SOLAR 2023

ASES 52nd Annual National Solar Conference

Designing All – Electric & Net Zero Energy Commercial Buildings

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STRATEGY

first: REDUCTION

- Establish baseline EUI for the building type, and goal EUI
- Reduce the amount of energy needed through best design practices
- Site the building to maximize solar benefits
- Tight envelope to maximize insulation and minimize air leakage
- Daylighting, efficient lighting
- Ventilation optimization

STRATEGY

second: ELECTRIFICATION

- Use efficient all-electric systems for building heat, water heating:
  - Ground source heat pump
  - Air source heat pump (VRF, mini-split)
- Other potential problem systems:
  - Cooking equipment – induction cooktops
  - Fire pits / fireplaces – water vapor
  - Pools – solar thermal, hybrid heat pump boiler

STRATEGY

third (last): GENERATION

- Generate electricity onsite
  - Photovoltaics on roof, over parking, or ground mount
- Wind turbines are generally not efficient at small scale
- Hydro, if a river runs through it
- Purchase off-site renewable power
- As the electric grid becomes more renewable, how important is on-site generation?

example 1

Renaissance Secondary Charter School

- Charter School in Castle Rock, Colorado (Douglas County school district)
- Expeditionary learning school
- 40,000sf school for 7-12 grades
- New build on undeveloped land
- Desire for NZE
- Tight budget ($8million for construction=$200/sf)
- Designed in 2016, opened in Aug 2017


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Renaissance Secondary Charter School Mechanical System

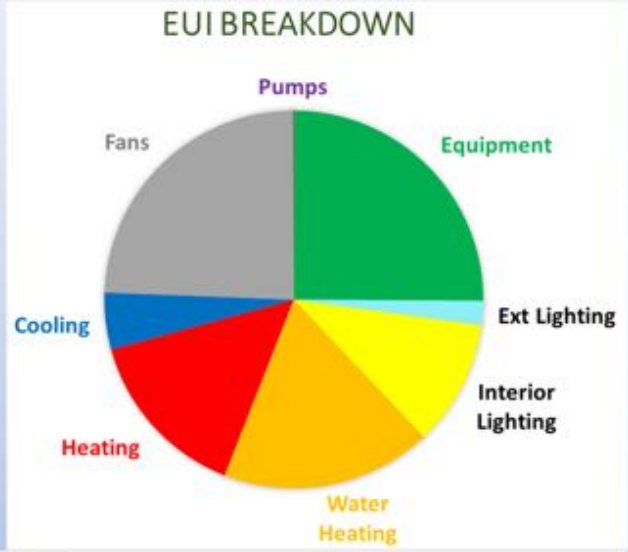
- VRF for classrooms & offices
- Air cleaners (bipolar ionization)
- Natural gas RTU for gathering spaces
- Water heating using natural gas

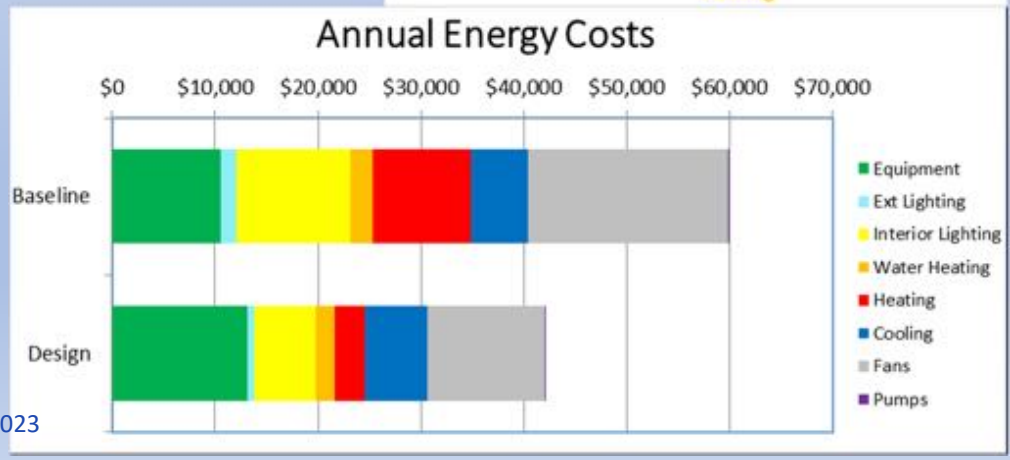
Also…

- Interior & exterior gas fireplaces
- Air curtain at entrance to central gathering space

Renaissance Secondary Charter School Energy Modeling

- Code = 30% energy cost reduction from baseline 2015 IECC
- Douglas County school district average 2017 = 65
- EUI design target = 25 kBtu/sf/yr
- EUI modeled = 42.9 kBtu/sf/year
  - Electric = 30.8
  - Natural gas = 12.1
- Plan for future PV (185kw needed for Net Zero Electricity)





example 2

Foothills Unitarian Church Addition

- Existing church in Fort Collins, Colorado
- 13,000sf addition w/ 400-seat sanctuary
- Desire for NZE
- Limited but flexible budget ($6.5million)
  - $500/sf new finished construction
  - $300/sf new unfinished spaces
  - $200/sf remodel areas
- Designed 2018-2022
- Finishing construction now (Aug 2023)

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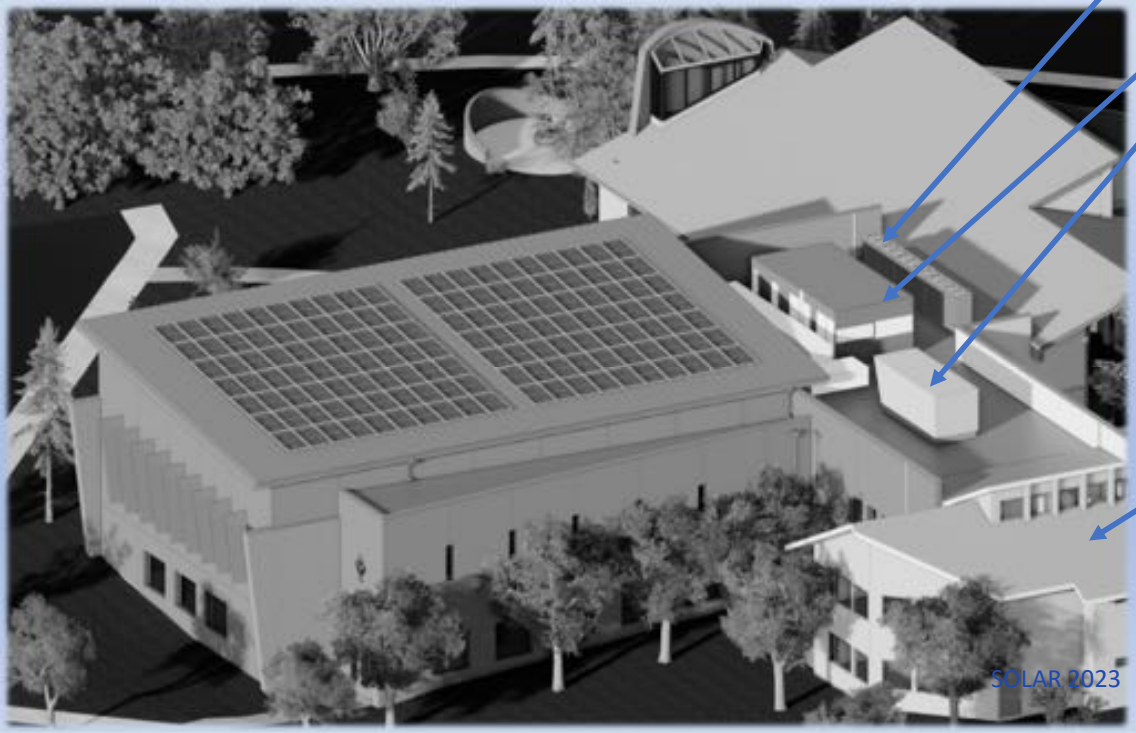
Foothills Unitarian Church Addition Mechanical System

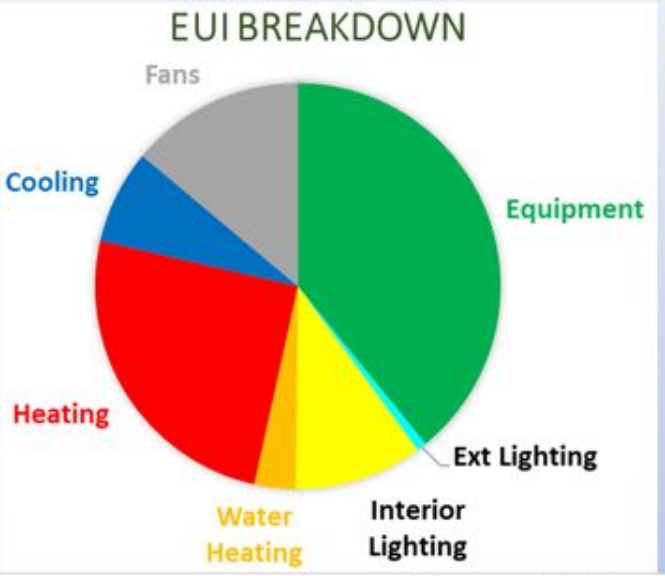


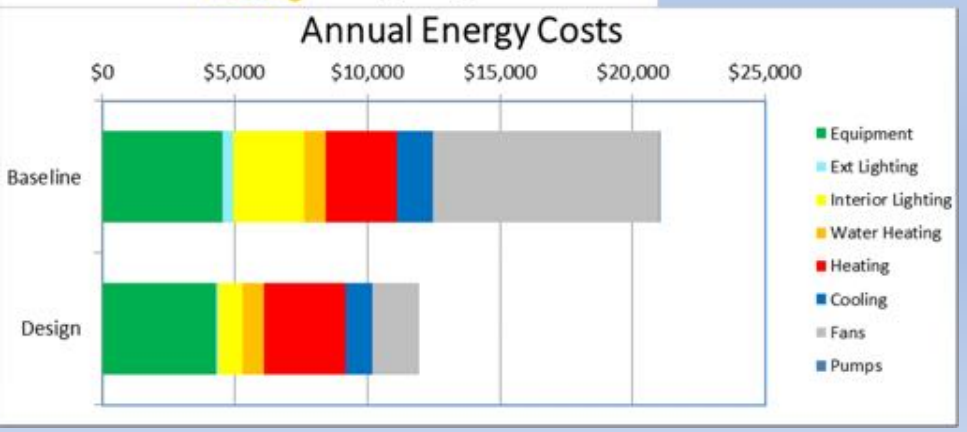
- VRF to serve new construction + some existing spaces
- RTU for Sanctuary
- DOAS with electric heat pump to provide fresh air
- Replaced existing natural gas HVAC to existing offices with elec heat pump
- Heat pump water heater

Also…

- Existing education wing still has natural gas units (future project, not a part of this remodel)

Foothills Unitarian Church Addition Energy Modeling





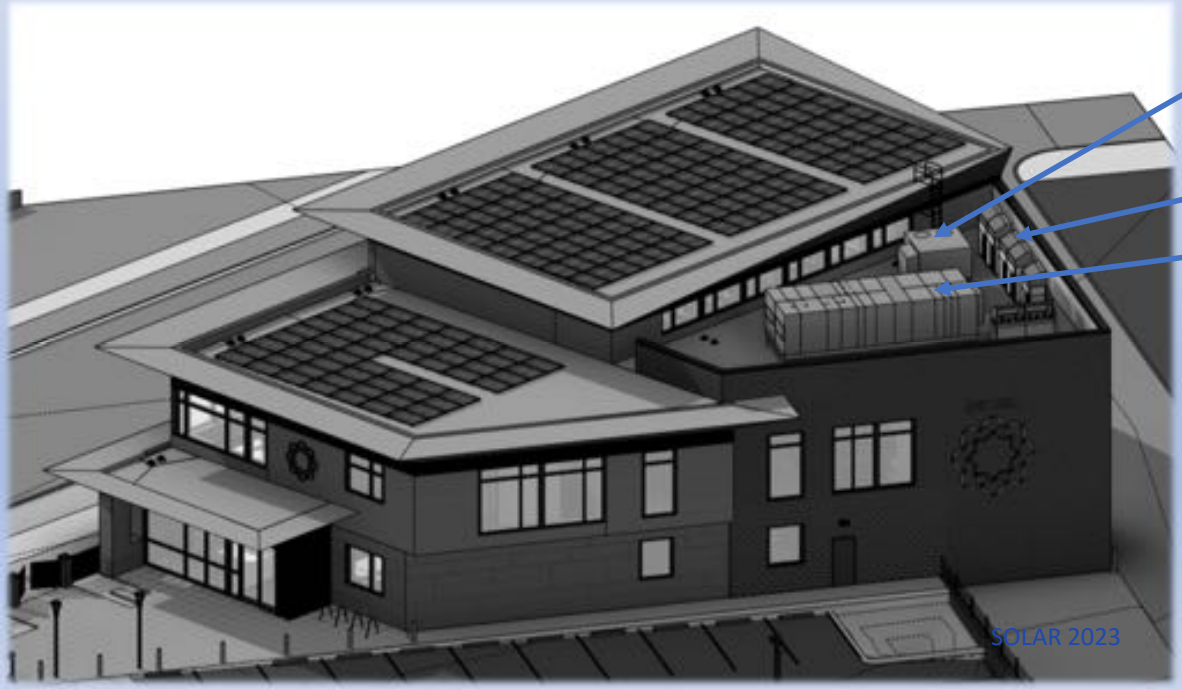
- Code = 42% energy cost reduction from baseline 2018 IECC
- EUI design target = 25 kBtu/sf/yr
- EUI modeled = 23.4 kBtu/sf/year
- Fort Collins IDAP program provided kickoff charrette, energy modeling reimbursement, and owner incentives

example 3

SGI-USA Denver Buddhist Center

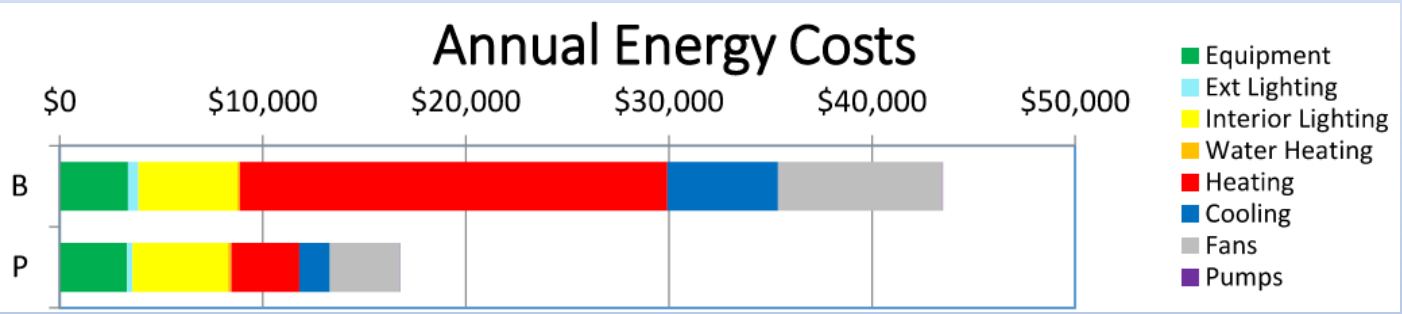
- New building in downtown Denver
- 16,000sf on two floors
- Could not save existing cast-in-place concrete structure
- Desire for NZE w/flexible budget
- Current cost estimated at $11.3million
  - $700/sf
- Designed 2019-2023
- Start construction late 2023
- Received City of Denver electrification grant

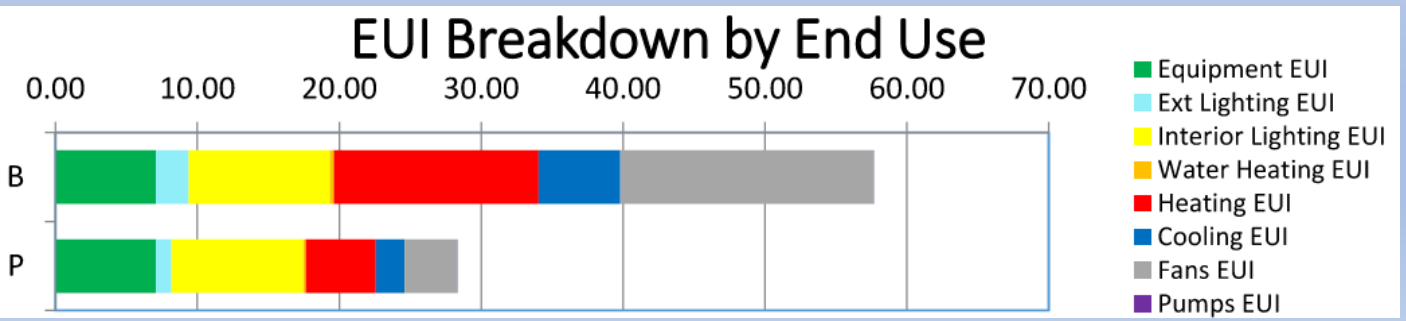
SGI-USA Denver Buddhist Center Mechanical System



- DOAS w/ERV to provide fresh air to interior VRF fan coils
- VRF condensing units
- RTU for Main Hall
- Heat pump water heater
- No natural gas connection

SGI-USA Denver Buddhist Center Energy Modeling





- Code = 24% energy cost reduction from baseline (EUI = 57.3)
- EUI design target = 25 kBtu/sf/yr
- EUI modeled = 28.1 kBtu/sf/year
- City of Denver providing $100,000 grant for all-electric

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Q & A

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