



The Elephant in the Room: Addressing Plug Loads in Laboratories

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My Green Lab

Overview

Introduction to My Green Lab

Energy savings opportunities in labs

Introduction to the Center for Energy Efficient Labs

Current plug load study

Plans for 2015-2016

My Green Lab



- California-based 501(c)3 non-profit dedicated to making all labs sustainable
- energy, water, waste, green chemistry

What is a Lab?

- A room used for laboratory experimentation, research, or training in research methods, or professional research and observation

Our Approach: Institutional Level

- **Top-down**
 - Engage sustainability managers, facilities managers, energy managers, EH&S Directors, procurement specialists
- **Bottom-up**
 - Engage laboratory personnel, key opinion leaders, grad students, sustainability interns

2014-2015 Initiatives: Institutional

- Mercury-free microscopy
- Ultra-low freezers
 - -70 is the new -80 campaign
- Re-branding the fume hood campaign
 - 'be good in the hood'



Our Approach: Systems Thinking

- Bring together all stakeholders
 - organizations with laboratories, scientists, manufacturers, architects, consultants, utility companies

2014-2015 Initiatives: System-wide

- UC-wide green lab certification program
- Center for Energy Efficient Laboratories

Why Address Energy Efficiency?

- laboratories are the largest consumers of energy at research universities

S-Labs, CHESC

- And California has the most research universities in the country

Carnegie Classification of Institutions of Higher Education

- As well as the highest density of biotech and pharmaceutical companies

Ernst & Young

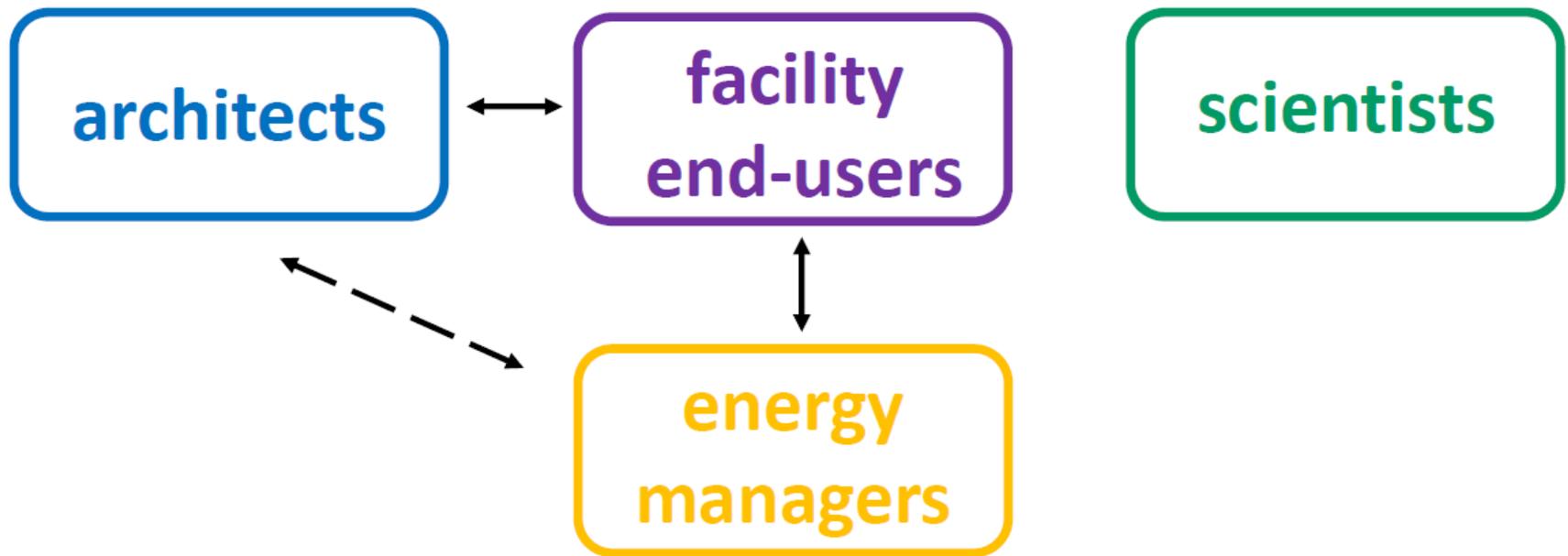
Why Are Labs so Energy-Intensive?

- 100% outside air requirements, ACH requirements
- Labs contain many pieces of energy-intensive equipment that generally run 24/7

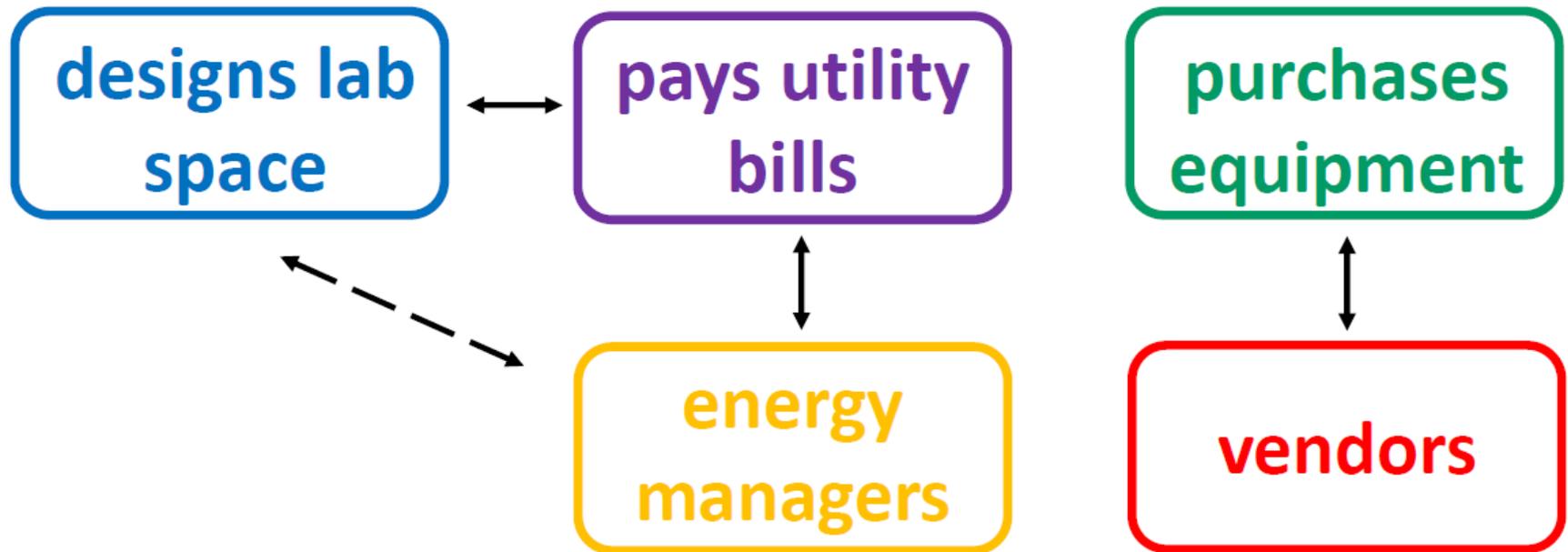
But...

- Little is known or communicated about the energy consumption of laboratory equipment

Why?



In Other Words



Opportunities for Energy Reduction in Labs

- Facility operations
- Equipment operations



- short term,
- driven by technology & behavior

- Facility design
- Equipment design



- long term,
- driven by operations

Energy Efficiency Opportunities: Facility Operations

- Lighting
- Ventilation rates
- Heating/cooling
- Water systems
- Compressed air
- Gas systems

Energy Efficiency Opportunities: Equipment Operations

- Fume hoods
- Ultra-low temp freezers
- Autoclaves
- Ice machines
- Centrifuges
- Microscope lighting
- Heat blocks
- Computers
- NMR
- Mass spec
- Thermocyclers
- Tissue culture hoods

Energy Efficiency Opportunities: Equipment Operations

Table C4: Estimated Annual Electricity Consumption of Selected Equipment in the Academic Section of the Biosciences Building, U Liverpool

| Equipment | Typical Peak Rated power (W) | Assumed Av Power (W) (% reduction factor) | Typical usage (hrs/y) | Typical Energy Consumption per Unit (kWh/y) | Estimated numbers ¹³ | Estimated Total Energy Consumption (kWh/y) |
|-------------------------------|------------------------------|---|-----------------------|---|---------------------------------|--|
| Freezer (-20) | 1,000 | 500 (50%) | 8,760 | 4,380 | 57 | 249,660 |
| Environmental Chamber | 2,000 (1,500-2,500) | 1,000 (50%) | 8,760 | 8,760 | 12 | 105,120 |
| Water Bath | 1,000 (500 – 1,500) | 750 (75%) | 4,368 | 3,276 | 31 | 101,556 |
| Incubator | 850 | 425 (50%) | 8,760 | 3,723 | 24 | 89,352 |
| Freezer (-80) | 1,200 | 600 (50%) | 8,760 | 5,256 | 14 | 73,584 |
| Oven | 1,500 | 495 (33%) | 8,760 | 4,336 | 11 | 47,698 |
| Ice Maker | 2,400 | 1,200 (50%) | 8,760 | 10,512 | 3 | 31,536 |
| Hybridiser | 750 | 375 (50%) | 8,760 | 3,285 | 6 | 19,710 |
| Incubator-shaker | 1,500 | 750 (50%) | 3,456 | 2,592 | 7 | 18,144 |
| Thermal Cycler (PCR machines) | 800 (250-1,600) | 400 (50%) | 720 | 288 | 33 | 9,504 |

Case Study: Ultra-low Freezers

- Energy use
 - min 15,000 in California
 - min 7,300 kWh/year PER FREEZER
 - = 109,500,000 kWh/year



Case Study: Ultra-low Freezers

- Example measure
 - Stirling freezers
 - Switching to Stirling freezers can save min 60,225,000 kWh/year = 55% min energy reduction
- Additional benefits
 - Reduced HVAC related usage
 - Reduced risk to samples

Energy Efficiency Opportunities: Behavior

- Ultra-low freezers: temperature tuning, proper maintenance

-70 is the new -80

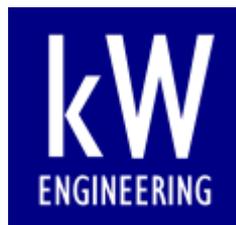


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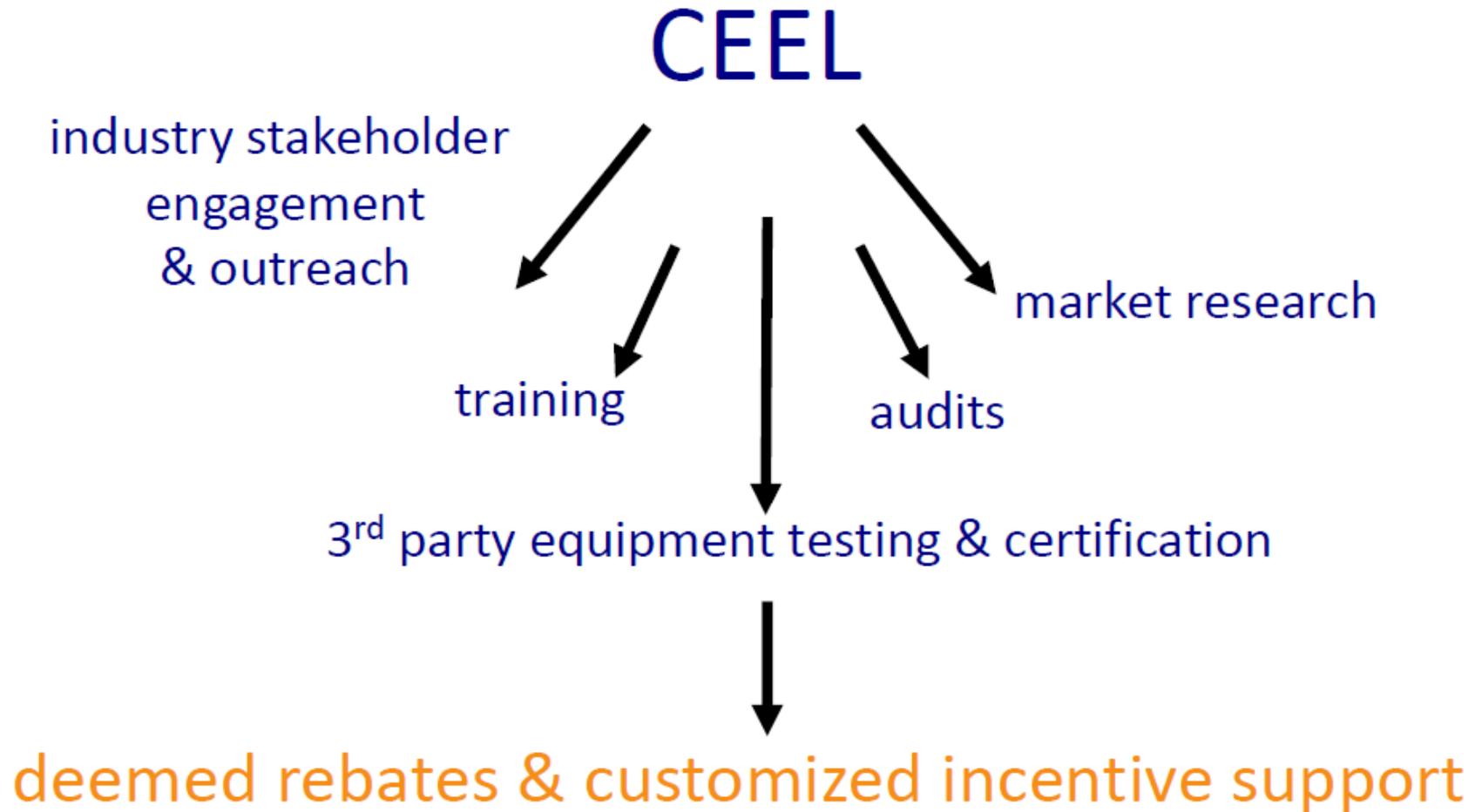


The Center for Energy Efficient Laboratories (CEEL)

Our core team



A Proposed Model: Center for Energy Efficient Labs



Our Core Team



Industry stakeholder
engagement, outreach, training



Consulting: audits, measure
development & implementation,
training, deemed measure
workpapers, HVAC modeling



3rd party equipment testing,
outreach, training



3rd party equipment testing

The Strategy

- Market assessment/plug load study
- Product testing
- HVAC modeling
- Financial incentive development
- Audits/outreach

Phase I: Market Assessment/Plug Load Study

- Online survey
- In-person interviews
- Market research

Phase I: Online Survey

- Breadth, not necessarily depth

Phase I: Online Survey

- General attitudes about energy, water & hazardous materials
- Ability of a financial incentive to influence purchasing decisions
- Number & type of equipment in the lab, and operating hours
- Laboratory square footage, hours of operation, expected growth/decline

Phase I: Online Survey

- Scientists
- Facilities managers

Phase I: In-person Interviews

- Depth, not breadth

Phase I: In-person Interviews

- Energy data

Phase I: In-person Interviews

- Interviews with energy managers at key accounts across the state

Phase I: Market Research

- Gathering existing market data on:
 - Number of laboratories
 - Square footage of laboratories
 - Market trends in growth/decline
 - Energy use in laboratories
 - Equipment found in laboratories

Phase I: Market Research

- Online searches
- Organizations that support industry segments
- Direct contact with organizations in the state
- Information from manufacturers

Phase I: Study Deadlines

- Deadline: Jan 22, 2015
- Final report due: March 12, 2015

Future Outlook: 2015-2016

- Market assessment/plug load study
- Product testing
- HVAC modeling
- Financial incentive development
- Audits/outreach

Future Outlook: Product Testing/HVAC Modeling

ultra-low temperature freezers

other forms of refrigeration



rebates

In Conclusion...



In Conclusion...



Thank you!

survey link: www.surveymonkey.com/s/CEEL

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