Need: Reduce economic losses in dairy operations due to heat stress in cattle.

Background
- Organic dairy produces 2.4 billion pounds of milk yearly.
- Small organic dairy farms use a rotational grazing method.
- Milk production per cow can decrease up to 5 lbs./day due to heat stress.
- This can potentially result in a loss of about $1800 per cow per year.

Objectives
- Reduce heat stress on free-range cows
- Mobile structure for rotational grazing
- Energy-independent
- Act autonomously using onboard logic

Design for 25 cows
Dairy cattle require approximately 40 ft²/cow of personal space. This necessitates a shade footprint of 1000 ft². Heat stress should be reduced to a THI of 71. Weather conditions are monitored to control the cooling system.

Approach
Evaporative Cooling
The temperature-humidity-index is managed by a cooling system combining forced air circulation and water sprinkling to mimic sweating across the cow.

Intelligent Management
Current weather conditions are monitored by sensors and a microcontroller will actuate the fan and the sprinkler pumps accordingly. The electronics package has long-range wireless communication for monitoring.

Stand-Alone System
Solar Energy
Three PV panels are monitored and controlled by a MPPT charge controller. Two deep cycle batteries will store excess energy collected.

Water Storage
Water is stored in a 55-gallon drum and dual diaphragm pumps provide flow to irrigation sprinklers.

Structure
Skids
Skids are used for uncomplicated mobility through the pastures. Two D-rings allow for chain towing with a tractor or utility vehicle

Expanding Panels
The structure features folding panels on four sides to vastly expand shaded area for the herd.

Acknowledgements: Dr. John Wilkerson, Dr. Daniel Yoder, Dr. Paul Ayers, Dr. William Hart, David Smith
Thomas Canonico, Elizabeth Fortunato, Mary Nyhus, Phillip Ward