Successful Strategies for

Designing Net-Zero Energy Campuses

presenting today

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DLR Group

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Greg Donavan
Superintendent

West-MEC

learning objectives

1. Identify the challenges and limitations of achieving net-zero energy at a building level within a higher education campus;

2. Educate peers about the opportunities for scaling net-zero energy concepts at a campus level;

3. Learn to implement the key steps involved in planning for a net-zero campus;

4. Discuss how to overcome the practical challenges in scaling up net-zero at a campus level.

What's your institution type?

Education
Government Agency
Healthcare
Other








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Net Zero Energy **and Campuses**

Why?

- Mission Alignment
- American College and University President's Climate Commitment
- Long-Term Capital and Operations Planning

Opportunities

- Utility Providers
- Diverse Building Types
- Life-Cycle Mindset

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overview of today

1 – Language of Net-Zero Energy

2 – Case Study #1 – West-MEC

3 – Case Study #2 – LBCCD

4 – Q&A

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Defining **Net Zero Energy**

Zero Energy Building (ZEB)

an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

Zero Energy Campus

an energy-efficiency campus where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

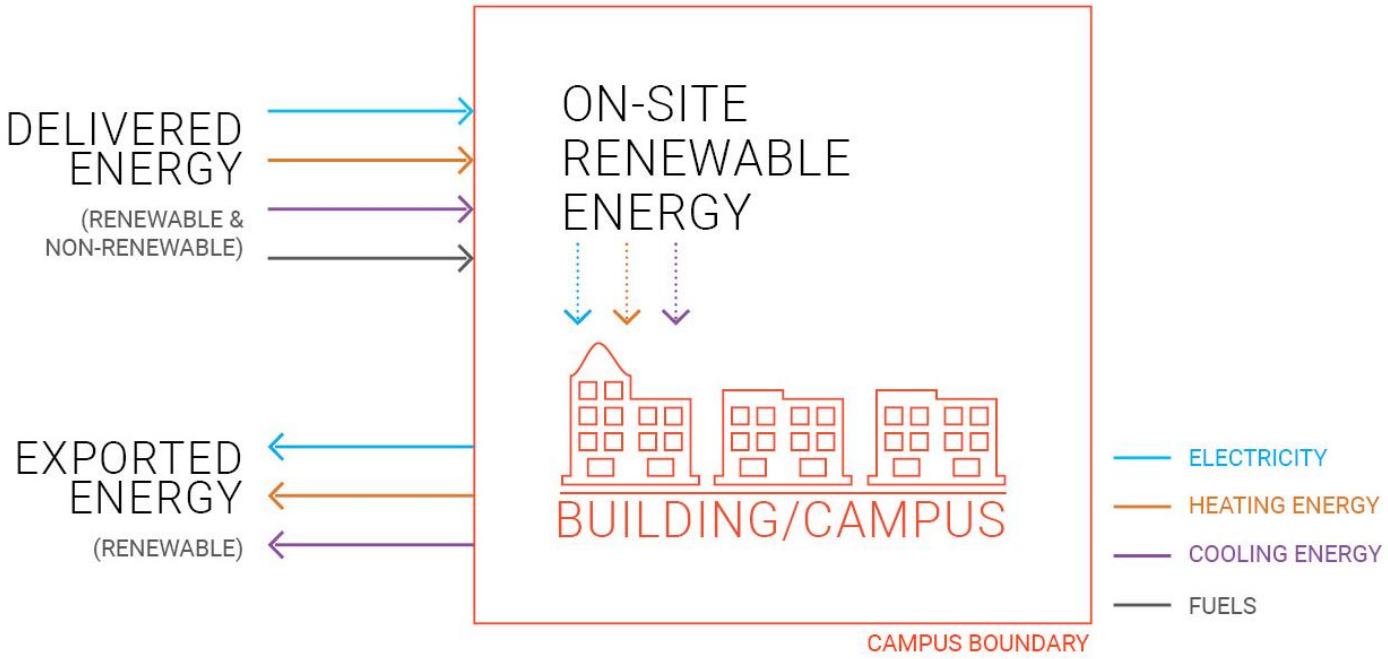
Zero Energy Portfolio

same as above, but with portfolio instead of campus.

Zero Energy Community:

same as above, but with community instead of campus.

boundaries



Notes
1. The dotted lines represent energy transfer with the boundary
2. The solid lines represent energy transfer entering/leaving the boundary used for zero energy accounting

Building vs Campus
Net Zero Energy Challenge #1

Defining the boundary

By definition ZNE is achieved if Delivered Energy is less than or equal to Exported Energy

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campus **energy**

- **Benchmarking (ENERGY STAR)**
  Median Site EUI: 130.7 kBTU/yr-gsf
  Median Source EUI: 262.6 kBTU/yr-gsf

- **Variables**
  Campus Utility System
  Building Types
  Academic Calendar
  Building Stock Vintage
  Submetering

- **Opportunity with a campus**
  Diversity of programs
  Diversity of generation assets

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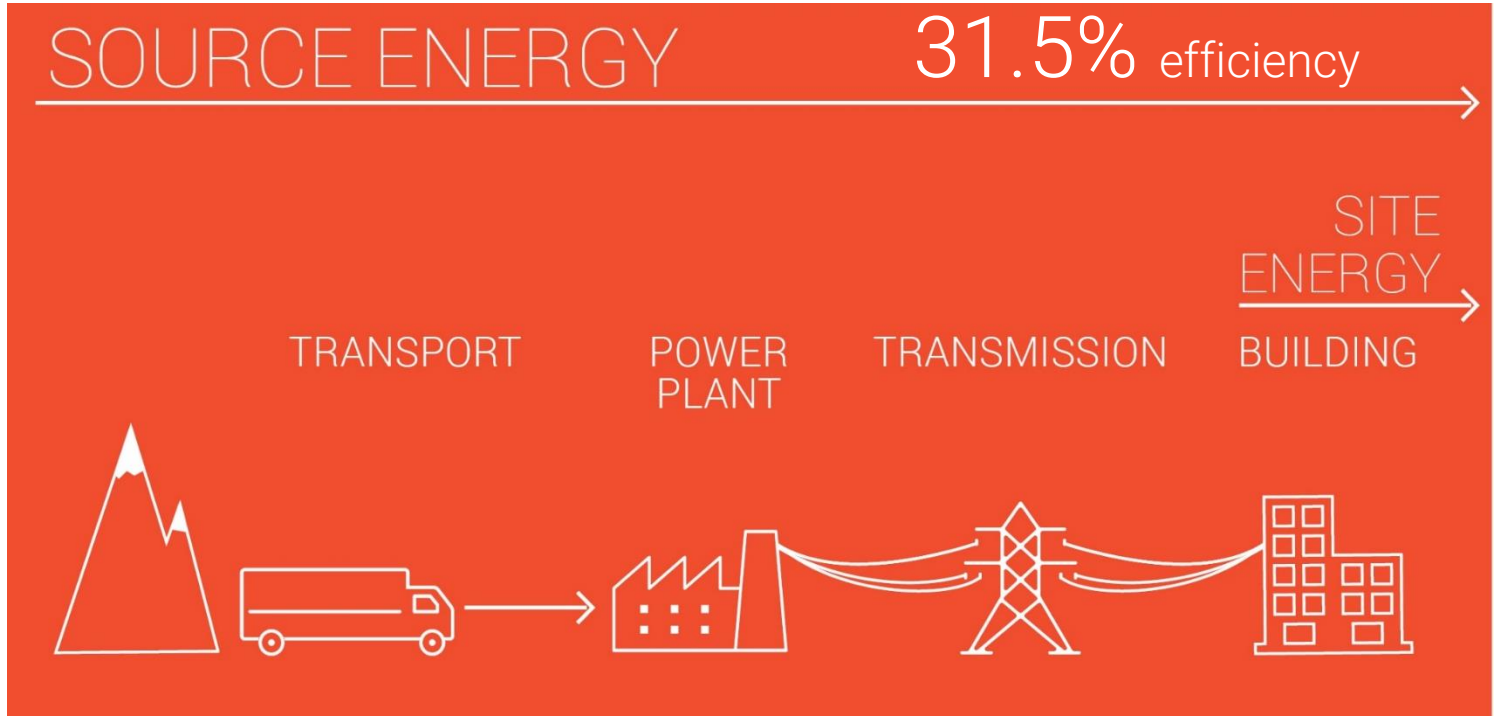
not all metrics **are created equal**



Zero energy ≠ Zero carbon ≠ Zero cost
Definitions are key: Boundary driven

Building vs Campus
Net Zero Energy Challenge #2

Choosing the right metric

ZNE Site vs ZNE Source
ZNE Energy vs ZNE Carbon vs ZNE Cost

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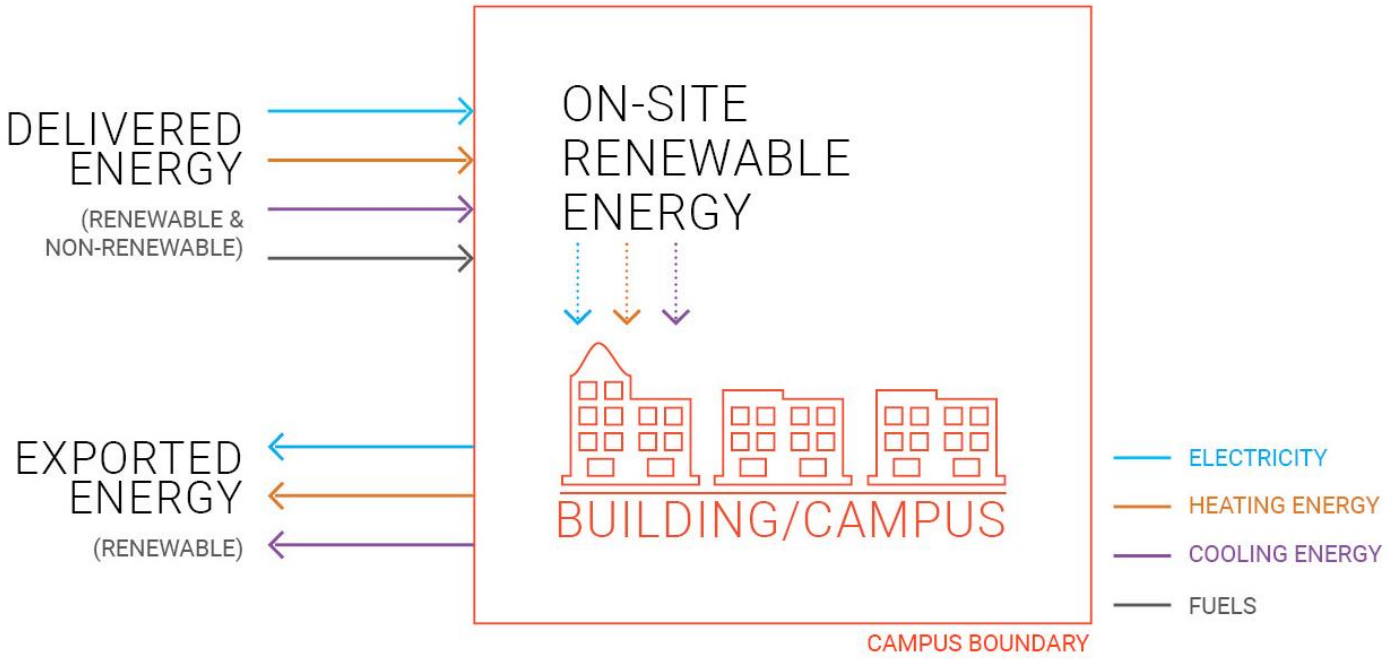
source energy



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<u>Site to Source Ratio</u>

Electricity – 3.15
Natural Gas – 1.09

Exported Electricity – 3.15

Opportunity with a Campus
Diversity of fuel sources

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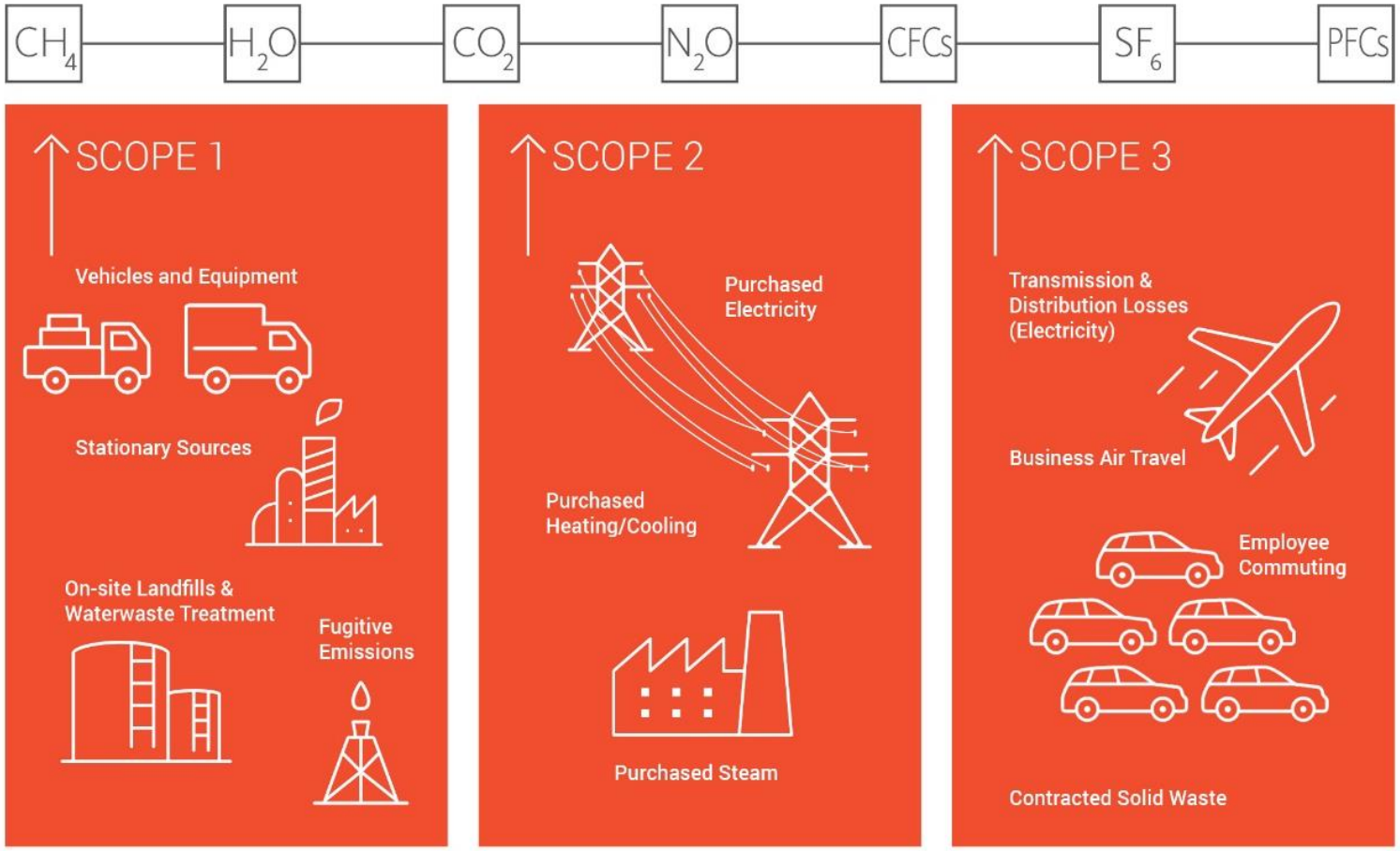
Defining **Net Zero Carbon**



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

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

GREENHOUSE GAS EMISSIONS
from sources not owned or directly controlled by a federal agency but related to agency activities.

Opportunity with a Campus

Address a range of sustainability aspects than just energy

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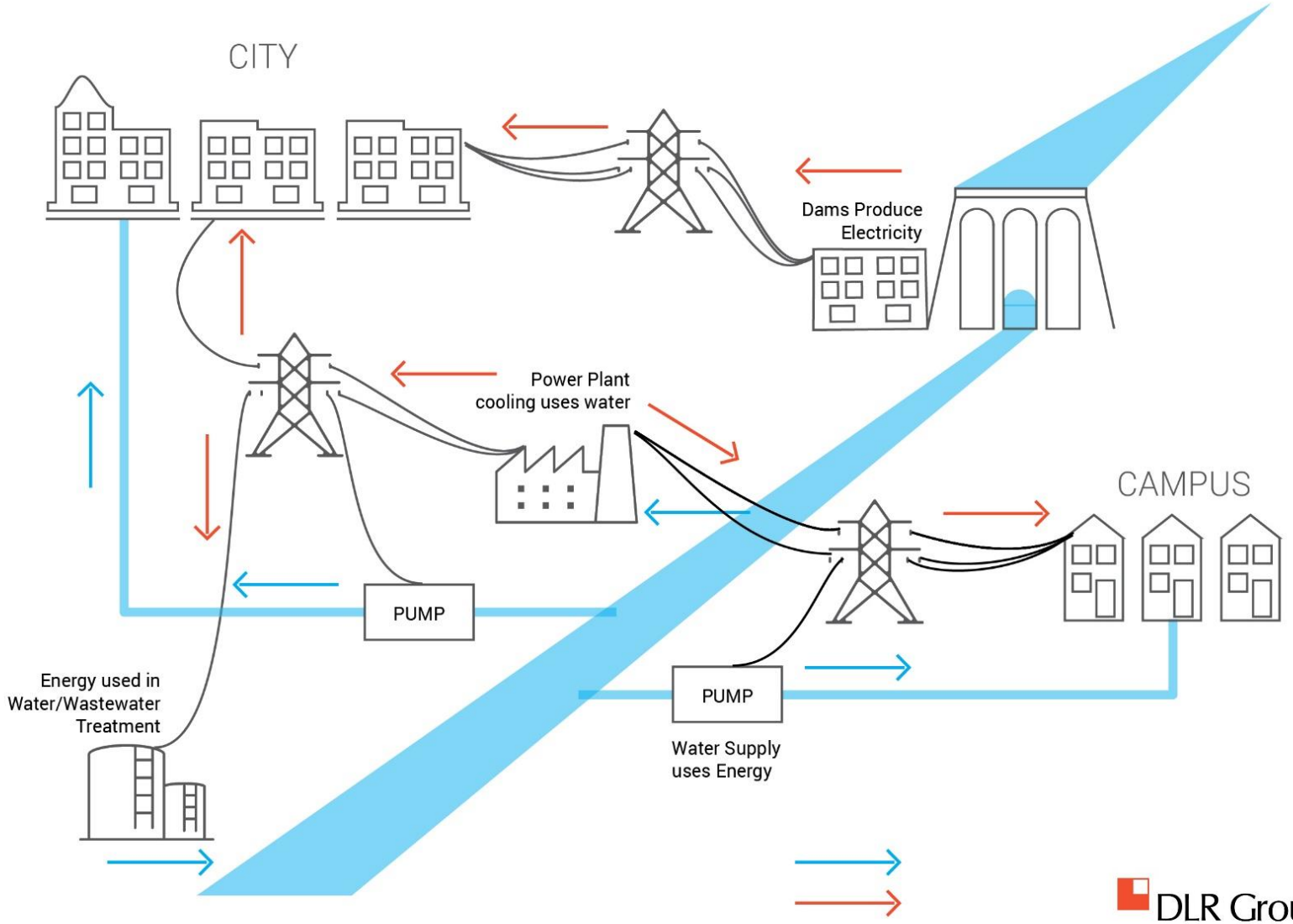
types of **energy**

- Non-renewable vs. Renewable
- Embodied Energy
- Water-Energy Nexus

Opportunity with a Campus

- Address a range of sustainability aspects than just energy



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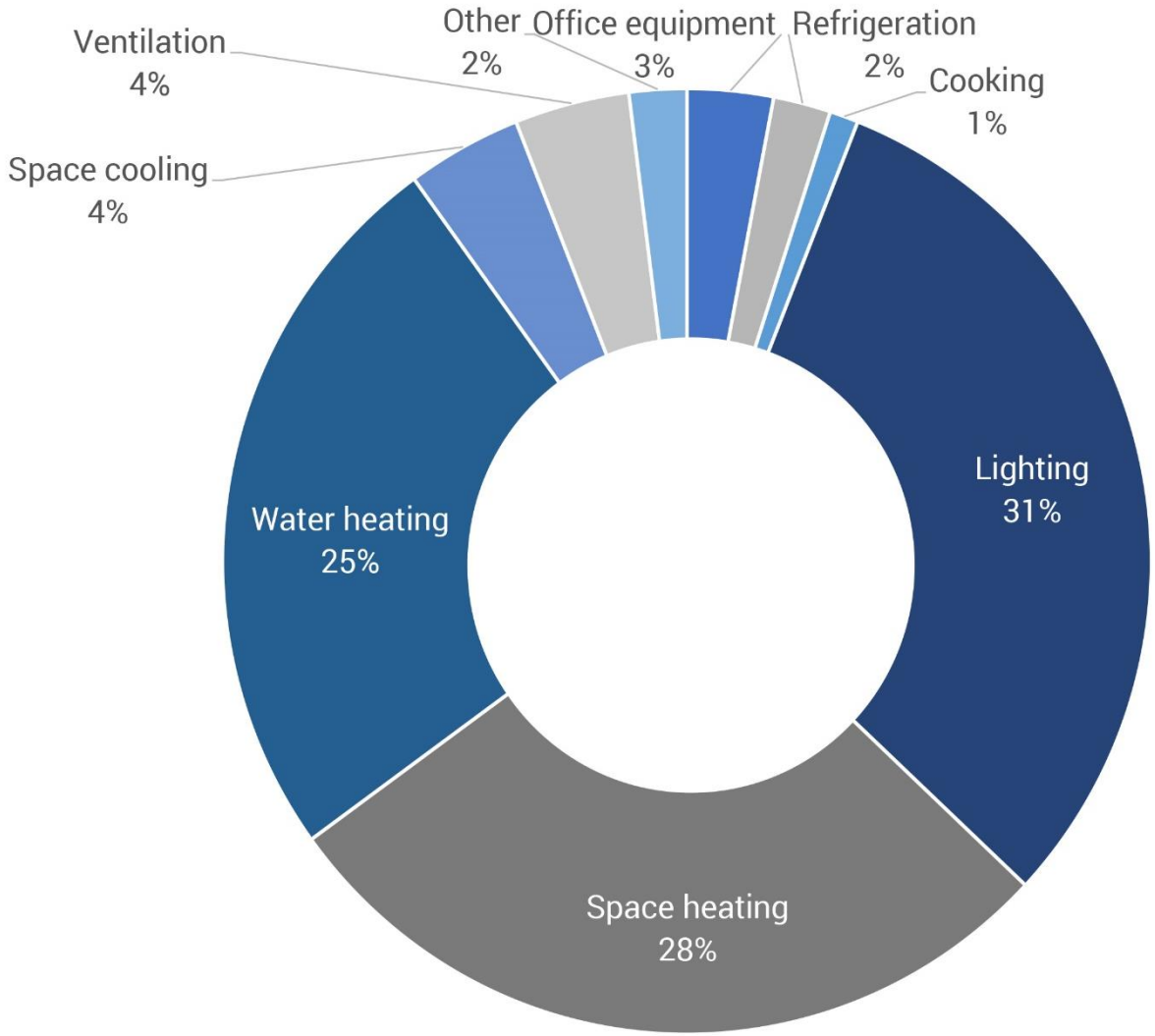
campus **energy**

energy by end use



Building vs Campus
Net Zero Energy Challenge #3

Applying the right strategies at the right scale to achieve ZNE

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design for **net zero**

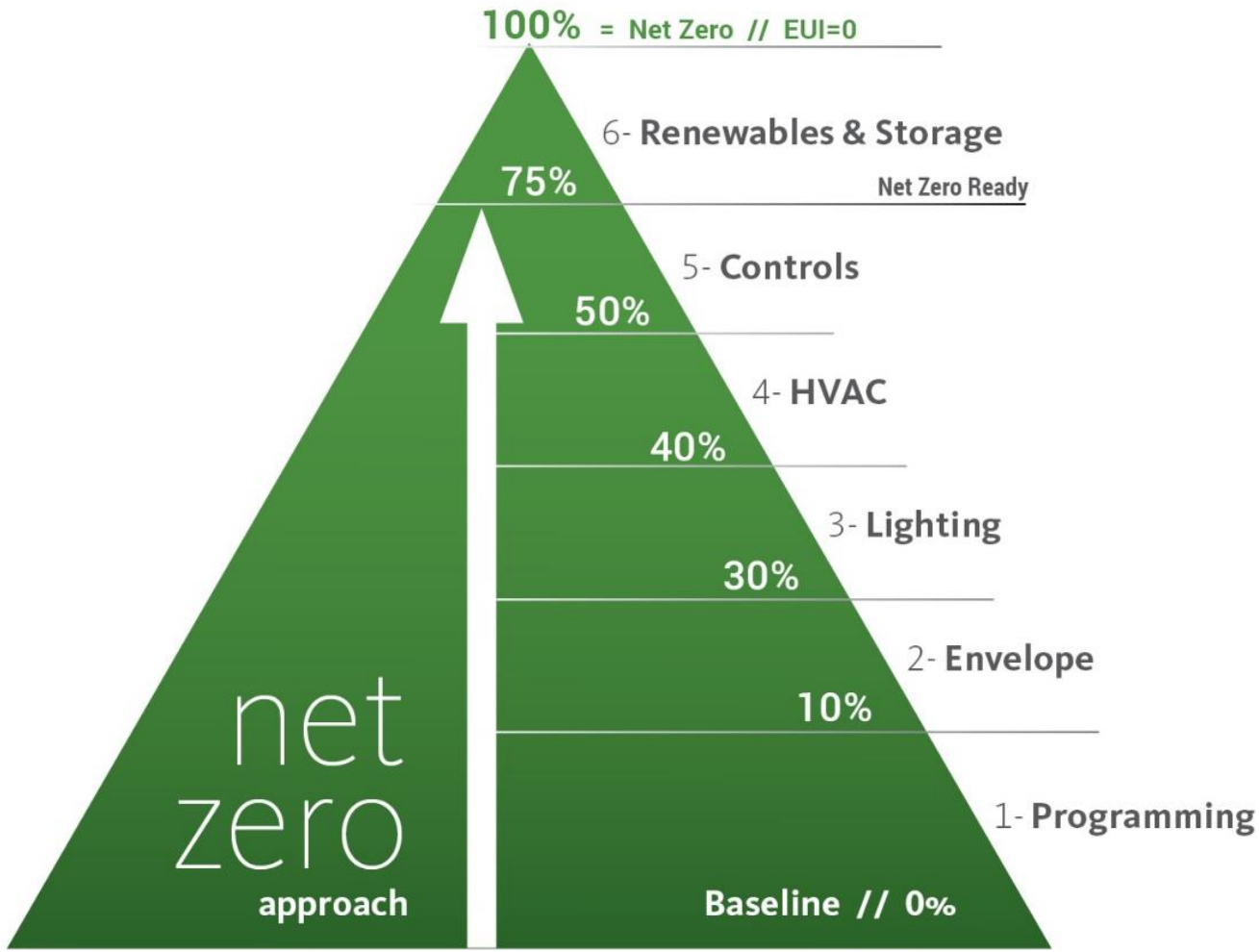
net zero approach

When considering strategies:

- Life cycle costs including maintenance
- Procurement of fuel

Opportunity with a Campus

- Several strategies are practical, efficient and cost effective at a campus level



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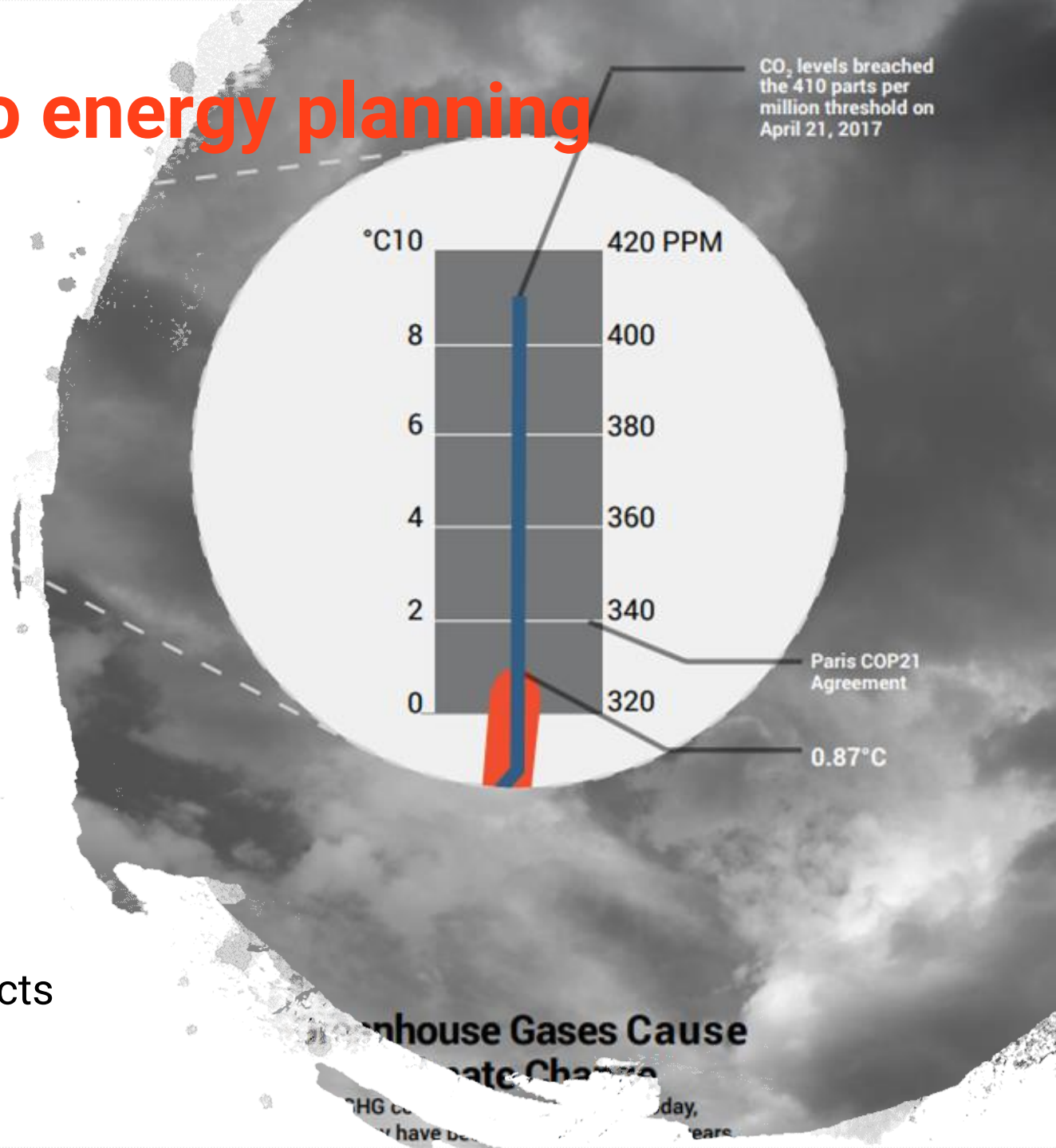
steps in **net zero energy planning**

- **Step 1: Vision**
  - Identify drivers and set goals with timelines
  - Convert goals into measurable KPIs (Key Performance Indicators)

- **Step 2: Macro-scale Plan**
- Implementable plan that identifies
    - Strategies to achieve set goals.
    - Projects that includes Strategies with acceptable ROI.
    - Timelines with funding opportunities.

- **Step 3: Micro-scale Initiatives**
- Measurable and verifiable implementation projects
    - At campus level
    - At building level



case **studies**

West-MEC

West-MEC SW Campus

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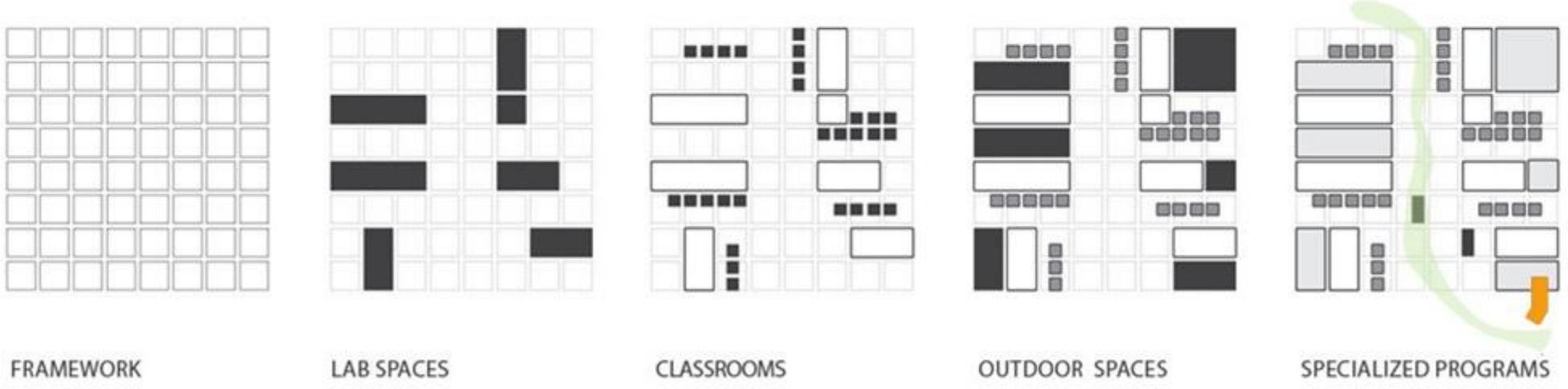
West-MEC

master plan

The new Western Maricopa Education Center (West-MEC) Southwest Campus is a first-of-its-kind innovative partnership between a public utility; Arizona Public Service, a community college; Estrella Mountain Community College and a joint technical education high school district; West-MEC. The primary goal of this triumvirate of industry, higher education and secondary education is to encourage and provide a career pathway into the energy industry and augment an aging workforce. The West-MEC Southwest Campus is a unique Career and Technical Education campus with a specialized focus on sustainable energy; ranging from solar, water conservation, to geothermal strategies to minimize dependence on the nation's 'Energy Grid'

The 'National Energy Grid' is the inspiration for the campus physical plan and is symbolic of a didactic educational curriculum; the photovoltaic canopy becomes a tool to teach students about renewable energy systems.



West-MEC

context

West-MEC

master plan

the BIG idea

... what if an education campus not only taught about the energy industry, but incorporated energy related concepts into every aspect of the curriculum and environment?

... what if it created the first off-the-grid high school building in the nation as a teaching tool?

... what if it harvested the power of the sun while providing protective shade to the inhabitants below?

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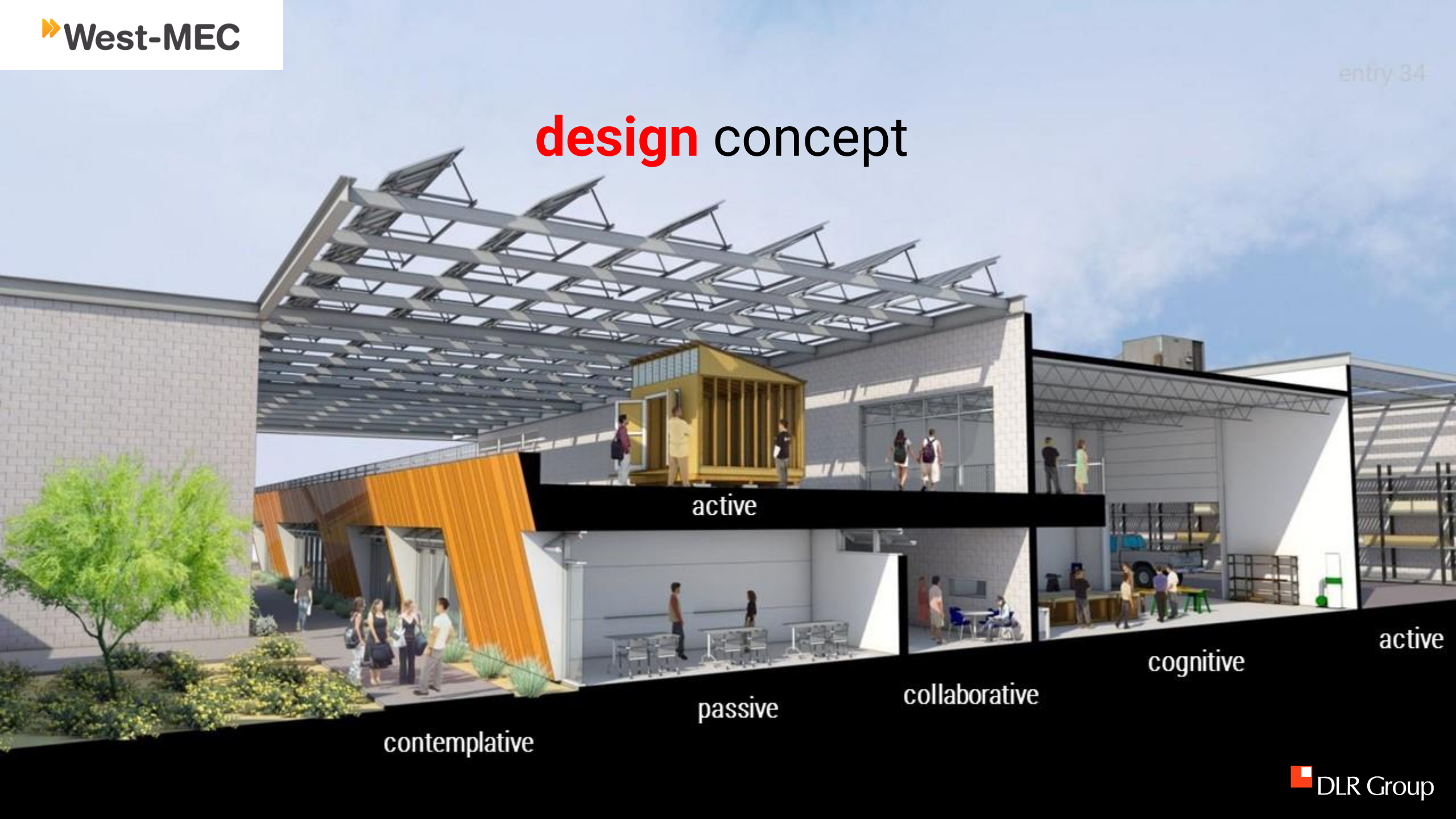
design concept



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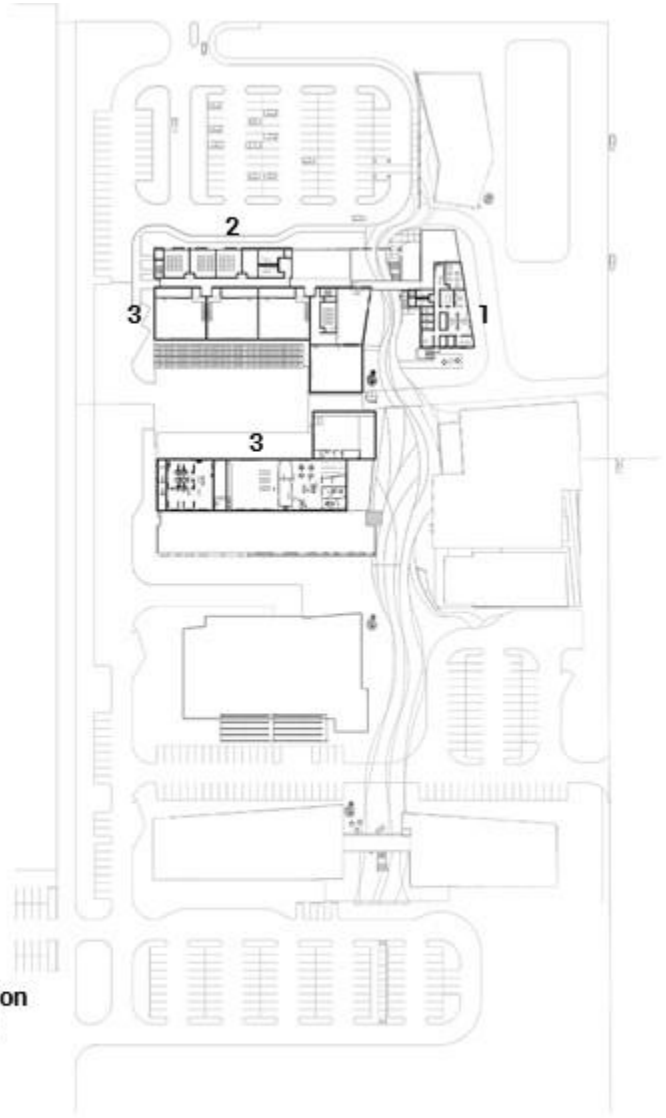
master plan

SITE PLAN

FIRST LEVEL



1. Administration
2. Classrooms
3. High-Bay
4. Courtyard

SECOND LEVEL

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design concept to reality

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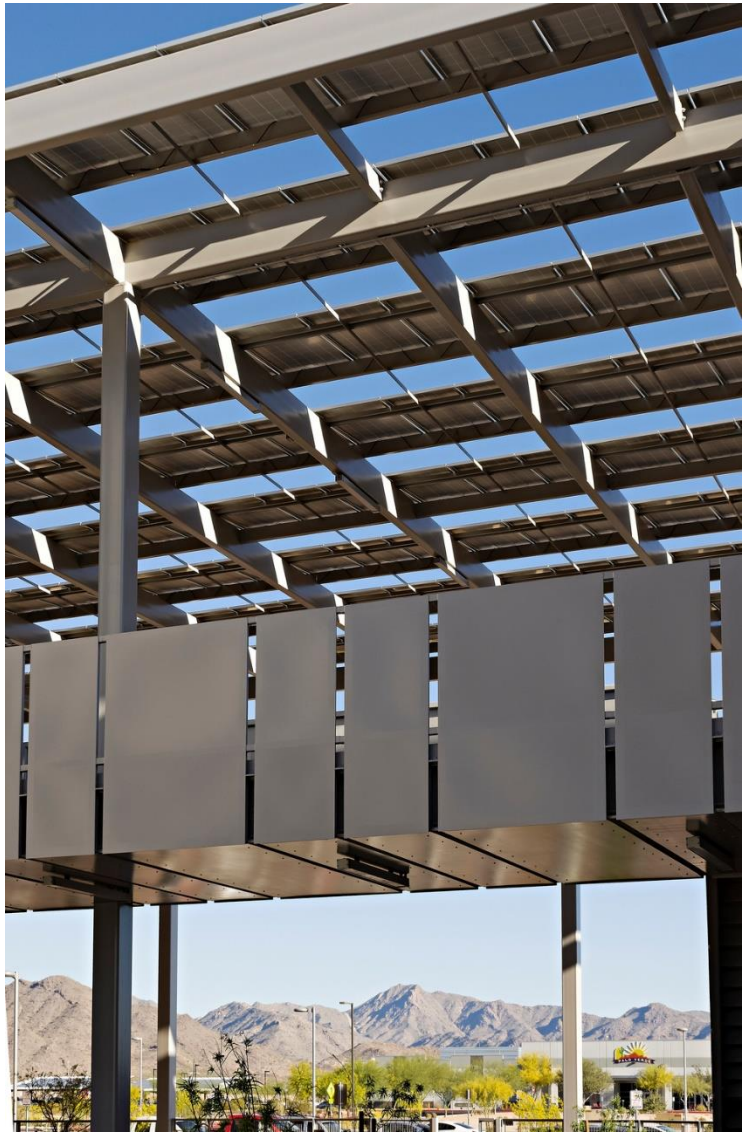
active learning



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cognitive learning

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collaborative learning

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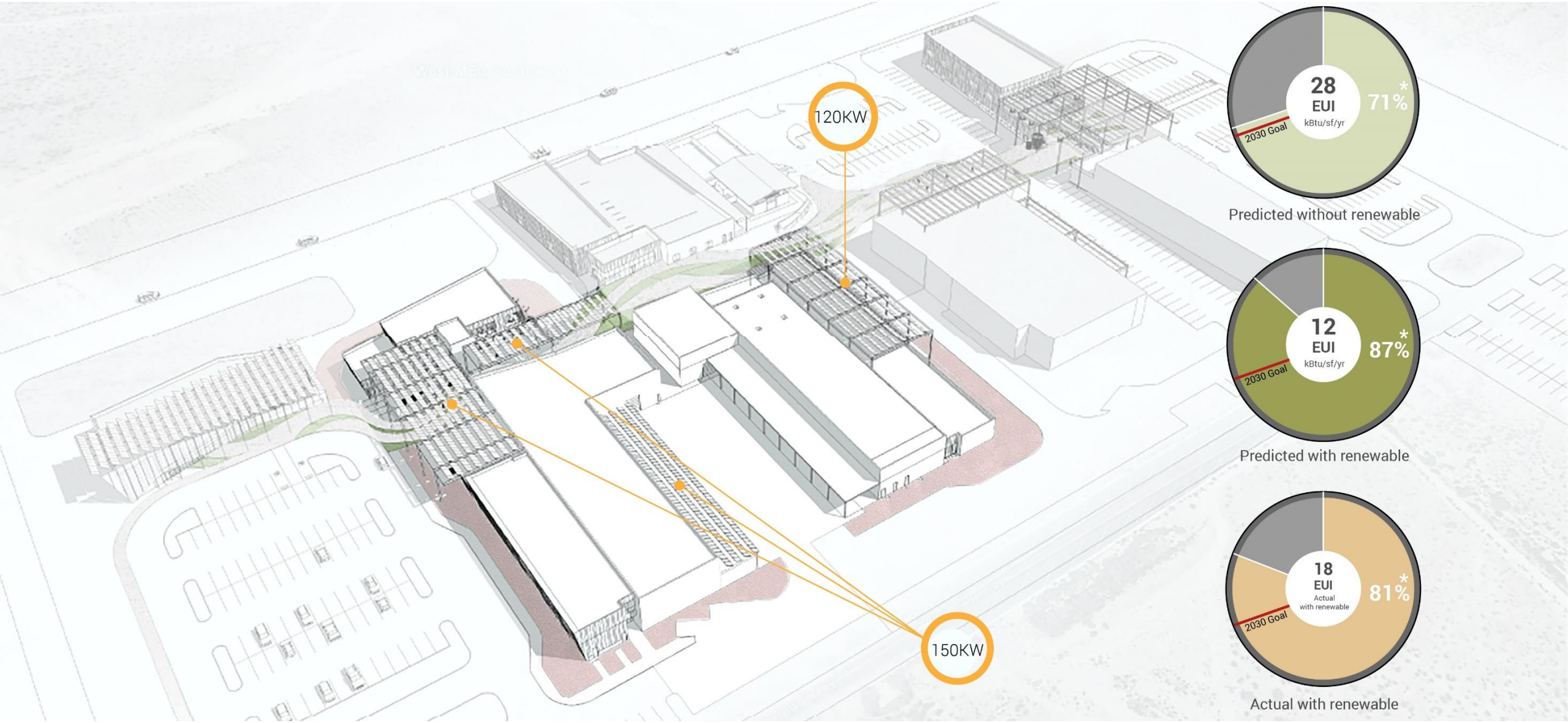
net-zero design



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net-positive design

West-MEC

lessons learned

Creating a ‘microgrid’ – **scale down**

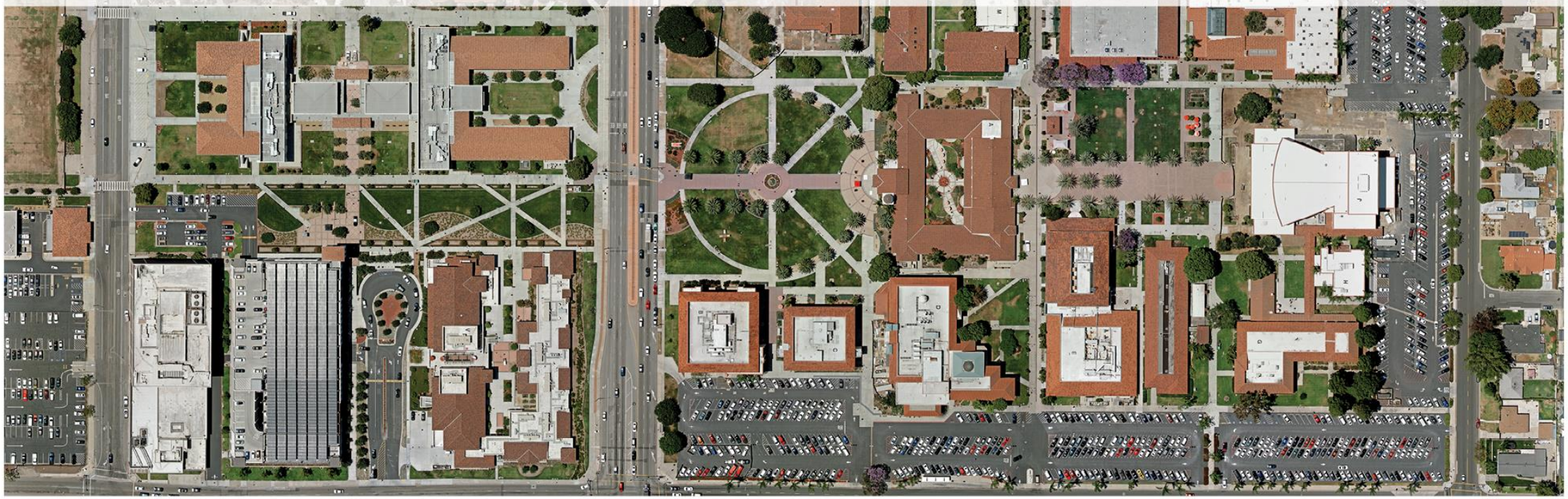
- **Establish the electrical load** and its upstream electrical utility impact
- **Recognize** the infrastructure limitations - medium voltage service in lieu of a series of 3000 Amp services as determined by utility company
- Solar technology **advancements are advantageous**

Building Usage Changes – good to do post-occupancy reviews to adjust master planning for future phases
We were able to balance the additional need in energy through a much more aggressive passive design and optimized solar design.

If micro-grid is the vision, explore a variety of strategies:
- Diversity in usage between buildings
- Ownership of individual buildings over the period of development if it is not under one management
- Development agreements to include load shedding, connected utilities and utility purchase and sale costs
- Energy recovery between various building usages
- Maintenance agreements on centralized energy sources

INTEGRATED ENERGY MASTER PLAN

LONG BEACH COMMUNITY COLLEGE DISTRICT | JUNE 2018



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Architecture Engineering Planning Interiors

P2S ENG

LBCC – Integrated Energy Master Plan

LONG BEACH CITY COLLEGE

	District	LAC	PCC
No. of Buildings	48	30	18
Gross SF of Buildings	1,581,982	1,293,419	288,563
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	/	/

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driving factors

- Develop an integrated energy master plan (IEMP) to primarily meet the requirements of Executive Order (EO) B-18-12.
- Align the IEMP with other energy policies such as EO B-30-15, EO S-3-05, AB 32 etc.
- Good stewards of public funds with environmentally conscious projects.
- Energy codes getting more stringent – driving toward zero net energy.
- Student population expecting stewardship.
- Include recommendations for larger sustainability goals as part of the IEMP as an additional scope.

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AMERICAN COLLEGE & UNIVERSITY PRESIDENTS CLIMATE COMMITMENT

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IEMP **goals**

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→ 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

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key metrics + **timelines**

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2014
CCC Renewables

2017
Today

2018
EO B-18-12 Grid-based Energy
2003 Baseline
20% Reduction

2020
EO B-18-12 GHG
2010 Baseline
20% Reduction

2020
EO B-18-12 ZNE
2010 Baseline
50% of NEW SF

2020
EO B-18-12 Water Use
2010 Baseline
20% Reduction

2025
EO B-18-12 ZNE
2010 Baseline
50% of EXISTING SF

2025
EO B-18-12 ZNE
2010 Baseline
100% of NEW SF

2030
EO B-30-15 GHG
1990 Baseline
40% Reduction

2041
LBCC FMP

2050
EO B-30-15 GHG
1990 Baseline
80% Reduction

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scope and **schedule**

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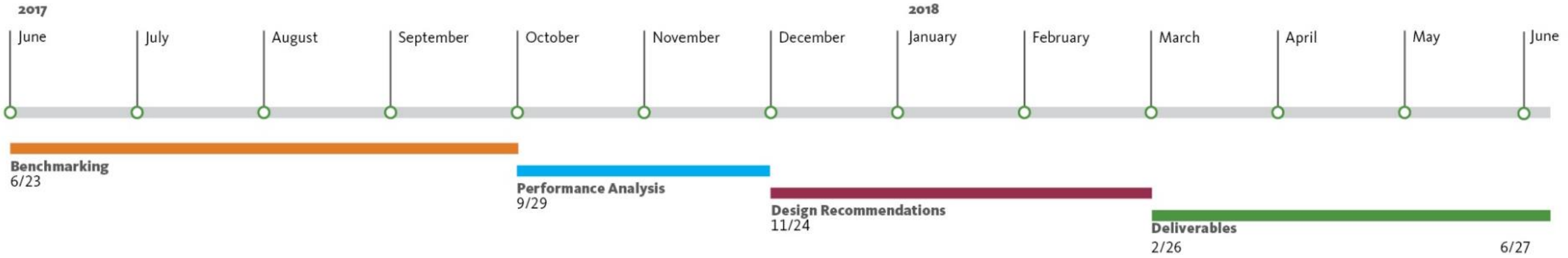

PLANNING PROCESS

Benchmark	Analyze	Design
DATA GATHERING + BENCHMARKING	PERFORMANCE ANALYSIS + TARGET SETTING	DEVELOPING DESIGN RECOMMENDATIONS

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design **recommendations**

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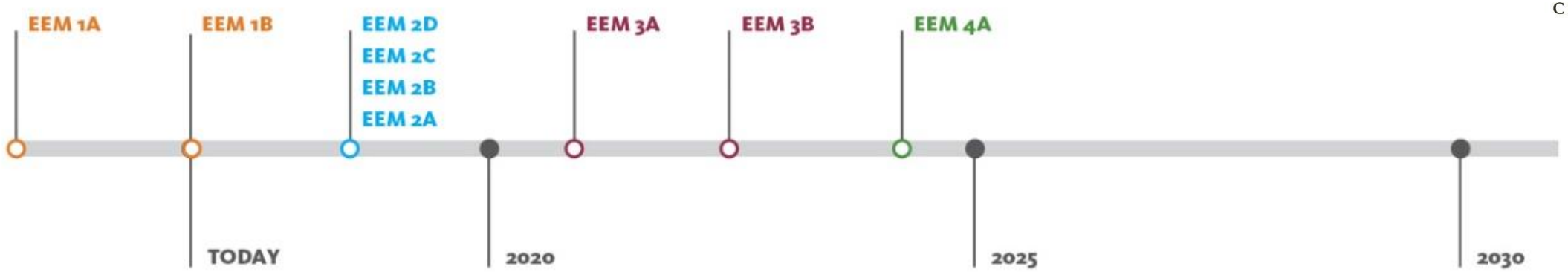

EEM 1 A

- Measures taken in the past.
- Measure E 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.

setting **targets**

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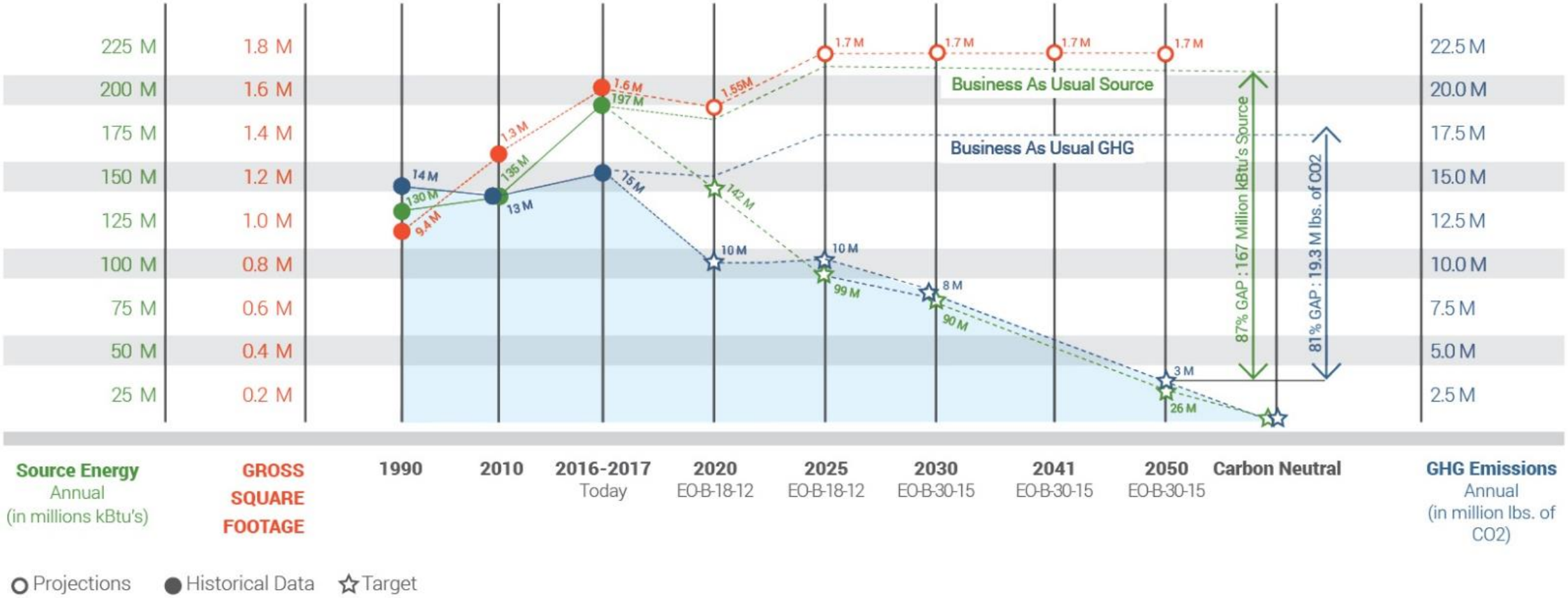

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anticipated **results**

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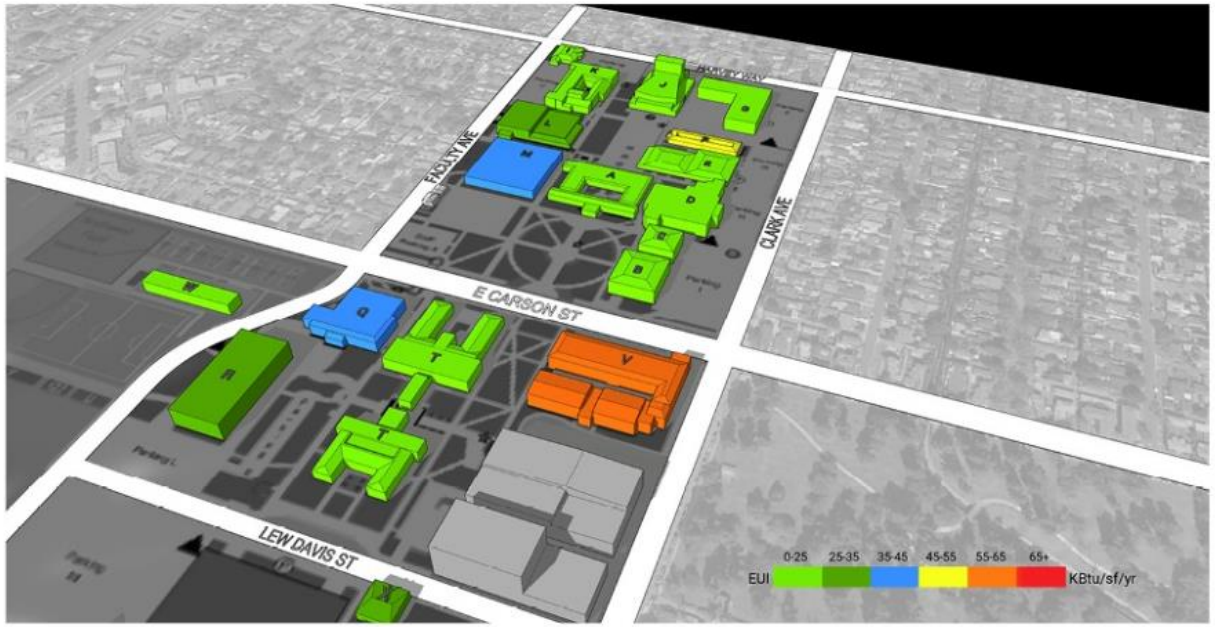
BEFORE:
Energy Use Intensity Graph for LAC

AFTER:
Energy Use Intensity Graph for LAC



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anticipated **results**

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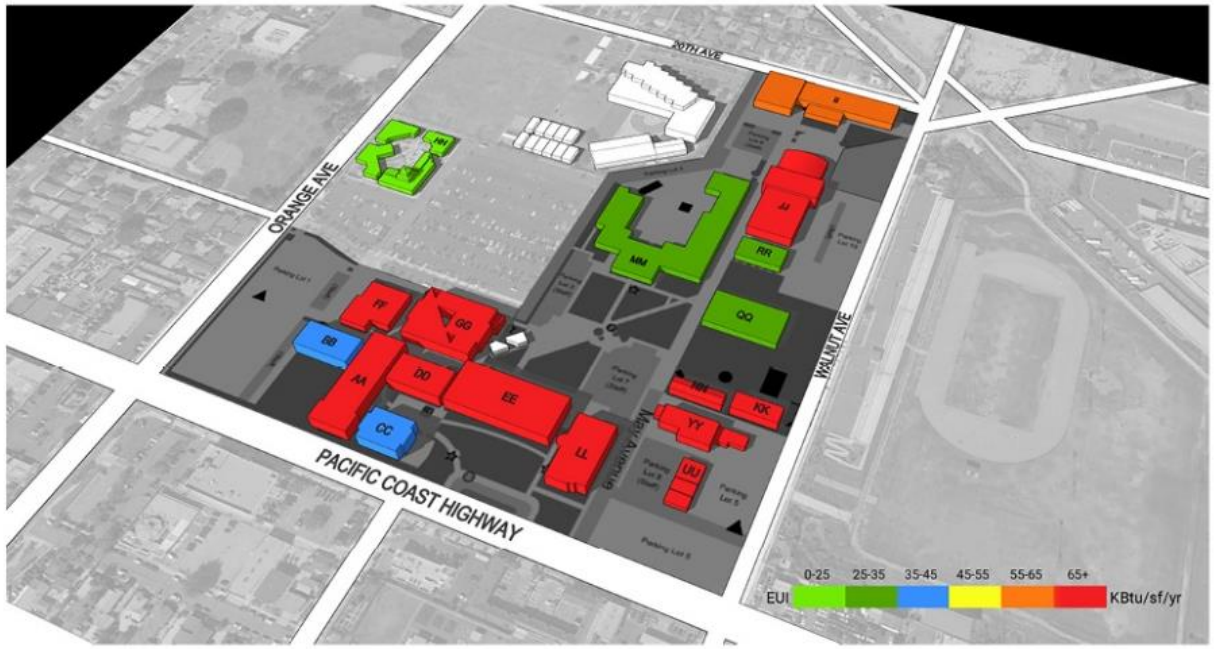
BEFORE:
Energy Use Intensity Graph for PCC



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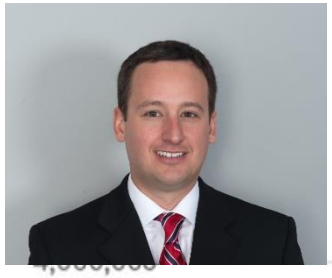

general fund **savings**

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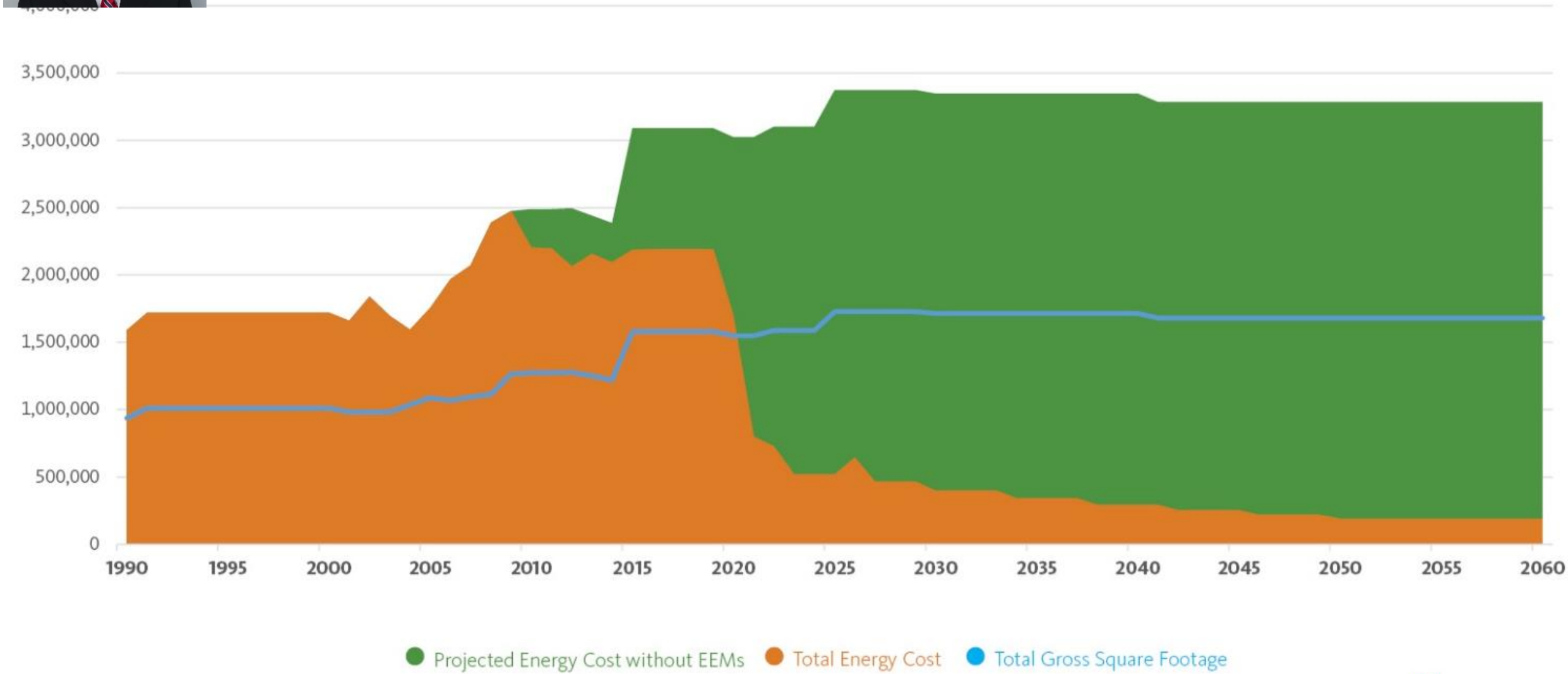

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general fund **savings**

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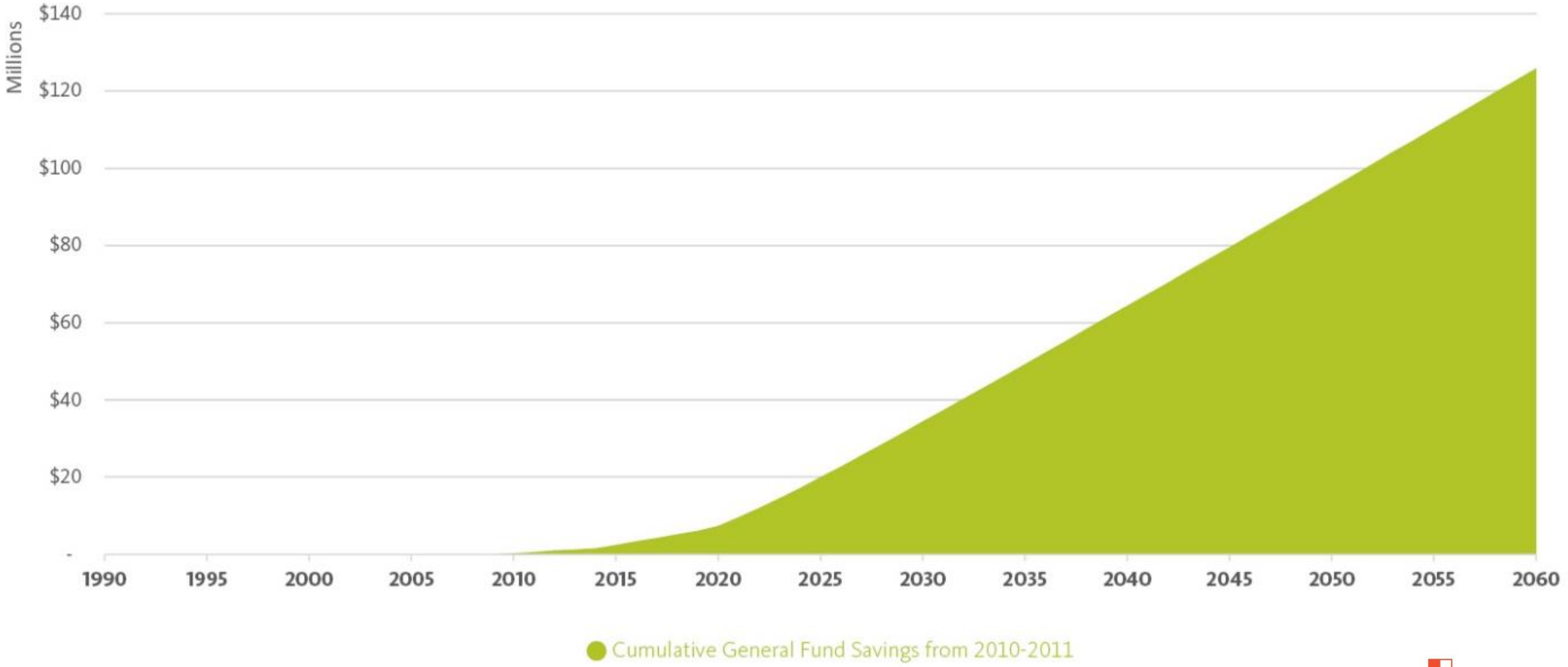

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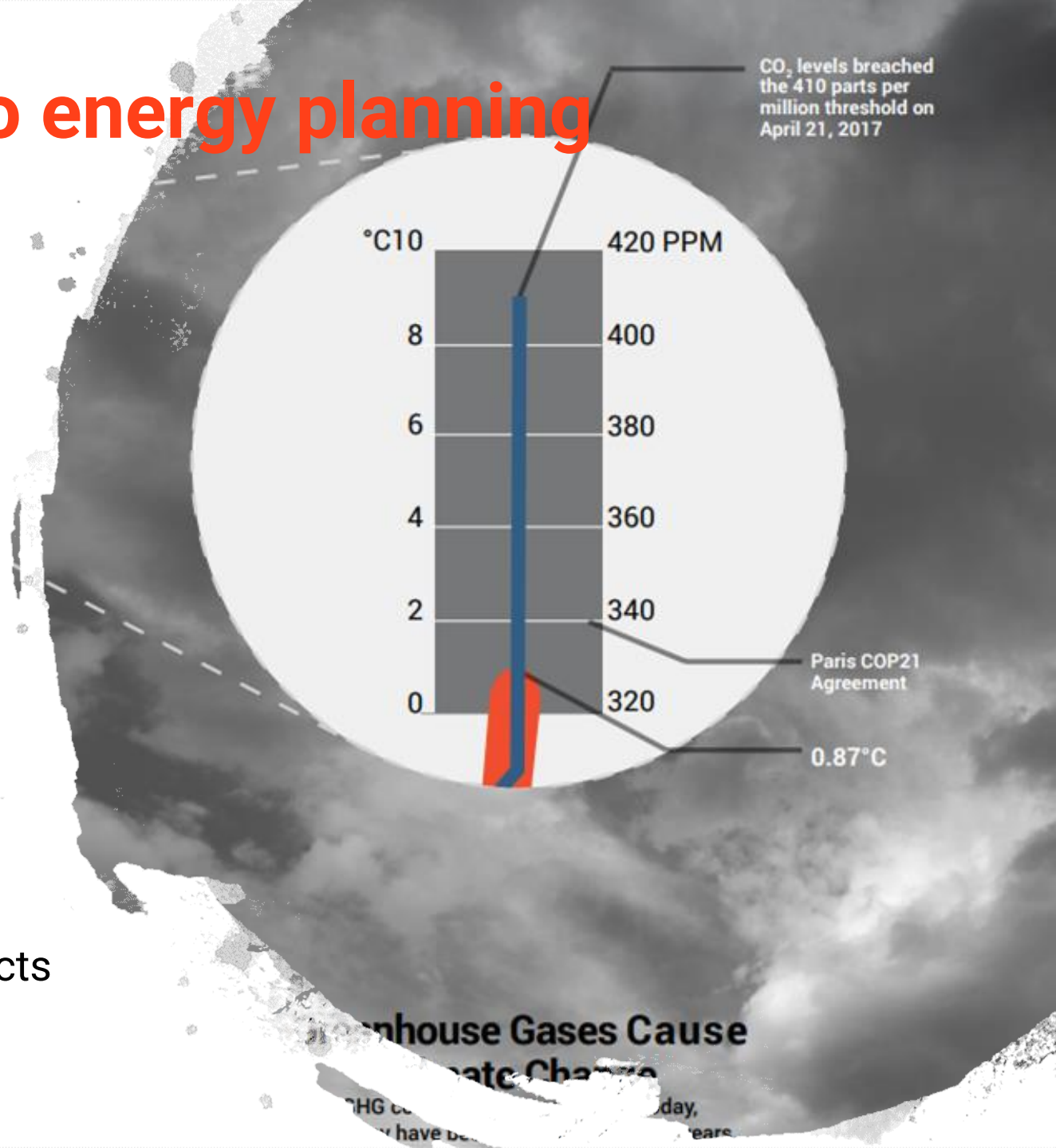

QUESTIONS & ANSWERS

- Does your entire stakeholder team understand the “Language of Net-Zero?”
- Where are you in the process of achieving entity wide net-zero energy?
- What are your primary challenges with accomplishing the goals?