# ENERGY CONSERVATION AND CALCULATING USAGE

# ENERGY CONSERVATION VS ENERGY EFFICIENCY

- Conservation is behavior.
  - Examples:
    - Turning off lights when facility is not use.
    - Shutting off car while waiting to pick up a friend.
- Energy efficiency is technology.
  - Examples:
    - Using a LED lamp vs an incandescent lamp.
    - Driving a car that gets 30 MPG vs a car that gets 15 MPG

# WHY CALCULATE ENERGY USAGE

- Define Paybacks on Energy Efficient projects for customers
- Identify areas of high usage
- Assist in High Bill Complaints
- Estimate usage for future equipment
- Identify area's with good Return on Investments (ROI's)

# ON-SITE DATA COLLECTION

- Meet producer on site
- Gather information in a timely manner
  - Information includes:
    - Lbs of milk produced daily
    - Time it takes to milk
    - Gallons of water used to wash equipment
    - Type of water heating equipment
    - HP of Compressors
    - HP of Vacuum pump

# WHAT ARE WE CALCULATING

- Usage in Kilowatts (kWh)
- We buy electricity per kWh
- 1 kw = 1000 watts
- Watts/1000 = kw

# ENERGY SAVINGS & PAYBACK

- Key Factors Include:
  - Equipment Runtime
  - Load on Equipment
  - Equipment/Project Cost
  - Cost of Electricity

Audits should factor in ALL of these variables!

# HOW TO CALCULATE ENERGY USAGE GIVEN WATTS

- (watts/1000) x hours = kWh
  - Example Ted has a 200 watt light that is on 2000 hours per year.
- (200/1000) x 2000 = ?
- 400 kWh
  - Works for Lights, Heating elements, or any device that has a wattage listed.

# HOW TO CALCULATE COST

- Example Ted has a 200 watt light that is on 2000 hours per year.

- kWh X Rate per kWh = $ cost
  - Ted Pays $.135 per kWh
  - Ted used 400 kWh last

- 400 X .135 = ?

- $54 annually

# CALCULATING SAVINGS

- Ted wants to replace his 200 watt incandescent bulb with an equivalent LED bulb
  - LED equivalent bulb uses 18watts
  - Savings = old usage – New usage

# TEDS SAVINGS

- (watts/1000) x hours = kWh
  - New watts = 25
- Old usage = (200/1000) X 2000 = 400 kWh
- New usage = (18/1000) X 2000 = 36 kWh
  - Old Operational Cost = 400 X $.135 = $54
  - New Operational Cost = 36 X $.135 = $5

- Savings = $49

# PAYBACKS AND ROI'S

- Payback = how many years it takes to pay for the price of a project from the savings it delivers
  - Less than 4 years is attractive
  - Less than 2 years is ideal
- ROI (return on investment) Percentage of the price of a project returned in energy savings over a given period of time
  - Projects with less than a 1on lifetime ROI, will never pay for themselves.

# TED'S PAYBACK

- Ted's Bulb cost $6
- Annual savings $49
- Payback = cost/savings
- $6/$49 = .12 years or 2 months

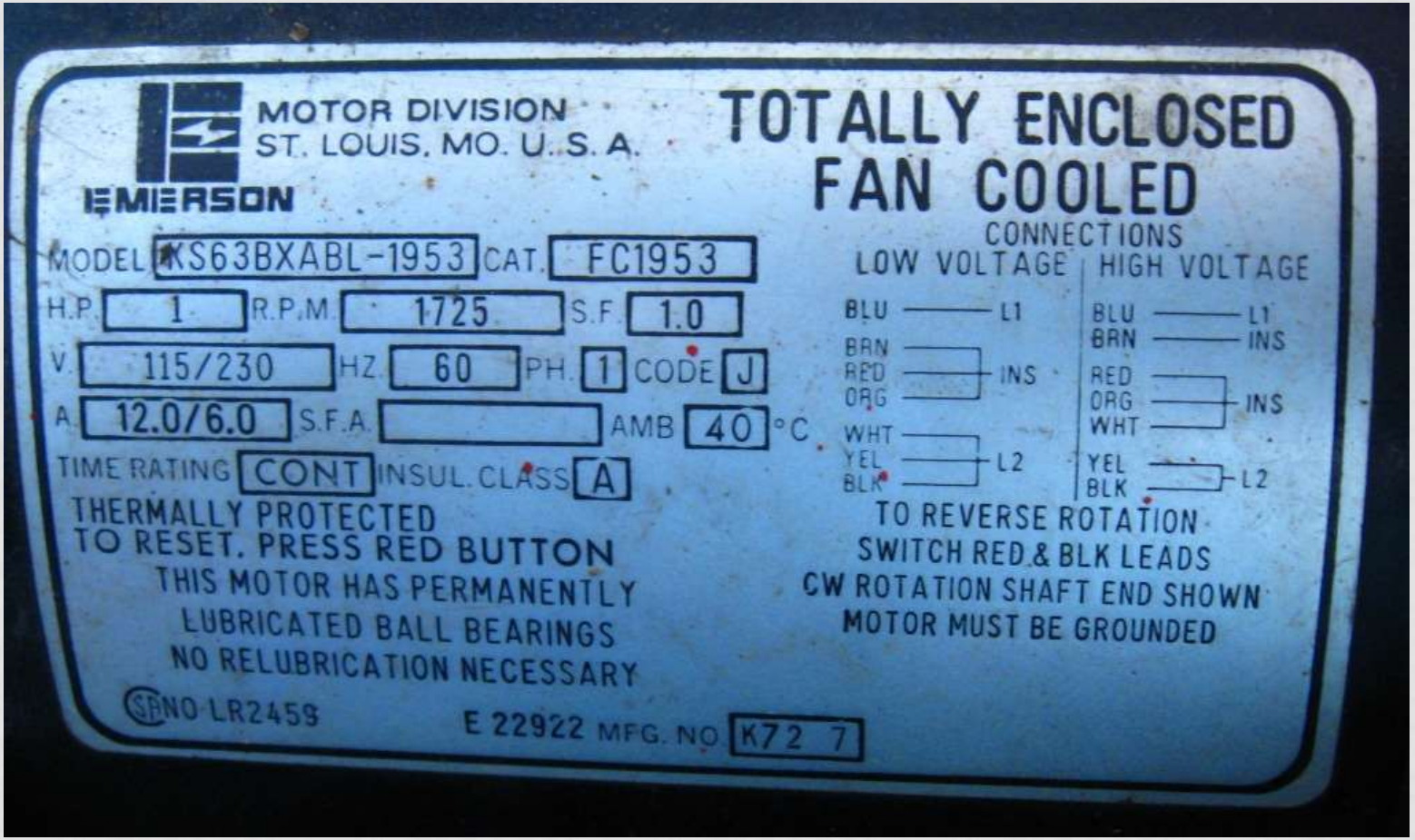
# TED'S RETURN ON INVESTMENT (ROI)

- cost of improvement/savings of improvement

- $49/$6 = 817% annual ROI

# WHAT HAPPENS IF WE DON'T KNOW WATTS

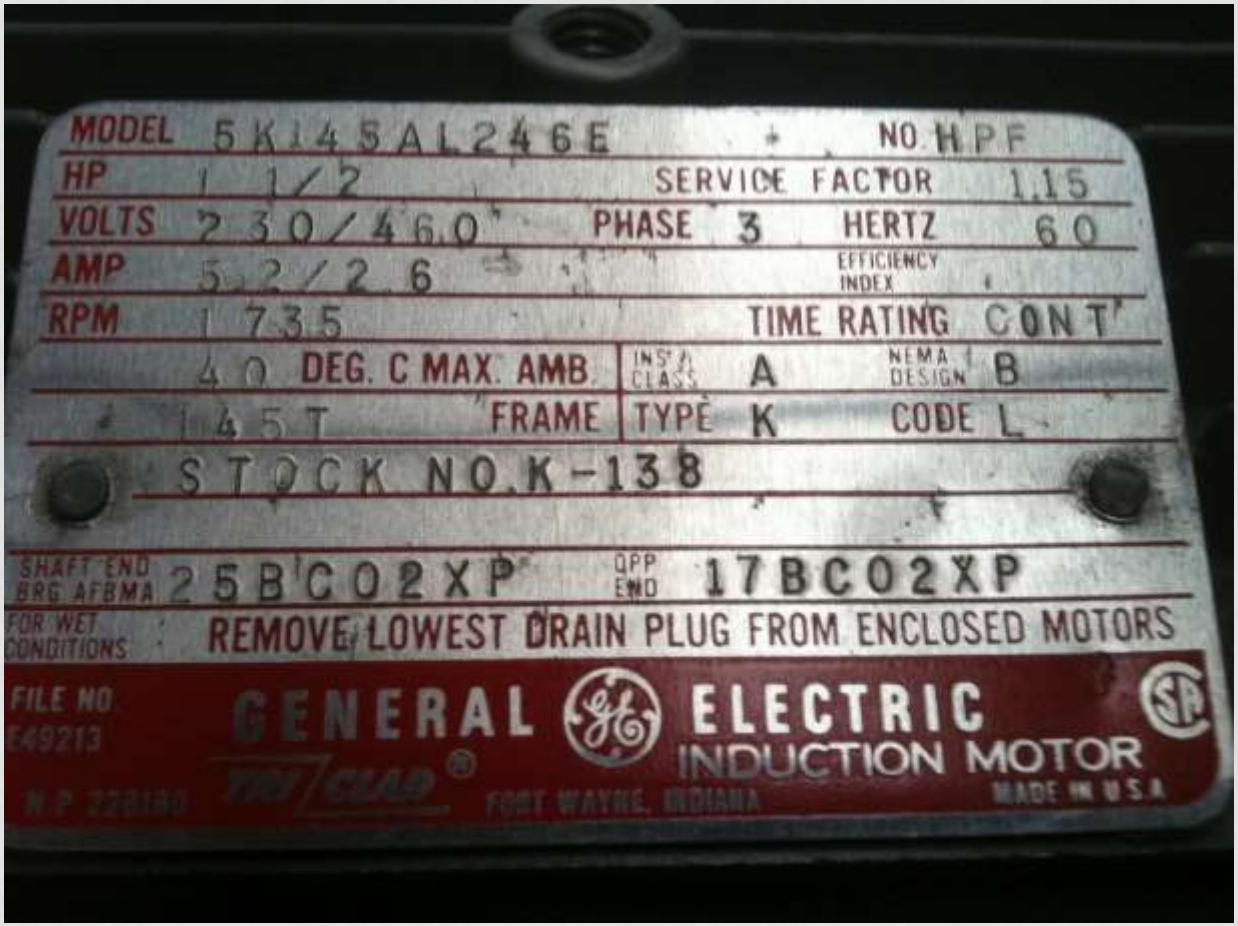
# CONVERTING AMPS TO WATTS SINGLE PHASE SYSTEM



# ASSUMPTION IS MOTOR IS FULLY LOADED

- P=VAPf
- Power(watts) = Volts X Amps X Power Factor
  - Use .8 if unknown
- Jack has a fan with a nameplate rating of 12 amps and the fan is wired for 115 volts
- P= 115 * 12 * .8 = ?
- P = 1401 watts

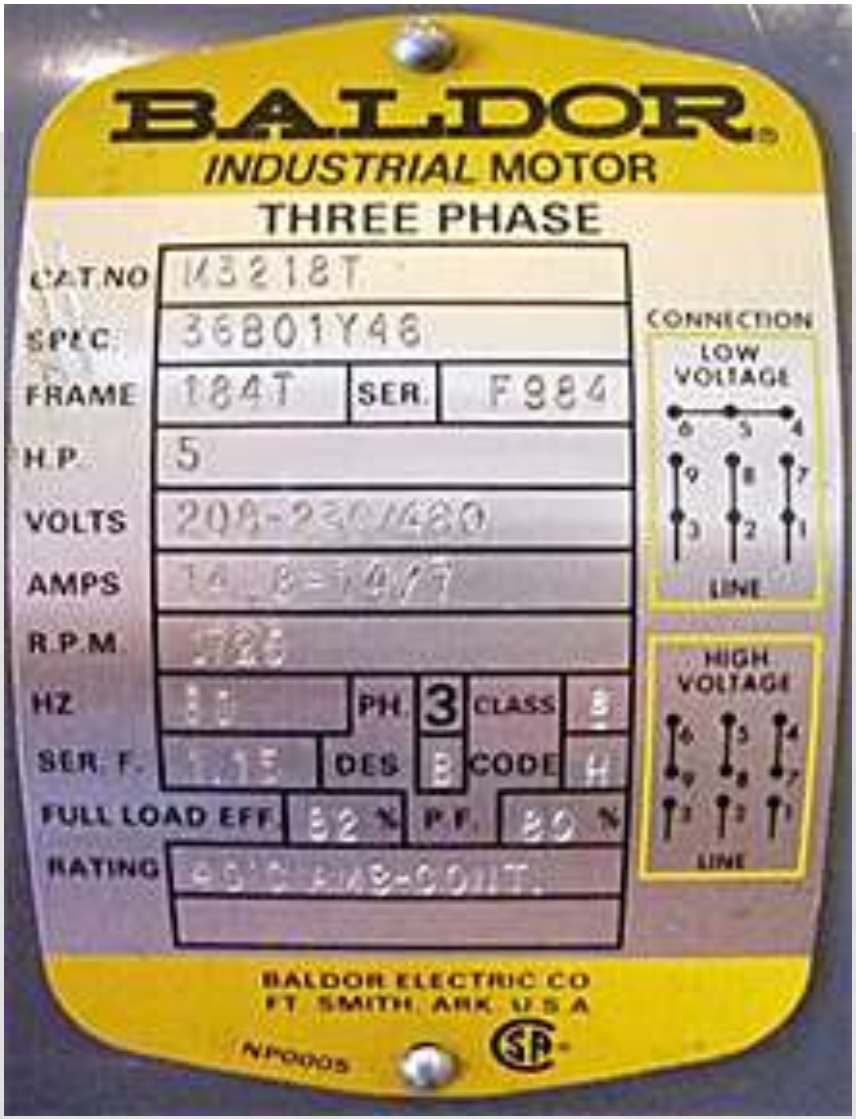
# CONVERTING AMPS TO WATTS THREE PHASE SYSTEM



# CONVERTING AMPS TO WATTS THREE PHASE SYSTEM

- P=V*A*PF*$\sqrt{3}$
- Watts = Volts*Amps*PowerFactor*$\sqrt{3}$
- Use .85 if unknown power Factor
- Steve has a manure pump that draws 5.2 amps
- Watts = 230*5.2*.85*1.73
- Watts = 1759

# CONVERTING HP TO WATTS



# CONVERTING HP TO WATTS

- Dave has a 5 hp fan motor that has a rated efficiency of 82%
- Watts = HP X (746/Efficiency of Motor) X Load Factor
  - .746 = kw per Horse Power
- 5 X (746/.82) X 1 = ?
- 4,549 Watts

# CONVERTING WATTS TO KW

- KW = watts/1000
- Dave's Fan uses 4549 watts
- KW = 4549/1000
- KW = 4.55

# CONVERTING KW TO KWH

- kW * runtime = kWh
- Dave's 5hp fan Example
- 4.55kW * 1000 Hours = 4550 kWH
- Dave Pays $.135 per Kwh
- $614.25 to operate annually

# CALCULATING WATER HEATER USAGE

# ASSUMPTIONS

- Universally Given
  - 8.66 LBS per gallon of water
  - 3413 BTU per kWh
- Site Specific Given
  - 200 Gallons of water per day
  - Temperature rise 120 Degrees F
  - Cost per kWh $.135
  - Standby loss range from 1% per hour
    - Typical range is 1% to 3% per hour

# CALCULATING THE COST TO HEAT WATER

- **Kilowatts = (Gallons*LBS per Gallons*Temp Rise)/BTU per kWh**

- Kilowatts = (200*8.33*120)/3412
- Kilowatts = 58.6
- kWh = 58.6kWh
- Cost = $7.91 per day

# CALCULATING STANDBY LOSS

- 1% per hour * 24 hours per day
- Total cost = cost to heating + cost for standby loss
- Standby loss = $7.91 x 24%
- Standby loss = $1.90
- Total cost per day = $9.81

# EXAMPLES OF GOOD ENERGY EFFICIENT OPPORTUNITIES

# LED SCREW-IN LAMPS

- 85% energy savings vs incandescent
- Teds example had .12 years annual payback
- 10 year life
- 817% Annual ROI
- 8166 % Lifetime ROI
  - Payed for itself 81times over

# LIGHTING

## FREE STALL BARNS

- LED High Bay
- Saves $229 per/year
  - 18hrs per day
  - $.135 Kwh
  - $400 cost of fixture
  - 10 year life cycle
  - Payback 2.5 years
  - 57% annual ROI
  - 572% Lifetime ROI

# EXAMPLES OF BAD ENERGY EFFICIENT OPPORTUNITIES

# WINDOWS

- Cost $25,000
- Savings per year $400
- Annual Payback 62.5 years
  - Windows have a useful life of 25 years
- Annual ROI of 2%
- Lifetime ROI of 40%
  - Never pays for itself in energy savings

# VSD VACUUM PUMP ON 40 COW FARM

- Cost $4000
- Savings $275
- Annual Payback  14.5 years
- Annual ROI  7%
- Lifetime ROI 48%
  - 7 year life cycle
  - Never pays back in energy savings

# EXAMPLES OF TECHNOLOGIES THAT TRIGGER HIGH BILL COMPLAINTS

# GENERAL LIVESTOCK FARMS

# ELECTRIC RESISTANCE HEAT

- Can be 1500 watts
- Can run full time in coldest months
- 1080 kWh per month in cold month
- $145 per month
  - Cattle waterers
  - Engine Block Heaters
  - Heat tape
  - Milk house heaters

# COOLING FANS

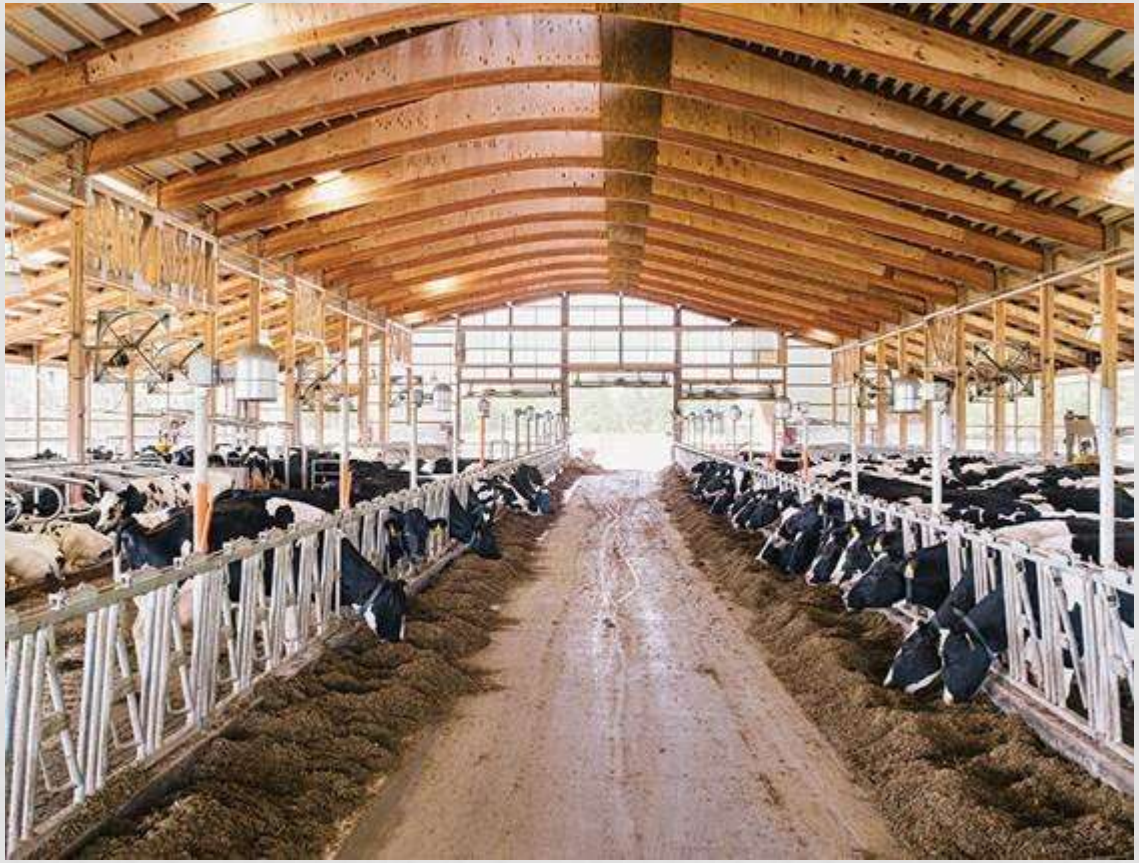
- 1 ph motor
- Run full time in hottest months
- 537 kWh per month
- $72.5 per month per fan

# DAIRY FARMS

# CROSS VENTED FREE STALL

- 96 fans @ 3 hp each
- Demand charge of $10.95
- kWh charge of $.045
- 154,690 kWh in Hottest months
- $9,313 per month to operate fan system

# OPPORTUNITIES FOR ON-SITE FARM ASSESSMENTS

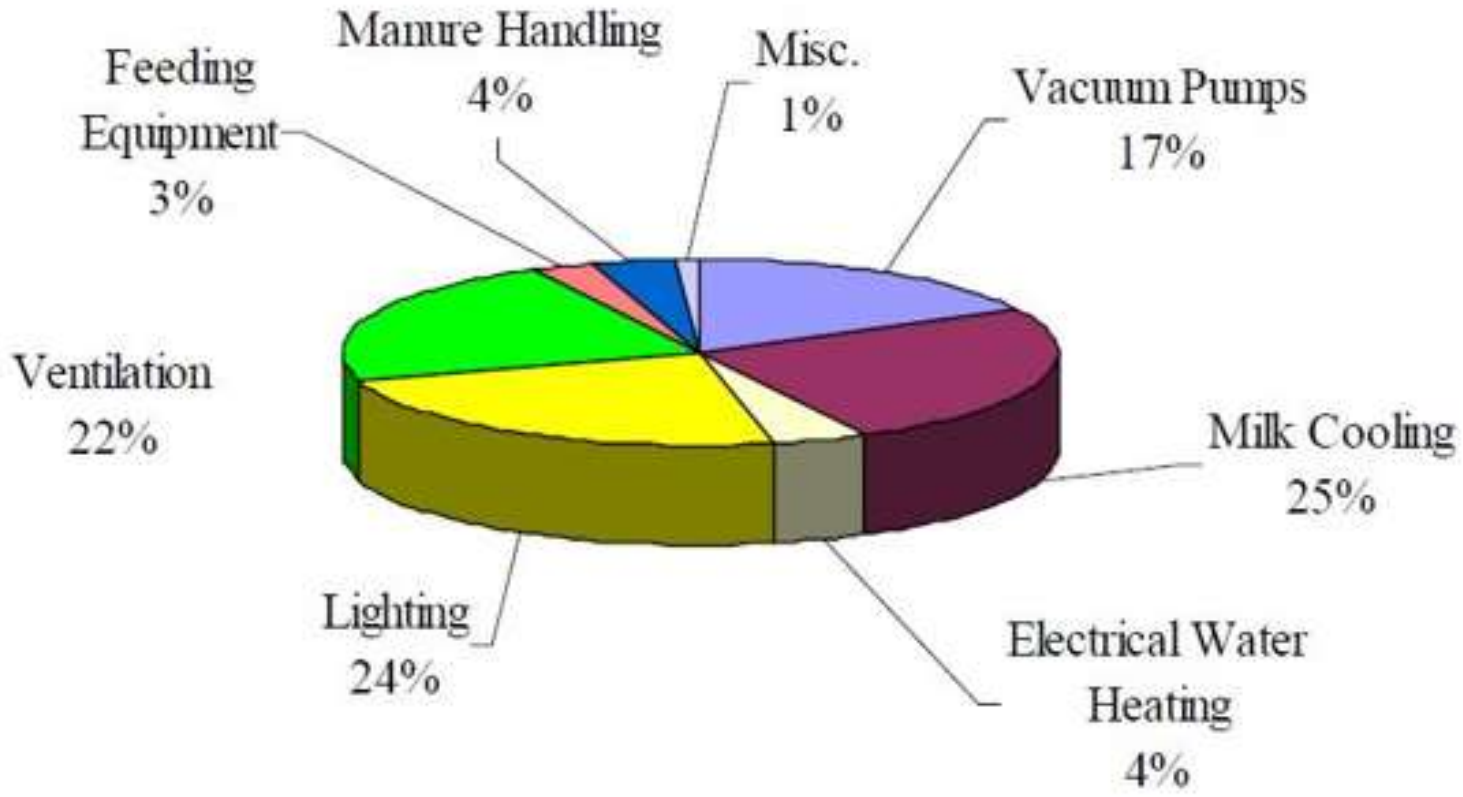


- Dairy Farms with:
  - Vacuum pumps running ≥ 7 hours a day
  - No refrigeration heat recovery
  - 60+ cow farms that have electric water heat
  - 6,000+ lbs. of milk/day with no plate cooler
  - 8,000+ lbs. of milk/day with no VSD on the receiver jar
  - Long day lighting using HID fixtures.

- Any Farms that:
  - Are rebuilding or building new
  - Use a Center Pivot Irrigation systems
  - Store vegetables in Refrigerated storage systems

# DAIRY FARM ELECTRICAL USE

**New York State Farm Survey**




Source: Dairy Farm Energy Audit Summary, NYSERDA, July 2003

# PROVIDING AUDIT RESULTS

- Important: Share results the same day AND on-site.
  - Allows for question and answer
  - Interactive reports
  - Offers comparisons

# QUESTIONS

# CONTACT INFORMATION

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