

## **PART II ENERGY MANAGEMENT FOR DAIRY FARMS**

**Determining the  
best energy  
conservation  
and energy  
management  
opportunities  
for dairy farms**



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### **Get an Energy Audit**

- **Find out which processes on the farm use the most electric energy.**
- **Learn which energy efficiency improvements will save the most energy.**

## What are EUIs?

- Energy Utilization Indices refer to the amount of energy used to accomplish a certain activity or process.
- EUIs for dairy farms are stated in one of two ways:
  - kWh/cow/year
  - kWh/cwt. milk shipped

## Average EUIs for Dairy Farms

- Summary of EUIs from DLtech audits

	Tiestall Barn		Freestall Barn		Total All Farms
Farm - kWh/cow-yr. Range	934 (542 - 1561)		811 (424 - 1736)		865
Vacuum Pump - kWh/cow-yr-milking Range	72 (33 - 116)		54 (12 - 149)		62
Milk cooling - kWh/CWT Range	0.92 (0.435 - 1.8)		0.75 (0.40 - 1.4)		0.824

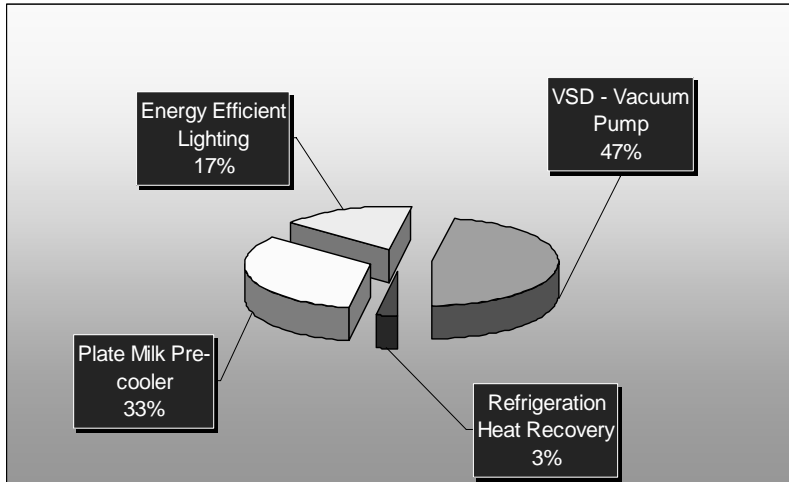
## **What are ECMs?**

- **Energy Conservation Measures refer to equipment or operational measures that will increase efficiency and save energy**

## **Most Common ECMs for Dairy Farms**

- **Variable speed drive vacuum pump**
- **Plate milk precooler**
- **Energy efficient lighting**
- **Refrigeration heat recovery**

## Percent of Dairies that could Implement Selected ECMs



## Energy use Areas on a Dairy Farm

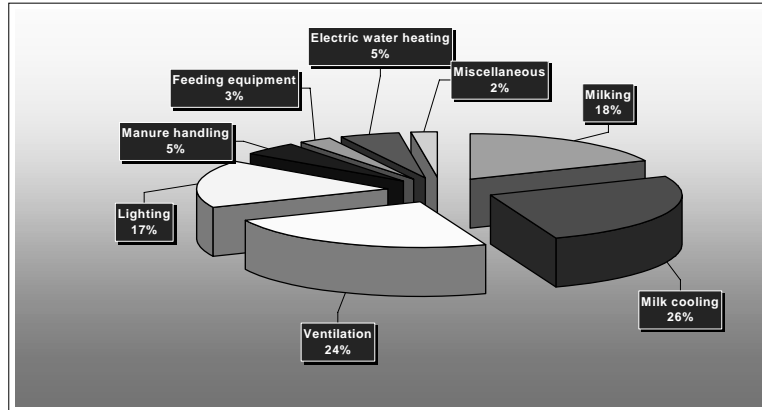
- Milk Harvest \*
- Lighting\*
- Water systems/Water heating\*
- Manure Handling
- General Energy Management issues
- Long Day Lighting for improved milk production



\* Indicates areas where significant savings is possible

# WHERE IS ELECTRICITY USED ON DAIRY FARMS?

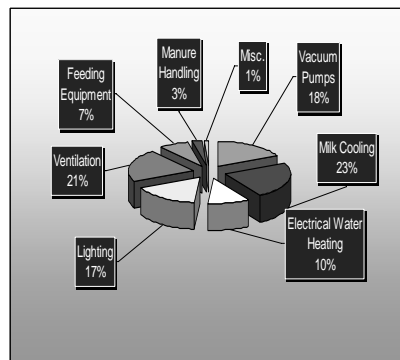
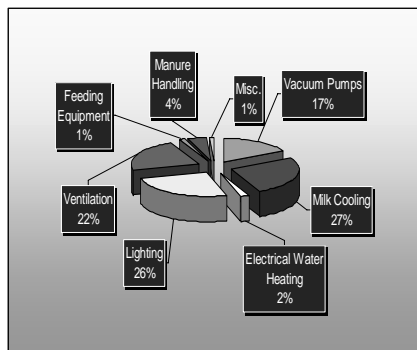
Summary of electric energy use on a typical dairy farm



Source: NATC, Ithaca, NY

## Freestall vs. Tie Stall Operations

■ Freestall operations    ■ Tie stall operations



## Saving Energy Used for Milking

- First the easy stuff
  - **Check vacuum levels often** – vacuum levels that have changed from the desired value cause system performance changes, efficiency changes, and herd health problems
  - **Check vacuum pump temperature near the end of milking** – a significantly higher temperature than normal indicates that service is required including vacuum adjustment, removal of exhaust restrictions, repair of rotary vane oiling systems, or cleaning lobe blower pumps

## More Easy Stuff

- **Check vacuum pump motor temperature** – high vacuum pump motor temperatures indicate a high motor load perhaps caused by a vacuum pump problem or a problem with the supply voltage to the motor
- **Check variable speed drive operation** – if vacuum pump motor is running too fast, too slow or erratically, check for problems with the variable speed drive system or the milking system such as
  - **Air leaks in milking system**
  - **Loose pump belts**
  - **Malfunctioning pulsators**
  - **Variable speed drive vacuum sensor fouled**

## Check Air Leaks in Vacuum System

- **A 5 cfm air leak in your milking system could cost you \$150 per year in reduced milking system efficiency!**

## Variable Speed Drives on Vacuum Pump

- Variable speed drives on vacuum pumps can save 50% or more of the energy used for milking.
- If you milk more than 4 hours per day, a Variable Speed Drive might be a good investment
- VSDs also reduce wear on the vacuum pump and reduce pump noise for better operator comfort

## Savings Potential with VSD Vacuum Pump

■ System	Without VSD	With VSD
■ Pump Size	10 hp	10 hp
■ Hours/day	12 hrs	12 hrs
■ Average load (kW)	9 kW	4.5 kW
■ Energy/Day	108 kWh	54 kWh
■ Annual Energy Cost (@ 12¢/kWh)	\$4,730	\$2,365
■ Annual Savings	----	\$2,365
■ Cost of VSD	----	\$4,100
■ Simple payback	----	1.75 yr
■ Source: NATC		

## Pre-cool your milk Before it Reaches the Bulk Tank

- Can reduce the milk temperature by as much as 20 degrees
- Can reduce cooling costs by as much as 30% or 0.3 kWh/cwt.
- Adding a VSD to the milk pump will enhance pre-cooler savings
- Pre-cooling can improve milk quality

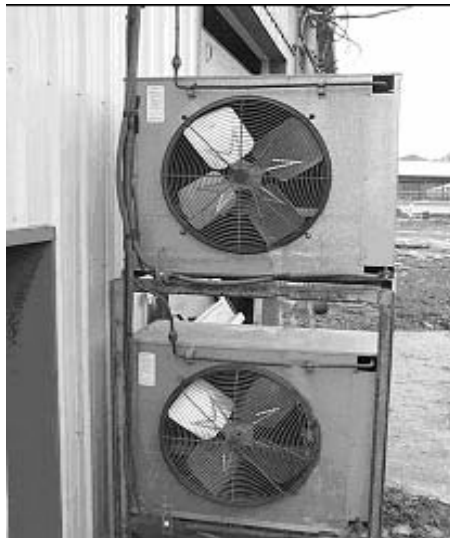
## Typical EUIs for Milk Cooling Systems

Milk cooling system	EUI, kWh/cwt cooled
Conventional	1.2 – 0.8
Well water precooler	0.9 – 0.6
Well water precooler with VFD on receiver pump	0.7 – 0.4

## Low Cost Refrigeration Maintenance

- Keep your condenser well ventilated with cool air
- Keep air-cooled condensers clean
- Repair all refrigerant leaks
- For every 10-degree rise in ambient air temperature, cooling capacity is reduced 6%
- Dirt on condenser reduces air flow volume and decreases heat transfer
- Check refrigerant sight glass often. There should be no bubbles

## Remote Outdoor Condensers



## Scroll Compressors Use Less energy




- Replacing an old, worn hermetically seal reciprocating compressor with a new scroll compressor can reduce milk cooling costs by 20%



## Fix Air Leaks in Compressed Air Systems

- Air leaks in compressed air systems waste a lot of energy.
- Poor system maintenance can reduce air compressor system efficiency by 20% to 30%

### ■ Annual cost of compressed air leaks

Size	Cost per Year
 1/16"	\$523
 1/8"	\$2,095
 1/4"	\$8,382

Costs calculated using electricity rate of \$0.05 per kWh, assuming constant operation and an efficient compressor.

1998)

## Save Energy with High Efficiency Lighting

- Lighting represents 17% of dairy farm electric energy use, on average
- Incandescent lights are still used extensively on many dairy farms.
- High efficiency lighting systems can help dairy farmers save energy dollars
  - Compact fluorescent
  - Fluorescent
  - High Intensity Discharge (Metal Halide, High Pressure Sodium)

## Take a Serious Look at Your Lighting

- Are you still using incandescent lamps in the barn?
- Consider an economical switch to compact fluorescent and save up to 70%



## Lighting Savings Potential

Installation	Incandescent Lights	Compact Fluorescent	Flourescent Fixture
	100 Watt	30 Watt	4' - 2 tube, T-8
# of lamps	30	30	20
Total Lighting Load	3kW	0.9 kW	1.44 kW
Hours per day	8	8	8
kWh/day	24	7.2	11.52
kWh/yr	8,760	2,628	4,205
Energy Cost/yr	\$1,051	\$315	\$505
Bulb Replacement Cost/yr cost/yr	\$144	\$204	\$70
Total Annual Operating Cost	\$1,195	\$519	\$575
Annual Savings	----	\$676	\$620
Installed Cost	existing	\$240	\$1,900
Simple Payback	----	0.36 yrs	3.1 yrs
Good Investment?	no	yes	yes

## **Refrigeration Heat Recovery**

**On average, a heat recovery system will save from \$200 to \$1,100 per year depending on the level of milk production and daily hot water requirements**

**If you have an existing heat recovery system, is it still functioning properly? They wear out, too!**

## **What if you adopt all these ECMs on your Dairy Farm?**

- **You could save as much as \$3600.00 per year in electric energy costs.**
- **Energy conservation pays!**