UCSB Operational Effectiveness: Energy Management Initiative

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UCSB Energy Use
Energy Management Initiative Framework

Reduce Energy Consumption

Behavior Change

Pilot Program Strategies

Design Campus Wide Initiative
Pilot Buildings

Education

Social Science

Lab
Pre-Pilot Behaviors

- **Walkthrough**: Lights on in offices with sufficient natural lighting
  - 64%
  - n=68

- **Survey**: Not using computer power saving settings
  - 32%
  - n=35

- **Survey**: Would use a space heater
  - 55%
  - n=35
Education Building Pilot Program

Occupant Approaches
- Information
- Strategic messaging
- Competition

Building Approaches
- Lighting settings
- Temperature controls
Messaging Research Design

Control
Commitment
Normative

Education (With Incentive)

Social Science (No Incentive)

November
Computers

December
Lighting

January
Space Heaters
Strategic Messaging

89% of faculty at UCSB use a blanket or jacket instead of a space heater.

I commit to leave my lights off if there is sufficient natural lighting.

Contact facilities if your building is too hot or cold: 893-8300.
Education Electricity Reduction

Monthly Electricity Use (kWh)

<table>
<thead>
<tr>
<th>Month</th>
<th>Baseline (2013-2014)</th>
<th>Pilot Program</th>
<th>Pilot Program + Strategic Initiatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul</td>
<td>-3.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug</td>
<td>.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep</td>
<td>-4.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td>-10.2%</td>
<td></td>
<td></td>
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<tr>
<td>Nov</td>
<td>-4.0%</td>
<td></td>
<td></td>
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<tr>
<td>Dec</td>
<td>-5.1%</td>
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<tr>
<td>Jan</td>
<td>-6.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb</td>
<td>-6.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>-4.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>-1.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>-10.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>-8.4%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Behavior Change

- 64% of lights on in offices with natural lighting
- 32% of occupants not using computer power saving settings
- 55% of occupants who would use a space heater

19% n=48 Walkthrough
9% n=23 Survey
21% n=23 Survey
Energy Savings: Lighting

Education Lighting Energy Use

- Baseline
- Lighting Energy Use

October: -4.5%
November: -0.5%
December: -4.8%
January: -4.5%
February: -1.4%
March: -0.3%
April: 3.8%
May: -7.9%
June: -9.25%
Energy Savings: Plug Load

Education Plug Load Energy Use

<table>
<thead>
<tr>
<th>Month</th>
<th>Baseline</th>
<th>Plug Load Energy Use</th>
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</thead>
<tbody>
<tr>
<td>October</td>
<td>-7.7%</td>
<td>-1.2%</td>
</tr>
<tr>
<td>November</td>
<td></td>
<td>-8.7%</td>
</tr>
<tr>
<td>December</td>
<td></td>
<td>-8.5%</td>
</tr>
<tr>
<td>January</td>
<td></td>
<td>-0.9%</td>
</tr>
<tr>
<td>February</td>
<td></td>
<td>-0.2%</td>
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<tr>
<td>March</td>
<td></td>
<td>4.3%</td>
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<tr>
<td>April</td>
<td></td>
<td>-3.2%</td>
</tr>
<tr>
<td>May</td>
<td></td>
<td>-4.2%</td>
</tr>
<tr>
<td>June</td>
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</tbody>
</table>

Electricity Use (kWh)
Normative and Commitment Messages Compared to Control

<table>
<thead>
<tr>
<th>Month</th>
<th>Normative Messaging</th>
<th>Commitment Messaging</th>
<th>Control Messaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>November</td>
<td>-6.7%</td>
<td>-3.2%</td>
<td>-3.6%</td>
</tr>
<tr>
<td>December</td>
<td>-6.1%</td>
<td>-5.7%</td>
<td>-9.5%</td>
</tr>
<tr>
<td>January</td>
<td>-7.3%</td>
<td>-6.5%</td>
<td>-8.4%</td>
</tr>
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</table>
Strategic Messaging Effectiveness

3 Month Average of Different Messaging Techniques

- Normative Messaging
- Commitment Messaging
- Control Messaging

Percent Energy Reduction

-6.7%  -6.4%  -5.9%
Financial Incentive

Effectiveness of Financial Incentive

November: -7.1%, -4.0%
December: -5.1%, -3.3%
January: -6.1%, -5.5%
February: -6.2%, -4.9%
March: -3.3%, -4.4%
April: -2.9%, -1.0%
May: -3.8%
June: -4.2%

Education Average Reduction = 5.7%
Social Science Average Reduction = 4.4%
Lab Building Pilot Program

**Occupant Approaches**
- Information
- Strategic messaging
- Stickers

**Building Approaches**
- Ventilation setbacks
- Fume hood calibration
Lab Energy Use

<table>
<thead>
<tr>
<th>Month</th>
<th>Baseline (2013-2014)</th>
<th>Pilot Program</th>
<th>Pilot Program + Strategic Initiatives</th>
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<tbody>
<tr>
<td>Jul</td>
<td>50,000</td>
<td>50,000</td>
<td>50,000</td>
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<tr>
<td>Aug</td>
<td>100,000</td>
<td>100,000</td>
<td>100,000</td>
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<tr>
<td>Sep</td>
<td>150,000</td>
<td>150,000</td>
<td>150,000</td>
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<tr>
<td>Oct</td>
<td>200,000</td>
<td>200,000</td>
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<tr>
<td>Nov</td>
<td>250,000</td>
<td>250,000</td>
<td>250,000</td>
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<td>Dec</td>
<td>300,000</td>
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<td>300,000</td>
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<tr>
<td>Jan</td>
<td>-2.3%</td>
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<td>-3.3%</td>
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<td>-3.2%</td>
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<tr>
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<tr>
<td>Jun</td>
<td>-1.6%</td>
<td>-3.3%</td>
<td>-4.8%</td>
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Monthly Electricity Use (kWh)
Pilot Energy Reduction

Education
-6.2%

Social
-4.4%

Lab
-2.6%

Average
-4.4%
Campus Wide Program

- Full time employee
- Interns
- Meter installation and maintenance
- Online resources
- Physical materials
Energy Efficiency Cost Comparison

$120,000

$5,000,000
Campus Wide Benefits

$260,000

700 tons CO$_2$/year
Acknowledgements

- Sarah Anderson*
- Jordan Sager*
- Dave McHale
- Amorette Getty
- Phil Ehret
- Perrin Pellegrin
- Dave Auston
- Alex Moretto
- Cabe Fletcher

- Allison Horst
- LabRATS and PowerSave UCSB
- UCSB Utility and Energy Services
- UCSB Sustainability
- TGIF
- Patrick Callery
Education Timeline

Pilot Program Began.
Initial email and energy report sent out.

Presented at department and staff meetings.
Changed light controls.

Energy Competition

July
Aug
Sept
Oct
Nov
Dec
Jan
Feb

Energy emails not distributed by department contact.

Computers
Lighting
Space Heaters

Comprehensive messaging rollout.
Including printed materials and emailed reports.
Behavior Change: Individual Comparisons

20 → 7
n=38
Walkthrough

8 → 6
n=8
Survey

5 → 1
n=8
Survey
Social Science Timeline

- Social Science building introduced into Pilot Program.
- Comprehensive messaging rollout.
  - Including printed materials and emailed reports.
- Sent Email Report

July | Aug | Sept | Oct | Nov | Dec | Jan | Feb
- Computers
- Lighting
- Space Heaters
Social Science Monthly Electricity Use

- **Baseline (2012-2013)**
- **2014 Electricity Use**
- **Months with Strategic Initiatives**

<table>
<thead>
<tr>
<th>Month</th>
<th>2012-2013</th>
<th>2014</th>
<th>Strategic Initiatives</th>
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</thead>
<tbody>
<tr>
<td>Jul</td>
<td>2.1%</td>
<td>-3.8%</td>
<td>-3.5%</td>
</tr>
<tr>
<td>Aug</td>
<td>-2.4%</td>
<td>-7.1%</td>
<td>-3.3%</td>
</tr>
<tr>
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<tr>
<td>Mar</td>
<td>-3.3%</td>
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Lab Timeline

**Pilot Program Began.**
Initial email and energy report sent out.

**LabRATS sustainability training for new graduate students.**

**Lab energy Assessments and sticker distribution.**

**July**
- Energy emails possibly not distributed by department contact.

**Aug**
- Comprehensive messaging rollout. Including printed materials and emailed reports.

**Sept**
- LabRATS sustainability training for new graduate students.

**Oct**
- Lab energy Assessments and sticker distribution.

**Nov**
- Energy emails possibly not distributed by department contact.

**Dec**
- LabRATS sustainability training for new graduate students.

**Jan**
- Lab energy Assessments and sticker distribution.

**Feb**
- LabRATS sustainability training for new graduate students.
Lab Energy Use

Lab Monthly Electricity Use

- Baseline (2013-2014)
- Pilot Program
- Pilot Program + Strategic Initiatives

Monthly Electricity Use (kWh)

- Jul: -2.3%
- Aug: 4.9%
- Sep: 7.8%
- Oct: 5.4%
- Nov: -3.7%
- Dec: -0.6%
- Jan: -1.6%
- Feb: -3.9%
### Lab Energy Use Breakdown

| Lab       | Coefficient | PR(>|t|) |
|-----------|-------------|---------|
| Intercept | 18.72792    | < 2e-16 *** |
| Temp Above| 0.41        | 8.75e-10 *** |
| Temp Below| -0.085196   | 5.00e-08 *** |
| Daylight  | 4.600416    | 4.02e-07 *** |
| HVAC      | 391.46093   | < 2e-16 *** |
| Work hours| 37.931824   | < 2e-16 *** |
| Weekend   | -13.96064   | 2e-16 ***  |
| Holiday   | -6.072824   | 0.00341 **  |
| R-squared | 0.6544      |         |

**PSBN Energy Model**

- Actual Electricity Use
- Modeled Electricity Use

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Energy Use (kW)

- 5/11/14
- 5/13/14
- 5/15/14
- 5/17/14
- 5/19/14
- 5/21/14
- 5/23/14
- 5/25/14
- 5/27/14
Stickers

- ALWAYS POWER DOWN!
- SLEEPS AUTOMATICALLY
- ASK BEFORE TURNING OFF!
- ALWAYS LEAVE ON!
Strategic Messaging Effectiveness

Commitment Messaging Compared to Control

- November:
  - Commitment Messaging: -3.2%
  - Control Messaging: -3.6%

- December:
  - Commitment Messaging: -9.5%
  - Control Messaging: -5.7%

- January:
  - Commitment Messaging: -6.5%
  - Control Messaging: -8.4%
Strategic Messaging Effectiveness

Normative Messages Compared to Control

November

December

January

Percent Energy Reduction

-10%

-8%

-6%

-4%

-2%

0%

Normative Messaging

Control Messaging

November: -6.7% vs. -3.6%

December: -6.1% vs. -5.7%

January: -7.3% vs. -8.4%