COLD STORAGE FOR SMALL TO MEDIUM-SIZED AG PRODUCERS
Group Members

- Jamie Cremeans
  - Mechanical Engineering

- Christian Guynes
  - Mechanical Engineering

- Stephen Kelley
  - Mechanical Engineering
Group Members Continued

- Nicolas Meacham
  - Mechanical Engineering

- Ben Severe
  - Mechanical Engineering
Sponsor
- 3Core, Inc.

Faculty Advisor
- Gregory Kallio, Ph.D.
Overview

- Farmers need on-site cold storage
- Function:
  - Reduce waste and excess costs
  - Provide more efficient cooling solution
  - Ability to increase volume based on need
  - Functional Portability
<table>
<thead>
<tr>
<th>Requirement:</th>
<th>Qual./Quant.</th>
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</thead>
<tbody>
<tr>
<td><strong>Must Do:</strong></td>
<td></td>
</tr>
<tr>
<td>Reach/maintain required temperature, at 108 °F ambient temp, wind, clear sky</td>
<td>quantitative</td>
</tr>
<tr>
<td>Maintain humidity within 20% of target</td>
<td>quantitative</td>
</tr>
<tr>
<td>Temporal/Spatial temperature distribution</td>
<td>quantitative</td>
</tr>
<tr>
<td>Alert System</td>
<td>qualitative</td>
</tr>
<tr>
<td>Run off 120v/240v AC power source.</td>
<td>qualitative</td>
</tr>
<tr>
<td><strong>Full-scale cost under $20,000</strong></td>
<td>quantitative</td>
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<tr>
<td><strong>Should Do:</strong></td>
<td></td>
</tr>
<tr>
<td>Modular</td>
<td>qualitative</td>
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<tr>
<td><strong>Full-scale cost under $15,000</strong></td>
<td>quantitative</td>
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<tr>
<td></td>
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<tr>
<td><strong>Would Be Nice:</strong></td>
<td></td>
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<tr>
<td>Solar Powered</td>
<td>qualitative</td>
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<tr>
<td>Have mobility of some form</td>
<td>qualitative</td>
</tr>
<tr>
<td><strong>Full-scale cost under $10,000</strong></td>
<td>quantitative</td>
</tr>
<tr>
<td>Requirement</td>
<td>Engineering Specification</td>
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<tr>
<td>--------------------------------</td>
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</tr>
<tr>
<td>Temperature Range</td>
<td>Degrees</td>
</tr>
<tr>
<td>Temperature Control Temporal/ Spatial</td>
<td>Degrees</td>
</tr>
<tr>
<td>Humidity Range</td>
<td>Mass water / Unit Volume of Air &amp; Water</td>
</tr>
<tr>
<td>Energy Savings</td>
<td>Power</td>
</tr>
<tr>
<td>Fork lift Accessible</td>
<td>Dimensions/Strength</td>
</tr>
<tr>
<td>Mobile</td>
<td>Mass</td>
</tr>
</tbody>
</table>
Full Scale Design Solution

- SIP Walls and Roof
- Reinforced Floor Structure
- Split V-C Refrigeration
  - 7,300 BTU/hr
- Lengthwise Modularity
- Transportable
- Solar PV (optional)
Full-Scale Unit
Prototype Final Design

- **Size**
  - Height: 5 ft
  - Width: 5 ft
  - Length: 6 ft

- **Total heat rate**
  - \( Q_{in} \approx 812 \text{ BTU/hr} \)

- **Cooling**
  - Window A/C modified with the CoolBot

- **Validate full-size calculations**
  - Sensors: temperature, watt-meter, etc.
Prototype Final Design

- Exterior – Gel Coated Fiberglass Panels
- Vapor Barrier – 6 mil plastic
- Structurally insulated panels (SIPs)
- FRP – Fiber reinforced Plastic
Roof in place
Gel Coated Fiberglass Exterior
Test Day
Power Test
Test Fixture
Temperature Test Results

Temperature Distribution vs. Time
Forklift Test
Floor Testing Results

Delta = Pretest – Posttest
Final Budget

Total Project Cost: $13,680.00

Material Cost: $3,500.00
Trailer: $380.00
Labor: $2,300.00
Donated Material: $2,300.00

$7,500.00
Reflections

- Structure and insulation were completely effective
- Difficulties encountered in sealing doors
- Next iteration should focus on more efficient refrigeration unit
- Produce prototype size without forklift accessible floor
- Gather information from more farmers
Acknowledgments

- **Donations**
  - SIP material from Todd Harris of SIPerior Homes
  - Fiberglass Exterior from Bill Hill of Precision Craft Boat Works
  - Decal design and purchase from North Valley Food Hub
  - Generator from CSU Chico College of Agriculture
  - Welding from Gordon of Butte College Welding Program
  - Guy Rents forklift for testing
Conclusion