

PSSRB Vivarium Monitoring Based Retro-Commissioning

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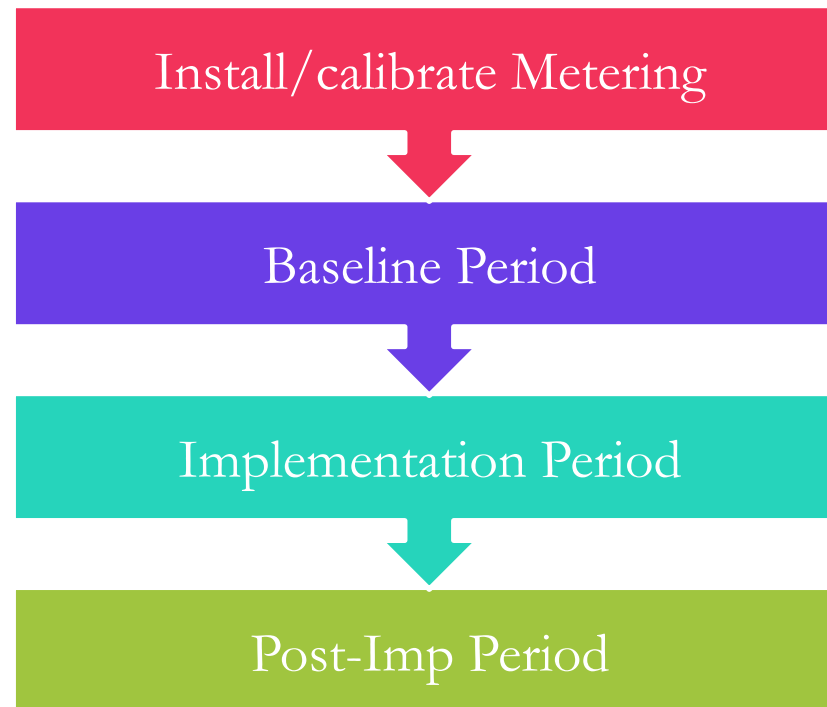
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Topics

- Project Overview
- Building Description
- Project Results (Savings and cost)
- Energy Conservation Measures (ECMs)
- Innovative Control Strategies
- Some “Perfect” Conditions that Allowed this project to succeed

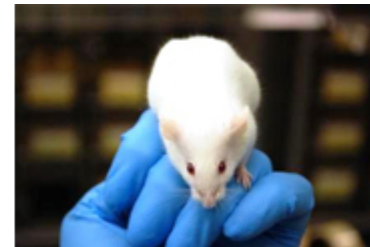
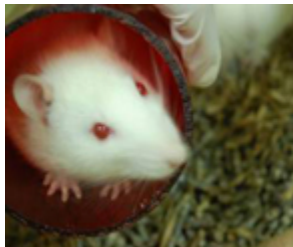
Project Overview

- Performed under a CEC program known as the Higher Education (UC, CSU, CCC) / IOU (Investor Owned Utility) Partnership that offers rebates based on savings that can be proven with monitored meter data.



Building/Project Description

- Specialized Vivarium Building
- Constructed 2003-2005
- 80,000 ft² and 6 floors, 250,000 mice
- 4 floors devoted to lab animal housing and support spaces
- Fully ventilated (Independent Supply and Exhaust) cage racks
- Continuous lab animal occupancy; 100% Outside Air ventilation



Typical floor plan

PSSRB FLOOR 5

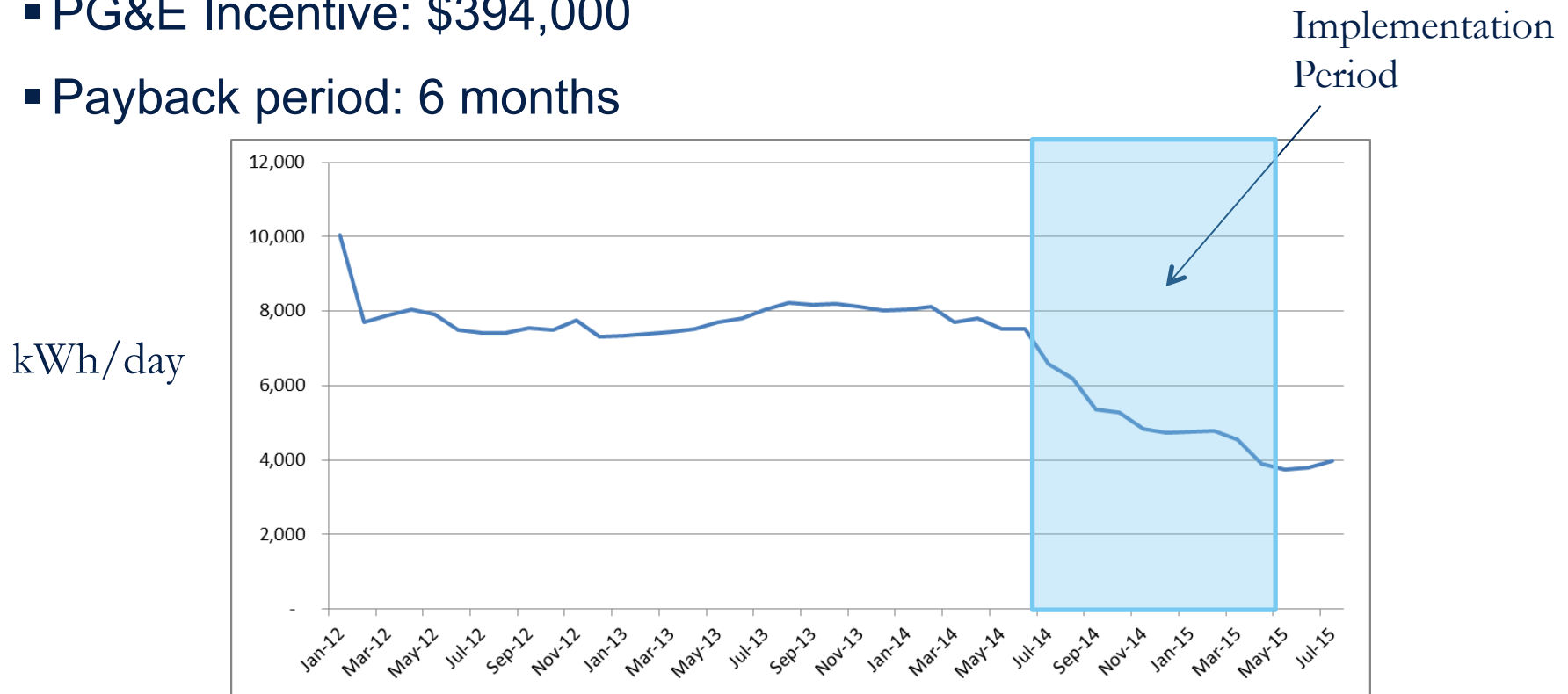


Mechanical

- 4 rooftop AHUs; 75 HP each, HW, CHW, Steam Humidifiers
- 4 Exhaust fans; 60 HP each
- Plant Steam for HHW generation, HHW pumps
- Plant Chilled Water, adequate pressure (no pumping in bldg)
- ~ 420 Pressure independent VAV Airflow Control Valves with Vortex shedding airflow measurement and HW reheat
- HEPA filtration and carbon filters (odor and VOC mitigation)
- DDC controls throughout building

Project Results

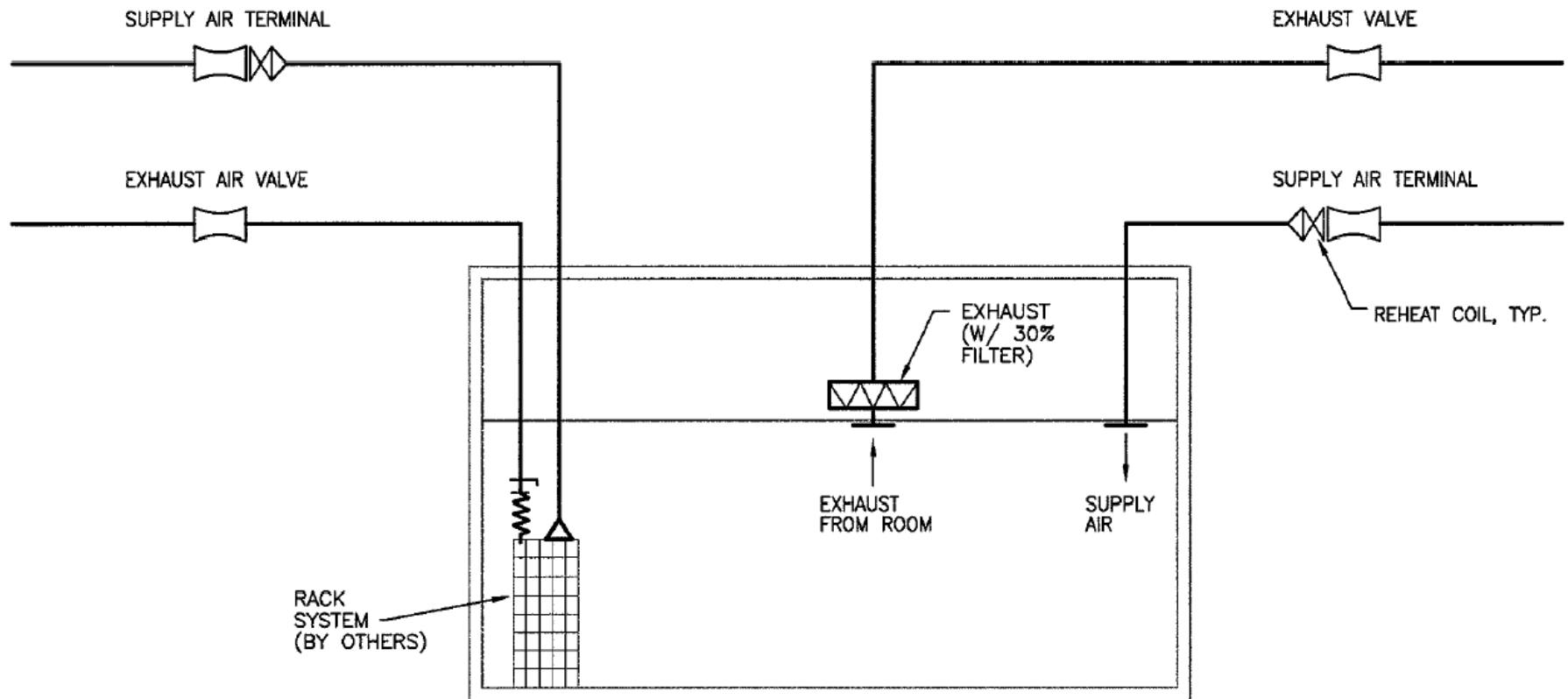
- Savings: 1,440,000 kWh (>50%) and 48,200 therms per year (about \$218k/yr). EUI reduced from 118 to 62 kBtu/ft²/yr
- Total costs: \$510,030 (includes all overhead)
- PG&E Incentive: \$394,000
- Payback period: 6 months



Energy Conservation Measures (ECMs)

- Consultant recommended about 30 ECMs
 - Vast majority were controls logic changes
- Examples:
 - Static pressure and temp reset (SA, EA, HHW) with deadband
 - Eliminated bypass flow; Opened HHW reheat balance valves
 - Demand Control (temp and ventilation) added for many zones
 - Motion Sensors & Schedules for Human occupied spaces
 - Standby mode for unoccupied / unused spaces
 - Airflow and Temperature Set Point adjustments
- Not all measures implemented due to time & effort “budget.”

Typical Small Animal Room



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TYPICAL SMALL A.R.L. ROOM SCHEMATIC

SCALE: NONE

Small Animal Room ECMs

- Design: 3 double and 6 single-sided cage racks
- Installed: 2 double and 6 single
- Result: More air than the needed
- Solution: BMS calculates flow SP based on # of racks in room
 - If change occurs: User caps/uncaps SA/EA drops as needed and facilities edits BMS parameters accordingly
- Actual occupancy determined by detailed audit
- Airflow changes carefully validated at cage level to assure ventilation effectiveness
- Labor intensive but worth it!

Animal Support Rooms ECMs

- Each floor has several procedure rooms in addition to animal housing
- Existing condition: PR saw limited use but ventilated 24/7
- Installed motion sensors to determine occupancy
- Depending on use, sensitivity, etc. the rooms could be either;
 - Turned off when unoccupied
 - Turned down whenever unoccupied
 - On during normal hours, reduced ACH off-hours when no occupancy sensed (most sensitive areas)

Innovation: SA/EA Static Pressure Reset

- Existing: fixed static pressure
- New strategy – Reset static pressure as follows:
 - Pull Air Flow Control Valve (AFCV) position for all zones
 - Average population of most open dampers (Second Decile used)
 - Create setpoint for this average position (via testing)
 - Initially: lots of ‘problem’ zones w/ dampers 100% open
 - Use DDC alarms to address outliers
- Controls and building engineers worked to greatly the reduce the number of ‘problem’ zones

Innovation: Fight Hysteresis

- Existing: Airflow control valve (AFCV) plus airflow measurement causes static pressure to “creep” up due to mechanical hysteresis
 - Airflow overshoot compresses spring in AFCV
 - Transient underflow opens valve, calling for more system static.
- New Strategy – Drop System Static pressure to relax springs
 - Every four hours static pressure setpoint is dropped 10%
 - System seeks optimum static pressure “from below”
 - Static Pressure Set Point “Creep” Eliminated
 - Acceptable airflow conditions maintained

Elements Contributing to Project's Success

- Differences between design and actual use (100% vs. 50% 24/7)
 - Single user controls building, bought-in to project
 - Detailed knowledge of building needs
 - Commissioning agent (CxA) performed detailed new bldg Cx
 - CxA had detailed knowledge of process needs & equipment
 - Zone-by-zone analysis labor intensive but worth it
 - Critical nature of building dissuaded prior optimization
 - Functionality & Schedule main concern for new building
 - Sophisticated in-house resources: Controls, Engineering, Maint.
 - Team willing to invest resources and Persevere (2.5 years)!
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