Smart Labs Accelerator

I2SL China

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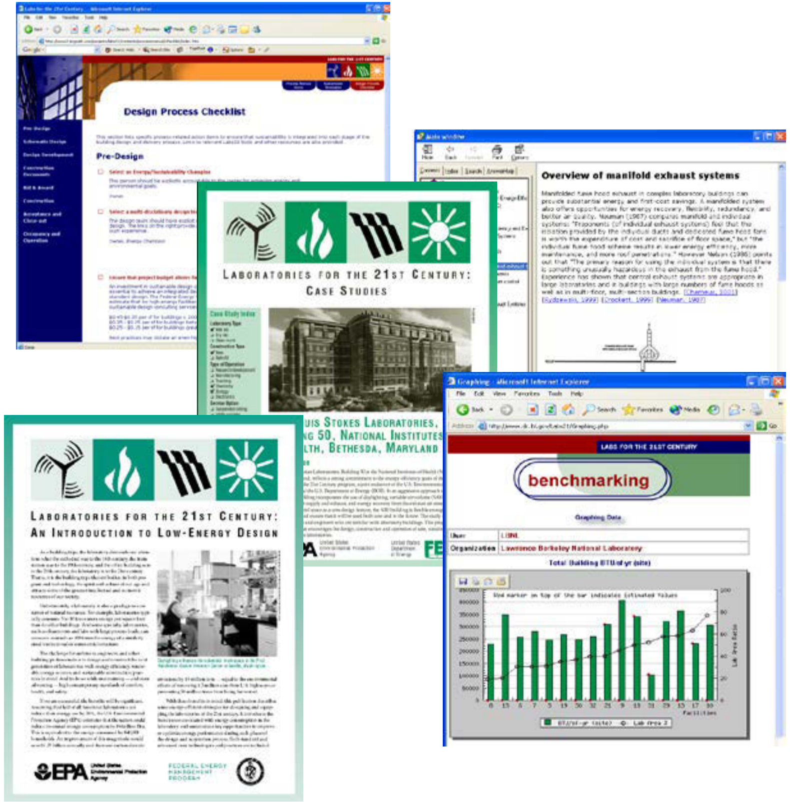
Labs21, I2SL, UCI, Smart Labs

- Labs21 was started in the late 1990s, developed many tools such as best practice guides for labs, case studies, training, annual conferences (http://www.i2sl.org/resources/toolkit.html)
- Labs21 transitioned to I2SL (http://www.i2sl.org)
- University of California Irvine (UCI) incorporated all best practices into the UCI Smart Lab program (https://www.ehs.uci.edu/programs/energy/)
- U.S. Department of Energy began the Better Buildings Smart Labs Accelerator in September 2016 (https://betterbuildingsinitiative.energy.gov/accelerators/smart-labs)

Labs21 Toolkit: http://www.i2sl.org/resources/toolkit.html



- Core Information Resources
  - Design Guide
  - Best Practice Guides
  - Technical Bulletins
  - Case Studies
  - Energy Benchmarking
- Design Process Tools
  - Labs21 Process Manual
  - Design Intent Tool
  - Environmental Performance Criteria

Labs are Specially Designed to Provide Safe and Controlled Environments That Promote Science

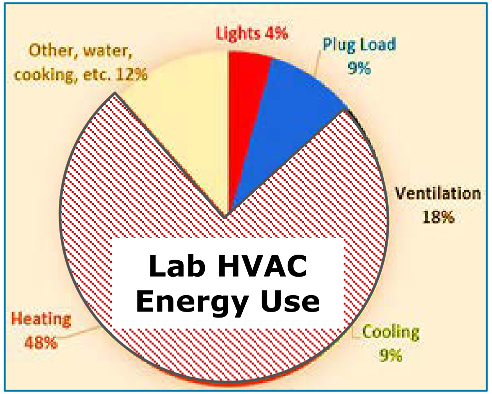
- Hazards
  - Chemical
  - Biological
  - Radiological
  - Physical

Courtesy of ECT

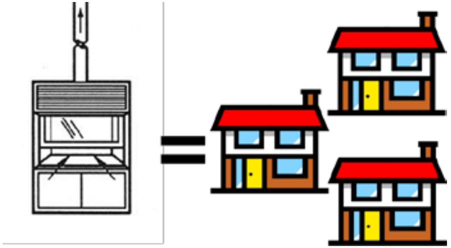
Laboratories are Expensive and Complicated

- Average lab size ≈ 100,000 ft^2
- Construction$_{(USA)}$ ≈ $45 million to $100 million
- Energy cost ≈ $700,000/year (avg. $7 per ft^2)

45% to 85% of the energy is consumed by fume hoods and the lab HVAC systems.



- Lab HVAC and fume hoods ≈ 30% of construction cost
- Fume hood installation ≈ $25,000–$50,000 each
- Fume hood annual cost ≈ $2,400–$5,000 per year



As much as <u>50% of HVAC energy is wasted</u> by excess airflow, inefficient fume hoods, and improper modulation of flow.

Courtesy of ECT

UCI—Components of a Smart Lab

1. Fundamental platform of dynamic, digital control systems
2. Demand-based ventilation
3. Low power density, demand-based lighting
4. Exhaust fan discharge velocity optimization
5. Pressure drop optimization
6. Fume hood flow optimization
7. Commissioning with automated cross-platform fault detection




Success of Smart Labs™ Implementation at UCI

Laboratory Building		Before "Smart Lab" Retrofit			After "Smart Lab" Retrofit		
Name	**Type***	**Estimated Avg. ACH**	**VAV or CV**	**Was more efficient than code?**	**kWh Savings**	**Therm Savings**	**Total Savings**
Croul Hall	P	6.6	VAV	~ 20%	41%	60%	55%
McGaugh Hall	B	9.4	CV	no	40%	66%	47%
Reines Hall	P	11.3	CV	no	70%	76%	72%
Natural Sciences II	P, B	9.1	VAV	~ 20%	48%	62%	50%
Biological Sciences 3	B	9	VAV	~ 30%	45%	81%	60%
CALIT2	E	6	VAV	~ 20%	46%	78%	62%
Gillespie Neurosciences	M	6.8	CV	~ 20%	58%	81%	61%
Sprague Hall	M	7.2	VAV	~ 20%	58%	82%	71%
Hewitt Hall	M	8.7	VAV	~ 20%	58%	77%	69%
Engineering 3	E	8	VAV	~ 30%	59%	78%	61%
Averages	–	8.2	VAV	~ 20%	**55%**	**76%**	**58%**

Even the most well-designed and well-maintained buildings will degrade over time!

DOE Better Buildings Smart Labs Accelerator Goals

- Establish a 10-year target of at least 20% energy reduction across laboratory building portfolio
  - Implement no- and low-cost savings measures at one lab to achieve a 5% reduction by the end of three years
  - Provide DOE with details on the measures taken and savings achieved

- Develop a detailed road map to achieving the 20% target
  - Implement at least one capital investment project and/or establish a strategic energy management plan

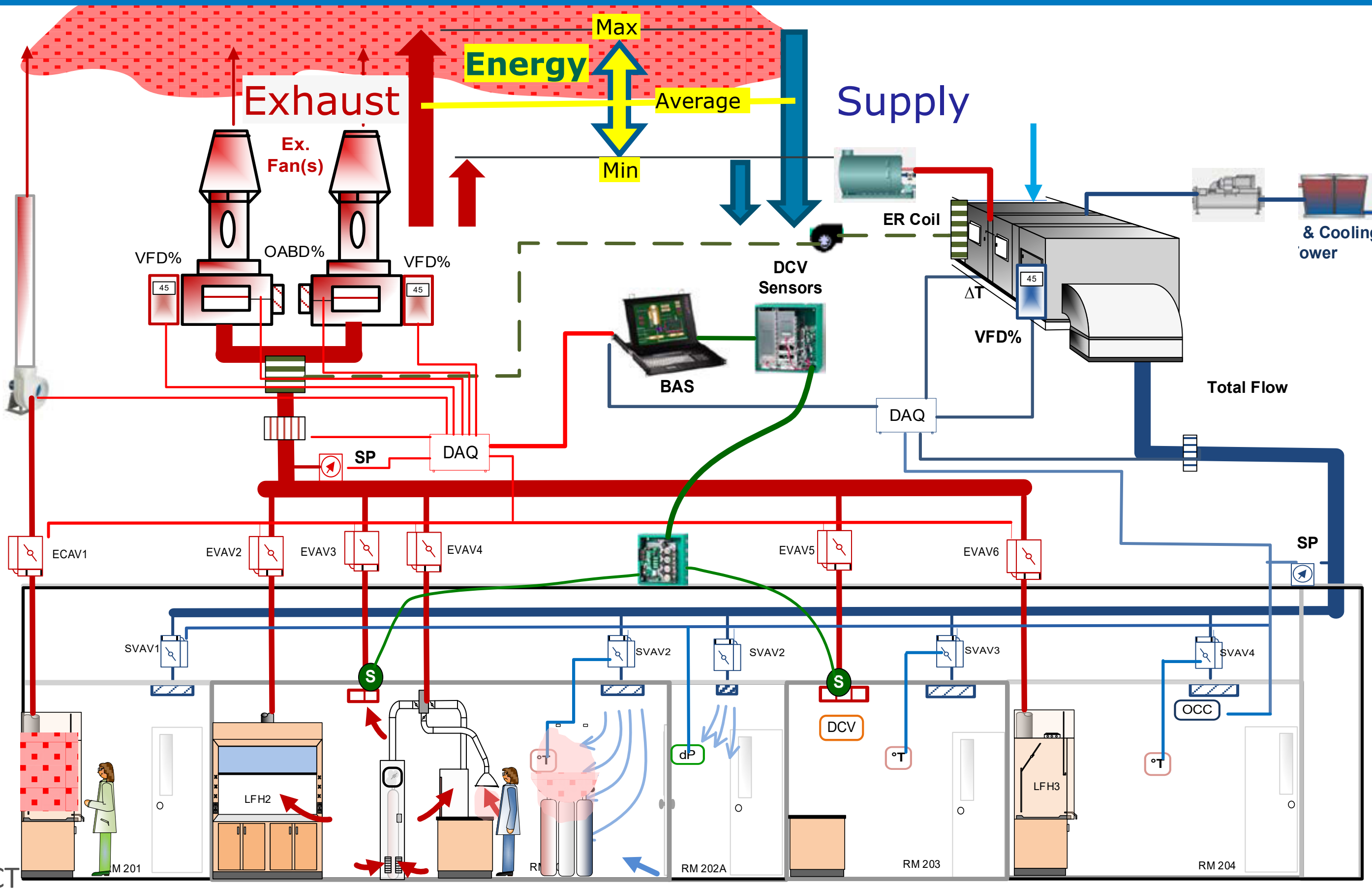
- Collaborate with DOE/I2SL/partners to develop metering and energy performance measurement approaches
  - By the end of year one, develop a metering plan, baseline, and metrics measuring whole building energy performance

- Share results and lessons learned with DOE/I2SL/partners (https://betterbuildingssolutioncenter.energy.gov/accelerators/smart-labs)

Key Elements of a Smart Lab

Key Element	Approaches to Overcome Barriers
Optimized ventilation and exhaust systems	Partner with industrial hygiene to determine lowest safe ventilation rate for each lab space and exhaust stack discharge velocity
Variable air volume	Upgrade constant air volume systems to variable air volume
Minimized system fan energy	Minimized system pressure drops and set duct static pressure to lowest adequate level
Optimized fume hoods	Partner with EHS/IH and lab staff to determine fume hood number, size, and containment requirements
Continuous commissioning	Use building control system and tools to optimize lab mechanical systems operations
Energy-efficient lighting	Implement energy-efficiency lighting technologies and controls
Lab staff is engaged in sustainable practices	Provide sustainable best practices to lab staff
Consider Demand Based Ventilation Controls	Partner with EHS/IH to determine if DBVC would allow reduced ventilation rate, especially for non fume hood driven labs.

Ventilation Drives Both Safety and Energy Use



Courtesy of ECT

Follow the Smart Lab Roadmap to Success

Phase 1 – Plan → Multi-Building Scoping Study
- Identify Opportunities
- Establish Budgets & Schedules
- Prioritize Building Projects

Phase 2 – Assess → Lab Building Demand vs. Performance Assessment
- Risk and Performance Assessment
- System Operation & Energy Use
- Project Scope, Costs, and Payback

Phase 3 – Optimization → Construction / Renovation Project
- High Performance Hoods
- Controls, Sensors, & Analytics
- TAB, CX, & Benchmarking

Phase 4 – Management → Lifecycle Management & Maintenance Program
- Maintenance & Operations
- Monitoring & Diagnostics
- Change Management

Courtesy of ECT

How Can China Develop a Smart Labs Program?

- Goals of China Smart Labs?
- Timeframe?
- Who will manage China Smart Labs?
- Role of I2SL?
- Role of Universities?
- Design Professionals?
- Government?
- Capturing China Smart Labs Best Practices
- Discussion

Questions?

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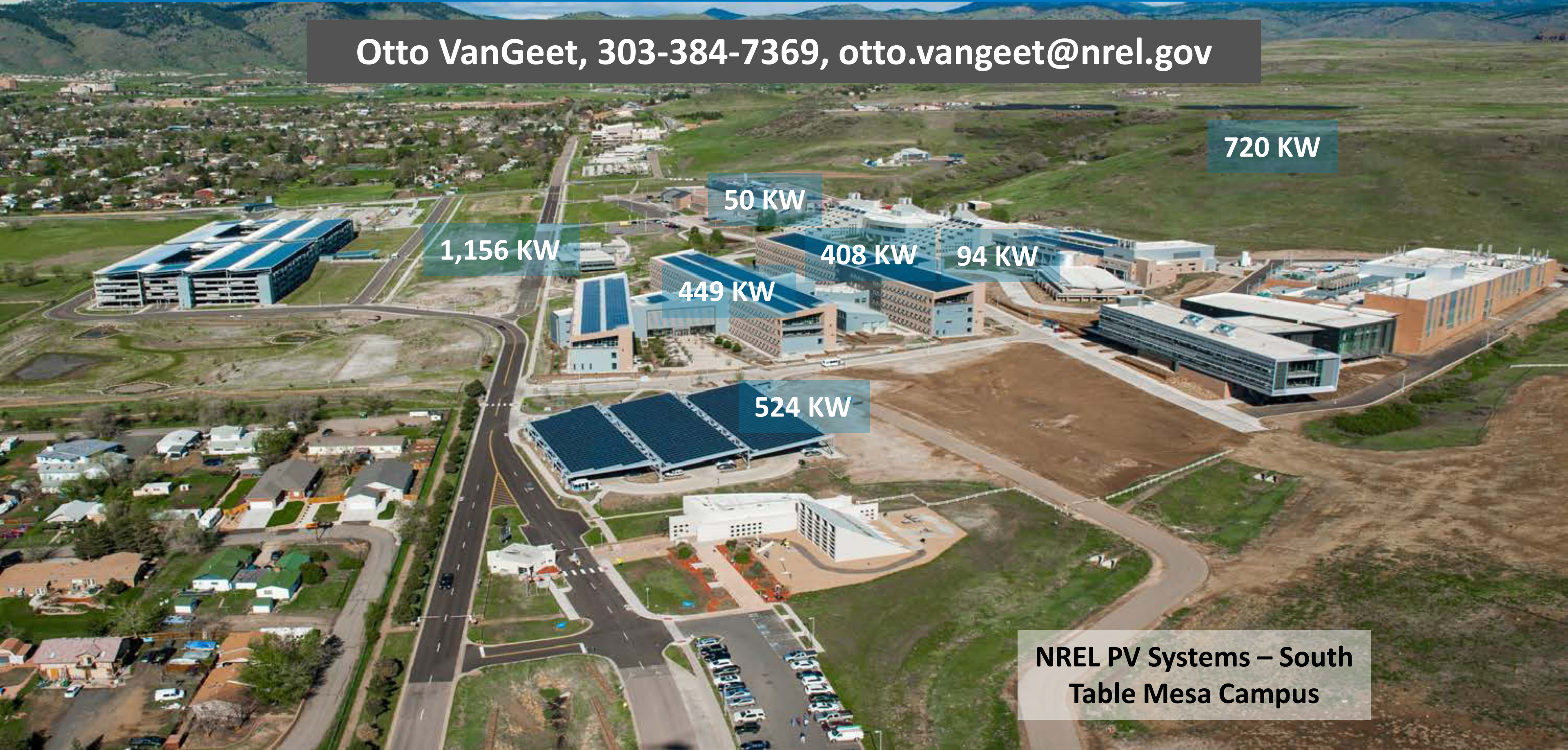

NREL PV Systems – South Table Mesa Campus

Notice

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