Energy Usage in Dairy Production Systems

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WCROC Dairy Herds

• Organic herd
  • 126 cows
  • 36 lbs milk, 4.1% fat, 3.1% protein, 288 SCC
  • Milk price: $35.62 /cwt.

• Conventional herd
  • 140 cows
  • 57 lbs milk, 3.7% fat, 3.2% protein, 286 SCC
  • Milk price: $17.65/cwt.

• Dairy breeds
  • Holstein, Jersey, Montbéliarde, Viking Red, Normande, 1964 Holstein
Dairy research and outreach at WCROC

- Grain supplementation strategies
- Summer annuals for grazing
- Pasture forage quality
- Out wintering
- Fodder production systems
- Group rearing of dairy calves
- Crossbreeding of dairy cattle
- Renewable energy for dairy farms
Major energy use on a Dairy Farm

- Milk Harvest*
- Milk Cooling*
- Lighting*
- Air Circulation* and Ventilation
- Washing and Water Heating*
- Feed Handling
- Manure Handling
- Water Pumping
- Compressed Air

*Indicates significant use
Dairy farm energy generation

Source: Innovation Center for U.S. Dairy
Electricity use on dairy farms

- Milking: 18%
- Milk cooling: 26%
- Ventilation: 24%
- Lighting: 17%
- Electric water heating: 5%
- Feeding equipment: 3%
- Manure handling: 5%
- Miscellaneous: 2%

Source: NATC, Ithaca, NY
Freestall vs. Tie Stall operations

- Freestall operations
  - Feeding Equipment: 1%
  - Ventilation: 22%
  - Lighting: 26%
  - Electrical Water Heating: 2%
  - Milk Cooling: 27%
  - Manure Handling: 4%
  - Vacuum Pumps: 17%
  - Misc.: 1%

- Tie stall operations
  - Feeding Equipment: 7%
  - Ventilation: 21%
  - Lighting: 17%
  - Electrical Water Heating: 10%
  - Milk Cooling: 23%
  - Manure Handling: 3%
  - Vacuum Pumps: 18%
  - Misc.: 1%

Source: NATC, Ithaca, NY
Dairy hot water needs

- Rule of thumb: 2 – 2.5 gal hot water/cow/day
- “Hot” water means temperatures from 160 to 170°
- High temperatures are required for proper sanitation and equipment wash
Pre-cooling milk

• Can reduce the milk temperature by as much as 20°

• Can reduce cooling costs by as much as 30%

• Adding a variable speed drive to the milk pump will enhance pre-cooler savings

• Pre-cooling can improve milk quality
Energy flow for small dairy farm
Dairy/Swine project objectives

- Conduct baseline energy audits of dairy and swine facilities
- Develop and evaluate energy-optimized system for conventional and alternative production systems
- Conduct life cycle assessment in dairy and swine production systems
Scroll vs. Reciprocating compressor

Scroll compressor bulk tank

Reciprocating compressor bulk tank
Scroll vs. Reciprocating compressor
VFD vacuum pump

Sep 2013 WCROC Dairy Electricity After VFD

- vacuum pump
- Conv. Milk
- Org. Milk

VFD installed 9/24/2013

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Daily dairy hot water usage

Sep 22, 2013 Daily Dairy Hot Water Usage

Flow rate (gpm)

Time

- Wash sink
- Pressure washer
- Tank wash
- Wash machine
Monthly dairy water usage

September 2013 Dairy Water Usage

Gallons/Day

Day

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Yearly dairy water usage

Gallons/Day

- All Water
- Total Hot Water
- Press. Washer
- Sink H
- Tank Wash H
- Washer H

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Yearly dairy electricity usage
Yearly dairy electricity usage
November 2014 dairy electricity usage

![Graph showing electricity usage over 31 days, with a peak around the 15th day.](image-url)
WCROC dairy milk production

Milk (Lbs/Day)

Conv. Milk
Org. Milk
Total Milk
WCROC dairy cows

[Graph showing the number of cows over time, with lines for Conv. Cows, Org. Cows, and Total Cows.]
Electricity usage January/May 2015

2015 Electricity Usage (JAN) (310 kWh/day Total)
- Milk Refriger. 27%
- Heaters 24%
- Vacuum Pump 7%
- Washer/Dryer 8%
- Pressure Washer 2%
- Lights 11%
- Ventilation 6%
- Misc. 12%
- Office 3%

1.44 kwh/cow
.58 kwh/lb fat and protein (Org)
.42 kwh/lb fat and protein (Conv)

2015 Electricity Usage (MAY) (280 kWh/day Total)
- Milk Refriger. 31%
- Washer/Dryer 16%
- Ventilation 10%
- Office 5%
- Lights 6%
- Vacuum Pump 6%
- Pressure Washer 2%

1.05 kwh/cow
.52 kwh/lb fat and protein (Org)
.35 kwh/lb fat and protein (Conv)
Water usage January/May 2015

2015 January Hot Water Usage
(349 gal/day Total)

- Milk Lines: 48%
- Milk Tanks: 18%
- Washing Machine: 17%
- Parlor: 12%
- Bathroom: 5%

1.62 gal/cow

2015 May Hot Water Usage
(362 gal/day Total)

- Milk Lines: 44%
- Milk Tanks: 20%
- Washing Machine: 17%
- Parlor: 13%
- Bathroom: 6%

1.05 gal/cow
Conclusions

• Greatest energy usage for cooling milk

• Milk house heaters use an immense amount of energy

• Greatest water usage is for cleaning milking system

• More education needed for producers about renewable and energy saving technologies
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