INTEGRATED ENERGY MASTER PLAN

LONG BEACH COMMUNITY COLLEGE DISTRICT | JUNE 2018

LONG BEACH CITY COLLEGE

CORDOBA CORPORATION
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DLR Group
Architecture Engineering Planning Interiors

P2S ENG

ACKNOWLEDGEMENTS

Long Beach Community College District

Dr. Reagan F. Romali, Superintendent-President
Marlene Dunn, Vice President of Business Services
Medhanie Ephrem, Interim, District Facilities and Maintenance
Michael Burke, Deputy Director, District Facilities and Maintenance
Sean Rivell, Grounds & Transportation Supervisor, District Facilities and Maintenance

Long Beach Community College District Board of Trustees

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Facilities Advisory Committee

Cordoba Corporation

Terrance DeGray, Program Director
Nicole Soria-Velarde, Program Coordinator
Lexi Donovan, Financial Analyst

DLR Group

Prem Sundharam, Global Sustainability Leader
Ben Talbot, Senior Building Performance Analyst
Alok Deshpande, Project Architect
Andrea Cohen Gehring, Higher Education Leader
Tony Cocea, Energy & Engineering Leader
Ruairi Barnwell, Building Optimization Leader
Eric Loos, Senior Electrical Engineer
Dan Frank, Business Development Leader
Yi Zheng, Building Performance Analyst

P2S Engineering, Inc.

Kent Peterson, Vice President & COO
Aravind Batra, Vice President & Higher Education Public Market Segment Leader
James Del Monaco, Associate Principal & Higher Education Private Market Segment Leader
Melissa Amaya, Mechanical Designer
Abram Largoza, Electrical Designer

Constellation Energy

Tisha Agha, Sr. Business Development Manager

Southern California Edison

Lisa Hannaman, Sr. Account Manager

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The following document titled “Integrated Energy Master Plan” (IEMP) was prepared by DLR Group in conjunction with LBCCD staff and key District consultants to provide a road-map to align previous energy efficiency projects along with future projects noted within the 2041 Facilities Master Plan, which was published in May of 2016. In accordance with the 2041 Facilities Master Plan, there is a line item titled “Energy/Water Conservation Projects”, which is a place holder to improve already energy and water efficient systems and address outdated systems. As one of the largest of the 114 community college Districts in the State of California, LBCCD is at the forefront of several initiatives and continues to set the bar among other CCDs. This document is driven by various assembly bills, state goals, and executive orders and will be the most ambitious plan, to date, of any Community College District in the State of California or the United States. This plan will outline the processes that were utilized to determine the current energy use, future energy use, energy efficient projects completed to date and the path and cost benefits of zero net energy.

Beyond the benefits to the environment of the reduction to our LBCCD carbon footprint and zero net energy are the cost savings benefits to the operational costs to LBCCD. The energy reduction measures along with the savings from operations costs are estimated to be approximately $1.5 million annually.

The IEMP addresses the following information:

- Driving factors for the Integrated Energy Master Plan (IEMP)
- Long-term and near-term goals with energy, water, and greenhouse gas emissions targets.
- Assessment of historic data and assumptions for data gaps.
- Interpretations of Executive Orders for application at a District and campus level.
- Specific Key Performance Indicators (KPIs) to measure success.
- Appropriate techniques to verify established KPIs.
- Recommendations on Energy Efficiency Measures (EEM) to achieve the goals and KPIs.
- Road map on implementation of BMS.
- Results of IEMP in achieving goals when completely executed.

The Design Team (DLR Group and P2S) worked with LBCCD, it’s various utility providers and vendors that help LBCCD manage the operations of the facilities to develop this comprehensive assessment and design recommendations. LBCCD provided all the necessary background information and access to utility bills and building management systems. The design team went through the following process to develop this road-map:

- Benchmarking
- Performance Analysis
- Design Recommendations

Final design recommendations identified by the IEMP provides a clear road-map to achieving set goals. This IEMP is to be revisited and adjusted as needed during the implementation of BMS to accommodate other facilities’ priorities, timing, and availability of funding and newer technology. Summaries of calculations and analyses that were developed to support the IEMP are presented as Appendices for further detailed review.

ABOUT LBCCD

Since 1927, LBCCD has been at the heart of the community providing educational programs with a commitment to excellence in student learning in a culturally diverse and vibrant environment.

LBCCD is a two-year community college that encompasses state of the art, technology-rich learning environments, a broad range of academic and career technical instructional programs, strong community partnerships, and economic and workforce development initiatives that prepare students to be successful in the 21st century.

As one of the largest of the 114 community colleges in California, LBCCD is governed by the five-member, elected District Board of Trustees and serves the cities of Long Beach, Signal Hill, Lakewood, and Santa Catalina Island. It offers many associate degrees and certificate programs which prepare students for transfer to four-year institutions, career advancement, and personal development.

With four schools to house its instructional programs, LBCCD provides program offerings in Career and Technical Education, Language Arts and Communication, Social Sciences and the Arts, and Health, Science & Mathematics.

Founded as Long Beach Junior College, the college started at Woodrow Wilson High School until the 1933 earthquake which destroyed the building. Classes were held outside in tents at neighboring Recreation Park until the college moved to the site of its present-day Liberal Arts Campus at Carson Street and Clark Avenue in 1935.

From its earliest days, the college established traditions that are alive today, such as the mascot, Ole, and the team name, the Vikings.

Student newspaper, yearbook, social services, and intramural programs were launched in the first year. Academic honors included having a library that was viewed as a national model and the state's top junior college debate team. Athletic honors included Southern California championships in wrestling, baseball, men's and women's swimming and the state championship in men's basketball, all during the 1928-20 school year.

The college grew rapidly during and after World War II and added the Pacific Coast Campus, formerly Hamilton Junior High, in 1949. Numerous extension campuses and satellite locations were added as growth continued in the early 1970s. As a result of state law, the college separated from the Long Beach Unified School District and became the independent District with its own locally elected Board of Trustees.

Changes in the workplace, and in the community's demographics, brought about rapid changes in the mid-1980s. The influx of Southeast Asian refugees led to extensive courses in English as a Second Language and other programs to assist and acculturate this burgeoning population. A later wave of amnesty applicants ensured that ESL remained one of the college's core programs and garnered awards as a state model.

Computers entered nearly every instructional program necessitating the acquisition of new equipment and revisions to the curriculum.

Apple Computer presented LBCCD with one of 10 grants nationally for its extensive commitment to computer technology.

In 1987, the college completed a decade of negotiations with the City of Long Beach to acquire the neighboring Veterans Stadium. Through the sale of surplus land to another neighbor, McDonnell Douglas (now Boeing), the college was able to finance the $3 million in renovations required to upgrade the facility.

Within the last decade, the college has celebrated completion of a wide range of new construction projects and building modernizations at both campuses. The passage of the Measure E & LB bond in 2002, and its extension in 2008, by the overwhelming majority of voters in the LBCCD District has provided $660 million in local funds and qualified District to receive an additional $60 million in state matching grants. In 2016, the voters approved of a third bond measure that provides an additional $850 million to modernize LBCCD's infrastructure. LBCCD has identified six projects to be submitted for State funding. The estimated State match for these potential projects is $79 million in capital outlay funding.

The resulting building program has provided new facilities and modern learning environments to support new programs, allowing LBCCD to prepare its students to meet the changing demands of the 21st Century.

District continues to have a deserved reputation for excellence for its instructional programs and its graduates achieve tremendous success after transferring to four-year colleges or entering the workforce. The college's reputation is further enhanced by key partnerships and economic development initiatives. With its many accomplishments, LBCCD is well-positioned to build on its tradition of success in serving the community for generations to come.

LBCCD STATS AS OF SCHOOL YEAR 2016-2017

	District	LAC	PCC
No. of Buildings	54	30	18
Gross SF of Buildings	1,372,549	1,040,230	322,319
Staff	1282	1105	177
Students	25,811	20,642	5161
Electricity (kwh)	14,597,844	11,018,909	3,578,935
Natural Gas (therms)	369,315	307,085	62,230
Water (gallons)	21,120,452	14,246,408	6,874,044
Utility Costs	$2,592,418	$1,869,657	$722,761
Vehicles	127	/	/

KEY DEFINITIONS

Organizations

CCCCO
California Community College Chancelor's Office.

Types

Buildings
All buildings that are conditioned. This will include unconditioned walkways and canopies that are part of the building.

Non-Buildings
Parking lots, parking garages, sports fields and stadiums.

Mobile
Vehicles owned and operated by LBCCD.

Entity-wide
Encompasses the entire District including all of its physical and personal assets.

Key Performance Indicators (KPI)

Gross Square Footage (GSF)
The overall square footage of a building including the exterior envelope and area under attached canopies. GSF is usually higher than the net square footage that is conditioned.

Electricity Consumption (kWh)
1,000 Watt-hours or 1 Kilowatt hours is a unit of energy being transmitted or used at a constant rate over a period of time.

Electricity Demand (kW)
1,000 Watt or 1 Kilowatt is a unit of power transmitted or used. It is the energy used per unit of time. Electricity demand is often referred to as peak demand. When electrical devices are turned on, they consume massive amounts of energy for a fraction of a second leading to astronomically high power demand. It is for this reason that billed peak demand is averaged over larger portions of time, called “demand intervals.” Typical demand intervals range from 15 to 30 minutes.

Natural Gas Consumption (Therms)
1 therm or 100,000 British thermal units (Btu) is the unit of heat energy. It is approximately the energy equivalent of burning 100 cubic feet (often referred to as 1 CCF) of natural gas.

Heat Energy (kBtu)
1000 Btu’s or 1 kBtu is a common unit used in building energy use tracking and heating and cooling system sizing. 1 kW = 3.412 kBtu’s.
1 therm = 100 kBtu’s.

Energy Use Intensity (EUI)
Expressed in kBtu’s/GSF/Year, EUI is the amount of energy consumed by a building per square foot of gross floor area over a period of one year.

Cost ($)
US Dollars expressed for first costs and utility costs. Future costs are also expressed in today costs and no net present value is accounted for.

Green House Gas Emissions – GHG
Expressed as Pounds of Carbon Dioxide Equivalent – lbs. of CO2, GHG emissions represents quantity of any of the atmospheric gases that contribute to the greenhouse effect by absorbing infrared radiation produced by solar warming of the Earth’s surface. They include carbon dioxide (CO2), methane (CH4), nitrous oxide (NO2) and water vapor.

Water – Gallons
Expressed as the unit of volume of water, gallons apply to both potable water quantity as well as reused or reclaimed water quantity.

Timeline

Present
This timeline represents School Year 2016-17 as that was the most comprehensive data set available during the course of the IEMP planning process. It is also referred to as Today.

Measures Taken in the Past
This timeline generally refers to energy and water efficiency projects already taken place during the implementation of Prop 39 and Measure E & LB bond projects.

Baselines in the Past
Baselines refer to a time in the past for which a particular KPI is measured at that time and set for comparison of progress in the present and in the future.

Future Target
This timeline refers to a time in the future for which a particular KPI is set as a goal to achieve.

Future
This generally is any time after the publication of this IEMP.

Strategy Categories

Use-Reduce
These set of efficiency strategies generally lead to a reduction in the need for a resource such as energy and water or propose alternative uses of the same resource. These strategies also include optimization of space as a resource.

KEY DEFINITIONS

Produce
These strategies include different methods to generate new resources. It could be the production of renewable resources or collecting new resources produced as byproducts of other processes.

Store
These strategies include methods to transfer a resource between different uses by storing that resource to be used for a later time.

Share
These strategies look for unique opportunities to share the resource between two different uses without necessarily storing that resource.

Procure
These strategies include alternative methods of sourcing a resource, particularly looking for a source that has a low carbon footprint or lower resource value such as reclaimed water.

Energy and Sustainability Definitions

Zero Net Energy (ZNE)
A building, or a group of buildings or a campus achieve Zero Net Energy when the energy produced through renewable energy technologies is equal to or greater than the fossil-fuel based energy consumed over the course of a year.

Source and Site Energy
Site energy is the electricity or fuel consumed within a property boundary. Source energy is the initial fuel consumed to produce either electricity or fuel. Below are the two Source Energy Conversion Factors from American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Standard 105 that used in this IEMP.

1. Imported Electricity – Source Energy Conversion Factor = 3.15. i.e. 3.15 units of electricity are consumed at the source to produce one unit of site electricity for electricity generated by fossil fuels.
2. Natural Gas – Source Energy Conversion Factor = 1.09 meaning that the energy consumed through generation of the power is virtually equivalent to the energy distributed to the site with very minor losses along the way.

Carbon Neutrality
Carbon neutrality or having a net zero carbon footprint, refers to achieving net zero carbon emissions by balancing a measured amount of carbon released with an equivalent amount sequestered or offset, or buying enough carbon credits to make up the difference.

Scope 1: Direct GHG emissions
Scope 1 accounts for direct GHG emissions from sources that are owned or controlled by LBCCD. Scope 1 emissions are principally the result of the following activities:

- production of electricity, heat, or steam
- transportation of materials, products, waste, and employees, e.g. use of mobile combustion sources, such as: trucks, and cars
- fugitive emissions: intentional or unintentional releases such as: equipment leaks from joints, seals; and HFC emissions during the use of air conditioning equipment

This IEMP only accounts for transportation of employees, materials and products using trucks and cars owned by LBCCD.

Scope 2: GHG emissions from imports of electricity, heat, or steam
Scope 2 accounts for indirect emissions associated with the generation of imported/purchased electricity, heat, or steam. For LBCCD, electricity usage represents one of the most significant opportunities to reduce GHG emissions.

Scope 3: Other indirect GHG emissions
Scope 3 allows for the treatment of other indirect emissions that are a consequence of the activities of LBCCD, but occur from sources owned or controlled by another entity, such as:

- employee business travel
- transportation of products, materials, and waste
- outsourced activities, contract manufacturing, and franchises
- emissions from waste generated by LBCCD when the point of GHG emissions occurs at sources or sites that are owned or controlled by another company, e.g. methane emissions from landfilled waste
- employees commuting to and from work

This IEMP only accounts for LBCCD staff business travel and commuting to and from work.

On-Site Renewable Energy
On-site renewable energy, such as solar and wind power, is a way to supply some of the power for the facility while reducing its reliance on fossil fuels and minimizing emissions of carbon dioxide and other greenhouse gases that contribute to global warming.

Environmentally Preferable Purchasing (EPP)
EPP refers to products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose.

EV Charging Stations
An electric vehicle charging station, also called EV charging station, electric recharging point, charging point, charge point and EVSE (electric vehicle supply equipment), is an element in an infrastructure that supplies electric energy for the recharging of electric vehicles, such as plug-in electric vehicles, including electric cars, neighborhood electric vehicles and plug-in hybrids.

Zero Emissions Vehicle (ZEV)
A zero-emissions vehicle, or ZEV, is a vehicle that emits no exhaust gas from the on board source of power.

DRIVING FACTORS

In response to the Governor's Executive Order (EO) B-18-12, LBCCD's IEMP document's goal is to provide a comprehensive roadmap and set of design recommendations to achieve Zero Net Energy (ZNE) for existing and new buildings by 2025. This plan is also informed by Executive Orders B-16-12 and B-30-15. These Orders affect all Institutions receiving state funding, including California Community Colleges, as well as the California State University and University of California systems. Additionally, the IEMP addresses the Sustainability and Energy Policy set forth by the California Community Colleges Board of Governors and the Climate Commitments held by the American College and University Presidents' Climate Commitment.

These driving factors and the design recommendations will support the Facilities Master Plan and augment LBCCD's ongoing efforts toward energy efficiency. Working with LBCCD, the IEMP should analyze building energy-related challenges as well as operations and align target dates identified in the EOs with Facilities Master Planning goals. These objectives, targets, and requirements are designed to protect and enhance California's sustainability, economy, and livability. Fulfilling these requirements is a comprehensive task that requires careful coordination with an Institution's Capital Projects program.

The following paragraphs provide more detailed expectations of various driving factors categorized by different levels – District, campus & buildings.

State of California Executive Orders

Executive Order B-18-12

EO B-18-12 and the Green Building Action Plan were issued on April 25, 2012. The orders incorporate green practices into building and system operations to reduce environmental impacts of state operations including greenhouse gas (GHG) emissions, energy, and water use, as well as improve indoor air quality, onsite renewable energy, environmentally preferable products (EPP), and develop the infrastructure for electric vehicle charging stations at state facilities. The Green Building Action Plan also established two oversight groups to ensure these measures are met. This EO addresses the following key metrics at various levels.

DRIVING FACTORS

Executive Order B-30-15

EO B-30-15, further reduces GHG emissions by setting reduction goals for 2030 and calls for additional efforts to improve California's resiliency. The Order establishes a GHG reduction target of 40% below 1990 levels by 2030. This EO addresses the following key metrics at various levels.

DISTRICT LEVEL

- GHG Emissions

Executive Order B-16-12

EO B-16-12, the Zero Emission Vehicles (ZEV) Action Plan, encourages the development and success of ZEVs to protect the environment, stimulate economic growth and improve the quality of life in the state. It pushes the state toward the integration of zero emission vehicles (ZEVs) into the mainstream. It directs the state toward establishing an infrastructure that can support increased public and private sector ZEVs. Additionally, it directs state agencies to replace at least ten percent of fleet vehicle purchases with ZEVs by 2015, and at least 25% of fleet vehicle purchases with ZEVs by 2020. This EO addresses the following key metrics at various levels.

DISTRICT LEVEL

- EV Charging Stations
- Zero Emissions Fleet

California Community Colleges Board of Governors Energy and Sustainability Policy

The Energy and Sustainability Policy provides goals and guidance for Districts to achieve energy conservation, sustainable building, and physical plant management best practices necessary to reduce energy consumption. This policy is consistent with Executive Order S-12-04, which requests the community colleges active participation in statewide energy conservation and reduced electrical demand. This policy addresses the following key metrics at various levels.

CAMPUS LEVEL

- Energy
- Cogen Plants, Thermal Storage
- On-Site Renewables
- Monitoring and Reporting
- Environmentally Preferable Purchasing
- Physical Plant Management
- Water Use

BUILDING LEVEL

- Demand Response
- On-Site Power
- Commissioning
- LEED Certification
- Indoor Environmental Quality

American College & University Presidents' Climate Commitment (ACUPCC)

The Climate Commitment is an effort by a network of colleges and university presidents who have made institutional commitments to promote the research, education, and community engagement efforts needed to create a sustainable society and to eliminate net greenhouse gas emissions from specified sources in their own campus operations.

District Level

- GHG Emissions
- Climate Friendly Investing
- Air Travel Offset
- Environmentally Preferable Purchasing

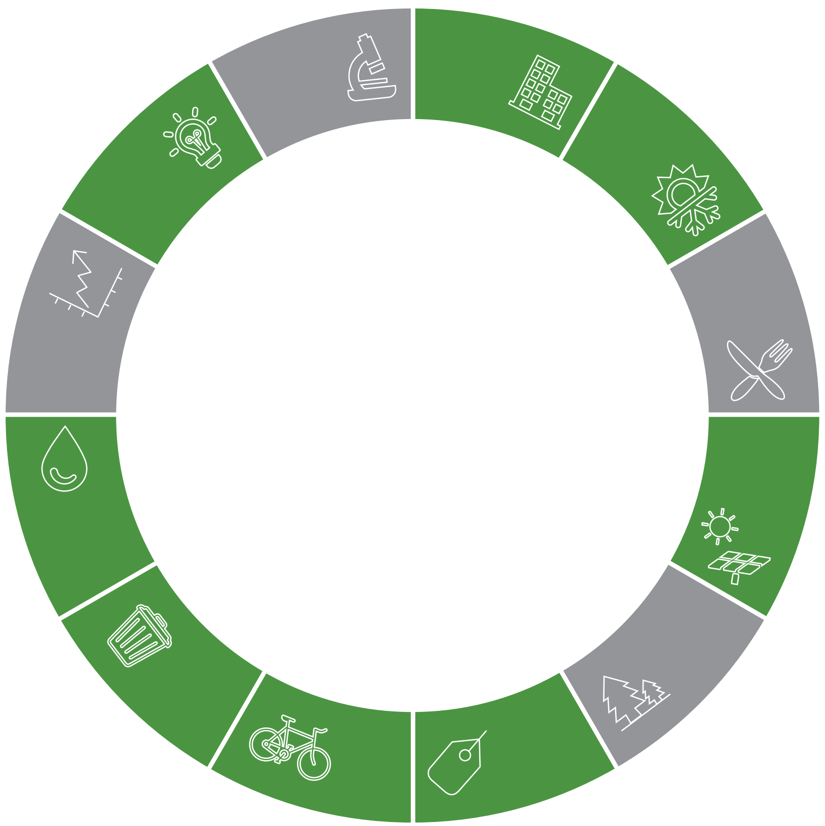
Campus Level

- Energy
- Cogen Plants, Thermal Storage
- On-Site Renewables
- Monitoring and Reporting
- Physical Plant Management
- Water Use
- Provision of Public Transport

Building Level

- On-Site Power and Green Power
- Commissioning
- LEED Certification

IEMP GOALS



Current Focus
Future Focus

→ Sustainability

- Education & Research
- Utilize Green Building Practices
- Climate Change Management
- Sustainable Food & Dining
- Renewable Energy
- Sustainable Land Use
- Purchase Sustainable Goods & Services
- Alternative Fuel
- Waste Management
- Manage Water Resources
- Improve Social & Economic Factors
- Energy Use Optimization

District Priorities for IEMP

Using the driving factors as a guideline, IEMP addresses a number of conservation considerations beyond energy use to ensure that sustainability is addressed throughout a wide range of natural resources. In discussing with the LBCCD, the design team identified the following top priorities of IEMP:

- Greenhouse Gas Emission Reduction
- Zero Net Energy
- On-Site Renewable Energy
- Indoor Environmental Quality
- Environmental Product Purchasing
- EV Charging Stations
- Commissioning
- Water Use Reduction

The other areas of sustainability identified in this graphic are topics that were discussed and District plans to consider developing strategies in the future.

IEMP GOALS

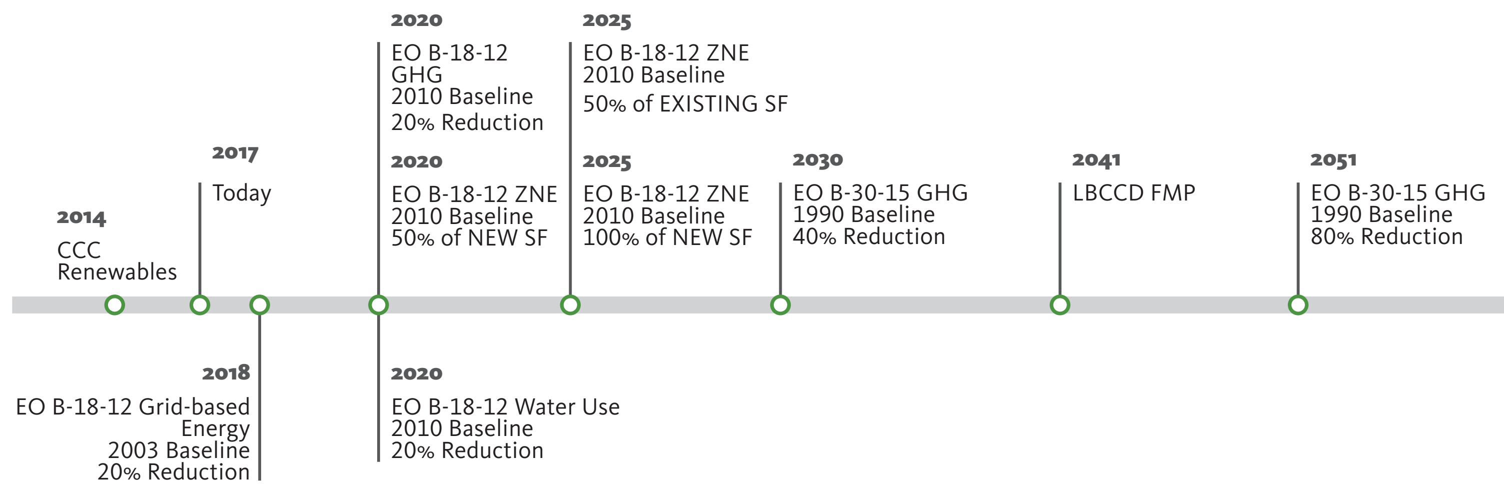
Focus Area	Topic	Driving Factors	Metric	Baseline	Timeline	Scale
1	Management of Climate Change					
	Entity-wide Greenhouse Gas reduction	EO B-18-12	10% Reduction	2010	2015	District Level
	EO B-18-12; AB 32	20% Reduction	2010	2020	District Level	
	EO B-30-15	40% Reduction	1990	2030	District Level	
	EO B-30-15; EO S-3-05	80% Reduction	1990	2050	District Level	
2	Energy Use Optimization					
	2a ZNE for new buildings	EO B-18-12	50% of SF	Avg. Building EUI	2020 to 2025	District Level
	2b ZNE for new buildings and major renovation	EO B-18-12	100% of SF	Avg. Building EUI	2025 onwards	District Level
	2c ZNE for existing buildings	EO B-18-12	50% of SF	Avg. Building EUI	2025	District Level
	2d Reduce grid-based energy purchases for buildings	EO B-18-12	20% Reduction	2003	2018	District Level
	2e Reduce grid-based energy purchases for non-buildings	EO B-18-12	20% Reduction	2003	2018	District Level
	2f Participate in demand response programs	EO B-18-12			2012 onwards	Building Level
3	Renewable Energy					
	On-site energy generation for new or major renovation	EO B-18-12	> 10,000 SF		2012 onwards	District Level
	Purchase electricity from renewable energy sources	ACUPCC	15% of total electricity purchase			
4	Manage Water Resources					
	Water use reduction	EO B-18-12	10% reduction	2010	2015	District Level
		EO B-18-12	15% reduction	2010	2020	District Level
5	Utilize Green Building Practices					
	5a LEED Silver or higher on new and major renovation	EO B-18-12	> 10,000 SF	current version	2012 onwards	Building Level
	Comply with Cal Green Building Standards' Tier 1 measures	EO B-18-12	< 10,000 SF	current version	2012 onwards	Building Level
	LEED EBOM certification on existing buildings	EO B-18-12	> 50,000 SF, Energy Star >75	Avg. Building	2015	Building Level
	5b Building commissioning on new or major renovation	EO B-18-12	>5,000 SF		2012 onwards	Building Level
	Building commissioning on existing buildings	EO B-18-12	As needed	Avg. Building EUI	2012 onwards	Building Level
	Monitoring Based commissioning on existing buildings	EO B-18-12	>5,000 SF as needed	Avg. Building EUI	2012 onwards	Building Level
	5c Develop operation and maintenance policies and guidelines	EO B-18-12		2013	Building Level	
6	Indoor Environmental Quality					
	Implement Division A5.5 of Cal Green Building Std code	EO B-18-12		current version	2012 onwards	Building Level
7	Use Alternative Transportation & Fuels					
	7a Electric vehicle charging station	EO B-18-12	Plan for future demand		2012 onwards	Campus Level
8	Sustainable Land Use					
	Develop sustainable land use planning principles		Address in the future			Campus Level
9	Purchase Sustainable Goods & Services					
	Purchasing policyEO B-18-12	Public Contract Code 12400		2012 onwards	District Level	
10	Waste Management					
	Participate in waste minimization measures	ACUPCC	Adopt 3 or more reduction measures			

EO - Executive Order; ACUPCC - American College & University Presidents Climate Commitment; AASHE - The Association for the Advancement of Sustainability in Higher Education

KEY METRICS + TIMELINES

IEMP GOALS

TIMELINE | BASELINES | SPECIFIC TARGETS | DESIGN GUIDE



It is vital to clearly identify the key metrics and associated timelines for any goal. Using the timelines prescribed by various executive orders, the design team developed an overall timeline chart that clearly identifies the specific target that needs to be met. Baselines for comparison considerably changes between and within these different executive orders and so, it is also crucial to associate specific targets with specific baselines. Below are the major targets for each of the incremental timelines.

2020
By 2020, LBCCD will reduce its GHG emissions by 20% and potable water use by 20% compared to amounts in 2010 as a Baseline.

Between 2020 and 2025, LBCCD will produce enough renewable energy or purchase energy from renewable energy sources to offset the fossil fuel based energy consumed by 50% of new Gross Square Footage added in this time period.

2025
By 2025, LBCCD will produce enough renewable energy or purchase energy from renewable energy sources to offset the fossil fuel based energy consumed by 50% of its EXISTING gross square footage.

Beyond 2025, LBCCD will add and renovate building facilities at a zero net energy Basis, i.e., energy consumed by Gross Square Footage added or offset by renewable energy production or clean energy procurement.

2030
By 2030, LBCCD will reduce its GHG emissions by 40% compared to a 1990 Baseline. Since utility records on energy consumption were not available, the design team has assumed the 1990 Baseline GHG emissions as a factor of Gross Square Footage between 1990 and School Year 2016-2017.

2050
By 2050, LBCCD will reduce its GHG emissions by 80% compared to the same 1990 Baseline as above.

EO B-18-12 also requires, as an interim step, to reduce the grid-based energy purchase by 20% by 2018 based on a 2003 Baseline. 2003 happens to be the first year after Measure E & LB bond passage and District experienced a tremendous growth after 2003. During this growth, between 2010 and School year 2016-2017, however, District implemented a number of energy efficiency measures to reduce grid-based energy purchase. The design team deemed it is unrealistic to pursue this particular requirement of EO B-18-12 as it is unfairly aligned for growth. Recognizing that such requirements are in place to systematically and incrementally achieve carbon neutrality, the design team pursued solutions such as installing renewable energy production systems before 2020 to address the larger GHG emissions reductions target.

ENERGY EFFICIENCY MEASURES

COMPLETED TO DATE

Between 2010 and 2016, District grew by 17% in Gross Square Footage through various additions, renovations and new construction. However, its annual utility costs remained the same and potable water consumption actually reduced by 26% with only a 10% increase in overall annual energy consumption. District has completed various energy efficiency projects funded by Measure E & LB.

- Energy Efficient Central Plants
- Energy Efficient Upgrades – Mechanical Systems and Controls, Lighting Upgrades
- Building Management System
- Virtualization of all physical servers
- PV system on Parking Structure
- Water Efficiency/Reclaimed Water Conversion
- Commissioning of Buildings
- Storm water retention system
- Environmental friendly products/low emitting materials
- Exceeding applicable Title 24 Part 6 requirements by at least 10% for modernized buildings and 15% for new buildings

ENERGY EFFICIENCY MEASURES

ANTICIPATED RESULTS OF THE EXECUTION OF PLAN

LBCCD GHG EMISSIONS

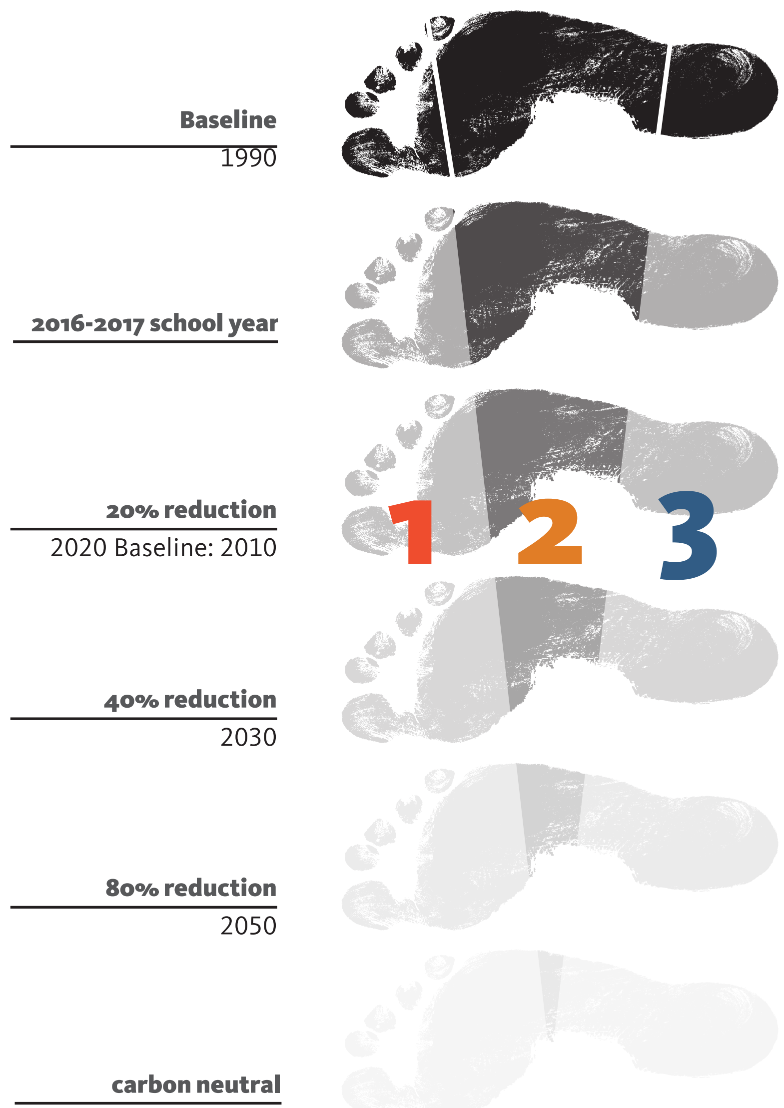
District records on vehicle inventory, and utility consumption only dates back to 2000. The design team used the following assumptions to set the baseline emissions both at 1990 and 2010.

Since District owned and operated vehicles contribute to the majority of direct GHG emissions, for Scope 1, we used data available from 2000 as the baseline for 1990. Scope 1 Baseline is set at 441,388 lbs of CO2 - emissions from 42 vehicles.

Similarly, a ratio of current emissions from electricity and natural gas usage based on Gross Square Footage in 2000 is used to derive at the 1990 baseline for Scope 2 indirect GHG emissions. Scope 2 baseline is set at 8,919,061 lbs of CO2.

Employee travel contributes to the majority of Scope 3 other indirect GHG emissions. Based on the data District has on travel emissions offset and Gross Square Footage, we have derived at a proportional emissions from travel of District employee. Scope 3 baseline is set at 4,745,111 lbs of CO2.

Overall 1990 baseline emissions is set at 14,105,560 lbs of CO2 and the 2050 emissions reduction target is set at 2,821,112 lbs of CO2 which is a reduction of 81% from current emissions in school year 2016-2017.



Scope 1

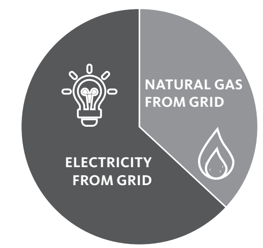
Direct GHG Emissions
Fleet, Combustion, Fossil Fuel

Baseline 441,388 lbs of CO2

Scope 2

Indirect GHG Emissions From Purchase Energy

Buildings + Non-Buildings
Parking Lots, Sports Fields, etc.



Baseline 8,919,061 lbs. of

Scope 3

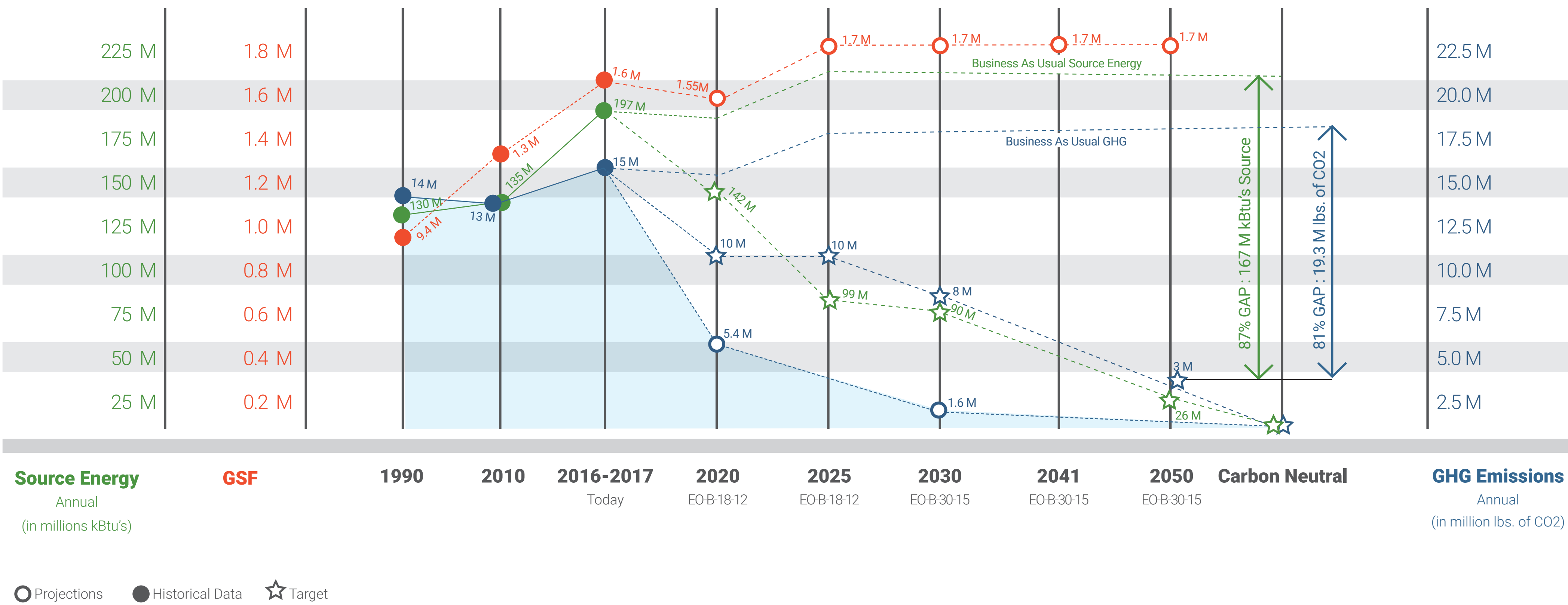
Other Indirect GHG Emissions
Employee Travel

Baseline 4,745,111 lbs. of CO2

ENERGY EFFICIENCY MEASURES

ANTICIPATED RESULTS OF THE EXECUTION OF THE PLAN

Through the process of benchmarking, performance analysis and design recommendations, the design team developed a set of strategies to achieve the targets of GHG emissions reduction, potable water reduction and net-zero energy goals. Out of the 23 strategies evaluated, 10 strategies are recommended as part of this IEMP. Recommended strategies include, a series of energy reduction measures; innovative thermal energy storage technology measures; energy production measures; battery storage technology measures, micro-grid solutions and reclaimed water re-purposing measures. These recommended measures when implemented successfully will enable District toward achieving the set targets.



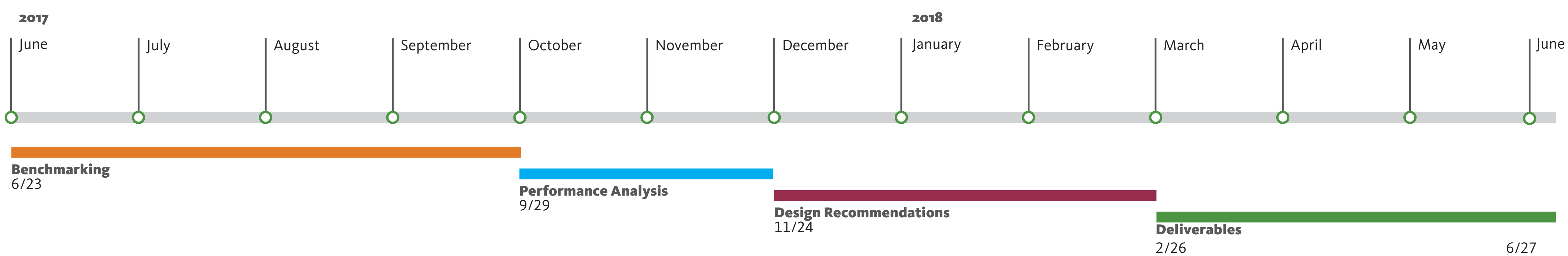
02

INTEGRATED ENERGY MASTER PLAN

PLANNING PROCESS

A comprehensive energy master plan requires a detailed work plan, collaboration and creativity. The design team met with the Bond Management Team weekly and choreographed discussions virtually through online collaboration tools and developed tasks for each week to follow up. This rigor enabled us to consider all the aspects of energy and water and provide a detailed and comprehensive solution. We met with LBCCD facilities team once a month in person and reviewed progress and received input. The entire process was effective and engaging as illustrated through photos from working sessions in the Appendix section. The entire team learned a lot through this process and have updated CCCCO on our findings and interpretations of the various Executive Orders as it would help other Community Colleges with their pursuit of carbon neutrality.

The sections below give a brief overview of the various steps involved in this process as it relates to the key performance indicators established during the goal setting sessions. Subsequent sections describe detailed phases in the process as well as the descriptions.



PLANNING PROCESS

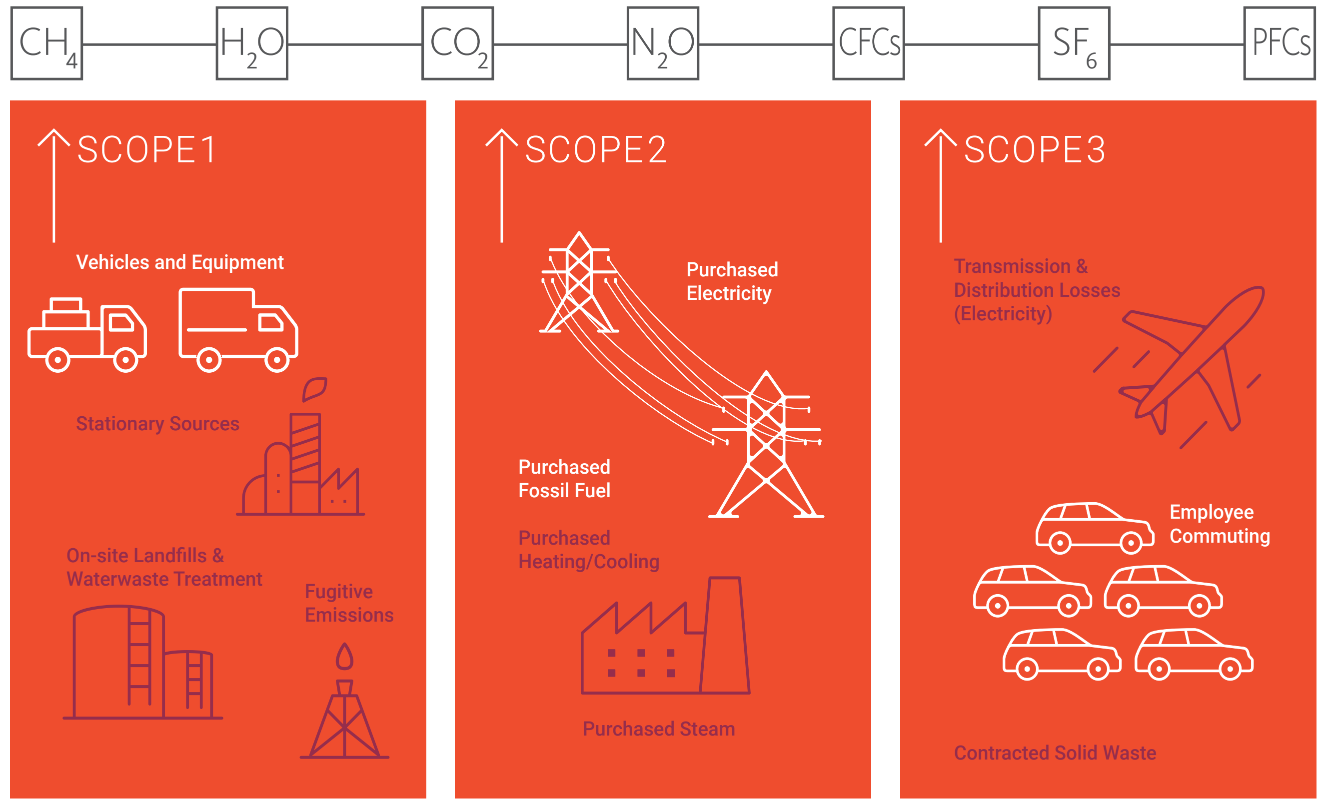
The design team developed an overall project timeline of 12 months that included four major steps: Benchmarking; Performance Analysis; Design Recommendations and Deliverables. There was tremendous collaboration between District Facilities Team, the Bond Management Team, CCCCO staff and the Design Team with weekly virtual meetings and in-person presentations after each major step to make decisions and progress the planning process. The following provides a detailed summary of the steps involved per each IEMP goal.

Benchmark	Analyze	Design	Deliver
DATA GATHERING + BENCHMARKING	PERFORMANCE ANALYSIS + TARGET SETTING	DEVELOPING DESIGN RECOMMENDATIONS	STORYTELLING + IMPLEMENTATION TIMELINE

PLANNING PROCESS

COMMON SOURCE OF GREENHOUSE GAS EMISSIONS

One of the very first steps that the design team clarified in the planning process was to identify the sources of greenhouse gas emissions that can be tracked effectively and documented for the IEMP. The graphic below shows the common sources of greenhouse gases and sources highlighted in white are accounted for in this IEMP as it relates to LBCCD.



GREENHOUSE GAS EMISSIONS from sources that are owned or controlled by a public agency.

GREENHOUSE GAS EMISSIONS resulting from the generation of electricity, heat, or steam purchased by a public agency.

GREENHOUSEGASEMISSIONS from sources not owned or directly controlled by a public agency but related to agency activities.

PLANNING PROCESS

GREENHOUSE GAS (GHG) EMISSIONS

CO_2 Campus CO_2 Emissions Including Future Emission Reduction Projects

Facts

- District has 54 buildings on two campuses.
- District owns a fleet of vehicles.
- District uses natural gas and other fossil fuels on site.

Planning Process Steps

- Collect utility data from 1990 on electricity and gas for both campuses.
- Collect vehicle fleet inventory data for today and estimate for 1990.
- Collect fossil fuel burning equipment today and estimate for 1990.
- Establish benchmark for 1990.
- Compare benchmark for 2010 against 1990.
  Identify gap between 2017 and benchmarks.
  Plan for future growth.
- Develop road map to meet 2050 goals.

Observations and Assumptions

- Individual Utility Meters often span a group of buildings, so assumptions were made to break down the data further to estimate the energy end use for each building based on the capacities of installed equipment, operating hours, and building classification (ie. Library, classrooms, offices, etc.)
- Best estimates were made for the historical use of vehicles based on LBCCD staff knowledge.
- Building timelines were developed for each building with the assistance of LBCCD staff to clearly show when each building was built, major renovations, and demolitions.
- Reasonable assumptions for carbon emissions from 1990 electricity consumption were made.

PLANNING PROCESS

ZERO NET ENERGY

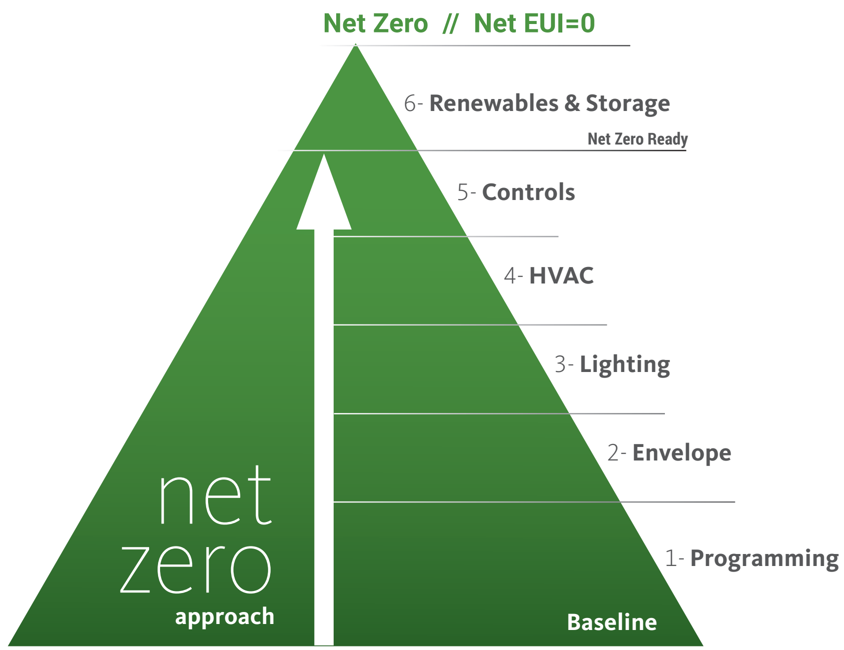
ZNE for New Buildings from 2020 till 2025 and ZNE for all construction after 2025

Facts

- District has been pursuing 10% for modernized buildings and 15% for new buildings than Title 24 energy performance.
- District is re-prioritizing the construction projects in their 2041 Facilities Master Plan.

Planning Process Steps

- Identify the set of new building projects before 2025 from the 2041 Facilities Master Plan as well as between 2025 and 2041.
- Identify Baseline Energy Use Intensity (EUI) based on the average building of the same type in the same zip code.
- Set appropriate Energy Use Intensity (EUI) targets relevant to achieve GHG reductions.
- Assess renewable energy potential at the campus level.
- Develop a road map and set of design recommendations to achieve ZNE.



Observations and Assumptions

- To align with Department of General Service's definition of ZNE, District is pursuing ZNE at Source, IEMP recommends on-site generation at the campus level.
- Under Design recommendations, IEMP provides a discussion on purchasing on-site renewable energy vs. power purchase agreements.
- ZNE-Source is defined as the amount of source energy consumed over a year equal to the amount of source energy offset produced over a year at a District level.
- ZNE-source to be achieved as an overall gross square footage of new buildings and major renovations added as opposed to individual buildings.

PLANNING PROCESS

ZERO NET ENERGY

ZNE for Existing Buildings by 2025

Facts

- Electrical sub-meters at a building level are installed for 80% of all the buildings within District. All main meters are only available at the campus level.
- Natural gas and water meters are only available at the campus level.
- All of the buildings are connected and controlled via a Building Management System (BMS).
- A variety of energy conservation measures have been installed over the years.

Planning Process Steps

- Utilize data collected for GHG reductions and develop a plan to address EUI for individual buildings.
- Utilize BMS trending data as needed to close the gap.
- On all buildings provide an ASHRAE Preliminary Energy Analysis.
- Identify EUI for all the buildings and compare against average building EUI.
- Categorize all existing buildings into good, medium, poor EUI performance.
- Set target EUI for individual existing buildings toward ZNE relevant to achieve GHG reductions.
- Provide industry best practice recommendations for reducing EUI on the existing buildings.
- In order to develop a set of actionable energy savings measures, perform the following ASHRAE investigations:
    a. Perform ASHRAE Level 1 Audit on all of existing buildings except for buildings that were built new or went through major renovation in the past 5 years.
    b. Assess buildings for further investigation and highest energy savings potential.
- Identify the next tier of existing buildings to go through ASHRAE Level 2 Audits prior to 2025 to achieve the goal of ZNE for 50% of SF for existing buildings.
- Continue to develop a plan to take action on energy conservation measures during major renovations for the rest of the existing buildings planned within the 2041 Facilities Master Plan.

Observations and Assumptions

- Campus level energy usage information is readily available through the utility bills and utility service provider websites.
- However, there are many instances of a single electric or gas meter that serves multiple buildings, making it difficult to get the energy usages of individual buildings. Note that this effort may not be worth the cost, but ensuring all new buildings are individually sub-metered should be done.
- Metering available from the controls system was also collected to obtain more granular energy usage data.

PLANNING PROCESS

ZERO NET ENERGY

Reduce Grid-based Energy Purchase for Buildings/Non-Buildings

Facts

- District already reduces its grid-based energy purchase by producing renewable energy on-site at LAC.
- District is currently planning on adding another solar system on-site at PCC.
- There are individual natural gas boilers in some buildings. Central plants use natural gas boilers.

Planning Process Steps

- Collect all the renewable energy production data.
- Utilize data collected for GHG reductions.
- Identify fuel sources for back-up or emergency power supply systems and investigate options to convert them to battery backed or other less carbon intensive fuel options.
- Assess reduction in grid-based energy purchase compared to a new Baseline set for 2003 while accounting for growth.
- Develop a set of energy procurement recommendations to achieve the target and maintain or exceed the goals through 2050.

Observations and Assumptions

- There are very few emergency backup generators that are running on fossil fuel and so the design team decided to not capture their emissions as well as change their fuel source since they are a very minute portion of the overall emissions.
- District is in contract with a Direct Access provider and the design team explored different options to purchase cleaner power from them as part of our strategy. This option needed to be weighed against renewable energy producing systems and battery storage solutions.

Participate in Demand Response Programs

Facts

- District has some concerns over the effectiveness of such programs.

Planning Process Steps

- Identify latest demand response program options from the utility providers.
- Assess future trends in demand response programs.
- Assess existing electrical infrastructure at a campus level to accommodate demand response.
- Assess demand response opportunities based on peak demand assessment made for central plant design.
- Develop recommendations for existing buildings and future projects.

Observations and assumptions

- Southern California Edison (SCE) and several third-party providers offer financial incentives for participation in demand response (DR) programs. These programs require participants to reduce their energy use during select times of the year, typically during peak utility events. Typical strategies for participation include, but are not limited to, modifying space temperature set points, turning off equipment, reducing lighting levels, shifting hours of operation, etc.
- In general, the service provider will notify the owner of an event in advance to allow them to prepare and notify building occupants accordingly. Dependent on the DR program, the response may be automatic or manual. In addition, the owner may opt to participate in all events or limit the number of events.
- The 2016 California Energy Code (CEC) requires HVAC systems with DDC controls to the zone level to be programmed to allow centralized demand shedding for non-critical zones. In addition, the CEC requires new lighting and lighting controls to be capable of receiving a demand response signal to allow for demand shedding.
- The CEC only requires that the HVAC and lighting to be programmed to allow for these controls. It does not mandate that one participate in the demand response program. That decision is in the hands of District.
- District should consider demand response programs for all new buildings as well as evaluate existing buildings with the capability already in place. Some modifications from the service provider are required, but these are minimal if the existing infrastructure is already in place. District would need to evaluate which spaces would be deemed non-critical to their operation and consider the best method to communicate these events to the occupants.
- District has an existing micro-grid pilot for education purposes at their PCC and has expressed interest in developing a larger micro-grid solution for the entire District which would integrate battery storage and demand response features.

PLANNING PROCESS

WATER USE REDUCTION

Water Use Reduction

Facts

- District has a strong water conservation practice in place already.
- Recently went through updating irrigation water to reclaimed water at LAC.
- Has a District standard to replace with efficient plumbing fixtures during renovations?

Planning Process Steps

- Utilize data collected from utility for GHG reductions.
- Assess opportunities to provide temporary meters to identify building level water use.
- Use industry standard estimation methods to identify Water Use Intensity (WUI) per building.
- Develop recommendations to reduce WUI at a building level for existing buildings.
- Develop recommendations to reduce WUI significantly at new buildings.

Observations and Assumptions

- There are 40 water meters at both campuses and the design team was able to identify water usage for indoor vs. outdoor use as well as reclaimed water usage for LAC. Further breakdown of water usage per building was a costly measure that didn't provide more value as District has been a good steward of water already through best design and management practices.

PLANNING PROCESS
USE GREEN BUILDING PRACTICES

LEED Certification

Facts

- District follows best practice guidelines aligned with California Green Building Code.
- District decides on a project by project Basis whether to go through the certification process.

Planning Process Steps

- Identify projects that are over 10,000 sf, since 2012 and perform a post-design assessment on their compliance to LEED certification.
- Identify any gaps and provide recommendations for future modifications.
- Identify future projects and develop an appropriate set of recommendations specific to LBCCD standard practices to be compliant with LEED and Cal Green guidelines.
- Assess opportunities for LEED Existing Building certification.

Observations and Assumptions

- LEED Platinum - Building V Math and Technology, Culinary Arts Building
- LEED Silver - Building GG - Student Services

Building Commissioning

Facts

- District has a standard of requiring commissioning on all new and major renovation projects.

Planning Process Steps

- Identify new or major renovation projects after 2012 that have not been commissioned.
- Assess need for retro-commissioning those projects.
- Develop a plan to address the rest of existing buildings related to retro-commissioning and monitoring-based commissioning.

Observations and Assumptions

- District has a standard for commissioning all new construction and major renovation.

Operation and Maintenance Guidelines

Facts

- District has design standards and operations policies.

Planning Process Steps

- Review District standards and revise standards as needed to align with IEMP goals.
- Incorporate lessons learned through pilot projects from ASHRAE Level 2 implementation projects.

Observations and Assumptions

- None.

PLANNING PROCESS

IMPLEMENT CAL GREEN DIVISION A5.5 – INDOOR AIR QUALITY

Implement Cal Green Division A5.5 Indoor air quality

Facts

- District standards are to comply with Title 24 air quality standards.

Planning Process Steps

- Develop design recommendations to meet and exceed IAQ standards for existing buildings and new construction.

Observations and Assumptions

- A CO_2 survey was conducted in each building on campus. The survey used a hand held CO_2 sensor/data logger to take measurements in various room types in each building. Overall the campus has acceptable CO_2 levels. A few areas with high occupancy were observed to have over 1,000 ppm. Note that this is common for high occupancy spaces. The strategy to mitigate high CO_2 concentrations is to ensure a demand controlled ventilation is implemented on the HVAC systems.
- Many of the facilities have classroom doors that open to outdoors (as opposed to opening into interior hallway). HVAC systems for these units are target candidates to implement demand controlled ventilation to reduce heating/cooling of outside air, as outdoor air is frequently brought in through the doors.

PLANNING PROCESS

ELECTRIC VEHICLE CHARGING STATION

Electric Vehicle Charging Station

Facts

- Campus level planning for EV infrastructure already in place.
- Portable EV chargers are currently in place through the District.

Planning Process Steps

- Develop a campus map with EV charging availability permanently and temporarily.
- Anticipate future growth and assess needs for future buildings and provide recommendations for design consideration for EV.
- Include the anticipated demand in GHG emissions calculations.
- Include the anticipated EV charging stations on the campus map.

Observations and Assumptions

- None

ENVIRONMENTAL PURCHASING POLICY (EPP)

Environmental Purchasing Policy

Facts

- District is following Public Contract Code section 12400 for procurement of goods and services.

Planning Process Steps

- None

Observations and Assumptions

- None

WASTE MANAGEMENT

Waste Management

Facts

- District is engaged in many net zero waste practices such as organic waste composting programs.

Planning Process Steps

- None

Observations and Assumptions

- (AB 1826) The bill requires a business which generates eight cubic yards, or more, of compostable organics a week to participate in an organic waste composting program. The bill commenced on April 1, 2016.
- Building V Culinary Department and S&B Catering Service sort and separate the organic waste from the regular waste stream and deposits the waste in a special dumpster in the loading dock.
- Athens Services, a Waste Disposal company provides the special dumpsters and picks up the organic materials three times a week.
- Athens Services sorts and recycles all recyclable material out of the waste stream.
- Athens Services recycles all the green waste into mulch.

PLANNING PROCESS
BENCHMARKING

Benchmarking existing buildings and taking an accurate inventory of resources consumed is a critical step in the planning process. Benchmarking happens in the following four steps:

1. Data gathering
2. Data organization
3. Data gap analysis
4. Data improvement

Data Gathering
Toward achieving the key goals for the IEMP, the design team started with gathering data from utility bills, vehicle inventory, current and projected student enrollment and projected growth in campus facilities,

Data Organization
Energy data gathered from meters did not match building usage one-to-one, i.e., one electric meter measures four buildings, for instance. Similarly, there is one gas meter that serves several buildings. The design team organized this data by estimating the EUIs for each building to account for the overall EUI for each meter.

Data gap analysis
Once data is organized and accounted for, the design team analyzed the data for any gaps.

At LAC, high electric usage appears to be isolated in the largest group of buildings on the north half of campus. Building V has a high gas EUI of 41, compared to LBCCD average of 28. Three gas meters have high usage and unconfirmed service areas. The design team concluded that energy reduction efforts should focus on these three gas meters.

At PCC, electric EUI is highest above expected value at the utility meter level. Buildings AA and EE show higher usage from the Siemens meters than predicted energy models, lending themselves to be potential targets for electric use reduction.

Data Improvement
Realizing these gaps in energy data and providing meaningful assumptions to close the gap, the design team recommends installing sub-metering to improve the quality of the data.

A sub-metering plan is recommended to identify installation of sub-meters to track individual buildings, or buildings groups or energy use. The plan should also provide measurement and verification protocols on tracking methodology.

At LAC, install Electric sub-meters at Buildings B, C, and F; Gas sub-meters at Buildings F, G, and T.

At PCC, install electric sub-meters at buildings GG, LL, QQ, PP, RR, YY, JJ, UU, FF, NN, and KK. Sub-meters at buildings BB, CC, and DD need calibration or repair.

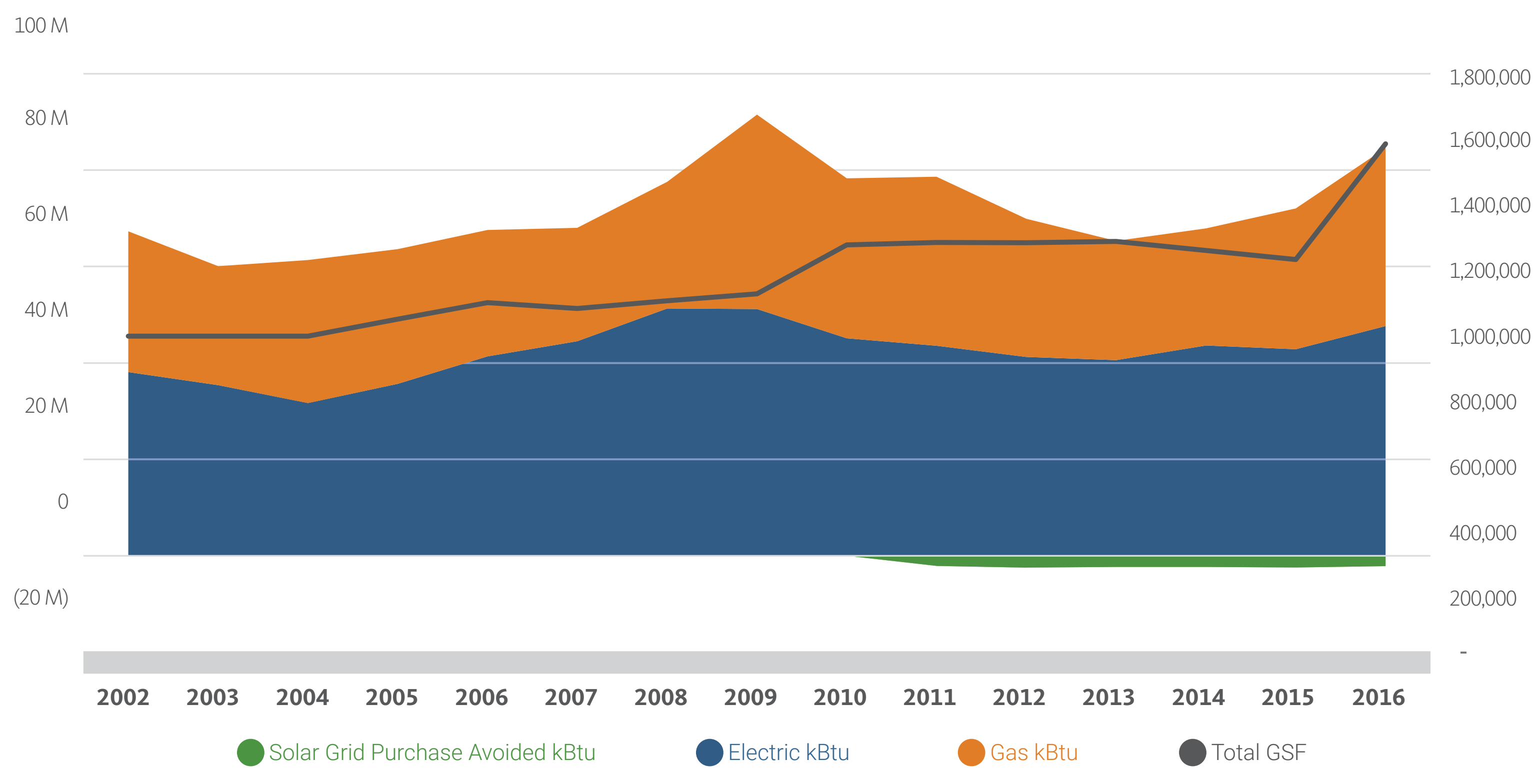
The design team also recommends Ongoing Monitoring and Issue Resolution Framework to continuously ensure the high quality of data to implement and verify design recommendations.

If the sub-metering plan is implemented then a framework should also be implemented in effectively accessing, retrieving, and reporting on this data. Such a framework will:

- Ensure data is tracked in a central location such as the Siemens BMS, or a cloud application such as SkySpark.
- Ensure data will generate the needed KPIs such as Peak KW, kWh/SF, therms/SF, gallons/SF, EUI etc.
- Ensure alerts are provided when measured data is higher (or lower) than expected. Such alerts could be provided to LBCCD facilities team to proactively investigate before the occurrence of any major challenge or loss of educational opportunities.

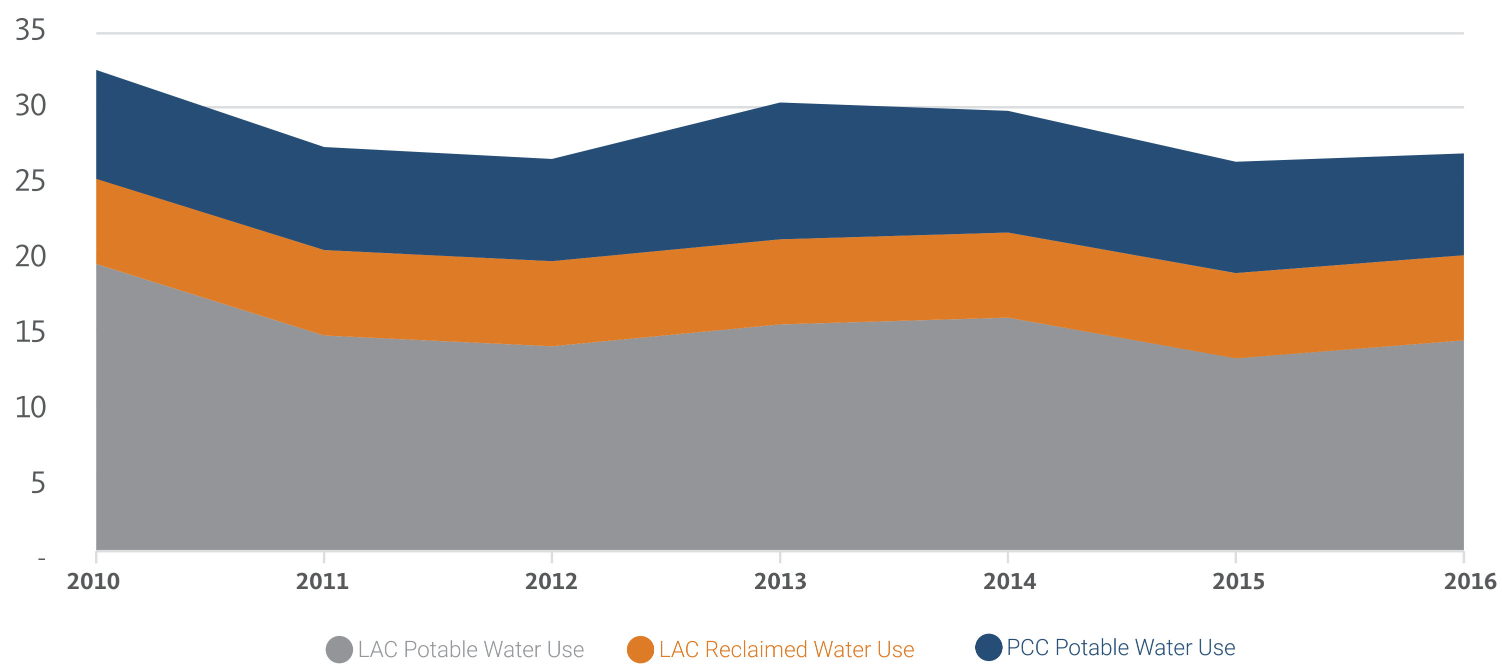
PLANNING PROCESS
BENCHMARKING

Data Gathering:
Annual Energy Use of Buildings (In Million kBtu) vs. District Gross Square Footage



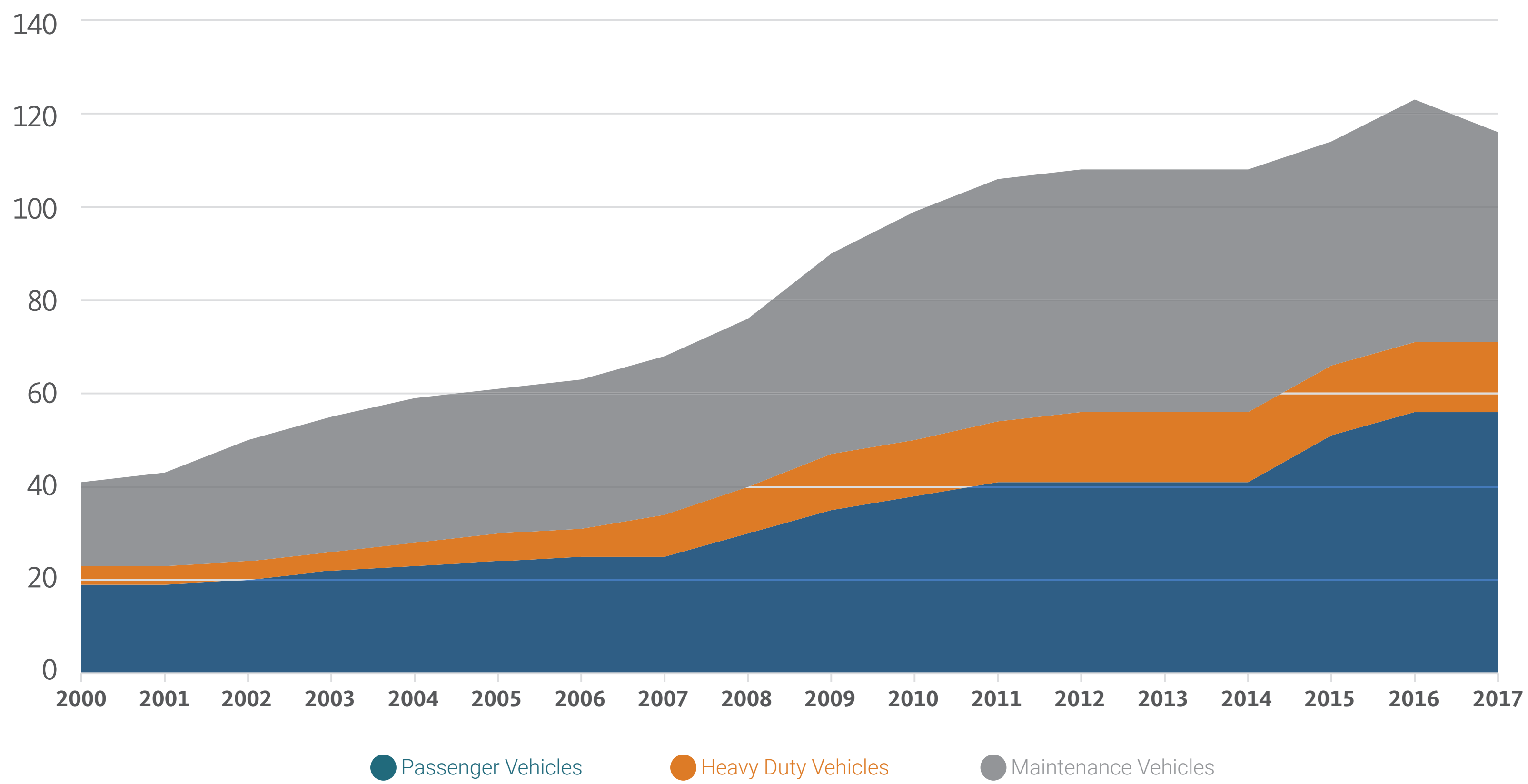
PLANNING PROCESS
BENCHMARKING

Data Gathering:
Annual Water Use (Million Gallons)



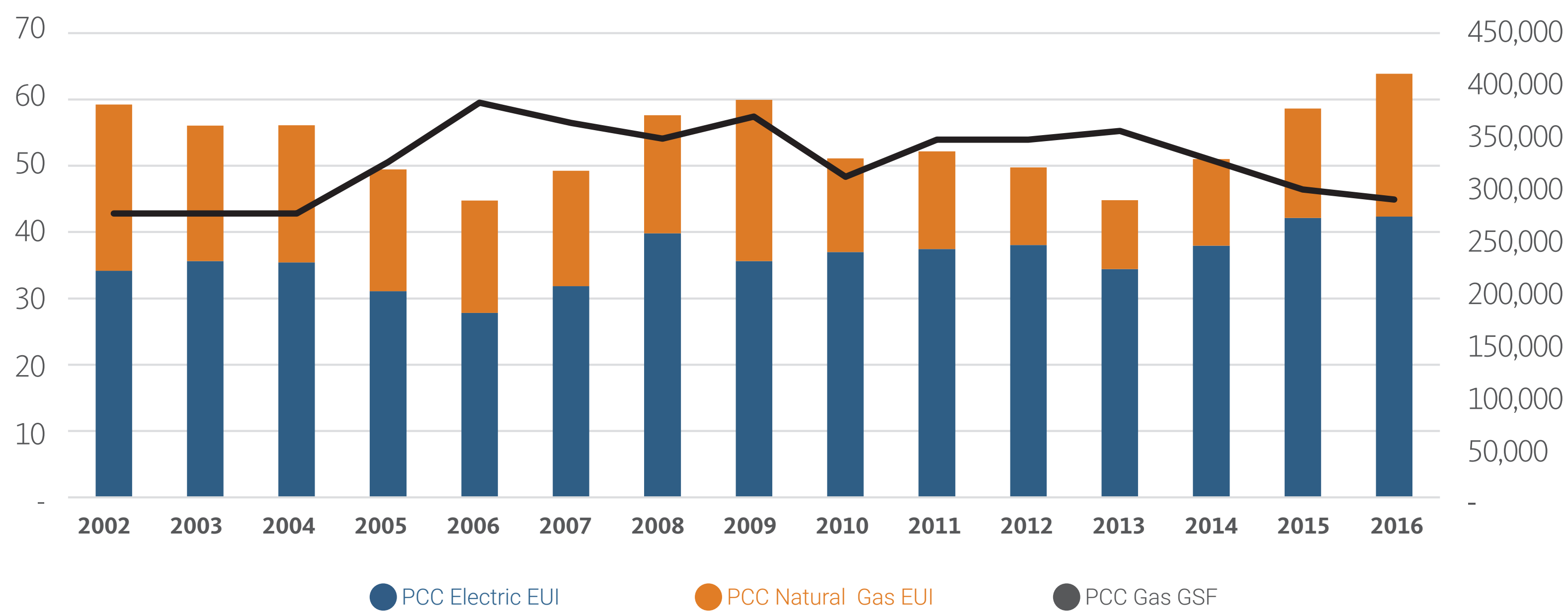
PLANNING PROCESS
BENCHMARKING

Data Gathering:
Vehicular Inventory



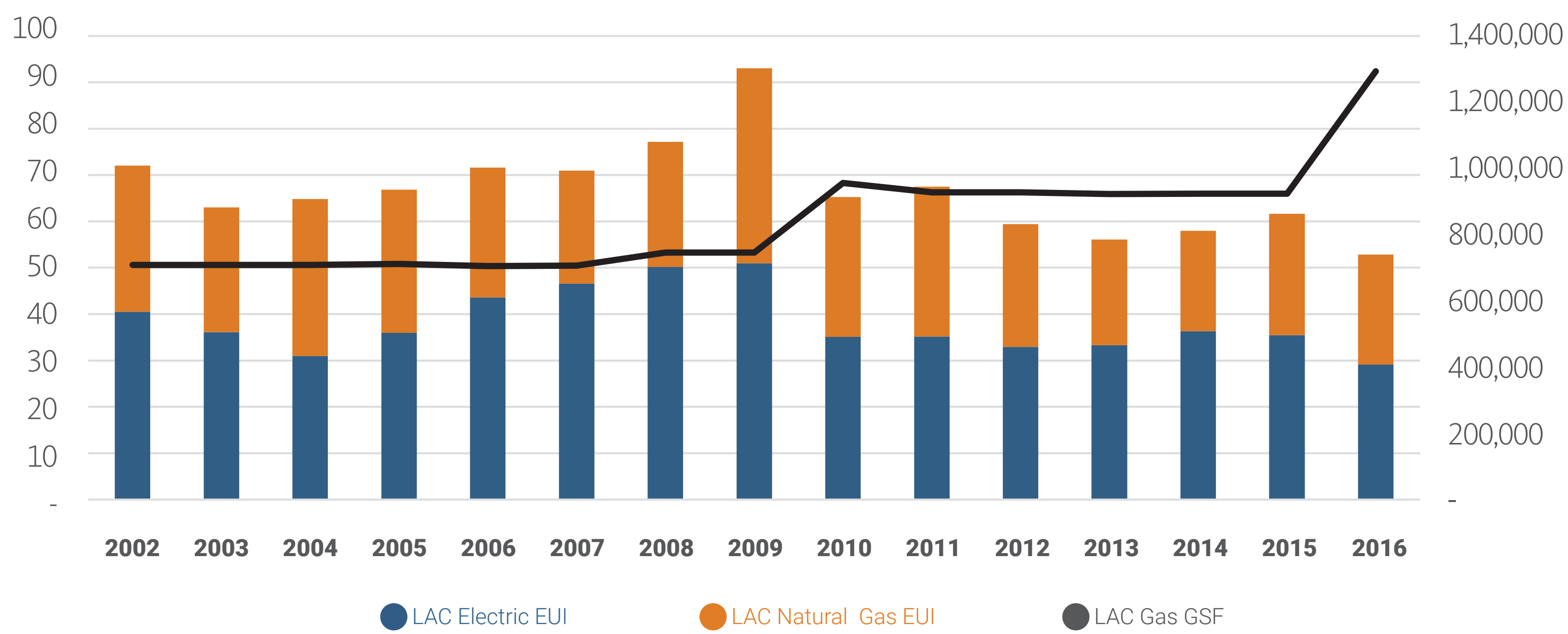
PLANNING PROCESS
BENCHMARKING

Data Organization:
PCC Energy Use Intensity (EUI - kBtu/sf/yr)



PLANNING PROCESS
BENCHMARKING

Data Organization:
LAC Energy Use Intensity (EUI - kBtu/sf/yr)



PLANNING PROCESS

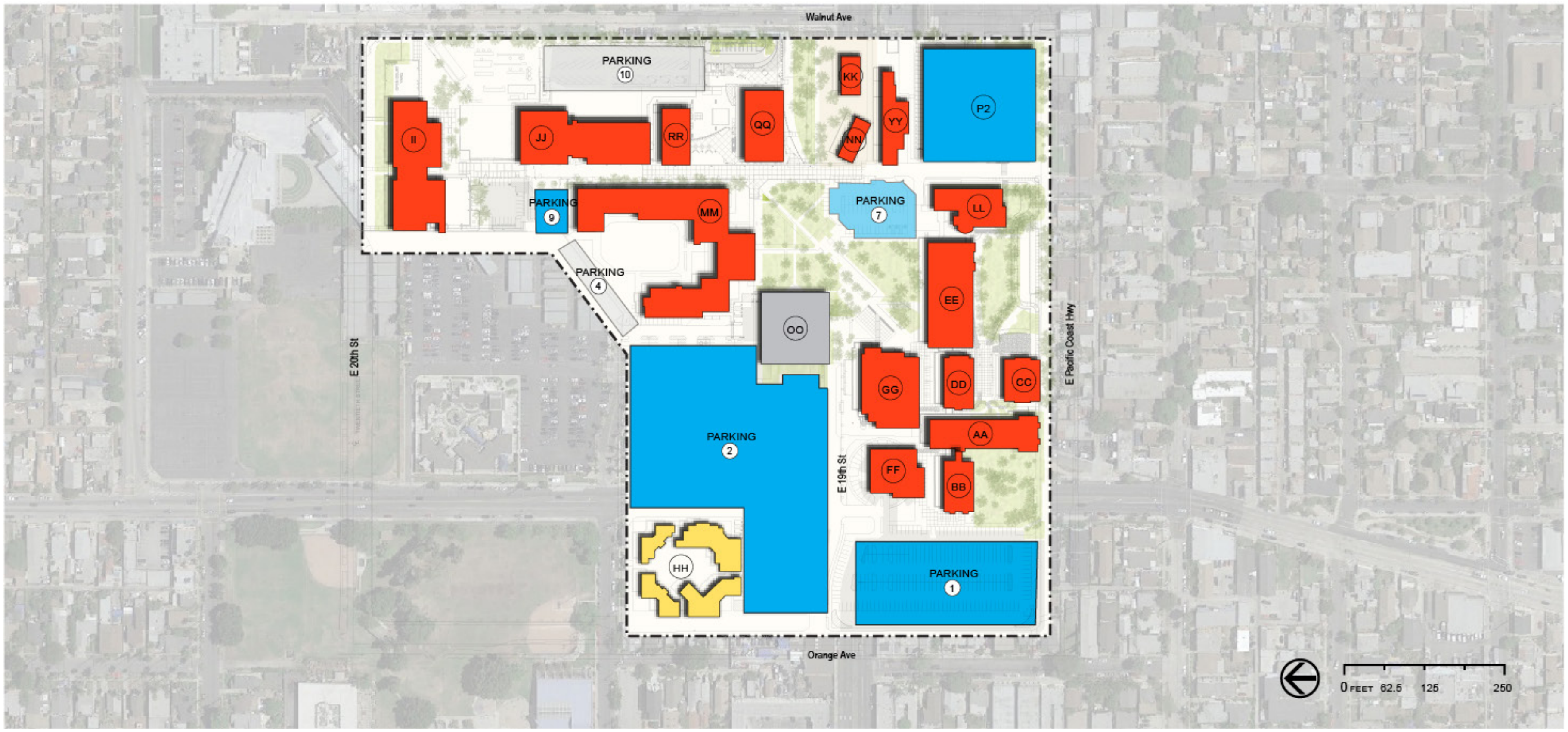
BENCHMARKING | LIBERAL ARTS CAMPUS

DATA IMPROVEMENT- ELECTRIC METER GROUPING

- Child Study Center | 86,122 kWh/Year
- Campus Meter Group - A | 9,338,544 kWh/Year
- Campus Meter Group - B | 18,119 kWh/Year
- Street Lamps | 1,196 kWh/Year
- Traffic Control Signal | 15,811 kWh/Year
- Campus Meter Group - C | 1,353,361 kWh/Year
- Stadium | 820,572 kWh/Year

PLANNING PROCESS

BENCHMARKING | PACIFIC COAST CAMPUS
DATA IMPROVEMENT- ELECTRIC METER GROUPING



Campus Meter Group - AA | 3,788,556 kWh/Year

Campus Meter Group - BB | No Usage Data for 2016

Campus Meter Group - CC | 3,824 kWh/Year

PLANNING PROCESS

BENCHMARKING | LIBERAL ARTS CAMPUS
DATA IMPROVEMENT- GAS METER GROUPING

- Verified Exterior Meter Location
- Child Study Center | 1,170 therms/year
- Campus Meter Group - 1 | 0 therms/year
- Campus Meter Group - 2 | 12,541 therms/year
- Campus Meter Group - 3 | 78,871 therms/year
- Campus Meter Group - 4 | 129 therms/year
- Campus Meter Group - 5 | 48,948 therms/year
- Stadium | 9,465 therms/year
- Campus Meter Group - 6 | 80,925 therms/year
- Campus Meter Group - 7 | 3,137 therms/year
- Building X | 319 therms/year
- Building V 57,931 therms/year
- Building V 57,931 therms/year

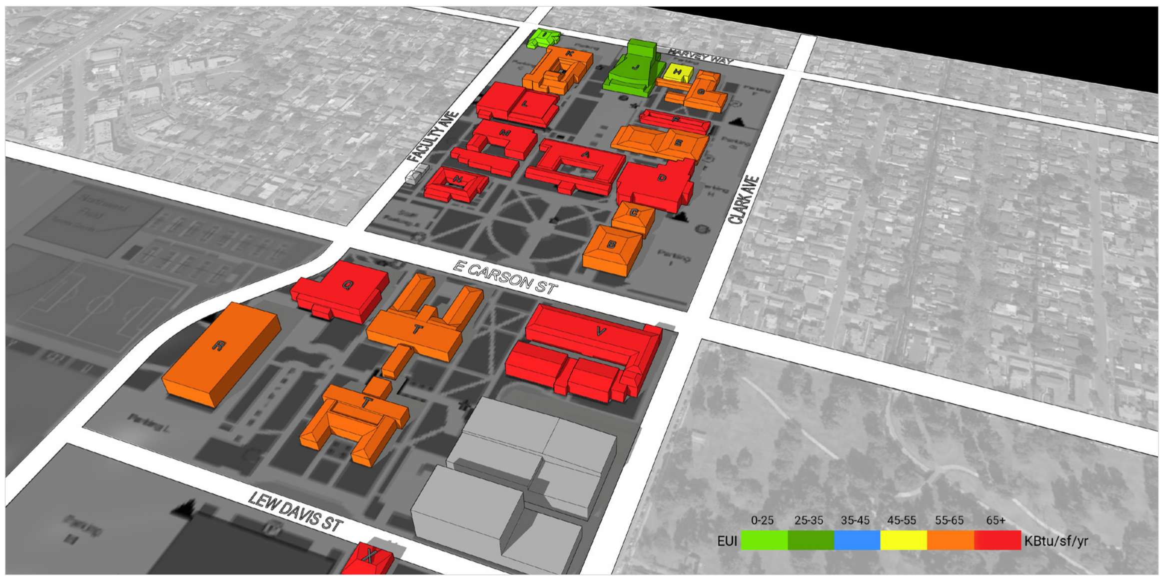
PLANNING PROCESS

BENCHMARKING | PACIFIC COAST CAMPUS
DATA IMPROVEMENT- GAS METER GROUPING

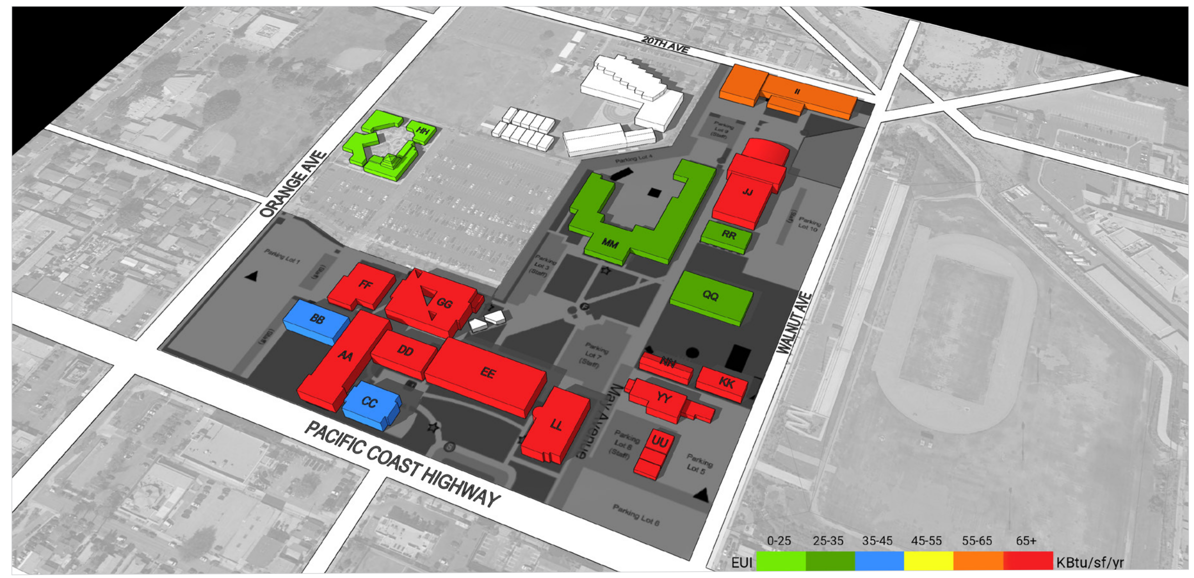
- Verified Exterior Meter Location
- Campus Meter Group - 11 | 44,014 therms/year
- Campus Meter Group - 22 | 802 therms/year
- Unassigned Buildings and Meters | 16,908 therms/year
- Building JJ | 506 therms/year

PLANNING PROCESS
BENCHMARKING

Data Improvement:
Energy Use Intensity Graph for LAC

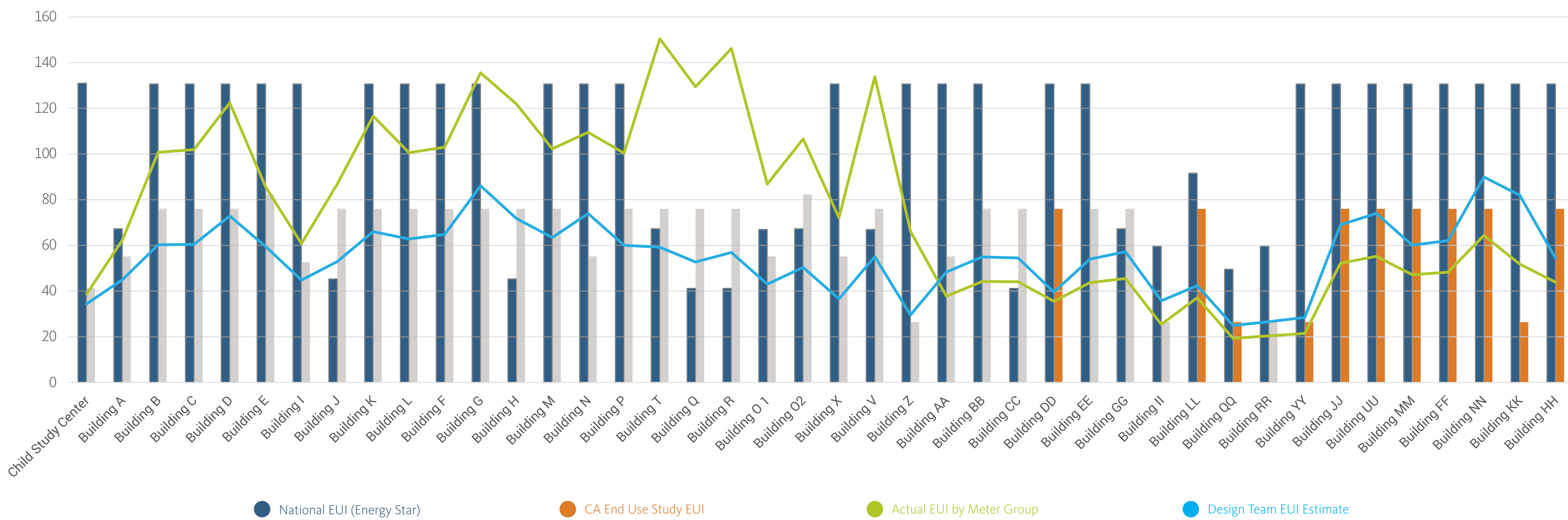


Data Improvement:
Energy Use Intensity Graph for PCC



PLANNING PROCESS
BENCHMARKING

Building Level Energy Use (EUI-kBtu/sf/yr) Comparison



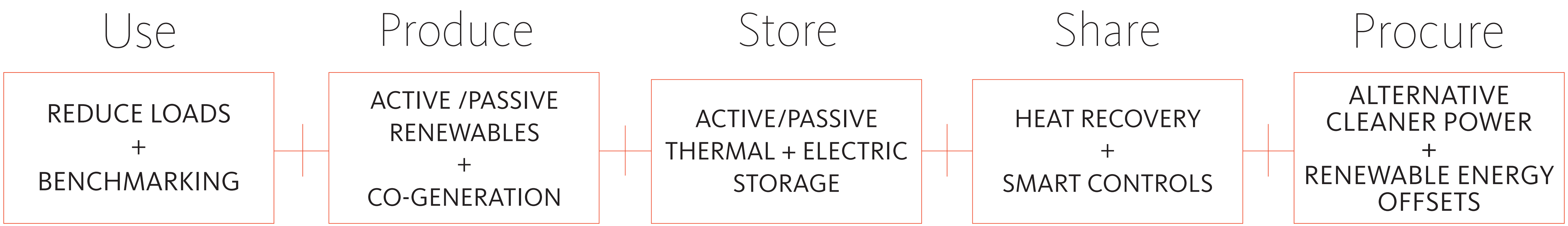
PLANNING PROCESS

PERFORMANCE ANALYSIS

Utilizing data from Benchmarking, the design team began the next phase of the process by first identifying different strategies to achieve the KPIs established. To assist in further discovering and analyzing strategies we developed a framework:

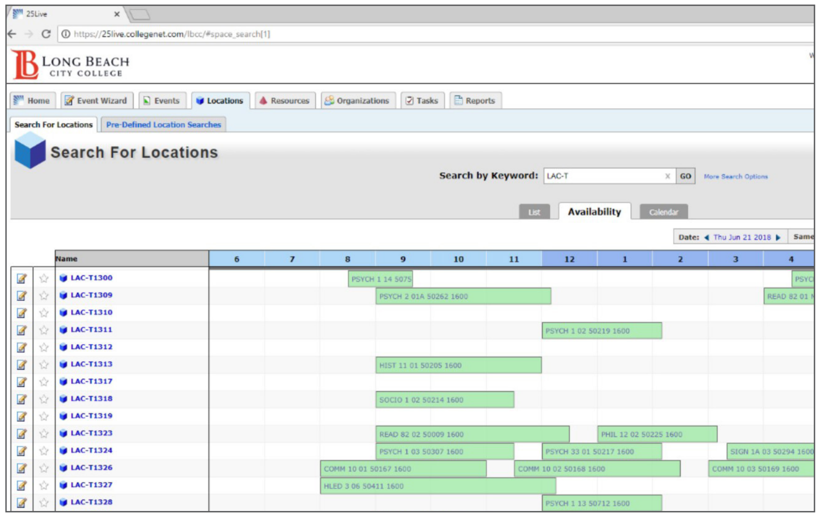
- Use-Reduce
- Produce
- Store
- Share
- Procure

By applying this framework, the design team identified 23 different strategies to explore further with performance analysis. For every strategy, the team evaluated implementation cost on a rough order of magnitude; estimated energy savings; estimated water savings; estimated utility cost savings; estimated GHG reductions; return-on-investment in simple payback years and discussed pros and cons of implementing such strategy from a maintenance and operations standpoint. Of the 23 strategies, 10 strategies were identified as they are estimated to have a good return on investment. A brief description of all the strategies is provided below. A detailed discussion of selected strategies are included in the design recommendations.



PLANNING PROCESS

PERFORMANCE ANALYSIS



Use-Reduce: Space Utilization

The best way to save energy is to not expend it in the first place. Looking at opportunities to leverage existing space within the campuses and the District should be the first step. District has implemented a web-based space scheduling system since 2018. 25Live is a web-based scheduling and event-publishing system that provides a centralized scheduling system, data repository, and calendar of events for the college and to optimize the usage of District facilities. The software can also help to identify areas of increased demand so sufficient rooms can be made available for additional classes for our students.

District plans to continue to develop and assign scheduling FTEs targets per school and connect them to efficiency and budget. The goal is also to implement 25Live to inform room utilization and reallocate room space where needed, saving energy and other resources.

Use-Reduce: ASHRAE Level 1 Analysis – HVAC, Lighting, Controls Measures Taken

Measures were taken in the past by District between 2010 and today through various projects effectively have allowed District to grow 307,054 GSF but maintain the same amount of energy and GHG emissions.

District has completed various energy efficiency projects funded by Measure E & LB. Measure E & LB is a $660 million bond to fund new construction, renovations and repairs at the PCC and LAC campuses. A detailed list of projects is included in the Design Recommendations section - Energy Efficiency Measure Completed to Date.

Use-Reduce: ASHRAE Level 1 Analysis – HVAC, Lighting, Controls

An energy audit was performed at LBCCD to determine potential energy efficiency measures (ECMs) for reducing energy use and Greenhouse Gas (GHG) emissions. The energy audit was performed at both campuses, Pacific Coast Campus (PCC) and the Liberal Arts Campus (LAC). The first stage of the energy audit consisted of an ASHRAE Level I audit of all buildings on both campuses. A deeper ASHRAE Level II analysis was performed and focused on buildings with the greatest potential for energy savings. The purpose of these audits is to identify opportunities for energy savings within the buildings. The following describes the methodology behind a Level I audit, as well as the ECMs, analyzed at the corresponding buildings.

A field survey of each building on campus (PCC and LAC) was performed to investigate potential energy improvements. The intent of the survey was to document equipment quantities/capacities, identification of improvements for major systems, and development of high level energy savings. Where equipment was unacceptable or model information not available, the team made assumptions for the size, capacity, and performance of equipment based on known system types. Based on this survey, a list of recommended energy conservation measures (ECMs) was developed and applied to each building. Calculations were conducted on a per ECM/building basis to determine the following: annual electrical savings (kWh), annual natural gas savings (therms), annual electrical cost savings, annual natural gas cost savings, and total energy cost savings.

Use-Reduce: ASHRAE Level 1 Analysis – Envelope

Over 65% of facilities at both campuses were built prior to 1990. Although there is an excellent opportunity to upgrade the envelope to meet or exceed today's energy codes, this strategy will require extensive remodeling and disruption to buildings that are not designated for renovation or demolition. 17 out of 54 buildings are designated to be renovated or demolished and replaced. The design team recommends analyzing the opportunity to improve the existing building envelope during the time or renovation. Strategies to consider are to improvement to thermal mass, the insulation, air tightness, glazing and fenestration design to allow for more energy savings and natural light and views. A detailed envelope commissioning is recommended during renovation projects.

Use-Reduce: ASHRAE Level 1 Analysis – Plug Load Management

Plug loads refer to equipment other than HVAC equipment such as computers, printers, copiers, fax machines etc., that are plugged into the electrical outlets. Typically, plug loads represent at least 25% of energy consumption of a commercial building. Through high performance design strategies, as a building's overall energy consumption is reduced, the proportion of plug load energy consumption can go as high as 50%. So, it is increasingly becoming important to manage the type of plug loads as well as how and when they consume energy. The common methodology is to provide dedicated electrical circuits and panels to accommodate plug loads so, at any given time, the entire circuit could be turned off to save energy. Such a strategy is increasingly being required by California Title 24 Part 6. The design team realizes that revising the electrical circuits for existing buildings to allow for plug load management is cost prohibitive and so is recommending exceeding Title 24 requirements on new and renovation building projects as it relates to plug load management.

Use-Reduce: ASHRAE Level 1 Analysis – Exterior Lighting

An audit of the site lighting was performed at LBCCD to determine potential energy efficiency measures (ECMs) for reducing energy use and Greenhouse Gas (GHG) emissions related to outdoor lighting. The audit was performed at both campuses, Pacific Coast Campus (PCC) and the Liberal Arts Campus (LAC). The first stage of the site lighting audit consisted of walking both campuses to get a count on the quantity of fixtures and fixture types. Some portions of the campus were upgraded with LED fixtures, however, a number still consisted of metal halide and other inefficient technologies. Also, site lighting controls for the older fixtures was limited to a time clock. The audit excluded fixtures connected to the exterior of the building as these are more decorative in nature and replacement for energy savings would involve further study to comply with the aesthetics of each building. The next step of the site lighting audit consisted of finding replacement fixtures and lighting controls to improve energy efficiency. Calculations were conducted to determine the following; annual electrical savings (kWh), annual electrical cost savings, and ROI. This strategy had an estimated source energy annual savings of 13,057,266 kBtu with an implementation cost of $1,345,683. The ROI for this strategy was 9 years.

Use-Reduce: ASHRAE Level 2 Analysis

Level II audits built upon the Level I audits and developed a more in depth savings calculations for several key buildings on both campuses. The IEMP team and he District generated a list of the top 10 buildings to be targeted based on potential energy savings. The Level II audit consisted of generating an energy model of the current building conditions utilizing Trane Trace software. A Baseline model was constructed to recreate the known conditions for today. The ECMs proposed under Level I were then applied in greater detail in the energy model to more accurately capture the potential savings.

Use-Reduce: EV Charging Stations

To achieve the requirements of EO B-16-12, which is to replace at least 25% of the fleet owned by LBCCD to ZEV as well as providing infrastructure for charging. District currently owns 120 vehicles that include fork lifts, golf carts, trucks, and maintenance vehicles. The design team recommends reviewing ZEV options for new and replacement vehicles. The need for infrastructure to charge these ZEVs is actually driven by student's driving ZEVs. District currently has 22 temporary/portable EV Charging Stations at their campuses and plans to add another 86 to 130 stations to support the growing need for ZEV infrastructure. A detailed plan showing locations of EV Charging stations existing as well as planned is provided under the Energy Efficiency Measures Recommended section.

Use-Reduce: Retro-commissioning – HVAC, Lighting, Controls

Retro-commissioning is a systematic process to ensure a building is operating per its design intent. It involves calibrating sensors and reviewing HVAC and lighting components to ensure they are installed and working as intended. Retro-commissioning seeks to identify and implement low/no cost energy saving opportunities from controls adjustments, or minor component replacements and general targets projects that pay back in under two years based on energy savings. In comparison to an ASHRAE Energy audit, which recommends large system replacements and long term energy saving retrofits, a retro-commissioning project seeks to use what is already installed in the building and make sure it is operating as efficiently as possible. This strategy had an estimated annual source energy savings of 9,857,502 kBtu for an implementation cost of $300,000. The ROI for this strategy was 3 years.

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Produce: Cogeneration

Cogeneration, also referred to as Combined Heat & Power (CHP), is the use of a gas-fired engine/turbine to produce electricity. This process generates waste heat which can be used in another application, e.g., heating. This strategy was evaluated for the future Kinesiology Lab and Aquatic Center (KLAC) at the LAC Campus. The waste heat from the cogeneration system could be utilized for the aquatic center pool, which requires a constant source of heating, in addition to domestic water and hydronic heating. This system provides independence from the electrical utility. An 875kW natural-gas cogeneration system was evaluated for use at KLAC as well as Buildings R and Q. This strategy had an estimated source energy annual savings of 22,230,500 kBtu with an implementation cost of $3.5M. The ROI for this strategy was 14 years. Due to capital costs and annual maintenance costs this strategy has not been recommended for implementation. LBCCD has experience with cogeneration in Building R. This system has been offline and has experienced maintenance issues throughout its life.

Produce: Fuel Cells

Fuel Cells refer to the technology of devices that convert chemical potential energy, or energy stored in molecular bonds, into electrical energy. There are four main types of fuel cells and are classified by the type of electrolyte that they use; Proton exchange membrane fuel cells (PEMFCs), Phosphoric acid fuel cell (PAFC), Solid acid fuel cell (SAFC), or Alkaline Fuel cell (AFC). The most widely used fuel cell systems are PEMFC based. The process involves an anode, cathode and an electrolyte to allow positively charged hydrogen ions to move between the two sides of the fuel cell. Fuel, most commonly hydrogen, is added to the anode side and air is added on the cathode side, most commonly nickel, to produce waste chemicals which often is water. If other fuel options are available onsite, hydrogen can be substituted, but at the expense of water being produced. A fuel cell can be used with stored hydrogen to produce electricity and some water to be used on campus.

The use of co-generation is an option to capture the waste heat from fuel cells and produce heating hot water for the campus.

This strategy was evaluated for the future Kinesiology Lab and Aquatic Center (KLAC) at the LAC Campus. The waste heat from the fuel cell system could be utilized for the aquatic center pool, which requires a constant source of heating, in addition to domestic water and hydronic heating. A 1,400 kW fuel cell was evaluated for use at KLAC as well as Buildings R and Q. This strategy had an estimated source energy annual savings of 34,600,000 kBtu with an implementation cost of $8.4M. The ROI for this strategy was 21 years.

Produce: Solar Thermal

Solar hot water systems use rooftop collectors to convert solar energy into hot water. These systems are most appropriate for buildings with a constant heating load, such as pools, athletic facilities, residential, and food service. This strategy was evaluated for the future Kinesiology Lab and Aquatic Center (KLAC) at the LAC Campus. The solar collectors could be utilized for the aquatic center pool, which requires a constant source of heating, in addition to domestic water and hydronic heating. A 3,500 kBtu solar thermal array was evaluated for use at KLAC as well as Buildings R and Q. This strategy had an estimated source energy annual savings of 5,000,000 kBtu with an implementation cost of $1.2M. The ROI for this strategy was 43 years.

Produce: Solar Photovoltaics

Renewable energy generation through Solar Photovoltaic (PV) panels are increasingly becoming a common strategy for achieving net-zero energy goals at a campus level. The executive order B-18-12 requires renewable energy devices on each building. For economy of scale, ease of construction and maintenance as well as ability to provide resiliency, this strategy was evaluated more at a campus level than at a building level. This strategy should only be pursued when feasible energy reduction strategies are completely evaluated, so the need for renewable energy systems is reduced. The design team first explored the capacity of PV systems required to offset the remaining energy on an annual source energy standpoint. It is important to note that natural gas consumption, even though it is 43% of overall energy consumption, it only contributes to 20% of annual source energy as electricity has a higher site to source energy ratio. The PV system should be sized sufficiently enough to offset this natural gas source energy. Based on current energy consumption levels at the entire District, without taking into account energy reduction and future growth of the campuses, an initial PV system size of 12 MW AC would have had to be installed to achieve net-zero annual source energy goals.

However, after exploring and evaluating energy reduction strategies, the design team recommends a PV system capacity of a total of 6 MW AC. This strategy required extensive coordination with the utility provider Southern California Edison (SCE). The design team also has applied for Net-Metering 2.0 Interconnection application for both campuses and are working through the technical evaluations. SCE engineers required to perform a study on the upstream infrastructure to be able to intake the peak generated power input of 3960 KW AC at LAC and 2040 KW AC at PCC. The study may result in upgrading SCE's upstream infrastructure to accommodate this peak power input as it is considerably higher than the existing peak electric demand at both campuses.

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This strategy is recommended to be implemented in two phases. The first phase will reduce the PV system capacity to be within the existing peak electric demand of 2716 KW at LAC and 1098 KW at PCC. The second phase will complete the additional PV system proposed in this recommendation. Overall, this strategy will cost $18M and has an estimated annual source energy savings of 98,987,238 kBtu with an estimated ROI of 20 years. This strategy also assumes that the savings could be realized when an electrical battery storage system is also installed in the future. See discussion on Store: Electrical Storage – Batteries.

Store: Thermal Storage – Chilled Water

Chilled water thermal energy storage (TES) is the process of generating chilled water during off-peak hours, which is then stored in a tank for use at a later time. The tank is then discharged to provide cooling during peak hours. This process shifts the generation of chilled water to off-peak hours to reduce operating costs and reduce peak demand charges. The tank would ideally be located near the central plant but could be located remotely on the campus, which would require additional pumps. This strategy was evaluated on both campuses and would require roughly a 1M gallon tank for LAC and a 0.6M gallon tank at PCC. This strategy had an estimated source energy annual savings of 8,800,000 kBtu with an implementation cost of $4.25M. The ROI for this strategy was 21 years. The ROI for this strategy is based on a flat-rate electrical structure, negotiated with the Utility Provider. If this changes to a TOU rate, the ROI would improve, making this strategy more viable.

Store: Thermal Storage – PCM

Phase Change Materials (PCM) save energy by actively absorbing and releasing heat. The most common phase change phenomenon is between ice and water. This phase change from water to ice requires freezing at 32 degrees F or below and is an energy intensive process. PCMs have the ability to change phase at room temperature, which gives them an advantage over Ice Storage systems in terms of size of the storage tanks and the required efficiency of the chiller. Similar to Chilled Water and Ice Storage tanks, energy is stored in the PCM storage tanks during the night when the energy costs are low. The storage tanks then are discharged to provide cooling during peak hours. PCM Storage tanks that require an 8 hour of charging during the night and have the capacity of 8 hours of discharge during the peak time of the day, were estimated to have a capacity of 11,600 ton-hours at LAC and 4,300 ton-hours at PCC. This is taking into account the anticipated peak hour shift from Southern California Edison to 2 pm to 9 pm. The PCM storage tanks have a number of advantages over the ice storage tanks.

1. PCM Storage requires only 10 degrees F below central plant set point for charging and not 17 degrees F as in the case of Ice. This results in a more efficient chiller plant operation.
2. Glycol percentage for PCM tanks are much less than for ice due to the higher operating temperatures. The larger the glycol, the less the heat transfer.
3. Ice expands when frozen, PCM does not. Therefore, there is less physical stress on heat exchanger in tank with PCM compared to ice.

In addition to saving peak energy demand, this strategy is estimated to save annual source energy of 10,196,975 kBtu at an implementation cost of $4.8 M. The ROI for this strategy is 14 years. The ROI for this strategy is based on a flat-rate electrical structure, negotiated with the Utility Provider. If this changes to a TOU rate, the ROI would improve, making this strategy more viable.

Store: Thermal Storage – Ice

Ice thermal energy storage (TES) is the process of generating ice water during off-peak hours, which is then stored in a tank for use at a later time. The ice tank is then discharged to provide cooling during peak hours. Similar to chilled water TES, this process shifts the generation of chilled water to off-peak hours to reduce operating costs and reduce peak demand charges. The existing central plants would need to be modified to accommodate ice storage heat exchangers/tanks. In addition, the system would utilize water with either 25% ethylene or propylene glycol. As a result, the chillers currently installed would need to be evaluated for compatibility and derating associated with ethylene or propylene glycol.

This strategy was evaluated on both campuses using the storage capacity of 11,600 ton-hours at LAC and 4,300 ton-hours at PCC for an 8-hour peak shift. In addition to saving peak energy demand, this strategy is estimated to save annual source energy of 8,866,935 kBtu at an implementation cost of $3.9 M. The ROI for this strategy was 11 years. The ROI for this strategy is based on a flat-rate electrical structure, negotiated with the Utility Provider. If this changes to a TOU rate, the ROI would improve, making this strategy more viable.

Store: Electrical Storage – Batteries

Batteries store the excess power generation from renewable energy making them available for peak hours of the day when power consumption is higher than generation. As incentives for renewable energy from the federal, state and local utilities continue to pare back, the concept of combining solar with storage to enable entities to make and consume their own power on demand, instead of exporting power to the grid is beginning to be an attractive opportunity. For facilities with Net Energy Metering (NEM), the grid acts as the battery and receives the excess generation which can be accounted for at the end of the month or year toward consumption. During each billing cycle or at the end of the year, the net surplus energy is compensated by the utility at a certain rate. Although the compensation rate from the utility for net surplus generation from the solar systems are continuing to increase ($0.0308/kWh as of June 2018) it is less than half of the negotiated rate with the Utility Provider. With a flat-rate structure, the savings in using the electricity stored on the battery during the day only helps with peak demand charges and has limited effect on consumption charges. This strategy was evaluated to offset 6 hours of peak hours every day which resulted in the need for 4,800 kWh battery system for LAC and 1,500 kWh battery system for PCC. This strategy is expected to save $300,000 annually on peak demand charges. With the current implementation cost of $800/kWh this strategy has an ROI of 15 years. It is expected that the cost of batteries will significantly drop in the next few years making them an attractive investment with ROI of less than 4 years in the near future. The ROI for this strategy is based on a flat-rate electrical structure, negotiated with the Utility Provider. If this changes to a TOU rate, the ROI would improve, making this strategy more viable.

Store: Thermal Storage – PCM within the buildings

When PCMs are applied within the building, PCM works by storing heat during the day when temperatures are warm and releasing the energy into the building at night when temperature cools off. This allows the building to need less cooling during the day as some of the heat is trapped in the PCM material, as well as reduces the need for heating during the night as the stored energy will be released. Various materials have been considered for building applications, such as paraffin wax, bio-based organic materials, and eutectic salts, to take advantage of the PCM latent heat capacities and high storage densities. Like conventional thermal mass, such as concrete or adobe, PCMs can store similar amounts of heat but with significantly less mass. PCMs act differently than building insulation. PCMs provides energy savings by increasing the thermal mass of the building. Insulation derives savings by increasing thermal resistance. Applying PCM technology within a building is by laying blankets of PCM over the existing ceiling tiles. This allows for maximum heat transfer with very little insulation as the ceiling is closer to the people. Various capacities of PCM will need to be installed at different locations depending on the heat radiation. This strategy was evaluated by covering 60% of existing facilities, for 60% of the floor area with PCM blankets. At an implementation cost of $1.8 M, this strategy is expected to save an annual source energy of 15,269,125 kBtu. The ROI on this strategy was 14 years.

Share: Reclaimed water for Cooling Tower

A cooling tower (CT) is a heat rejection device that rejects waste heat to the atmosphere through the cooling of a water stream to a lower temperature. The cooling towers at LAC and PCC are open-circuit CTs that reject heat from the chillers to the ambient. Water is distributed from the top of the tower and sprayed downward into a basin. During this time, air is drawn across the flow of water to promote heat transfer between the two fluids via evaporative cooling. Open-circuit cooling towers can be major users of water as water is lost through the evaporation process, drift, and blow-down. Drift is the loss of water to the environment via droplets of water that become entrained in the air stream. Evaporation and drift lead to elevated levels of minerals and impurities, requiring a portion of the CT system water to be blown-down/discharged from the system. These three components of loss in a cooling tower system require make-up water to keep the system operational. An open circuit cooling tower typically uses make-up water from the utility.

Share: Micro-grid Systems

A micro-grid is a scaled down version of the centralized power system that generates, distributes, and regulates the flow of electricity. It can operate either grid connected or islanded and, if required, can switch between the two. Micro-grid controllers take a broad view of micro-grid infrastructure which includes the generation, distribution, and consumption of electricity, water and gas. A micro-grid solution is secured using the same tools, techniques, and best practices that would be used to secure a larger utility grid. This advanced software solution will be responsible for optimally managing the grid assets and ensuring that economic goals are reached while meeting energy demand. As District applies more energy efficient technology such as renewable energy, battery storage, and central plant optimization systems, it will be important to apply such a micro-grid solution to optimize the energy efficient technology to its fullest potential.

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Procure: Biomass Offsets

Biomass energy is energy from the sun captured in organic materials derived from plants or animals. Biomass power generation facilities harness the energy stored in such organic materials to produce clean, renewable power. Similar to carbon offsets with renewable energy, biomass carbon offset programs could be considered as an alternative way to offset GHG emissions off site. About 20% of annual source energy at LBCCD is from natural gas and considering procurement options when they are feasible and available could be a cost effective way to get to carbon neutrality. This strategy requires further study once all the energy efficiency and energy production measures are implemented.

Procure: Alternate Direct Access Agreement

District gets a negotiated utility rate of $0.06/kWh from Constellation Energy as the Direct Access provider. Southern California Edison charges for transmission and distribution of electricity at the blended rate of $0.07/kWh (including cost for peak demand charges). As a Direct Access provider, Constellation has access to renewable energy directly from an offsite source without the use of virtual power purchase agreements. This strategy was evaluated to consider off-site renewable energy purchase as a method to achieve the GHG emissions goals. Constellation Energy could increase the percentage of renewable energy provided from 33% (to comply with California's Renewables Portfolio Standards) to 100% for an estimated premium of $2/MWh. This strategy should be evaluated further at the time of next term's contract renewal in July of 2020 to close the gap in achieving the GHG emission goals after applying renewable energy and energy efficiency measures first.

Procure: Travel Emissions Offset

Employee travel emissions contribute to a major portion of Scope 3 Indirect GHG emissions for most organizations. LBCCD has been participating in the Air Quality Investment Program (AQIP) with South Coast Air Quality Management District (SCAQMD) for over 20 years. As one of the On-Road Motor Vehicle Mitigation Options, the annual investment per employee is used by SCAQMD on projects that result in emissions reductions/air quality improvements. Based on the current full-time and hourly employee count and assumed average miles per day travel, the employee travel emission is estimated at 8,003,923 lbs of CO_2 for the school year 2016-2017. This is completely offset with the AQIP program. Using the Gross Square footage in 1990, the Baseline emissions for employee travel is set at 4,745,111 lbs of CO_2 as District began its participation with AQIP in 1998. This strategy will be continued and so Employee Travel Emissions will continue to be offset with AQIP.

DESIGN RECOMMENDATIONS

ENERGY EFFICIENCY MEASURES COMPLETED TO DATE

District has completed various energy efficiency projects funded by Measure E & LB. Measure E & LB is a $660 million bond to fund new construction, renovations and repairs at the PCC and LAC campuses. The major projects noted below have effectively allowed District to grow while maintaining the same amount of energy and GHG emissions.

Energy Projects (Phase 1)

Prior to this project, District had multiple inefficient chillers and various antiquated building management systems on both campuses. Not only were these systems unsustainable, but maintenance and operational resources were burdened by heavy costs on both personnel and continued equipment maintenance. Phase 1 of energy projects included the following scope and outcomes.

- Two Central Plants constructed:
  - LAC – ((2) 600 ton chillers, (1) 300 ton chiller, (1) 900 ton chiller
  - PCC – (2) 300 ton chillers, (1) 300 ton multi-stack chiller
- Centralized automated Building Management System (BMS)
- District saves approx. 1.5 million in kWh in energy consumption annually
- Reduces approximately 1,000,000 lbs. of CO2 emissions
- Operational savings of approximately $150,000/year
- Received $1 million as a grant from CCC/IOU for construction of the Central Plants

DESIGN RECOMMENDATIONS

ON-GOING ENERGY EFFICIENCY MEASURES TO CONTINUE

Energy Projects (Phase 2A)

Phase 2A consisted of Energy Improvement Measures which do not require intensive design and/or which are not required to go through a Division of State Architect (DSA) approval process such as, unitary equipment upgrades, where existing old equipment will be replaced by like-in-kind new, energy efficient equipment, which is of equal or lesser weight. Phase 2A of energy projects included the following scope.

- Controls Upgrades. Replaced various building management systems to utilize new centralized automated Building Management System. New front end system provides the ability to schedule, track and control HVAC, Lighting and building energy meters
- Lighting Upgrades. Installed new energy efficient light fixtures to classrooms, walkways, parking lots and connected them to new Building Management System
- Unitary Mechanical Upgrades. Replaced old HVAC units with new energy efficient units and connected them to the new Building Management System
- Water System Upgrades. Removed old sink/toilet/urinal fixtures and replaced with higher efficient and low flow water fixtures
- Pool Upgrades. Provided new automatic power wall-mounted pool cover reels and new insulated 5,700 sq ft. solar pool double-laminated blanket to cover the pool during non-operating hours to save water heat loss
- Hot Water System Improvements
- Re-roofing
- Virtualization of all physical servers

    From 100 servers to 15 high end servers in virtual environment

Energy Projects (Phase 2B)

Consisted of Energy Improvement Measures requiring intensive design, which require DSA approval such as major mechanical improvements or replacement of large air handlers, interconnecting this equipment to the new central plant, converting constant volume systems to VAV (Variable Air Volume) systems etc. The scope of this phase included work in buildings and other measures as follows:

- Lighting
- Campus interior/exterior/walkway lighting
- Stadium ball-field lighting
- Controls upgrade (Centrally Automated System)
- HVAC
- Lighting
- Sub-metering at each building

Infrastructure Project - In conjunction with the Phase 2B work, there was a campus wide infrastructure project, which included extending the Chilled Water Return/Supply lines to connect the majority of the campus to the new constructed Central Plants. Approximately 3 miles of underground piping was installed. In addition, irrigation water supply changed from Domestic Water to Reclaimed Water at LAC.

Sustainable Building and Operation Practices

District has been practicing sustainable building and operation practices such as below.

- Energy Efficiency Strategy – Energy modeling and Savings-by-Design. CCC/IOU is the group that manages the Savings by Design incentive program. They're involved in the early design phase review and make recommendations to District for energy savings. All construction projects go through the Savings-By-Design process during the Design Development phase of our projects. In turn, Energy Efficient buildings are constructed and District receives a one-time rebate check. All Construction projects are designed to at least be 10% for modernized buildings and 15% for new buildings above Title 24 Energy requirements. If a project is designed more than 15% above Title 24 (equivalent to LEED Silver), the design team also receives an incentive.
- Daylighting – Utilize in conjunction with lighting controls to conserve energy.
- Water Conservation – Reclaimed water for irrigation, low flow fixtures, filtered drinking fountains with bottle fillers. Water bottle fillers provide convenient hydration with a rapid fill of filtered water to quench thirst and minimize plastic bottle waste in the environment.
- Commissioning - Third-party commissioning agent utilized in all phases of a project to ensure optimal building performance.
- Climate Control – Maintain building temperate set points with a maximum of 70°F heat and minimum of 76°F cooling.
- Mechanical and Lighting Controls – utilize Building Management System to schedule, control and maintain equipment to maximize energy efficiency. Because District utilizes an Building Management System with thermostats in occupied spaces to maintain the temperature set points, District Guidelines do not allow the use of

space heaters, fans or refrigerators in offices.

LAC Parking Structure

Approximately 900 parking spaces with lighting system that uses high-efficiency ballasts achieve 77% better than 2008 Title 24 and received $25,050 in incentives. The parking structure also has a 450 KW solar system. At the time of construction in Long Beach, this solar system was the largest partially funded by California Solar Initiative (CSI) system and the second largest solar power system. CSI provided approximately $621,000.

PCC Building GG – Student Services (LEED Silver)

The 38,555-square-foot building houses all student services for PCC including Admissions & Records, Financial Aid, Disabled Student Programs and Services (DSPS), Extended Opportunity Programs and Services (EOPS), Student Counseling, Student Health Services, the Cashier's Office and Dining Services.

- Materials were selected for recycled content, energy efficiency, indoor air quality and availability from local manufacturing sources.
- Native and drought tolerant plants were planted, contributing to a 52 percent reduction in landscaping water for Building GG. Potable water use was reduced by 30 percent.
- All occupied spaces are equipped with occupancy sensors, contributing to energy efficiency.

LAC Building V – Mathematics and Culinary (LEED Platinum)

The building houses the Math and Culinary Arts Departments and contains a total of 25 new classrooms, including production, baking, pastry and multi-use kitchens, along with two mathematics labs.
• Building V has received the Platinum LEED award from the USGBC for utilizing 7 important sustainable areas.

- The 7 areas include sustainable sites, water efficiency, materials and resources, energy and atmosphere, indoor environmental quality, innovation and design and regional priority.
- Some of the notable features being reduced storm water runoff, an energy savings of more than 40% by the use of several building materials, and the plants are drought tolerant and use high efficiency irrigation systems this approach reduces the use of potable drinking water by more than 50%.

Proposition 39 – Energy Projects

The California Clean Energy Jobs Act (Prop. 39) was approved by Voters in November 2012. The Act changed the corporate income tax code and allocates projected revenue to California's General Fund and the Clean Energy Job Creation Fund for five fiscal years, beginning with fiscal year 2013-14. Under the initiative, roughly up to $550 million annually is available for appropriation by the Legislature for eligible projects to improve energy efficiency and expand clean energy generation in schools statewide.

Year 1 optimized central plants to run more energy efficient by expanding the capabilities of our current Building Management System. Year 2 included LED Lighting Upgrades for Bldg. Z, Parking Lot Z Lights, PCC Parking Lots 1,2 & 4, LAC Tennis Courts and Walkway, LAC Pool Lights, Bldg. Q and R Gym Lights. Years 3, 4 & 5 included LED Lighting

Summary of achievements after Measure E & LB and Prop 39 projects 2010 to 2016-2017 School Year

Key Performance Indicator	2009	Today	% Change
Annual Source Energy (kBtu)	199,627,950	197,150,043	-1%
GHG Emissions (lbs. of Co2)	14,538,916	14,827,802	2%
Net Potable Water (gallons)	26,589,861	21,119,780	-21%
Gross Square Footage	1,267,189	1,581,982	24%

DESIGN RECOMMENDATIONS

ON-GOING ENERGY EFFICIENCY MEASURES TO CONTINUE

Retrofits, Buildings T, HH, and O2.

Design Recommendations – On-Going Efficiency Measures to Continue

LBCCD has been pursuing several best practices for a number of years that this plan recommends to continue. Measures to continue are listed below.

- Design standards – All construction projects are to be designed to at least be more than 10% for modernized buildings and 15% for new buildings above Title 24 Energy requirements. All new buildings to be designed with latest energy efficient technology resulting in a maximum Energy Use Intensity (EUI) of 40 kBtu/sf/yr before applying renewable energy technologies.
- Travel offsets – Continue to participate in AQIP with SCAQMD and invest to offset employee commute related GHG emissions. This strategy completely offsets such emissions.
- Water efficiency – Continue to apply design standards to reduce potable water consumption within buildings. As new technologies are available, the design standards are to be improved to include high efficient plumbing fixtures and reduce potable water demand. Also, continue to practice native and drought tolerant landscape and high efficient irrigation practices.
- Waste management – Continue to follow Hazardous Waste and Medical Waste Management plans and update such plans periodically. Continue to follow zero waste best practices including Organic Waste Composting Programs and best practices below at Viking Food Court and PCC Cafeteria.

    No Styrofoam or polystyrene, minimal use of petroleum-based plastics.

    Only use disposable utensils made from cornstarch. They are compostable and biodegradable. Cornstarch is readily available and a renewable resource.

    In lieu of polystyrene, only use take out containers and plates made primarily from sugarcane pulp and wheat straw. They are biodegradable, compostable, and made from a renewable resource.

    Use Ingeo (also known as PLA) as often as possible for clear plastic containers. Ingeo is a plant-based plastic. It is biodegradable, compostable and made from a renewable resource.

    Encourage students and staff to reuse or bring their own beverage containers by offering a discount on their beverage.

    Support local businesses and have an agreement with The Growing Experience, an urban farm at the Carmelitos Housing Project in Long Beach, to provide cafeterias with vegetables and greens.
- Space Utilization – Continue to leverage 25Live online scheduling platform to utilize existing space more effectively. Potentially in the future, have the opportunity to export data from 25Live to be cross referenced against building occupancy reports from Building Management Systems to further optimize space use and associated energy usage.

DESIGN RECOMMENDATIONS

ENERGY EFFICIENCY MEASURES RECOMMENDED

The design team evaluated 23 strategies at both campuses toward GHG emissions reduction goals, Zero-net annual source energy goals and potable water reduction goals. As a team, including District and the Bond Management Team, the following 10 strategies were selected to be implemented based on the criteria below:

- Return on investment
- Compatibility with current sustainability best practices at LBCCD
- Opportunity to lead through innovative design technology

Most of the strategies are planned to be implemented immediately and some of them are slated for future implementation pending assessment of progress toward the set goals as well as anticipating future technological advancement. A set of strategies are grouped together as projects and are referred to as Energy Efficiency Measures (EEM). Many EEMs will start at the same time as they are interdependent. A detailed description of scope, level of improvement from existing conditions, implementation costs and anticipated reductions towards set targets are explained in the following pages. For near-term measures, campus maps are provided to reflect the scope of such measures. For short-term and long-term measures, a description of opportunities is provided.

Strategy Category	Strategy	Location	Timeline for Implementation	Impact on GHG Emissions	Impact on Net Annual Source Energy	Impact on Potable Water
Use-Reduce	ASHRAE Level 1 & 2 Analysis – HVAC, Lighting, & Controls Strategies	LAC, PCC	Near Term	Yes	Yes	
Use-Reduce	ASHRAE Level 1 & 2 Analysis – Exterior Lighting Strategies	LAC, PCC	Near Term	Yes	Yes	
Use-Reduce	Retro-commissioning – HVAC, Lighting at Controls	LAC, PCC	Near Term	Yes	Yes	
Use-Reduce	Electric Vehicle Charging Stations	LAC, PCC	Near Term	Yes	Yes	
Produce	Solar Photovoltaic Systems	LAC, PCC	Near Term and Short Term	Yes	Yes	
Store	Electrical Storage - Batteries	LAC, PCC	Short Term	Yes	Yes	
Store	Thermal Storage - Phase Change Material Technology within Buildings	LAC, PCC	Near Term	Yes	Yes	
Share	Reclaimed Water Conversion for Cooling Towers	LAC	Near Term			Yes
Share	Micro-grid Solution	LAC, PCC	Short Term	Yes	Yes	
Procure	Employee Travel Emissions Offset	LBCCD	On-going	Yes		

DESIGN RECOMMENDATIONS

ENERGY EFFICIENCY MEASURES RECOMMENDED

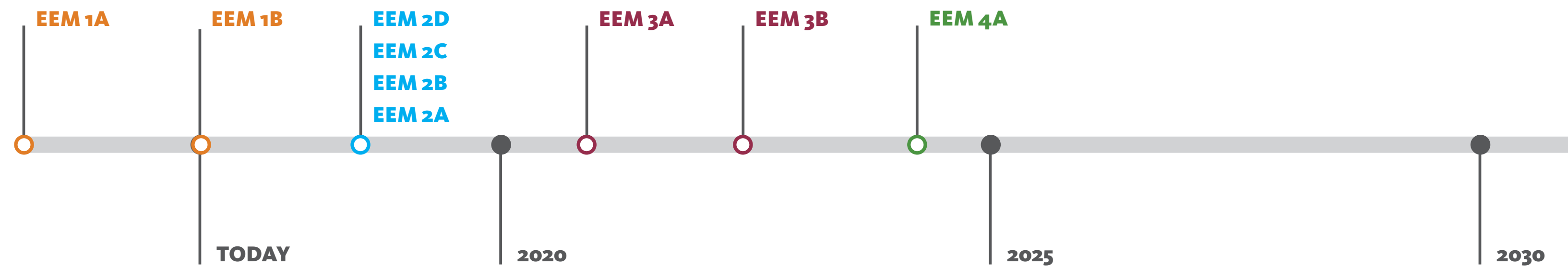
The following strategies were not recommended to either pursue or develop deeper implementation opportunities mainly for the reasons described. As technology, prices and policies change, these strategies should be re-evaluated.

Strategy Category	Strategy	Comments
Use-Reduce	Space Utilization	Ongoing strategy to be continued. Possibility to explore data analytics by linking 25Live platform data with Building Management System
Use-Reduce	ASHRAE Level 1 Analysis – Envelope and Plug Load Management	Opportunities to improve envelope energy performance and manage plug loads using latest control strategies to be considered during deep renovation projects as well as new construction projects
Use-Reduce	Reclaimed Water for Irrigation	As opportunities for accessing reclaimed water for irrigation at PCC arise, developing an infrastructure project for reclaimed water conversion is to be considered
Produce	Solar Thermal Systems	As incentives from state and local utilities for solar thermal systems and control strategies for integrating with heating systems develop, solar hot water systems should be considered especially as 43% of site energy usage is from natural gas consumption
Produce	Fuel Cell Systems	As incentives from state and local utilities for fuel cell technology and sustainable sources of fuels improve, fuel cell system should be considered
Produce	Cogeneration	As advancements in cogeneration technology improve as it relates to its maintenance requirements and GHG emissions, Combined Heat and Power systems should be considered
Storage	Chilled Water, Ice and PCM Thermal Storage Systems	These systems have a modest improvement in energy consumption savings but could have a larger impact on electricity peak demand cost savings when District utility rates changes to a Time-of-Use rate structure
Procure	Biomass offsets and Alternative Direct Access Provider agreements	As a close-the-gap strategy such alternative energy procurement opportunities should be considered in the future

ENERGY EFFICIENCY RECOMMENDED

PROJECT TIMELINE

Each EEM described below on the time line indicates a project. Detailed implementation plans for each project will be developed as the projects start. The general timeline indicated below will need to be adjusted as needed to be aligned with other capital improvement projects within District. The energy, water and GHG emissions savings will be realized after one year of completion of these projects and will be verified against savings projections.



EEM 1 A

- Measures taken in the past.
- Measure E & LB and Prop 39 Projects

EEM 1 B

- Measures currently pursuing to continue best practices in travel offsets, water efficiency and design standards.

EEM 2A

- Energy Use Reduction Strategies
- Implementing retro-commissioning and ASHRAE Level 1 & 2 recommendations including additional metering and reclaimed water conversion at LAC cooling tower.

EEM 2B

- Renewable Energy Production Strategies
- Solar system installations in phases.

EEM 2C

- Thermal Storage Strategies within buildings.
- Phase Change Material Technology implementation pilot at PCC followed by full implementation.

EEM 2D

- Clean energy use strategies for transportation.
- Install electric vehicle charging stations District wide.

EEM 3A

- Electric storage strategies at campus level.
- Install battery storage solutions.

EEM 3B

- Share and manage energy for resiliency
- Implement micro-grid solutions utilizing Siemens Controls.

EEM 4A

- Renewable Energy Production Strategies
- Install additional solar systems as needed to accommodate growth.

EEM 5-10

- Continue best practices periodic assessment of meeting targets every three years until 2050 and applying necessary best practices and technology to close the gap.

ENERGY EFFICIENCY MEASURE 2

PROJECT TIMELINE

EEM 2 comprises of 4 separate projects referenced as EEM 2A, 2B, 2C and 2D. Each of these projects are planned to be started at the same time. However, depending on other capital improvement projects, their near-term implementation timeline will need to be adjusted. Refer to campus maps with scopes identified, at the end of these descriptions.

EEM 2A – Energy and Potable Water Use Reduction Strategies

- Fine tune and save energy by retro-commissioning the scope of Buildings under ASHRAE Level 1 and 2 analyses prior to implementing modifications to HVAC equipment
- Implementing recommendations from ASHRAE Level 1 and 2 Analysis at the following locations:

  LAC: Buildings A, B, C, D, E, G, J, I, K, L, P, T, O1, and O2

  LAC: Parking Lots A, C, D, E, F, G, H, I, L, M, and O and walkways and roadways

  PCC: Buildings AA, BB, CC, DD, EE, HH, JJ, and MM

  PCC: Parking Lot 7 and walkways and roadways

A detailed scope per building is identified in the Appendix.

- About 80% of the buildings have individual meters or opportunities via Building Management System to understand the usage profiles. As part of this EEM, the design team recommends adding additional metering at the following location:

  LAC: Electric sub-meters at Building B, C, and F.

  LAC: Gas sub-meters at Building F, G, and T

  PCC: Electric sub-meters at Buildings GG, LL, QQ, PP, RR, YY, JJ, UU, FF, NN, and KK

  PCC: Existing sub-meters at Buildings BB, CC, and DD need calibration or repair

- Convert cooling tower water use at LAC Central Plant, Building X from potable water to reclaimed water
- Maintenance and Operations (M&O) Cost: No significant changes are expected due to the implementation of this measure as the strategies are aligned with District design standards and their existing facilities maintenance and operational protocols.

EEM 2B – Renewable Energy Production Strategy

- Implementing Solar PV array systems either in two phases or in one phase depending on the outcome of upstream infrastructure study currently underway by Southern California Edison.

  LAC: Phase 1 – West side of Parking Lot M with new switchgear infrastructure located south of Stadium S

  LAC: Phase 2 – East side of Parking Lot M with additional switchgear infrastructure located south of Stadium S

  LAC anticipated total PV system capacity is 3,960 KW AC. This total capacity can be divided into any proportion based on SCE's study results

  PCC: Phase 1 – North of Parking Lot 1 with new switchgear infrastructure at the northwest corner of the parking lot

  PCC: Phase 2 – South of Parking Lot 1 with new switchgear infrastructure at the west end of the parking lot

  PCC anticipated total PV system capacity is 2,040 KW AC. This total capacity can be divided into any proportion based on SCE's study results

- Maintenance and Operations Cost: Some incremental changes are expected due to the implementation of this measure as the solar system maintenance for a system size of over 1 MW is more involved depending on the design, equipment and components. The industry average maintenance and operations cost budget for large solar systems is about 1% of initial construction cost of the system on an annual basis.

EEM 2C – Thermal Storage Strategy within Buildings

- Prior to full implementation at LAC and PCC, a pilot phase of installing PCM technology at PCC Buildings AA, BB, CC, and DD to be conducted.
- Once established measurement and verification protocols verify the estimated savings, a full implementation of PCM technology at the following buildings are to be conducted:

  LAC: Buildings A, B, C, D, E, G, J, I, K, L, P, T, O1, and O2
  PCC: Buildings EE, HH, JJ, and MM
- Maintenance and Operations Cost: Some incremental changes are expected due to the implementation of this measure as the PCM technology requires appropriate controlling of the mechanical systems to provide comfort and realize the energy savings. The pilot phase of the project will establish such controls protocol which will then be documented for future operations and maintenance.

EEM 2D – Clean Energy Use Strategies for Transportation

- Prior to full implementation at LAC and PCC, a pilot phase of installing Electric Vehicle Charging Stations at the Parking Lot 10 to the west of Building QQ at PCC to be conducted.
- Once preferred Southern California Edison rate plans for EVCS are effective for LBCCD, full implementation of EVCS at the following parking lots are to be conducted:

  LAC: Parking Lots A, C, E, I, J, L, M, Z, and O
  PCC: Parking Lot 2 and Parking Structure P2

- Maintenance and Operations Cost: No significant changes are expected due to the implementation of this measure as the strategies are aligned with District design standards and their existing facilities maintenance and operational protocols.

ENERGY EFFICIENCY MEASURE 2

PROJECT TIMELINE

EEM 2 comprises of 4 separate projects referenced as EEM 2A, 2B, 2C District has been pursuing a number of energy and water efficiency strategies at both campuses and have already leveraged a variety of strategies ranging from no-cost to low-cost as well as high-cost of implementation projects as part of the Measure E & LB and Prop 39 funding. The following EEM projects will improve the existing conditions as described below.

- Based on our analysis, there are still a number of opportunities to fine-tune the equipment installed as part of Measure E & LB and Prop 39 projects.
- EEM 2A has identified deep energy retrofits that will require Division of State Architect approval and will complement the low-cost measures that have already been implemented.
- LAC has the first solar project for LBCCD at 450 KW and has played a significant role in maintaining the energy use while growing as a District between 2010 and today. The new solar system installations as part of EEM 2B will dramatically reduce the purchased energy at both campuses. The majority of electricity usage at LAC is on the north side of Carson Street and the existing switchgear is to the west of Building P. The existing medium voltage line loop at LAC crosses Carson Street at the intersection of Faculty Avenue. The design team evaluated the carrying capacity of the medium voltage line to take the power generated at Parking Lot M over to the main meter north of Carson Street. Further investigation in conjunction with Southern California Edison's upstream infrastructure study will influence the size of solar systems to be deployed. If only Phase 1 of this solar system can be implemented due to technical feasibilities and/or high infrastructure upgrade costs, the second phase will need to be delayed till EEM 3A when battery storage is available to handle infrastructure challenges.
- At PCC, Parking Structure P2 is currently being designed and planned to have a Solar System of 400 KW. Depending on SCE's upstream infrastructure study results and the timing of completion of P2 and EEM 2B, phase 2 of EEM 2B at PCC may be delayed or solar system capacity may be downsized.
- Almost all of District facilities are under intelligent Building Management System independent at each campus level. Applying PCM technology requires adjusting HVAC control strategies to allow for PCM to stabilize the indoor environment and provide comfort. Such Measurement and Verification protocols need to be evaluated and added to the design standards prior to installing PCM across District.
- If the installation of solar panels be funded through bond funds, the savings will be immediate. In comparison, if the District enters a Power Purchase Agreement (PPA) with a third party energy providing company, although bond funds will not be used, General Savings Fund will be used to pay the PPA and the savings to the District will be substantially less. For this reason, it is recommended to utilize the bond funds for the implementation of this measure.
- District currently has 22 portable EVCS at their campuses and the demand for EVCS is increasing. With the pilot project at PCC supported by SCE, the new rate structure will be evaluated. Since the electricity consumption toward EV charging is not counted toward overall peak demand as well as the solar system production amounts, EVCS do not impact EEM 2B. However, the initial assessment done by District on the count of EVCS in both campuses estimates an average of 108 new EVCS to be installed in the next few years. SCE has EV related incentives that are recommended to be utilized during the execution of this EEM.

Detailed Timeline of implementation

2018 – Starting design on EEM 2A, 2B, 2C, 2D

2019 – Implement EEM 2A

2019 – Start design and construction for EEM 2B

2019 – Implement pilot for EEM 2C

2020 – Verify savings from EEM 2A

2020 – EEM 2B and majority of 2D operational

2020 – Verify savings from EEM 2C pilot

2021 – Verify savings from EEM 2B and 2D

2021 – Implement rest of EEM 2C scope

2022 – Building W operational at this point and adds to the energy load

2022 – Verify savings from EEM 2C full implementation

ENERGY EFFICIENCY MEASURE 2

ESTIMATED OUTCOMES

With the successful implementation of the above strategies, below are the estimated performance of the facilities at a District level after one full year of evaluation at the end of the last project under EEM 2.

Key Performance Indicator	Today - LBCCD	2022 - After EEM 2	% Change
Annual Source Energy (kBtu)	197,150,043	38,435,776	80%
GHG Emissions (lbs of Co2)	14,827,802	4,902,706	-67%
Net Potable Water (gallons)	1,119,780	20,949,446	-1%
Gross Square Footage	1,581,982	1,588,091	2.5%

ENERGY EFFICIENCY MEASURE 2A

- ASHRAE LEVEL 1 & 2 STRATEGIES
- RECLAIMED WATER CONVERSION AT COOLING TOWER
- SITE LIGHTING IMPROVEMENT & WALKWAY/ROADWAY

ENERGY EFFICIENCY MEASURE 2A

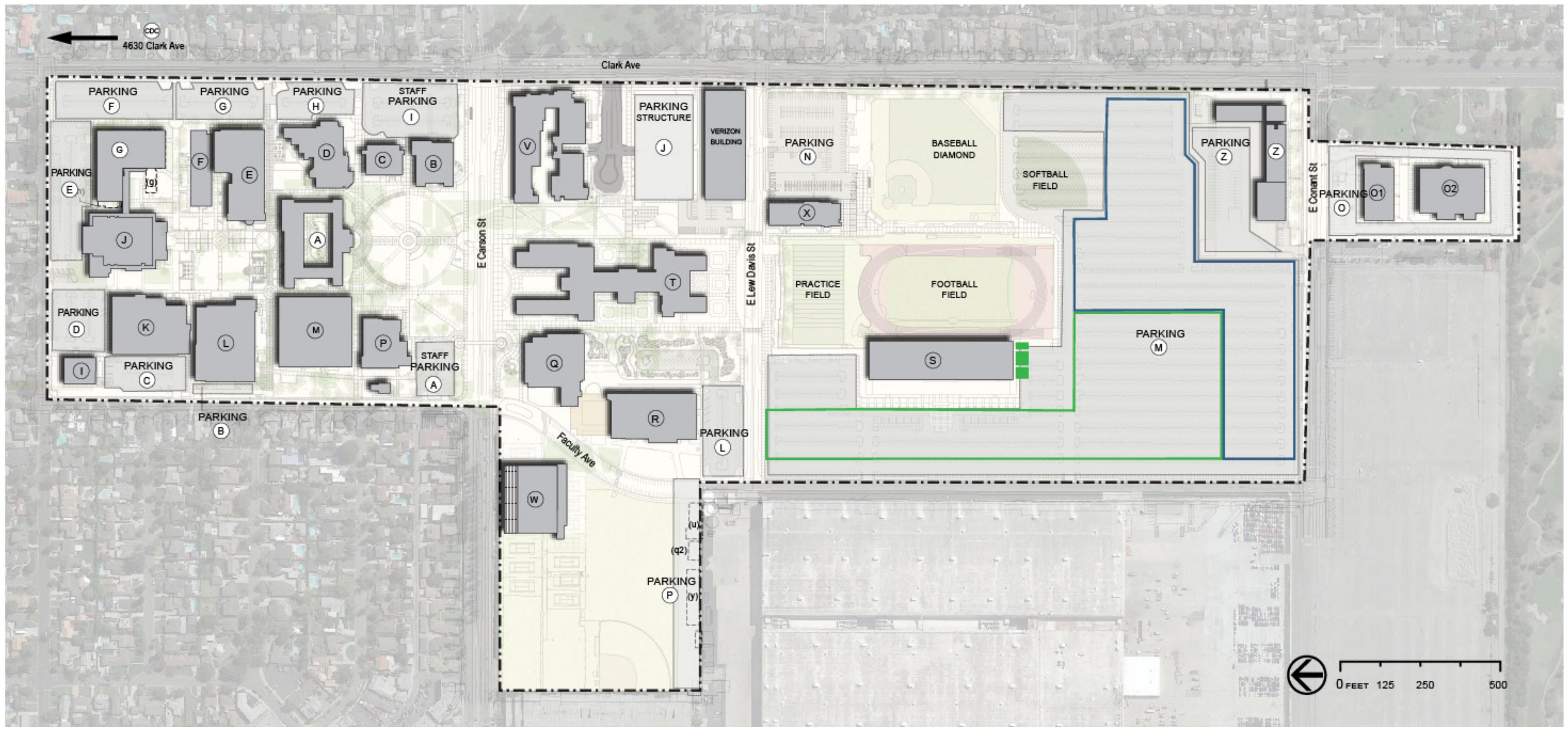
PACIFIC COAST CAMPUS

ASHRAE LEVEL 1 & 2 STRATEGIES

SITE LIGHTING IMPROVEMENT & WALKWAY/ROADWAY

ENERGY EFFICIENCY MEASURE 2B

LIBERAL ARTS CAMPUS



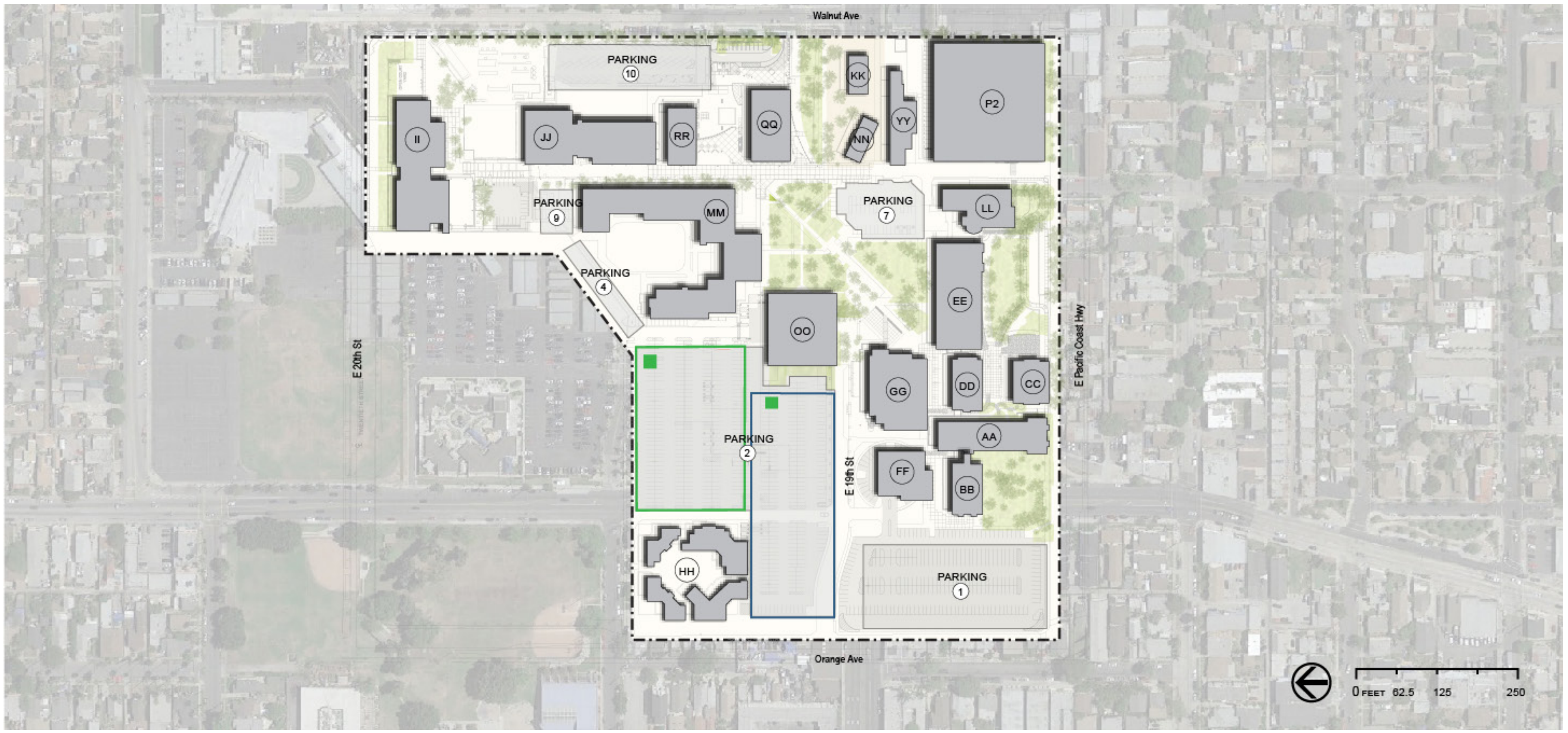
SOLAR SYSTEM PHASE 1

NEW SWITCH GEAR

SOLAR SYSTEM PHASE 2

ENERGY EFFICIENCY MEASURE 2B

PACIFIC COAST CAMPUS



SOLAR SYSTEM PHASE 1

NEW SWITCH GEAR

SOLAR SYSTEM PHASE 2

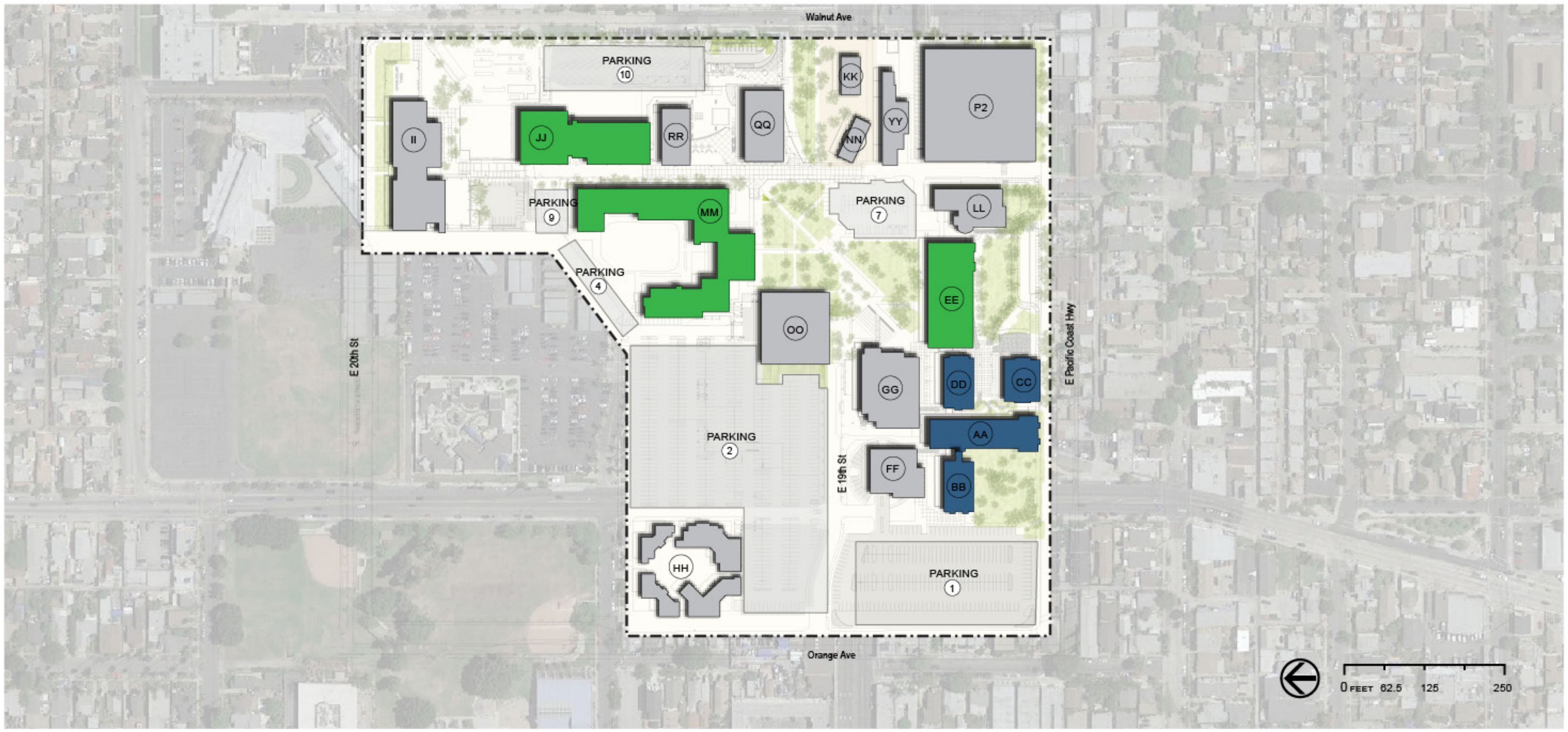
ENERGY EFFICIENCY MEASURE 2C

LIBERAL ARTS CAMPUS

PHASE CHANGE MATERIAL(PCM) STRATEGY

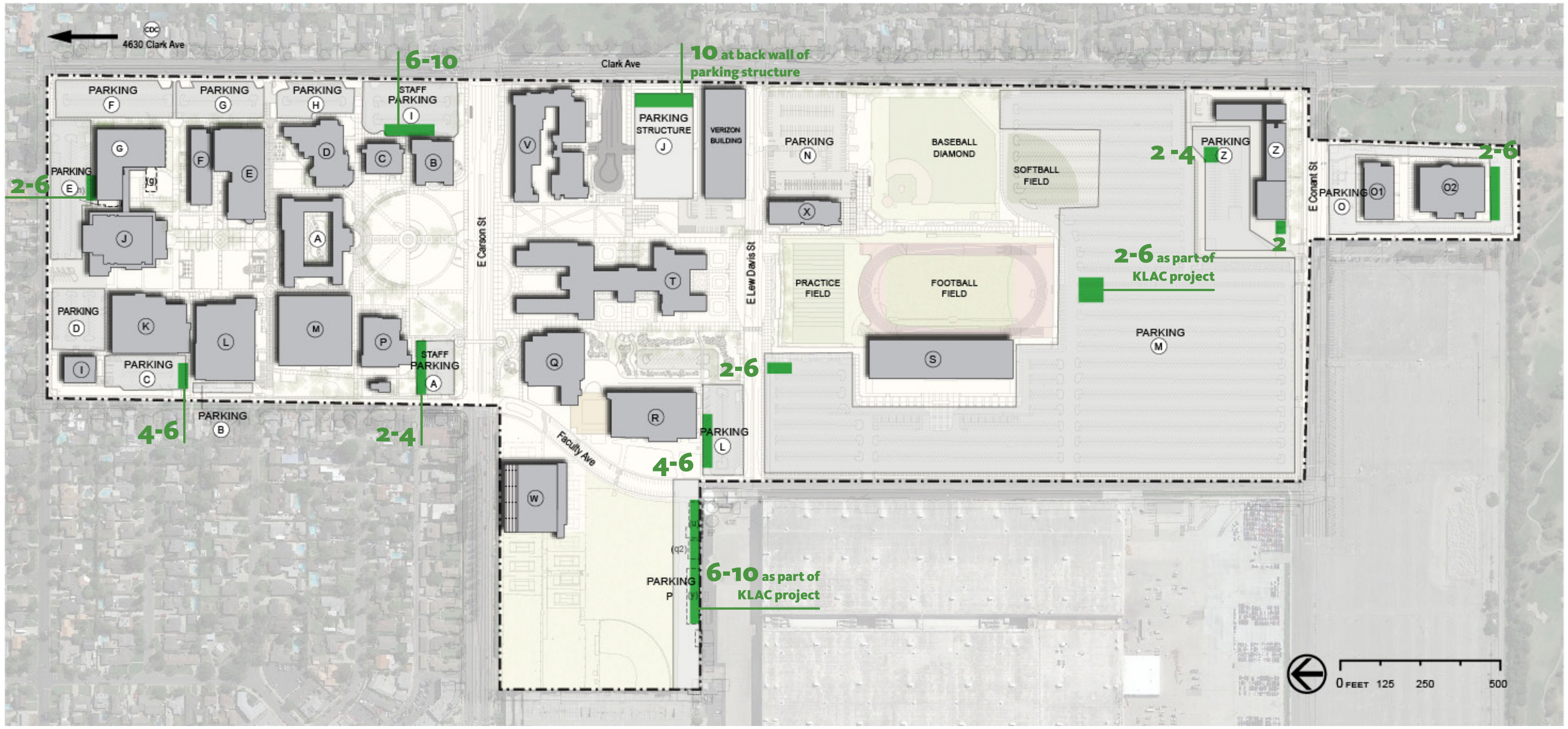
ENERGY EFFICIENCY MEASURE 2C

PACIFIC COAST CAMPUS



- PHASE CHANGE MATERIAL(PCM) STRATEGY
- PCM PILOT BEFORE FULL IMPLEMETATION

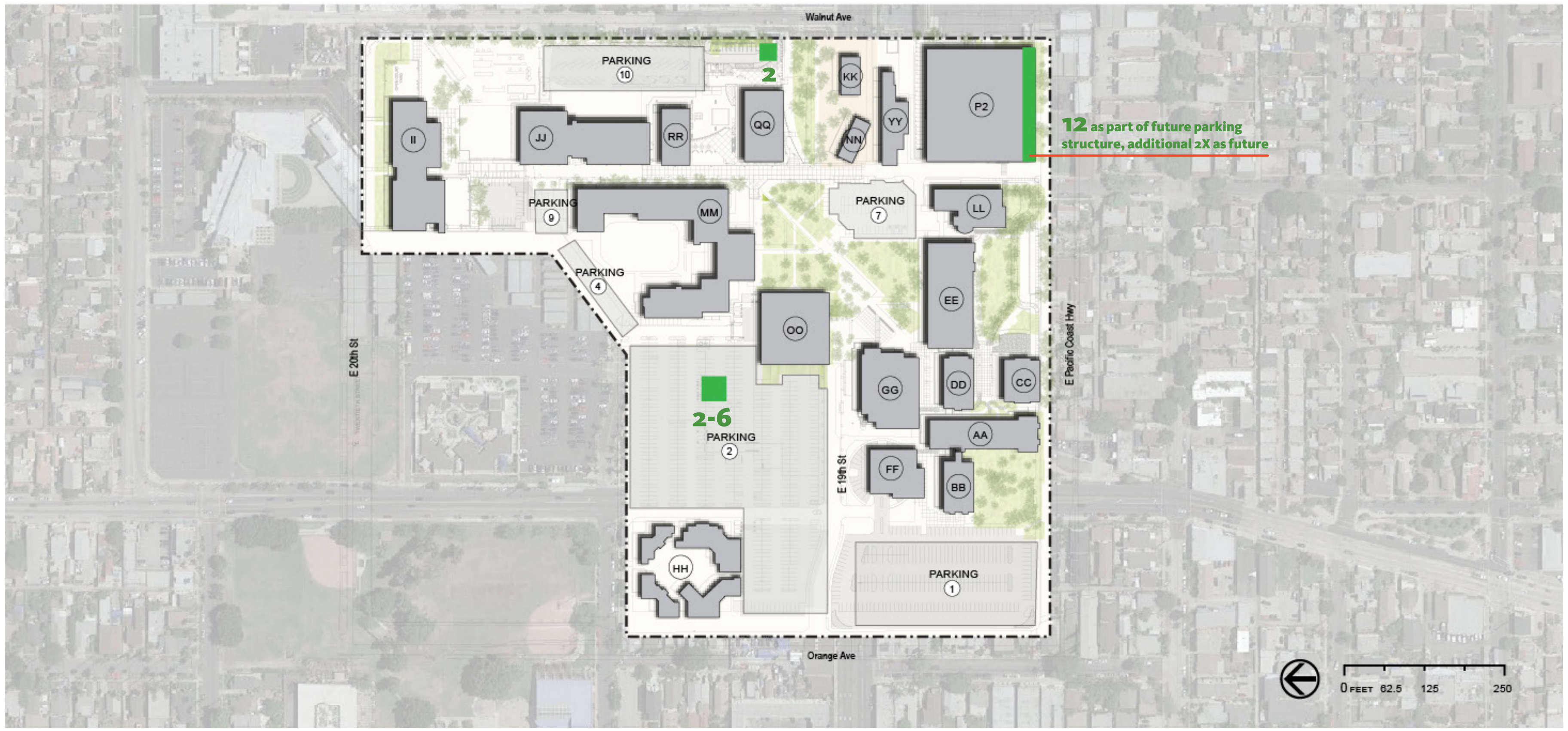
ENERGY EFFICIENCY MEASURE 2D
LIBERAL ARTS CAMPUS



● LOW TO HIGH COUNT AT POTENTIAL LOCATIONS FOR EV CHARGING STATIONS

ENERGY EFFICIENCY MEASURE 2D

PACIFIC COAST CAMPUS



LOW TO HIGH COUNT AT POTENTIAL LOCATIONS FOR EV CHARGING STATIONS

ENERGY EFFICIENCY MEASURE 3

PROJECT TIMELINE

Scope Overview

Beginning in 2023, District will be two-third the way toward meetings its key targets. Many buildings on both campuses will have their electricity usage completely offset by the solar system production on an annual Basis. EEM 3 consists of two major projects that will set District on the path of not only leading in energy efficiency but also in securing a resilient campus for the LBCCD.

EEM 3A – Electrical Storage Strategy

To further position for growth and to take advantage of TOU rates at that point, we recommend implementing battery storage. The design team anticipates that the price point per kWh of battery storage will significantly drop at this point along with increasing incentives from utility companies to promote peak demand shaving. The following steps will need to be followed at this point.

- Ensure 15-minute interval data on electrical usage is available for all buildings.
- Ensure 15-minute interval data is available for all solar power generation systems
- Develop a detailed rate structure from SCE that District is utilizing at that time as well as alternate rate structures District would like to explore.
- Develop a detailed load vs. energy production vs. cost analysis to determine the optimal battery storage system capacity.
- Install battery systems near the switchgear locations for the major solar production systems.
- Maintenance and Operations Cost: Significant changes are expected due to the implementation of this measure as battery storage is still a maintenance heavy strategy. At the time of implementation of this strategy, the design team expects the battery storage market to further mature in terms of maintenance and operations protocols as well as the first cost and M&O cost.

EEM 3B – Share and Manage Energy for Resiliency

Once effective feedback loop on building operations, dynamic power generation information and battery storage information is made available, it becomes critically important to connect all these systems and control them through a controller/network for communication. Such a micro-grid solution will essentially help optimize all these systems and investments to their fullest potential. It will also enable LBCCD campuses to be more resilient in the event of natural or manmade threats. The following steps will need to be followed at this point.

- Identify which components of energy assets need to be connected and communicated through a network and software at each campus.
    - Assets will include generation assets, solar inverters, battery inverters and distribution equipment such as switchgears and others.
- Identify any compatibility challenges for such assets to communicate with the micro-grid provider software as the micro-grid controller will directly interface and command these subsystem components.
- A micro-grid functional requirement will need to be developed in conjunction with District's scheduling platform and Building Management System.
- A fully configured micro-grid controller system which is pre-tested at the provider's facilities will be implemented over LBCCD network.
- Detailed training for LBCCD facilities team will be provided by the micro-grid provider.
- Benefits of the micro-grids are listed below.
    - Cost savings
        - Cost of power: local resources (PV) less $ than grid power.
        - Cost of operations: maximize productivity through increased up-time.
        - Market participation: revenue potential to offset costs through demand response or Transactive Energy solutions.
        - Cybersecurity continuous monitoring savings by using the platform enclave.
    - Reliability
        - Local power generation helping against grid outage.
        - Isolated from a typical natural disaster.
        - Intelligent transitioning schemes: grid to island; island to grid.
    - Sustainability
        - Integrate local renewable generation.
        - Leverage energy storage to reduce overall emissions.
        - Increased efficiency for energy production assets.
        - Carbon cost reduction.
- Maintenance and Operations Cost: No significant changes are expected due to the implementation of this measure as the strategies will be aligned with District design standards and their existing facilities maintenance and operational protocols. Additional training for micro-grid controller systems will be provided after installation as part of this measure.

ENERGY EFFICIENCY MEASURE 3

PROJECT TIMELINE

The battery storage systems will provide backup power for critical functioning areas within each campus for a set period of time. Overtime, District can remove fossil fuel based backup systems. Battery storage systems also make electrification (no natural gas or other fossil fuel usage) of the campuses more attractive and feasible.

At PCC, prior to the implementation of Batteries, there will be a surplus energy production sent back to the power grid if the solar systems are installed per total capacity anticipated today. The difference between cost of production vs. surplus generation cost paid by SCE at current buy-back rates is a very small premium to pay for anticipated growth in 2025 with Building OO. Battery storage will nullify this premium and provide the opportunity to leverage all of the generated electricity.

In comparison to the energy management systems, a micro-grid controller provides advanced flexibility and management of all energy assets for District and improves the return on these investments.

Detailed Timeline of implementation

2022 – Start design and construction of battery storage systems

2023 – Verify reliability and savings of EEM 3A

2023 – Start design and implementation of micro-grid solutions

2025 – Building OO at PCC is operational

ENERGY EFFICIENCY MEASURE 3

ESTIMATED OUTCOMES

Even though there are opportunities for energy savings and GHG emissions reductions with EEM 3 projects, the design team defers from taking such savings into account until after installation of EEM 3. So, the expected outcomes are set at the same level as the results of EEM 2 in terms of energy and GHG emissions. Building OO is expected to be complete by 2025 and its full impact on the energy load will not be realized until 2026. However, the design team anticipates a heavy usage increase in potable water consumption due to major construction – increase in potable water is proportioned as a function of increase in GSF.

Key Performance Indicator	2022 - After EEM 2	2025 - After EEM 3	% Change
Annual Source Energy (kBtu)	38,435,776	38,435,776	0%
GHG Emissions (lbs of Co2)	4,902,706	4,902,706	0%
Net Potable Water (gallons)	20,949,446	24,269,858	16%
Gross Square Footage	1,588,091	1,727,491	9%

ENERGY EFFICIENCY MEASURE 4

PROJECT TIMELINE

Scope Overview

By 2026, LBCCD will have reached its peak GSF per the 2041 Facilities Master Plan (FMP). Projects identified on FMP after 2026 are mainly demolition and renovation or renovation and minor additions. All new projects and major renovations until this point will have to be designed to a maximum EUI of 40 kBtu/sf/yr. With the addition of a major building with 150,000 GSF at PCC and to accommodate other GSF changes between 2019 and 2026, EEM 4A propose to revisit solar systems installation to close the gap.

A new set of solar systems at the following anticipated capacities will need to be designed and constructed.

- LAC: 500 kW system
- PCC: 400 kW system

- Maintenance and Operations Cost: No significant changes are expected due to the implementation of this measure as the strategies will be aligned with District design standards and their existing facilities maintenance and operational protocols.

Improvement over Existing Conditions

As the micro-grid and battery storage systems are installed prior to EEM 4A, the need for this project can be validated very effectively. if such need still exists, EEM 4A will be the last major capital investment toward achieving the targets set by the executive orders.

Detailed Timeline of implementation

2026 – Assess need and start design for EEM 4A

2027 – EEM 4A is operational

2028 – Verify estimated savings from EEM 4A

ENERGY EFFICIENCY MEASURE 4

ESTIMATED OUTCOMES

In the event that EEM 4A is necessary and assuming further savings have not been realized through EEM 3, the following is the anticipated outcomes of EEM 4A.

Key Performance Indicator	2025 - After EEM 3	2028 - After EEM 4	% Change
Annual Source Energy (kBtu)	38,435,776	37,225,103	-3%
GHG Emissions (lbs of Co2)	4,902,706	4,967,652	1%
Net Potable Water (gallons)	24,269,858	24,269,858	0%
Gross Square Footage	1,727,491	1,727,491	0%

ENERGY EFFICIENCY MEASURE 5-10

PROJECT TIMELINE

Scope Overview

By 2029, District will be very close to the GHG emissions, annual source energy ,and potable water targets but still may need additional efforts to close the gap. Starting in 2029, the design team proposes to have an allowance of capital investment every four years to revisit the status of achieving these targets and develop design recommendations to close the gap.

A number of opportunities will be available by 2030 with technology, access to capital etc. the design recommendations could leverage one of the strategies already implemented or could be a set of brand new strategies appropriate at that time. Prime areas to apply innovative technology are:

- Electric Vehicle Fleet
  To comply with EO B-16-12, 25% of District fleet should be converted to EVs. The addition of EVCS in EEM 2D and the market transformation with newer and effective electric vehicles that serve District's purpose will certainly influence the achievement of this goal.
- Natural gas reduction strategies
  Even though this IEMP defined Zero-net energy on a source energy Basis allowing natural gas usage within the facilities, the design team anticipates stricter carbon cost/cap and trade programs by 2030 driving for more electrification of facilities.
- Potable water re-use strategies.
  Although District is close to the 20% potable water reduction target, the design team anticipates more stringent legislation around water in the coming years that will require District to look for water re-use within the buildings.
- Maintenance and Operations Cost: Additional water conservation measures will include water reuse within the building level, which will require additional maintenance and operations. Similarly electrification will lead into learning new operations protocols for traditionally natural gas operated equipment. The impact on M&O costs with these strategies will have to be evaluated at the time of implementation.

Improvement over Existing Conditions

At this point in time, District will be equipped with every strategy available to get to the targets and we see an opportunity to improve upon that by providing third-party validations on GHG emissions reductions. Such evaluations may be mandated at that point.

Detailed Timeline of Implementation

2029 – Assess and star design and implementation of additional strategies to achieve 15% improvement from 2028 on GHG emissions, annual source energy reductions (including natural gas reductions) and potable water reduction.

2033 – Assess and star design and implementation of additional strategies to achieve 15% improvement from 2032 on GHG emissions, annual source energy reductions (including natural gas reductions) and potable water reduction.

2037 – Assess and star design and implementation of additional strategies to achieve 15% improvement from 2036 on GHG emissions, annual source energy reductions (including natural gas reductions) and potable water reduction.

2041 – Assess and star design and implementation of additional strategies to achieve 15% improvement from 2040 on GHG emissions, annual source energy reductions (including natural gas reductions) and potable water reduction.

2045 – Assess and star design and implementation of additional strategies to achieve 15% improvement from 2044 on GHG emissions, annual source energy reductions (including natural gas reductions) and potable water reduction.

2049 – Assess and star design and implementation of additional strategies to achieve 15% improvement from 2048 on GHG emissions, annual source energy reductions (including natural gas reductions) and potable water reduction.

ENERGY EFFICIENCY MEASURE 5-10

ESTIMATED OUTCOMES

Assuming the application of newer technology to close the gap on the remaining resource targets, as well as assuming District doesn't grow in GSF beyond 2041, the anticipated outcomes are listed below.

Key Performance Indicator	2028 - After EEM 4	2050 - After EEM 10	% Change
Annual Source Energy (kBtu)	37,225,103	12,032,783	-68%
GHG Emissions (lbs of Co2)	4,967,652	1,756,186	-65%
Net Potable Water (gallons)	24,269,858	9.096,612	-63%
Gross Square Footage	1,727,491	1,681,759	-3%

SUMMARY OF OUTCOMES

Summary of outcomes from Today at District level

Key Performance Indicator	Today - LBCCD	2050 - After EEM 10	% Change
Annual Source Energy (kBtu)	197,150,04	12,032,783	-94%
GHG Emissions (lbs of Co2)	14,827,802	1,756,186	-88%
Net Potable Water (gallons)	21,119,780	9.096,612	-57%
Gross Square Footage	1,581,982	1,681,759	-6%

SUMMARY OF OUTCOMES

Summary of outcomes from Today till EEM 2 at LAC building level

Building's energy efficiency is measured through Energy Use Intensity (EUI). Since the majority of reductions in energy and energy production strategies happen in EEM 2, building level analysis is taken until the end of EEM 2. The table represent the net EUI after taking into account the renewable energy production applied equally to all the buildings within a campus.

Campus	Building	Description	Before IEMP	After IEMP
LAC	E	College Center	58	7
LAC	F	Family/Consumer Education	96	50
LAC	G	Performing Arts	56	24
LAC	H	Theatre Arts	49	24
LAC	I	Bookstore	13	0
LAC	J	Auditorium	33	16
LAC	K	Art	61	6
LAC	L	Library/Learning Resource Center	88	30
LAC	M	Liberal Arts	98	35
LAC	N	Admin. Services	110	77
LAC	O1	IITS/Warehouse	35	2
LAC	O2	CAED/Foundation	25	2
LAC	P	Language Arts	89	43
LAC	Q	Secondary Gymnasium	79	43
LAC	R	Primary Gymnasium	55	26
LAC	T	Academic Services	58	13
LAC	V	Math/Culinary Arts	96	61
LAC	W	Kinesiology Labs/Aquatic Center	40	17
LAC	X	Campus Police/Central Plant	37	5
LAC	Z	Facilities	50	22

SUMMARY OF OUTCOMES

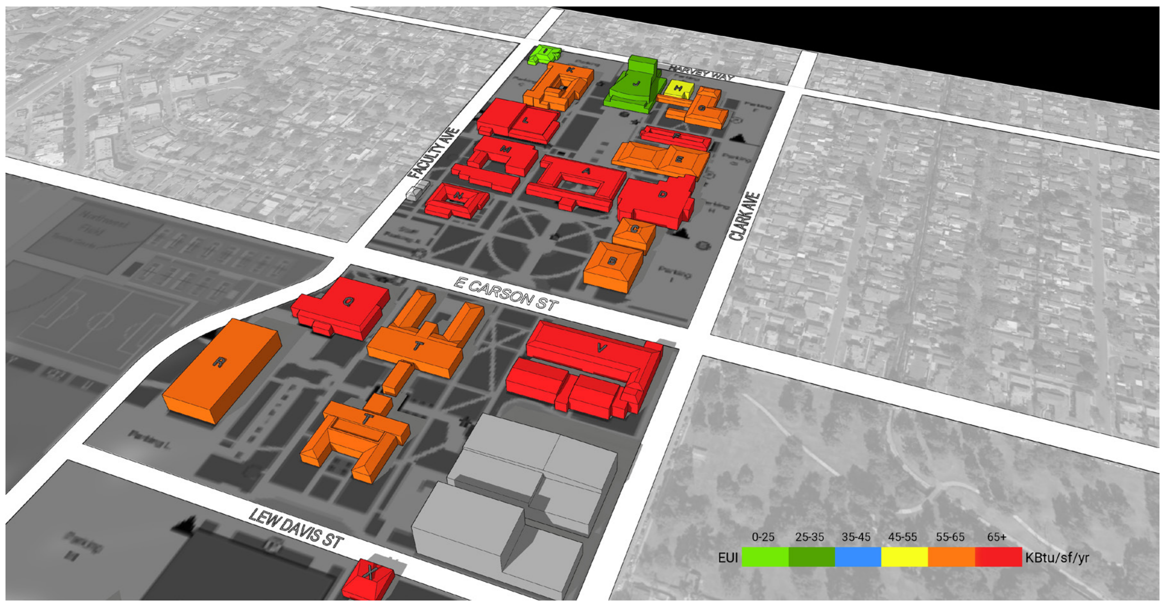
Summary of outcomes from Today till EEM 2 at PCC building level

Building's energy efficiency is measured through Energy Use Intensity (EUI). Since the majority of reductions in energy and energy production strategies happen in EEM 2, building level analysis is taken until the end of EEM 2. The table represent the net EUI after taking into account the renewable energy production applied equally to all the buildings within a campus.

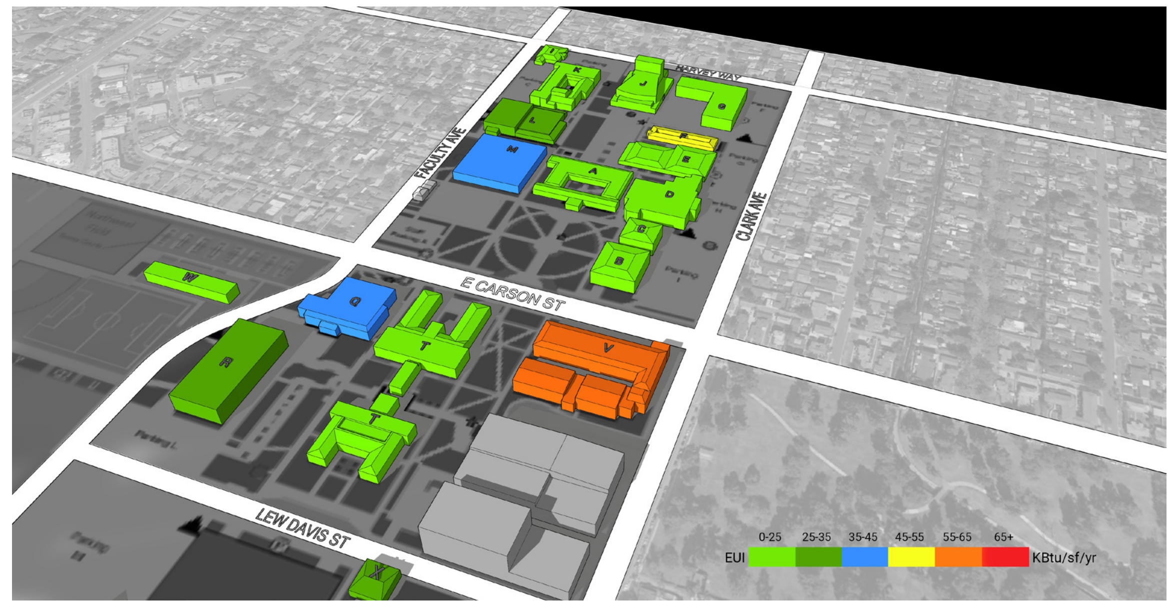
Campus	Building	Description	Before IEMP	After IEMP
PCC	AA	Administration	70	1
PCC	BB	Classrooms	39	2
PCC	CC	Fitness Center	38	10
PCC	DD	Science/Math	99	68
PCC	EE	Student Center/Multidisciplinary	76	4
PCC	FF	Family Consumer Studies	89	37
PCC	GG	Student Support Services/Cafeteria	84	32
PCC	HH	Child Development Center	13	4
PCC	II	Sheet Metal/Welding	56	9
PCC	JJ	Advanced Transportation/Automotive Technology	71	12
PCC	KK	Greenhouse	109	56
PCC	LL	Library/Learning Resource Center	69	11
PCC	MM	Construction Trades	32	3
PCC	NN	Horticulture	117	63
PCC	OO	Classrooms	40	17
PCC	QQ	Electrical/Dyer Hall/Lifetime Learning Center	27	2
PCC	RR	Electrical	29	2
PCC	UU	Foster Kinship Care	101	53
PCC	YY	Facilities/Central Plant	80	28

SUMMARY OF OUTCOMES

BEFORE:
Energy Use Intensity Graph for LAC

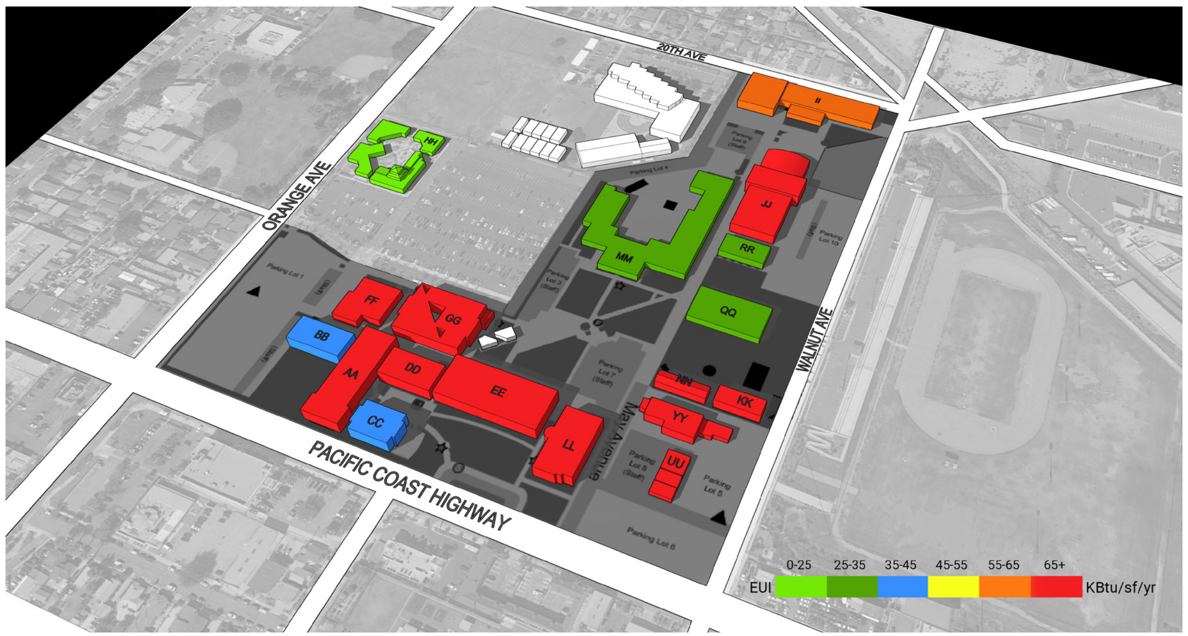


AFTER:
Net Energy Use Intensity Graph for LAC (taking renewable energy production into account)

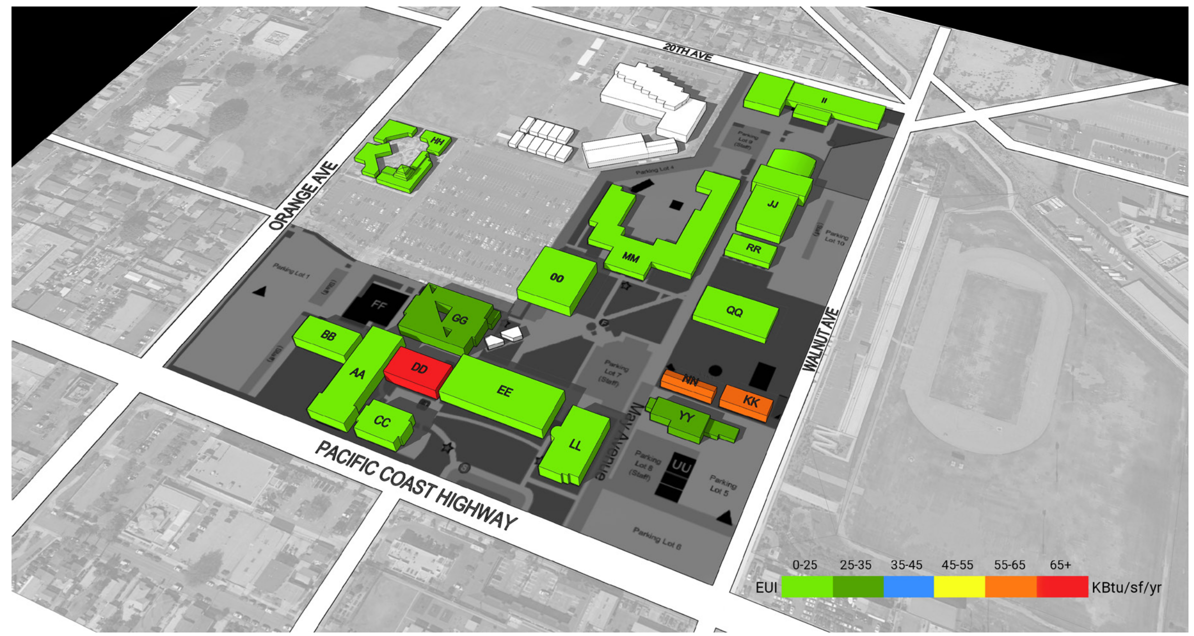


SUMMARY OF OUTCOMES

BEFORE:
Energy Use Intensity Graph for PCC



AFTER:
Net Energy Use Intensity Graph for PCC (taking renewable energy production into account)



03
FUNDING PROJECTIONS

FUNDING PROJECTIONS

OVERVIEW OF FMP 2041 FUNDING

In 2016, the voters approved of a third bond measure that provides an additional $850 million to modernize LBCCD's infrastructure. LBCCD has identified six projects to be submitted for State funding. These estimated State match for these potential projects is $79 million in capital outlay funding. 2041 FMP identifies Energy and Water Conservation Projects as an allowance of $25 Million as required amount outside of State and Measure E & LB funding.

For the purposes of meeting the targets set by Executive Orders, the capital outlay discussed in this section refers to only projects that directly improve energy and water efficiency and does not include the capital required for infrastructure upgrades (such as site work) to support energy efficiency. All of the capital outlay, expected annual energy savings, projected utility costs are based on today's dollar value and does not take into account time value of money, escalation in commodities and utilities costs, interest rates as well as life cycle costs of equipment. Since the majority of the capital outlay is expected in the next few years, today's dollar value is used for simplicity of setting expectations. Energy costs and the capital outlay to reduce that is a major portion of the costs involved in achieving the Executive Order targets and so, for simplicity reasons, costs of travel emissions and water costs are not included in the charts.

Energy Costs vs. Gross Square Footage Growth

District started major energy efficiency projects in 2010 leveraging the Measuring E and Prop 39 funding. In 2009, District's energy costs were close to $2.5 million. Between 2010 and 2016, due to a series of energy efficiency projects, District was able to maintain the energy costs well below 2009 levels at $2.2 million while growing 24% in its facilities. The capital cost outlay for this period equated to $18.5 million without taking into account the various infrastructure projects that supported this energy efficiency. In addition, District also received about $1.6 in grants and incentives from CCC and SGI toward the capital cost outlay.

Had the District not pursue such energy projects, the energy cost annually will have remained and grew to a larger portion of the General Savings Fund. Projected energy costs in School Year 2016-17 could have been at over $3 million and rising. Due to the energy efficiency projects via Measure E & LB and Prop 39, District also received approximately $1.0 million in rebates and anticipates another $0.7 million in rebates from utility providers.

After implementation and verification of EEM 2 by 2022, the energy costs are expected to drop to approximately $0.73 million, which is a 66% estimated reduction in energy costs in 4 years. Without any energy intervention, energy costs at today's dollar are projected to be at $3.1 million by 2022.

After successful implementation and verification of EEM 3 through 10, the anticipated energy costs are expected to be reduced to under $300,000 annually by 2050.

GENERAL FUND SAVINGS

Executive Order Implementation Cost vs. General Fund Savings

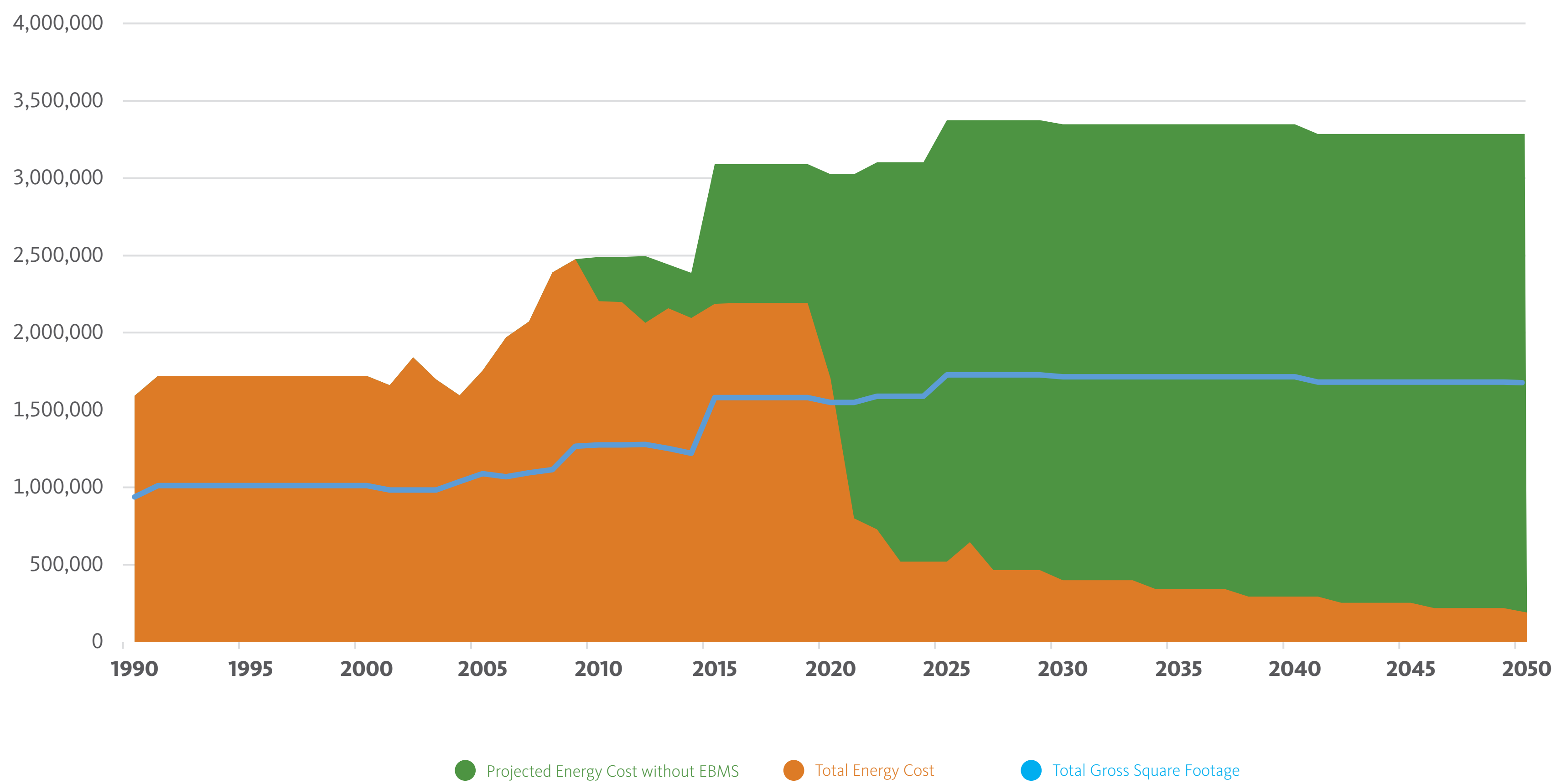
Each EEM has an estimated implementation project cost and associated energy cost savings per campus. An allowance of $1.5 million dollars every four years toward closing the gap for remaining resource conservation targets are set starting 2029. The following table lists the expected capital outlay for each measure in today's dollar.

By 2050, a total of $78 million would be invested toward implementing the Executive Order for energy and water efficiency. Compared to 2009 year's energy costs as a Baseline, the cumulative savings toward General Fund Savings will amount to $98 million by 2050. Payback of EEMs will be immediate since these measures utilize Bond Funds.

Year	Efficiency Measures	Strategy Category	Total EEM Implementation Project Cost
2010-2018	Energy Efficiency Measure 1	EEM 1A	$18,500,000
2019	Energy Efficiency Measure 2	EEM 2A	$11,528,433
2019	Reclaimed Water Conversion at LAC	EEM 2A	$200,000
2020	Energy Efficiency Measure 2	EEM 2B, 2D	$29,318,400
2021	Energy Efficiency Measure 2	EEM 2C	$2,577,428
2022	Energy Efficiency Measure 3	EEM 3A	$2,520,800
2023	Energy Efficiency Measure 3	EEM 3B	TBD
2026	Energy Efficiency Measure 4	EEM 4A	$4,320,000
2029	Energy Efficiency Measure 5-10	Latest Technology	$1,500,000 every four years

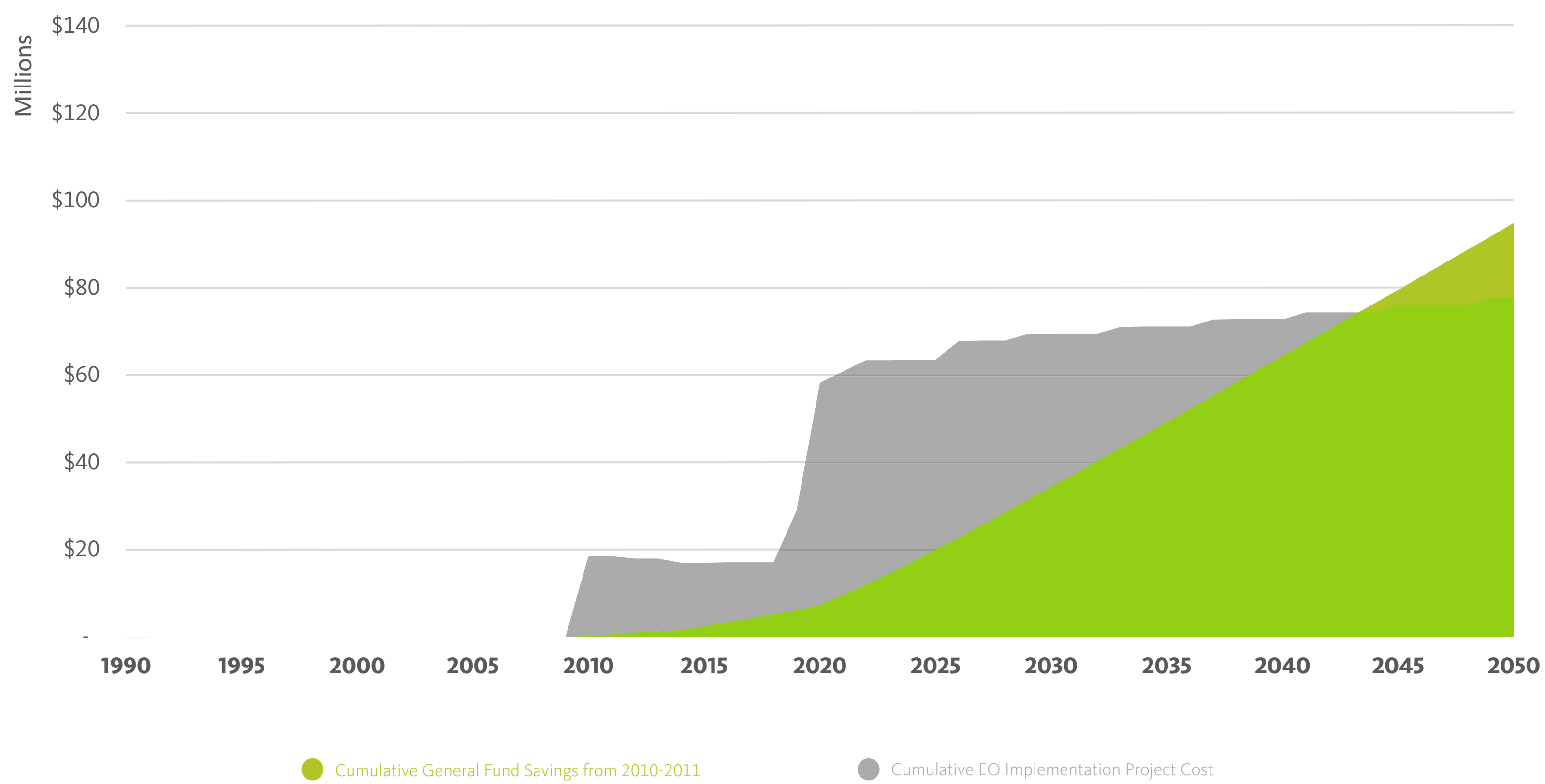
GENERAL FUND SAVINGS

ENERGY COSTS vs. GROSS SQUARE FOOTAGE GROWTH



GENERAL FUND SAVINGS

EXECUTIVE ORDER IN IMPLEMENTATION COST vs. GENERAL FUND SAVINGS



04
APPENDIX

APPENDIX EXHIBITS

1. Detailed ASHRAE analyses recommendations per building
2. Solar system concept plans and one-line diagrams
3. Summary of planning process via photographs