EPIC Symposium

Improving Water and Energy Efficiency in California’s Dairy Industry

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“Accelerate the development and commercialization of efficient heating, cooling, and energy distribution solutions through stakeholder engagement, innovation, R&D, education, and outreach.”
California’s Dairies

- California has:
  - 1,450 Dairies
  - 1.78 million dairy cows
  - Mostly located in the central valley
Milk Production = Heat Production

- Average CA cow produces over 8 gallons of milk each day
- Production generates a lot of metabolic heat
Cattle Responses to Heat Load: Behavior and Physiology

- ↑ Use of heat abatement resources
- ↑ Sweating (limited)
- ↑ Respiration rate, panting
- ↓ Eating
- ↑ Time standing up
- ↓ Movement/activity
If Heat Load is Not Managed…

↑ Body temperature
↓ Milk production
↓ Reproduction/fertility
↑ Disease risk
↑ Mortality
Typical Cooling Strategy

- One of top 3 uses of water at a dairy
- Sprinklers over feed bunk, milking parlor
- Fans in bedding area, milking parlor
Energy Costs for a California Dairy

*Energy costs at California’s dairies peak in summer.*
Scope of the Project

BASELINE APPROACH

(A) CONDUCTION COOLING

(B) TARGETED CONVECTION COOLING
Conduction Cooling

Conduction Cooling Mats Under Bedding

Heat Exchanger

Insulator

Sub Wet-bulb Evaporative Chiller
# Calculated Water and Energy Impacts for Baseline vs Proposed Cooling Systems

<table>
<thead>
<tr>
<th></th>
<th>Baseline (fans/soakers)</th>
<th>Conduction Cooling Approach</th>
<th>Targeted Convection Cooling Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water use Gallons/cow/year</strong></td>
<td>11,424 (soakers)</td>
<td>2,166 (soakers)</td>
<td>1,560 (chiller)</td>
</tr>
<tr>
<td></td>
<td>11,424 (total)</td>
<td>928 (chiller)</td>
<td>1,560 (total)</td>
</tr>
<tr>
<td><strong>% Water Use Reduction</strong></td>
<td>-</td>
<td>73%</td>
<td>86%</td>
</tr>
<tr>
<td><strong>Electricity use kWh/cow/year</strong></td>
<td>86 (fans)</td>
<td>19 (fans)</td>
<td>94 (chiller)</td>
</tr>
<tr>
<td></td>
<td>55 (on-site pumps)</td>
<td>14 (on-site pumps)</td>
<td>8 (on-site pumps)</td>
</tr>
<tr>
<td></td>
<td>17 (CC recirc pump)</td>
<td>37 (chiller)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>141 (total)</td>
<td>87 (total)</td>
<td>102 (total)</td>
</tr>
<tr>
<td><strong>% Electricity use Reduction</strong></td>
<td>-</td>
<td>38%</td>
<td>28%</td>
</tr>
</tbody>
</table>
Technical Tasks and Approximate Timeline

**PHASE 1 - UC DAVIS DAIRY**

- **PLANNING, DESIGN & INSTALLATION**
  - Nov. 16 - Apr. 17
- **DATA COLLECTION AND ANALYSIS**
  - May 17 - Oct. 17

**PHASE 2 - COMMERCIAL DAIRY**

- **PLANNING, DESIGN & INSTALLATION**
  - Nov 17 - Apr. 18
- **DATA COLLECTION AND ANALYSIS**
  - May 18 - Dec. 18

**MARKET ANALYSIS**
- Jun. 17 - Dec. 18

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**At UC Davis Dairy**

Compare conduction cooling and targeted convection cooling approaches against a baseline. Select most promising technology based on energy consumption, water consumption, performance, and cost.

**At Commercial Dairy**

For selected approach, characterize energy, water use and cow productivity and health at a commercial dairy scale in Tulare, CA.