CALIFORNIA STATE UNIVERSITY LONG BEACH

CLEAN ENERGY MASTER PLAN

LONG TERM CAMPUS PLANNING FOR CARBON NEUTRALITY

SHAWN CUN, PE, CSULB
GORDON STEWART, PE, GLUMAC
JULY 9, 2019
PROJECT BACKGROUND

Climate Action Planning
FAQ1.2: How close are we to 1.5°C?
Human-induced warming reached approximately 1°C above pre-industrial levels in 2017.
PROJECT BACKGROUND

EMISSION REDUCTION GOALS

CSU System: 80% below 1990 by 2040
CSULB Climate Action Plan: 2030
Carbon Neutrality


Campus Carbon Neutrality Goals

Achieving carbon neutrality is a monumental challenge, and by setting these goals, CSU campuses are leaders in pioneering the transition to a sustainable economy.

<table>
<thead>
<tr>
<th>TARGET CARBON NEUTRALITY DATE</th>
<th>CAMPUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030</td>
<td>Chico</td>
</tr>
<tr>
<td>2030</td>
<td>Long Beach</td>
</tr>
<tr>
<td>2030</td>
<td>Monterey Bay</td>
</tr>
<tr>
<td>2030</td>
<td>San Luis Obispo</td>
</tr>
<tr>
<td>2040</td>
<td>Northridge</td>
</tr>
<tr>
<td>2050</td>
<td>Fullerton</td>
</tr>
<tr>
<td>2050</td>
<td>Humboldt</td>
</tr>
<tr>
<td>2050</td>
<td>San Diego</td>
</tr>
</tbody>
</table>
PROJECT BACKGROUND

CHALLENGES WITH LONG TERM PLANNING

1. Funding
   > GHG reduction as a function of dollars spent
   > Optimizing how funds are spent

2. Campus Growth
   > Infrastructure projects may not be expected when CAP is developed

3. Dynamic Utility Rates
   > Fluctuating rates make it hard to forecast and strategically plan infrastructure projects
PROJECT BACKGROUND
HISTORICAL ENERGY RELATED EMISSIONS

41% REDUCTION in energy related GHG emissions [MTE/sf]

Energy GHG Emissions vs. Built Area¹

1990 Total Emissions Reduction (AB 32) 16%

¹Estimated based on 2017 electricity use and expected PV generation
PROJECT BACKGROUND

CLEAN ENERGY MASTER PLAN SCOPE

1. Energy Audits
   > 28x ASHRAE Level I – 2.2M SF
   > 9x ASHRAE Level II – 690k SF
2. Energy Efficiency Measures (EEMs) Inventory
3. Renewable Energy Plan
4. 5-year Implementation Plan
5. Model Deep Energy Retrofit Plan
6. Funding/Financing Plan
8. Clean Energy Vehicle Transition Plan
9. Carbon Offset Guidelines
10. Planning and Visualization Tool

CSULB Clean Energy Master Plan
PROJECT BACKGROUND

GLUMAC
A TETRA TECH COMPANY

SUB-CONSULTANT SUPPORT

- arc ALTERNATIVES: Developing a renewable energy plan, funding plan and supporting implementation plan
- eco-shift CONSULTING: GHG emission offset plan, scenario analysis, and Planning/ Visualization Tool Development
- SEED CONSULTING GROUP: Clean energy fuel vehicle transition plan & non-profit liaison
- fs3 Hodges: Cost Estimating
SCENARIO ANALYSIS PLANNING

Custom Carbon Neutrality Planning Resource
SCENARIO ANALYSIS

WHY CSULB INVESTED IN A DYNAMIC RESOURCE

1. Tracking
   > Progress towards CAP commitments

2. Planning
   > Project phasing
   > Financial planning

3. Analysis
   > Market sensitivities can be analyzed to assess how potential changes will affect neutrality goals
SCENARIO ANALYSIS
CSULB SCENARIO ANALYSIS AND VISUAL INSIGHT (SAVI) TOOL

Campus Data

CEMP Analysis
(EE, RE, VF projects)

Scenario Definitions

CSULB SAVI Tool.xlsx

Data Visualization

Financial Analysis

Planning

GHG Emissions

Scenario Assessment

Sensitivity Analysis
SCENARIO ANALYSIS

CSULB SCENARIO ANALYSIS AND VISUAL INSIGHT (SAVI) TOOL
SCENARIO ANALYSIS
LONG TERM VERSATILITY

1. Add/Change/Remove Energy Projects
   > Energy Efficiency
     - Update EE project directory
     - Update actual project cost
   
   > Renewable Energy
     - Add new RE projects
     - Adjust PPA rates, term & escalation rates
   
   > Vehicle Fleet
     - Update VF fossil fuel consumption
     - Add new clean energy vehicles to VF
SCENARIO ANALYSIS

LONG TERM VERSATILITY

1. Add/Change/Remove Energy Projects
2. Economic Sensitivity Analysis
   - Discount & Inflation rate
   - Utility Prices & Escalation rates
   - Fuel Prices & Escalation rates

1. Define current scenario  •  2. Select projects  •  3. Set economic assumptions  •  4. Adjust carbon offsets  •  5. Save scenario

<table>
<thead>
<tr>
<th>Economic assumptions</th>
</tr>
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<tbody>
<tr>
<td>Discount rate (default = 5%):</td>
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<tr>
<td>Inflation rate (default = 2%):</td>
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</table>

<table>
<thead>
<tr>
<th>Electricity prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric source</td>
</tr>
<tr>
<td>Electricity base price ($/kWh):</td>
</tr>
<tr>
<td>Electricity escalation rate (default = 3%):</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas base price ($/thm):</td>
</tr>
<tr>
<td>Natural gas escalation rate (default = 3%):</td>
</tr>
<tr>
<td>Gasoline base price ($/gal):</td>
</tr>
<tr>
<td>Gasoline escalation rate (default = 2%):</td>
</tr>
<tr>
<td>Diesel base price ($/gal):</td>
</tr>
<tr>
<td>Diesel escalation rate (default = 2%):</td>
</tr>
</tbody>
</table>
### SCENARIO ANALYSIS

**LONG TERM VERSATILITY**

1. Add/Change/Remove Energy Projects
2. Economic Sensitivity Analysis
3. Carbon Offsets
   - Offset costs can be updated
   - Escalation rates included

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|---------------------------|-------------------|-----------------------------|------------------------|-----------------|

#### Carbon offset pricing

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>GHG offset base price (default = $4.79/MT CO2e)</td>
<td>$4.79</td>
</tr>
<tr>
<td>GHG offset escalation rate (default = 2%)</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

[Restore defaults button]
SCENARIO ANALYSIS

KEY BENEFITS

1. Budgeting
   > Allocate funding towards carbon neutrality goals
   > Plan for projects

2. Project development and prioritization
   > schedule high opportunity projects first

3. Resiliency
   > Staff turnover
ROADMAP
CSULB’s Roadmap to Carbon Neutrality
# Scenario Analysis

## Scenario Definitions

<table>
<thead>
<tr>
<th>Scenario Name</th>
<th>Energy Efficiency (EE)</th>
<th>Renewable Energy (RE)</th>
<th>Vehicle Fleet (VF)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(1)</strong> Business as Usual (BAU)</td>
<td>Current investment rate</td>
<td>Economical PV projects</td>
<td>None</td>
</tr>
<tr>
<td><strong>(2)</strong> Increased Investment</td>
<td>Increased investment rate</td>
<td>BAU + Main Campus No-Export Option 1</td>
<td>Fleet electrification: most vehicles</td>
</tr>
<tr>
<td><strong>(3)</strong> Operational/ Policy Changes</td>
<td>Lower investment rate</td>
<td>No additional projects</td>
<td>Fleet electrification: most vehicles</td>
</tr>
<tr>
<td><strong>(4)</strong> Cost-Effective Investment</td>
<td>Lower investment rate</td>
<td>No additional projects</td>
<td>None</td>
</tr>
<tr>
<td><strong>(5)</strong> Ambitious NZE Investments</td>
<td>Significantly higher investment rate</td>
<td>BAU + Main Campus No-Export Option 1</td>
<td>Fleet electrification: all potential vehicles</td>
</tr>
</tbody>
</table>
SCENARIO RESULTS

ENERGY EFFICIENCY INVESTMENT SCENARIOS

Utilizing scenario building for climate action planning

Financial Impact vs. EUI Savings

Average Annual Investment 2019-2030 ($ Millions)
Increased EE Investment + Sustainable Operational Policies

![Financial Impact vs. EUI Savings Graph]
Key Takeaways

**Energy Efficiency:** Significant emission reductions potential through increased investment

**Renewable Energy:** Solar PV plays an important role, competitive pricing is necessary for financial feasibility

**Vehicle Fleet:** Prioritize electric vehicles

**Carbon Offsets:** Offsets will be required to meet carbon neutrality goal
CONCLUSIONS
CONCLUSIONS

POTENTIAL ENERGY SAVINGS

2030 Campus EUI Target: 38.9 kBtu/sf

CSULB Site EUI Breakdown

<table>
<thead>
<tr>
<th>Year</th>
<th>Site EUI (kBtu/sf)</th>
<th>Electricity</th>
<th>Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>116.5</td>
<td>58.1</td>
<td>58.4</td>
</tr>
<tr>
<td>2018</td>
<td>68.5</td>
<td>38.7</td>
<td>30.8</td>
</tr>
<tr>
<td>2030 (BAU)</td>
<td>52.7</td>
<td>25.0</td>
<td>27.7</td>
</tr>
<tr>
<td>2030 (Increased)</td>
<td>46.3</td>
<td>24.4</td>
<td>21.9</td>
</tr>
<tr>
<td>2030 (Increased + CUP)</td>
<td>38.9</td>
<td>16.3</td>
<td>22.6</td>
</tr>
<tr>
<td>2030 (Ambitious)</td>
<td>35.5</td>
<td>16.3</td>
<td>19.2</td>
</tr>
</tbody>
</table>

2030 Campus EUI (Increased Investment + CUP Electrification) 38.9
CONCLUSIONS

POTENTIAL ENERGY SAVINGS

CSU Systemwide Average EUI: 74.6 kBtu/sf (2016/2017)

Systemwide Energy Use Intensity (BTU/GSF)

BAU
Increased
Increased + CUP
Ambitious
CARBON OFFSETS
CARBON MANAGEMENT HIERARCHY

1. Direct Projects
   Quantifiable results that lower energy costs, allowing justification for further investment in the campus

   Energy Efficiency  Renewable Energy  Vehicle Fleet  Other

2. Carbon Offsets
CONCLUSIONS

FINANCING REQUIREMENTS

1. Project Costs: $29-$37M ($6.0-$7.5/sf)

2. Increased Investment Scenario (~$2.8M / year)
   > Requires additional $15-$22M funding through 2030
   > Doubles current average annual investment rate ($1-1.5M)

3. Planned Central Plant electrification upgrades
   > TES & Heat Recovery adds significant additional investment gap yet to be fully quantified
CONCLUSIONS

FINANCING STRATEGY

Matrix of 30+ financing options

Current Sources

1. Annual Energy Retrofit Budget / Revolving Energy Account
2. Deferred Maintenance (DM) and Capital Renewal Budget

Potential New Sources

1. SCE On-Bill Financing (OBF)
2. Other External Financing (prioritize lowest cost)
THANK YOU

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Energy Analyst  
Glumac  
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213-988-6241
APPENDIX SLIDES
CAMPUS ELECTRIFICATION
CA SENATE BILL 100
Carbon free electricity by 2045

Typical Residential Hall

100% Electric Residential Hall
Central Plant natural gas use needs to be addressed
ENERGY EFFICIENCY

ENERGY ANALYSIS PROCESS

- Level 1 Energy Audit
  - 28 Level 1 Audits – 2.2 million SF
  - EE Projects Identified
- Level 2 Energy Audit
  - Strategic Building Selection
  - 9 Level II Audits – 690k SF
- Campus Extrapolation
  - EE Projects Extrapolated to 60 Buildings

Energy Audit Scope (% of Total Campus)

- 38% Level 1 Audit
- 41% Level 2 Audit
- 17% Extrapolation
- 4% Out of Scope

Gordon
ENERGY EFFICIENCY
SUMMARY OF FINDINGS

CEMP Identified over 567 EE Projects

> 279 capital improvements (HVAC, Lighting, DHW)
> 57 general commissioning (Retro-Cx, MBCx, etc.)
> 217 energy savings operational policies
> 14 deep energy retrofit/modernization

Potential Annual Savings

> 20,280,000 kWh annually
> 658,000 therms annually
> $2.6 million energy costs

<table>
<thead>
<tr>
<th>Energy efficiency projects</th>
<th>Annual kWh savings</th>
<th>Annual cost savings</th>
<th>Total project cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE29 ACADEMIC SERVICES: Ox - Building Shutter - Summer only</td>
<td>365,560</td>
<td>1,819</td>
<td>$44,812</td>
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<tr>
<td>EE283 ACADEMIC SERVICES: Ox - Building Shutter - Summer on</td>
<td>67,106</td>
<td>698</td>
<td>$6,830</td>
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<tr>
<td>EE391 ACADEMIC SERVICES: Ox - Building Shutter on Friday all year</td>
<td>301,479</td>
<td>4,896</td>
<td>$100,105</td>
</tr>
<tr>
<td>EE360 ACADEMIC SERVICES: Deep HVAC Retrofit - Service manure plant</td>
<td>69,444</td>
<td>1,999</td>
<td>$0,616</td>
</tr>
<tr>
<td>EE34 ACADEMIC SERVICES: Lighting - LED Retrofit</td>
<td>272,152</td>
<td>0</td>
<td>$27,615</td>
</tr>
<tr>
<td>EE244 ACADEMIC SERVICES: Lighting - LED Retrofit - Control I</td>
<td>121,022</td>
<td>0</td>
<td>$29,150</td>
</tr>
<tr>
<td>EE245 ACADEMIC SERVICES: HVAC - HVAC Retrofit</td>
<td>56,062</td>
<td>1,066</td>
<td>$7,080</td>
</tr>
<tr>
<td>EE502 BEACHSIDE RESIDENTIAL COLLEGE - Hot Water - Hot Water Heat P</td>
<td>246,340</td>
<td>1,775</td>
<td>$11,809</td>
</tr>
<tr>
<td>EE115 BEACHSIDE RESIDENTIAL COLLEGE - Lighting - LED Retrofit Replace</td>
<td>42,950</td>
<td>0</td>
<td>$4,722</td>
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<tr>
<td>EE341 BEACHSIDE RESIDENTIAL COLLEGE - Renewables - Solar Hot Water</td>
<td>26,812</td>
<td>0</td>
<td>$11,747</td>
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<tr>
<td>EE331 BDB AND BARBARA ELIUS EDUCATION BUILDING - Ox - Building Shutter</td>
<td>61,620</td>
<td>514</td>
<td>$7,050</td>
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<tr>
<td>EE477 BDB AND BARBARA ELIUS EDUCATION BUILDING - Ox - Building Shutter</td>
<td>10,021</td>
<td>120</td>
<td>$1,185</td>
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<tr>
<td>EE969 BDB AND BARBARA ELIUS EDUCATION BUILDING - Ox - Building Shutter</td>
<td>30,168</td>
<td>746</td>
<td>$3,940</td>
</tr>
<tr>
<td>EE422 BDB AND BARBARA ELIUS EDUCATION BUILDING - Ox - Building Shutter</td>
<td>25,343</td>
<td>408</td>
<td>$2,903</td>
</tr>
<tr>
<td>EE246 BDB AND BARBARA ELIUS EDUCATION BUILDING - General Commission</td>
<td>20,804</td>
<td>801</td>
<td>$2,180</td>
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<tr>
<td>EE245 BDB AND BARBARA ELIUS EDUCATION BUILDING - Lighting - LED Retrofit</td>
<td>30,969</td>
<td>0</td>
<td>$3,609</td>
</tr>
<tr>
<td>EE331 BDB AND BARBARA ELIUS EDUCATION BUILDING - Lighting - LED Retrofit</td>
<td>56,889</td>
<td>0</td>
<td>$3,940</td>
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<tr>
<td>EE332 BDB AND BARBARA ELIUS EDUCATION BUILDING - Lighting - LED Retrofit</td>
<td>19,502</td>
<td>0</td>
<td>$2,151</td>
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<td>EE320 BDB AND BARBARA ELIUS EDUCATION BUILDING - Lighting - LED Retrofit</td>
<td>100,609</td>
<td>0</td>
<td>$10,657</td>
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<tr>
<td>EE304 BDB AND BARBARA ELIUS EDUCATION BUILDING - Lighting - LED Retrofit</td>
<td>78,083</td>
<td>0</td>
<td>$8,486</td>
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<tr>
<td>EE305 BUSINESS ADMINISTRATION - Ox - Building Shutter - Summer only</td>
<td>201,400</td>
<td>0</td>
<td>$20,010</td>
</tr>
<tr>
<td>EE306 BUSINESS ADMINISTRATION - Ox - Building Shutter on Friday all year</td>
<td>30,562</td>
<td>0</td>
<td>$3,970</td>
</tr>
<tr>
<td>EE483 BUSINESS ADMINISTRATION - Ox - Building Shutter on Friday all year</td>
<td>30,562</td>
<td>0</td>
<td>$3,970</td>
</tr>
<tr>
<td>EE347 BUSINESS ADMINISTRATION - Ox - Building Shutter on Saturday all year</td>
<td>80,446</td>
<td>2,904</td>
<td>$11,007</td>
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<tr>
<td>EE349 BUSINESS ADMINISTRATION - Deep HVAC Retrofit - Service manure plant</td>
<td>377,483</td>
<td>0</td>
<td>$4,192</td>
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<tr>
<td>EE340 BUSINESS ADMINISTRATION - Deep HVAC Retrofit - Replace WHP</td>
<td>65,773</td>
<td>0</td>
<td>$7,036</td>
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<tr>
<td>EE226 BUSINESS ADMINISTRATION - HVAC Retrofit - Replace WHP</td>
<td>262,829</td>
<td>0</td>
<td>$26,812</td>
</tr>
</tbody>
</table>
## SCENARIO ANALYSIS
### CLEAN ENERGY INVESTMENT SCENARIOS

<table>
<thead>
<tr>
<th>Scenario Name</th>
<th>Energy Efficiency (EE)</th>
<th>Renewable Energy (RE)</th>
<th>Vehicle Fleet (VF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Business as Usual (BAU)</td>
<td>Maintain current average investment rate to $1-1.5 million annually. All EE projects completed by 2035</td>
<td>Invest in most economical PV projects (2.28 MW)</td>
<td>None – rely on incremental efficiency improvements</td>
</tr>
<tr>
<td>(2) Increased Investment</td>
<td>Increase average investment rate to $2.8 million annually. All EE projects completed by 2030</td>
<td>BAU + Main Campus Curtailment Option 1 (5.36 MW)</td>
<td>Fleet Electrification - transition most vehicles by 2030. Excludes diesel fuel grounds equipment</td>
</tr>
<tr>
<td>(3) Operational/Policy Changes</td>
<td>Lower than average investment rate – $0.6 million annually. Prioritize only cost-effective EE projects and implement ambitious energy savings operational policies</td>
<td>None – no additional PV projects</td>
<td>Fleet Electrification - transition most vehicles by 2030. Excludes diesel fuel grounds equipment</td>
</tr>
<tr>
<td>(4) Cost-Effective Investment</td>
<td>Lower than average investment rate – $1 million annually. Prioritize only cost-effective EE projects.</td>
<td>None – no additional PV projects</td>
<td>None – rely on incremental efficiency improvements</td>
</tr>
<tr>
<td>(5) Ambitious NZE Investments</td>
<td>Increase average investment rate to $4.4 million annually. Includes numerous electrification projects</td>
<td>All Potential PV Projects: BAU + Main Campus Curtailment Option 3 (7.71 MW)</td>
<td>Fleet Electrification – transition ALL possible vehicles by 2030. Includes diesel fuel grounds equipment</td>
</tr>
</tbody>
</table>
SCENARIO ANALYSIS
CSULB SENSITIVITY ANALYSIS

Campus Data
CEMP Analysis (EE, RE, VF projects)
Scenario Definitions

CSULB SAVI Tool.xlsx

Scenario Comparison Chart
Scenario Timeline
Scenario Comparison Table
CARBON OFFSETS
KEY RECOMMENDATIONS

1. High quality offsets provide an important mechanism for achieving carbon neutrality.

2. Adhering to a carbon management hierarchy ensures prioritization of direct projects before offset purchases.

3. Clearly communicate offset strategy and benefits

4. Track carbon offset price fluctuations
ENERGY EFFICIENCY

Higher Performance Buildings
## ENERGY EFFICIENCY

### CAMPUS BENCHMARKING

<table>
<thead>
<tr>
<th></th>
<th>CSU Systemwide</th>
<th>CSU Long Beach</th>
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</thead>
<tbody>
<tr>
<td>2004/2005</td>
<td>88.9</td>
<td>108.6</td>
</tr>
<tr>
<td>2016/2017</td>
<td>74.6</td>
<td>74.8</td>
</tr>
<tr>
<td>2018</td>
<td>74.6</td>
<td>68.5</td>
</tr>
</tbody>
</table>

1. Estimated based on 2017 electricity use and expected PV generation

### CSULB vs. CSU Systemwide Average

<table>
<thead>
<tr>
<th>Year</th>
<th>EUI (kBtu/sf)</th>
<th>CSULB vs. CSU Systemwide Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004/2005</td>
<td>108.6</td>
<td>-22.2%</td>
</tr>
<tr>
<td>2016/2017</td>
<td>74.8</td>
<td>-0.2%</td>
</tr>
<tr>
<td>2018</td>
<td>68.5</td>
<td>8.2%</td>
</tr>
</tbody>
</table>
ENERGY EFFICIENCY

LESSONS LEARNED

1. Database of energy projects & access to financing improves capital outlay for efficiency projects

2. Install building level energy meters (electricity, CHW, HHW)

3. Start trending all potentially relevant EMS Data

4. Start thinking about you central plant of the future

5. Efficient Space Utilization = Energy Savings
RENEWABLE ENERGY

Section 4.2
RENEWABLE ENERGY

EXISTING PV SYSTEMS

- 409 kW rooftop PV installed in 2008
- 4,749 kW carport PV array completed recently (20-year PPA)

2009 Self Generation [%] 2018 Self Generation [%]

1 Estimated based on 2017 electricity use and expected PV generation
No export agreement for existing 4.8MW system limits further potential for solar on main campus meter.
Additional PV Capacity: 5.57 MW
- Parkside/Beachside/Foundation Combined Project
- Main Campus No-Export Opt. 1

Total Campus PV Capacity: 10.77 MW

2020 ELECTRICITY SOURCE (no additional EE investment)

2030 ELECTRICITY SOURCE (increased EE investment)
RENEWABLE ENERGY

UTILITY RATE CHANGES

Investor Owned Utilities: PG&E, SDG&E, SCE (SCE shown below)

- Significant impact to ROI on solar PV & electrification projects

### Summer - Weekday

#### Current SCE Rates

- $0.00
- $0.02
- $0.04
- $0.06
- $0.08
- $0.10
- $0.12
- $0.14

#### Proposed SCE Rate

- $0.00
- $0.02
- $0.04
- $0.06
- $0.08
- $0.10
- $0.12
- $0.14

#### Solar Generation

- $0.00
- $0.02
- $0.04
- $0.06
- $0.08
- $0.10
- $0.12
- $0.14

### Winter - Weekday

#### Current SCE Rates

- $0.00
- $0.02
- $0.04
- $0.06
- $0.08
- $0.10
- $0.12
- $0.14

#### Proposed SCE Rate

- $0.00
- $0.02
- $0.04
- $0.06
- $0.08
- $0.10
- $0.12
- $0.14

#### Solar Generation

- $0.00
- $0.02
- $0.04
- $0.06
- $0.08
- $0.10
- $0.12
- $0.14
RENEWABLE ENERGY
STRATEGIC RECOMMENDATIONS

1. Conduct a competitive procurement process
   > Bundle PV projects to improve financial
   > 20-Year PPA Break Even Range: $0.105 – 0.115 / kWh
   > Consider additive features separately (security, parking upgrades, etc.)
   > Review energy use (kWh) and peak demand (kW) cost savings breakdown

2. Engage Chancellors Office for streamlined RFP process

3. 25 year PPAs will improve cash flow in early years
CLEAN ENERGY VEHICLES

Section 4.3
CLEAN ENERGY VEHICLES

KEY RECOMMENDATION

TECHNOLOGY ASSESSMENT

- Recommended: Battery Electric Vehicles (BEV)
- Not Recommended: Hydrogen Fuel Cell, CNG

VEHICLE REPLACEMENT PRIORITIES

- Continue utilizing electric carts
- Assess electric grounds equipment
- Begin purchasing electrical automobiles

Autos
- Developed market
- Purchase now

Pickups & Trucks
- Limited options
- Reassess early 2020s

Commercial
- Reassess in the future

By 2030, the average BEV will be cheaper than a comparable gasoline vehicle

1 – Bloomberg New Energy Finance: April 12, 2017
CLEAN ENERGY VEHICLES

STRATEGIC RECOMMENDATIONS

ESTABLISH A CAMPUS CLEAN ENERGY VEHICLE POLICY

> Vehicle replacement review process
> Clean energy vehicle standards
> Interim electrification targets
> Track and pursue funding opportunities
> Issue RFP for electric shuttle busses in 5 years

DEVELOP AN ELECTRIFICATION PILOT PROGRAM

> Electric autos (FM, Parking, UP)
> Electric grounds/landscaping equipment (FM)
PROJECT OUTCOMES

GHG EMISSIONS MANAGEMENT

1. Establish Internal Accountability/Reporting Structure
2. Establish Long Term Financing Plan & Capital Outlay
3. Track Changes in the Energy Market
4. Develop a Scope 3 Emissions Mitigation Plan
   - Alternative/Sustainable Transportation Plan
   - Air Travel Mitigation Fund
   - Additional On-Campus Housing
   - Numerous Other Options