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.

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

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**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
- 2019 ULI Houston Development of Distinction award winner.
- 2019 US Green Building Council’s TX Chapter Leadership Awards
  - Project of the Year Winner
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
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

- HARC has the potential to reach a score of 99
  - April ’17 - Mar ’18: 22.40 kBtu/sf
  - 2018: 20.22 kBtu/sf
  - Sep ’18 - Aug ’19: 17.50 kBtu/sf

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
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

![Graph showing lighting consumption in 2018 and 2019]

Energy Consumption Analysis

- Working on plug load consumption monitoring and optimization

![Graph showing plug loads in 2018 and 2019]
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 W x 5,616 h = 4,408 kWh

- 4.6% of annual consumption → potential EUI of 16.5 kBTUs/sq.ft.

Envisioning the Next Steps for Our Facility

- LIVING LAB
  - Real-Time Monitoring, Control and Fault Detection Systems (2022)
  - Grid-Connected Microgrid (2021)
  - NET ZERO CERTIFICATION (2020)

- First Operational NET ZERO office building in TEXAS
  - Energy Star 99/100 and LEED Platinum certified
  - Zero Energy and Water, Resilient Operations
  - IoT-based EIS, FDD and control systems, Machine Learning
  - Battery Storage and Microgrid Capabilities

- Energy Star 99/100 and LEED Platinum certified
Thank you very much!!

HARC (härk), n. an independent research hub helping people thrive and nature flourish.

Thank You!

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