New Construction Done Right:
Strategies to Improve Efficiency in Buildings

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Frick Environmental Center | Pittsburgh, PA *Photo: Ed Massey*

Today's panel:

Alexi Miller
Associate Technical Director
New Buildings Institute

Jeff Glover
Program Outreach Lead
Willdan

Susan Freed
Project Manager, Energy and Sustainability Division
County of San Diego

Pauline Souza
Partner & Director of Sustainability
WRNS STUDIO

David Kaneda
Principal & Thought Leader
IDeAs Consulting

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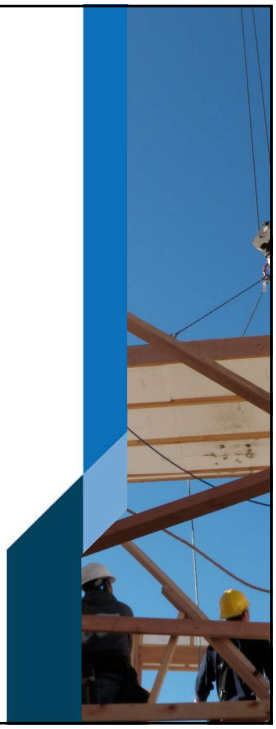
Agenda

- Introductions
- CEDA Introduction
- Key Energy Efficiency Measures
- Case Studies
- CEDA Program Overview
- Q&A



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Learning Objectives

- Understand core program structure and eligibility requirements
- Become familiar with major opportunity areas for savings beyond CA code and current practices
- See how some real project teams have tapped into similar programs over the years and learn from their experience
- Position yourself to take advantage of CEDA!

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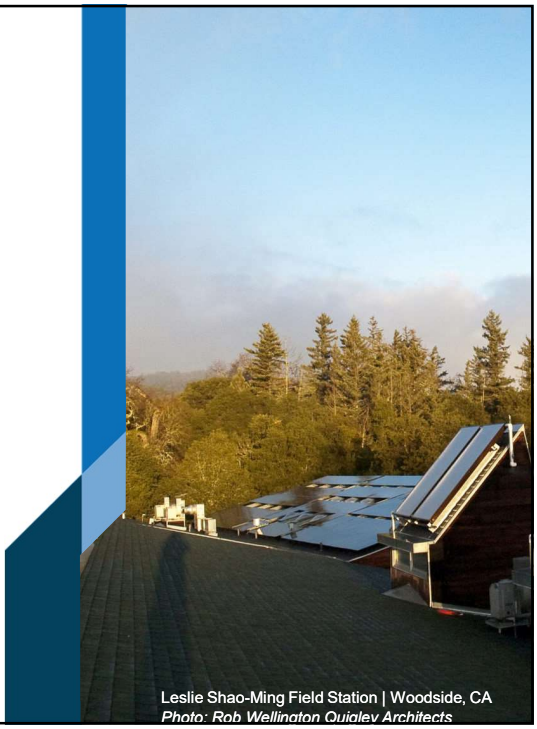
Polling Question #1

- What is your typical project role?
  - Owner
  - Architect/Engineer
  - Energy Consultant
  - Utility
  - Other



Leslie Shao-Ming Field Station | Woodside, CA
Photo: Rob Wellington Quigley Architects

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California Energy Design Assistance (CEDA) Program Introduction

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What is CEDA?

California Energy Design Assistance (CEDA) provides a **free analysis** of different energy efficiency options and **lays out their potential energy savings**, then provides **incentives** based on energy savings in **new construction or major alteration** projects.

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What Building Projects Can Tap Into CEDA?

- Publicly owned
- Commercial
- High-rise Multifamily
- Industrial
- Agricultural Projects
- PG&E, SCE, SoCalGas, or SDG&E customers*

*Most rate structures eligible

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Why Participate in CEDA?

- Receive complimentary custom **energy modeling**
- Get help identifying and evaluating **energy-saving opportunities**
- Gain analysis of **energy costs and paybacks**
- Receive **financial incentives** to help offset the costs of energy saving measures for qualified projects

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Key Energy Efficiency Measures

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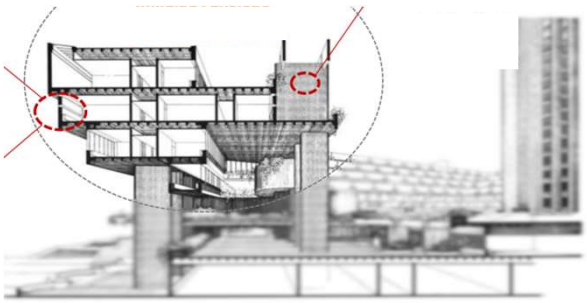
Building Envelope

- Limit thermal bridging
- Air sealing
- Insulation
  - Cavity
  - Continuous
- Fenestration
  - Windows
  - Doors
- Orientation & Shading



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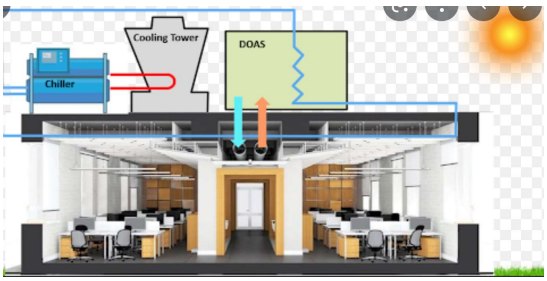
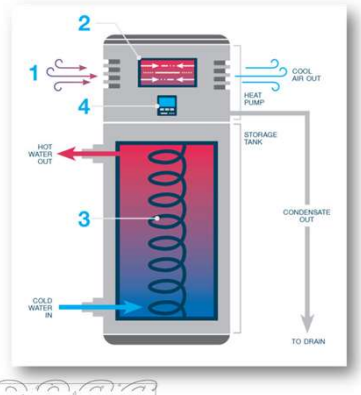
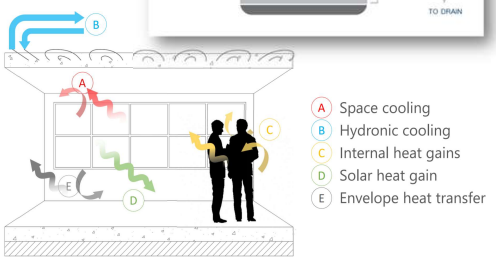
Heating and Cooling Equipment

- Radiant Heating/Cooling, esp. with Dedicated Outside Air System (DOAS)
- Air/Ground Source Heat Pumps
- Heat Pump Water Heaters







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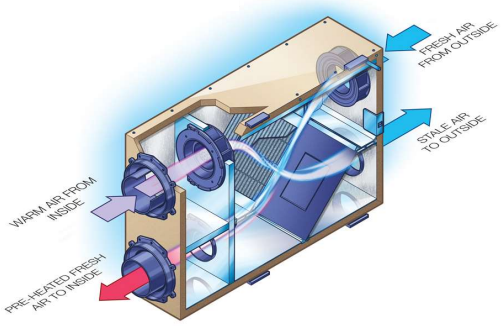
Energy Recovery & Thermal Energy Storage

- Heat Recovery Ventilators
- Heat Recovery Chillers
- Thermal Energy Storage



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The hot water tank at Stanford University, part of the campus central plant's thermal energy storage system; credit Matthew Anderson

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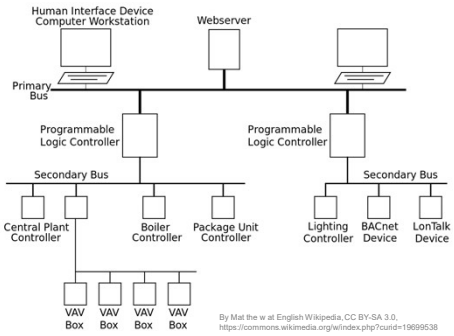
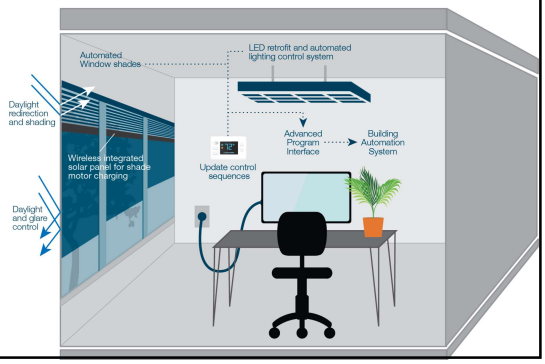
Controls

- Integration: HVAC, Lighting, Other
- Smart Grid Connectivity (OpenADR2.0b), Rates, Programs
- Individualized controls
  - Luminaire Level Lighting Control
  - Zonal HVAC



By Mat the w at English Wikipedia, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=19699538



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Polling Question #2

- Which of these technologies/ strategies do you expect to optimize in an upcoming project?
  - Envelope
  - HVAC & WH Equipment
  - Energy Recovery
  - Thermal Energy Storage
  - Controls

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Case Study 1: County of San Diego

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County of San Diego

- **Committed to energy efficient design**
  - Zero Net Energy and all-electric since 2014
  - LEED Gold since 2016
  - Savings by Design since 2010

Incentive Program provided:
- Subject matter expertise
- Design overview
- Financial incentives

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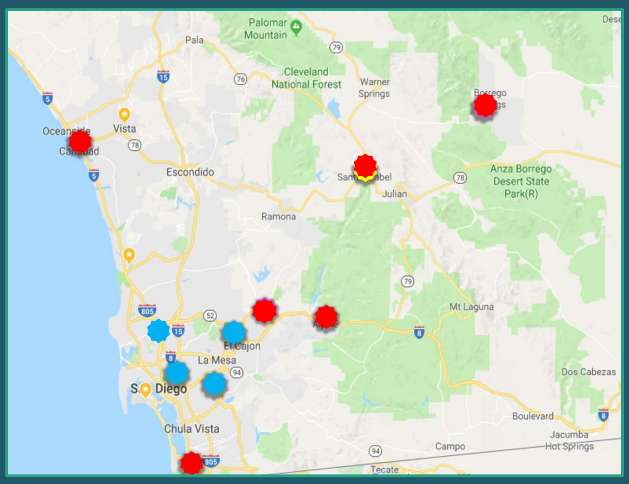
ZNE Inventory

- **20% better than code**
  - Deep energy efficiency
  - "Automatic" LEED Gold
  - Lower cost PV
- **Reduced carbon emissions**



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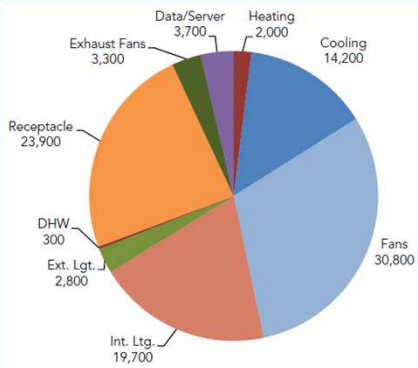
EE Essentials

- **Start with energy model**
  - Estimate end uses
  - Discover energy reduction opportunities



End-Use	Estimated Annual Use	% of Total Use
Heating	2,000	2%
Cooling	14,200	14%
Fans	30,800	31%
Pumps	0	0%
Int. Ltg	19,700	20%
Ext. Ltg	2,800	3%
DHW	300	0%
Receptacle	23,900	24%
Exhaust Fans	3,300	2%
Data/Server	3,700	4%
Total Annual	**100,700**	**100%**
PV	**-108,515**	**-108%**

Design and build for 50 years of operational savings

Source: Energy model by stok

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EE Essentials

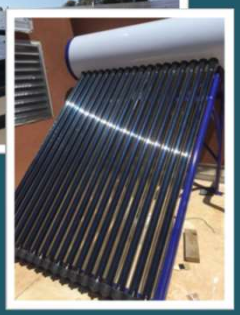
- **Use advanced technologies**

LED lighting

Daylight harvesting

VRF HVAC

Solar PV



Solar thermal

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Why use CEDA?

- **Benefits of incentive program**
  - Design assistance
    - OJT for inexperienced AE consultants
  - Energy modeling
    - As mentioned – essential for 50 year lifetime
  - Engineering evaluations keep with project schedule
  - Array of energy models for whole building assessment
    - Align with AE tools

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Case Study 2: Atherton Civic Center

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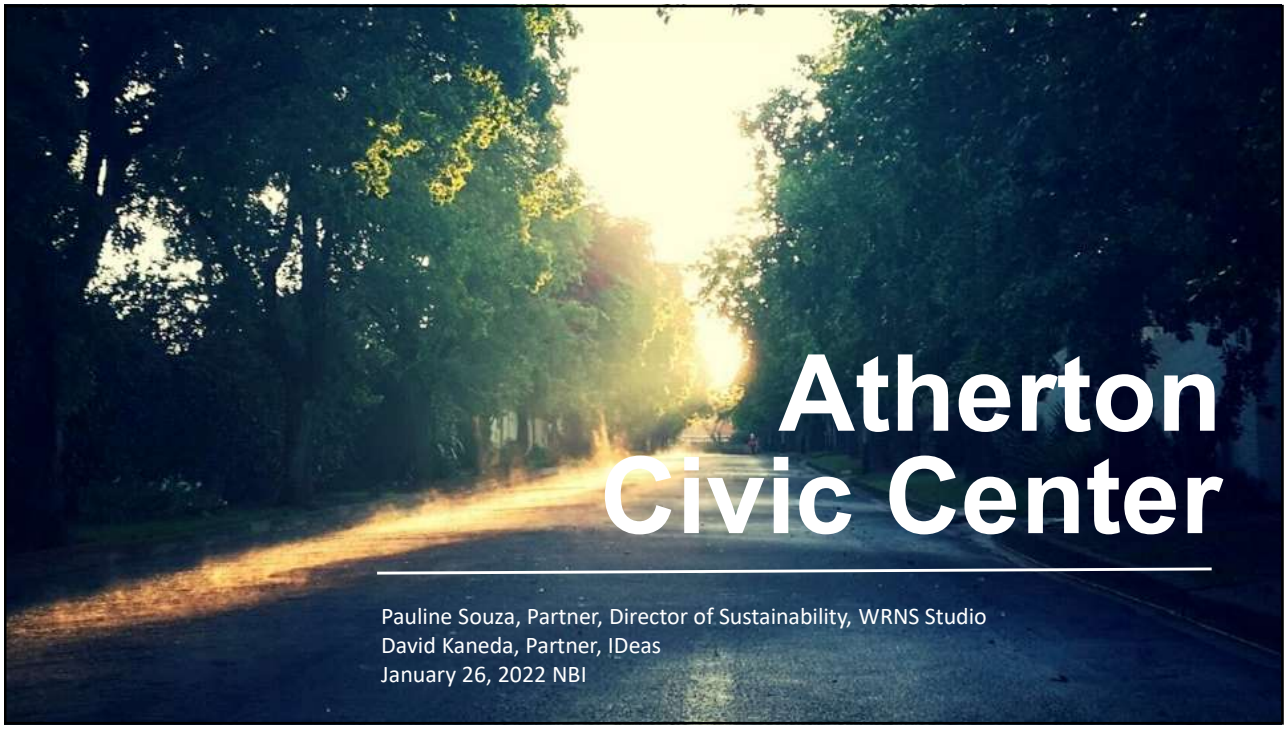

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How do you do this ? – Sustainable Design at neutral cost impact

CLIENT	TEAM SELECTION IS CRITICAL
	SET GOALS tied TO THE MISSION AT THE BEGINNING
ARCHITECT	START WITH HOW YOU CAN DO BETTER THAN (code, standards, baseline)
	INVOLVE THE ENTIRE DESIGN TEAM
	USE PASSIVE STRATEGIES
	KNOW THAT EVERY BUDGET CAN INCLUDE SUSTAINABLE OPTIONS
ENGINEER	ASK QUESTIONS, LISTEN FOR DETAILS, CONSIDER THE BIG PICTURE
	ITERATIVE PROCESS
ALL	MEETING THE GOALS TAKES TENACITY AND CREATIVITY

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Atherton Civic Center
A community center that showcases the most innovative technologies and environmentally responsible strategies
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To the client: translate and stay the course
Atherton Civic Center mission:
A community center that showcases the most innovative technologies and environmentally responsible strategies
All electric
Highly efficient and comfortable
Net Zero Energy
Microgrid ready
Site water handled on site
Everything to educate the community

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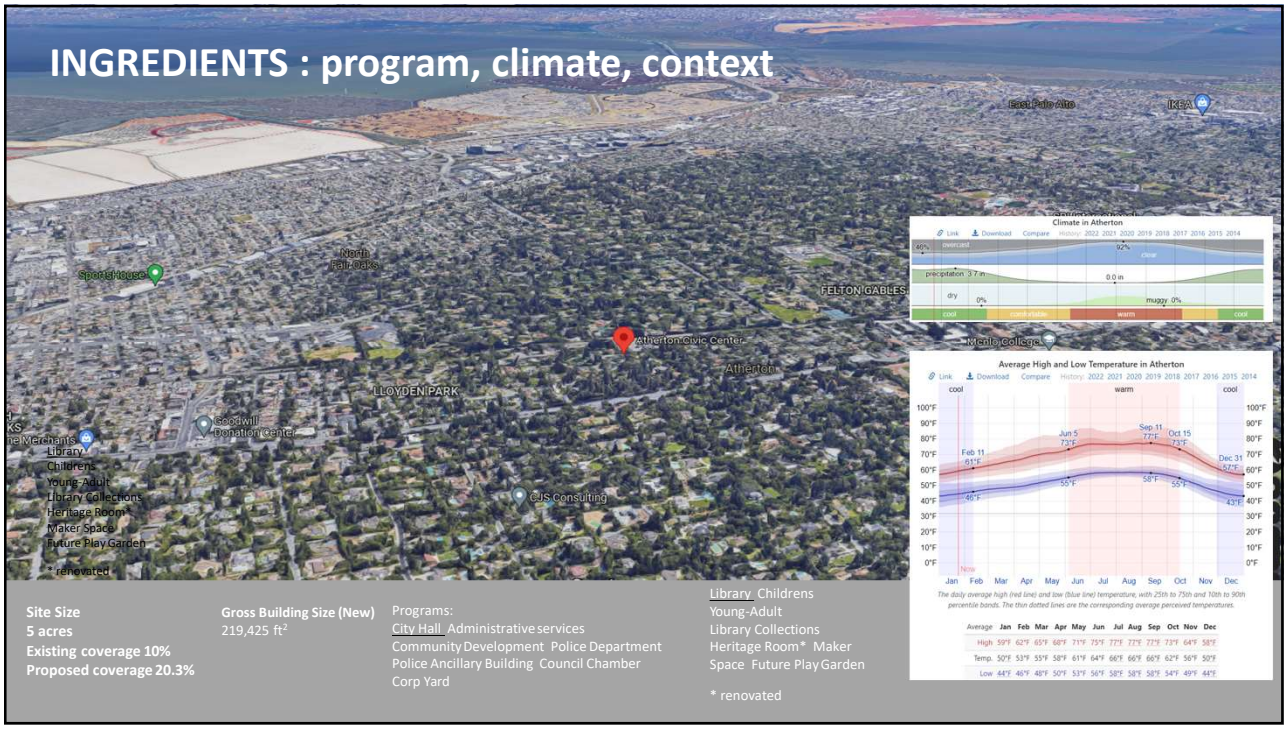
INGREDIENTS : program, climate, context
East Palo Alto
IKEA
North Fair Oaks
Sportshouse
FELTON GABLES
Atherton Civic Center
Atherton
LLOYDEN PARK
Goodwill Donation Center
Library
Childrens
Young-Adult
Library Collections
Heritage Room*
Maker Space
Future Play Garden
* renovated
CJS Consulting
Kepler College
Climate in Atherton
Average High and Low Temperature in Atherton
Site Size
5 acres
Existing coverage 10%
Proposed coverage 20.3%
Gross Building Size (New)
219,425 ft²
Programs:
City Hall Administrative services
Community Development Police Department
Police Ancillary Building Council Chamber
Corp Yard
Library Childrens
Young-Adult
Library Collections
Heritage Room* Maker
Space Future Play Garden
* renovated

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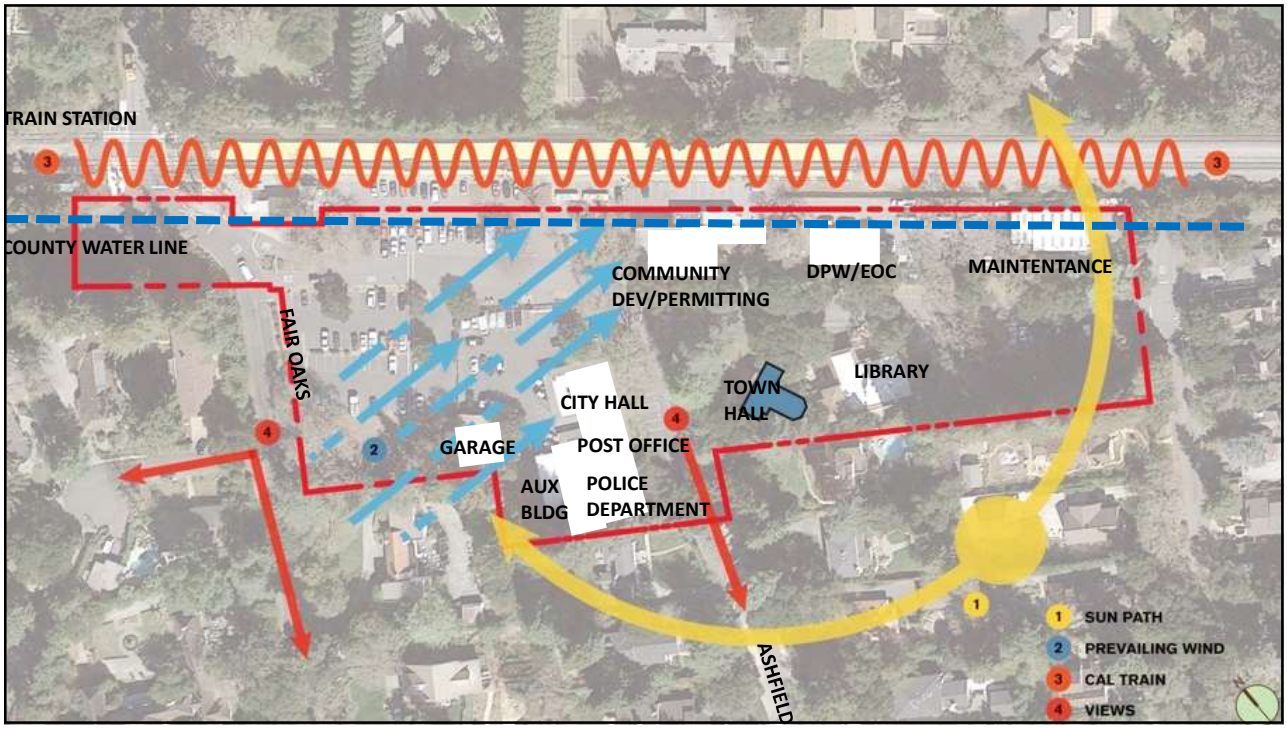
TRAIN STATION
COUNTY WATER LINE
FAIR OAKS
COMMUNITY DEV/PERMITTING
DPW/EOC
MAINTENTANCE
LIBRARY
TOWN HALL
CITY HALL
GARAGE
POST OFFICE
AUX BLDG
POLICE DEPARTMENT
ASHFIELD
1 SUN PATH
2 PREVAILING WIND
3 CAL TRAIN
4 VIEWS

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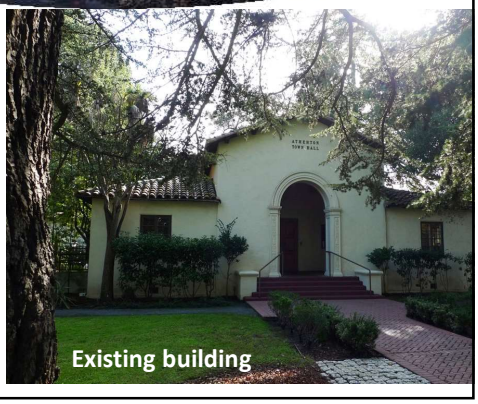

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Design + Construction as a relay race

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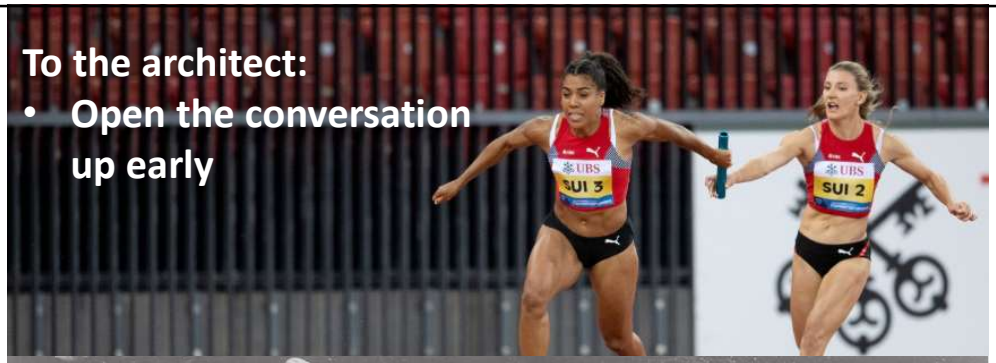
To the architect:

- Open the conversation up early



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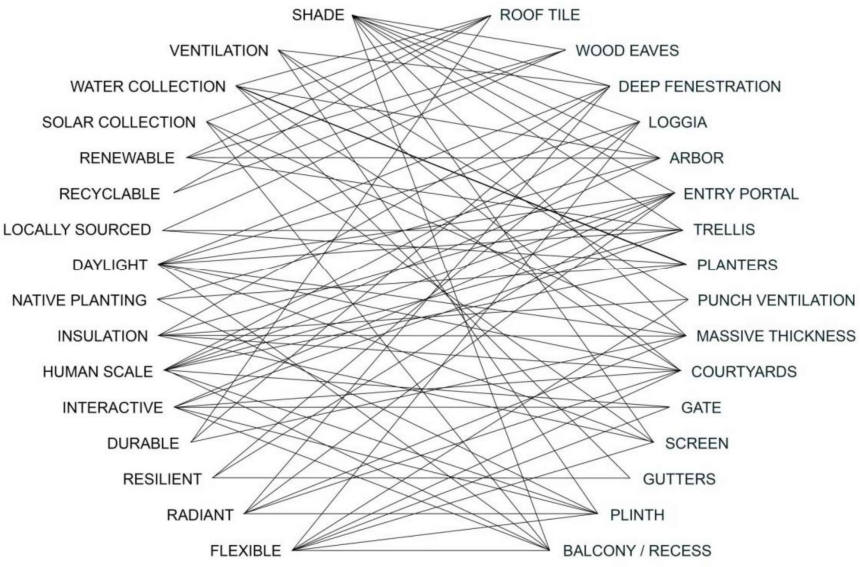

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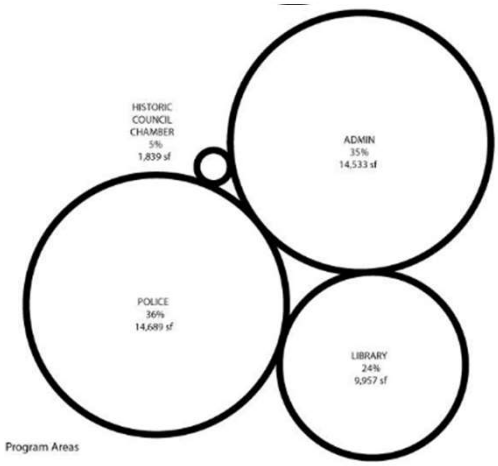
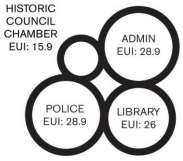
- **Understand your targets EARLY**



BASELINE EUI



PROPOSED EUI

ATHERTON CIVIC CENTER – BASELINE EUI VS PROPOSED EUI

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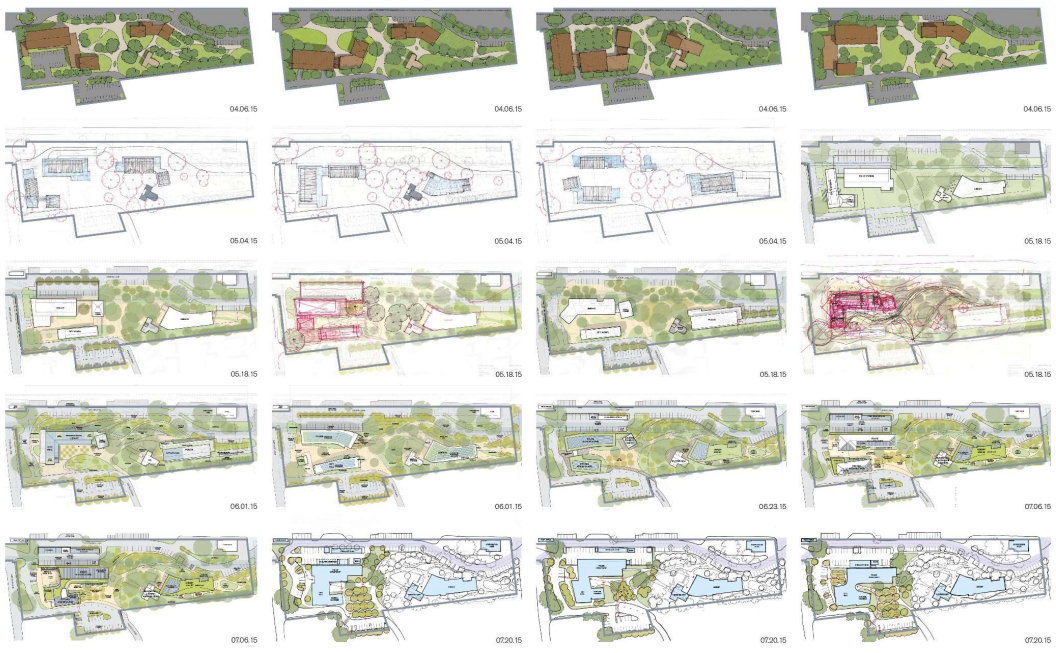

ATHERTON CIVIC CENTER · PROGRAMMING SUMMARY

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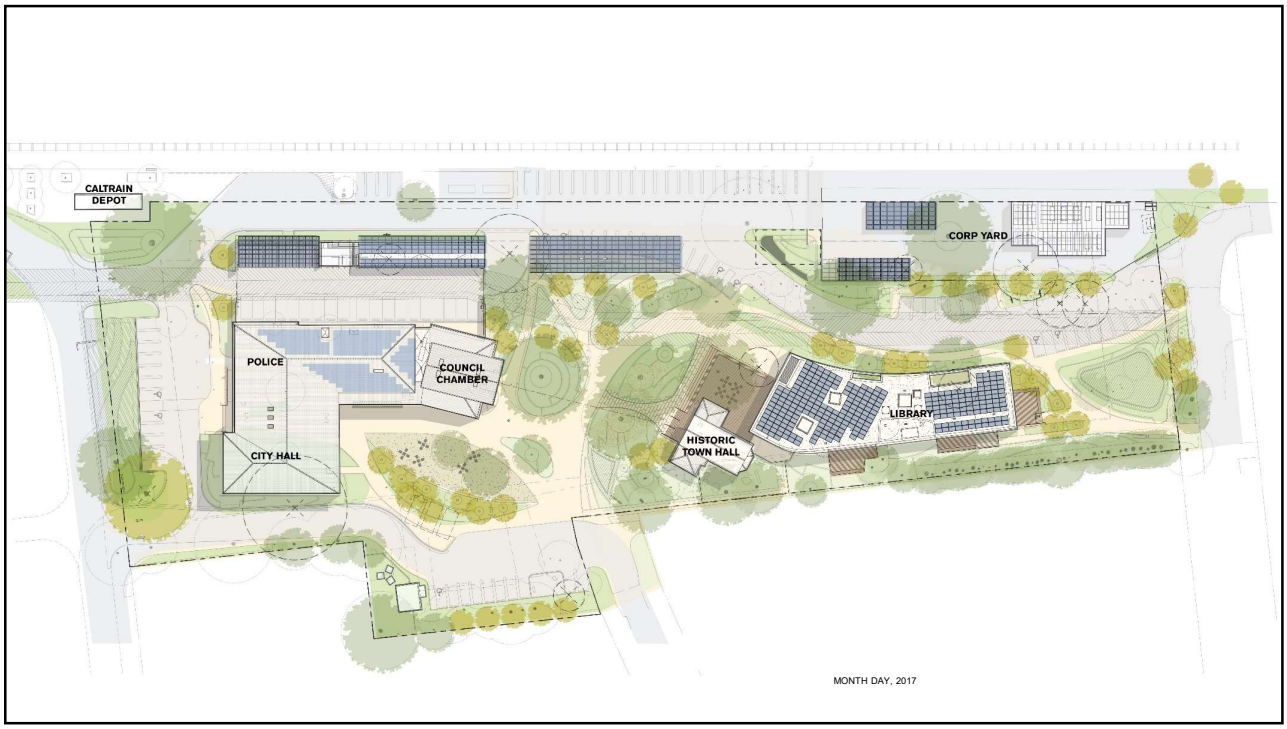
CALTRAIN DEPOT
CORP YARD
POLICE
COUNCIL CHAMBER
CITY HALL
HISTORIC TOWN HALL
LIBRARY
MONTH DAY, 2017

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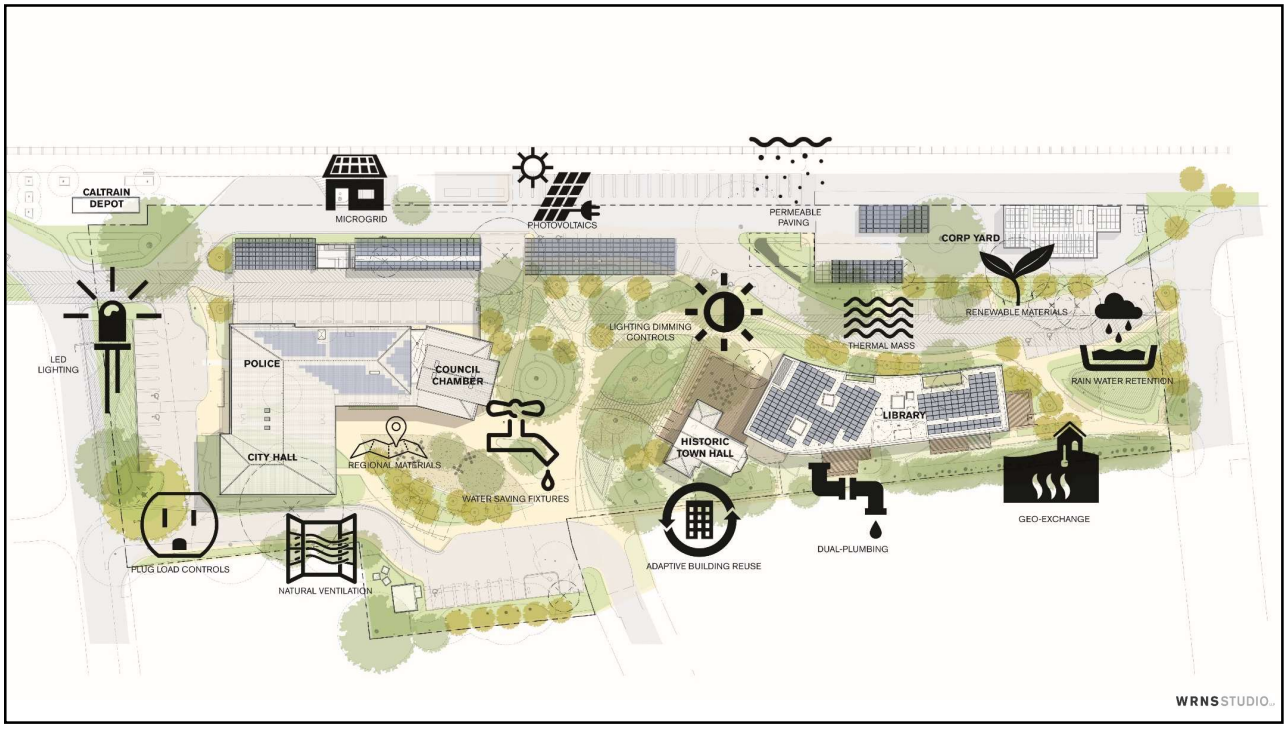
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MICROGRID
PHOTOVOLTAICS
PERMEABLE PAVING
CORP YARD
RENEWABLE MATERIALS
LIGHTING DIMMING CONTROLS
THERMAL MASS
LED LIGHTING
POLICE
COUNCIL CHAMBER
RAIN WATER RETENTION
LIBRARY
CITY HALL
HISTORIC TOWN HALL
REGIONAL MATERIALS
WATER SAVING FIXTURES
GEO-EXCHANGE
DUAL-PLUMBING
ADAPTIVE BUILDING REUSE
PLUG LOAD CONTROLS
NATURAL VENTILATION
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City Hall

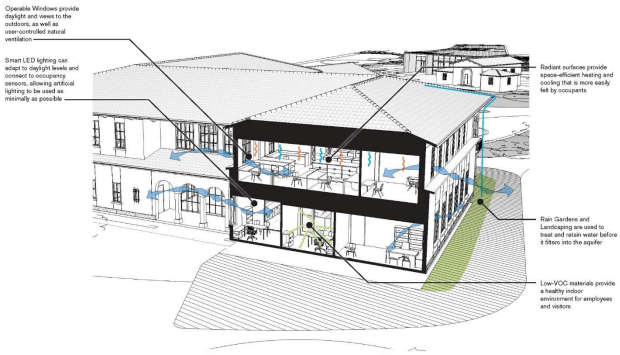

Table 3: EUI Comparison of Model Iterations

	Proposed	Improved Roof	Improved Wall	Improved Roof and Wall	Air Side Heat Recovery
Interior Lighting	5.7	5.7	5.7	5.7	5.7
Cooling	3.2	3.1	3.2	3.1	3.3
Heating	4.5	4.4	4.3	4.3	4.3
Fans	6.9	6.9	6.9	6.9	8.9
Receptacles	5.9	5.9	5.9	5.9	5.9
DHW	0.6	0.6	0.6	0.6	0.6
Heat Rejection	1.0	1.0	1.0	0.9	1.0
Pumps	0.2	0.2	0.2	0.2	0.2
Exterior Lighting	0.9	0.9	0.9	0.9	0.9
Elevators	0.6	0.6	0.6	0.6	0.6
Total	29.3	29.2	29.1	29.0	31.2

- Plaster wall, metal stud, R-19 batt+ rigid insulation; **R 14.1** overall, U 0.071
- Glazing: solarban 72(**SHGC 0.30**, VLT 70%, U 0.083)
- Roof: R-30 insulation, R-**31.25** overall

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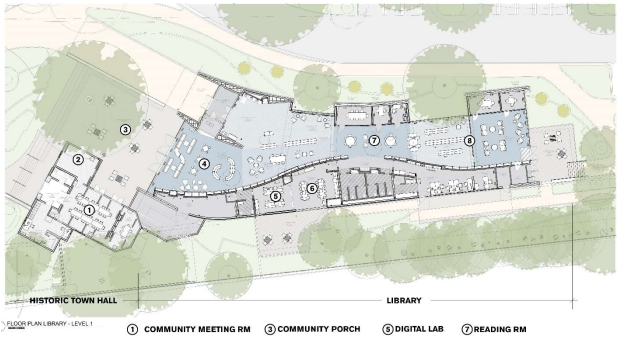
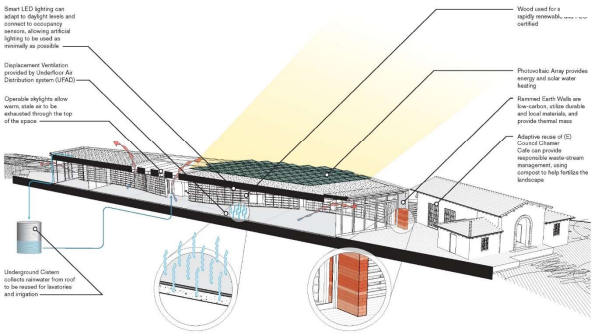
Library

- Plaster wall, metal stud, R-19 batt+ rigid insulation; **R 12.4** overall, U 0.071
- Glazing: solarban 72(**SHGC 0.30**, VLT 70%, U 0.083)
- Roof: R-30 insulation, R-**31.25** overall





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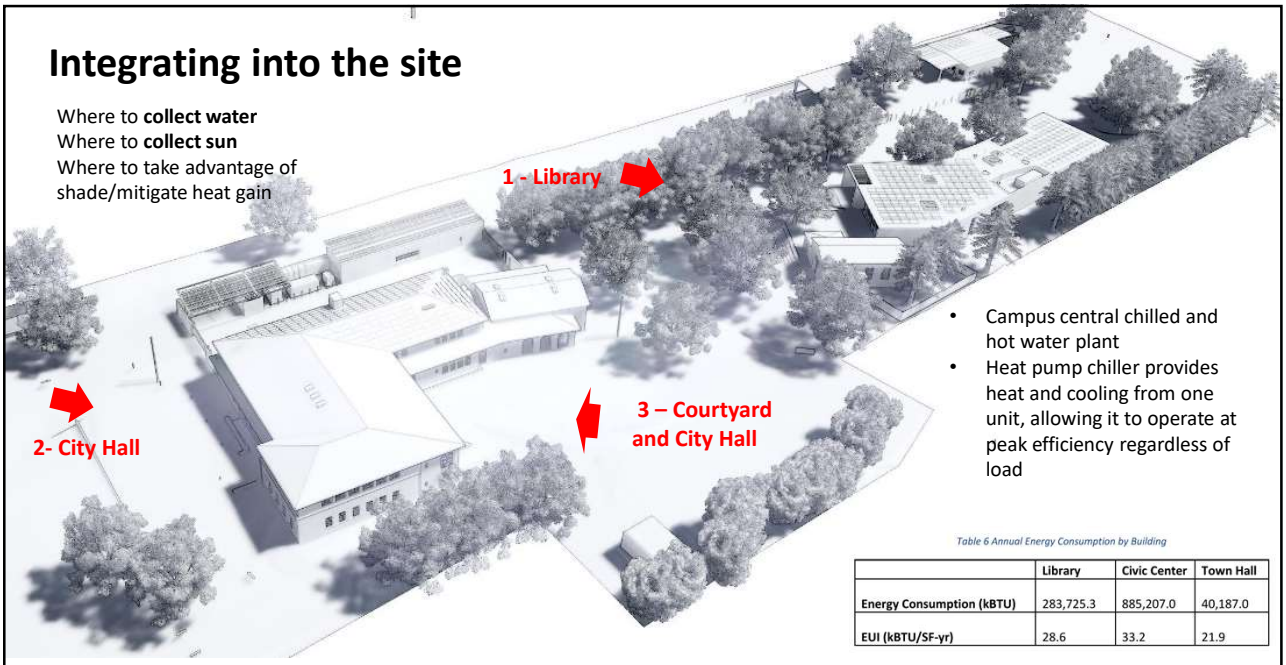
Integrating into the site

Where to **collect water**
Where to **collect sun**
Where to take advantage of shade/mitigate heat gain



- Campus central chilled and hot water plant
- Heat pump chiller provides heat and cooling from one unit, allowing it to operate at peak efficiency regardless of load

Table 6 Annual Energy Consumption by Building

	Library	Civic Center	Town Hall
Energy Consumption (kBTU)	283,725.3	885,207.0	40,187.0
EUI (kBTU/SF-yr)	28.6	33.2	21.9

MONTH DAY, 2017 WRNSTUDIO

ATHERTON CIVIC CENTER – SITE AERIAL

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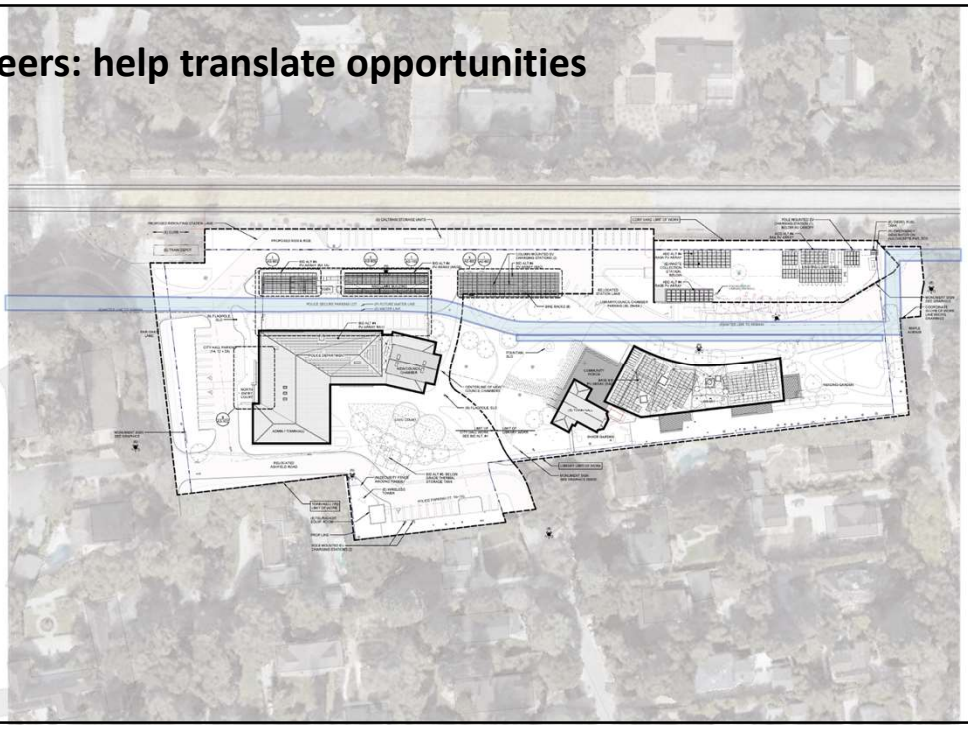
engineers: help translate opportunities



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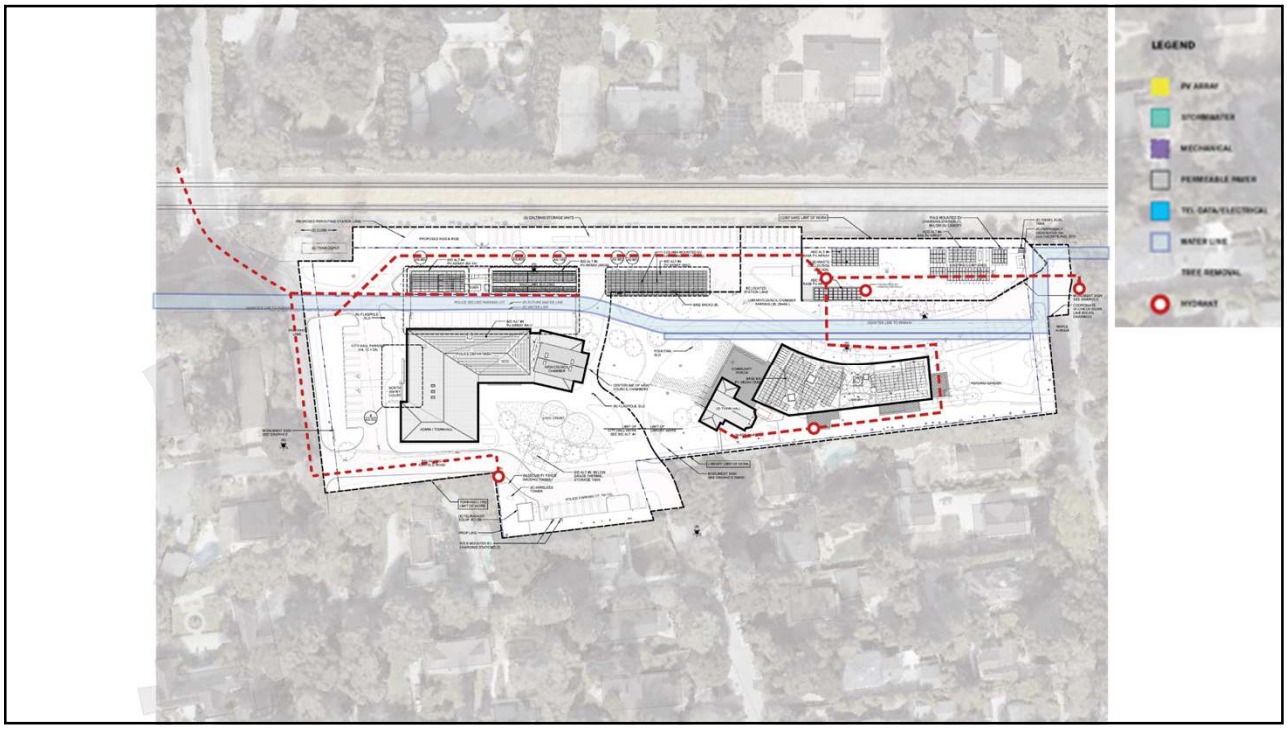
LEGEND
PV ARRAY
STORMWATER
MECHANICAL
PERMEABLE PAVER
TEL DATA/ELECTRICAL
WATER LINE
TREE REMOVAL
HYDRANT

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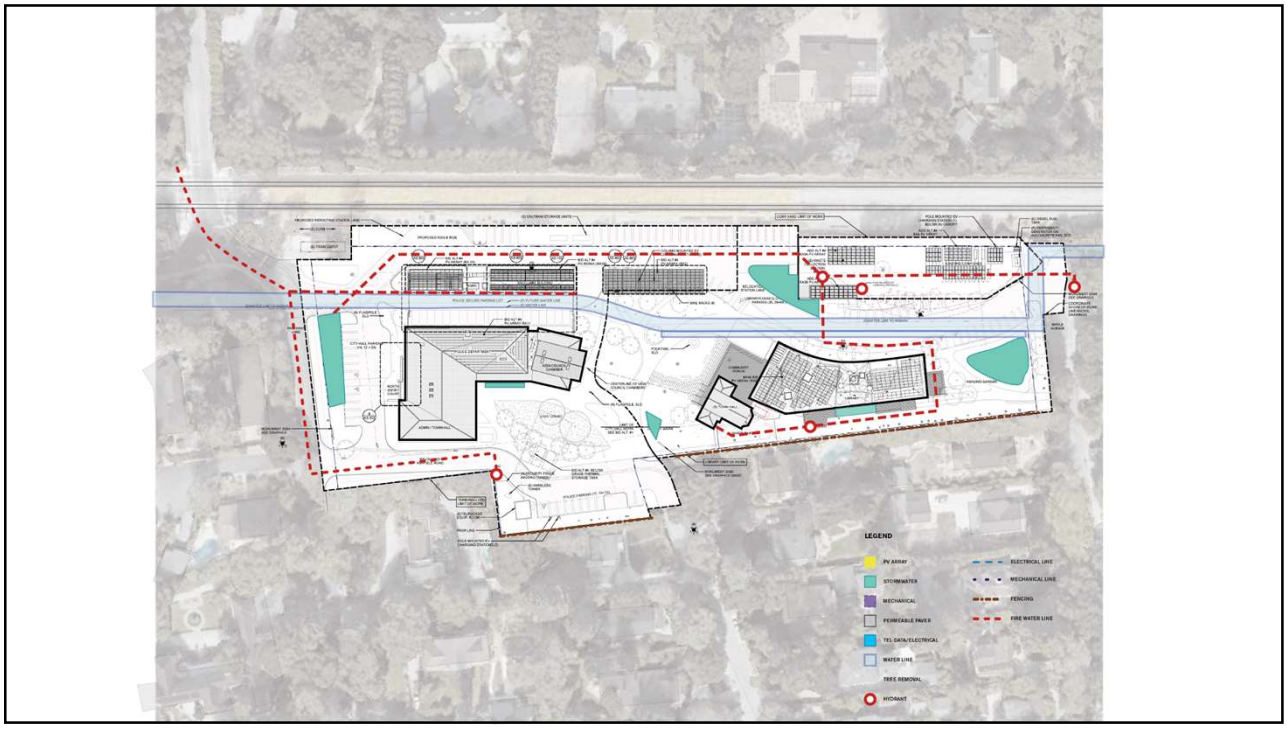
LEGEND
PV ARRAY
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PERMEABLE PAVER
TEL DATA/ELECTRICAL
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TREE REMOVAL
HYDRANT
ELECTRICAL LINE
MECHANICAL LINE
FENCING
FIRE WATER LINE

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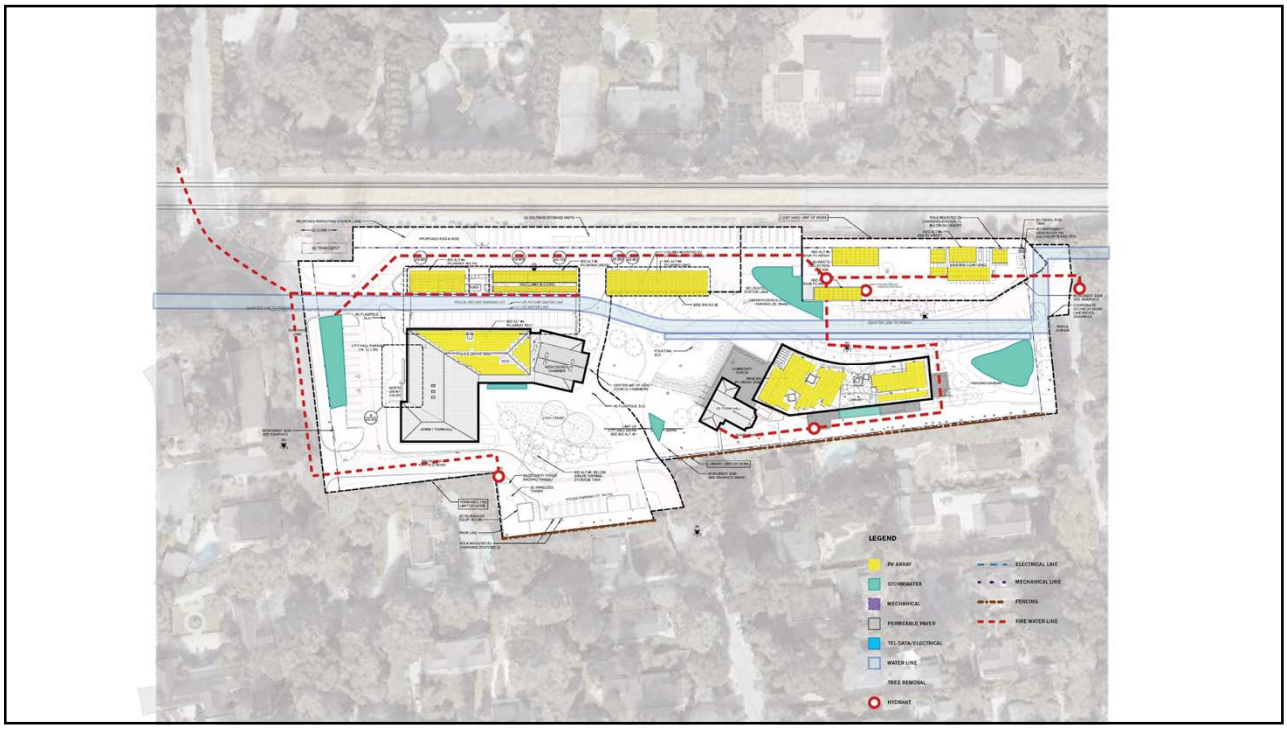
LEGEND
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FENCING
FIRE WATER LINE

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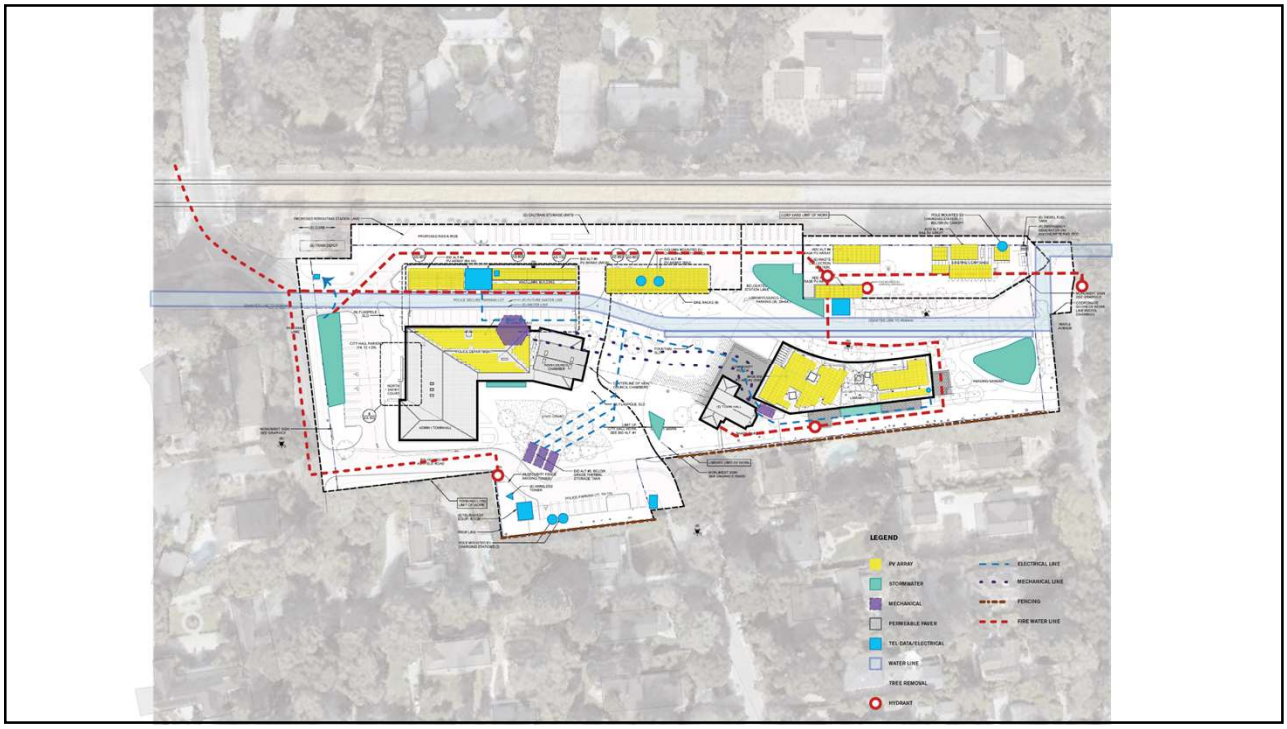
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FENCING
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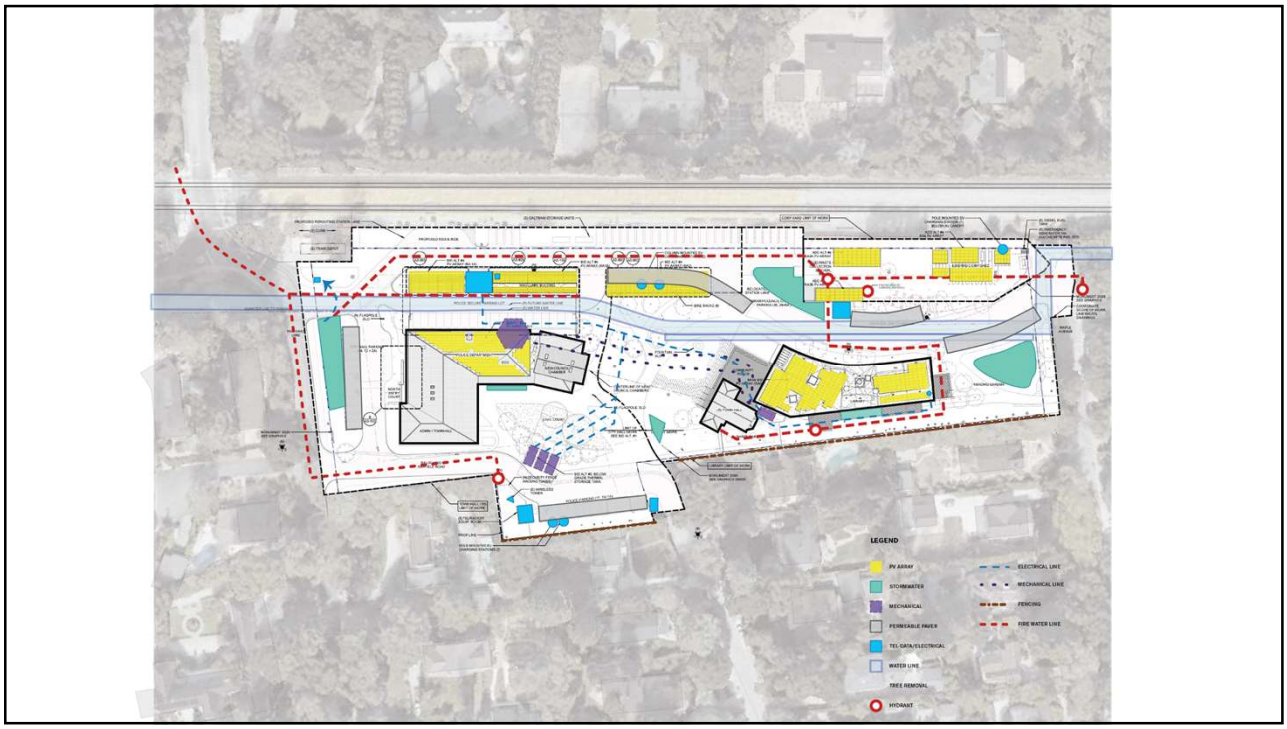
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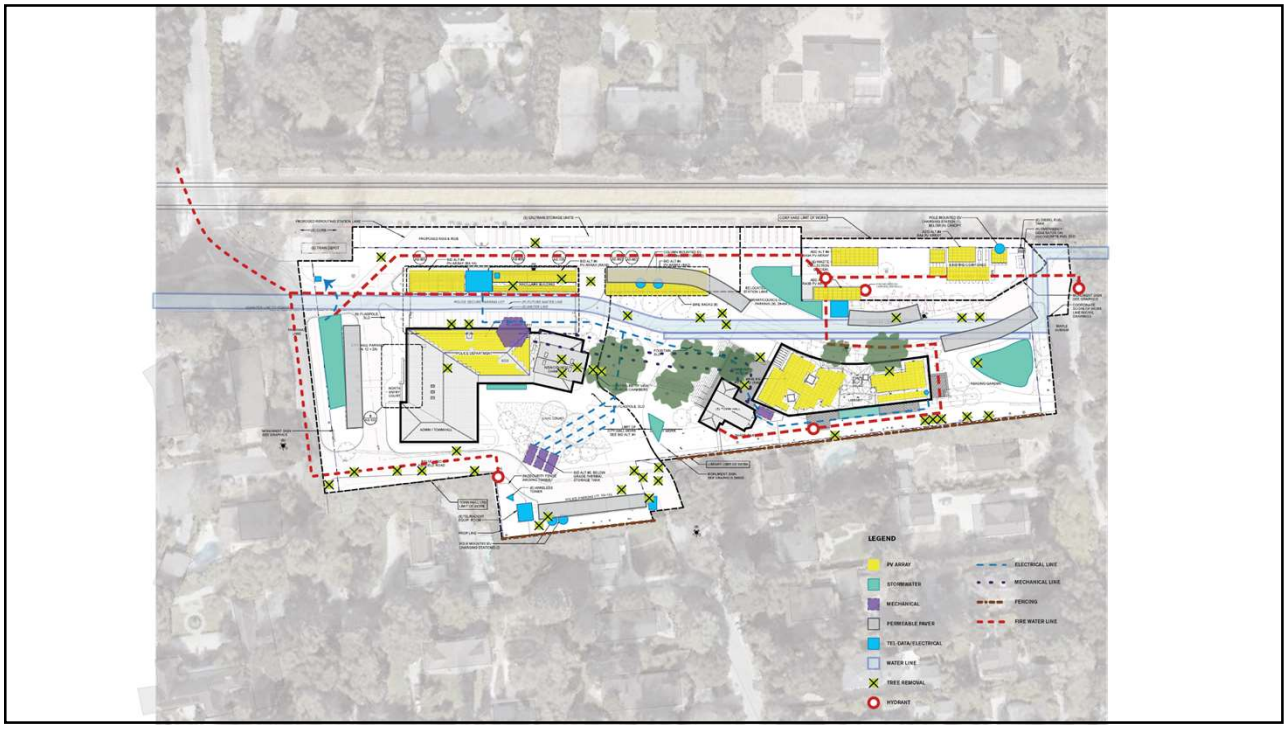
HYDRANT
ELECTRICAL LINE
MECHANICAL LINE
FENCING
FIRE WATER LINE

45


LEGEND
PV ARRAY
STORMWATER
MECHANICAL
PERMEABLE PAVER
TEL-DATA/ELECTRICAL
WATER LINE
TREE REMOVAL
HYDRANT
ELECTRICAL LINE
MECHANICAL LINE
FENCING
FIRE WATER LINE

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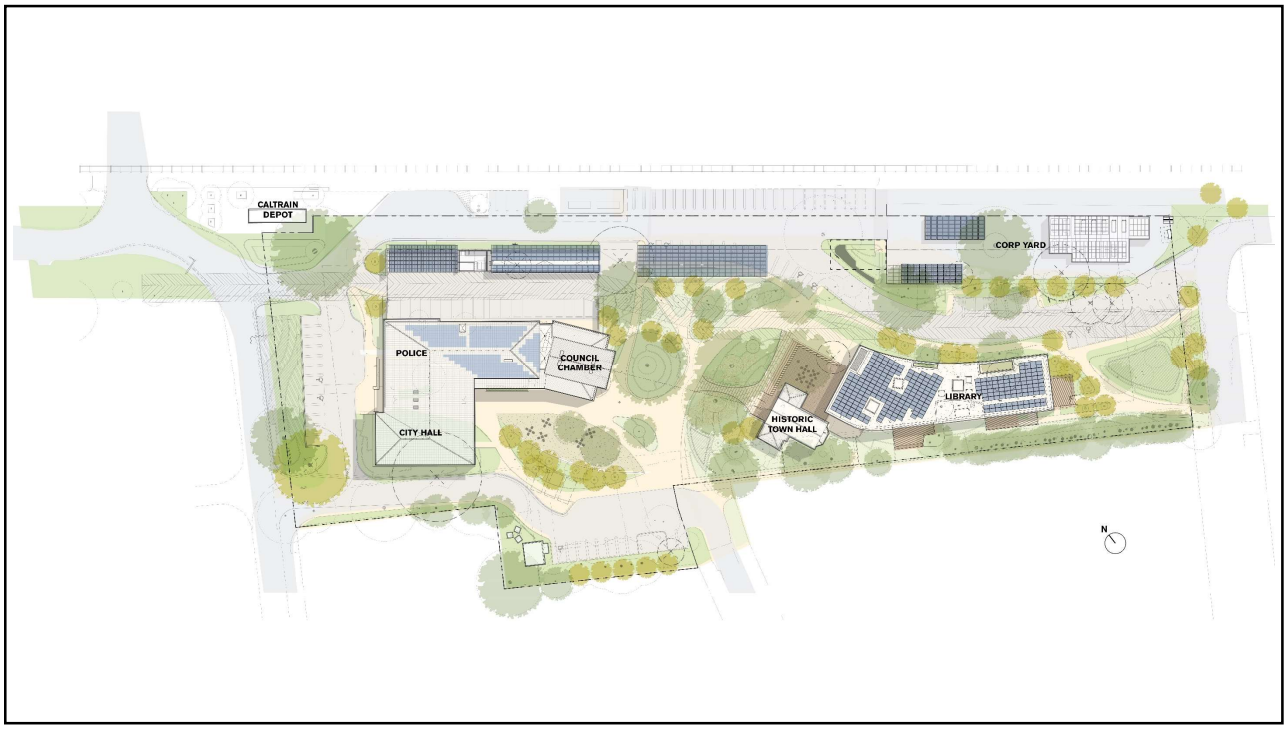

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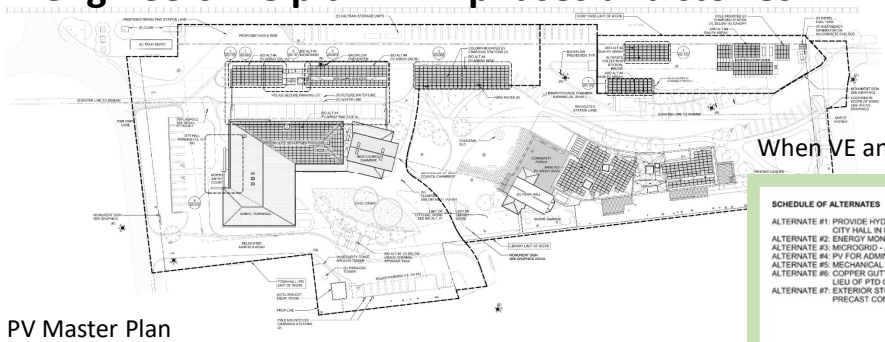
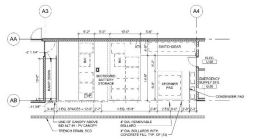
engineers: help think in phases and stories



PV Master Plan

1 SITE PLAN - BID ALTERNATIVES



2 ENLARGED UTILITY YARD PLAN - BID ALTERNATIVE #3

When VE and cost cutting is required…

SCHEDULE OF ALTERNATES

ALTERNATE #1: PROVIDE HYDROSEED PLANTING AT CITY HALL IN LIEU OF INDICATED.
ALTERNATE #2: ENERGY MONITORING ADMIN / PD
ALTERNATE #3: MICROGRID - ADMIN / PD
ALTERNATE #4: PV FOR ADMIN / PD
ALTERNATE #5: MECHANICAL CHILLED WATER THERMAL
ALTERNATE #6: COPPER GUTTER AND DOWNSPOUTS IN LIEU OF PTD GALV STEEL
ALTERNATE #7: EXTERIOR STONE BASE IN LIEU OF PRECAST CONC BASE

EXISTING PARKING

TRAIN STATION (On Property) :	86 STALLS
POLICE :	23 STALLS
CITY HALL :	13 STALLS
BUILDING/PLANNING :	5 STALLS
LIBRARY :	17 STALLS
TOTAL :	144 STALLS
TRAIN STATION (Off Property) :	33 STALLS
GRAND TOTAL :	177 STALLS

NEW PARKING

POLICE :	15 STALLS
CITY HALL :	14 STALLS
LIBRARY/COUNCIL CHAMBER :	35 STALLS
TOTAL :	64 STALLS
TRAIN STATION (Off Property)	20 STALLS
PROPOSED NEW CALTRAIN PARKING	9 STALLS
PROPOSED KISS & RIDE	1 DROP OFF
TOTAL :	30 STALLS

AREA BY ZONE

CORP YARD:	18,157 SF
LIBRARY:	89,554 SF
PD / ADMIN:	122,887 SF
TOTAL :	230,598 SF
TOTAL AREA W/IN PROP LINE	202,136 SF

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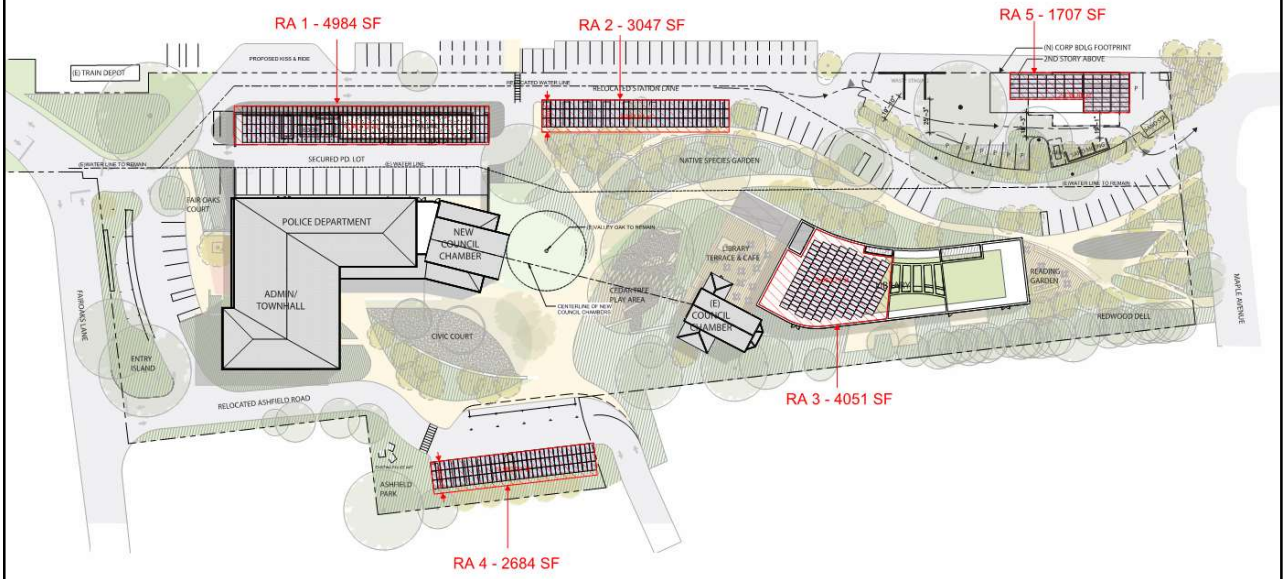
Identifying PV Opportunities



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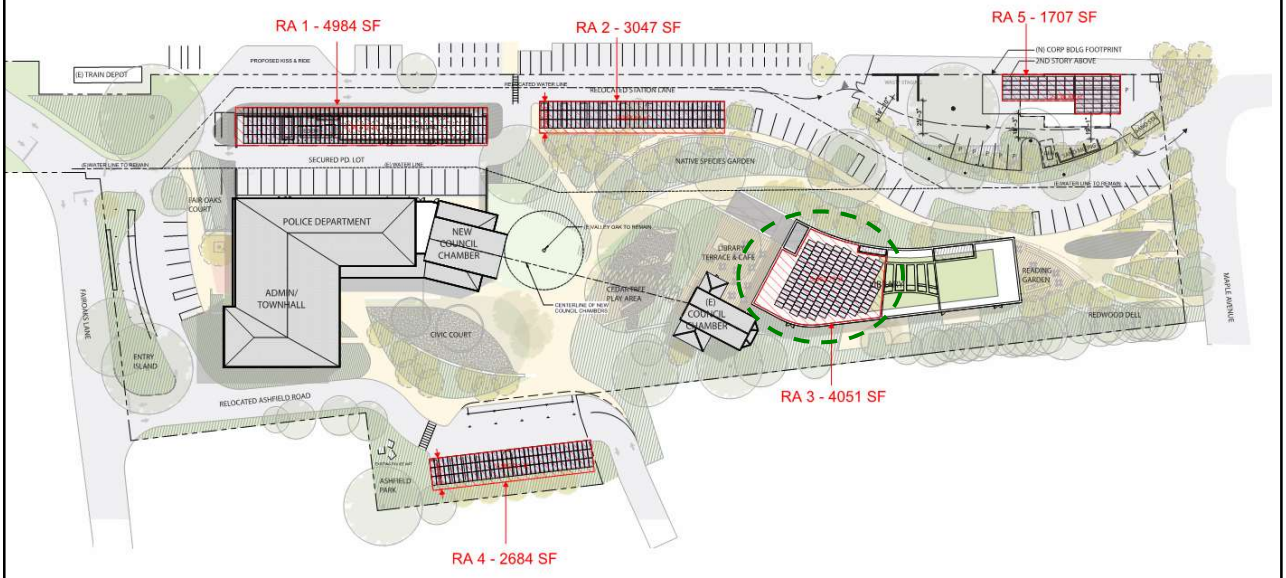
Identifying Net Zero for specific program: Library



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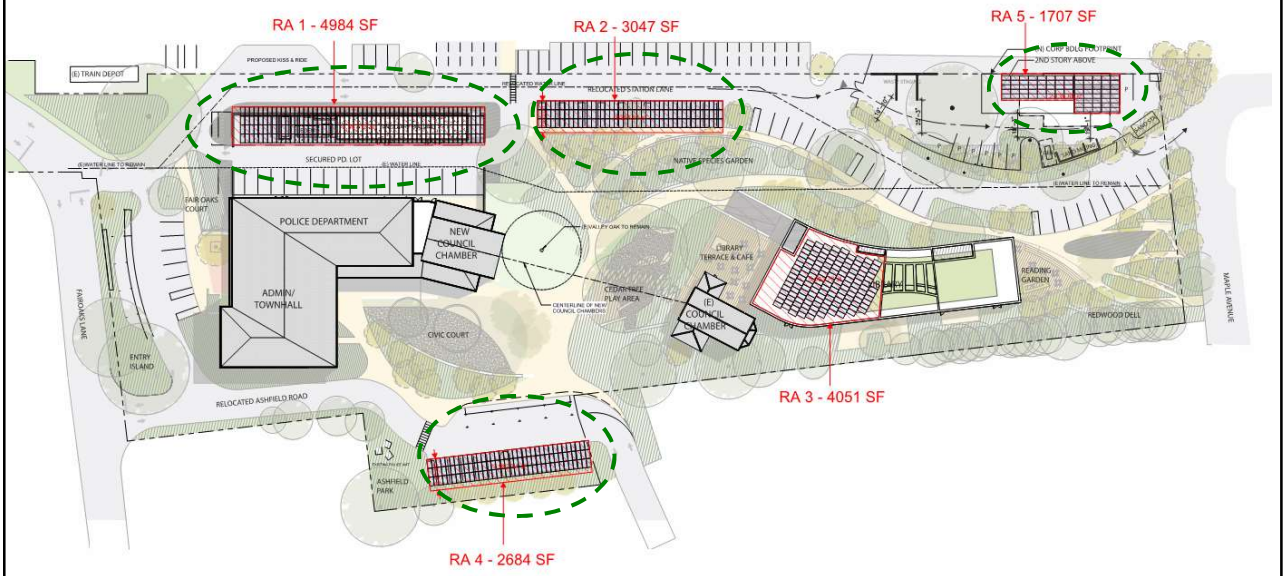
Identifying Net Zero for specific program: Police/Town Hall



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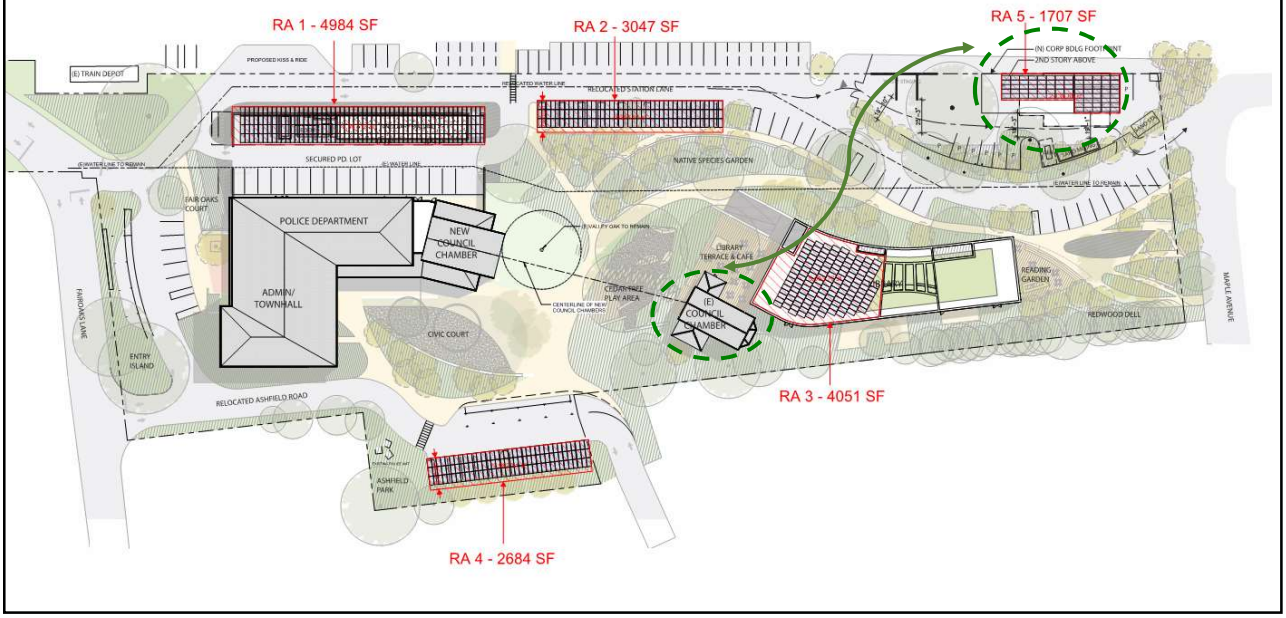
Identifying Net Zero for specific program: Existing Town Hall



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ATHERTON CIVIC CENTER · FAIR OAKS ENTRY COURT
WRNSSTUDIO

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Atherton, California
Google

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ATHERTON CIVIC CENTER · CIVIC COURT

WRNSSTUDIO

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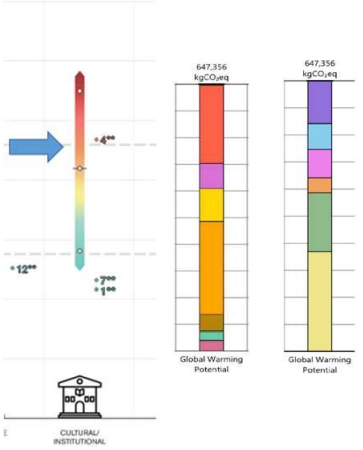
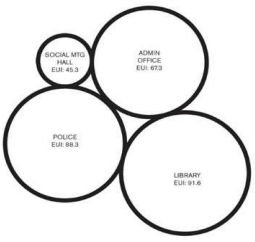
ATHERTON TOWN CENTER environmental strategies





BASELINE EUI

PROPOSED EUI

Revit Categories
- Ceilings
- Curtain Panels
- Curtain Wall Mullions
- Doors
- Floors
- Roofs
- Structure
- Walls
- Windows

Divisions
- 03 - Concrete
- 04 - Masonry
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

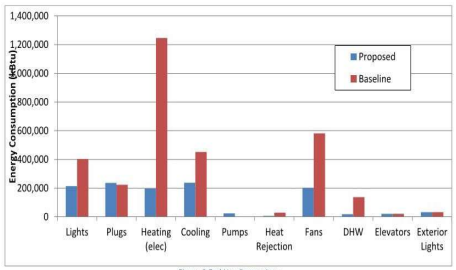


Figure 2 End Use Comparison

Benchmarking System:	**None**	
	Library designed to NZE with future PV array	
Energy Use Intensity:	**28.3**	kBTU/ft²/yr Campus
	28.6	kBTU/ft²/yr Library
	33.2	kBTU/ft²/yr City Hall
	21.9	kBTU/ft²/yr Town Hall
Lighting Power Density:	**0.65**	watt/sqft
Water Use Intensity:	**N/A**	gal/ft²/yr
Ceiling fans	provided in both private and shared spaces	
Embodied Carbon:	**650**	tons CO_2
Stormwater:	**15,586**	Cu. Ft.
	7,661	Cu. Ft. Detention
	7,925	Cu. Ft. Retention

WRNSSTUDIO

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Conclusion – Sustainable Design at neutral cost impact

CLIENT	**TEAM SELECTION IS CRITICAL –** some experience makes a BIG difference
	SET GOALS tied TO THE MISSION AT THE BEGINNING – engage the team with the specifics
ARCHITECT	**START WITH HOW YOU CAN DO BETTER THAN (code, standards, baseline) –** establish clear percentages
	INVOLVE THE ENTIRE DESIGN TEAM – set early team discussions ; multi-disciplinary benefits = savings
	USE PASSIVE STRATEGIES – Look at Cost Benefit through the energy model
	KNOW THAT EVERY BUDGET CAN INCLUDE SUSTAINABLE OPTIONS – be open; dig into the details
ENGINEER	**ASK QUESTIONS /CONSIDER THE BIG PICTURE–** create a set of questions for discussion; make sure it works for every team member
	ITERATIVE PROCESS – be ready for iterations
ALL	**MEETING THE GOALS TAKES TENACITY AND CREATIVITY –** check in on options throughout the phases

WRNS STUDIO

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CEDA Program Eligibility

- New construction projects and/or major alterations
- Projects in design phase
- Exceed standard practice, code, and current design
- Owner pays/will pay the Public Purpose Program surcharge on the account where the Energy Efficiency (EE) measures are installed

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CEDA Program Eligibility: Major Alterations

- Change in space function – OR
- Substantial changes (≥ 30%) in design occupancy (sf/pp) – OR
- Increase (≥ 10%) in conditioned floor area – OR
- Expansion of substantial process or conditioning load to an existing facility

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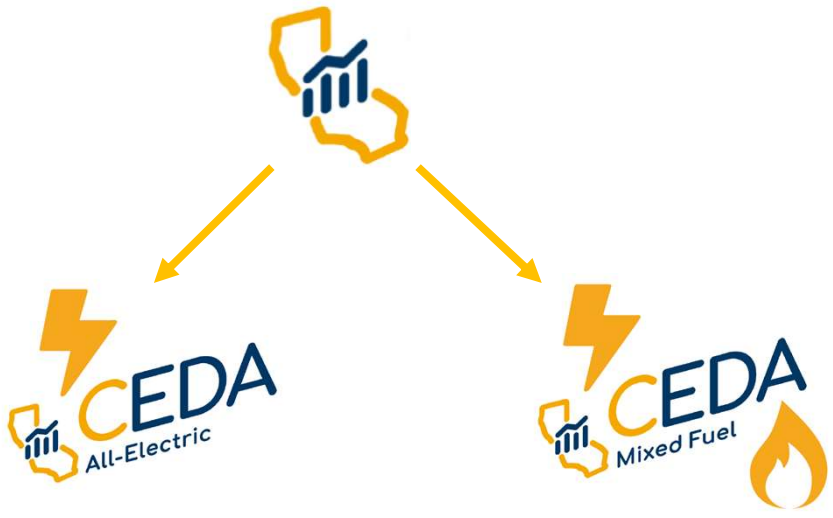
Two Paths- All Electric or Mixed Fuel



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Two Paths: All-Electric or Mixed-Fuel

- All-electric path offers substantially higher cash incentives
- Mixed Fuel path must optimize fossil gas and process heating systems to reduce carbon emissions
- Both paths encourage integration with:
  - Renewable energy generation
  - Electric vehicle charging
  - Battery storage

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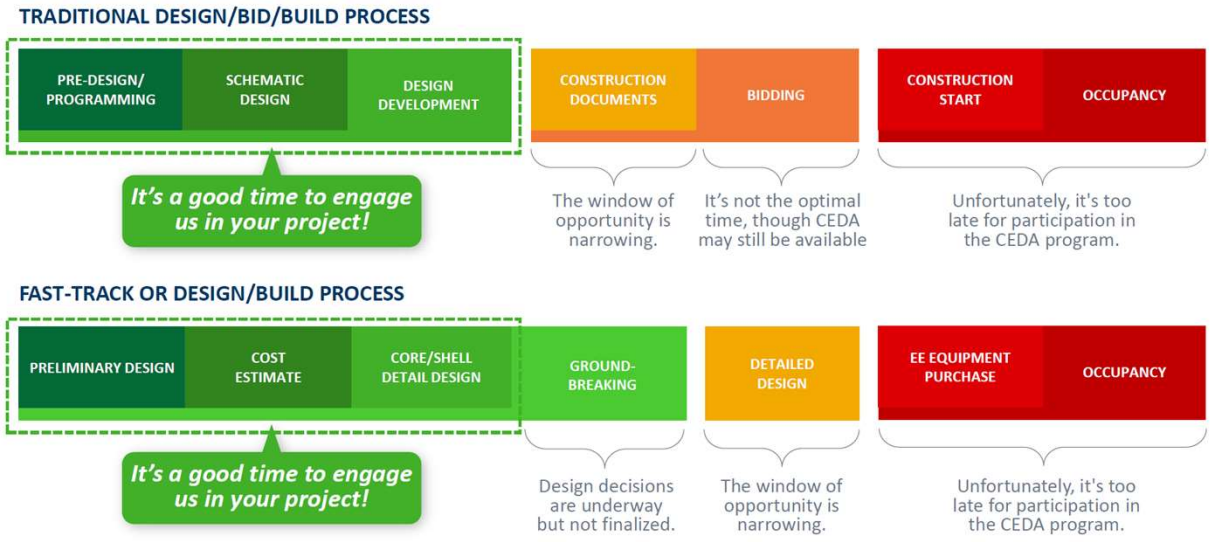
Timing



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Process

1 Enrollment
You provide schematic information about your building through our Energy Design Assistance application

2 Preliminary Analysis
Together we perform real-time evaluation of energy-efficiency measures and bundle potential whole-building strategies for further analysis

3 Final Analysis
You determine the strategies bundle that best aligns with your project goals, from which projected energy savings and utility incentives are determined

4 Verification
We confirm your project was constructed to plan and issue a final report for you and your utility provider

5 Incentives
Incentives will be issued for the strategies implemented in your project

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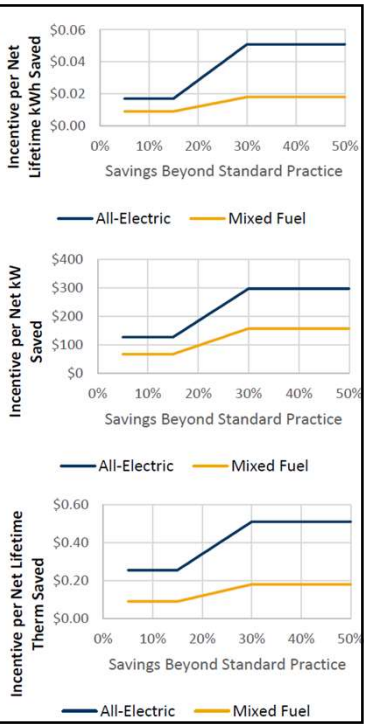
Incentive Summary

- Based on discounted net[1] life-cycle savings beyond standard practice baseline[2]
  - Measure effective useful life ranges from 8-20 years
  - Incentive rates for kWh, peak kW, and therms saved on a sliding scale
- Designated low-income housing projects get a 40% increased incentive
- Incentives cannot reduce payback below 2 years
- Incentives are capped at the lesser of 100% of incremental measure costs or 50% of full measure costs
- Incentives may be capped for buildings with onsite generation exceeding usage (generally, not residential or small commercial)

[1]Net savings are based on CPUC determined net-to-gross ratio to account for free-ridership and program influence

[2]The All-electric program's standard practice baseline is mixed fuel for buildings with fossil gas available nearby



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CEDA Incentivizes All-Electric Buildings

- Electrification dramatically reduces carbon emissions
- All-electric projects often lower-first-cost: no gas hookup fee
- Grid gets cleaner over time… while fossil gas combustion remains high-carbon-emitting through equipment life
- All-Electric projects get much higher incentives – around **double the rate** per kWh, peak kW, and therm!
- Mixed-fuel (fossil gas heat) baseline for electrification projects
- Over 50 jurisdictions in CA require or encourage all-electric new construction already!

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CEDA Lite

- Design teams can use their own energy consultant. If so:
  - Complete all program documentation requirements
  - Adhere to program modeling protocol
  - Calculate energy savings using CPUC Standard Practice Baseline (this is not CEC Title 24 modeling)
  - Receive approval for modeling approach and software tool
- May receive technical assistance stipend
  - Half paid at Project Feasibility Study acceptance
  - Half at Verification

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Polling Question #3

- What types of additional information do you need to participate in the CEDA program?
  - Program eligibility and rules
  - Energy modeling approach, methodology, and tools
  - How to integrate CEDA energy modeling into project workflow
  - Incentive calculation approach
  - Other topics

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Questions and Answers

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ceda.willdan.com

855-502-3914

CEDA@willdan.com

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Survey Questions

- How would you rate today's webinar content and presenters? (1-10)
- How many projects do you expect to bring into the CEDA program in 2022?
- Would you like to have a CEDA representative follow up with you directly to answer questions?

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