

2017 Building Technologies Office Peer Review



New Initiatives and Projects to Amplify BTO Portfolio

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Leverage Funds to Advance BTO Mission

- **MYPP mission:** develop, demonstrate, accelerate adoption of technology, techniques, tools to enable high-performing and energy-efficient buildings
- **Leverage** from DoD, LBNL-LDRD and CEC in current portfolio
- **LBNL expertise** in windows, roofs, plug loads, analytics and modeling, systems, and residential buildings
- **Direct benefit** to Emerging Technologies, Commercial Buildings Integration, Residential Buildings Integration



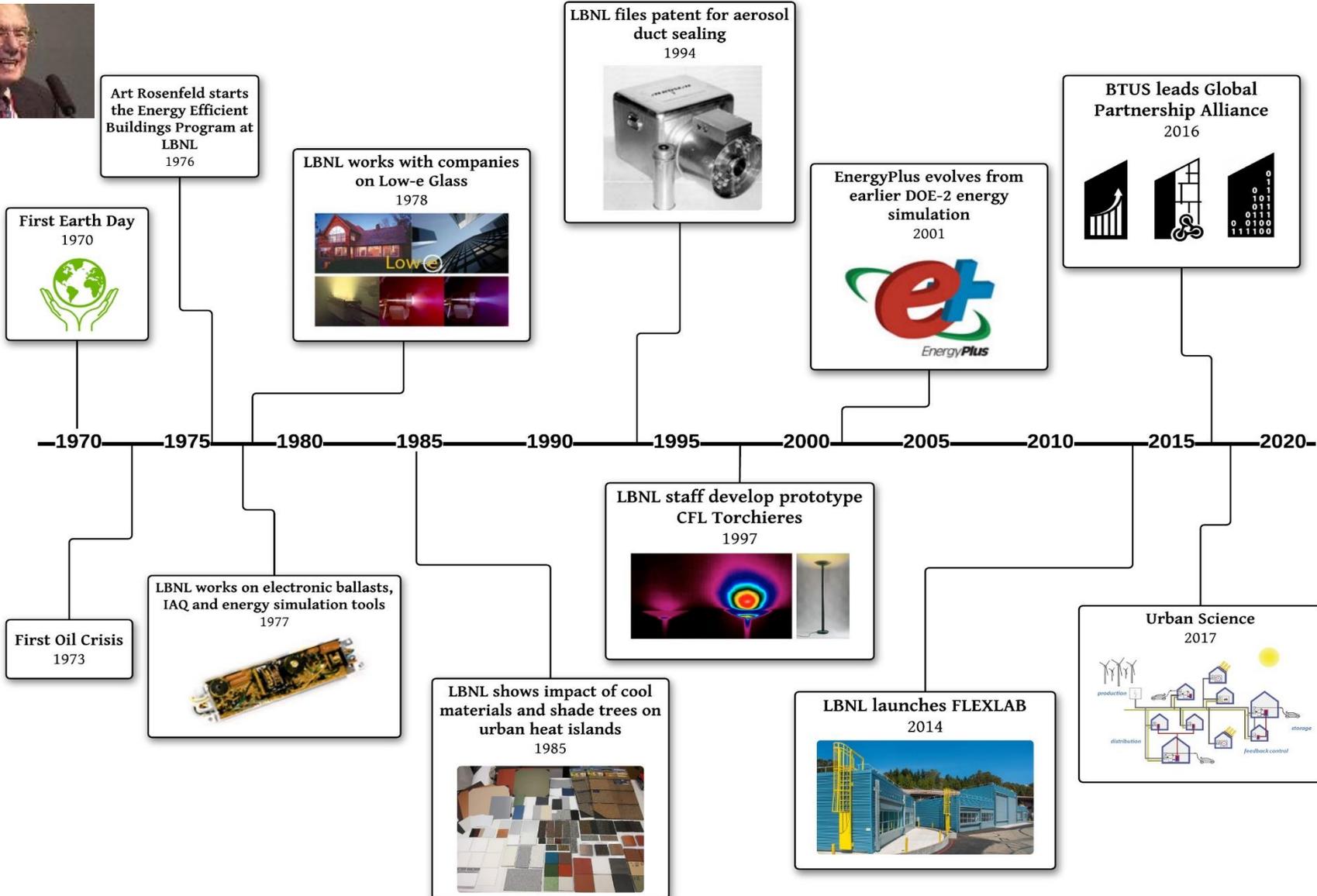
U.S. DEPARTMENT OF
ENERGY



ESTCP



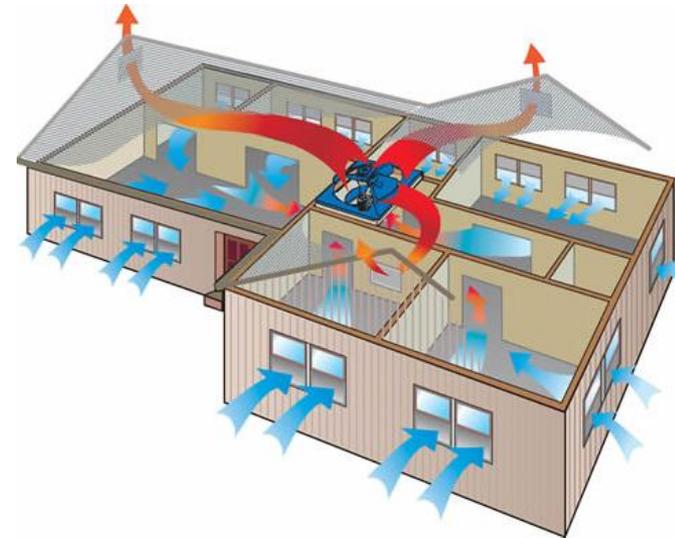
Berkeley History: From Components to Systems, Whole Buildings and Integrated City Scale Research



Support Code and Adoption of Healthy, ZNE homes

- **Smart Ventilation for Advanced CA Homes**

- Analysis of occupant exposure to contaminants in new and existing homes
- Knowledge transfer to manufacturers, integration of findings into codes and standards



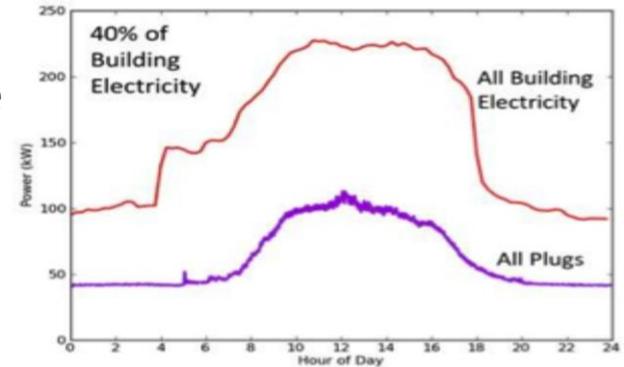
- **Comparing Attic Approaches for ZNE homes**

- Specs for assembly, air leakage, insulation requirements
- Leverage results from RBI's Building America
- Technical background for code and utility programs

Low-Energy Miscellaneous Equipment Loads to Reduce Fastest Growing End Use

- **Efficient and NZE plug loads**

Repower plug loads via zero Watt standby, device conversion to low-energy DC, high efficiency for security safety and medical requirements

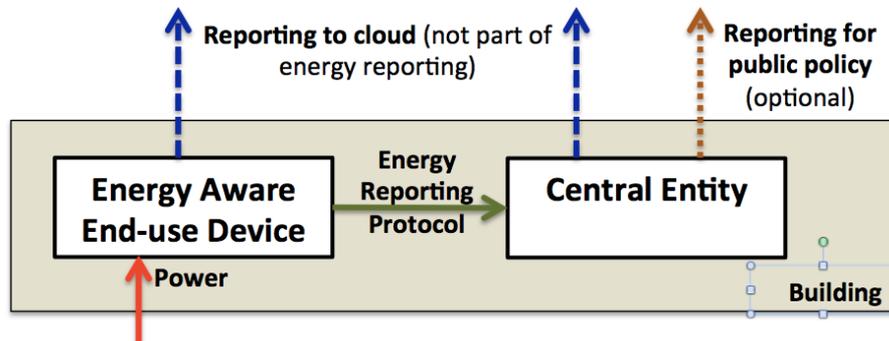


- **Ubiquitous Plug Load Energy Reporting**

Development and code readiness for device-level measurement and communication of energy use

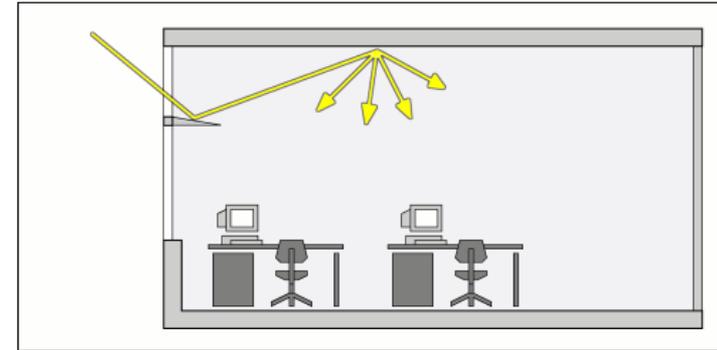


Above: Prototype communicating power supply hardware



Validating New Generation of Lighting and Daylighting Solutions for Commercial Buildings

- **High performance integrated window and façade solutions**
 - Verify savings, create design and management toolkits for application
 - Supports modeling and technologies of focus in ET-Windows program
- **Flexible networked lighting control systems**
 - Distributed intelligence, increased sensing and control granularity, pervasive communication
 - Increasing SSL system savings



Above: Daylight redirecting systems

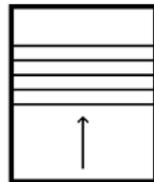
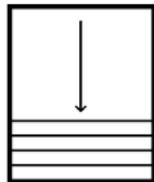
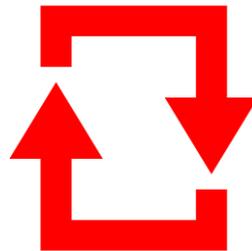


Above: Lighting and daylighting control testbed

Advancing System-based Emerging Technologies

Demonstrating scalable integrated system controls for existing buildings

- Testing, field demonstration of integrated façade, lighting, HVAC and plug load controls for deep savings in existing commercial buildings
- Extend M&V, test findings, from multi-year CBI “Beyond Widgets” effort for transition into CA utility program pipeline



Portfolio of Projects to Increase Adoption of M&V 2.0 and Whole Building Programs

Facilitate use of whole-building M&V 2.0 analytics to improve accuracy, reduce time/cost, enable delivery of new program designs



M&V 2.0 pilots – comparison of savings, accuracy, labor time vs. traditional M&V approaches



M&V 2.0 pilots – end-to-end workflows for P4P and SEM, non-routine events, ac



Application of M&V to historic program data

Open-source tools

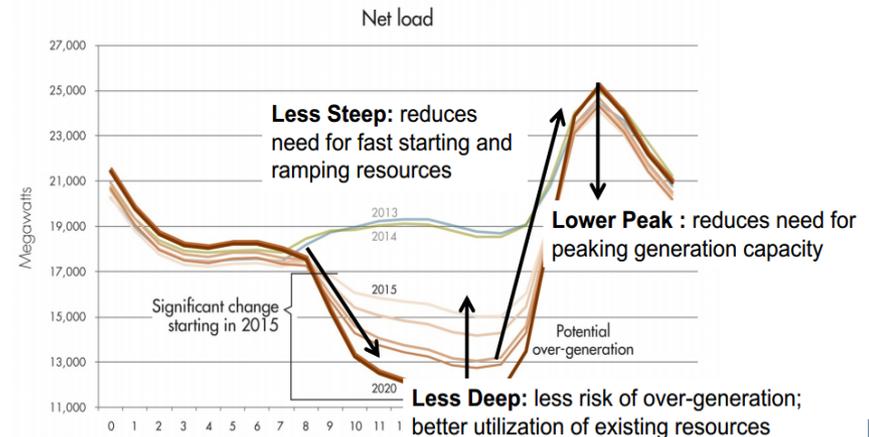
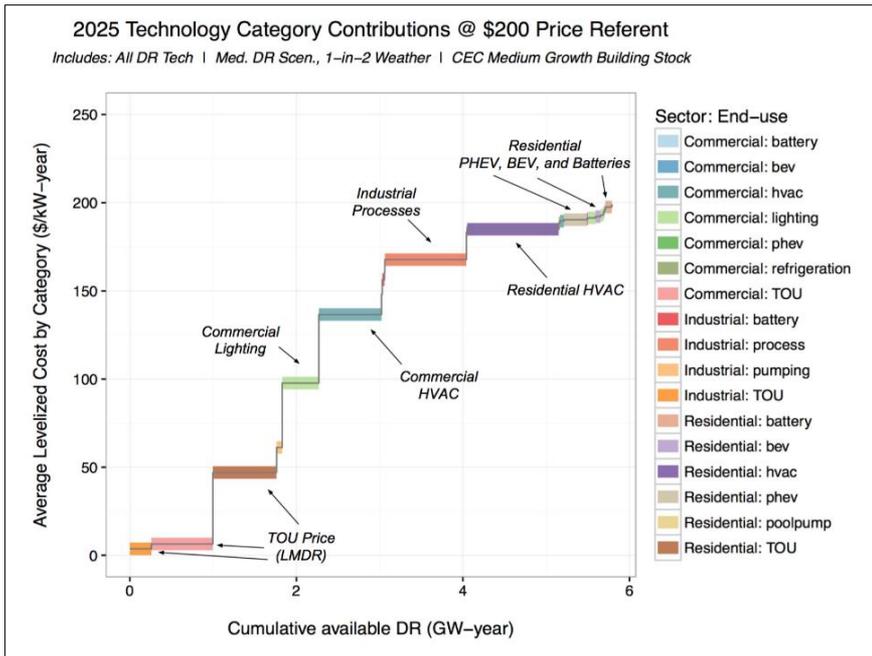
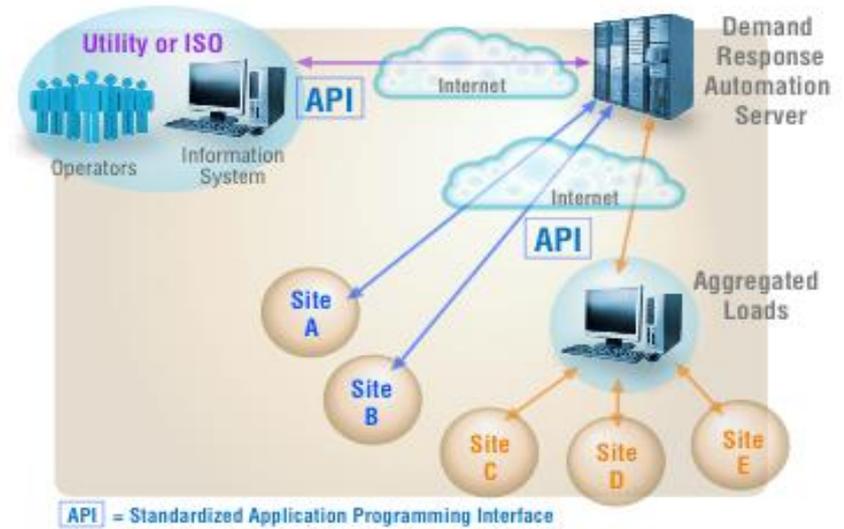
Acceptance criteria

Practitioner process

Non-routine events

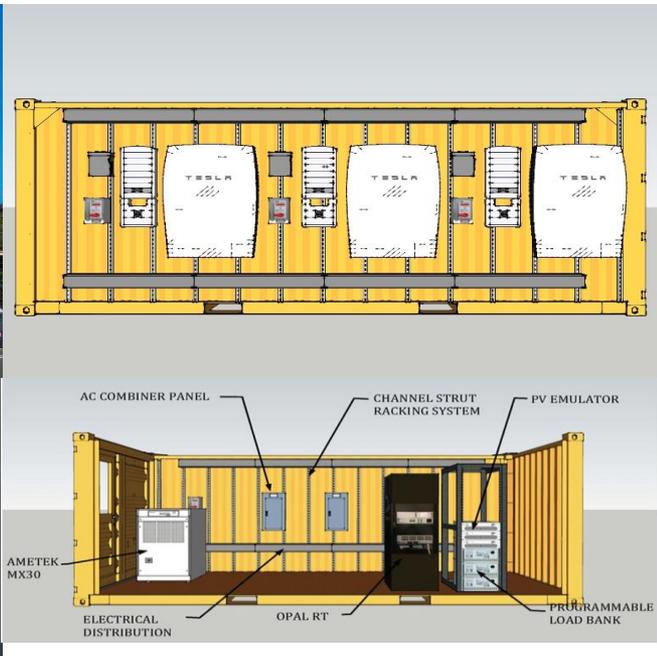
Increasing Automation of Demand Response with Communication Standards and DR Supply Curves

- 3000 sites in Calif use LBNL/NIST Open Automated DR standard, used in > 10 states and 10 countries
- New study March 2017 - supply curves of DR for 4 key types of DR markets



Note, this curve is being updated, it is used here to represent how we should look at what we are trying to accomplish

FLEXLAB Provides Unique Test Beds for Integrated Systems



HVAC

- Radiant and airside HVAC
- Radiant system tools

Lighting and daylighting

- Exterior shading and daylight redirecting
- Rollease automated shading and lighting
- Flexible, networked lighting

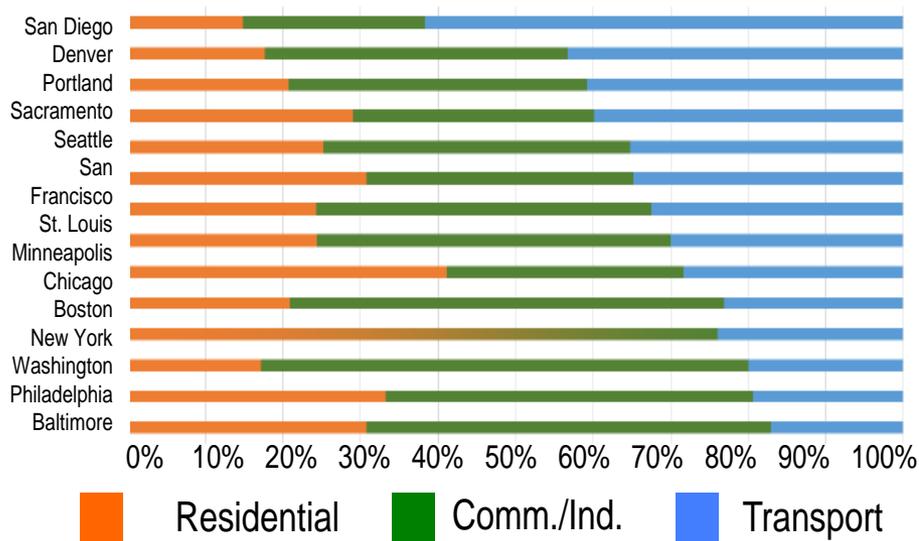
Other

- EnergyPlus Equest comparison study
- ZNE small commercial office retrofits
- Integrated PV and smart inverters



Lab Investment in Energy Modeling and Thermal Networks for City Scale Energy Efficiency

Why? Cities have long term commitment to buildings, which account for 30-70% total primary energy. Start with data!

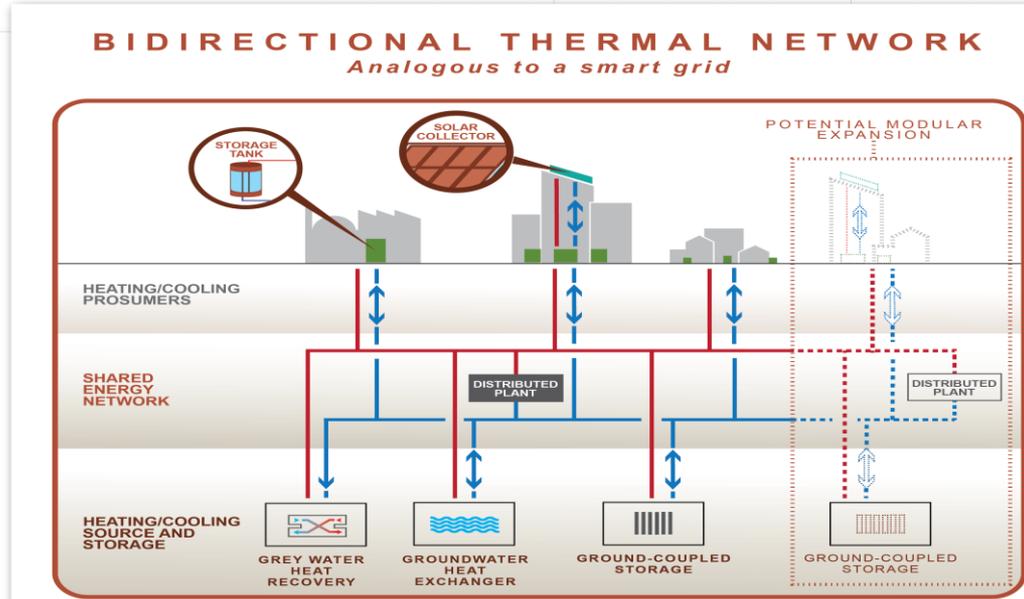
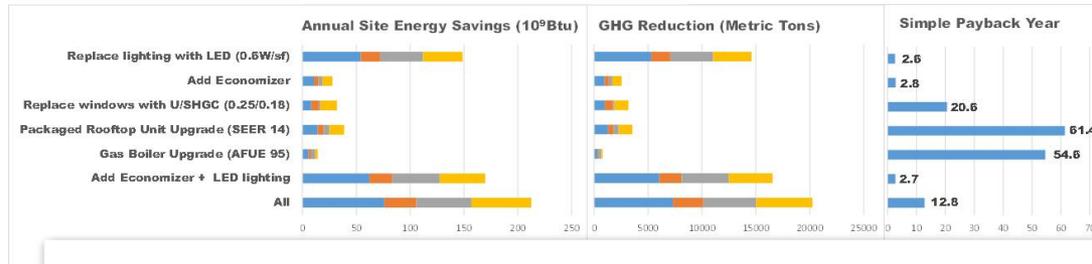
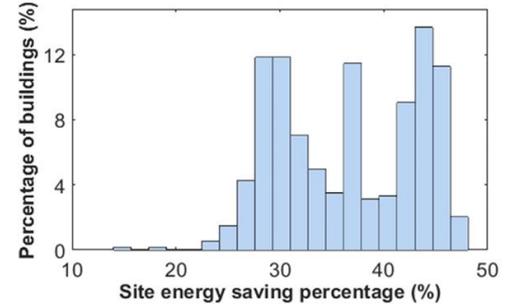
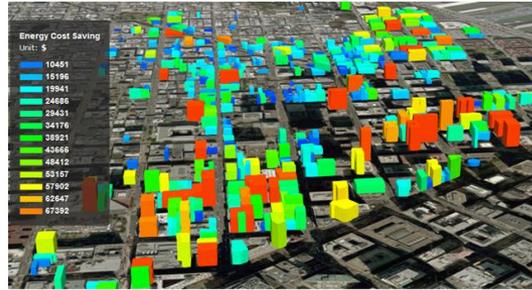


What? 2 areas: City scale models and Thermal Networks

How? 5 lab partnership to explore R&D opportunities

City Building Energy Saver and Bi-Directional Thermal Networks

- Aggressive energy reduction goals require new tools to prioritize investments and organize action
- Thermal networks use waste heat, integrate storage and renewables, and can provide 40% reduction in HVAC energy



Summary and Future Directions

- **Berkeley Lab provides local, state, national and international leadership** in energy efficiency and grid integration
- **Key areas of research**
 - Windows, cool roofs, daylighting, lighting controls
 - Radiant cooling, energy modeling, model predictive controls
 - Indoor air quality and ventilation
 - Integrated systems, ZNE, miscellaneous equipment loads, DC power
 - Commercial building energy data, M&V and energy analytics
- **New initiatives on urban science, energy in cities, and thermal networks**