

Laboratory Building Electrification Case Study at Berkeley Lab



Integrative Genomics Building

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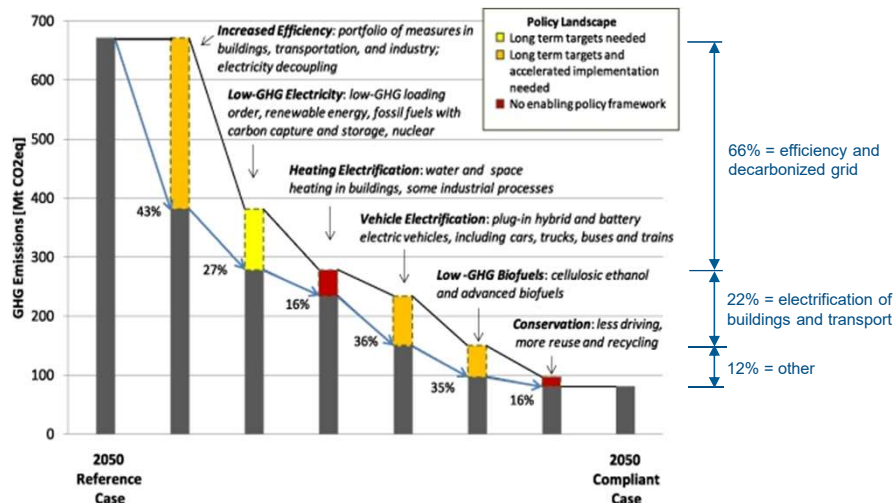
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Presented by:
John Elliott | Chief Sustainability Officer | 11 October 2019
Getting to Zero Forum

Hitting California State Climate Targets Requires Efficiency, Renewables AND Electrification



Max Wei et al, *Environmental Research Letters* 2013. "Deep carbon reductions in California require electrification and integration across economic sectors." Annotations by John Elliott.

Also see James Williams et al, *Science* 2012. "The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity."

Integrative Genomics Building



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Key IGB Sustainability Approaches

Key Project Approaches

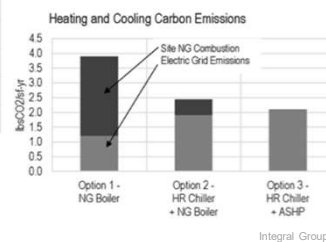
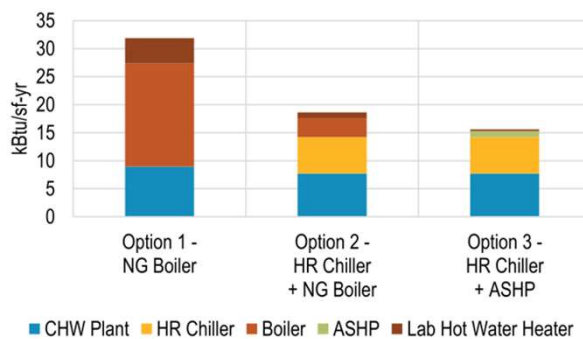
- All-electric heating
- Whole building energy performance targets*
- Maximizing solar PV*
- Specifying performance metrics*
- District medium temperature chilled water plant
- Plug load analysis and air cascading strategy
- Facade optimization
- LEED Gold*



* Implemented through Berkeley Lab Sustainability Standards for New Construction at <https://bit.ly/2SD6jO3>

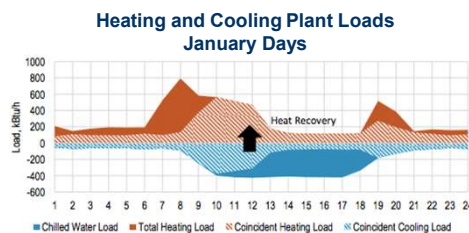
All-Electric Heating for Low Climate Impact

- Cuts initial carbon footprint in half
- Allows carbon footprint to decrease as the grid is decarbonized
- Is cost competitive, although our site is conducive to electrification:
 - No central thermal plant
 - Low electricity prices

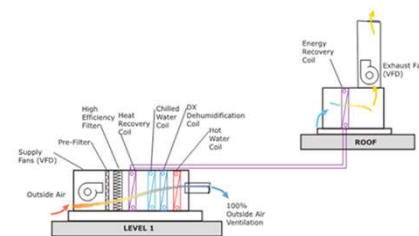


All-Electric Heating - Technical Approach

- Heat-recovery chiller recovers heat from building chilled water return - covering 70% of space heating and industrial hot water - with air-source heat pump used as backup
- Point-of-use electric heating used for domestic hot water
- Runaround coils provide airside heat recovery from lab and office exhaust streams



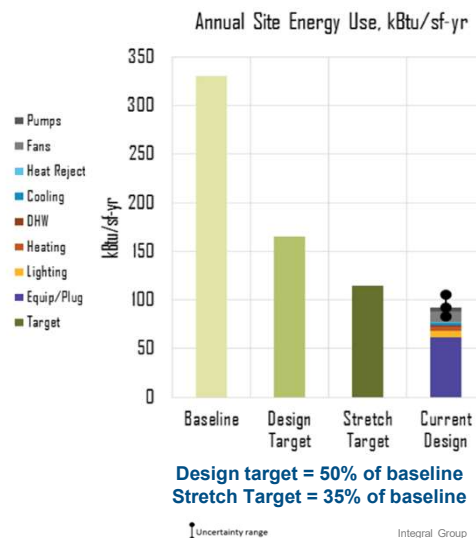
Laboratory Dedicated Outside Air System Heat Recovery Using Runaround Coils



All images from Integral Group

Whole Building Energy Performance Targets

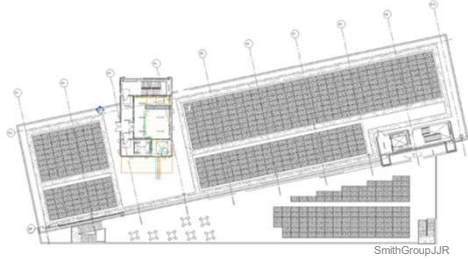
- Set an **aggressive but practical** performance target
- Identify target **early** to influence selection of design team
- Encourage **integrated** design
- Confirm meeting of target through modeling of **as-operated** energy performance (not code)
- Carry energy performance targets into **operations**



Also beat ASHRAE 90.1 by 30%

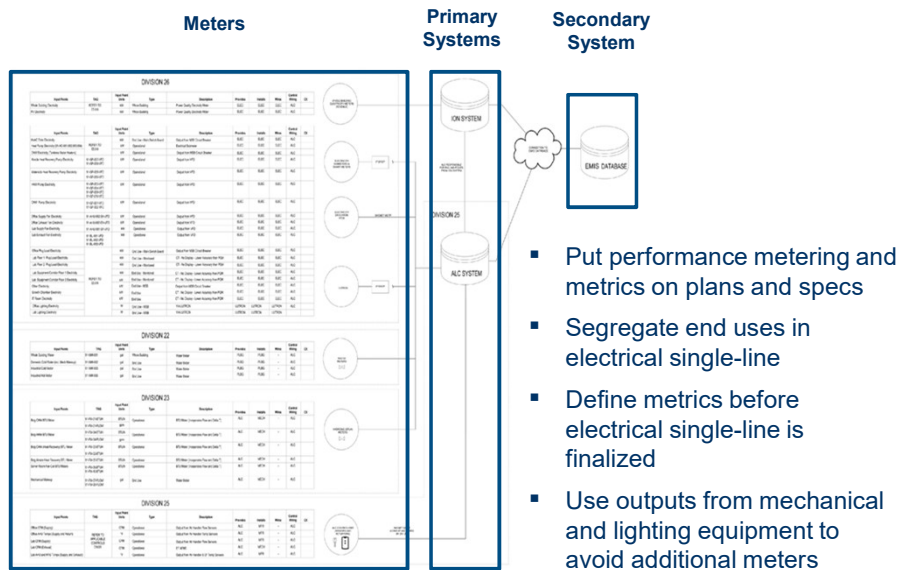
~\$650K annual energy utility cost savings

Maximizing Solar PV



- Building orientation lengthwise along east-west axis
- Lab policy requires PV-ready design, to offset a minimum of 7.5% energy
- Solar array as designed covers 14% of energy use
- Stanchions, conduit path, breaker space included
- Choice of mechanical system may affect availability of roof space

Plan for Performance Monitoring



Challenges

- Giving up natural gas supply even if the building space and water heating is electric
 - Natural gas for science
 - Future flexibility
- Operations and maintenance
 - Heat pumps rely on familiar technology
 - But they are new for most facilities organizations
- High construction costs in general
 - Downward pressure on budgets can limit appetite for trying something new

Upcoming All-Electric Buildings at the Lab



BioEPIC

- 70,000 square feet
- BioScience, Earth and Environmental Science Laboratories with Office
- Moving from schematic design to design development

Welcome Center

- 46,000 square feet
- Cafeteria (commercial kitchen), Conference Center, Health Center, HR Offices
- Conceptual design completed

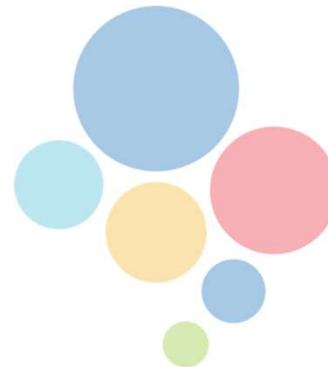


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Davis, Caldeira and Matthews, *Science* 2010. "Future CO₂ Emissions and Climate Change from Existing Energy Infrastructure."

If we had stopped creating any new CO₂-emitting infrastructure and devices in 2010, emissions from existing infrastructure over its useful life would still result in 1.3°C warming.



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