Energy consumption in commercial Midwest dairy barns
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Introduction
There is rising pressure from both food companies and consumers to reduce carbon emissions within agricultural systems. Determining baseline fossil energy use in agricultural systems is the first step towards reducing carbon emissions. Energy use data within agricultural systems, including dairy production, is scarce. Therefore, baseline electricity use data is needed to begin investigating areas within dairy production that have the potential for reduced energy consumption.

Objectives
- Conduct practical research in on-farm settings which can be directly applied to commercial dairies
- Monitor electricity used by specific components on dairy farms to determine areas of high energy use
- Disseminate results to producers to provide them a benchmarking tool to investigate and reduce electricity use within production systems

Materials & Methods
Commercial dairy farms:
Four dairy barns representative of typical Midwest dairy farms and located in west central Minnesota were monitored:
- **Farm A**- 9,500-cow cross-ventilated barn with a 106 stall rotary parlor
- **Farm B**- 300-cow naturally-ventilated barn with stirring fans for air movement and 6 automatic milking systems (AMS)
- **Farm C**- 200-cow naturally-ventilated barn with stirring fans for air movement and a double-eight parabone milking parlor
- **Farm D**- 400-cow naturally-ventilated barn with stirring fans for air movement and a double-eight herringbone milking parlor.

Energy monitoring:
- 292 electric loads were monitored from July 2018 to July 2019
- Data loggers and sensors (eGauge, Boulder, CO) recorded and stored electrical use from each monitored circuit at the dairy farm’s circuit panels
- Data were collected and analyzed on a monthly basis

Results

![Figure 1. Monthly total electricity in kWh used by various electrical loads in Dairy Farm A.](image)

**Farm A**- 9,500-cow, cross-ventilated barn with a 106 stall rotary parlor

![Figure 2. Monthly total electricity in kWh used by various electrical loads in Dairy Farm B.](image)

**Farm B**- 300-cow, naturally-ventilated barn with 6 AMS

![Figure 3. Monthly total electricity in kWh used by various electrical loads in Dairy Farm C.](image)

**Farm C**- 200-cow, naturally-ventilated barn with a double-eight parabone parlor

![Figure 4. Monthly total electricity in kWh used by various electrical loads in Dairy Farm D.](image)

**Farm D**- 400-cow, naturally ventilated barn with a double-eight herringbone milking parlor

Conclusions
- Fans for cooling cows used the largest amount of electricity during warm months (July-September) across the four farms.
- Electricity used for heat (space heaters, generator block heaters, etc.) increased during cooler months (October-March), and fan use decreased dramatically.
- Areas that may be targeted for improved energy efficiency include fans, lights, and heating mechanisms.

Future Directions
As one of the first energy monitoring studies conducted on Minnesota dairies, the results will be used for modeling clean energy alternatives, creating farm energy benchmarks, agricultural energy policy, and economic evaluations. The data will be useful to producers who are searching for areas to reduce energy usage. Improving the efficiency of electrical components in dairies could provide opportunities to improve the carbon footprint of dairy production.

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