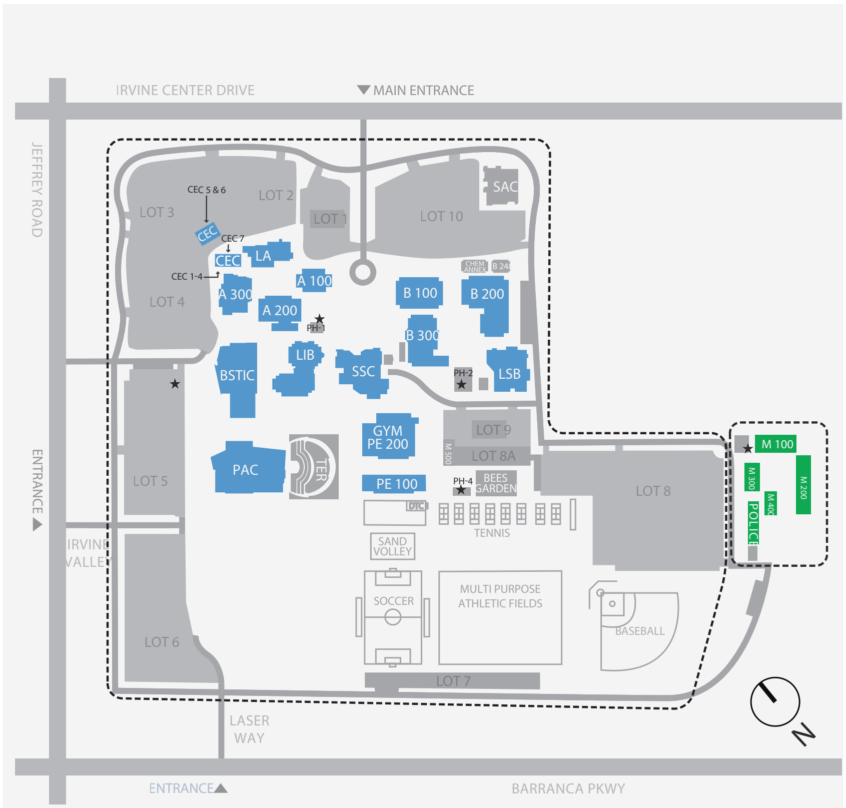
Irvine Valley College has been aggressive in its energy conservation efforts starting with retrofitting the existing electrical and mechanical systems and scheduled maintenance programs for chillers and boilers. Energy conservation projects that have been implemented so far are:

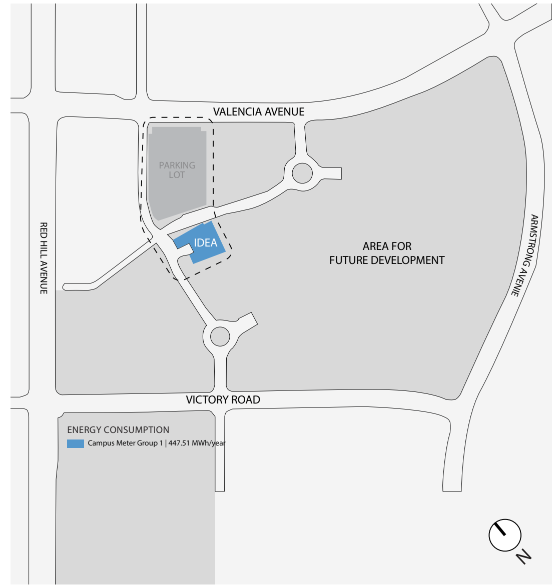
- A campus-wide exterior lighting retrofit was completed in 2014 at Irvine Valley College. This achieved a 53% reduction in energy consumption which resulted in over $89,000 in savings.
- An HVAC system retrofit was conducted in the Student Services building in 2014.
- Commitment to adhere to LEED performance criteria in all new construction in all retrofit projects.
- A generating facility which comprises of a 53.56 kW solar PV system and a 66 kW battery energy storage system was installed at the ATEP campus.

Current construction and renovation projects have included various energy conservation efforts such as:

- Liberal Arts Building: Upgraded envelope insulation, provision of increased daylighting, lighting controls & sensors and LED system replacement, building level energy metering, addition of a building management system.
- Life Sciences Building: Provision of increased daylighting using Solatubes, lighting controls & sensors and LED system replacement, use of a building management system.

[ENERGY ANALYSIS - ELECTRIC METER GROUPING]





ENERGY CONSUMPTION BY METER LOCATION

- Campus Meter Group 1 | 7002.67 MWh/year
- Campus Meter Group 2 | 193.37 MWh/year

NOTE: The campus is on two meters, one which serves the campus and the other serves the area near the campus police and FMO buildings as of 2019

[ENERGY ANALYSIS - BUILDING CONSUMPTION AND EUI SUMMARY]

Building Information			End Use (kBtu)						Fuel Type (kBtu)		Consumption & EUI	
Building Code	Building	Year	Heating	Water Heating	Cooling	Fans & Pumps	Lights	Equip	Gas	Electricity	Consumption (kBtu)	EUI (kBtu/SF-Year)
B300	Classroom and Labs	1988	31,348 (1.03%)	201,237 (6.6%)	1,953,426 (64.11%)	0 (0%)	469,621 (15.41%)	391,350 (12.84%)	232,585	2,814,397	3,046,982	149.5
SSC	Student Services Center	1991	12,268 (0.57%)	32,925 (1.52%)	961,489 (44.53%)	799,185 (21.84%)	314,298 (14.56%)	366,680 (16.98%)	45,193	2,441,652	2,486,845	113.8
B200	Mathematics and Physical Sciences	1987	479,013 (18.84%)	136,368 (5.36%)	1,343,286 (52.84%)	0 (0%)	318,239 (12.52%)	265,198 (10.43%)	615,381	1,926,723	2,542,104	108.4
B100	Classrooms, Offices and Bookstore	1981	29,760 (1.97%)	104,193 (6.91)	564,298 (37.4%)	401,874 (24.18%)	243,154 (16.11%)	202,630 (13.43%)	133,953	1,411,956	1,545,909	105.3
A-300	Humanities,Fine Arts	1979	18,589 (1.33%)	94,200 (6.76%)	878,579 (63.01%)	0 (0%)	219,833 (15.77%)	183,193 (13.14%)	112,789	1,281,605	1,394,394	105.1
LA	Liberal Arts	2016	174,486 (7.98%)	174,486 (7.31%)	607,682 (27.79%)	545,677 (25.62%)	373,280 (17.07%)	311,065 (14.23%)	348,972	1,837,704	2,186,676	105.1
LSB	Life Sciences Building	2014	36,769 (1.74%)	36,769 (6.94%)	788,999 (37.35%)	623,884 (24.29%)	341,972 (16.19%)	284,977 (13.49%)	73,538	2,039,832	2,113,370	105.0
PAC	Performing Arts Center	2007	95,913 (3.03%)	221,632 (7.01%)	1,118,925 (35.4%)	782,157 (24.56%)	517,215 (16.36%)	431,010 (13.64%)	317,545	2,849,307	3,166,852	101.2
A-100	Administration	1979	31,828 (19.37%)	14,662 (2.11%)	134,513 (4.58%)	210,054 (30.25%)	139,964 (20.16%)	163,296 (23.52%)	46,490	647,827	694,317	100.9
BSTIC	Business Sciences and Technology Innovation Center	2008	667,587 (19.12%)	202,188 (5.79%)	1,289,407 (36.92%)	707,770 (20.28%)	231,840 (6.64%)	393,197 (11.26%)	869,775	2,622,214	3,491,989	100.1

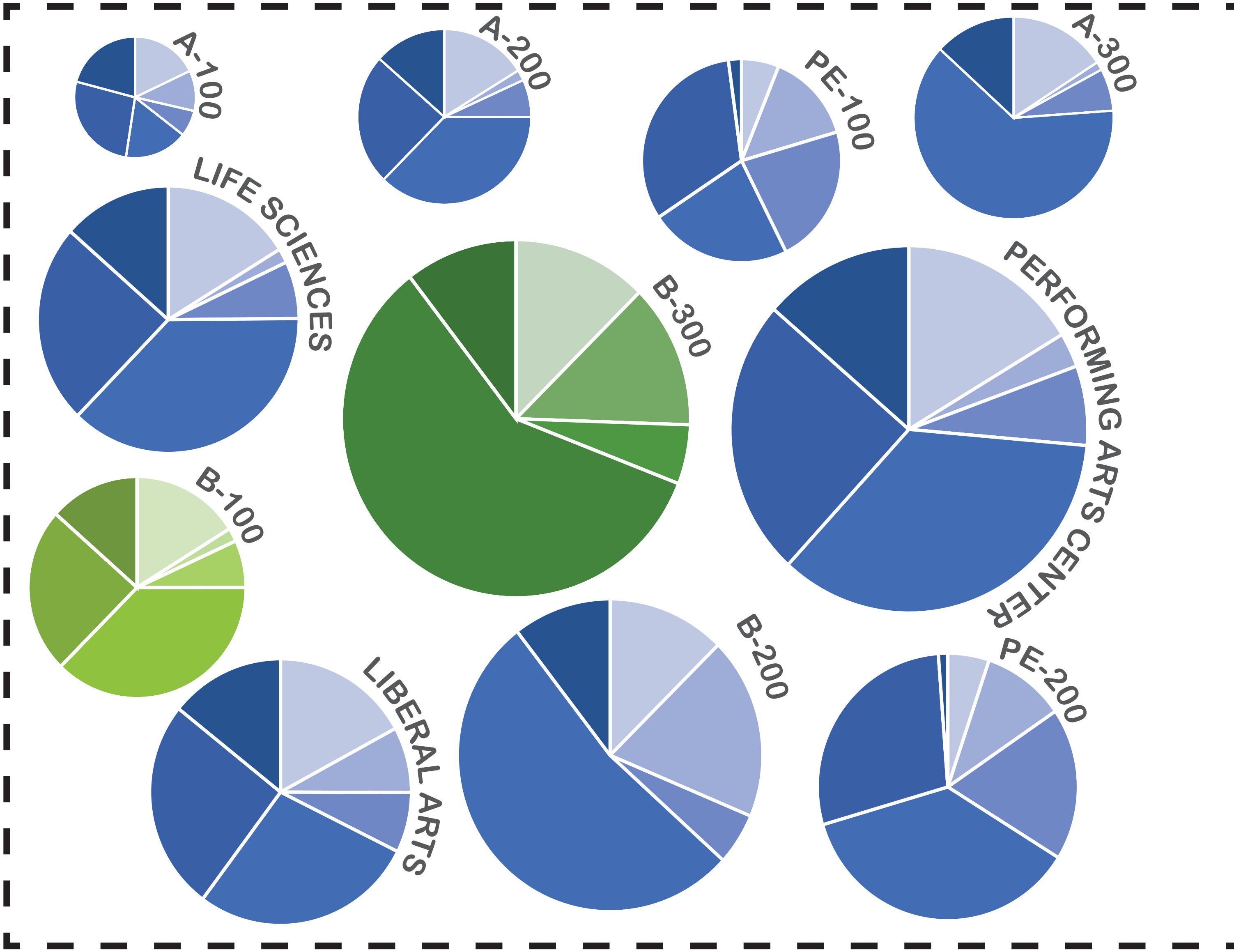
Building Information			End Use (kBtu)						Fuel Type (kBtu)		Consumption & EUI	
Building Code	Building	Year	Heating	Water Heating	Cooling	Fans & Pumps	Lights	Equip	Gas	Electricity	Consumption (kBtu)	EUI (kBtu/SF-Year)
PE-200	Hart Gymnasium	1994	251,619 (10.29%)	451,076 (18.46%)	893,523 (36.56%)	640,387 (28.4%)	125,377 (5.13%)	28,495 (1.17%)	702,695	1,687,782	2,390,477	92.0
A-200	Social Sciences	1979	27,961 (1.96%)	98,478 (6.92%)	530,630 (37.28%)	144,484 (24.23%)	229,815 (16.15%)	191,513 (13.46%)	1,26,439	1,096,442	1,222,881	88.1
PE-100	Health Fitness Complex	1992	187,830 (14.36%)	290,644 (22.22%)	300,439 (22.97%)	422,000 (32.26%)	79,400 (6.07%)	27,741 (2.12%)	478,474	829,580	1,308,054	87.0
LIB	Library	1997	79,486 (4.93%)	34,636 (2.15%)	430,383 (26.28%)	920,593 (33.1%)	237,612 (14.73%)	297,015 (18.41%)	114,122	1,885,603	1,999,725	75.0
CEC	Community Education Complex	2007	54,594 (21.85%)	20,472 (3.97%)	112,600 (10.6%)	197,190 (46.36%)	47,768 (9.27%)	40,945 (7.95%)	75,066	398,503	473,569	73.6
CP-100	Campus Police	2007	39,334 (8.34%)	23,192 (4.92%)	100,889 (21.4%)	0 (0%)	205,413 (43.56%)	102,708 (21.78%)	62,526	409,010	471,536	68.6
M-100	Facilities Management Office	2003	11,918 (8.97%)	5,048 (3.8%)	35,636 (26.81%)	0 (0%)	40,161 (30.21%)	40,161 (30.21%)	16,966	115,958	132,924	45.7
M-300	Shops	2007	16,891 (12.93%)	1,788 (1.37%)	34,775 (26.63%)	0 (0%)	65,723 (50.32%)	11,430 (8.75%)	18,679	111,928	130,607	42.0
M-400	Office	2001	10,814 (11.35%)	4,429 (4.65%)	29,583 (31.04%)	0 (0%)	35,236 (36.97%)	15,236 (15.99%)	15,243	80,055	95,298	33.1
ATEP IDEA	Integrated Design, Engineering and Automation	2018	516,179 (16.16%)	51,937 (3.4%)	246,712 (33.8%)	342,899 (22.43%)	222,672 (14.58%)	147,023 (9.63%)	568,116	959,306	1,527,422	50.4

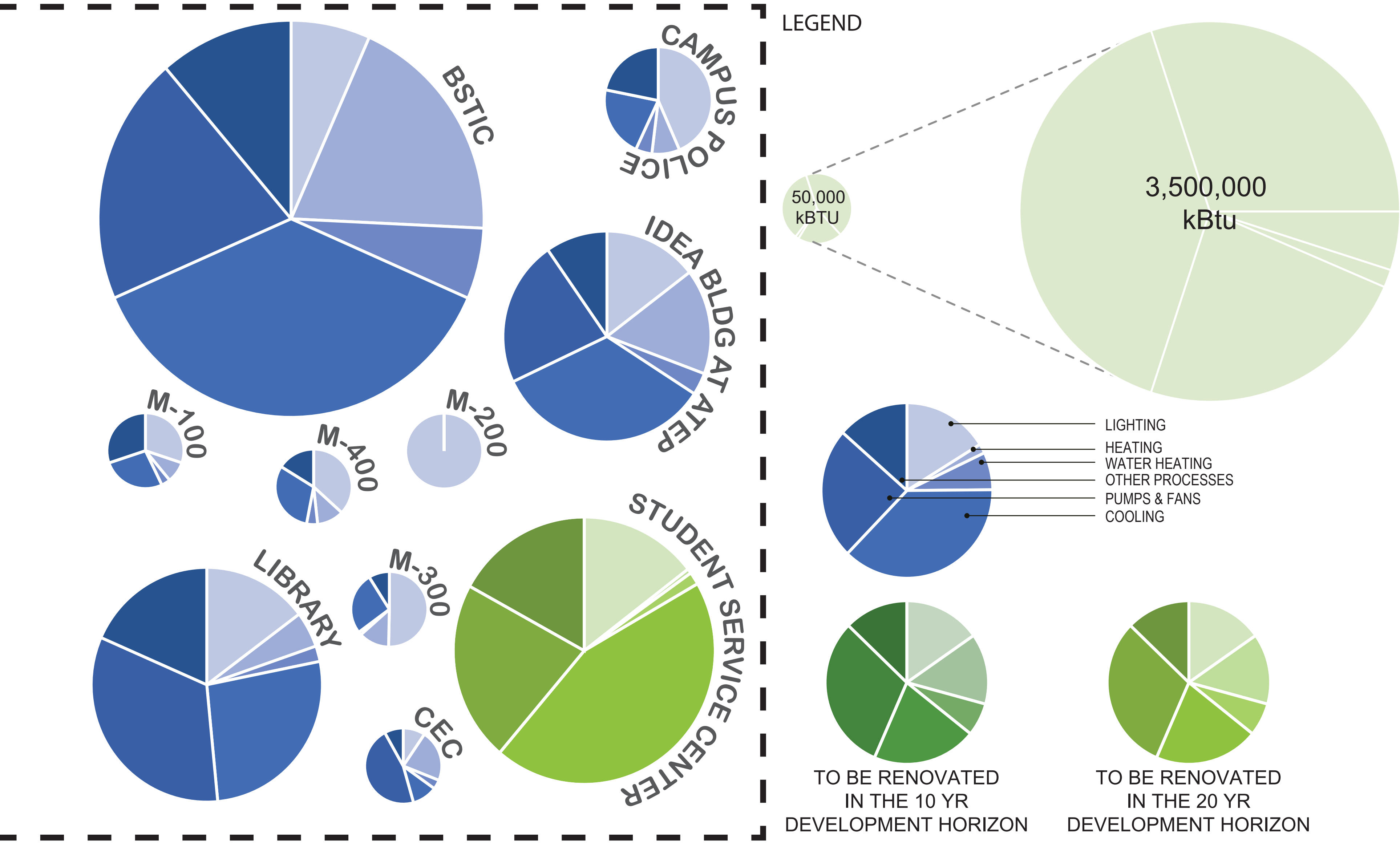
[ENERGY ANALYSIS - ENERGY CONSUMPTION BY BUILDING]

This graphic provides a comparative overview of the energy consumption of all existing buildings at Irvine Valley College and the IDEA building at ATEP. Each building is represented by a pie chart. The color indicates if the building is scheduled for demolition or planned for future renovation/expansion.

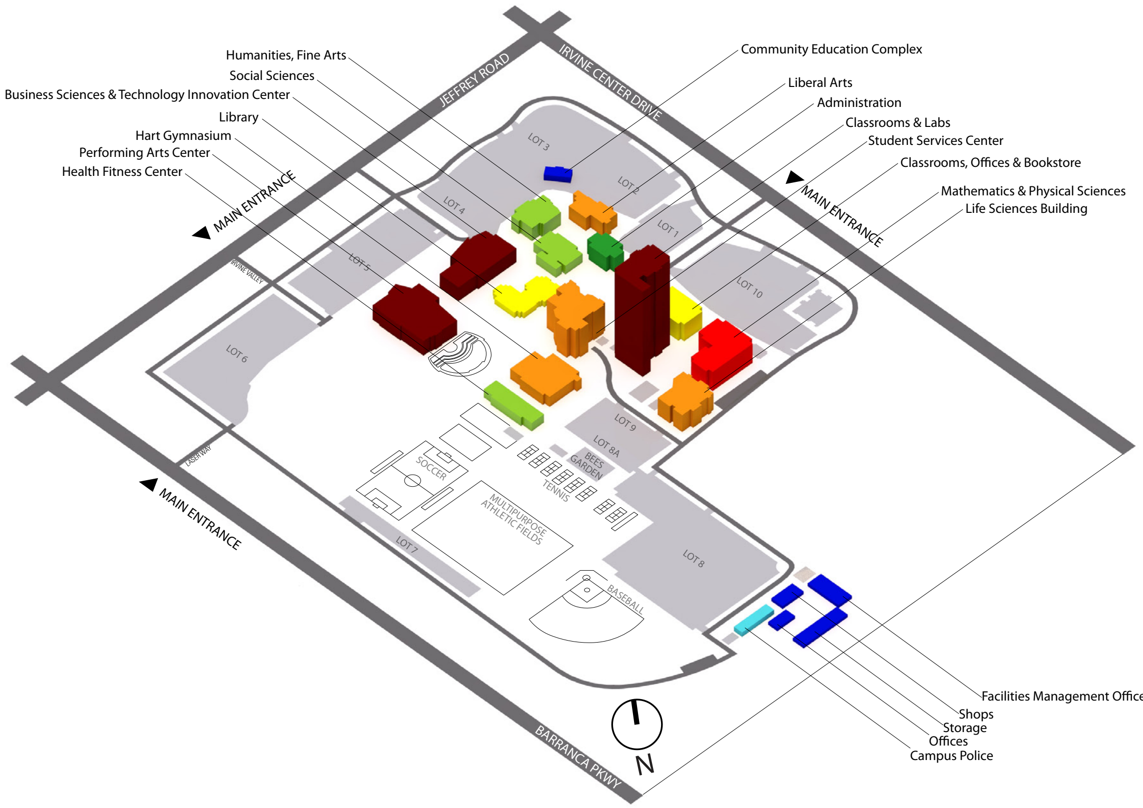
The size of each pie chart represents each building's annual energy consumption (the larger the pie, the higher the overall energy consumption). Each pie chart is divided into the percentage of energy consumed by each major building system (power, lighting, heating, cooling, process energy, and hot water).

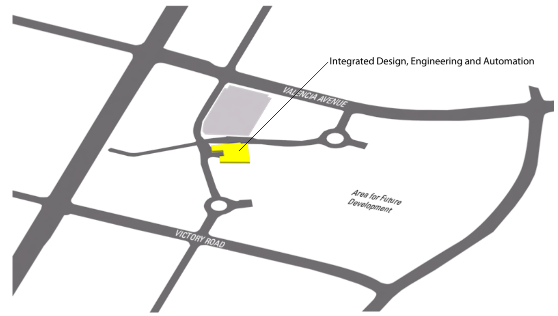
See the Legend on the opposite page for additional information.




BSTIC
CAMPUS POLICE
IDEA BLDG AT ATEP
M-100
M-400
M-200
LIBRARY
M-300
STUDENT SERVICE CENTER
CEC
LEGEND
50,000 kBTU
3,500,000 kBtu
LIGHTING
HEATING
WATER HEATING
OTHER PROCESSES
PUMPS & FANS
COOLING
TO BE RENOVATED IN THE 10 YR DEVELOPMENT HORIZON
TO BE RENOVATED IN THE 20 YR DEVELOPMENT HORIZON

[ENERGY ANALYSIS - EXISTING CAMPUS ENERGY USE INTENSITY]

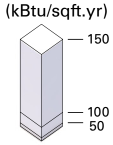




ENERGY CONSUMPTION (kBtu)

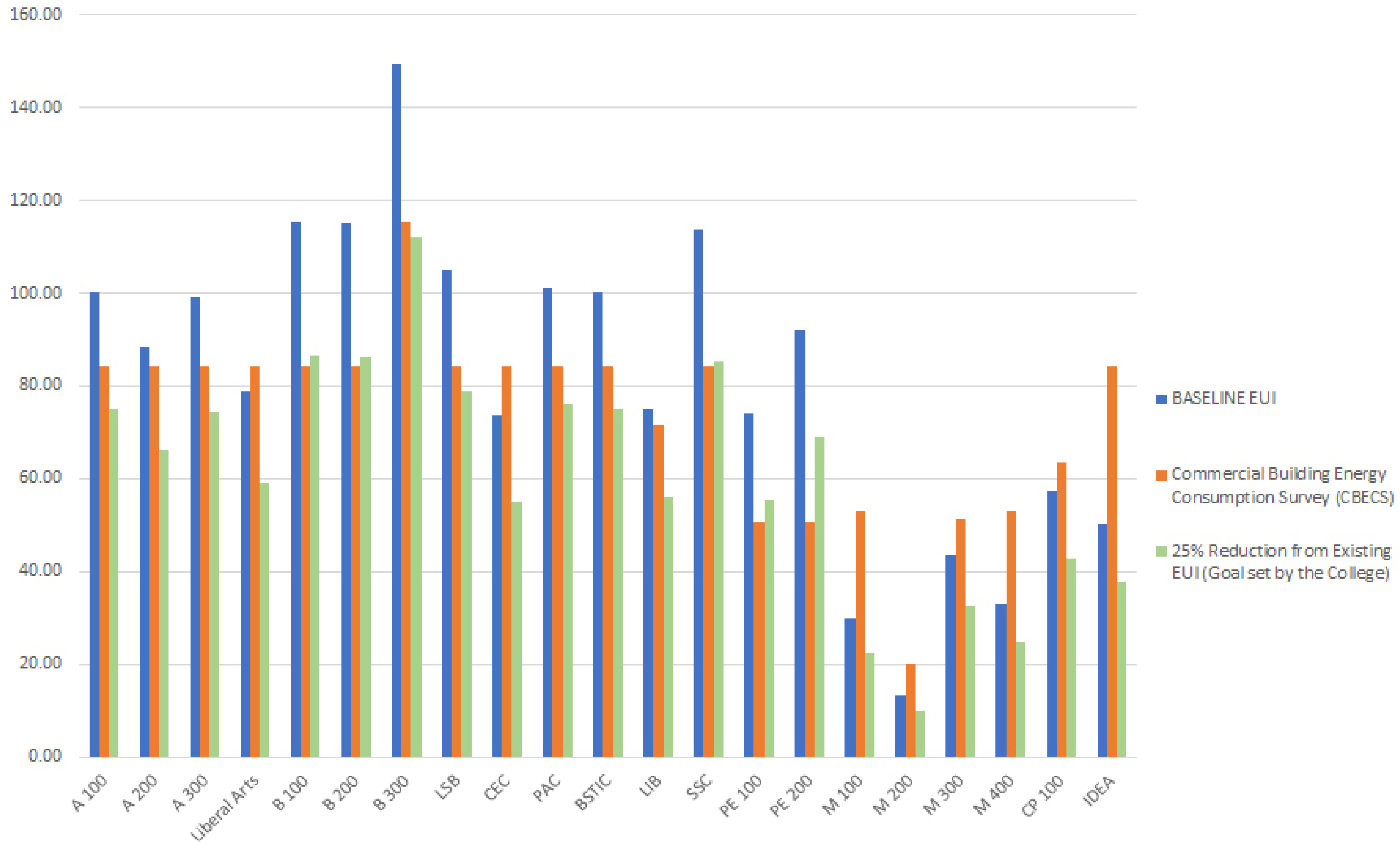
- 3,000,001 and above
- 2,500,001-3,000,000
- 2,000,001-2,500,000
- 1,500,001-2,000,000
- 1,000,001-1,500,000
- 500,001-1,000,000
- 250,001-500,000
- 0-250,000
- Not currently in use

EUI (kBtu/sqft.yr)



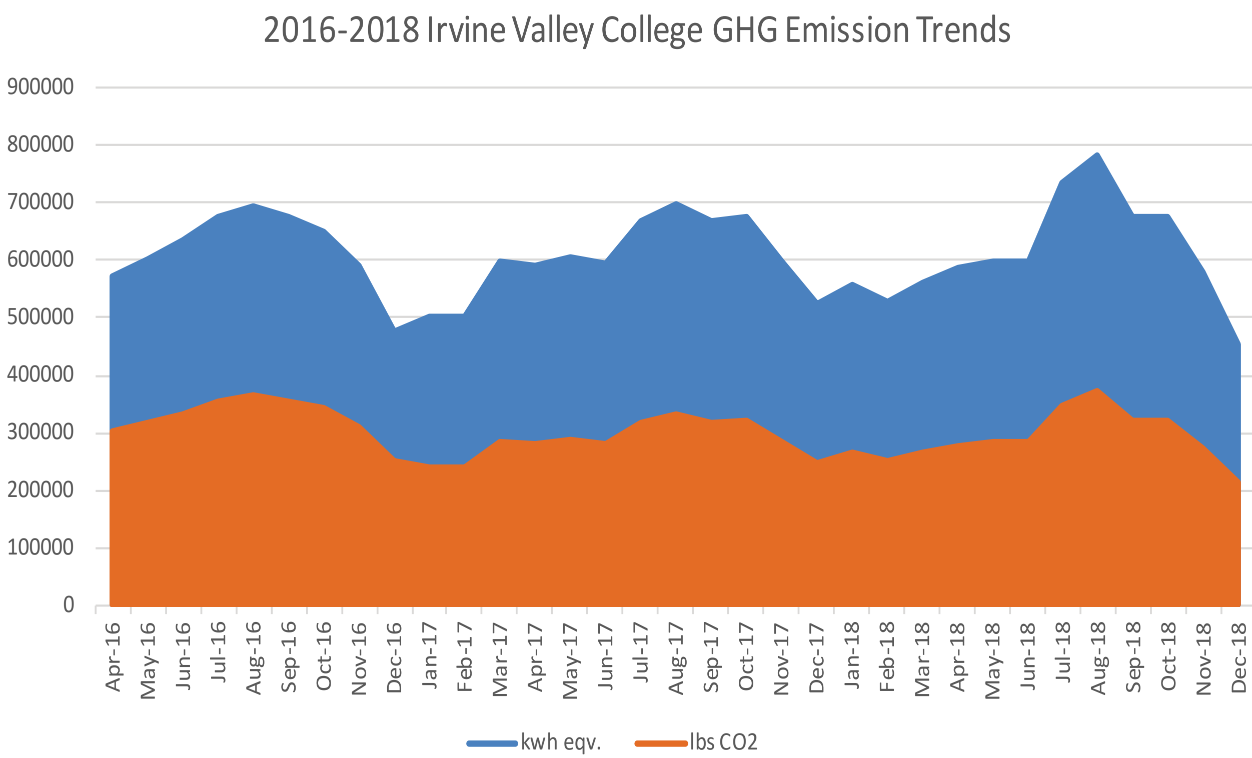
Note: This image shows two distinctive elements for each building. The first uses the color scale to show the actual energy consumption of the building per year (in kBtu). The second uses the height of the buildings to depict the Energy Use Intensity. Since buildings with larger area naturally consume more energy, EUI values provide a method of normalizing the consumption by dividing the energy consumption per year by the area of the building.

[ENERGY ANALYSIS - EUI COMPARISON OF ALL CAMPUS BUILDINGS]



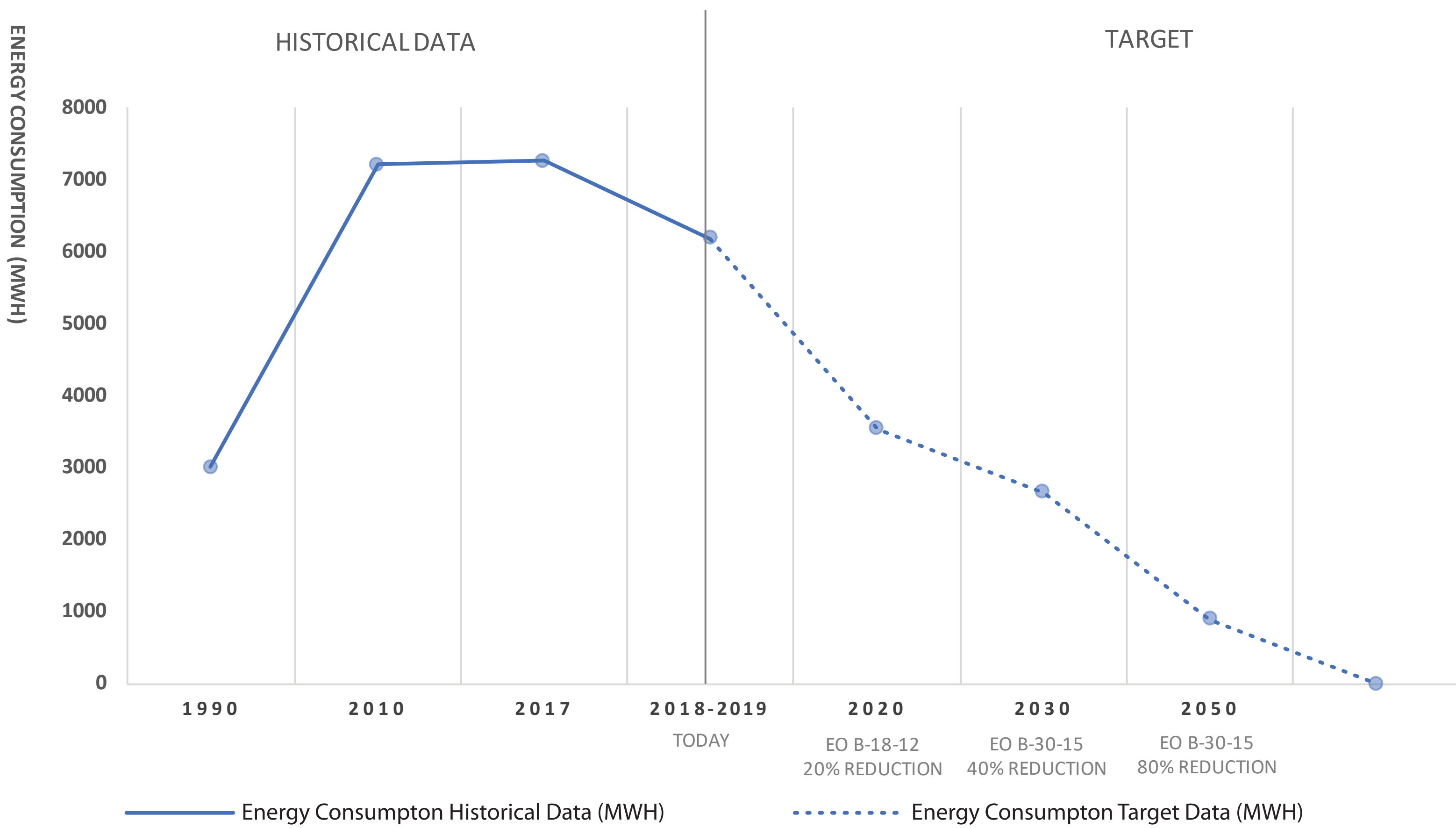
The Commercial Buildings Energy Consumption Survey (CBECS) is a sample survey that collects energy usage information from the existing U.S building stock. The survey provides the average EUI of similar buildings located in the same climate zone and therefore can be used for benchmarking. Currently, approximately 38% of the college's buildings are more efficient than the CBECS benchmark. Should the college achieve their 25% reduction in energy goal, over 75% of the buildings will be more efficient than the CBECS benchmark.

[CLIMATE ACTION PLAN- HISTORICAL MONTHLY GREENHOUSE GAS EMISSION TRENDS]

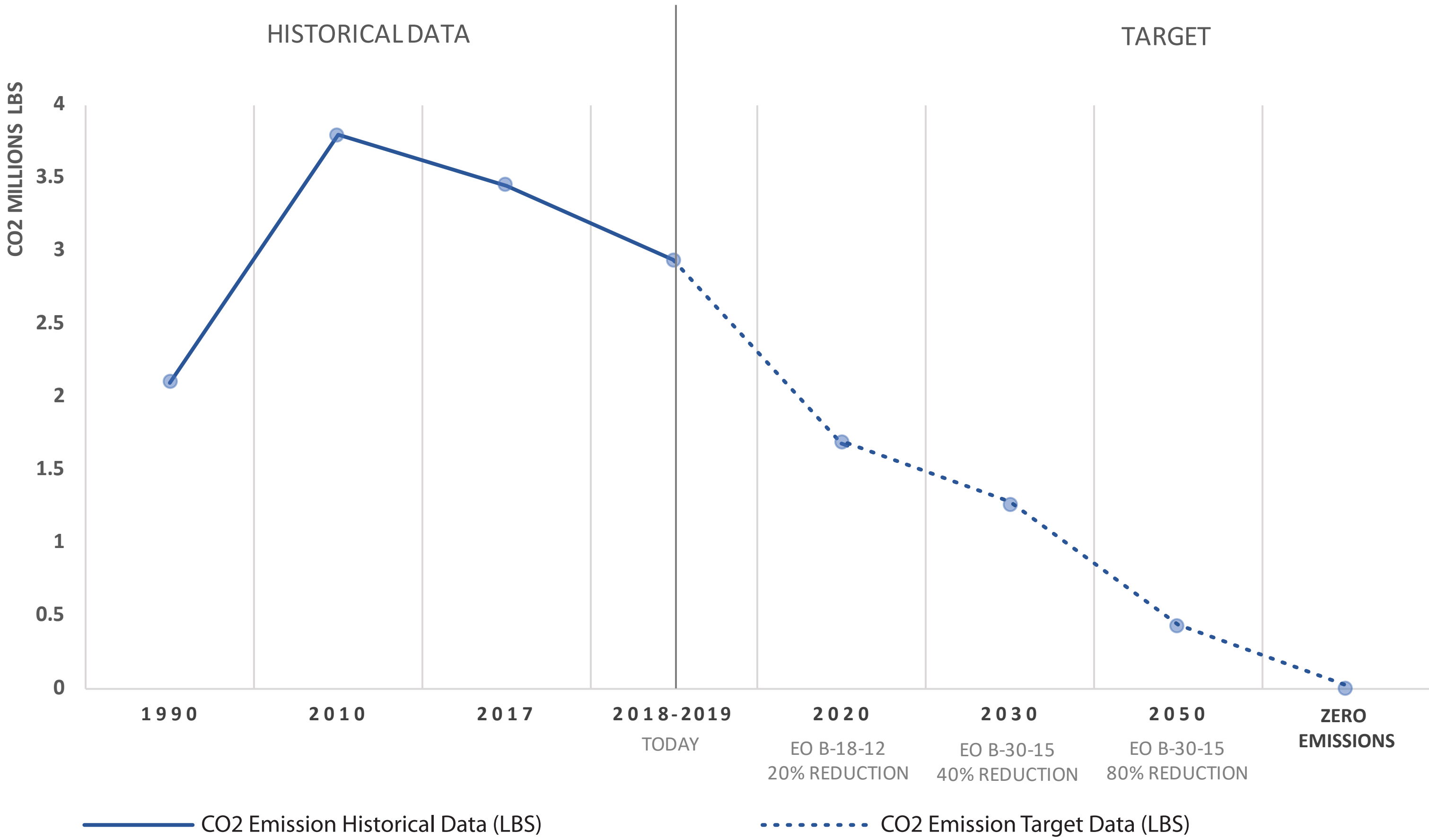


This figure depicts the monthly trend in GHG emissions levels between April 2016 and December 2018 at Irvine Valley College based on monthly utility consumption. There is a wide variation in GHG emissions from month-to-month. The more in-depth study was conducted to help better understand building-by-building energy consumption. There is a strong correlation between energy use reduction measures and GHG reductions. The goals and strategies outlined in the Plan will support the development of further measures that can be taken and projects that can be implemented to continue the college's effort towards reducing GHGs and the eventual goal of carbon neutrality.

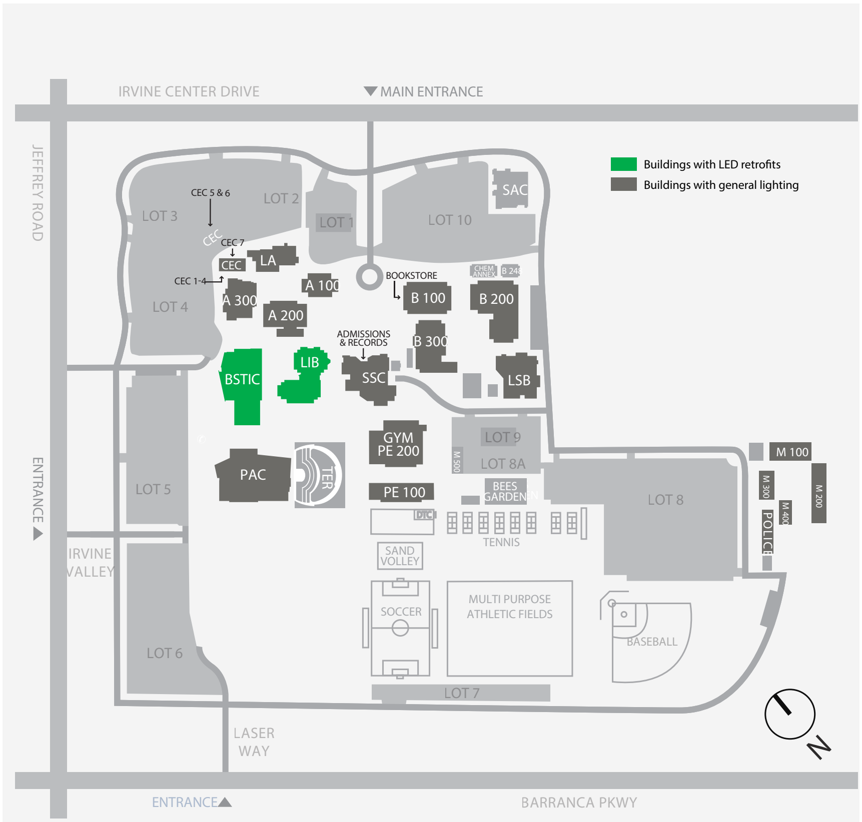
RECORDED AND PROJECTED DATA FOR ENERGY CONSUMPTION

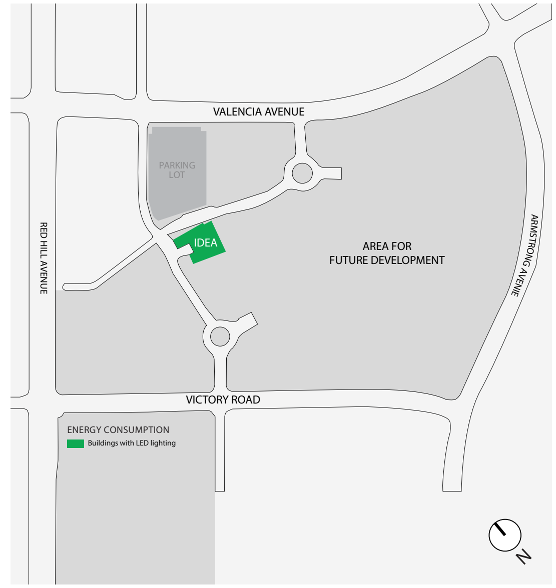


RECORDED AND PROJECTED DATA FOR CO2 EMISSION

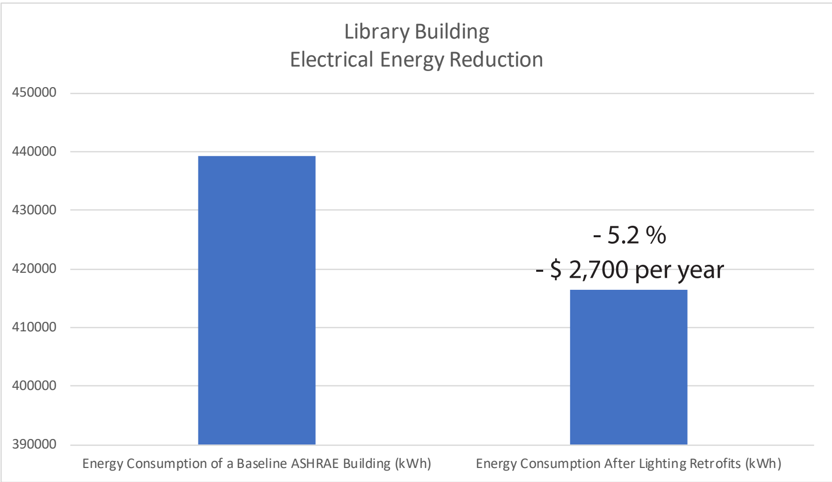


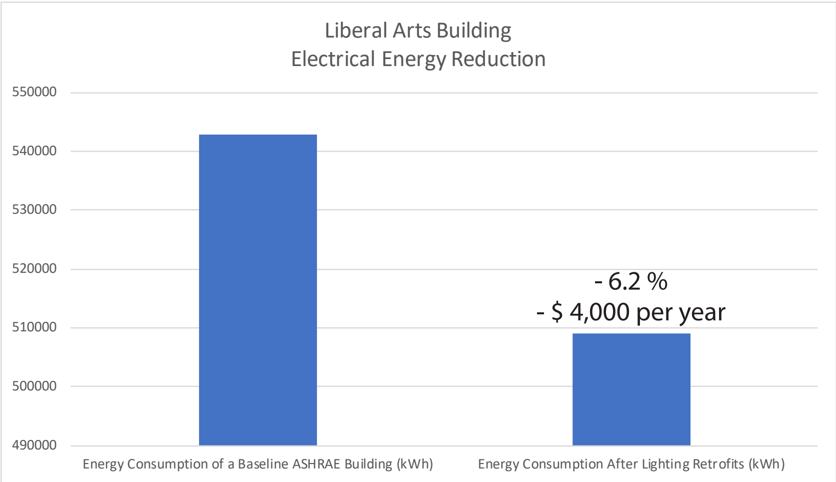
[STRATEGIES FOR MODERNIZATION - COMPLETED LIGHTING RETROFITS PROJECTS]



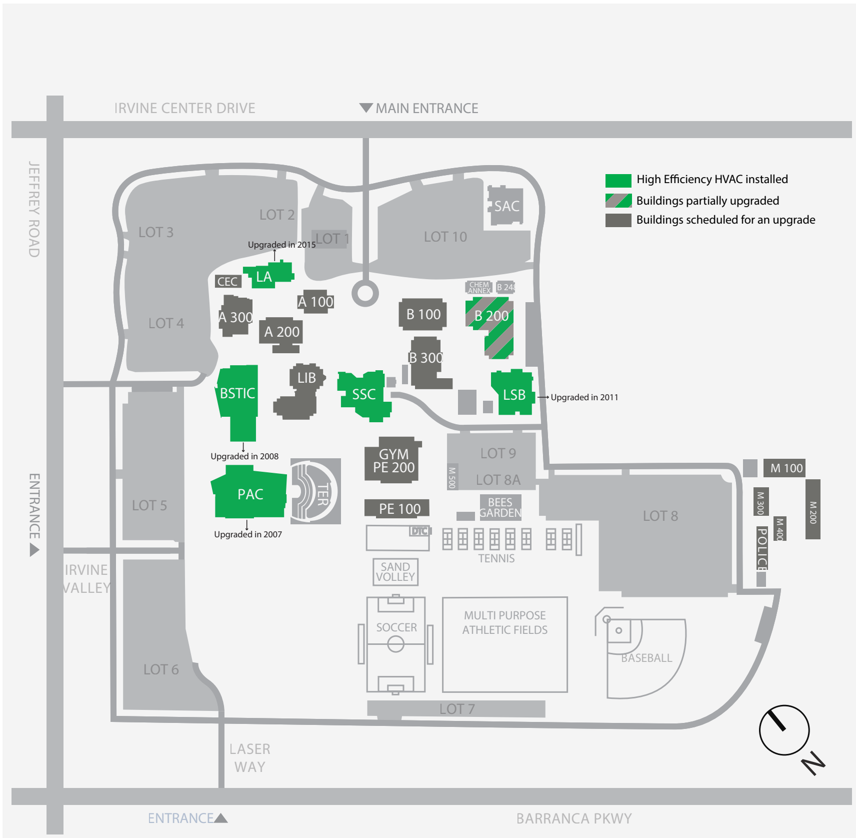


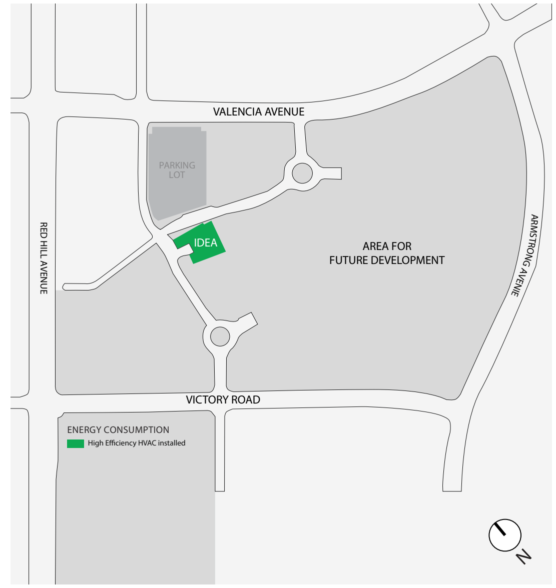
[STRATEGIES FOR MODERNIZATION - COMPLETED LIGHTING RETROFIT PROJECTS]



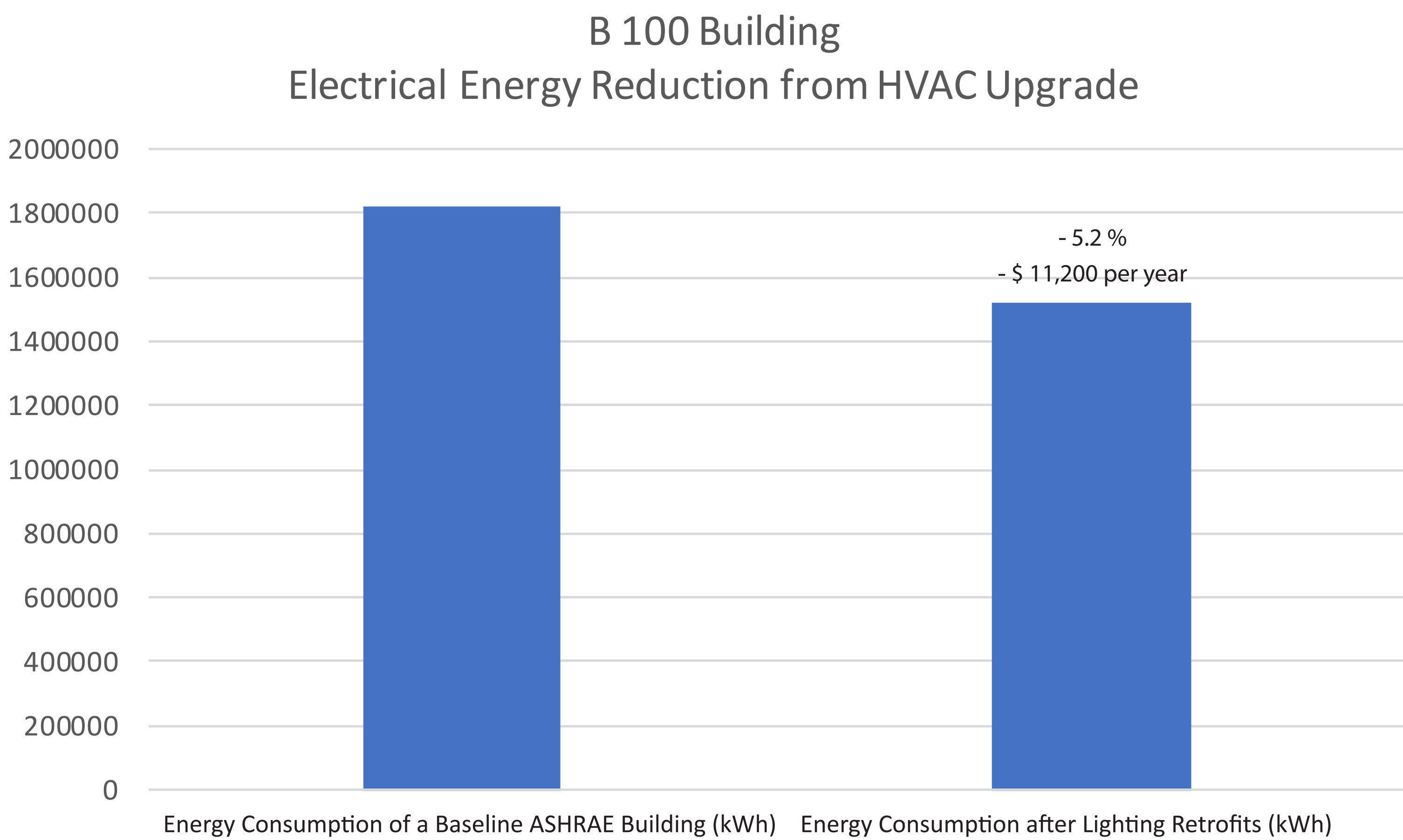


[STRATEGIES FOR MODERNIZATION - HIGH EFFICIENCY HVAC PROJECTS]

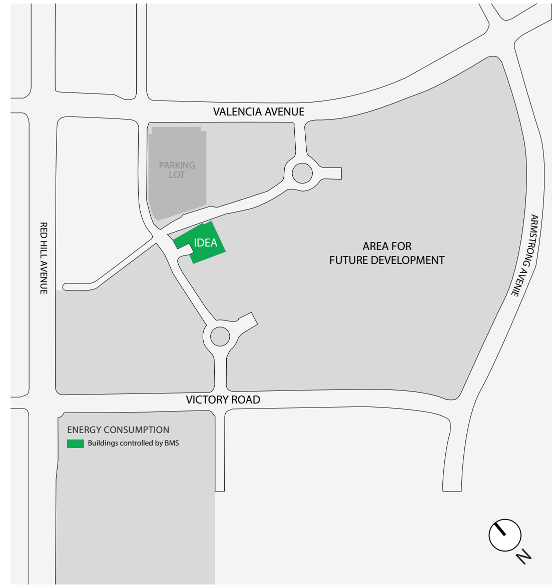




[STRATEGIES FOR MODERNIZATION - HIGH EFFICIENCY HVAC PROJECTS]

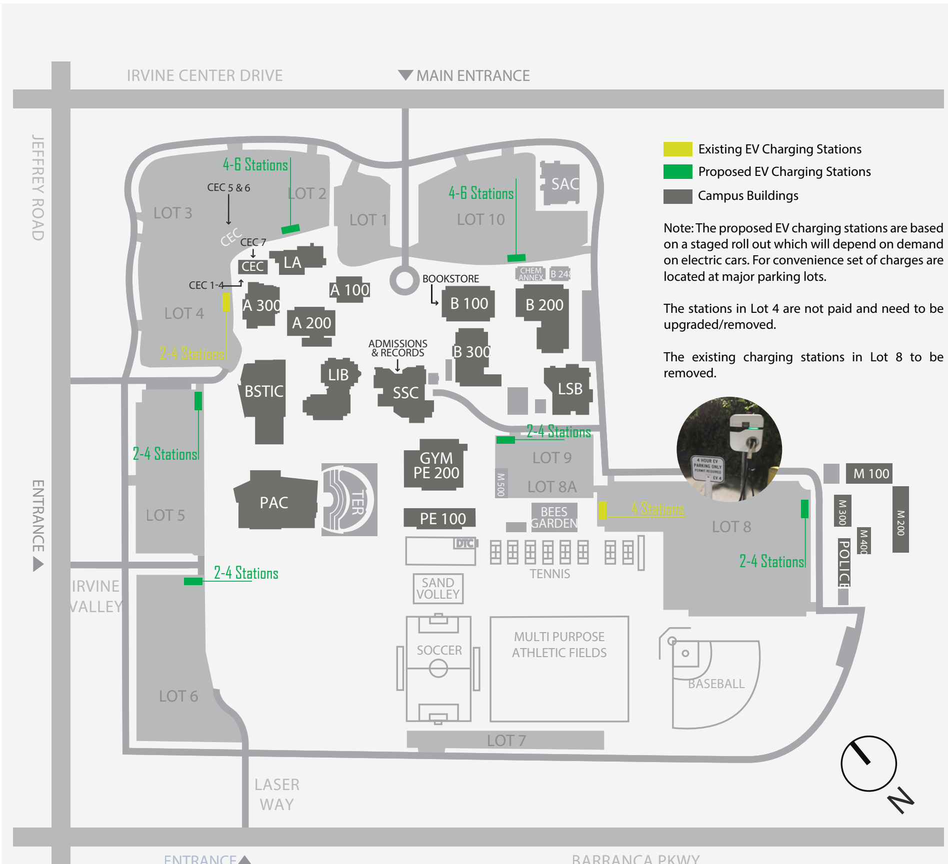


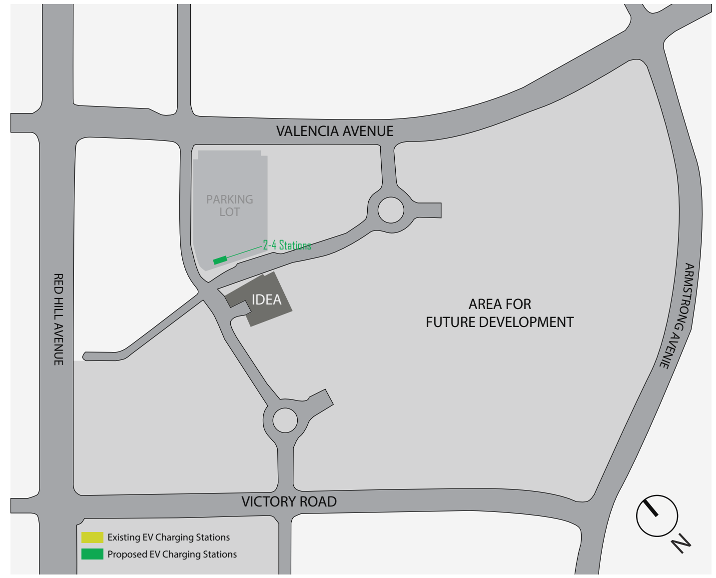
[STRATEGIES FOR MODERNIZATION - BUILDING MANAGEMENT SYSTEM]



The college has a campus-wide Building Management System (BMS). The graphic shows which buildings are connected to the central BMS and those that are not.

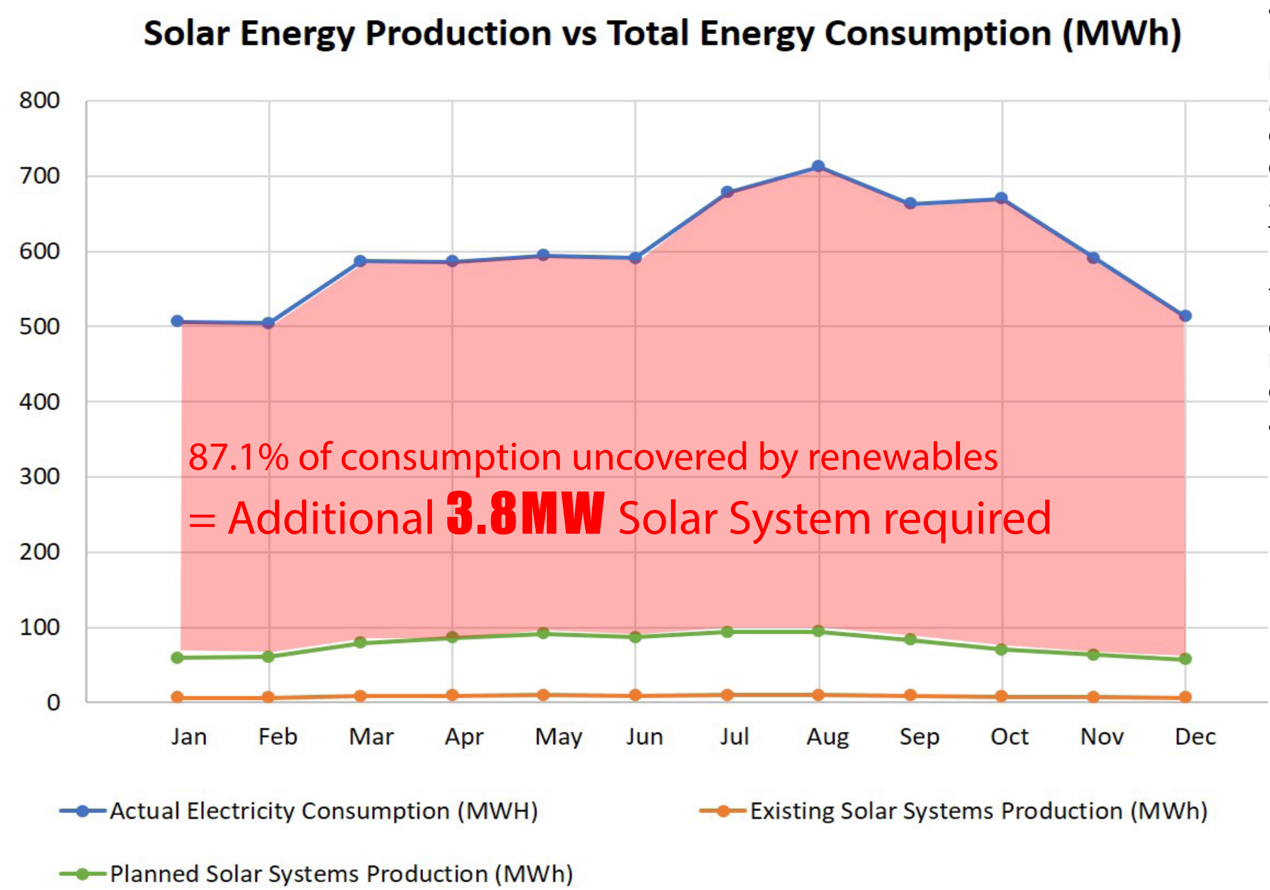
[STRATEGIES FOR MODERNIZATION - EV CHARGING STATION]





Electric charging stations are required by Title 24 Energy Code in all new parking lots. An electrical rate determined by the college will provide constant revenue. Depending on the rate charged to the consumer, the payback is usually less than 2 years and more importantly it encourages the use of clean vehicles, thereby reducing the carbon footprint and providing a positive image of an eco-friendly college.

[REACH TO ZERO NET ENERGY - SOLAR ENERGY DEMAND AT IVC]

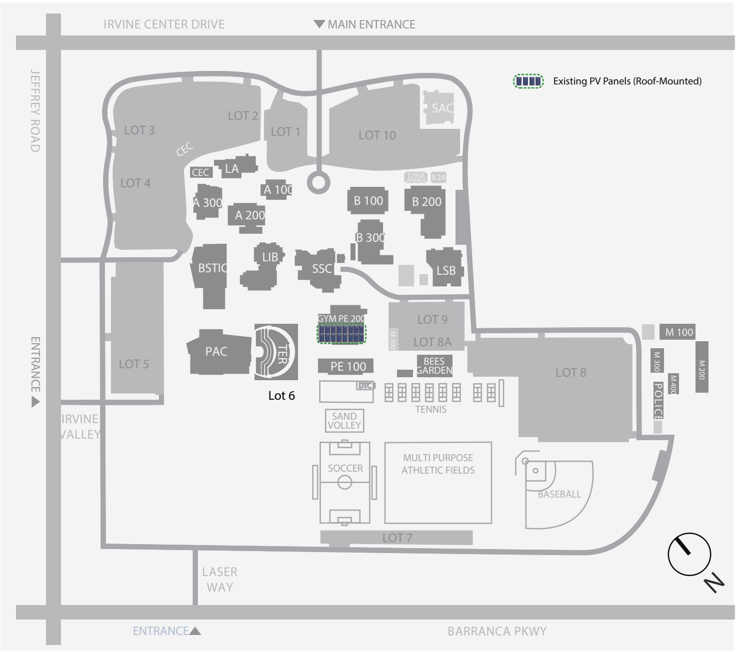


As shown in the diagram, the existing and proposed solar systems will provide 12.9% of the total electricity consumed by the campus. An additional 6,267.76 MWh of electricity is needed to be covered to reach the goal of zero net energy*, which means an additional 3.8MW solar system is needed in the future planning.

*Note: Zero Net Energy is an energy efficient campus where the annual renewable energy generated on the campus is equal or more than the amount of energy consumed

[REACH TO NET ZERO ENERGY- EXISTING SOLAR PV SYSTEMS AT IVC]

Roof Mounted PV system at PE-200



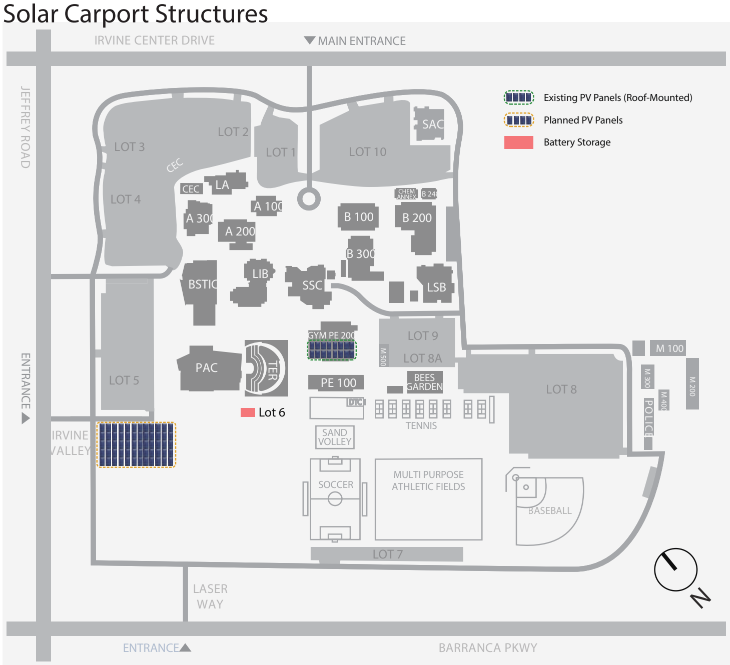
RESULTS

97,509 kWh/Year*

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	4.07	5,772	682
February	4.68	6,078	718
March	5.81	8,337	985
April	6.67	9,194	1,086
May	7.07	10,073	1,190
June	7.28	9,737	1,150
July	7.52	10,343	1,222
August	7.52	10,329	1,220
September	6.58	8,778	1,037
October	5.18	7,147	844
November	4.61	6,249	738
December	3.77	5,471	646
Annual	**5.90**	**97,508**	**$ 11,518**

[REACH TO NET ZERO ENERGY- PLANNED FUTURE SOLAR PV SYSTEMS AT IVC]

Solar Carport Structures

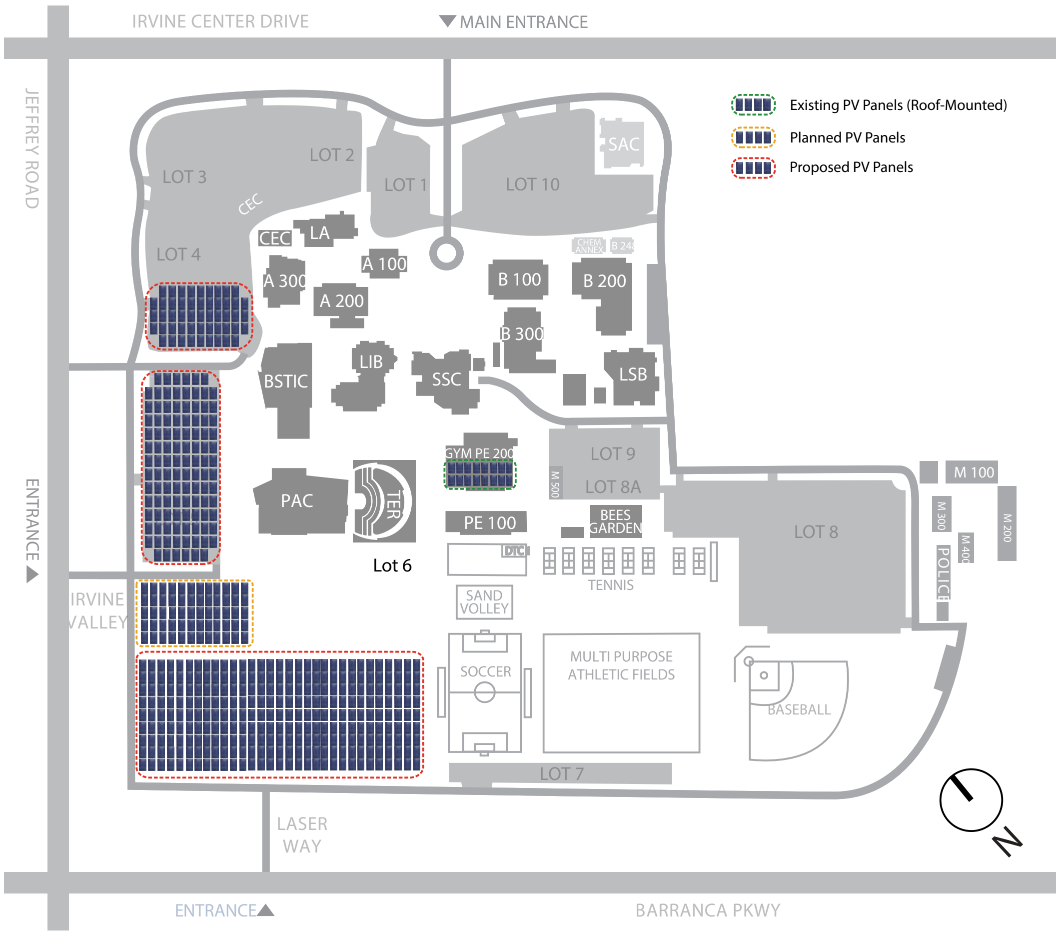


RESULTS

812,572 kWh/Year*

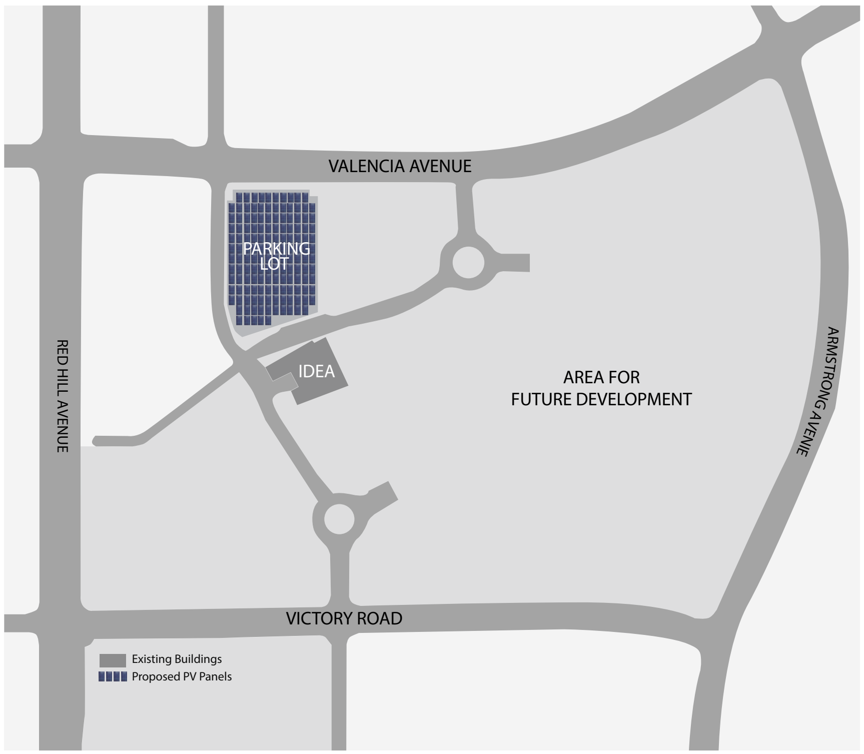
Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	4.07	48,096	5,680
February	4.68	50,653	5,982
March	5.81	69,477	8,205
April	6.67	76,617	9,048
May	7.07	83,939	9,913
June	7.28	81,141	9,583
July	7.52	86,193	10,179
August	7.52	86,078	10,166
September	6.58	73,150	8,639
October	5.18	59,562	7,034
November	4.61	52,077	6,150
December	3.77	45,589	5,384
Annual	**5.90**	**812,572**	**$ 95,963**

[REACH TO NET ZERO ENERGY - PROPOSED FUTURE PV LOCATIONS AT IVC]



PV panels should be part of a car port structure. This provides shading for the cars and can easily be phased as a stand alone project. Placing PV panels on existing roofs is not recommended because it will effect the building structure and will trigger a DSA structural upgrade.

[REACH TO NET ZERO ENERGY - PROPOSED FUTURE PV LOCATIONS AT ATEP]



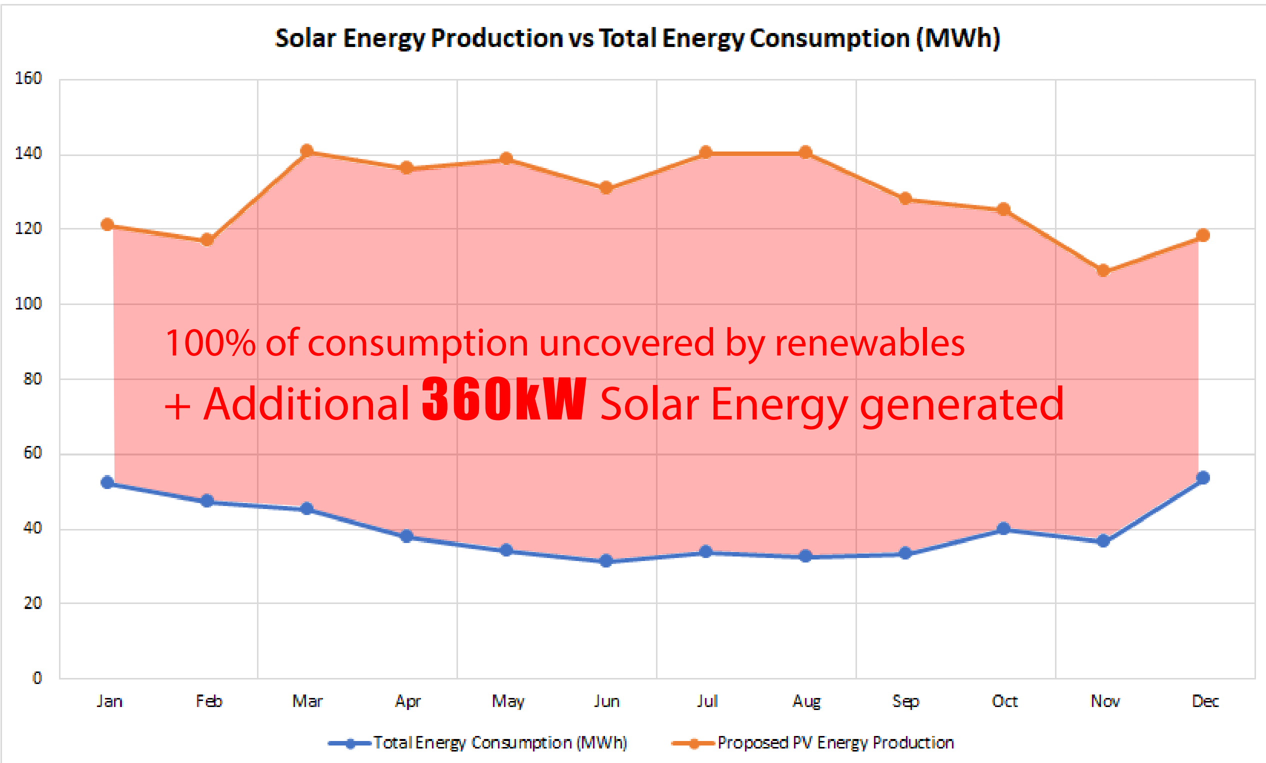
RESULTS

1,068,148 kWh/Year*

System output may range from 1,038,026 to 1,084,063 kWh per year near this location.

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	4.52	68,907	8,269
February	4.92	69,495	8,339
March	6.30	95,535	11,464
April	6.63	98,392	11,807
May	6.86	104,748	12,570
June	6.95	99,418	11,930
July	7.25	106,641	12,797
August	7.43	108,000	12,960
September	6.63	94,701	11,364
October	5.69	85,411	10,249
November	4.91	72,283	8,674
December	4.11	64,617	7,754
Annual	**6.02**	**1,068,148**	**$ 128,177**

[REACH TO ZERO NET ENERGY - SOLAR ENERGY DEMAND AT ATEP]



As shown in the diagram, the proposed solar systems will provide over 200% of the total electricity consumed by the campus. An additional 591.33 MWh of electricity is generated which can be used to power future development. This would make the campus a Net Positive campus.

[REACH TO NET ZERO ENERGY - LIFE CYCLE ANALYSIS]

IRVINE VALLEY COLLEGE

System Size: 3800 kW
Annual Generation: 6,275,689 kWh/year
Required PV Area: 3800 kW * 100 sqft/kw = 380,000 sf

Initial PV Cost: $ 3180 /kW x 3800 kW = $ 12,084,000
Annual O & M: $ 19 /kW-yr x 3800 kW = $ 72,200
Annual Payback: 6,275,689 kWh/yr x $ 0.12 /kWh = $ 753,082

ROI (excluding rebate):
$ 12,084,000 / ($ 753,082 - $ 72,200) = 17.6 yrs

ADVANCED TECHNOLOGY EDUCATION PARK

System Size: 650 kW
Annual Generation: 1,068,148 kWh/year
Required PV Area: 650 kW * 100 sqft/kw = 65,000 sf

Initial PV Cost: $ 3180 /kW x 650 kW = $ 2,067,000
Annual O & M: $ 19 /kW-yr x 650 kW = $ 12,350
Annual Payback: 1,068,148 kWh/yr x $ 0.12 /kWh = $ 128,177

ROI (excluding rebate):
$ 2,067,000 / ($ 128,177 - $ 12,350) = 17.8 yrs

RESULTS

6,275,689 kWh/Year*

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	4.49	400,447	48,054
February	5.01	409,757	49,171
March	5.99	538,606	64,633
April	6.73	582,548	69,906
May	6.93	619,378	74,325
June	6.98	586,725	70,407
July	7.37	636,331	76,360
August	7.42	638,762	76,651
September	6.76	565,430	67,852
October	5.51	477,349	57,282
November	5.04	431,062	51,727
December	4.24	389,294	46,715
Annual	6.04	6,275,689	$ 753,083

IRVINE VALLEY COLLEGE PV Production

Note: Typically PV panels have a warranty of 25 years and the inverter of 10 years. The panels decrease in efficiency output approximately 1% year per year. Therefore the only regular maintenance required depends on the location of the PV panels, typically PV panels should be hosed down twice a year to remove the dust. The District may finance the PV system from the District Capital Outlay Fund. This would enable the college to gain all the savings from the generation of power. However, adding PV panels may have financial implications that need to be analyzed.

Performing Arts Building

STRATEGIES

This section provides a broad framework for implementing energy solutions that deliver maximum savings and operating cost efficiencies, in alignment with institutional needs and California's loading order. Highlighted are varied technologies that address energy efficiency, energy conservation, renewable energy and renewable energy production across all campus buildings and infrastructure. Additionally, this section presents a holistic approach to energy planning by emphasizing the importance of Energy Design Guidelines for new construction as well as the value of stakeholder engagement as a driving force for positive outcomes.

This Section Includes:

36 Climate Analysis

43 Campus Level Energy Efficiency

46 Building Level Energy Recommendations

48 Lighting Hardware and Controls

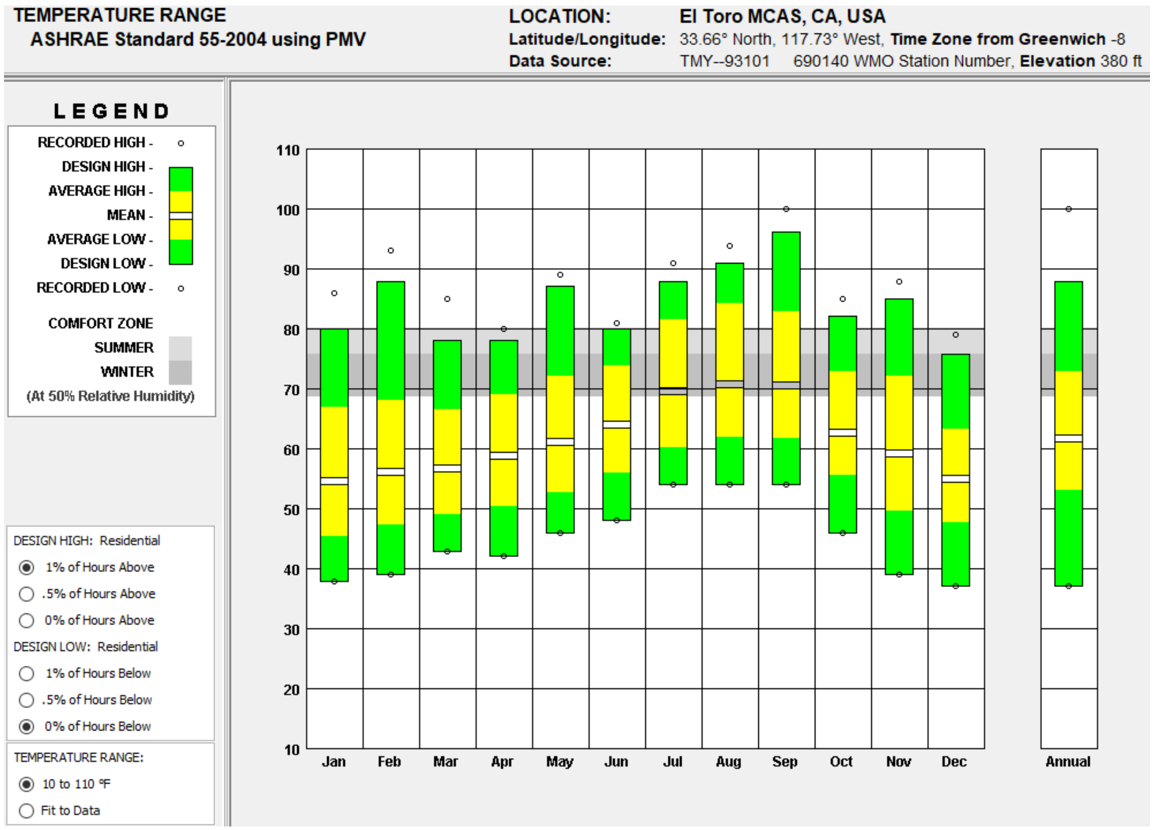
49 Demand Response

51 Battery Energy Storage

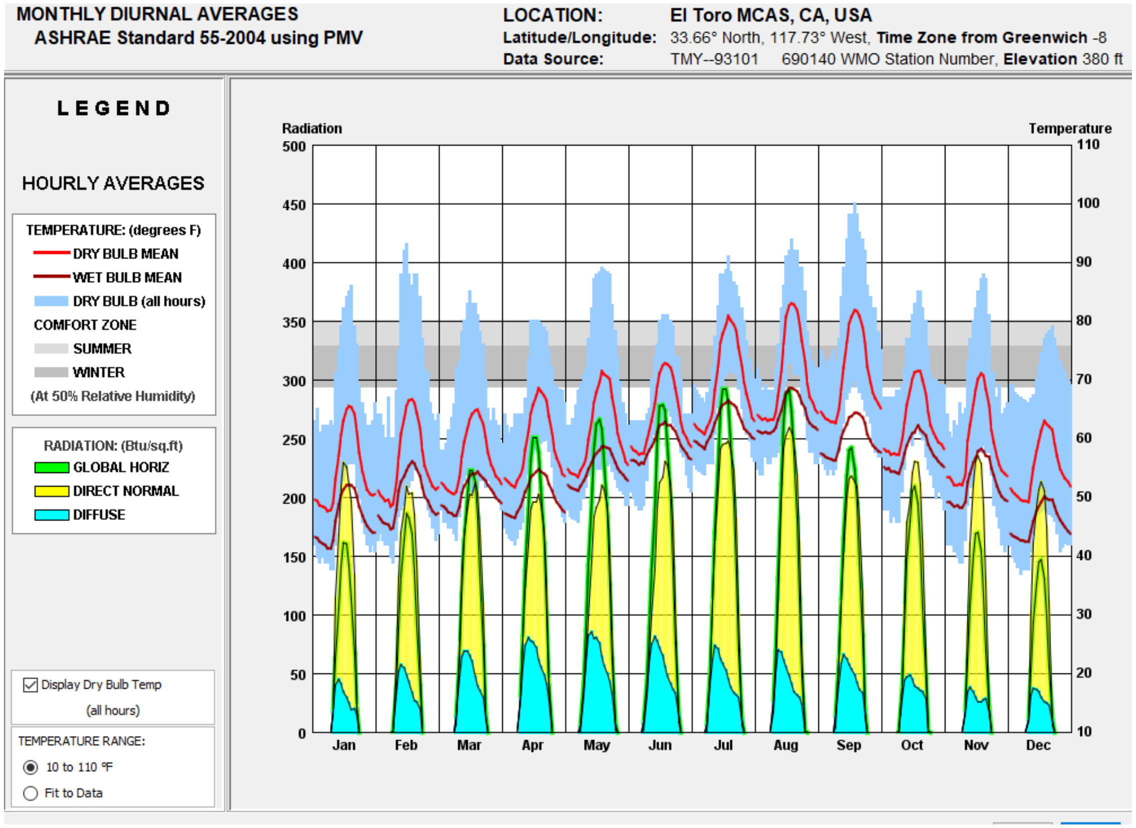
52 Building Management Systems

53 Water Conservation Efforts

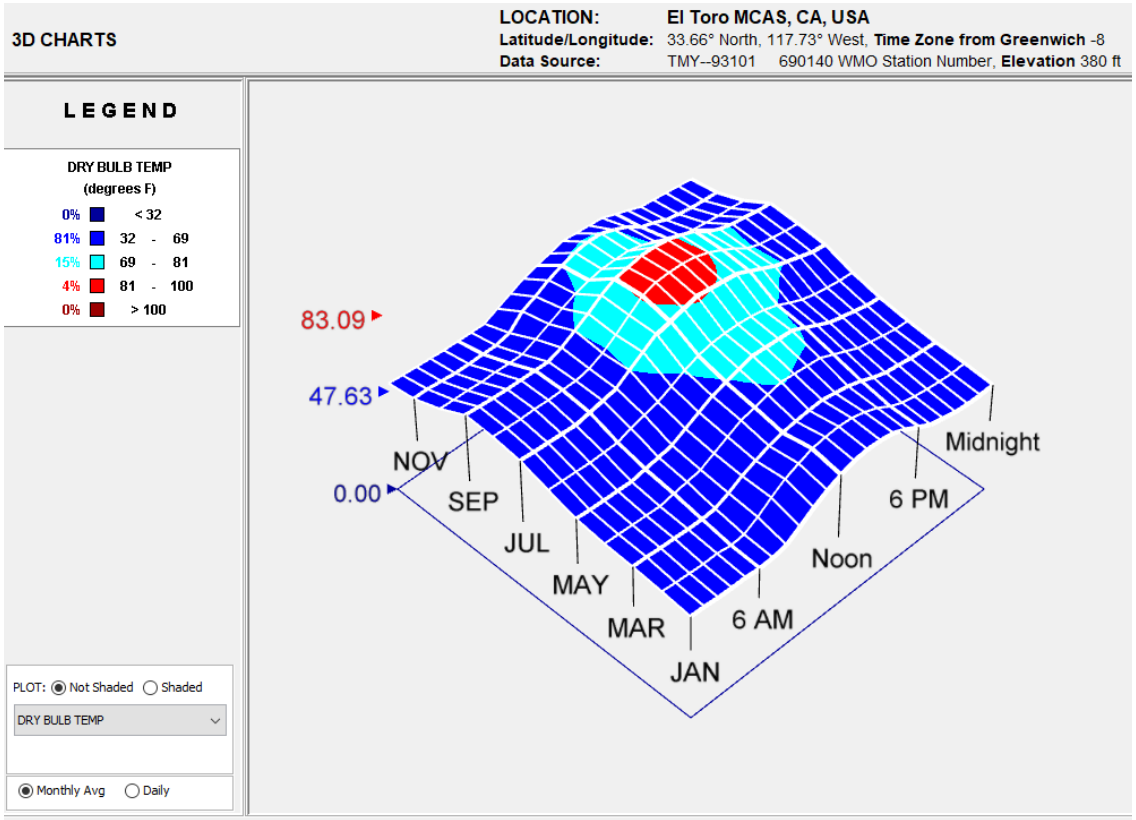
[CLIMATE ANALYSIS]



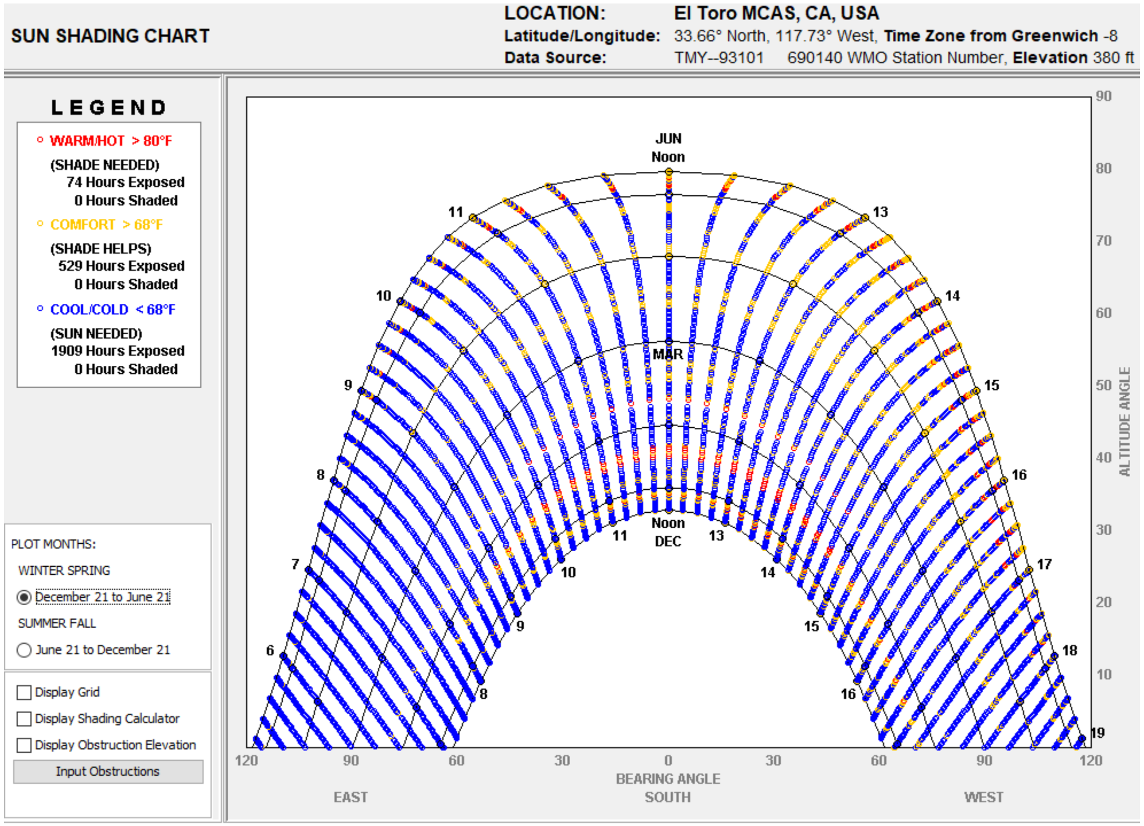
A climate analysis was performed to assess if the climate can be used to reduce the energy needed to cool and heat the buildings. The graph on the left shows the outside temperature against month of the year. The peak temperature can reach as high as 100F when mechanical cooling will be required. During winter the temperature can fall as low as 38F as denoted by the small circle when heating will be required. These are extreme conditions however the average temperature is shown by the white bars with green shade depicting upper and lower limits. Most of the time of the year the climate is moderate so that outside air can be used to cool the building (i.e. economizer mode). There is also a need for heating however this can may be achieved by heat provided by internal gains such as lighting, people etc.



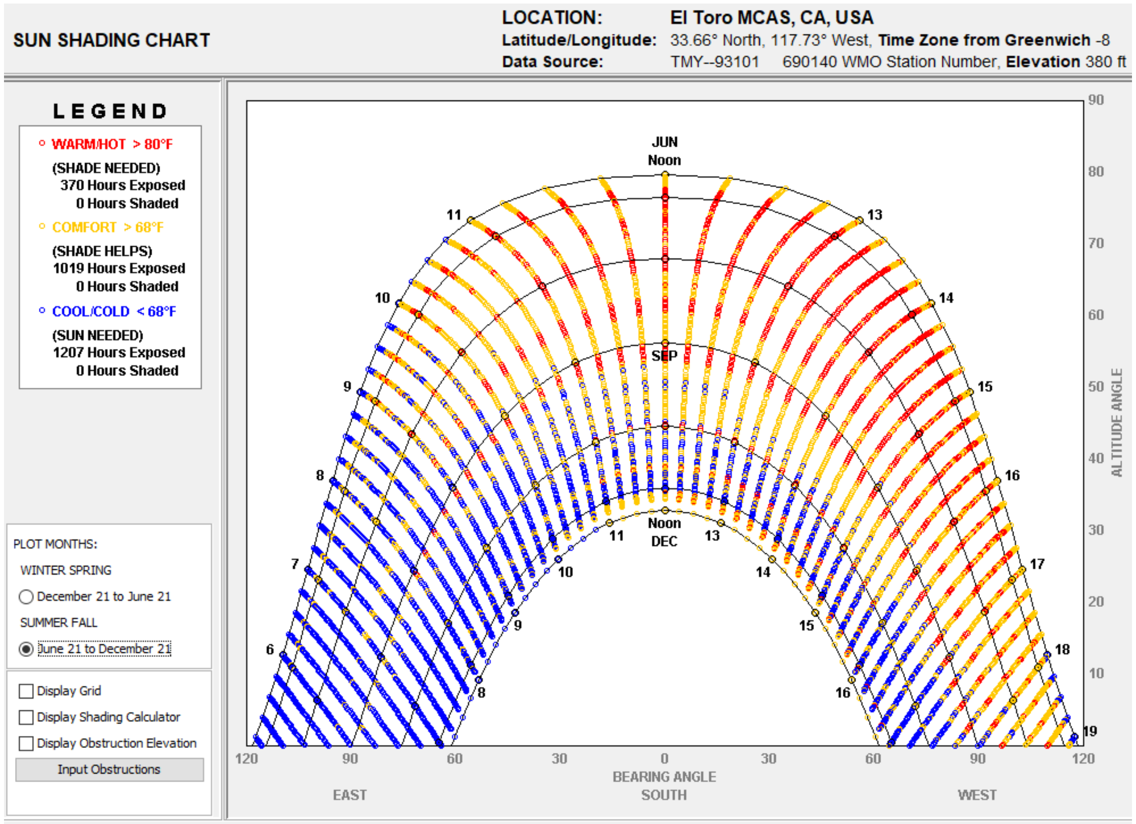
This graph shows the temperature range experienced during the month, this range can be used to justify thermal mass strategies. Thermal mass structures are those that include concrete, masonry, or other thermal mass assemblies which can store solar energy during the day and re-radiate it at night. This averages out the diurnal extremes. The building is cooled during the night when the temperature drops and the cold structure slows the heat from entering the building during the day, thus reducing the energy required to cool the building.



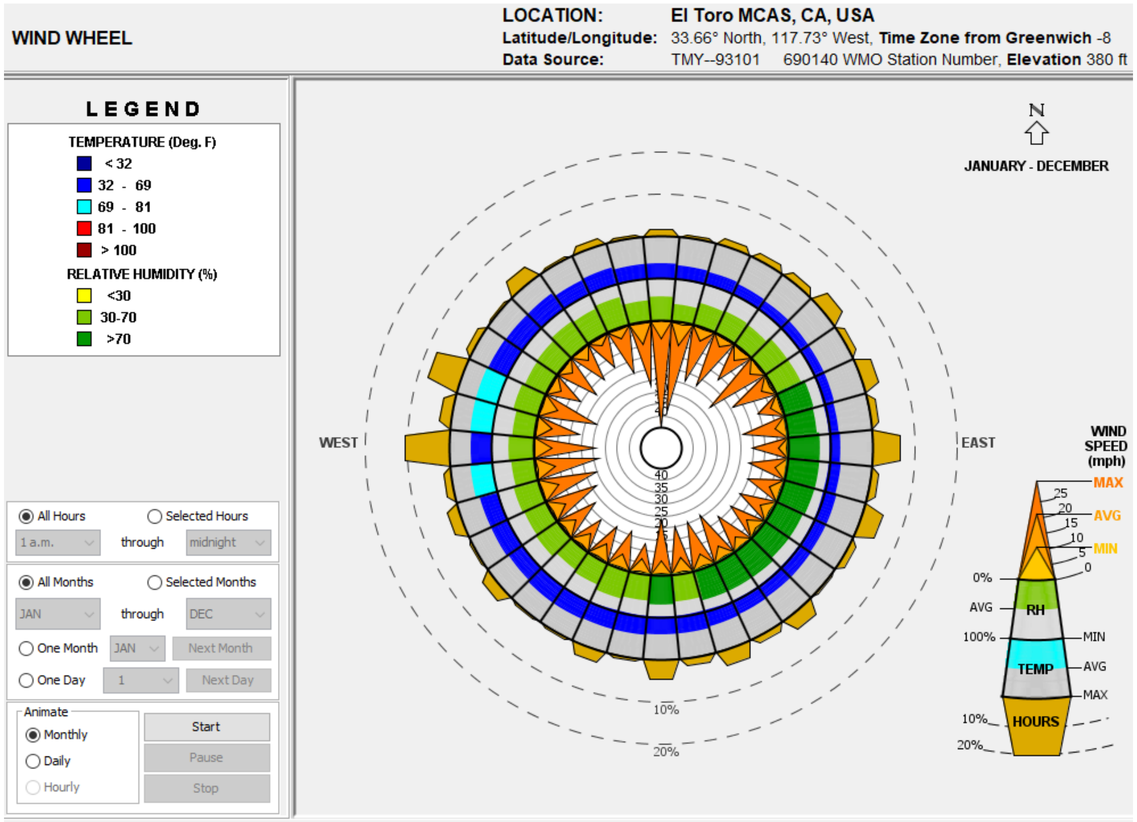
The image above provides a 3-D representation of outside temperature at monthly intervals and time of day. The red circle shows that the temperature can reach between 91F- 100F for only 4% of the time in the year in September during noon and 4:00pm period. This gives an indication on the cooling and heating requirements for the buildings.



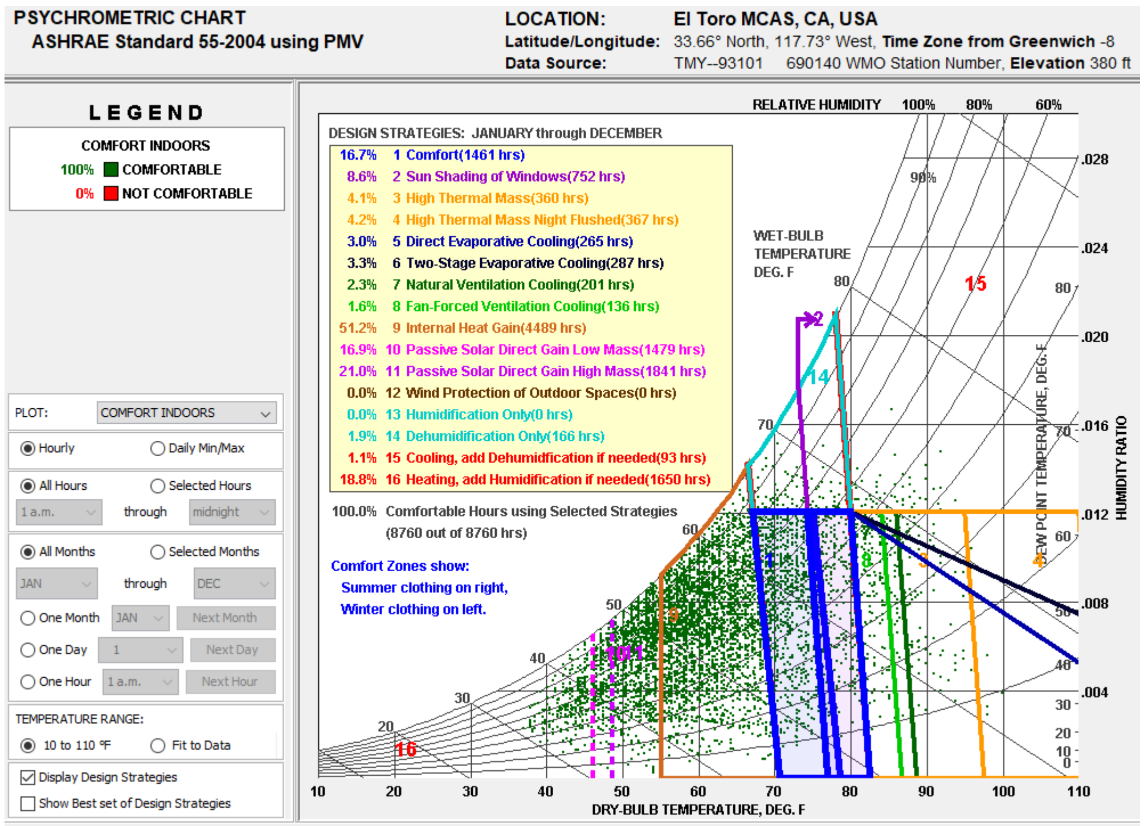
As the sun rises in the east and sets in the west it delivers different levels of sun intensity to the building. This chart plots the path of the sun during December 21st to June 21st and shows the temperature for most of the time is less than 68F. Therefore, shading is not required for that period.



This chart differs from the previous one and is for summer months from June 21st to December 21st. It shows that shading is needed for 370 hrs of the year.



This wind study indicates that there is a breeze of approx. 25 mph for less than 5 % of the year. This is insufficient to drive a wind turbine and therefore this technology should not be considered as a viable option in generating renewable power.



The strategies above show that for approx 17% of the time the outside climate is within the comfort conditions of the inside, so that the windows can be opened or the ventilation fans of the Air Handling Units can be used to bring in cool air without cooling.

It also demonstrates that 37% of the time the building would benefit with thermal mass. Typically high thermal mass construction is concrete, which has the property to slow the heat entering the building, when it does several hours later, it's evening and the windows can be opened to cool the space. If windows are not preferred then a night flushing strategy can be used instead.

[CAMPUS LEVEL ENERGY EFFICIENCY]

As designated in California's loading order, energy efficiency is the state's top priority for meeting its energy needs and for strengthening its notable economic prosperity and quality of life for all Californians. Energy efficiency is recognized for producing substantial savings in relation to implementation costs. In alignment with the loading order priorities and an ongoing desire to reduce energy consumption and costs, the college consistently seeks to identify energy efficiency projects that are scalable, cost-effective and support broader campus efforts toward increased sustainability and improved energy performance. Once identified, these projects are to be strategically implemented in a phased approach making sure to verify planned-for energy efficiency outcomes so that future adjustments can be made as needed.

The first step for identifying viable energy efficiency measures is to conduct a building-by-building analysis across campus, pairing energy modeling for each building with mechanical equipment surveys while also considering building size and age. Small and medium buildings ranging from 10,000 square feet to 25,000 square feet present challenges and potential dollar savings limits because the cost of an energy audit is fixed by the amount of time an auditor needs to survey the building. For buildings of this size, the savings can be more challenging because of a small overall footprint and related low energy usage. To ensure cost effective retrofits for these types of buildings, it is critical to provide streamlined energy surveys to minimize engineering time on site and maximize energy savings on energy projects.

Buildings that are larger than 25,000 square feet will benefit from an ASHRAE Level 2 audit which is likely to yield highly accurate results and recommendations. ASHRAE Level 2 audits should integrate the audit, scope of work, project management commissioning, and measurement and verification (M&V). Based on typical performance, each building larger than 25,000 square feet should benefit by way of a 10 to 20 percent reduction in cooling, heating and domestic hot water energy, upon implementation and commissioning.

Projects Planned for Completion 2019-2020

Project Name	Budget Amount
Health Center	$ 7,500,000

ASHRAE ENERGY AUDIT

ASHRAE Level 1 Energy Audit

Smaller buildings with smaller HVAC equipment and lower energy usage have fewer cost effective solutions available to reduce energy consumption. However, substantial results can still be achieved by investigating all rebates and incentives that are available for specified small projects in addition to conducting a complete energy survey through an ASHRAE Level 1 Energy Audit. When conducting such an audit on more than one building it is prudent to aggregate multiple buildings through an identified overall energy efficiency strategy.

ASHRAE Level 2 Energy Audit with Implementation and M&V

An ASHRAE Level 2 Energy Audit is designed to uncover the most cost-effective measures and projects for a particular facility. As a result, this level of audit typically includes recommendations to modify three or more types of equipment for the facility under review. In general, energy projects in buildings that are large enough for ASHRAE Level 2 Energy Audits have included one or more of the following upgrades shown on the right.

Note:
Rebates and Incentives are continuously changing so it is best to check websites
SCE website: https://www.sce.com/residential/rebates-savings/rebates
California Energy Commission:
https://www.energy.ca.gov/funding-opportunities/funding-resources

- Low pressure drop air filtration
- Supply air temperature reset
- Duct static pressure reset
- Duct sealing
- Automated scheduling
- Demand control ventilation (CO or CO_2 based)
- Optimizing outside air usage
- Repairing economizers
- Non-integrated to integrated economizers
- Allowing outside air to go to 0% during warm up periods
- Outside air based boiler lockout
- Outside air based chiller/ compressor/cooling tower lockout
- Interior lighting retrofit
- Exterior lighting retrofit
- Lighting occupancy controls
- Lighting daylighting controls
- Motor replacement
- VFD installation on supply fans
- VFD installation on return/ exhaust fans
- VFD installation on pumps
- VFD installation on cooling tower fans
- VFD installation on compressors
- Web bulb temperature reset on cooling towers
- Pump optimization and right sizing
- HVAC equipment retrofits
- Computer server room optimization
- Window films
- Hot water heater replacement
- Electric transformer retrofit
- Duct sealing
- Pneumatic to DDC conversions
- Adjusting zone temperature deadbands
- Installing energy management system
- Repairing/replacing sensors in an existing energy management system
- Repairing compressed air leaks

Conducting an ASHRAE Level 2 Energy Audit will identify the best possible combination of core project opportunities and, additionally, will define a tailored implementation package for each building. The ASHRAE Level 2 process will determine the exact mix of energy efficiency measures best suited for each building. Measures might range from simple lighting retrofits to deeper capital-intensive projects that can have positive implications throughout the campus and within the central plant.

As appropriate, the college should employ an integrated energy firm to install data loggers for each building to monitor energy consumption for a minimum period of 4 - 6 months. Monitoring should be used to confirm appropriate cost-effective strategies that include a payback analysis and deliver guaranteed savings. The vendor shall maximize all rebates, incentives and tax credits. In addition to identifying and implementing project opportunities, a rigorous data intensive commissioning and measurement & verification procedure should be built into the energy audit process for every building. For each building, electric and natural gas meters, as well as chilled water valve sensors should be installed. These meters and sensors should have the ability to communicate with the EMS. Having these technologies in place will assist in tracking usage and trends and will also help identify areas that have the most efficient return on investment strategies.

Natural light inside Irvine Valley College Library

[BUILDING LEVEL ENERGY RECOMMENDATIONS]

Perform an ASHRAE Audit, Type 2 for all buildings. Provide building systems commissioning as described in the Major Renovations checklist. Add lighting controls to the building management system.

BUILDINGS WITH EUI OVER 100 KBtu/sqft

B 300, SSC, B 200, B 100, A 300:, Fine Arts, LA, LSB, PAC, A 100, BSTIC

Prioritize passive solar design, passive cooling strategies and daylighting. Buildings built before 1990 might require an envelope upgrade.

- Maximize daylighting and minimize direct sun penetration- solar protected windows, skylights, light shelves (S, SE, SW façades)
- Implement daylighting controls, occupancy sensors and timers
- Upgrade to LED fixtures (B 300, SSC, B 200, B 100, A 300, LSB, PAC, A 100, BSTIC)
- Consider using high-emissivity roofing or PV panels to reduce heat load on roofs
- Redesign passive shading devices to block solar heat gain while admitting sunlight
- Improve envelope performance:
    - o Increase R-value of walls, roof, windows and floors
    - o Minimize thermal bridging
    - o Improve building airtightness
    - o Use high performance windows
- Consider using high thermal mass to store heat and to drive night flush ventilation
- Specify efficient office equipment and appliances to reduce plug loads and consider establishing a plug load budget
- Consider using solar water heating systems

BUILDINGS WITH EUI OVER 50 KBtu/sqft

PE 200, A 200, PE 100, LIB, CEC, CP 100

Prioritize passive cooling and daylighting strategies. Buildings built before 1990 might require an envelope upgrade.

- Maximize daylighting and minimize direct sun penetration- solar protected windows, skylights, light shelves (S, SE, SW façades)
- Implement daylighting controls, occupancy sensors and timers
- Upgrade to LED fixtures (PE 200, A 200, PE 100, CEC, CP 100)
- Consider using high-emissivity roofing or PV panels to reduce heat load on roofs
- Redesign passive shading devices to block solar heat gain while admitting sunlight
- Improve envelope performance:
    - o Increase R-value of walls, roof, windows and floors
    - o Minimize thermal bridging
    - o Improve building airtightness
    - o Use high performance windows

BUILDINGS WITH EUI UNDER 50 KBtu/sqft

M 100, M 300, M 400, M 200

Prioritize daylighting. Examine fan and pump use.

- Maximize daylighting and minimize direct sun penetration- solar protected windows, skylights, light shelves (S, SE, SW façades)
- Implement daylighting controls, occupancy sensors and timers
- Upgrade to LED fixtures
- Consider using high-emissivity roofing to reduce heat load on roofs
- Redesign passive shading devices to block solar heat gain while admitting sunlight

BSTIC and Performing Arts Center

[LIGHTING HARDWARE AND CONTROLS]

The college could increase energy efficiency through a campus-wide retrofit of interior and exterior advanced lighting hardware and controls. Like most institutions, the college recognizes that lighting retrofits reliably generate strong payback on investment as these projects can often yield energy reductions of up to 30 percent. The college consistently evaluates its existing lighting and controls for retrofit opportunities. Lighting strategies include the following:

- Occupancy sensors this strategy involves reducing lighting levels or automatically turning lights off in spaces when there is no occupancy. When motion is detected lights turn on automatically; they can also be set to come on partially dimmed. Occupancy sensors are highly suited for parking structures and parking lots, as well as smaller, enclosed spaces that are intermittently occupied such as private offices, classrooms, conference rooms, and restrooms.

- Daylight harvesting This strategy involves capturing daylight and supplementing it with electric lights to achieve a preset lighting level. For example, placing day light sensors at the perimeter of the buildings light levels to be measured so that should levels fall below a preset limit electric lights automatically turn-on to supplement the daylight in specified spaces.

- Building Management System It is important to have the lighting system operational only during times of occupancy. To that end the lighting control panel is connected to the Building Management System with a programmed occupancy schedule. This ensures lights are not inadvertently left on during non-occupied periods such as nights and weekend periods. However, there may be occasions when lights are required such as when a cleaning crew is performing work. In these instances, an override switch should be provided locally which allow lights to turn on manually for a preset period.

- LED lights This technology provides great dimming capabilities, longer life and reduction in operational costs.

Irvine Valley College Student Center natural light

[DEMAND RESPONSE PLAN]

Another cost saving plan is to enroll the college on a demand response program with the utility. Demand Response is a strategic and tactical tool used by utilities and grid operators to reduce energy demand across the system in order to prevent power outages from occurring during high stress times on the electricity grid. The periods of acute high demand for electricity are deemed emergency events and typically occur only during a few days each year, with durations usually lasting only for a few hours at a time. Demand Response is primarily called into action during the hottest days of summer, at times of extraordinary load on the system when energy efficiency and conservation practices are insufficient to curtail electric demand. Institutions who voluntarily participate in the Demand Response program benefit financially by receiving a monetary incentive from the utility provider and also through the utility cost savings derived by a reduction in kWh used. The Board of Governors of the California Community Colleges through its Energy and Sustainability Policy encourages each college to participate in all utility offered Demand Response programs and pursue all possible incentives offered by these programs.

The college is a prime candidate for participation in a utility provided Demand Response program. Based on the institution's current conditions, the campus should employ a combination of manual and semi-automated Demand Response strategies. By doing so, the college will be able to generate exceptional value through this no-cost, no-penalty program with very minimal impact to day-to-day operations. The dollars generated can be allocated to expanding other energy savings initiatives and the energy behavior the program generates is consistent with the college's overall goals.

Plan to Curtail Energy Load

Chiller System – Air / Water Cooled	Elevators
Chiller Water Pump	Personal Computers
Condenser Pump	Kitchen – Dishwasher / Freezer Units
Cooling Tower	Pool Pumps
Rooftop Units	Lighting
Split Units	Exhaust Fans
Packaged Units	Heat Pumps
Air Handling Units	Hot Water Heater Pumps
Fans	Electric Boiler

Additional energy reduction strategies that are commonly employed at college campuses include HVAC, elevator and generator procedures, as detailed below.

Heating, Cooling & Air Conditioning (HVAC)

- Pre-cool each of the areas prior to the event by reducing set point temperatures 5°F to 10°F or as low as 60°F on each of the units. Ten to fifteen minutes prior to the start of the event, turn off the units completely or raise the set points as high as 80°F in order to keep the compressors off as long as possible during the event.

- Similarly with chillers, pre-cool the building prior to the event by reducing chilled water temperatures 5°F to 10°F or as low as 38°F. Ten to fifteen minutes prior to the start of the event, turn off completely or raise the chilled water temperature to 48°F.
- Turn off as many air handling units/fans as possible or cycle them in a constant air volume system. Reduce fan VFD's or DSP (duct static pressure) as much as possible in a variable air volume system. Also reduce VFD's on chilled water pumps, condenser pumps and cooling tower fans to minimize pumping and fan power.
- Turn off as many refrigeration compressors as possible and keep freezer/cooler doors shut for the duration of the event.
- Turn off lighting in offices and all other unoccupied areas, as well as areas with natural lighting.
- For any areas that cannot be shut down fully, try reducing lighting by simply turning "off" every other row. Reduced lighting can assist in maintaining a cooler building temperature.

Elevators

- If there is more than one elevator, post signs in front of extra elevators and ask that they not be used. Only take elevators offline in accordance with building and safety codes, and ADA requirements.

Generator

- If running a generator, make sure to engage it 15 minutes prior to the Demand Response event time and keep it operating 15 minutes after the event time.
- Make sure the generator transfer switch is properly engaged and is fully fueled for a successful Demand Response reduction outcome.

Institutional Actions Required from Participation in Demand Response Program

For participation in a Demand Response program, the college must ensure that proper hardware and software controls are in place to effectively respond to Demand Response protocols from a utility. Moreover, the college must consistently communicate and emphasize to campus stakeholders the effects as well as the benefits of Demand Response to help ensure that the organizational culture accepts participation as a normal way of doing business. Additionally, and importantly, the campus community must understand through ongoing organizational communication and feedback that Demand Response is a strategy embraced by the college and that certain conditions may exist when participating in Demand Response. For example, when an electrical emergency event is declared, authorities will notify the college's contact personnel by 3:00 pm the day prior. Subsequently, all college staff should be notified and encouraged to participate by turning off lights, utilizing pre-cooling strategies and shutting blinds in rooms with southern and western exposures to help mitigate heat gain during hours of reduced air-conditioned loads. All applicable equipment from the following list should be shut down or reduced, if possible.

[BATTERY ENERGY STORAGE]

Battery storage is a new technology that would allow the college to charge the batteries during the night when electricity rates are at significantly low rates and discharge during peak hours during the day. There are two types of demand response (DR) structures the first price-based DR programs are designed to encourage electricity use off peak (i.e. time-of-use pricing or demand charge which assigns prices for different blocks of time). The other category is event based and compensates utility customers who allow program administrators to control energy consuming equipment directly to reduce energy consumption during grid emergencies. The purpose for the college is to reduce the demand charge and not necessarily reduce the energy consumption. The demand charge is significant and needs to be reduced or eliminated resulting in operational cost savings.

Currently, the college has installed 33 Tesla power packs each with a capacity of 50kW producing 6,930 kWh to reduce demand charge especially during a the summer months. Capacity is the amount of energy in kWh (units) that a battery can store. The battery storage system is designed to work with PV system to ensure maximum cost-savings are achieved. With the goal of having the college be a zero net energy campus, the recommendation is to increase the current size of the photovoltaic system as described earlier. As the PV system is increased to the recommended size of an additional 3.8-megawatt system. In order to shift the load even more and to provide for future time dependent rate structure changes, the battery storage should increase by approximately one-megawatt battery storage that would bring the total to approximately 1.5 megawatt of battery storage. The cost of a one-megawatt battery would be approximately $2 million. The added storage capacity would allow for anticipated peaking. It is anticipated the payback period to be approximately 10 – 13 years.

Tesla Battery Energy Storage System

[BUILDING MANAGEMENT SYSTEMS]

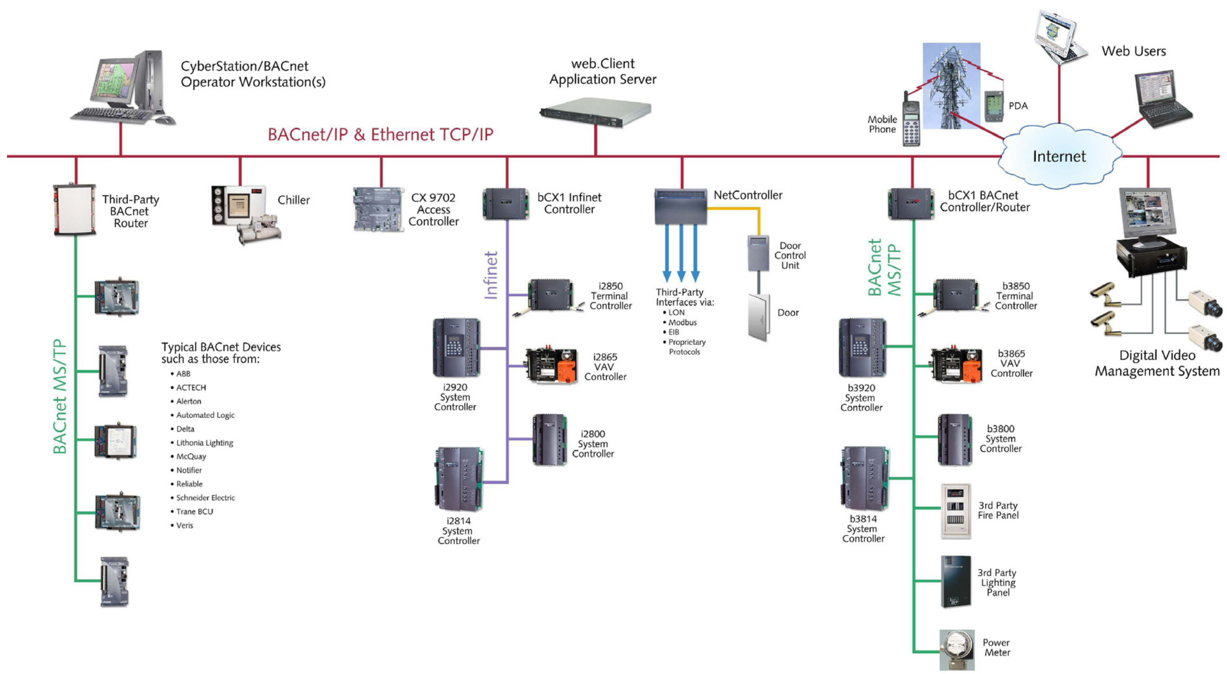
Today's buildings demand more from building automation and security systems. Buildings must adapt to many rapid changes, and be smarter, more comfortable, more efficient and safer than facilities designed just a few years ago. The controls system is the critical component to meeting these new demands. Improvements to existing building automation systems often require little investments and help save a significant amount of energy, reduce CO2 emissions and shorten payback periods.

Andover Continuum is the Building Automation System currently controlling the air conditioning systems at Irvine Valley College. It is recommended that the lighting controls that are compatible with the Andover system throughout the campus should be considered for future development.

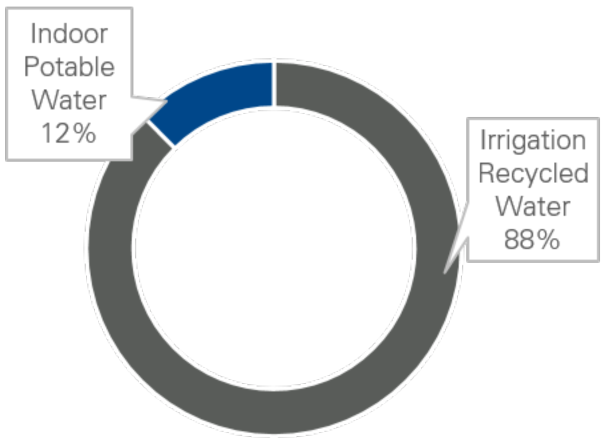
Benefits of a Building Management System include:

- Reduction of operational cost by energy optimization
- Reduction of operational cost through preventative maintenance
- Reduction of service cost through staff productivity
- Campus security such as fire alarms, site lighting, CCTV cameras, safety and security telephones
- Remote alert notifications prior to user complaints

Integrated Andover Continuum™ Architecture



[WATER CONSERVATION EFFORTS - EXISTING AND UPCOMING]



Water Consumption Distribution Pie Chart

Irvine Valley College has been striving to reduce water consumption since 2008 by replacing high water demand turf grass, shrubs and trees with drought resistant California native and desert landscaping. Water conservation efforts for new construction since 2015 have included:

- Water efficient landscaping
- Reclaimed water irrigation for all outdoor landscape
- Motion-sensing faucets in labs and restrooms
- Low flow urinals and toilets which use reclaimed water
- Exterior bio-swale retention for on-site treatment of rainwater (Liberal Arts Building)

Annual water consumption was calculated using utility bills from calendar years 2014 to 2016. The gross annual water consumption at Irvine Valley College is 45,243,777 gallons per year, the annual water use intensity is 16.1 gal/sqft per year and the per capita consumption is 2,782 gal/person per year.

Performing Arts Center Building at Night

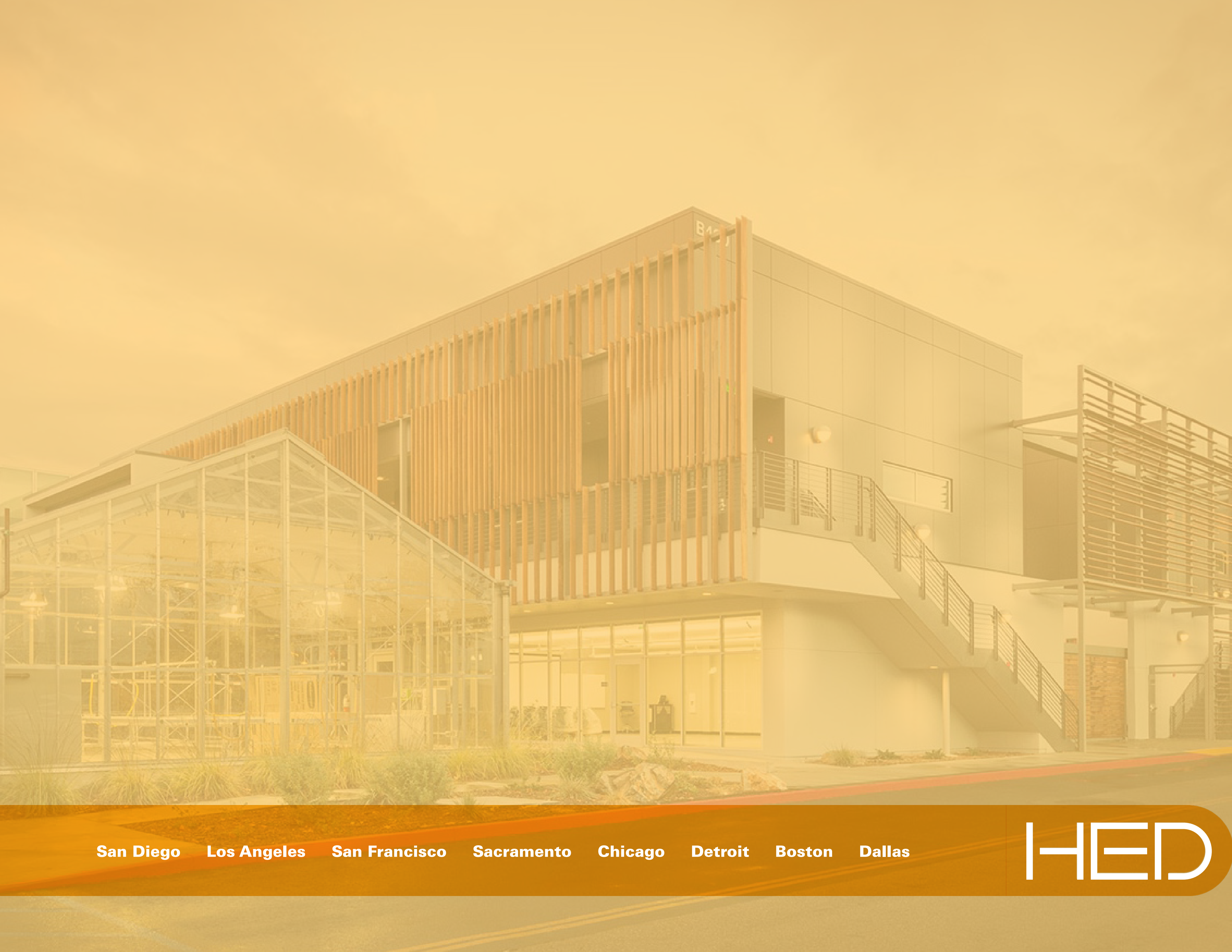
APPENDIX

This Section Includes:

57 Acronyms

[ACRONYMS]

AB	Assembly Bill
ADR	Automated Demand Response
ANSI	American National Standards Institute
ARB	California Air Resources Board
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BIS	Business Incentives & Services package
CALEPA	California Environmental Protection Agency
CEEP	Commercial Energy Efficiency Program
CHP	Combined Heat and Power
CO_2e	Carbon Dioxide Equivalent
CPAC	Comprehensive Packaged Air Conditioning Systems program
CPUC	California Public Utilities Commission
CSI	California Solar Initiative
DG	Distributed Generation
DOE	U.S. Department of Energy
DSIRE	Database of State Incentives for Renewable Energy
EE	Energy Efficiency
EERS	Energy Efficiency Resource Standard
EO	Executive Order
EM&V	Evaluation, Measurement, and Verification
EPA	Environmental Protection Agency
ESCO	Energy Service Company
Fc	Foot-candles
FiT	Feed in Tariff
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
GW	Gigawatt (1 GW = 1,000 MW)
GWh	Gigawatt-hour (1 GWh =1,00 MW)
HVAC	Heating, Ventilation and Air Conditioning
IDSM	Integrated Demand Side Management
IOU	Investor-Owned Utility
kW	Kilowatt
kWh	Kilowatt-hour
LBNL	Lawrence Berkeley National Laboratory
MW	Megawatt
MWh	Megawatt-hour (1 MWh = 1,000 kWh)
NEM	Net Energy Metering
PEV	Plug-in electric Vehicle
PG&E	Pacific Gas & Electric
PV	Photovoltaic
RCx	Retrocommissioning
REC	Renewable Energy Certificate
RES	Renewable Energy Standard
RPS	Renewable Portfolio Standard
SCE	Southern California Edison
SCG	Southern California Gas Company
SDG&E	San Diego Gas & Electric
SGIP	Self-Generation Incentive Program
SPC	Standard Performance Contract program
TOU	Time-of-Use
ZEV	Zero Emissions Vehicle
ZNE	Zero Net Energy



San Diego Los Angeles San Francisco Sacramento Chicago Detroit Boston Dallas

HED