



Getting to Zero Forum, Oakland CA

The Road to Net Zero and Beyond

October 10, 2019

About HARC



- The Houston Advanced Research Center (HARC) is an independent research hub helping people thrive and nature flourish
- Founded by George P. Mitchell in 1982
- A 501(c)(3) organization located in The Woodlands
- We provide objective, unbiased, non-advocacy approach to finding meaningful answers to complex questions



HARC Mission & Programs



Mission: To provide independent analysis on energy, air, and water issues to people seeking scientific answers and to operate as a research hub finding solutions for a sustainable future.

ENERGY



Accelerating clean, efficient and sustainable energy

AIR



Improving air quality through research

WATER



Protecting water resources and ecosystems

RESILIENCE



Providing science-based resilience solutions to communities

HARC's Headquarters

Certified **LEED Platinum** and **Energy Star 98/100**

- 18,601 SF office building
- 88.2 kW rooftop PV solar plant

Energy Star score of 98 → According to EPA, HARC's building is more efficient than 98 percent of comparable office buildings across the United States.

EPA's Energy Star scores in the Houston Area:

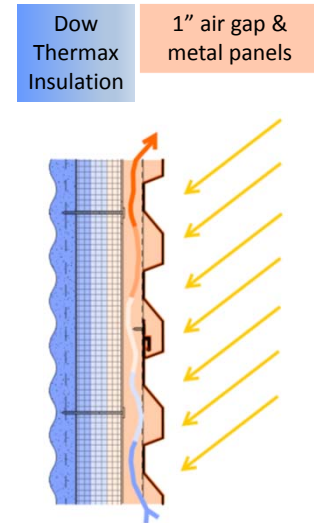
- 24 office buildings ≥ 95
- 14 office buildings ≥ 98
- 4 office buildings ≥ 99
- None of them certified Net Zero



Building Envelope

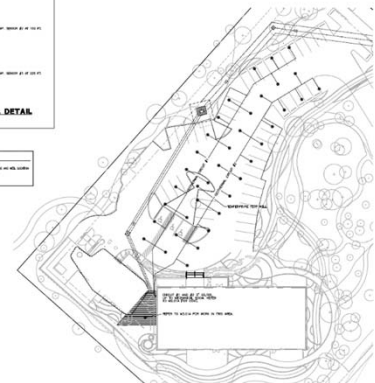
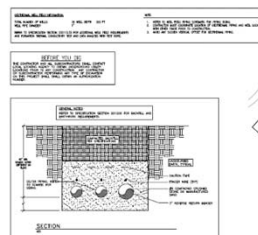
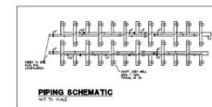
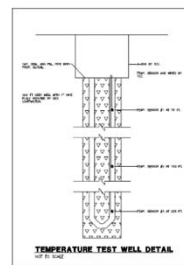
- **High performance building envelope**

- Uses Dow Thermax insulation system and thermal venting
- Heat from exterior metal panels transfers to air (rather than enclosure) and vents upwards
- Reduces amount of heat hitting the insulation
- Effectively brings enclosure to R50 value
- Cladding protects the slab from direct sunlight and eliminating the slab as an external heat sink



Geothermal Heat Exchange

- Closed loop geothermal heat exchange system
- 36 wells + 1 test well w/ sensors
- Wells 300' deep
- Constant temp ~70 degrees F
- 15 high efficiency heat pumps throughout building



Solar Array



- 252 solar panels
- 88 kW of power generation (DC)
- 5 DC to AC Inverters

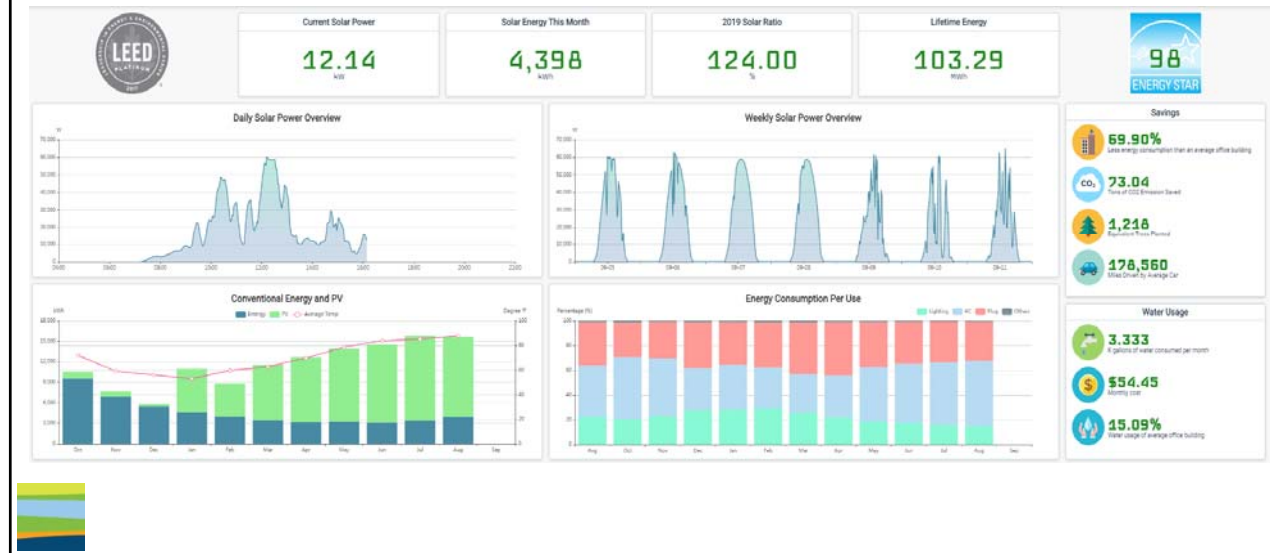


Building Awards

- October 2017 - Best Projects Award of Merit by Engineering News Record (ENR) Texas and Louisiana
- Houston Business Journal 2018 Landmark Awards finalist
- 2018 Gold Level (highest level) Association of General Contractors (AGC) [APEX Award](#)
 - Winner: Office Building: Under \$20M category.
- 2019 [ULI Houston](#) Development of Distinction award winner.
- 2019 US Green Building Council's TX Chapter Leadership Awards
 - Project of the Year Winner



HARC Public Dashboard



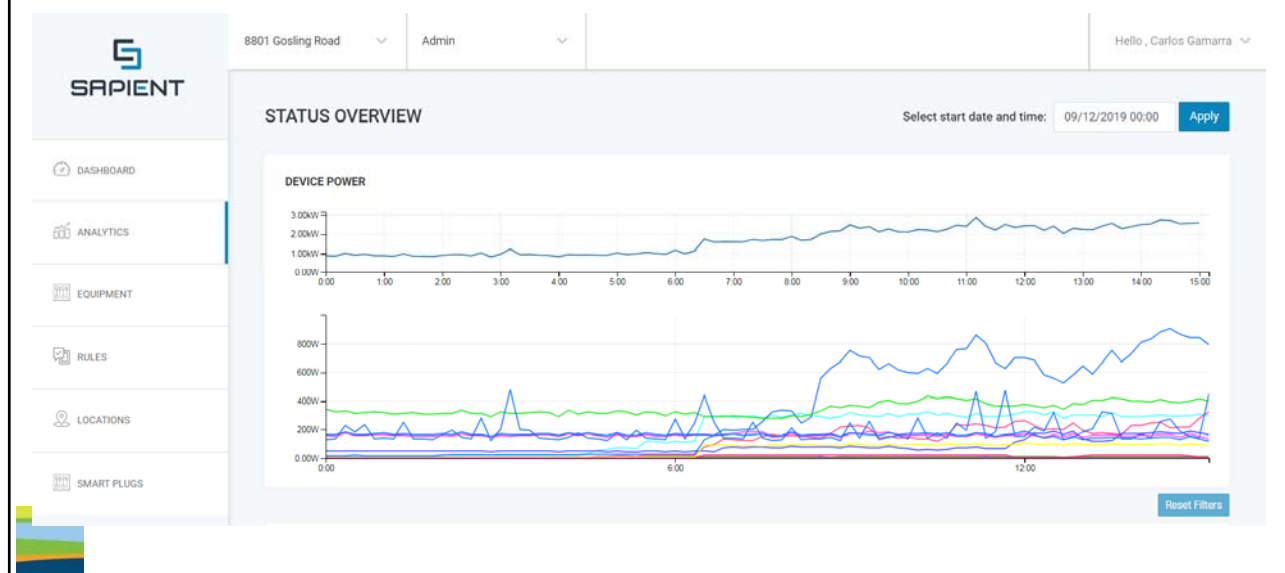
HARC's Internal Dashboard



HARC's Building Automation System



HARC's Plug Load Management Platform



HARC's Indoor Air Quality Monitoring Platform



Net Zero Office Buildings

- 46 Verified Net Zero Office Buildings in the US according to NBI
- **Aiming to be the 1st Net Zero office building in Texas**
- HARC expecting to achieve that status in October 2019
- Certification process to be started in November 2019

NBI Getting to Zero Buildings Database

Use the filters on the left to filter projects in the map, and/or select a bubble on the map to filter the table below. Click on the Analysis tab above to see the big picture and create customized charts.

Reset Filters



ZE Status	State or Province	Name	Certifications	City	Building Type	Size (sq ft)	Total Site EUI	Net Site EUI
Verified	AR	Emergency Headquarters	LEED, ILFI	Little Rock	Office	13,342	14	-1
Verified	AZ	OPR Construction Phoenix Net Zero Office	LEED, ILFI	Phoenix	Office	16,533	27	-3
Verified	CA	908 Energy Commission Building		Sacramento	Office	142,379	39	0
Verified	CA	010 Dept. of Rehabilitation		Sacramento	Office	163,350	49	0
Verified	CA	013 EDD Solar Building (incl. subterr.)		Sacramento	Office	272,548	38	0
Verified	CA	021 State Personnel Building		Sacramento	Office	94,400	47	0
Verified	CA	039 and 045 Office Building 8 and 9		Sacramento	Office	628,592	44	0
Verified	CA	049 Education Building		Sacramento	Office	562,582	41	0
Verified	CA	153 Cal Trans District Office 3		Marysville	Office	225,378	38	0
Verified	CA	330 California Towers (Riverside)		Riverside	Office	164,260	40	0



Energy Efficiency Goals

- Working to be in the top 1%:

- Energy consumption 2018: 110,225 kWh
- Energy consumption Sep '18 - Aug '19: 95,620 kWh
- Estimated threshold 98 → 99 : 93,768 kWh

2019 Goal

- HARC has the potential to reach a score of 99

- April '17 - Mar '18: 22.40 kBTUs per sf
- 2018: 20.22 kBTUs per sf
- Sep '18 - Aug '19: 17.50 kBTUs per sf

Metrics Summary			
Metric	Apr 2018 (Energy Baseline)	Aug 2019 (Energy Current)	Change
ENERGY STAR Score (1-100)	91	98	7.00 (7.70%)
Site EUI (kBtu/ft ²)	21.5	17.5	-4.00 (-18.60%)
National Median Site EUI (kBtu/ft ²)	47.4	57.0	9.60 (20.30%)
Source EUI (kBtu/ft ²)	55.6	37.7	-17.90 (-32.20%)
Electricity Use - Grid Purchase and Generated from Onsite Renewable Systems (kWh)	117,381.5	95,620.4	-21,761.10 (-18.50%)
Energy Cost (\$)	10,408.73	2,998.21	-7,410.52 (-71.20%)
Total GHG Emissions Intensity (kgCO ₂ e/ft ²)	2.1	1.3	-0.80 (-38.10%)

Metric	Design Target	Design Target	Design Target
ENERGY STAR score (1-100)	98	99	100
Source EUI (kBtu/ft ²)	32.9	32.4	26.4
Site EUI (kBtu/ft ²)	17.4	17.2	14.1
Source Energy Use (kBtu)	612,795.2	320,728.0	491,934.8
Site Energy Use (kBtu)	324,140.0	320,728.0	261,549.0
Energy Cost (\$)	1,410.00	1,380.00	1,125.37
Total GHG Emissions (Metric Tons CO ₂ e)	18.0	17.6	14.3

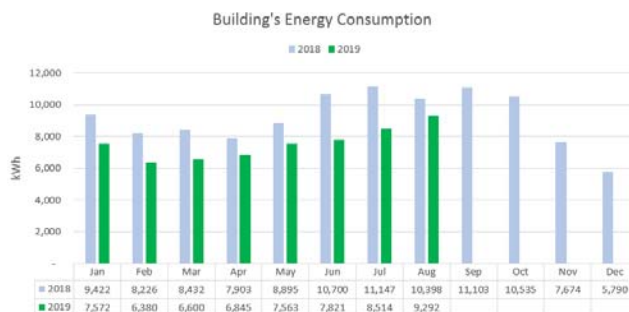
2019 Goal



Energy Consumption

- 95,620 kWh in the last 12 months

- 15.5% savings in comparison to same period last year
- 42,786 kWh in the 1st half of 2019
- 60,826 kWh consumed as of August 31st 2019



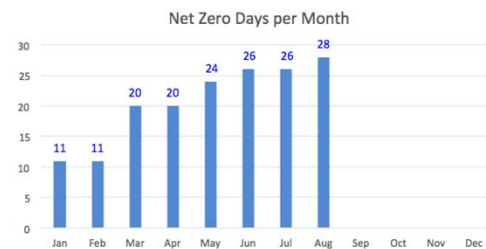
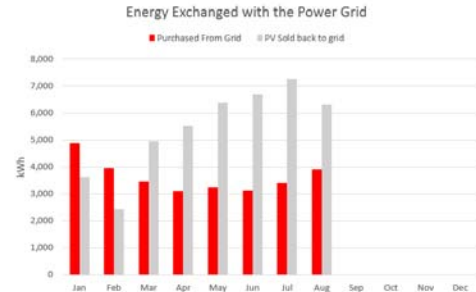
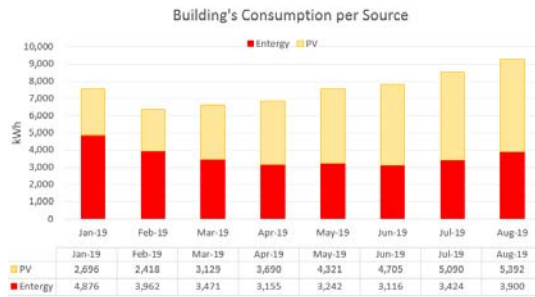
Metrics Summary			
Metric	Aug 2018 (Other)	Aug 2019 (Energy Current)	Change
ENERGY STAR Score (1-100)	93	98	5.00 (5.40%)
Site EUI (kBtu/ft ²)	20.8	17.5	-3.30 (-15.90%)
National Median Site EUI (kBtu/ft ²)	47.9	57.0	9.10 (19.00%)
Source EUI (kBtu/ft ²)	53.1	37.7	-15.40 (-29.00%)
Electricity Use - Grid Purchase and Generated from Onsite Renewable Systems (kWh)	113,174.6	95,620.4	-17,554.20 (-15.50%)
Energy Cost (\$)	9,724.34	2,998.21	-6,726.13 (-69.20%)
Total GHG Emissions Intensity (kgCO ₂ e/ft ²)	2.0	1.3	-0.70 (-35.00%)



Energy Supply Analysis

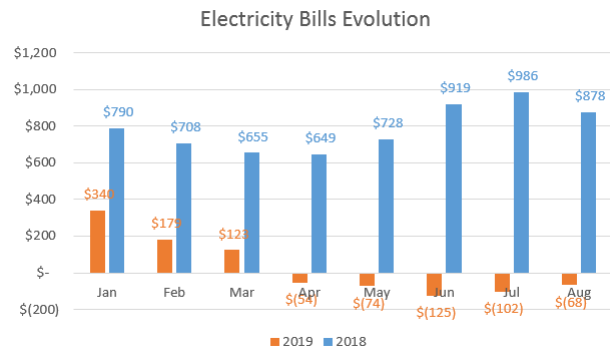
60,826 kWh consumed as of August 31st 2019:

- 31,735 kWh from our solar plant
- 29,091 kWh from Entergy (our local utility)
- 43,274 kWh of excess power sold back to Entergy

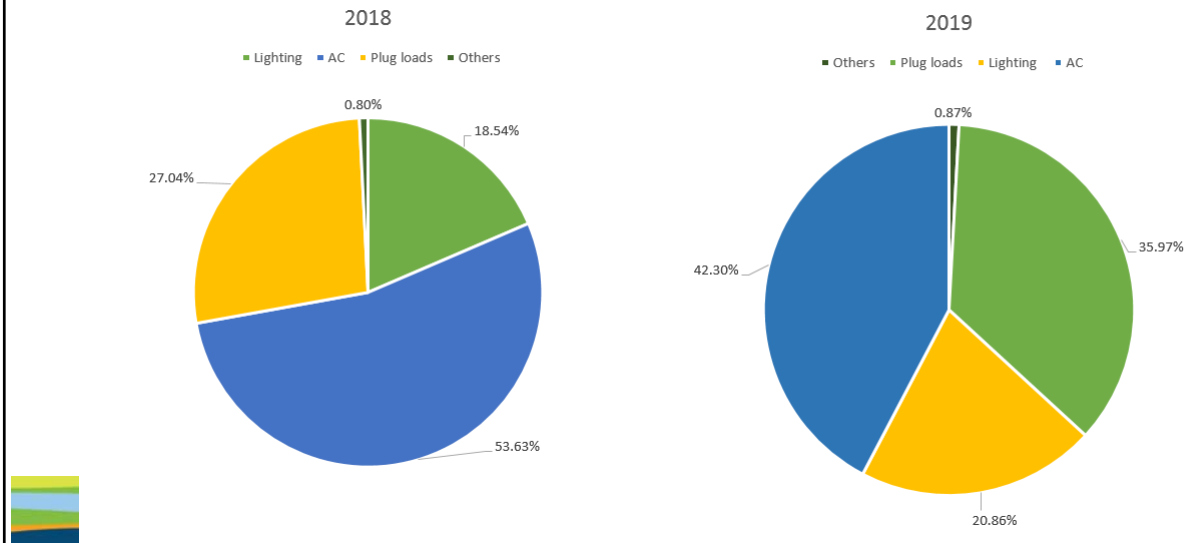


Energy Costs

- Energy Bills
 - \$9,747 in 2018
 - **\$287 in 2019 as of August 14th**
 - 91.25% lower costs than in the 1st half of 2018

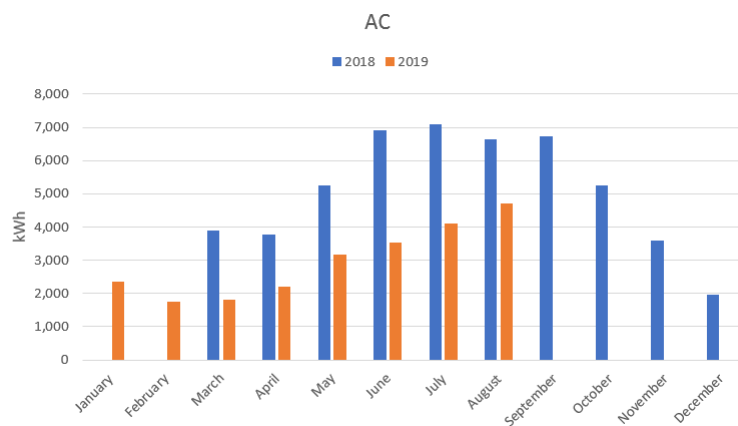


Energy Consumption



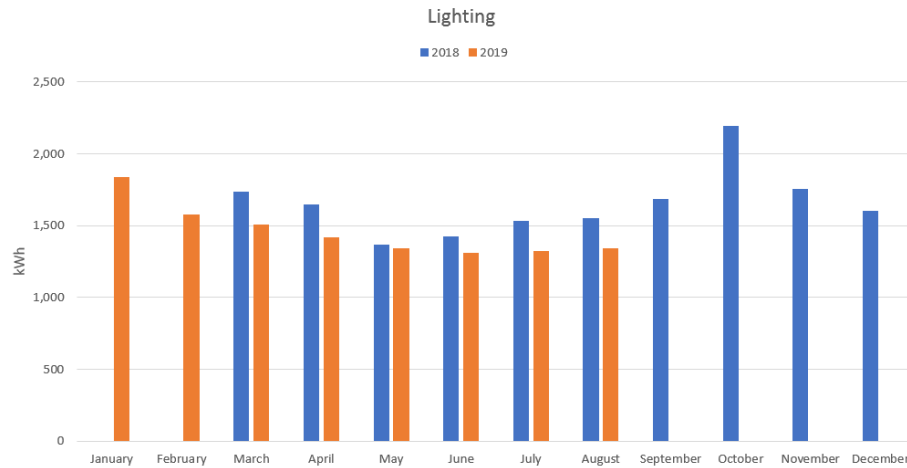
Energy Consumption Analysis

- Most of the current savings are coming from optimized AC management



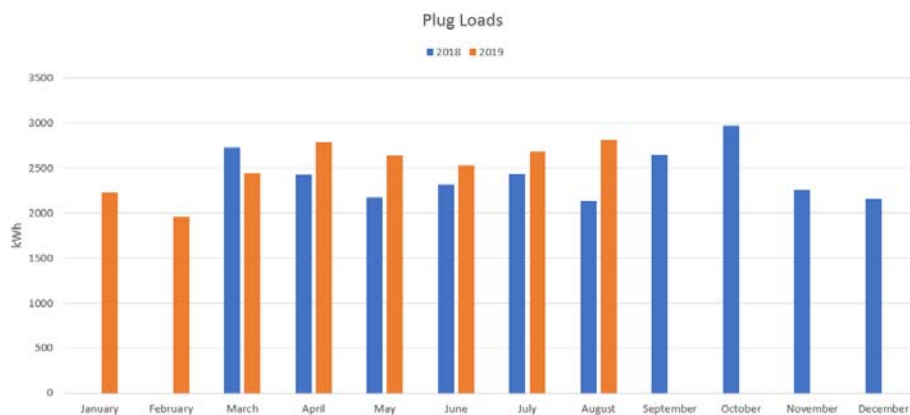
Energy Consumption Analysis

- Lighting consumption is following expected patterns in 2019



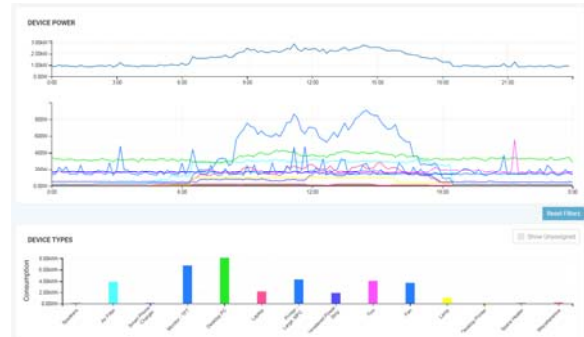
Energy Consumption Analysis

- Working on plug load consumption monitoring and optimization

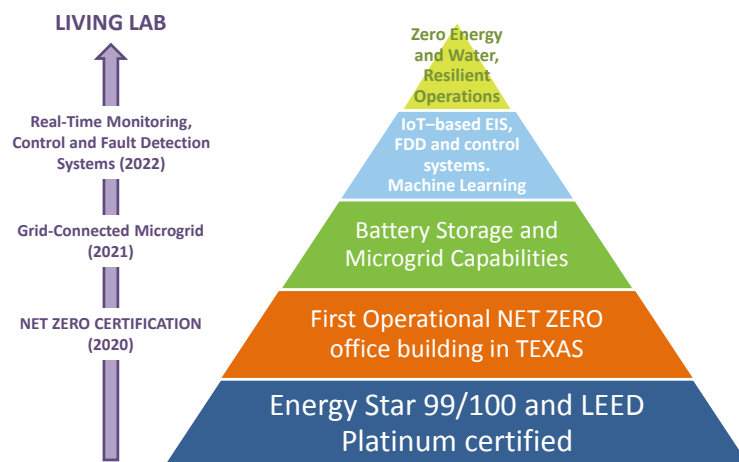


Immediate Plug Load Savings

- 0.785 kW in stand-by plug loads afterhours identified:
 - 140 W stand-by consumption by printers
 - 315 W in desktop computers left ON afterhours
 - 170 W in conference area
 - 160 W in server room
- OFF 12 hours on week days and 24 hours on weekends.
- Annual energy savings: $0.785 \text{ W} \times 5,616 \text{ h} = 4,408 \text{ kWh}$
- **-4.6% of annual consumption → potential EUI of 16.5 kBTUs/sq.ft.**



Envisioning the Next Steps for Our Facility



SIGN UP
NEWSLETTER



Thank You!



RESEARCH. PEOPLE. NATURE

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