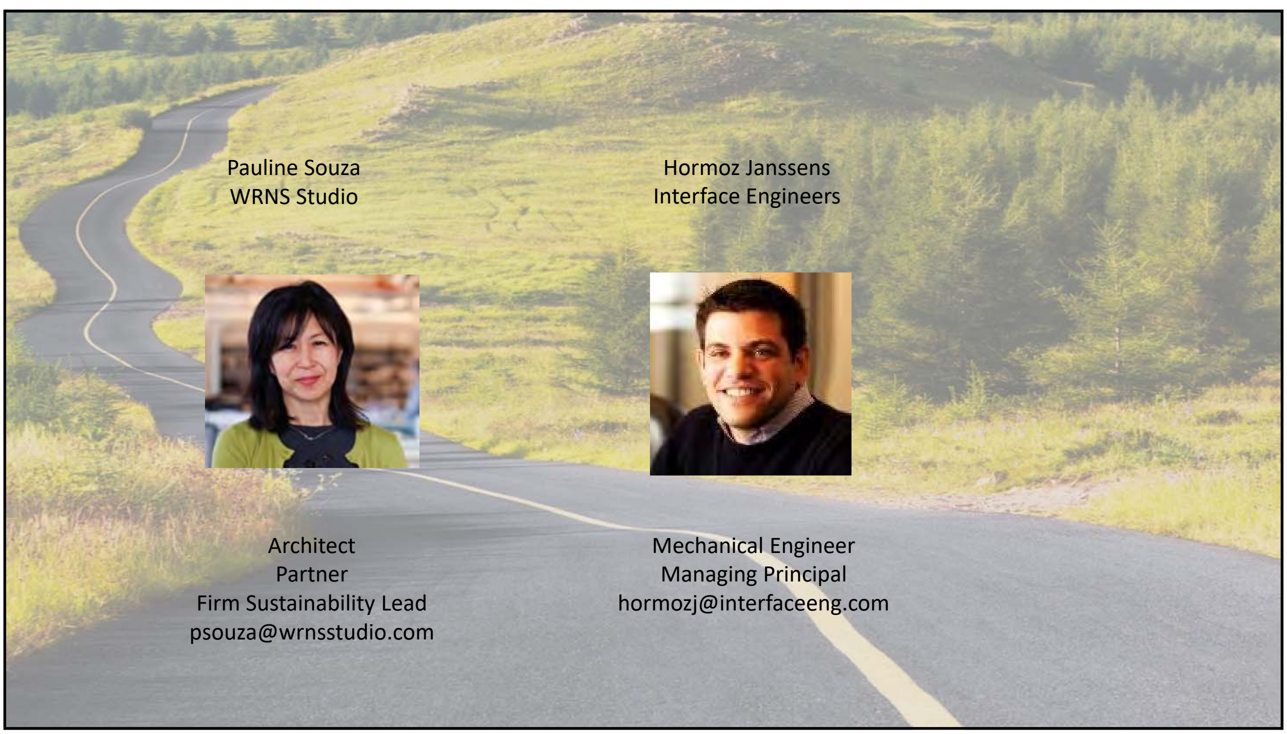

Zero Energy Educational Buildings:
An Integrated long lasting approach in K-12 & Higher Ed :
New tools and User Engagement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"How dare you pretend that this can be solved with business as usual "

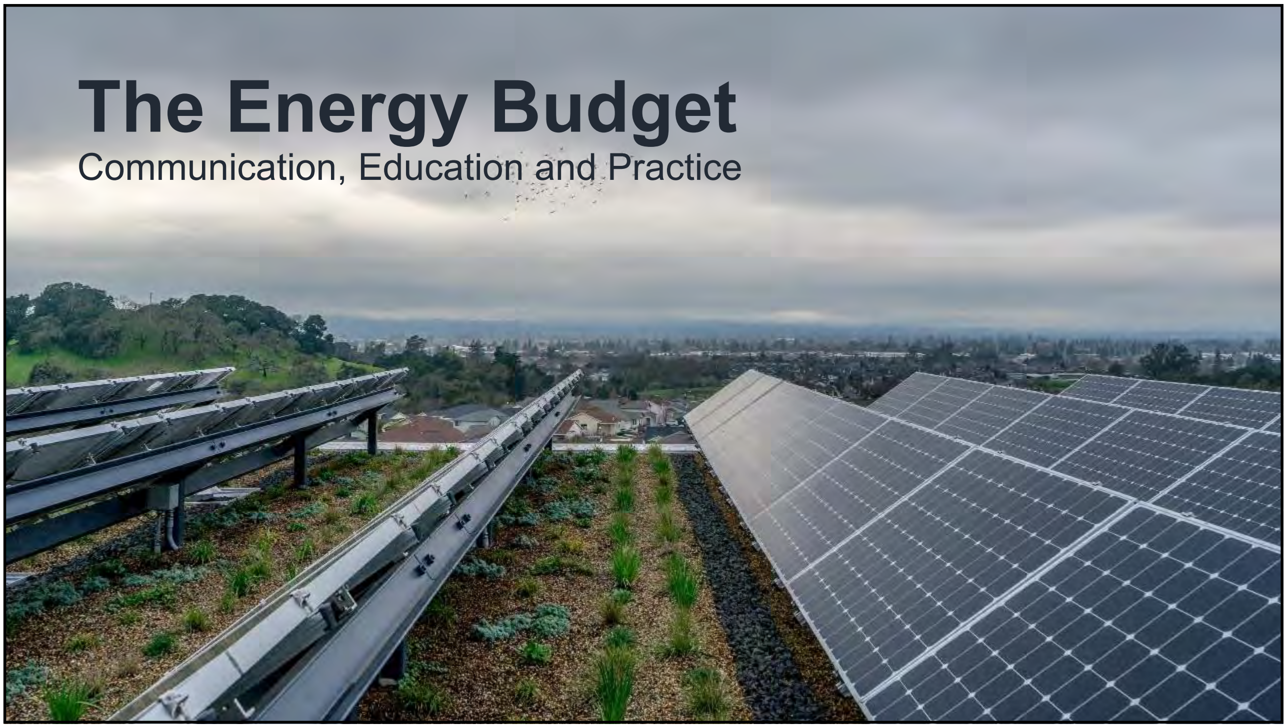
"The eyes of all future generations are on you"

" I want you to act as if the house is on fire…because it is….

https://www.youtube.com/watch?v=TMrtLsQbaok

The Energy Budget

Communication, Education and Practice



Energy Budget

Students play a key role in keeping with the energy budget.

Energy is monitored continuously. If it's out of balance, students will use a handsaw instead of a table saw in shop class, etc. As Becker tells his students.

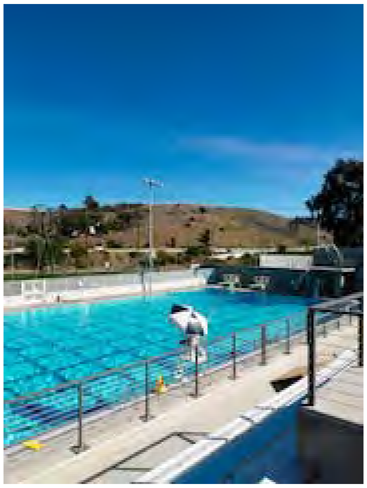
<u>"You have to eat your conservation vegetables before your solar cookies."</u>

Michael Becker, Science Teacher @ Hood River Middle School

Design Challenge: People

Occupant Comfort

» air temperatures
» relative humidity
» air movement
» mean radiant temperatures
» clothing worn



Post Occupancy Evaluation

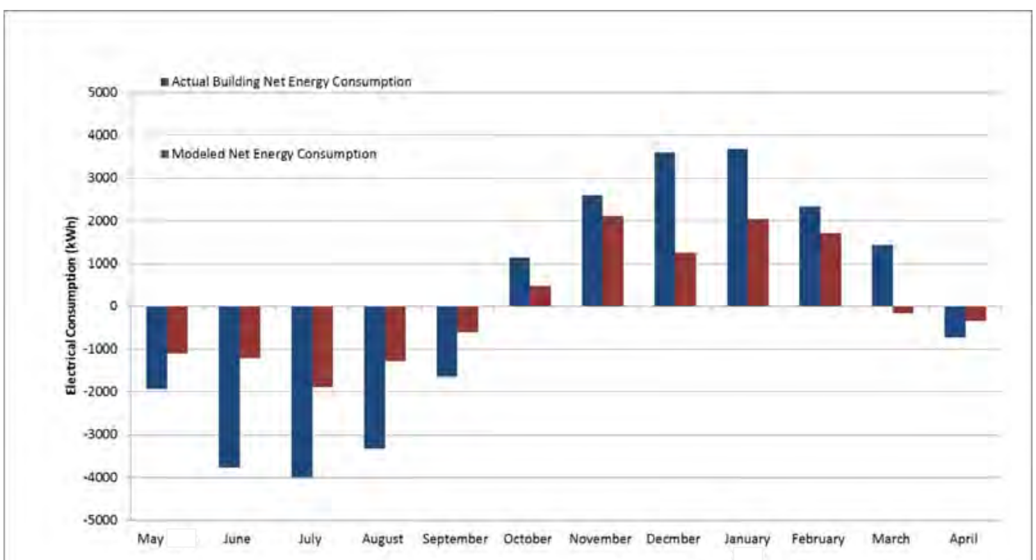
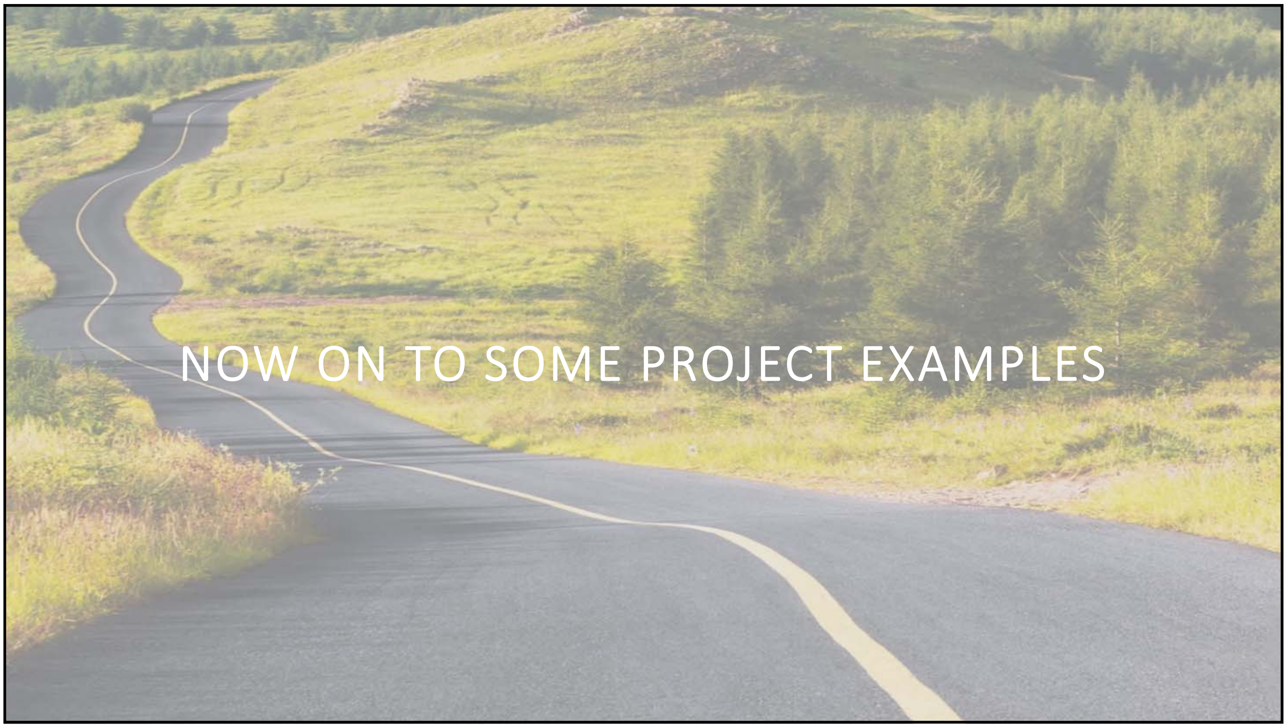
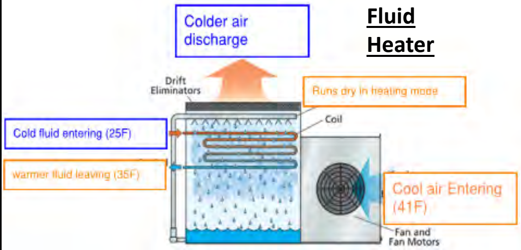


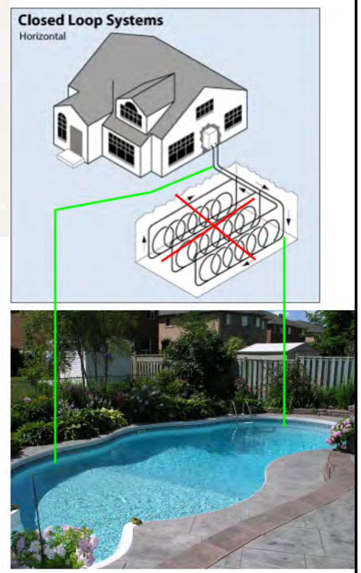
Figure 17: Original vs. Modeled Net Energy Usage (kWh)

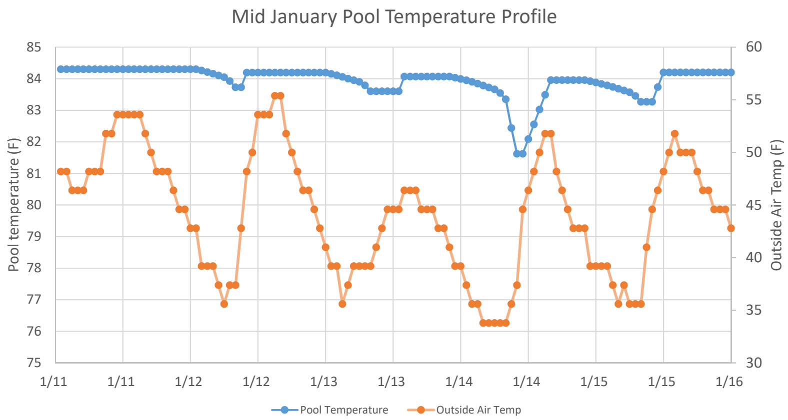


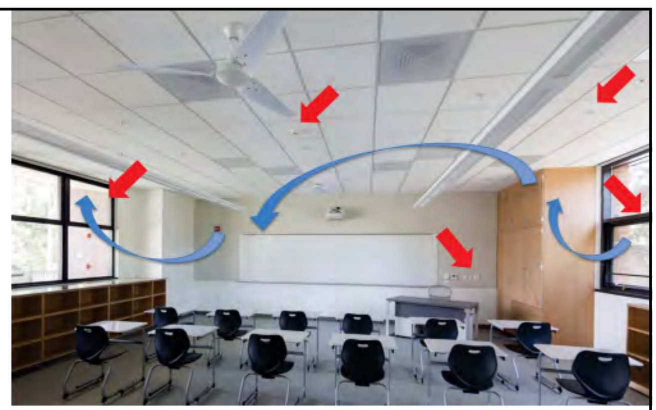
NOW ON TO SOME PROJECT EXAMPLES

Option	Increased First Cost after deducting cost of PV ($111,727 for Option 1 and $83,385 for Option 2) Investment Cost	Breakeven at 6% Electrical Cost Inflation per year	Breakeven at 8% Electrical Cost Inflation per year	Breakeven at 10% Electrical Cost Inflation per year	Net Positive Cash Flow (or reduced operating costs) after 30 years at 6% Electrical Cost Escalation	Net Positive Cash Flow (or reduced operating costs) after 30 years at 8% Electrical Cost Escalation	Net Positive Cash Flow (or reduced operating costs) after 30 years at 10% Electrical Cost Escalation
Option 1 - 23 Bores, no change to equipment	$256,273	23.5 years	20.5 years	18.5 years	$153,369	$330,707	$596,058
Option 2* – 23 bores, change equipment to cheaper equipment	$218,615	21.5 years	19.5 years	17.5 years	$191,028	$368,366	$633,716
Original Estimate assuming $7,000 per Ton for geoexchange bores	$98,273	13.5	12	11.5	$311,369	$488,707	$754,058







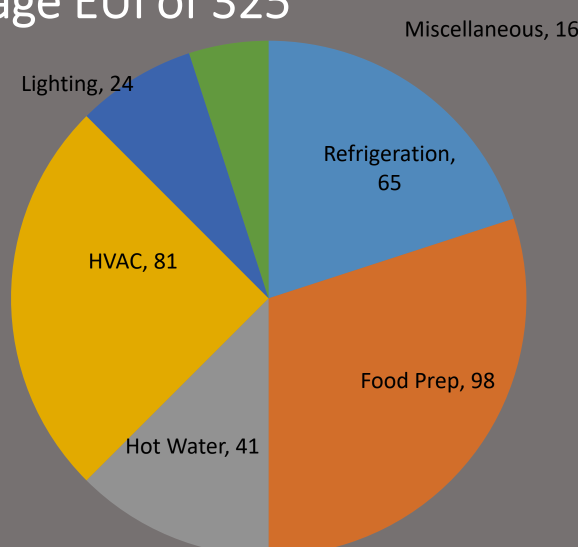


SACRED HEART RED LIGHT, NATURAL VENTILATION, DAYLIGHT

Typical Food Energy Stats

Average EUI of 325

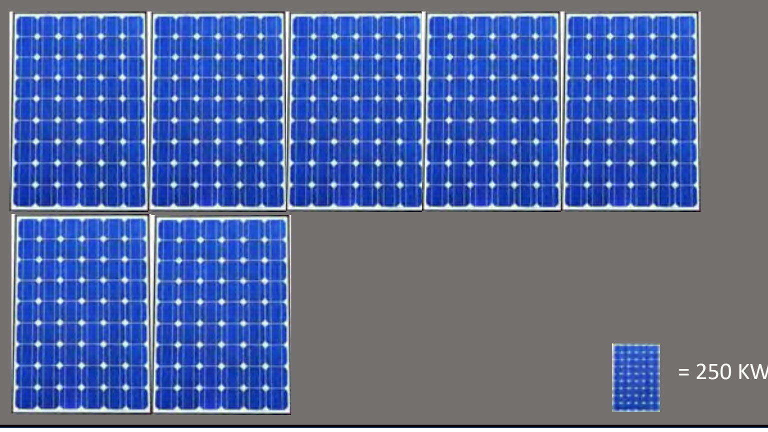
- Typical Cafeteria EUI Range: 250-400 kBTU/sf-yr
- No Ventilation Heat Recovery
- No VAV hoods



Chatham Commons

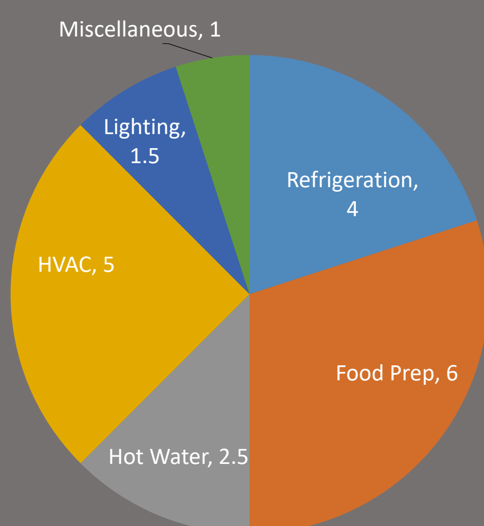
EUI of 325: PV Breakdown

- Floor area = 20,000 ft^2
- 1,905,041 KWh
- Requires 1733 KW of PV capacity, $6.93 Million



Requirements for 20 EUI Commons

- About 60% of energy use from kitchen equipment
- For a 20 EUI requirement, kitchen must be <= 12 EUI



Modeling Chatham Commons: **Initial Assumptions**

- Kitchen use: 16 hours/day, 7 days/week
- 3 meals per day for 150 students
- 1,500 gal/day hot water (dishwashing)
- Constant flow exhaust hoods
- Standard refrigeration

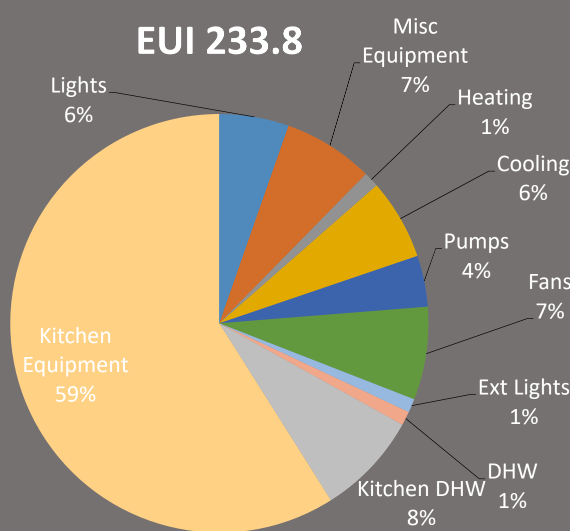


Table 5B Recommended Rates of Radiant Heat Gain from Hooded Electric Appliances During Idle (Ready-to-Cook) Conditions

	Energy Rate, Btu/h		Rate of Heat Gain, Btu/h		
Appliance	Rated	Standby	Sensible Radiant	Usage Factor F_u	Radiation Factor F_r
Broiler: underfired 3 ft	36,900	30,900	10,800	0.84	0.35
Cheesemelter*	12,300	11,900	4,600	0.97	0.39
Fryer: kettle	99,000	1,800	500	0.02	0.28
Fryer: open deep-fat, 1-vat	47,800	2,800	1,000	0.06	0.36
Fryer: pressure	46,100	2,700	500	0.06	0.19
Griddle: double sided 3 ft (clamshell down)*	72,400	6,900	1,400	0.1	0.2
Griddle: double sided 3 ft (clamshell up)*	72,400	11,500	3,600	0.16	0.31
Griddle: flat 3 ft	58,400	11,500	4,500	0.2	0.39
Griddle: small 3 ft*	30,700	6,100	2,700	0.2	0.44
Induction cooktop*	71,700	0	0	0	0
Induction wok*	11,900	0	0	0	0
Oven: combi: combi-mode*	56,000	5,900	800	0.1	0.15
Oven: combi: convection mode	56,000	5,500	1,400	0.1	0.25
Oven: convection full-size	41,300	6,700	1,500	0.16	0.22
Oven: convection half-size*	18,800	3,700	500	0.2	0.14
Pasta cooker*	75,100	8,500	0	0.11	0
Range top: top off/oven on*	16,600	4,000	1,000	0.24	0.25
Range top: 3 elements on/oven off	51,200	15,400	6,300	0.3	0.41
Range top: 6 elements on/oven off	51,200	33,200	13,900	0.65	0.42
Range top: 6 elements on/oven on	67,300	36,400	14,500	0.54	0.4
Range: hot-top	54,600	51,300	11,800	0.95	0.23
Rotisserie*	37,900	13,800	4,500	0.36	0.33
Salamander*	23,900	23,300	7,000	0.97	0.3
Steam kettle: large (60 gal) simmer lid down*	110,600	2,600	100	0.02	0.04
Steam kettle: small (40 gal) simmer lid down*	73,700	1,800	300	0.02	0.17
Steamer: compartment: atmospheric*	33,400	15,300	200	0.46	0.01
Tilting skillet/braising pan	32,900	5,300	0	0.16	0

Source: Swierczyna et al. (2008, 2009)

Table 5C Recommended Rates of Radiant Heat Gain from Hooded Gas Appliances During Idle (Ready-to-Cook) Conditions

	Energy Rate, Btu/h		Rate of Heat Gain, Btu/h		
Appliance	Rated	Standby	Sensible Radiant	Usage Factor F_u	Radiation Factor F_r
Broiler: batch*	95,000	69,200	8,100	0.73	0.12
Broiler: chain (conveyor)	132,000	96,700	13,200	0.73	0.14
Broiler: overfired (upright)*	100,000	87,900	2,500	0.88	0.03
Broiler: underfired 3 ft	96,000	73,900	9,000	0.77	0.12
Fryer: doughnut	44,000	12,400	2,900	0.28	0.23
Fryer: open deep-fat, 1 vat	80,000	4,700	1,100	0.06	0.23
Fryer: pressure	80,000	9,000	800	0.11	0.09
Griddle: double sided 3 ft (clamshell down)*	108,200	8,000	1,800	0.07	0.23
Griddle: double sided 3 ft (clamshell up)*	108,200	14,700	4,900	0.14	0.33
Griddle: flat 3 ft	90,000	20,400	3,700	0.23	0.18
Oven: combi: combi-mode*	75,700	6,000	400	0.08	0.07
Oven: combi: convection mode	75,700	5,800	1,000	0.08	0.17
Oven: convection full-size	44,000	11,900	1,000	0.27	0.08
Oven: conveyor (pizza)	170,000	68,300	7,800	0.4	0.11
Oven: deck	105,000	20,500	3,500	0.2	0.17
Oven: rack mini-rotating*	56,300	4,500	1,100	0.08	0.24
Pasta cooker*	80,000	23,700	0	0.3	0
Range top: top off/oven on*	25,000	7,400	2,000	0.3	0.27
Range top: 3 burners on/oven off	120,000	60,100	7,100	0.5	0.12
Range top: 6 burners on/oven off	120,000	120,800	11,500	1.0	0.1
Range top: 6 burners on/oven on	145,000	122,900	13,600	0.85	0.11
Range: wok*	99,000	87,400	5,200	0.88	0.06
Rethermalizer*	90,000	23,300	11,300	0.26	0.49
Rice cooker*	35,000	500	300	0.01	0.6
Salamander*	35,000	33,300	5,300	0.95	0.16
Steam kettle: large (60 gal) simmer lid down*	145,000	5,400	0	0.04	0
Steam kettle: small (10 gal) simmer lid down*	52,000	3,300	300	0.06	0.09
Steam kettle: small (40 gal) simmer lid down	100,000	4,300	0	0.04	0
Steamer: compartment: atmospheric*	26,000	8,300	0	0.32	0
Tilting skillet/braising pan	104,000	10,400	400	0.1	0.04

Source: Swierczyna et al. (2008, 2009)

Table 5E Recommended Rates of Radiant and Convective Heat Gain from Warewashing Equipment During Idle (Standby) or Washing Conditions

	Energy Rate, Btu/h		Rate of Heat Gain, Btu/h						
			Unhooded				Hooded		
Appliance	Rated	Standby/ Washing	Sensible Radiant	Sensible Convective	Latent	Total	Sensible Radiant	Usage Factor F_u	Radiation Factor F_r
Dishwasher (conveyor type, chemical sanitizing)	46,800	2700/43,600	0	4430	13490	17920	0	0.36	0
Dishwasher (conveyor type, hot-water sanitizing) standby	46,800	5700/N/A	0	4750	16970	21720	0	N/A	0
Dishwasher (door-type, chemical sanitizing) washing	18,400	1200/13,300	0	1980	2790	4770	0	0.26	0
Dishwasher (door-type, hot-water sanitizing) washing	18,400	1200/13,300	0	1980	2790	4770	0	0.26	0
Dishwasher* (under-counter type, chemical sanitizing) standby	26,000	1200/18,700	0	2280	4170	6450	0	0.35	0.00
Dishwasher* (under-counter type, hot-water sanitizing) standby	26,000	1700/19,700	800	1040	3010	4850	800	0.27	0.34
Booster heater*	130,000	0	500	0	0	0	500	0	N/A

Note: Heat load values are prorated for 30% washing and 70% standby. Source: Swierczyna et al. (2008, 2009)

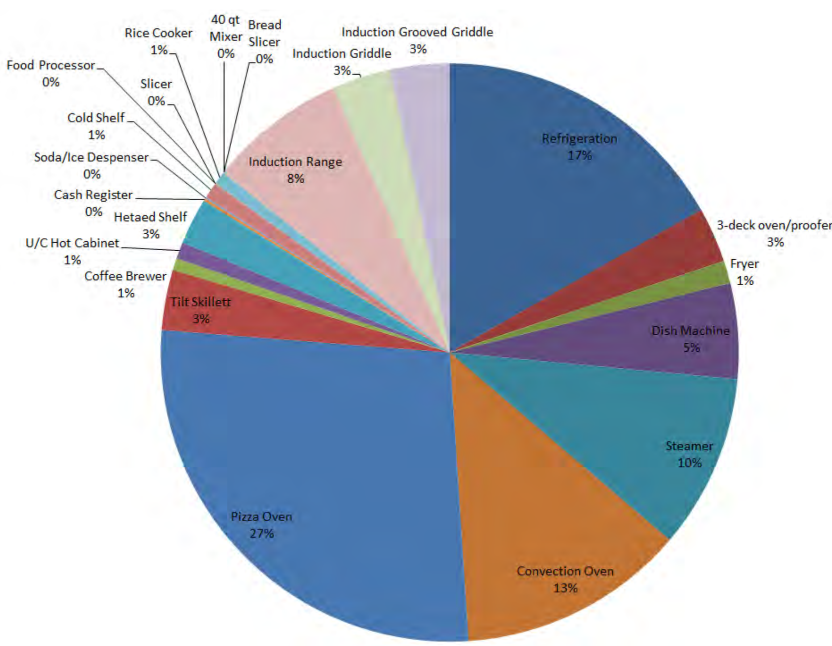
Table 5A Recommended Rates of Radiant and Convective Heat Gain from Unhooded Electric Appliances During Idle (Ready-to-Cook) Conditions

	Energy Rate, Btu/h		Rate of Heat Gain, Btu/h					
Appliance	Rated	Standby	Sensible Radiant	Sensible Convective	Latent	Total	Usage Factor F_u	Radiation Factor F_r
Cabinet: hot serving (large), insulated*	6,800	1,200	400	800	0	1,200	0.18	0.33
Cabinet: hot serving (large), uninsulated	6,800	3,500	700	2,800	0	3,500	0.51	0.2
Cabinet: proofing (large)*	17,400	1,400	1,200	0	200	1,400	0.08	0.86
Cabinet: proofing (small 15 shelf)	14,300	3,900	0	900	3,000	3,900	0.27	0
Coffee brewing urn	13,000	1,200	200	300	700	1,200	0.09	0.17
Drawer warmers, 2-drawer (moist holding)*	4,100	500	0	0	200	200	0.12	0
Egg cooker	10,900	700	300	400	0	700	0.06	0.43
Espresso machine*	8,200	1,200	400	800	0	1,200	0.15	0.33
Food warmer: steam table (2-well-type)	5,100	3,500	300	600	2,600	3,500	0.69	0.09
Freezer (small)	2,700	1,100	500	600	0	1,100	0.41	0.45
Hot dog roller*	3,400	2,400	900	1,500	0	2,400	0.71	0.38
Hot plate: single burner, high speed	3,800	3,000	900	2,100	0	3,000	0.79	0.3
Hot-food case (dry holding)*	31,100	2,500	900	1,600	0	2,500	0.08	0.36
Hot-food case (moist holding)*	31,100	3,300	900	1,800	600	3,300	0.11	0.27
Microwave oven: commercial (heavy duty)	10,900	0	0	0	0	0	0	0
Oven: countertop conveyorized bake/finishing*	20,500	12,600	2,200	10,400	0	12,600	0.61	0.17
Panini*	5,800	3,200	1,200	2,000	0	3,200	0.55	0.38
Popcorn popper*	2,000	200	100	100	0	200	0.1	0.5
Rapid-cook oven (quartz-halogen)*	41,000	0	0	0	0	0	0	0
Rapid-cook oven (microwave/convection)*	24,900	4,100	1,000	3,100	0	4,100	0.16	0.24
Reach-in refrigerator*	4,800	1,200	300	900	0	1,200	0.25	0.25
Refrigerated prep table*	2,000	900	600	300	0	900	0.45	0.67
Steamer (bun)	5,100	700	600	100	0	700	0.14	0.86
Toaster: 4-slice pop up (large): cooking	6,100	3,000	200	1,400	1,000	2,600	0.49	0.07
Toaster: contact (vertical)	11,300	5,300	2,700	2,600	0	5,300	0.47	0.51
Toaster: conveyor (large)	32,800	10,300	3,000	7,300	0	10,300	0.31	0.29
Toaster: small conveyor	5,800	3,700	400	3,300	0	3,700	0.64	0.11
Waffle iron	3,100	1,200	800	400	0	1,200	0.39	0.67

Source: Swierczyna et al. (2008, 2009).

Kitchen Equipment

Kitchen Energy by End-Use: **Updated Assumptions**

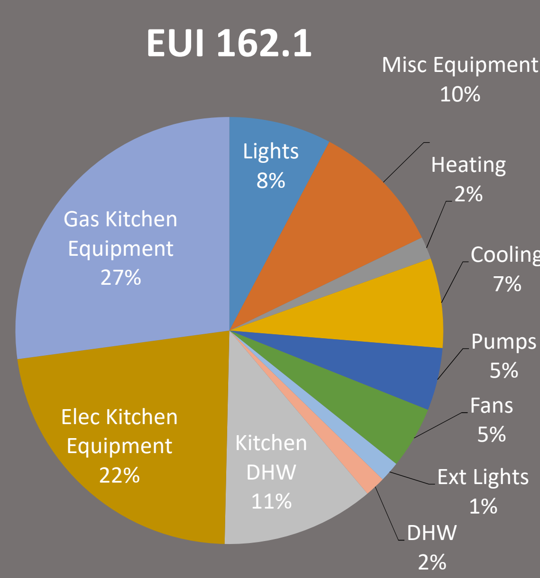


Kitchen Efficiency Charrette

Item	Standard Practice	Energy Use/PV Cost	Efficient Practice	Energy Use/PV Cost	Radical Energy Reduction	Energy Use/PV Cost
Walk in cooler/freezer	Air-cooled compressor with heat rejection to atmosphere or indoors		Water-cooled compressors using geothermal loop		Water-cooled compressors using geothermal loop and air side economizer. Refrigeration heat recovery to domestic hot water system	
TMA	Typical design is outdoor air cooled		Current design is indoor water cooled remote refrigeration		Heat recovery can be added to refrigeration system	
U/C Refrigerator	Standard Energy Star Equipment		Super-insulated refrigerators		Can food service be done in such a manner to limit the need of U/C refrigerator	
TMA	Energy star will be provided		Super-Insulated does not provide any substantial savings due to the typical operation of the unit (Opening/Closing Door, etc.		Undercounter Refrigeration can be eliminated. This will require additional labor with trips to the main cold storage room.	
Dish Machine	Water conserving dishwasher		Super low water use dishwasher		Super low water use dishwasher with heat recovery	
TMA			Super low unit will be specified		Units in the size proposed for this project are not available with heat recovery.	
Display Oven			Can this equipment be utilized to provide warm meals only twice a day		Can this equipment be utilizied to only provide one hot meal a day? Is a display oven required for a super efficeint food service facility	
TMA			Owner/Operator decision on quantity of hot meals served per day - factor pre heat time/operational training		High speed convection microwave oven could be a replacement. Owner/Operator decision	
Soda/Ice Dispenser					Is ice dispensing really required or can beverages be kept cold in the basement or refrigerators and only brought out just in time for meals? Can there be other drinks provided that do not require a soda machine? Is soda what a healthy campus should be serving as schools are pulling soda machines out of their cafeterias?	
TMA	Energy Star rated unit				Eliminate, Owner/Operator decision	

Modeling Chatham Commons: Updated Assumptions

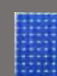
- Kitchen use: 16 hours/day, 7 days/week
- 3 meals per day for 150 students
- 1,500 gal/day hot water (dishwashing)
- Variable flow exhaust
- Remote refrigeration loop
- Induction range, griddle, and grooved griddle



Chatham Commons

EUI of 162.1: PV Breakdown

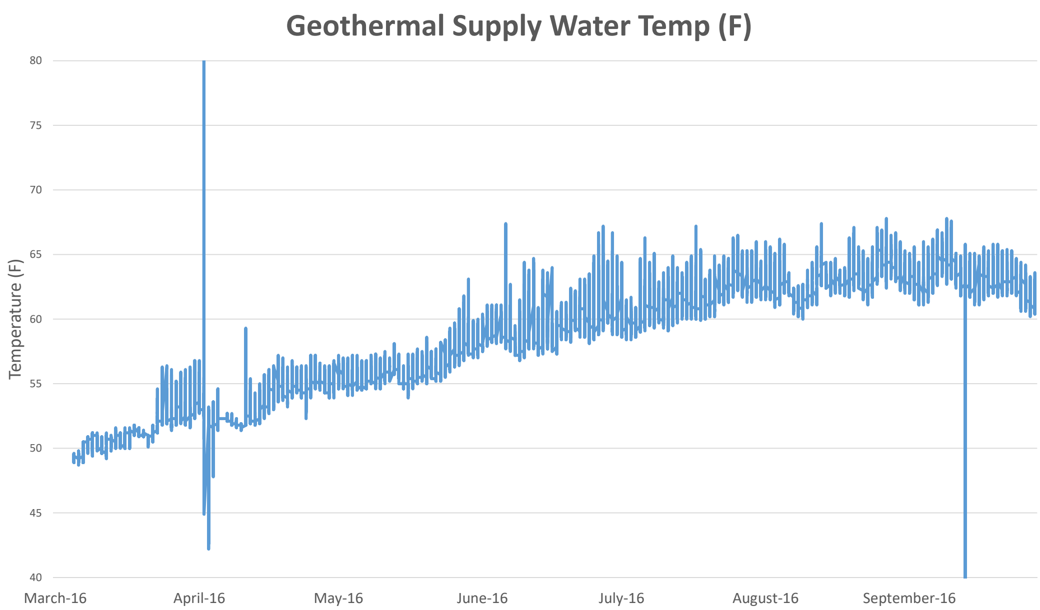
- Floor area = 20,000 ft^2
- 920,175 KWh
- Requires 865 KW of PV capacity, $3.46 Million (reduced by 50% from initial assumptions)


= 250 KW

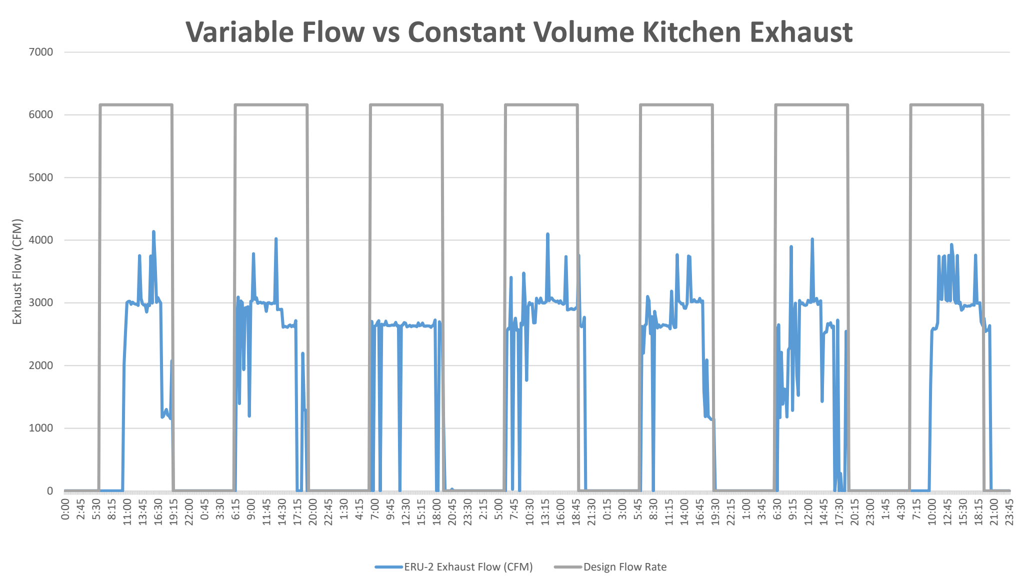
Strategies for Further Reduction

- Eliminate Hot Breakfast (11 hour/day use of equipment) → EUI = 142.7, PV = 761 KW
- Eliminate the Pizza Oven and Hot Breakfast → EUI = 126.8, PV= 676 KW
- Eliminate Pizza, Hot Breakfast, and Extreme Reduction of Equipment Use (8hrs/day) → EUI = 117.8, PV = 628 KW

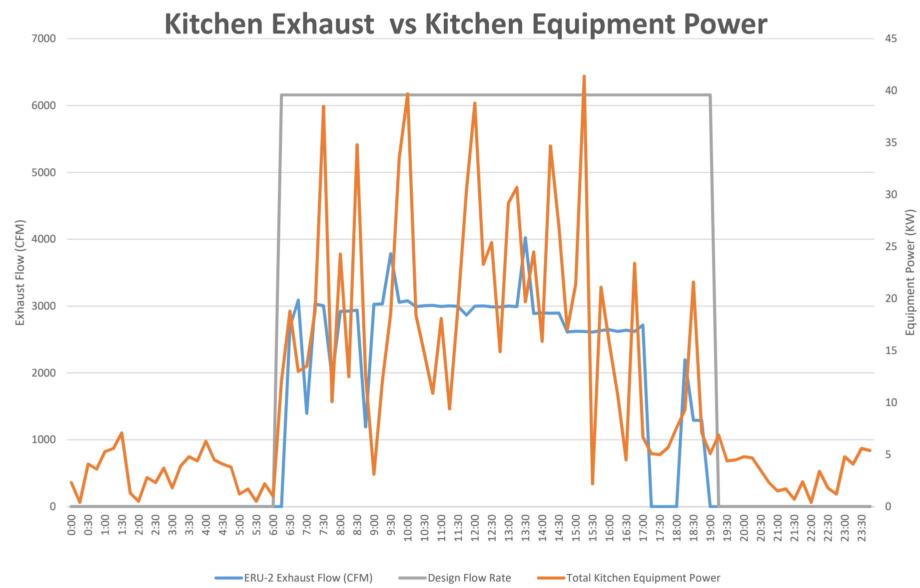
PRELIMINARY RESULTS



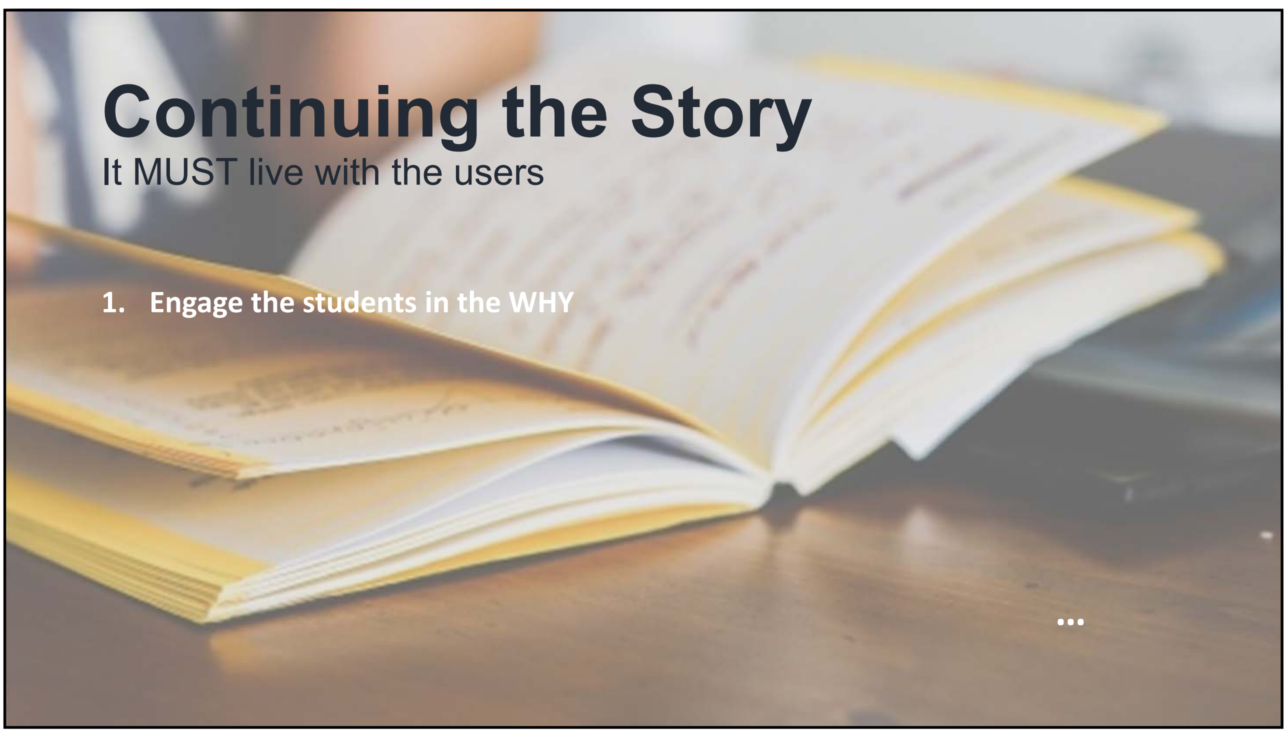
PRELIMINARY RESULTS



PRELIMINARY RESULTS




Continuing the Story
It MUST live with the users
…

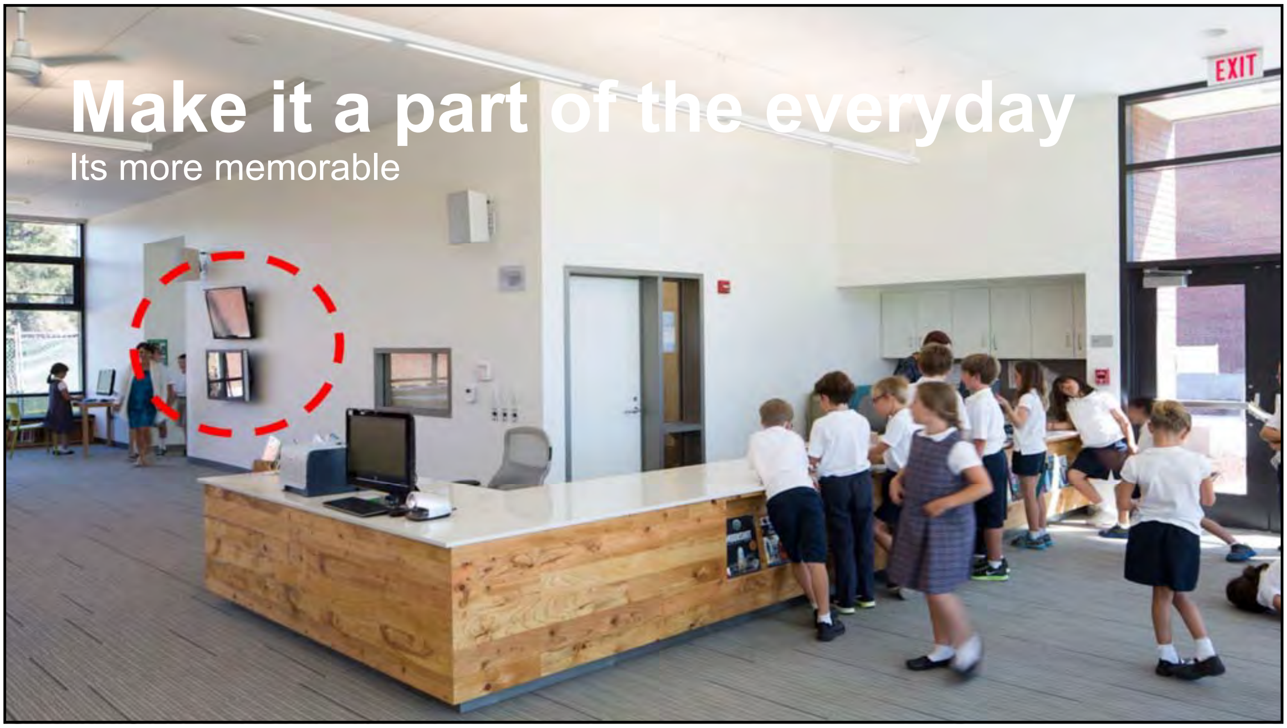

Continuing the Story
It MUST live with the users
1. Engage the students in the WHY
…

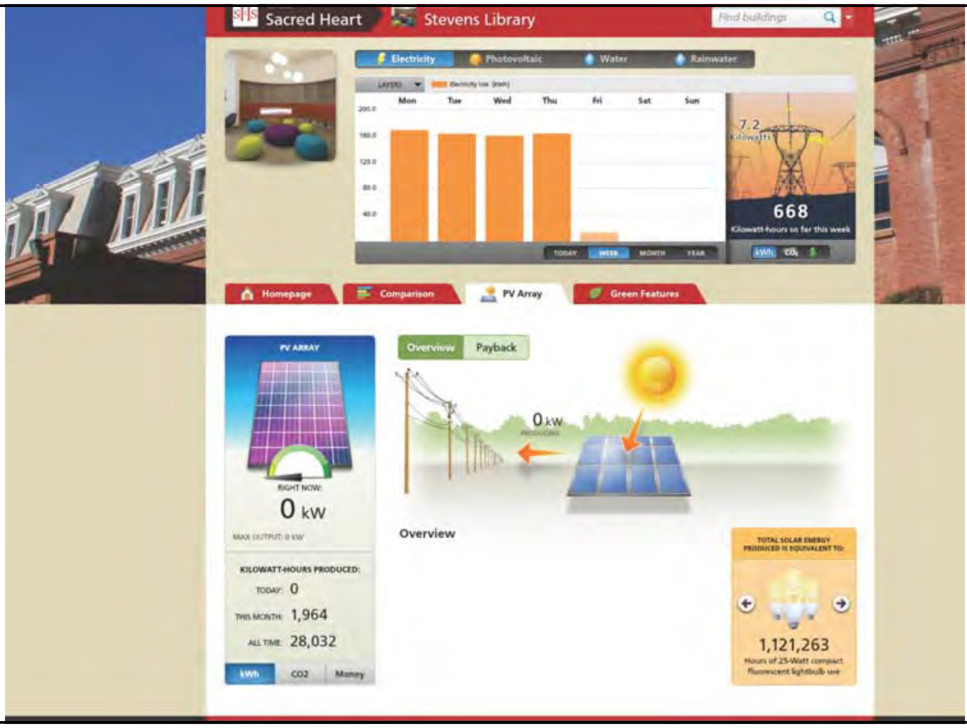

Start early in the engagement
Its more memorable

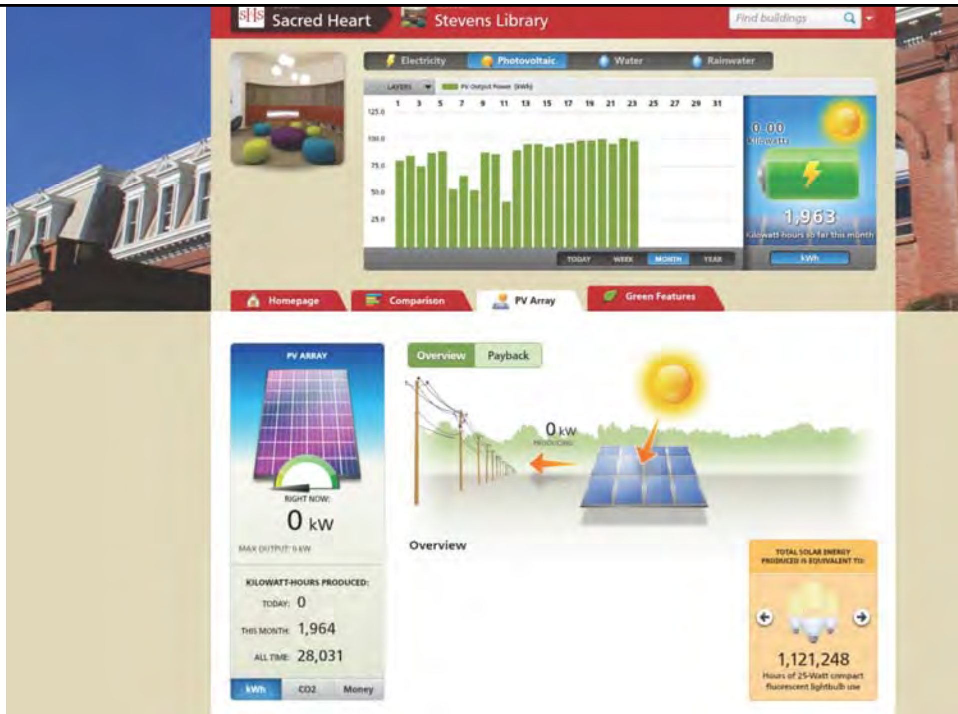

SHS Stevens Library - First Net Zero Certified Library and first CA School by ILFI

Make it a part of the everyday

Its more memorable



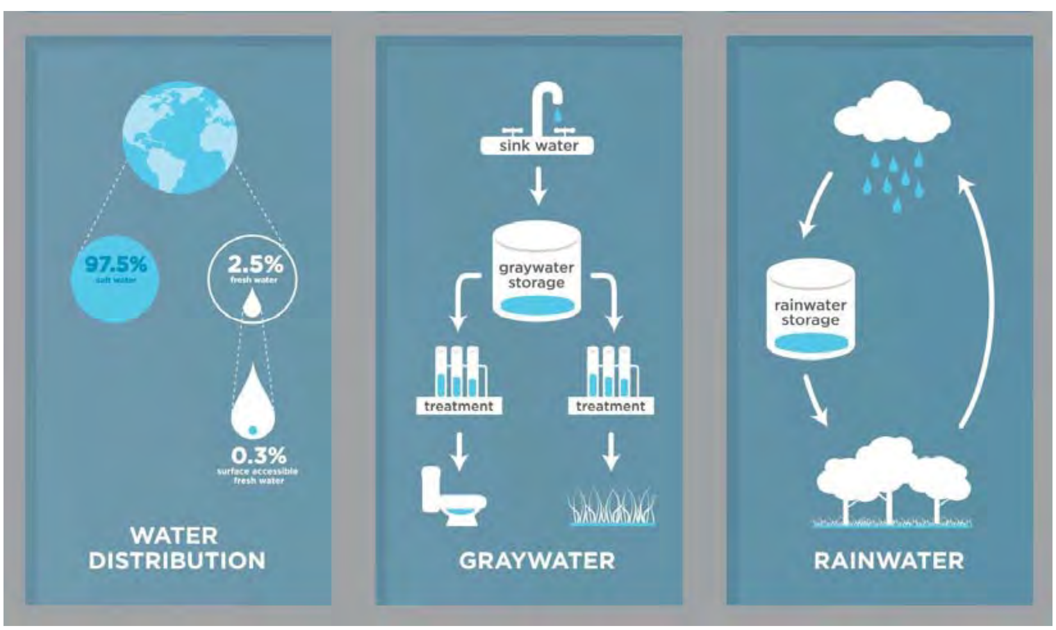



Sacred Heart
Stevens Library
Find buildings
Electricity
Photovoltaic
Water
Rainwater
0.00
Kilowatts
1,963
Kilowatt-hours so far this month
kWh
TODAY
WEEK
MONTH
YEAR
Homepage
Comparison
PV Array
Green Features
PV ARRAY
Overview
Payback
0 kW
RIGHT NOW:
0 kW
Overview
KILOWATT-HOURS PRODUCED:
TODAY: 0
THIS MONTH: 1,964
ALL TIME: 28,031
kWh
CO2
Money
TOTAL SOLAR ENERGY PRODUCED IS EQUIVALENT TO:
1,121,248
Hours of 25-Watt compact fluorescent lightbulb use

Make it a part of the everyday

Its more memorable

Water Conservation – the BIGGER picture



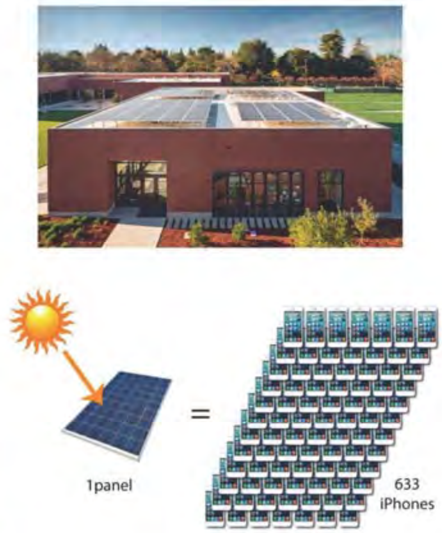

WELCOME PAULINE SOUZA.
Many many mini sessions
Shampoo, rinse, repeat

DO YOU KNOW...

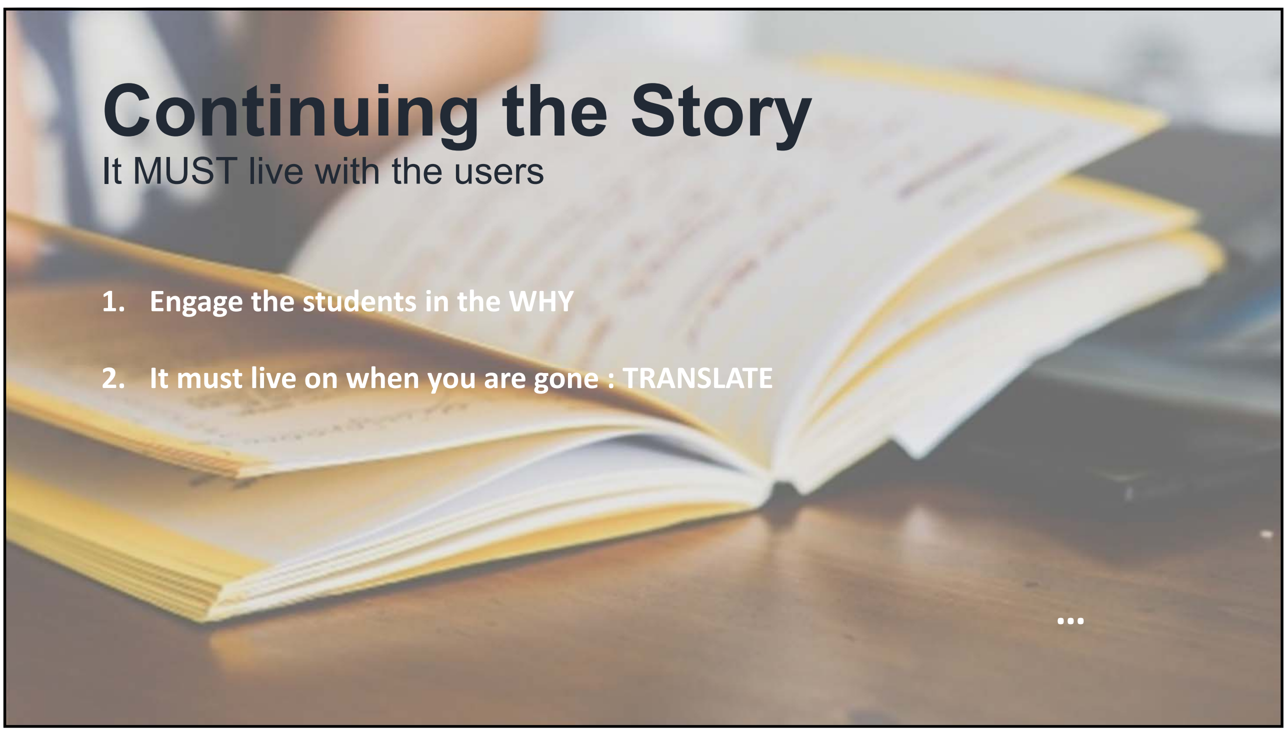
...where the rain goes when it falls?

DO YOU KNOW...

...what's on the roof of the library?




hat's on the roof of the library?


Continuing the Story
It MUST live with the users
1. Engage the students in the WHY
2. It must live on when you are gone : TRANSLATE
…

PROJECTED

- EUI 43 kBtu/sf (vs 63)
- PVs to NZ – 161 kW (345 w panel)
- W to W ratio: 37%; max daylight autonomy
- Operable windows reduced cooling demand by 25%; provide ventilation
- Stormwater/Rainwater supplies 88% of toilet flushing needs
- Green Roof filters 50% of rainwater falling on roof
- Greywater is filtered through stepped planters ; discharged to below grade dispersal trench per city code requirments

- Kitchen energy use reduction by 32 % (compared to baseline)
- Building water reduction by 36.4%
- Site water reduction by 61%
- Stormwater planters on site treat 7,817 gallons of site runoff
- Energy Star score 110 (vs 75)
- Total Energy use reduction by 38% (ASHRAE 2007)
- 100% reduction in carbon (vs51.4 metric tons)

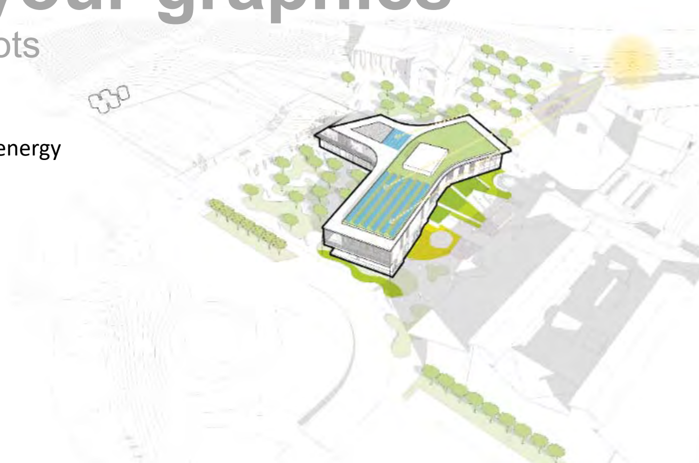
On going commitment

- Maker equipment energy budget
- Kitchen energy budget
- Material LBC purchase guide
- WELL policy guides

Share your graphics

Connect the dots

Reflect energy balance



…what falls on our site…

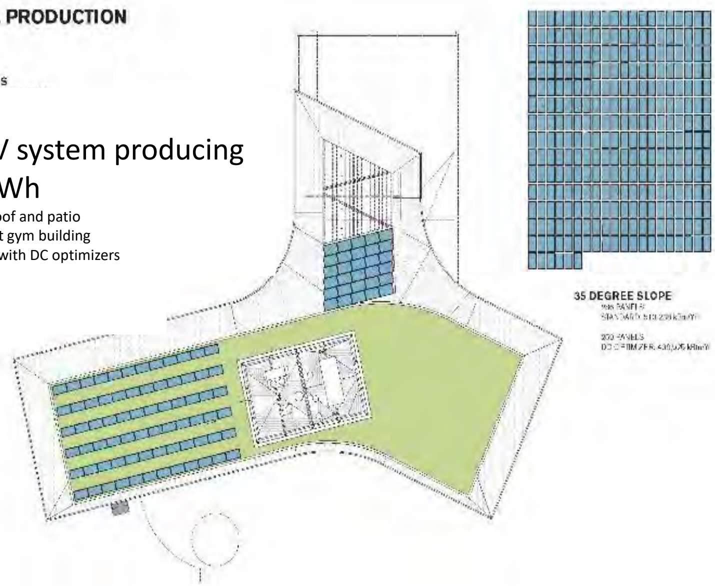
SONOMA ACADEMY

PV PANEL PRODUCTION
OPTION 1

USAGE NUMBERS

143 kW PV system producing 210,646 kWh

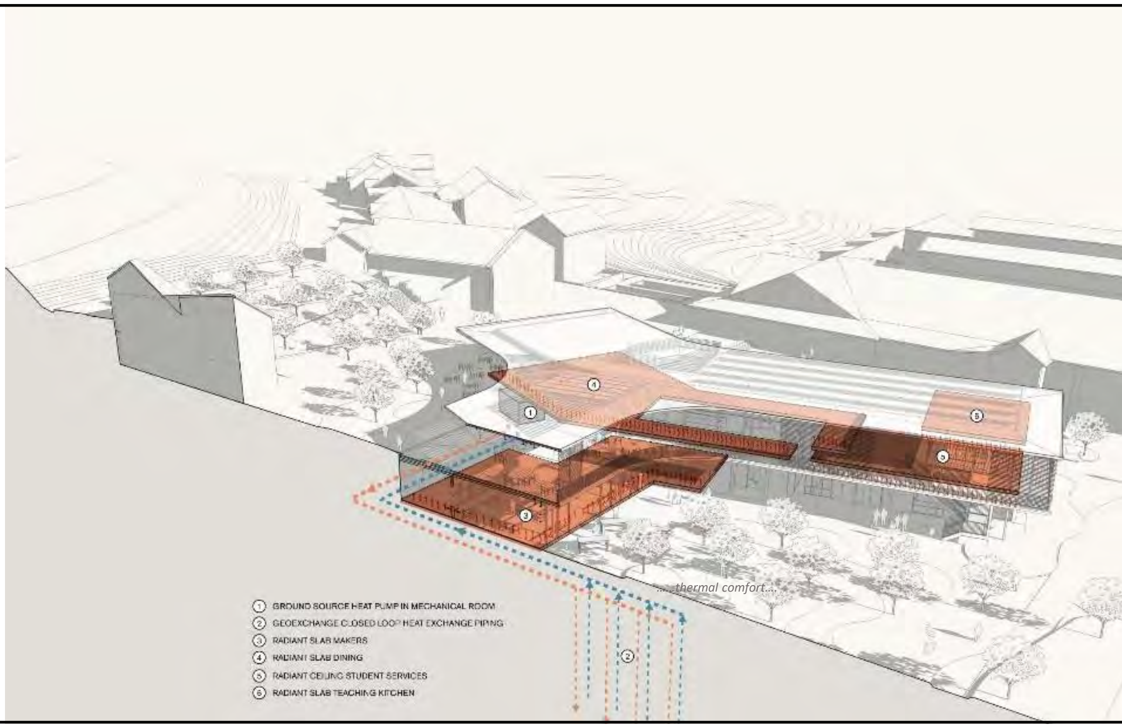
Placed over green roof and patio
Placed over adjacent gym building
Sunpower modules with DC optimizers
Safety factor of 13%



SONOMA ACADEMY

Share your graphics

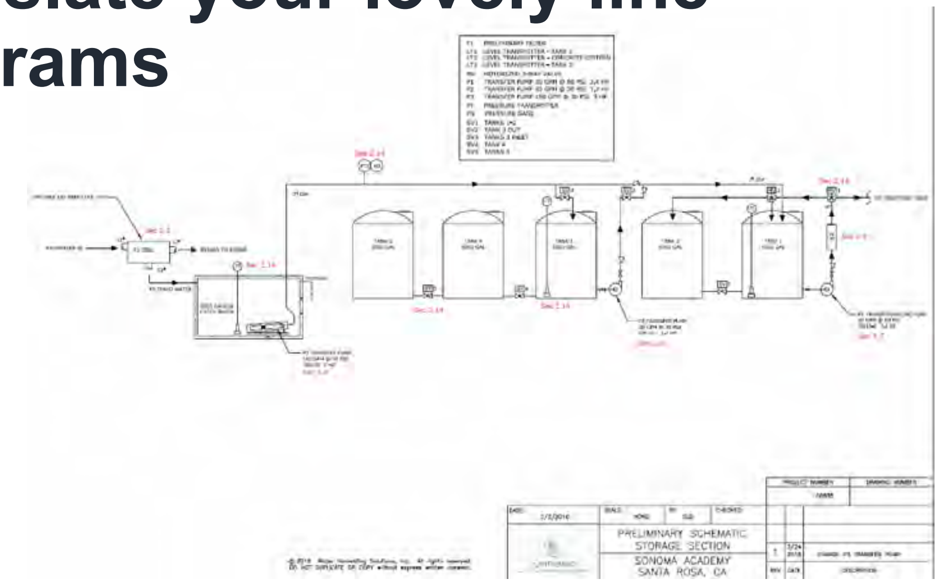
Its more memorable

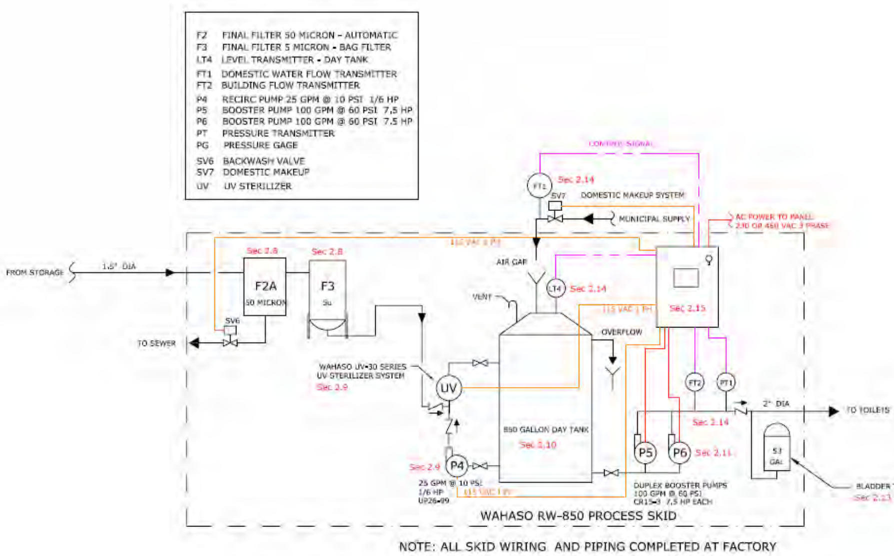


Share your graphics

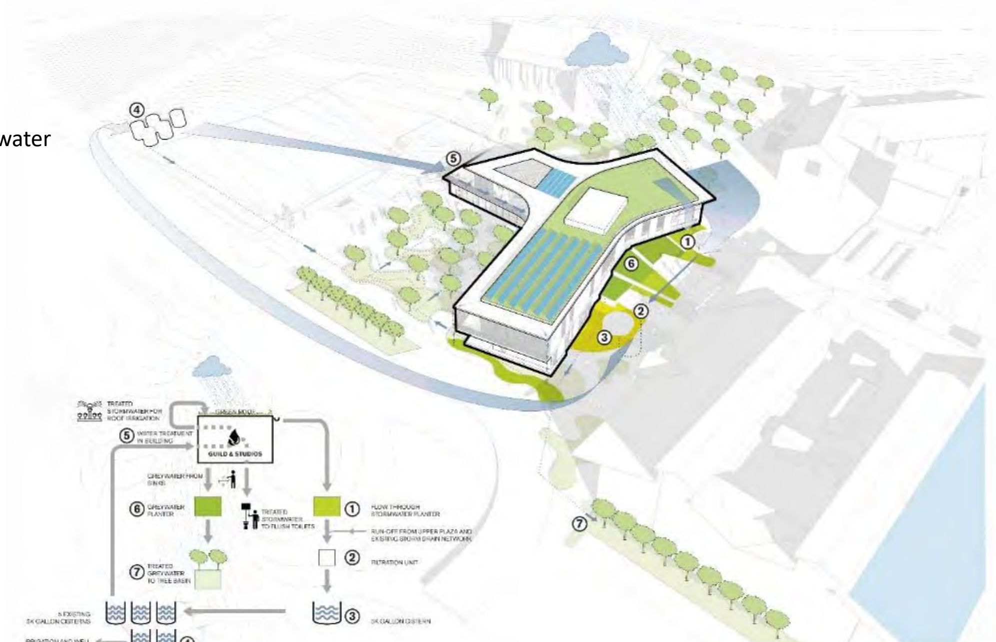
Connect the dots

Translate your lovely line diagrams



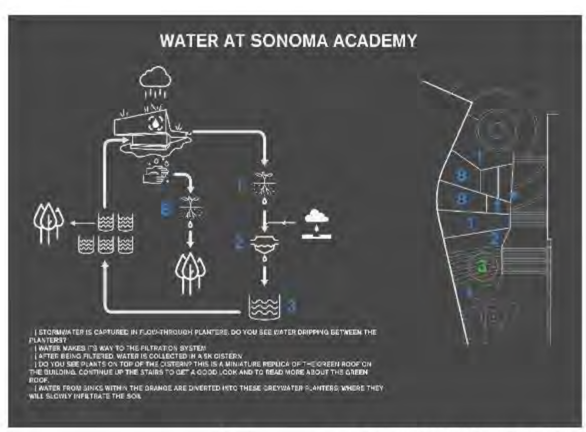


Reflect water balance



…what falls on our site…

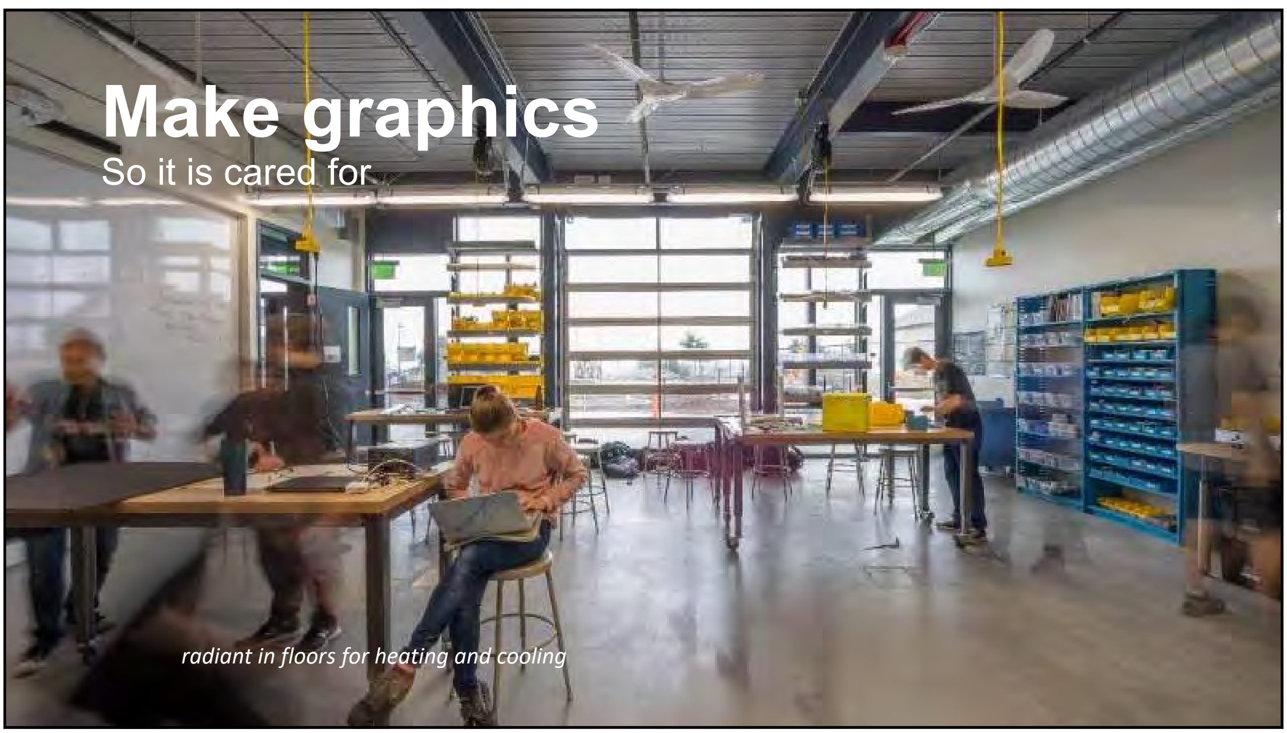
SONOMA ACADEMY



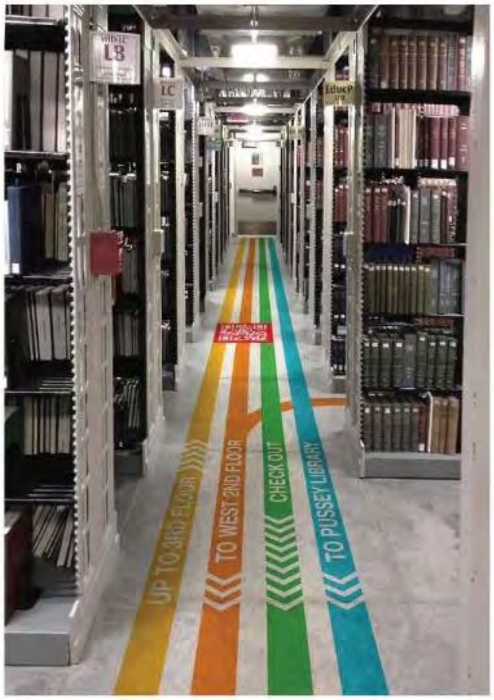
◆ LAND

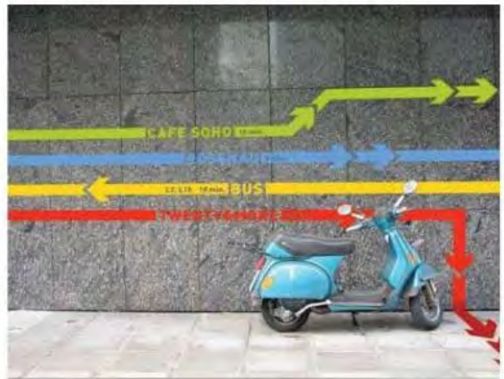
WATER STORY SIGNAGE | PRECEDENTS + STUDY

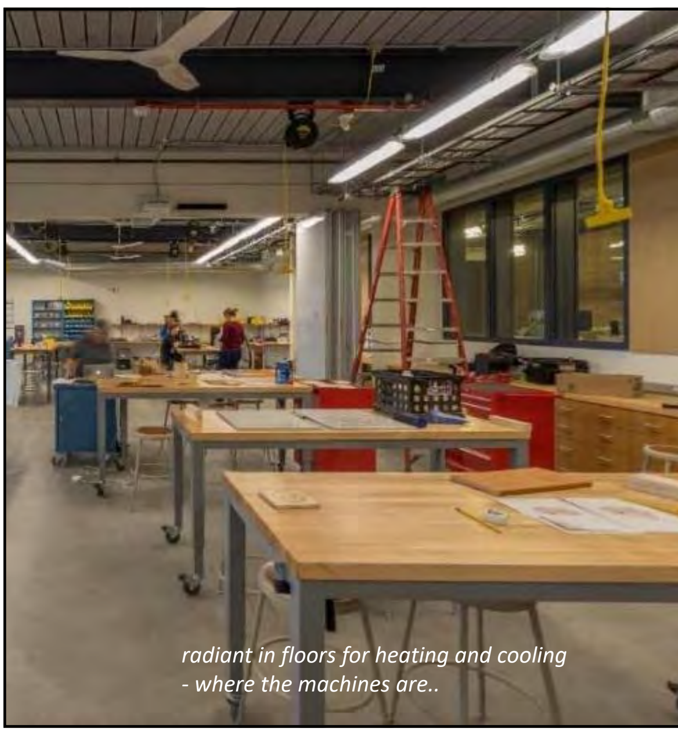

See how water moves through the site
How water and landscape and energy are connect
Everything does good service


Make graphics
So it is cared for
radiant in floors for heating and cooling

Radiant in concrete flooring

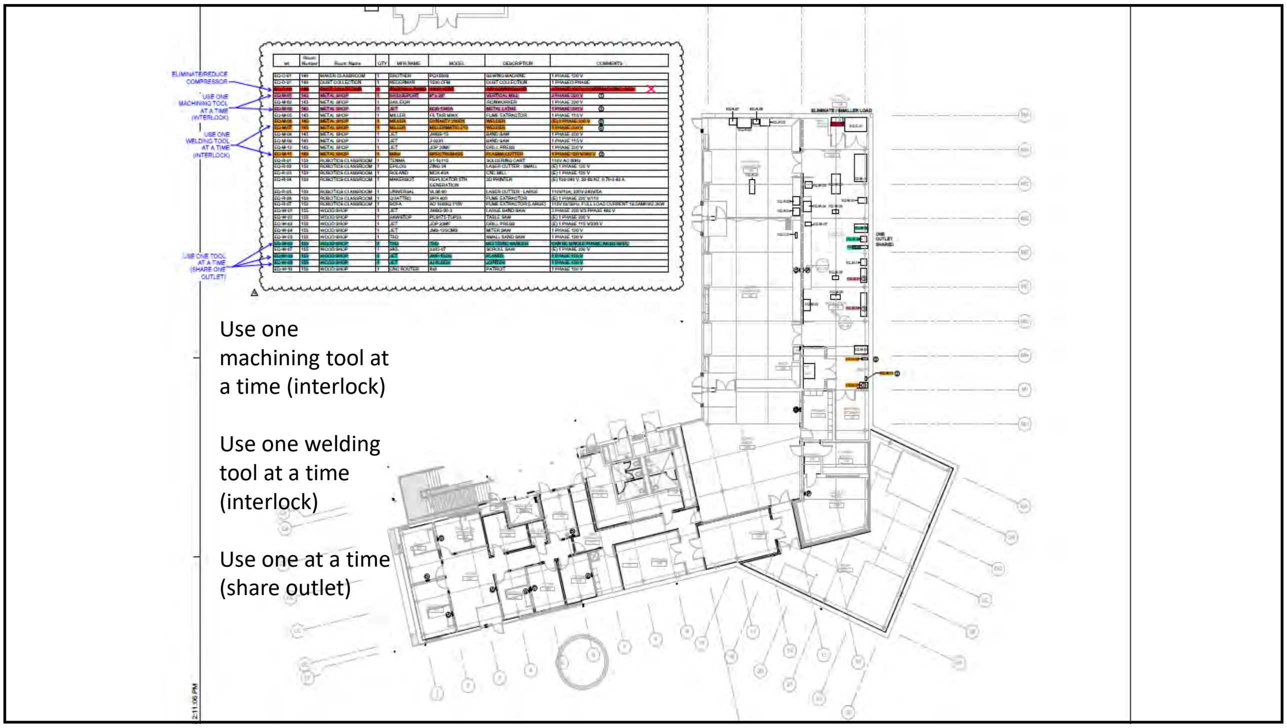






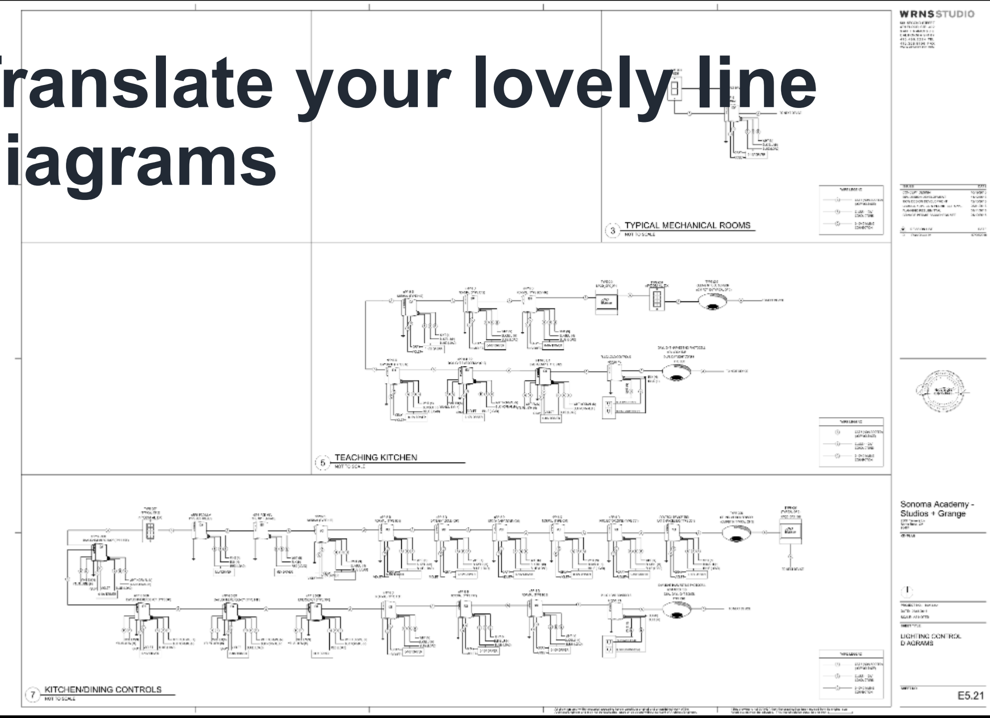
What is living with a net zero maker space like?

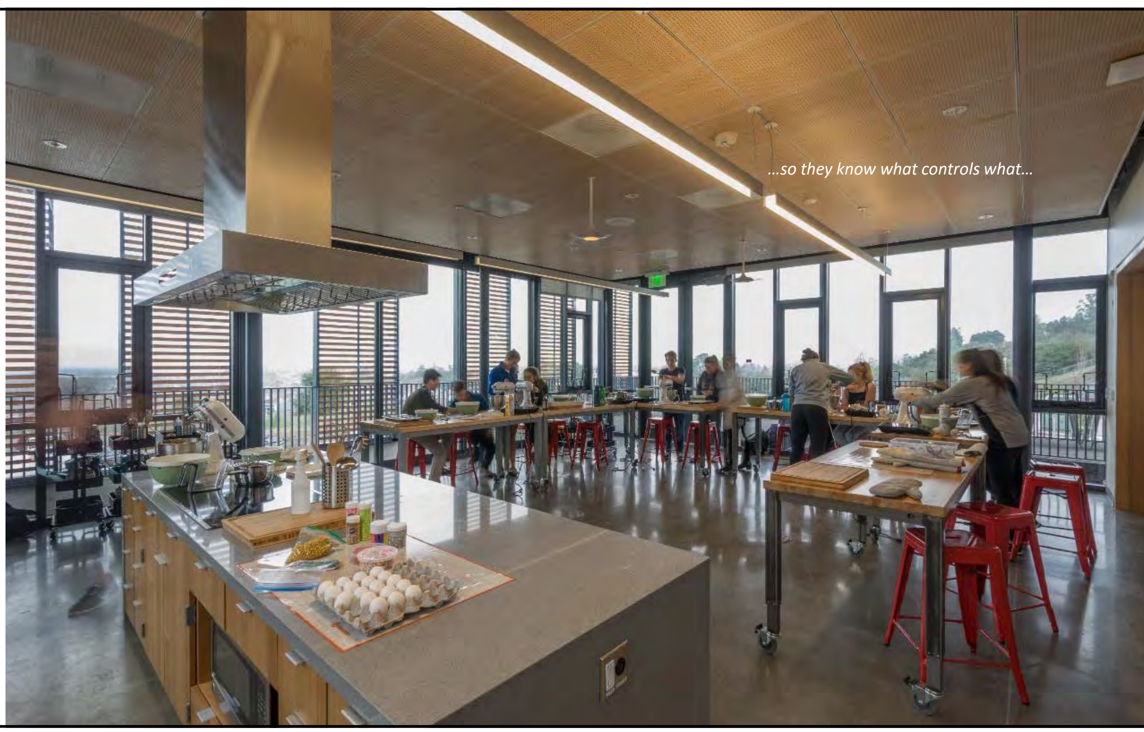
Color it for easy reading


Use one machining tool at a time (interlock)
Use one welding tool at a time (interlock)
Use one at a time (share outlet)


Boil it down
• Make it simple

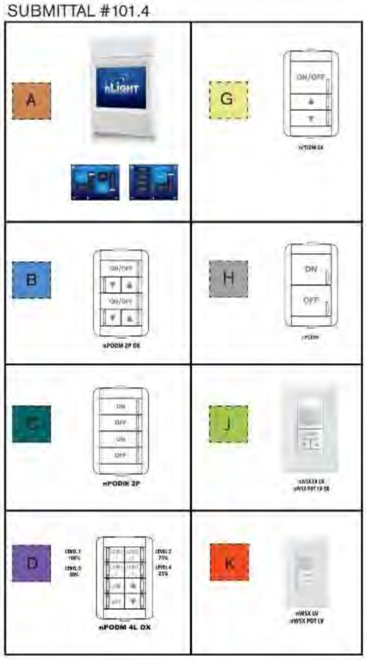
Translate your lovely line diagrams





…so they know what controls what…

SUBMITTAL #101.4



ELECTRICAL DRAWINGS

Q01 — PROGRAM SCENES FOR 25%, 50%, 75% AND 100% LIGHT OUTPUT. LABEL PRESETS IN TOUCH SCREEN. INCLUDE ON/OFF BUTTONS ON FIRST PAGE OF TOUCH SCREEN. PROVIDE ADDITIONAL PAGES FOR SLIDERS FOR EACH ZONE OVERRIDE IN THE IMMEDIATE AREA TO BE CONTROLLED.

Q03 — MANUAL ON, MANUAL RAISE/LOWER. VACANCY SENSOR SHOULD TURN LIGHTING OFF 30 MINUTES AFTER LAST MOTION IS DETECTED.

Q04 — MANUAL ON/OFF. TYPICAL FOR ALL MECHANICAL ROOMS.

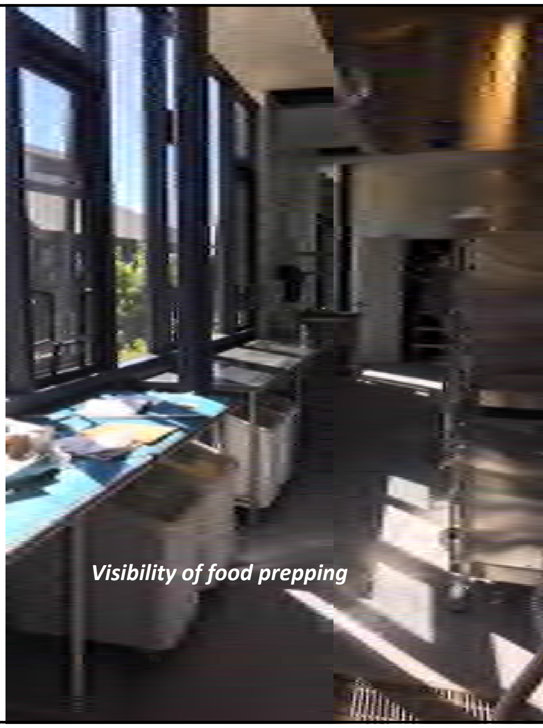
Q07 — PROGRAM LEVELS OF 25%, 50%, 75% AND 100% LIGHT OUTPUT. MANUAL RAISE LOWER. PROGRAM OCCUPANCY SENSOR TO TURN LIGHTS OFF 30 MINUTES AFTER LAST MOTION IS DETECTED.

Q08 — AUTO ON WITH MOTION/ AUTO OFF 15 MINUTES AFTER LAST MOTION IS DETECTED. TYPICAL OF RESTROOMS, STORAGE ROOMS AND INTERMITTENT OCCUPIED SPACES.

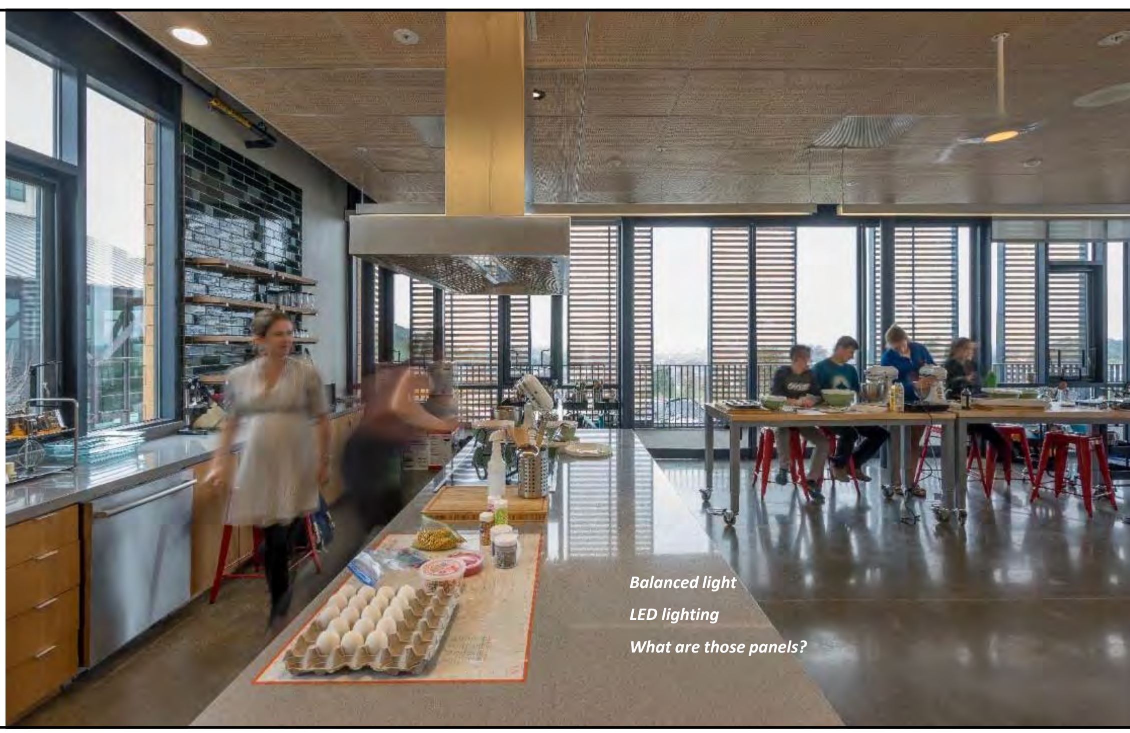

DINING TERRACE
DZ1- NORTH
DZ2- NORTH
DINING A
DZ2- SOUTH
DZ2- EAST
DZ1- EAST
DZ1- SOUTH
FOOD PREP
KITCHEN PREP
COLD STORAGE
DRY STORAGE
TEACHING KITCHEN
OFFICE
STAFF
TOILETS


Then they will notice and even ask….
Why were the shades ALWAYS down?

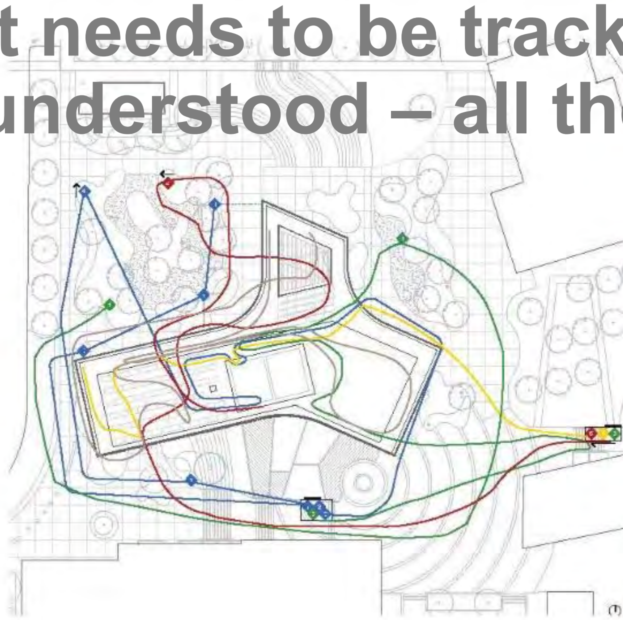

Do I use those shades?


Visibility of food prepping

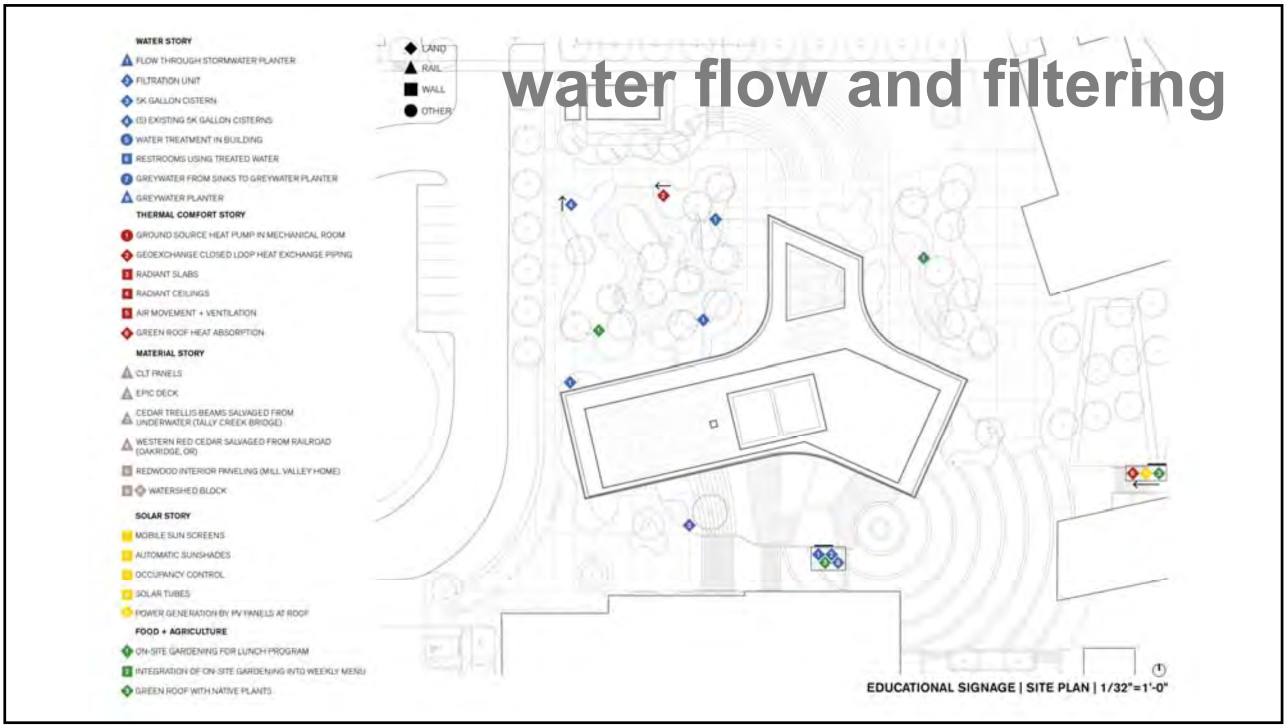

Daylight and views for
kitchen staff

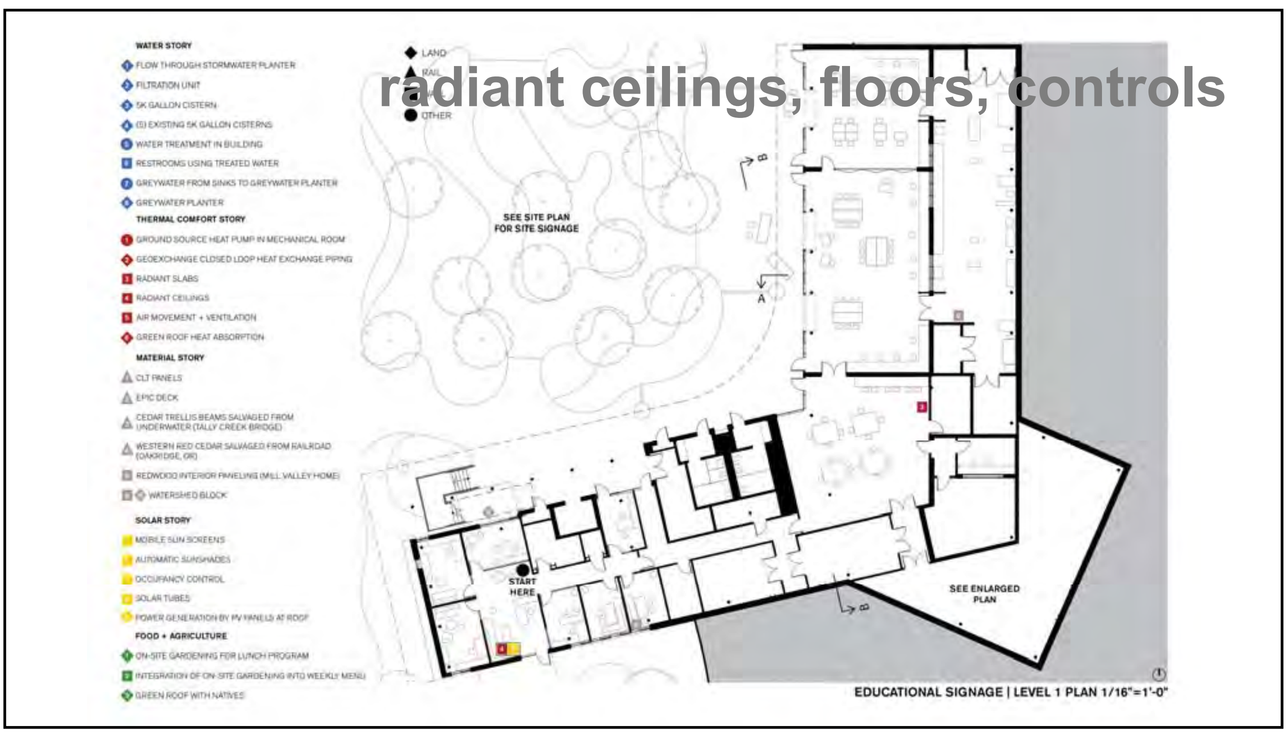

Balanced light
LED lighting
What are those panels?

It needs to be trackable and understood – all the time



OTHER EDUCATIONAL SCAVENGER HUNT | PRECEDENTS + STUDY


water flow and filtering
WATER STORY
FLOW THROUGH STORMWATER PLANTER
FILTRATION UNIT
5K GALLON CISTERN
(5) EXISTING 5K GALLON CISTERNS
WATER TREATMENT IN BUILDING
RESTROOMS USING TREATED WATER
GREYWATER FROM SINKS TO GREYWATER PLANTER
GREYWATER PLANTER
THERMAL COMFORT STORY
GROUND SOURCE HEAT PUMP IN MECHANICAL ROOM
GEOEXCHANGE CLOSED LOOP HEAT EXCHANGE PIPING
RADIANT SLABS
RADIANT CEILINGS
AIR MOVEMENT + VENTILATION
GREEN ROOF HEAT ABSORPTION
MATERIAL STORY
CLT PANELS
EPIC DECK
CEDAR TRELLIS BEAMS SALVAGED FROM UNDERWATER (TALLY CREEK BRIDGE)
WESTERN RED CEDAR SALVAGED FROM RAILROAD (OAKRIDGE, OR)
REDWOOD INTERIOR PANELING (MILL VALLEY HOME)
WATERSHED BLOCK
SOLAR STORY
MOBILE SUN SCREENS
AUTOMATIC SUNSHADES
OCCUPANCY CONTROL
SOLAR TUBES
POWER GENERATION BY PV PANELS AT ROOF
FOOD + AGRICULTURE
ON-SITE GARDENING FOR LUNCH PROGRAM
INTEGRATION OF ON-SITE GARDENING INTO WEEKLY MENU
GREEN ROOF WITH NATIVE PLANTS
LAND
RAIL
WALL
OTHER
EDUCATIONAL SIGNAGE | SITE PLAN | 1/32"=1'-0"


radiant ceilings, floors, controls
WATER STORY
FLOW THROUGH STORMWATER PLANTER
FILTRATION UNIT
5K GALLON CISTERN
(5) EXISTING 5K GALLON CISTERNS
WATER TREATMENT IN BUILDING
RESTROOMS USING TREATED WATER
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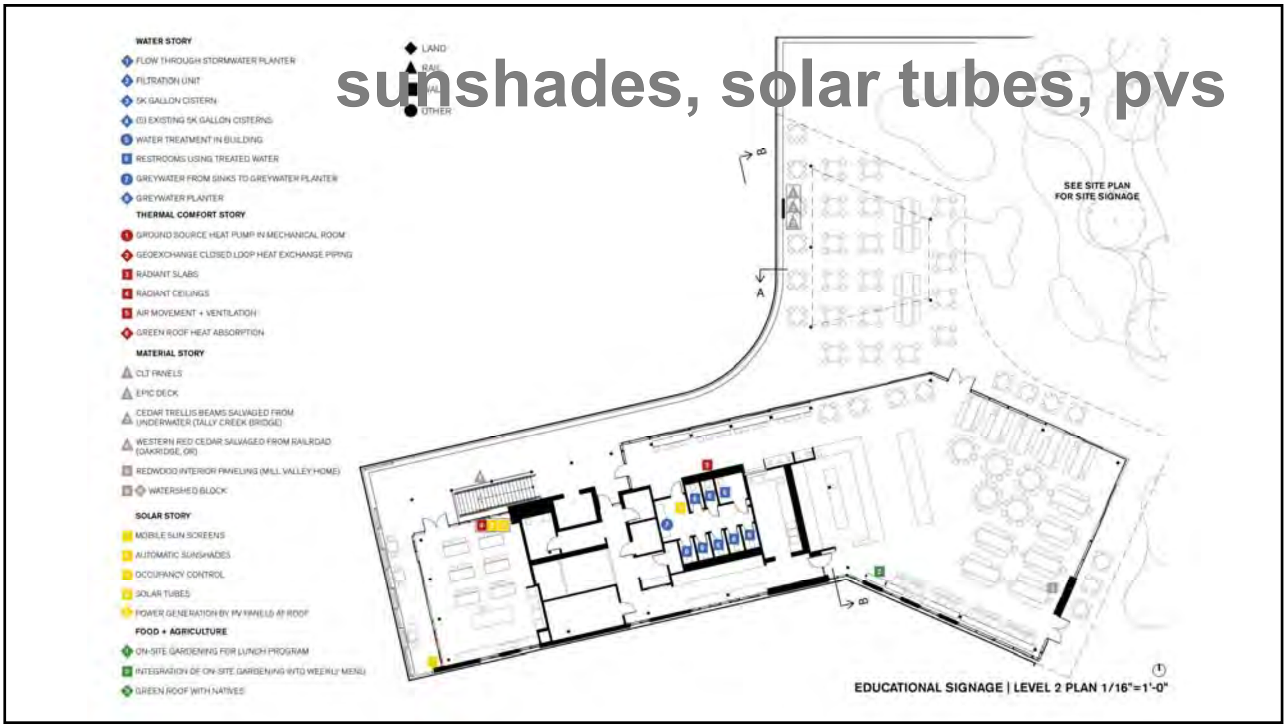
GREEN ROOF WITH NATIVES
LAND
RAIL
OTHER
SEE SITE PLAN FOR SITE SIGNAGE
START HERE
SEE ENLARGED PLAN
EDUCATIONAL SIGNAGE | LEVEL 1 PLAN 1/16"=1'-0"


sunshades, solar tubes, pvs
WATER STORY
FLOW THROUGH STORMWATER PLANTER
FILTRATION UNIT
5K GALLON CISTERN
(5) EXISTING 5K GALLON CISTERNS
WATER TREATMENT IN BUILDING
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ON-SITE GARDENING FOR LUNCH PROGRAM
INTEGRATION OF ON-SITE GARDENING INTO WEEKLY MENU
GREEN ROOF WITH NATIVES
LAND
RAIL
OTHER
SEE SITE PLAN FOR SITE SIGNAGE
EDUCATIONAL SIGNAGE | LEVEL 2 PLAN 1/16"=1'-0"


It needs to be trackable and understood – all the time
WATER STORY
FLOW THROUGH STORMWATER PLANTER
FILTRATION UNIT
5K GALLON CISTERN
(5) EXISTING 5K GALLON CISTERNS
WATER TREATMENT IN BUILDING
RESTROOMS USING TREATED WATER
GREYWATER FROM SINKS TO GREYWATER PLANTER
GREYWATER PLANTER
THERMAL COMFORT STORY
GROUND SOURCE HEAT PUMP IN MECHANICAL ROOM
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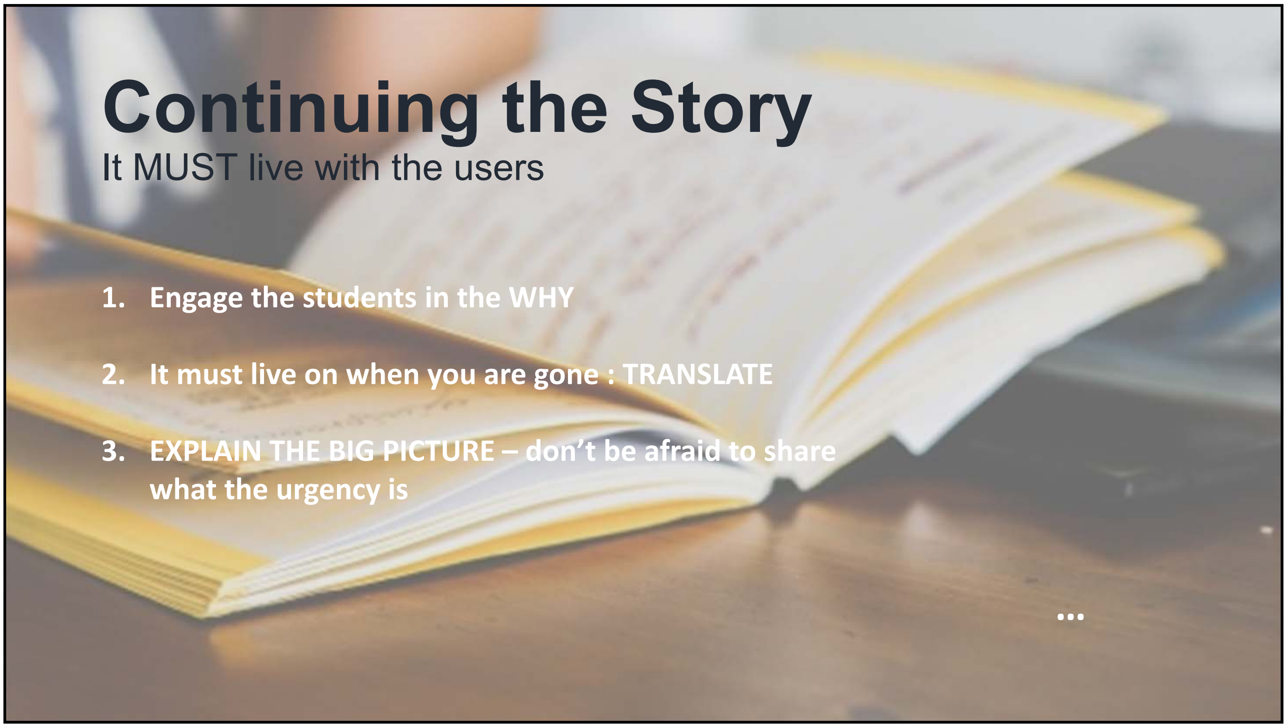
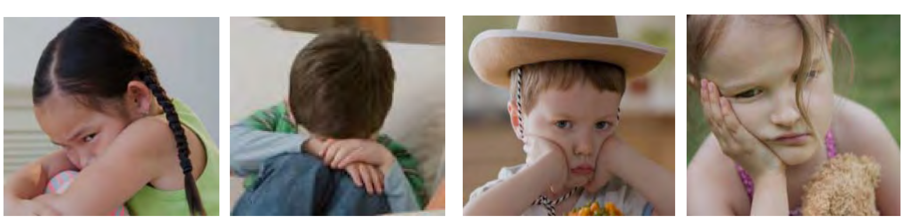
FOOD + AGRICULTURE
ON-SITE GARDENING FOR LUNCH PROGRAM
INTEGRATION OF ON-SITE GARDENING INTO WEEKLY MENU
GREEN ROOF WITH NATIVES
EDUCATIONAL SIGNAGE | MECHANICAL ROOM | 3/8"=1'-0"


Continuing the Story
It MUST live with the users
1. Engage the students in the WHY
2. It must live on when you are gone : TRANSLATE
3. EXPLAIN THE BIG PICTURE – don't be afraid to share what the urgency is
...

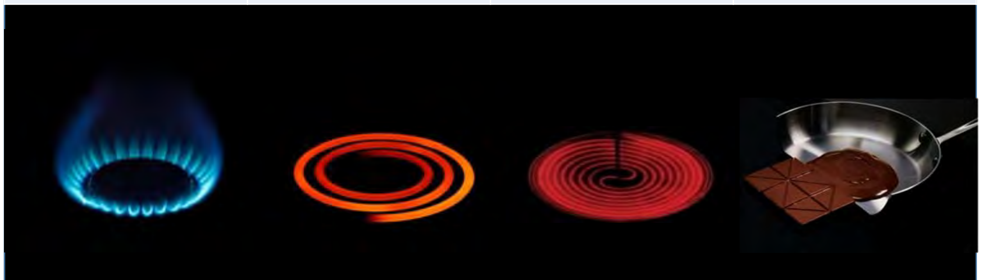

To truly reduce carbon impact...

Most chefs will not immediately agree



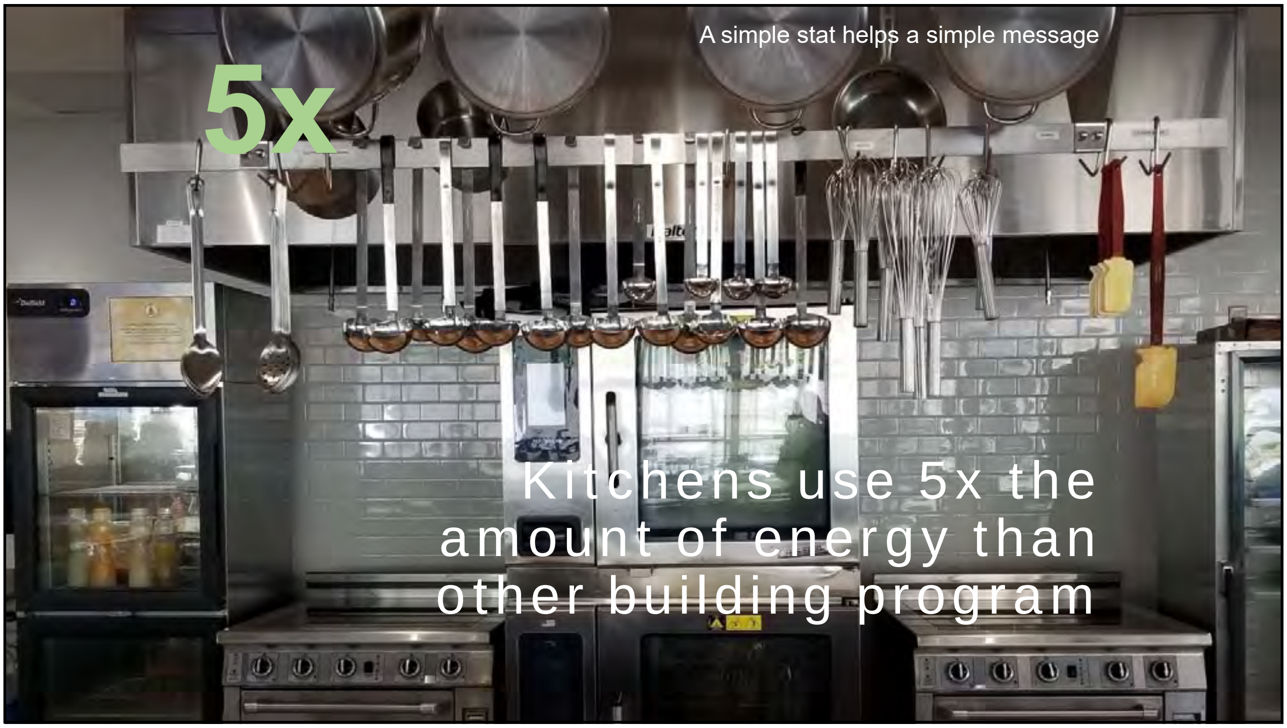
Range Energy Efficiency

Source: Natural Gas	Source: Electric Coil	Source: Electric Radiant	Source: Induction
Energy efficiency: 50%	Energy efficiency: 55%	Energy efficiency: 55%	**Energy efficiency: 90%**
Water boiling test (2qts): 8 minutes, 18 seconds	Water boiling test (2qts): 9 minutes, 50 seconds	Water boiling test (2qts): 9 minutes, 0 seconds	Water boiling test (2qts): **4 minutes, 46 seconds**



Source: http://www.bestinductioncooktopguide.com/what-is-induction-cooking/

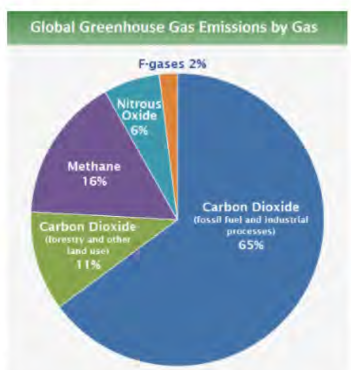
Even if there are good options out there



Global Emissions by Gas

At the global scale, the key greenhouse gases emitted by human activities are:

- **Carbon dioxide (CO_2)**: Fossil fuel use is the primary source of CO_2. CO_2 can also be emitted from direct human-induced impacts on forestry and other land use, such as through deforestation, land clearing for agriculture, and degradation of soils. Likewise, land can also remove CO_2 from the atmosphere through reforestation, improvement of soils, and other activities.
- **Methane (CH_4)**: Agricultural activities, waste management, energy use, and biomass burning all contribute to CH_4 emissions.
- **Nitrous oxide (N_2O)**: Agricultural activities, such as fertilizer use, are the primary source of N_2O emissions. Fossil fuel combustion also generates N_2O.
- **Fluorinated gases (F-gases)**: Industrial processes, refrigeration, and the use of a variety of consumer products contribute to emissions of F-gases, which include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).



Source: IPCC (2014) EXIT based on global emissions from 2010. Details about the sources included in these estimates can be found in the *Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. EXIT

CH_4

Coal, natural gas and oil production & transport

METHANE

CO_2

Burning of fossil fuels & chemical reactions (cement)

CARBON DIOXIDE

CFCs, HFCs, PFCs & HCFCs

N_2O

Agricultural and industrial activity + wastewater treatment

NITROUS OXIDE

Manmade, refrigerants

FLUORINATED GASES

H_2O

The stuff of life, balance, weather

WATER VAPOR

DRAWDOWN – GREENHOUSE GAS ATMOSPHERIC LIFE, CARBON BRIEF - GUARDIAN

APRIL 25, 2019

CO_2, by definition, has a GWP of 1

CH_4

Coal, natural gas and oil production & transport

METHANE

CO_2

Burning of fossil fuels & chemical reactions (cement)

CARBON DIOXIDE

CFCs, HFCs, PFCs & HCFCs

N_2O

Agricultural and industrial activity + wastewater treatment

NITROUS OXIDE

Manmade, refrigerants

FLUORINATED GASES

H_2O

The stuff of life, balance, weather

WATER VAPOR

DRAWDOWN – GREENHOUSE GAS ATMOSPHERIC LIFE, CARBON BRIEF - GUARDIAN

APRIL 25, 2019

Methane (CH_4) is estimated to have a GWP of 28–36

CO_2, by definition, has a GWP of 1

CH_4

Coal, natural gas and oil production & transport

METHANE

CO_2

Burning of fossil fuels & chemical reactions (cement)

CARBON DIOXIDE

CFCs, HFCs, PFCs & HCFCs

N_2O

Agricultural and industrial activity + wastewater treatment

NITROUS OXIDE

Manmade, refrigerants

FLUORINATED GASES

H_2O

The stuff of life, balance, weather

WATER VAPOR

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APRIL 25, 2019

Methane (CH_4) is estimated to have a GWP of 28–36

CO_2, by definition, has a GWP of 1

CH_4

12 years

METHANE

CO_2

20-200 years

CARBON DIOXIDE

CFCs, HFCs, PFCs & HCFCs

N_2O

114 years

NITROUS OXIDE

<1 – 1000's of years

FLUORINATED GASES

H_2O

Hours to days

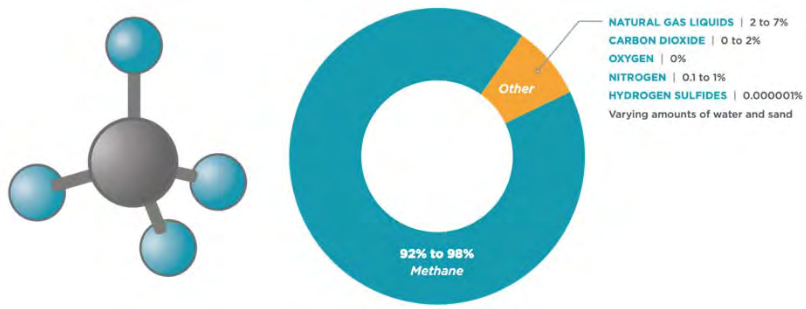
WATER VAPOR

DRAWDOWN – GREENHOUSE GAS ATMOSPHERIC LIFE, CARBON BRIEF - GUARDIAN

APRIL 25, 2019

A simple graphic helps a simple message

~~Natural Gas~~ Methane



But the fact that natural gas burns cleaner than other combustible fuels doesn't mean that it's *clean*. The reason why can largely be summed up in one word: methane

https://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/environmental-impacts-of-natural-gas

https://www.nrdc.org/onearth/natural-gas-industry-has-methane-problem

Not good for clean air

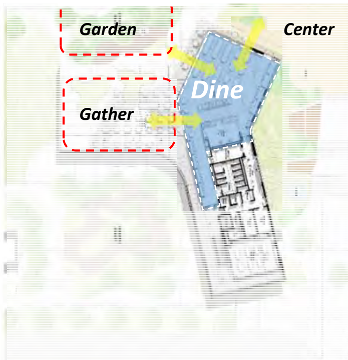
Leakage Attributed to California Natural Gas Demand

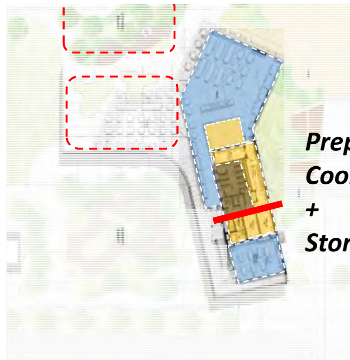
	Portion of CA Supply	Leak Rate Used (% of Production)	Leak Rate Sources	Total Production in Study Area (Billion Cubic Feet)
Permian	13.0%	2.2% [no range]	Presto 2017	2[illegible]
San Juan	3.0%	3.1% [2.6 - 3.5%]	Kort 2014, Frankenburg 2015	1,300
Anadarko	13.0%	1.6% [0.6 - 2.0%]	Miller 2013, Presto 2017	1,500
Western Canada	0.01%	0.6% [no range]	Atherton 2017	951
Rocky Mountains	31.5%	4.1% [1.1 - 5.6%]	Petron 2014, Petron 2012, Robertson 207	600
Southwest Wyoming	26.0%	0.38% [0.12 - 0.86%]	Brantley 2014, Robertson 2017	516
California	10.0%	*CEC full lifecycle used*	*CEC Study*	*Lifecycle used*

3.6% [2.4 - 4.3%]

BUILDING DECARBONIZATION COALITION

A budget led by efficiency…

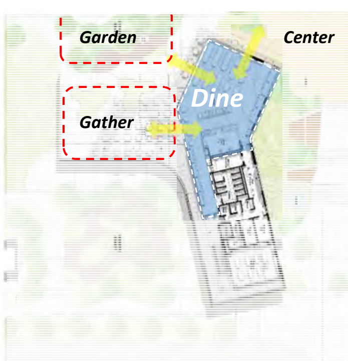


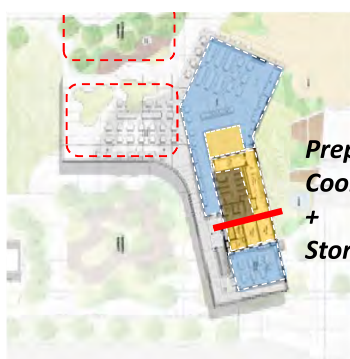


Dining area

Store, Prep, Make

A budget led by efficiency…





Dining area

Store, Prep, Make

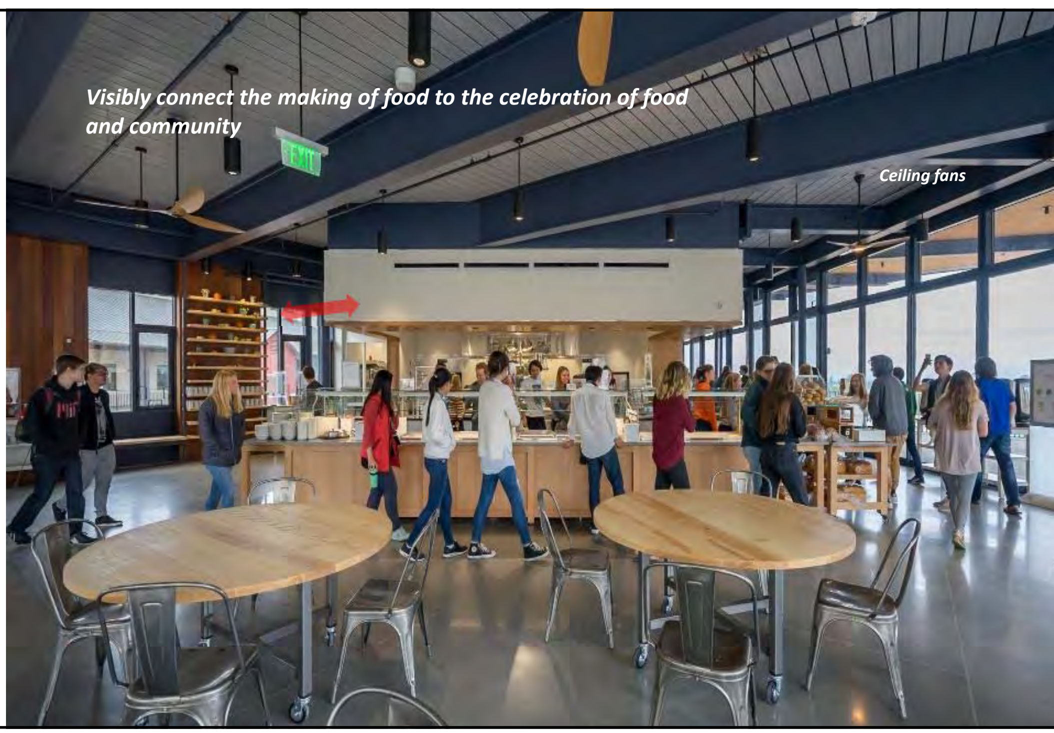
and health…

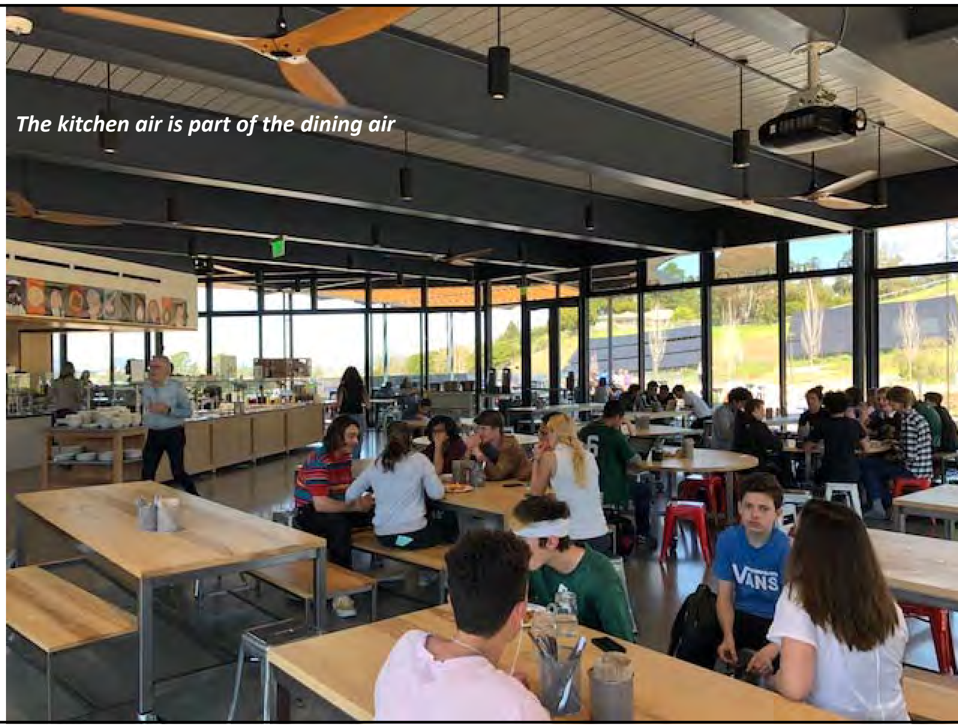
Example – Food Service

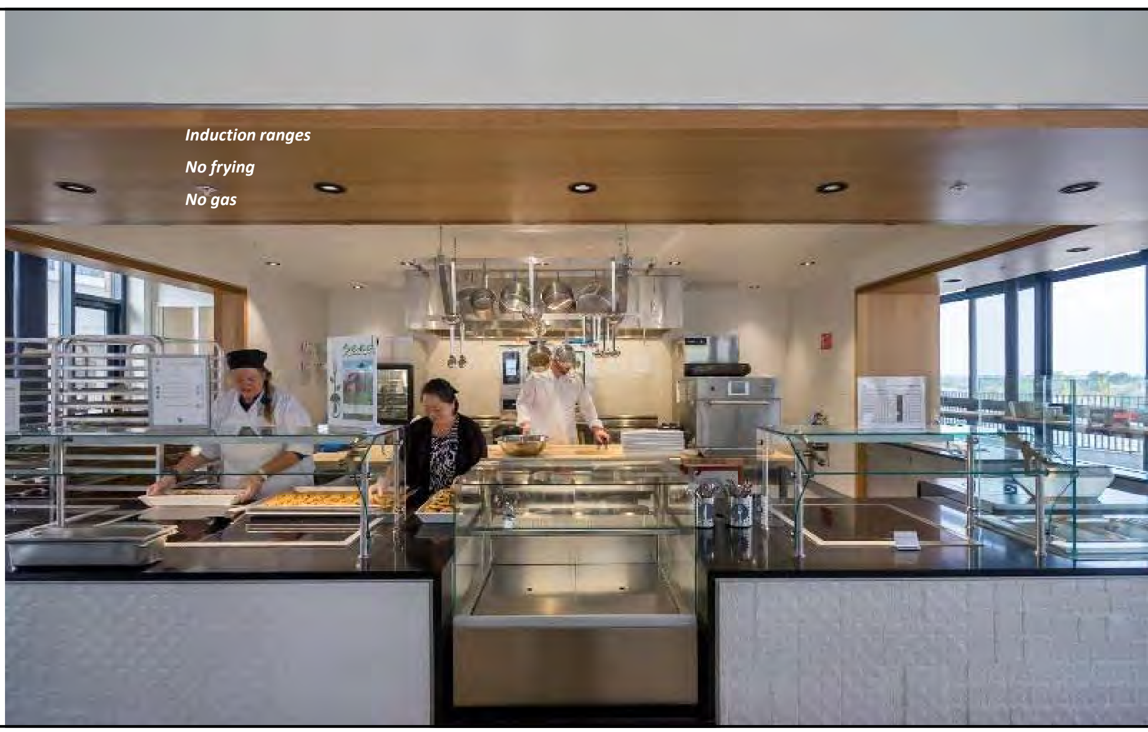
- Modeling each specific end use by equipment
- Kitchen and Menu Charrette

Table 9 Kitchen Equipment Use Estimates provided by Flik Hospitality

			Minimal Usage		Moderate Usage		Heavy Usage	
Item #	QTY	Description	Hours/day	days/wk	Hours/day	days/wk	Hours/day	days/wk
6	1	30QT MIXER	2	1	2.5	3	4	3
10	1	SLICER	1	5	1.5	5	2	5
16	1	STEAMER	2	3	2.5	5	4	5
17	1	25 GAL TILT KETTLE	3	3	4	5	6	5
18	1	30 GAL TILT SKILLET	3	3	4	4	6	5
23	1	HOT WATER SANITIZING DOOR-TYPE DISHWASHER	2	5	3	5	4	5
34	2	30" ELECTRIC INDUCTION TOP RANGE w/ CONVECTION OVEN	3	5	4	5	6	5
35.1	1	COMBI OVEN, ELECTRIC	3	5	5	5	8	5
35.2	1	COMBI OVEN, STEAMER	3	5	4	5	6	5
39	1	MERRYCHEF OVEN	2	5	3	5	4	5
43	1	COLD PAN, DROP-IN	2	5	3	5	4	5
44	1	HEATED SHELF, DROP-IN	2	5	2.5	5	3	5
45	2	COLD PAN, DROP-IN	1.5	5	2	5	3	5
46	1	COOKING SYSTEM, INDUCTION HEAT	2	5	3	5	5	5
47	1	COLD PAN, NARROW, DROP-IN	1.5	5	2	5	3	5
48	1	HEATED SHELF, DROP-IN	1.5	5	2	5	3	5
49	1	HEATED SHELF, DROP-IN	1.5	5	2	5	3	5
53	2	SOUP WELL, DROP-IN, INDUCTION	1.5	5	2	5	3	5
54	3	COLD PAN, DROP-IN	2	5	3	5	4	5




The kitchen air is part of the dining air
VANS

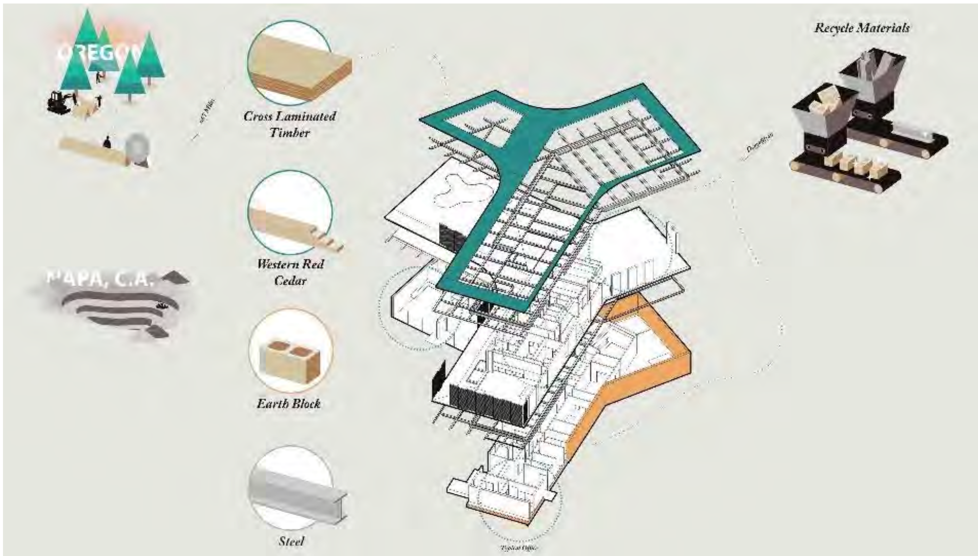

Induction ranges
No frying
No gas


Visibly connect the making of food to the celebration of food
and community AND HEALTHY AIR!


Many many mini sessions
Shampoo, rinse, repeat


Many many mini sessions
Shampoo, rinse, repeat

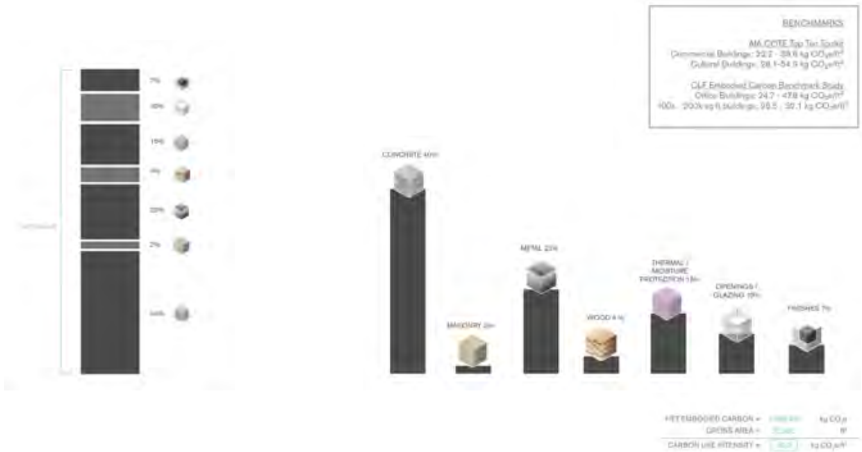

Map it
Graphically
make it stick


OREGON
NAPA, C.A.
Cross Laminated Timber
Western Red Cedar
Earth Block
Steel
Recycle Materials

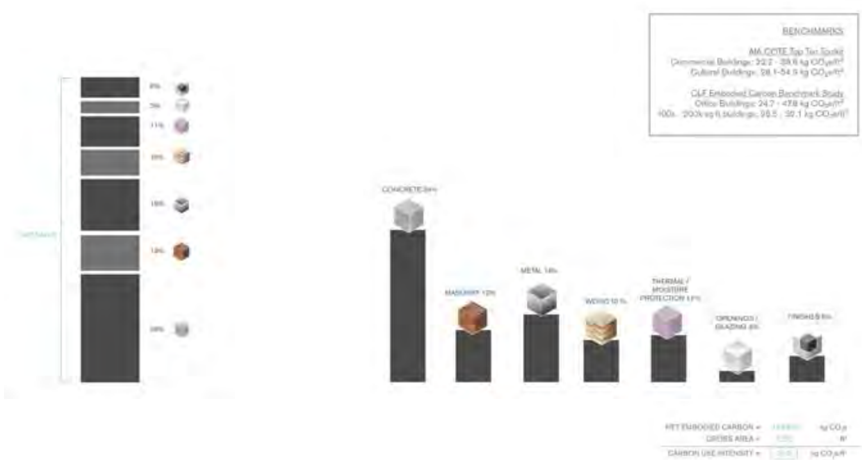

WASHINGTON
MONTANA
OREGON
IDAHO
NEVADA
UTAH
CALIFORNIA
ARIZONA

source

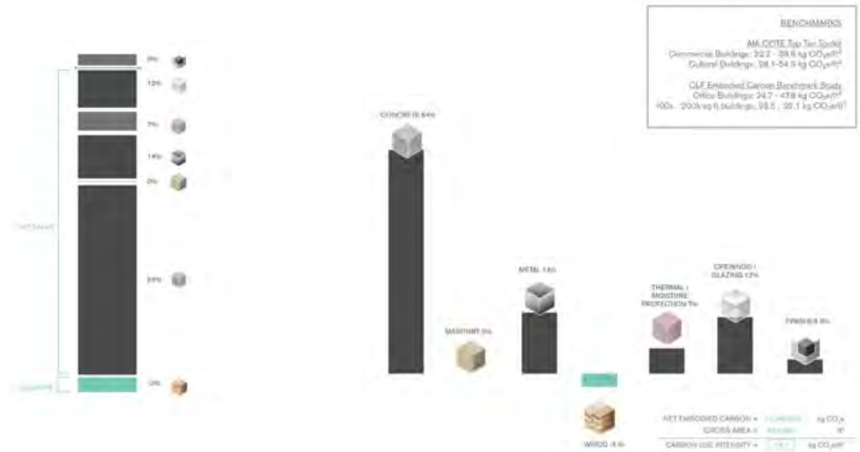
SONOMA ACADEMY STUDIOS
+ GRANGE

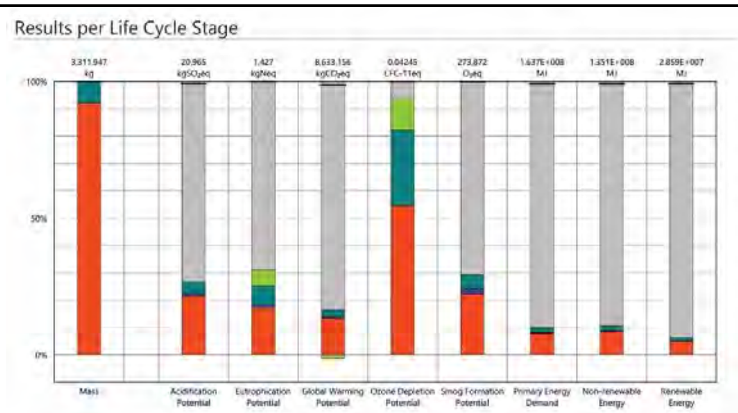


SHS STEVENS LIBRARY



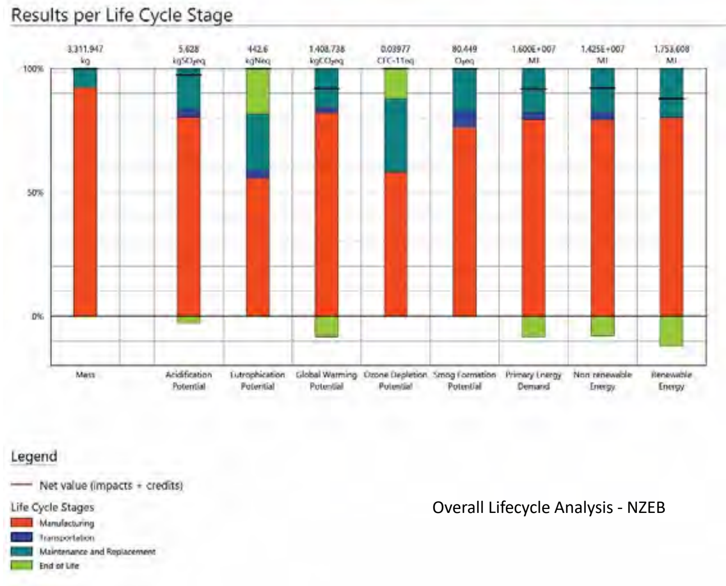
SILICON VALLEY CAMPUS



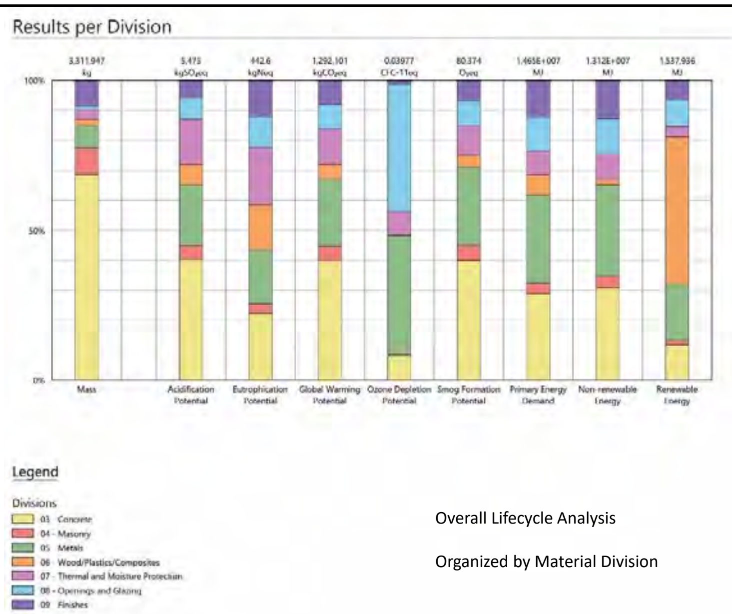


Overall Lifecycle Analysis

Assumption – all operational energy comes from CA power grid



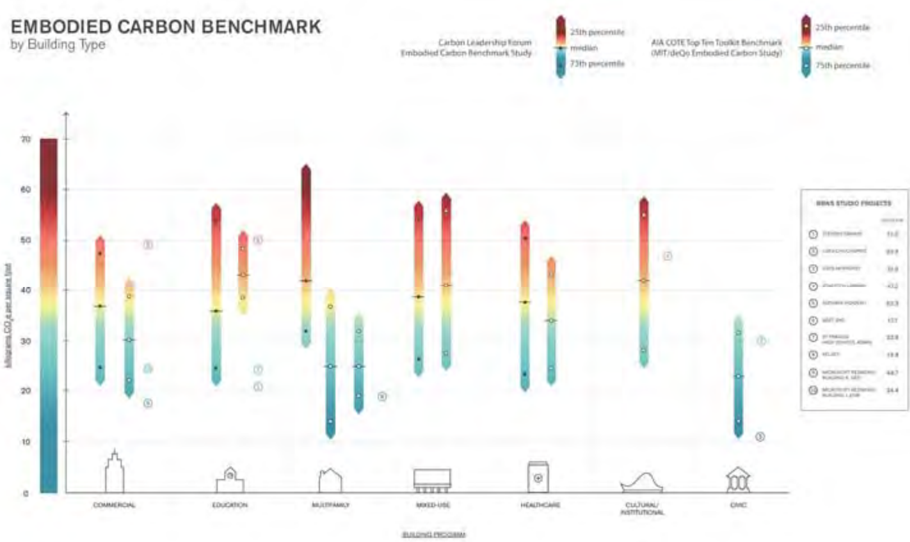
Overall Lifecycle Analysis - NZEB

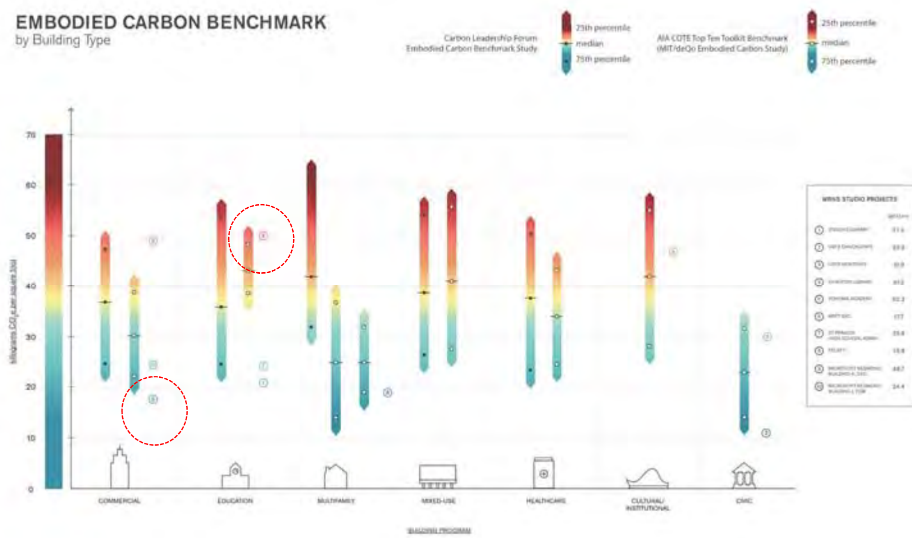


Overall Lifecycle Analysis

Organized by Material Division


Track It
Tap into the competitive streak


EMBODIED CARBON BENCHMARK
by Building Type
25th percentile
median
75th percentile
70
60
50
40
30
20
10
0
COMMERCIAL
EDUCATION
MULTIFAMILY
MIXED-USE
HEALTHCARE
CULTURAL/
INSTITUTIONAL
CIVIC
BUILDING PROGRAM

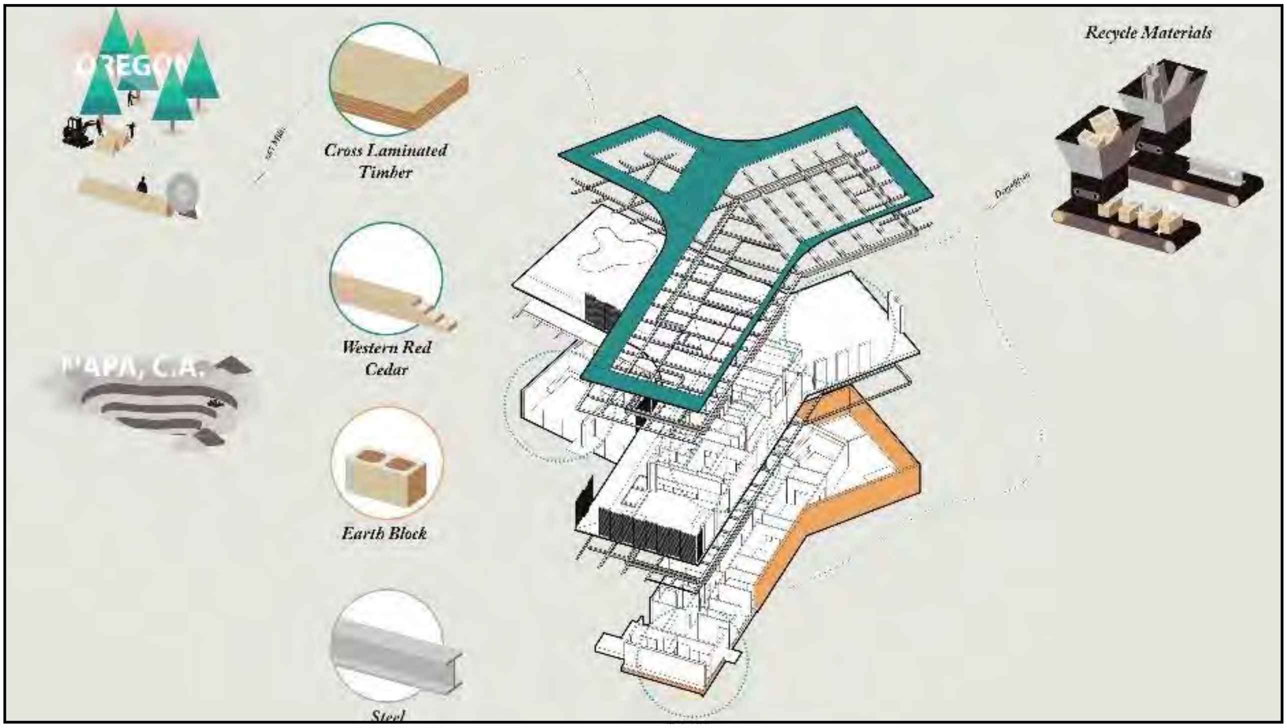


MATERIALS AND LIMITS

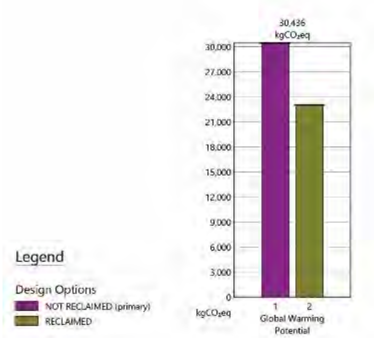
- Exterior Material – 15,300 sf
  - Masonry : 43%
  - Wood : 19%
  - Glass : 33%
  - Other : 5%
- 19,300 sf of occupied interior floor
  - 78% bare concrete
  - 8% tiled carpet
  - 10% epoxy resin kitchen
  - 4% tile

- Limit line 49, 790 sf
- Building footprint :17,019 sf
- Hardscape 13,290 sf incl green roof
- Green roof : 5,815 sf
- Landscape : 24,484 sf

- materials –all through LBC
- materials – regional/community 15%
- CLT
- Reclaimed wood interior and exterior
- All new wood FSC
- Low carbon Block made from soils



Reclaimed Cedar



reclaimed wood – overall ~2% of embodied carbon on project.

Reclaiming the wood (conservatively) represents 25% carbon savings, adds to the story, reuses an existing material


Highs
Value Proposition from standard projects

Sonoma Academy Guild and Commons

By Silas Grossman

Although new, the Sonoma Academy Guild and Commons, or GAC, has already been embraced by the students and become a fundamental aspect of this fantastic culture we call SA. As soon as you walk into the upper section, which is the main area I have spent time in, you are greeted with a wall of joyful noise as the happy enthusiastic students of SA converse and debate with the curiosity only truly amazing teachers can bring out. Next you are greeted by the smell of home grown vegetables and grass fed meat being cooked by the fantastic chiefs Sonoma Academy has employed. Finally the true beauty of this extravagant modern building hits you, and you know that this is where you want to spend your next four years as a student.

The food is simply amazing. The GAC has everything from brownies and warm freshly baked cookies to tikka masala and chicken tenders. Vegetarian options, vegan options, and even sugar free options, the Guild and Commons has it all. There are no sweet drinks, only flavored water and milk, but the food and deserts make up for it.. All in all, the food gets an A plus.

Next, the social aspect. The GAC provides a great area for the students of SA to gather during free periods and breaks and simply converse. In addition to this, it is a place to get homework done, or just to go and grab a piece of toast and some tea to relax. Either way, the SA Guild and Commons provides the perfect space to do it. The GAC is a great spot t either relax, socialize, or simply snack.

Although I haven't spent much time in the lower section, I've heard great things about it. S has a top notch robotics team, which is based out of our robotics lab in the lower studios. I addition, the builders workshop is home to many classes and exploratories, all of which I know for a fact the students love. The sound recording studio is top of the line, and I'm su the music that comes out of it will be as well. The computer lab is simply breathtaking. To of iMacs on desks with a constant stream of students coming in to use them. This lab was great touch and I look forward to using it in the future.

Overall, I think the GAC is well worth the cost. Although it was costly, it is effective, the students love it, and I think it was the main missing part of our school. The lines can be long, but what can you do? It is super useful to students, not to mention the food is amazing. I'm so happy I came after this was built, and am looking forward to my next four years. I think speak for all of the students when I say that I feel so incredibly blessed by this beautiful school and by the amazing staff that runs it.

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fantastic chiefs Sonoma Academy has employed. Finally the true beauty of this extravagant modern building hits you, and you know that this is where you want to spend your next four years as a student.

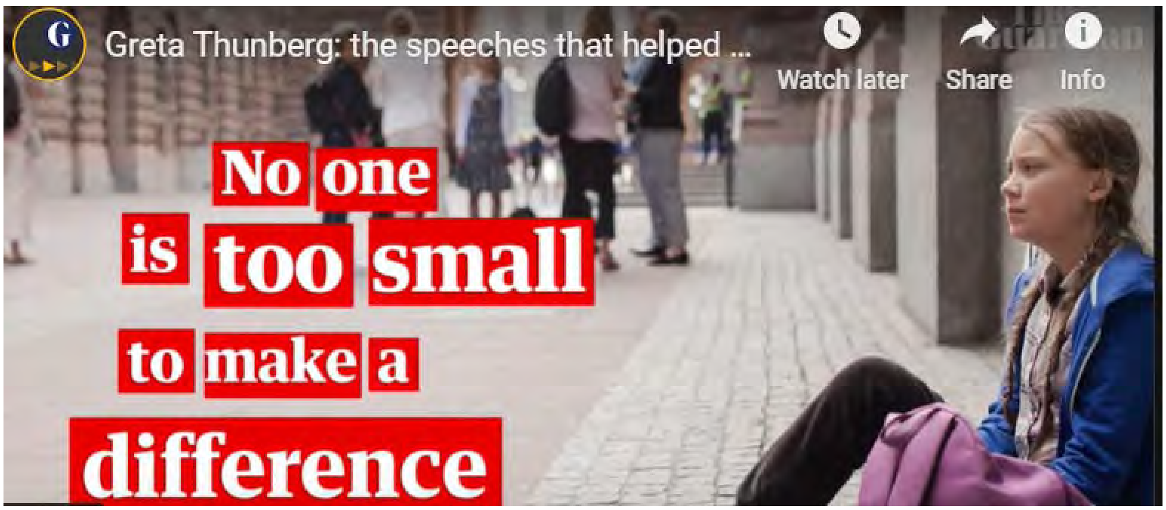
- By Silas Grossman, Freshman at Sonoma Academy and grandson of Peter Nosler

"How dare you pretend that this can be solved with business as usual "

"The eyes of all future generations are on you"

" I want you to act as if the house is on fire…because it is….

https://www.youtube.com/watch?v=TMrtLsQbaok



Questions?

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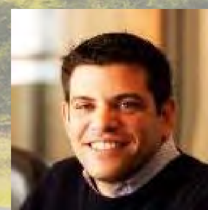

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