Farm Energy Audit Workshop

Sponsored by the Western Mountains Alliance, a member of the Maine Rural Partners Farm Energy Partners Network and

Efficiency Maine

Skowhegan, Maine
May 14, 2008

efficiency MAINE Saving Energy for Maine
Program of the Maine Public Utilities Commission

Walk-Through Energy Audit
April 10, 2008

Sarah and Garin Smith
Grassland Farm

Grassland Farm Details

- **Farm Type:** Organic dairy and beef
- **Milk Production:** 165,000 gallons per year
- **Farm Size (acres):** 298 acres
- **Farm Size (head):** 85 (43 milking cows)
- **Building (s) Sq. Ft.:** Main milking barn ~5,900 SF,
  - attached barn ~2,500 SF
  - hay storage ~1,800 SF
  - milk house ~600 SF
  - small barn ~2,900 SF

Energy

- Natural Gas 100,000 BTUs per CCF
  140,000 BTUs per gallon
- Fuel Oil 125,000 BTUs per gallon
- Propane 90,000 BTUs per gallon
- Electric 3,412 BTUs per KWH
- AC 12,000 BTUs per Ton
- HP 746 Watts
- Crude Oil 5.1M BTUs per barrel
- Solar Panel 21,000 BTUs per panel
- Cord of wood 200 Gallons of fuel oil

“Walk Through” Energy Audit Check List

- Energy
- Lighting
- Building Envelope
- Heating
- Domestic Hot Water
- Air Conditioning
- Ventilation
- Refrigeration
- Motors
- Electronic Equipment

Small Business/Farm Energy Audit Program

- Limited to ≤ 50 employees or sales ≤ $5 million;
- Provide Efficiency Maine with a copy of one year's worth of utility and heating bills
- Agree to participate in audit follow-up in 6 months to a year.
- Linda Titus, AgMatters, Farm Energy Partners Network Coordinators
- for Maine Rural Partners, 207-873-2108, ltitus21@verizon.net
- Shirley Bartlett is Efficiency Maine Program Manager (207) 287-3318 shirley.bartlett@maine.gov

Prescriptive Cash Incentives

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Agriculture Prescriptive Cash Incentives

efficiency MAINE

Leading the Way to a Brighter Future

Program of the Maine Public Utilities Commission

efficiencymaine.com

866-376-2463

Cash Incentives

Milk House Equipment	
Plate Heat Exchanger	$ 500.00
7.5 HP Vacuum Pump with Adjustable Speed Drive Package	$2,000.00
10 HP Vacuum Pump with Adjustable Speed Drive Package	$2,500.00
15 HP Vacuum Pump with Adjustable Speed Drive Package	$3,000.00
Scroll Compressor – 5 HP	$ 550.00
Scroll Compressor – 6 HP	$ 660.00

Cash Incentives

NEMA Premium® Efficiency Motors

Open Drip-Proof Motor

1 & 1.5HP	$ 45.00
2, 3 & 5HP	$ 54.00
7.5HP	$ 81.00
10HP	$ 90.00
15HP	$104.00
20HP	$113.00
25HP	$117.00
30HP	$135.00
40HP	$162.00
50HP	$198.00
60HP	$234.00
75HP	$270.00
100HP	$360.00
125HP	$540.00
150HP & 200HP	$630.00

NEMA Premium® Efficiency Motors

Enclosed Fan-Cooled Motor

1 & 1.5HP	$ 50.00
2, 3 & 5HP	$ 60.00
7.5HP	$ 90.00
10HP	$100.00
15HP	$115.00
20HP	$125.00
25HP	$130.00
30HP	$150.00
40HP	$180.00
50HP	$220.00
60HP	$260.00
75HP	$300.00
100HP	$400.00
125HP	$600.00
150HP & 200HP	$700.00

Cash Incentives

Lighting	
Vapor-tight High Performance T8 Lighting Fixtures	$ 25.00
Other Equipment	
High Volume Low Speed Fans (14, 16, 18, 20 & 24 foot diameter)	$ 1,000.00

Lighting Incentives

Efficiency Maine

Lighting Refer to our Lighting Application for more details and descriptions

L10 New HPT8 Lamp & Ballast – Existing fixture	$15.00 Per Fixture
L15 New Fluorescent Fixtures – Retrofit	$25.00 Per Fixture
L16 New Fluorescent Fixtures – New construction	$15.00 Per Fixture
L20 Fluorescent Fixtures with Reflectors	$25.00 Per 8' Section
L25 Compact Fluorescent Hard-wired Fixtures	$12.00 Per Fixture
L30 High Efficiency Fluorescent Fixtures – Retrofit	$35.00 Per Fixture
L31 High Efficiency Fluorescent Fixtures – New construction	$20.00 Per Fixture
L32 Low Glare High Efficiency Recessed Fixture – Retrofit	$50.00 Per Fixture
L33 Low Glare High Efficiency Recessed Fixture – New construction	$35.00 Per Fixture
L35 Pendant Mounted Indirect Fluorescent Fixtures	$35.00 Per 4' Section
L40 High Intensity Fluorescent (H.I.F.) – Retrofit	$75.00 Per Fixture
L41 High Intensity Fluorescent (H.I.F.) – New construction	$35.00 Per Fixture
L60 Controls for H.I.F. Systems	$40.00 Per Fixture
L70 Occupancy Sensors – Remote mounted only	$50.00 Per Control
L71 Vacancy Sensors	$25.00 Per Control
X10 LED Exit Signs – Retrofit only	$10.00 Per Sign

Efficiency Maine Refrigeration Incentives

Evaporator Fan Motor Controls for Coolers or Freezers

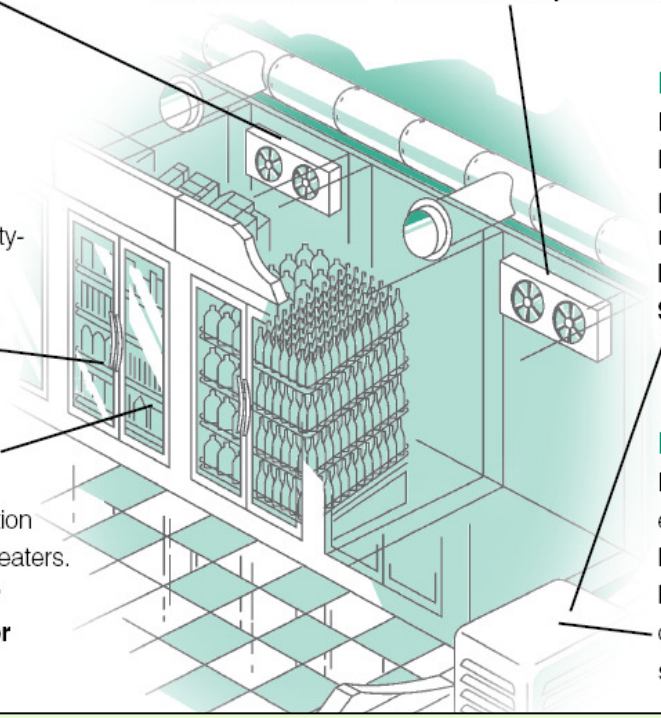
This control turns off a portion of your evaporator fan while the compressor is not running, saving a significant amount of energy.

Incentive: $550 per control

High-Efficiency Evaporator Fan Motors

"Permanent split capacitor" (PSC) motors and Electronically Commutated Motors (ECM) operate at variable speeds, offering significant savings when compared with conventional motors.

- Walk-in Coolers or Freezers – **$50 incentive per PSC motor**
- Refrigerated Warehouse – **$100 incentive per ECM motor**
- Merchandise Cases – **$20 incentive per ECM motor**



Door Heater Controls for Coolers or Freezers

Most cooler and freezer doors have heaters to prevent condensation and they run continuously all year. Humidity-based door heater controls limit operation of door heaters as needed.

Incentive: $150 per circuit

Floating Head Pressure Controls

Refrigeration systems are designed for the hottest, most humid days. Floating head pressure controls allow the system to operate more efficiently during typical conditions.

Incentive: $250 (1 coil), $375 (2 coils), $500 (3 coils)

Zero Energy Doors for Coolers and Freezers

Zero Energy Doors have a high insulation value, eliminating the need for door heaters.

- Coolers – **$125 incentive per door**
- Freezers – **$300 incentive per door**

New Compressors

Both discus and scroll compressors use less energy than standard compressors and can last up to one third longer. **Incentives of between $220 and $750** are available on new compressors, depending on the compressor size (see application for complete list).

Eligibility

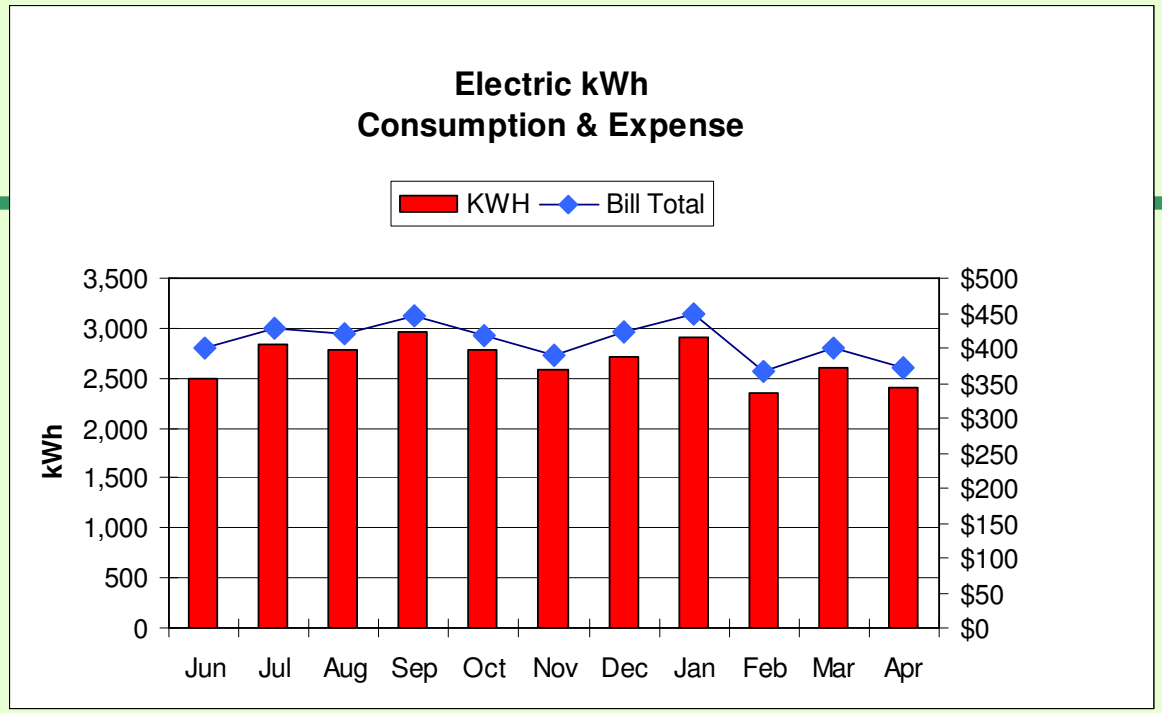
- Agricultural incentives are available to all Maine farms and agricultural-related businesses.
- Products purchased with Efficiency Maine incentives must be installed in your place of business in Maine.
- Pre-approval is NOT required for agricultural applications.
- Incentives are available for retrofit applications or new construction, unless otherwise specified.

Guidelines

- Each business is eligible for Efficiency Maine incentives up to $100,000 per business, per calendar year or $200,000 to be used in a one-year period, in lieu of funding the following year.
- Measures that save electricity, but are not noted as a prescriptive incentive measure, may be eligible under our custom incentive program. Contact us for more information at 866-376-2463.
- Efficiency Maine reserves the right to monitor and/or inspect the installation and energy use of the products for which incentives are paid.
- Efficiency Maine may publicize your participation in this program, unless otherwise requested.
- This offer may be changed, revised, or discontinued at any time by Efficiency Maine.

Milking Equipment Manufactures

- Dairy Equipment Company
  Bou-Matic – www.Bou-Matic.com
- Alfa Laval Agri
  Delaval – www.delaval.com
  Germania Dairy Automation – www.germaniadairy.com
  Universal Dairy Equipment –www.universaldairy.com
  Nu-Pulse Inc.
- Westfalia-Surge – www.westfaliasurge.com
- The Coburn Company, Inc. – www.coburnco.com
- BECO Dairy Automation Inc. - www.becoknows.com
- The Schlueter Company - www.schlueterco.com
- Paul Mueller Company – www.muel.com
- Ross-Holm, Inc – www.ross-holm.com
- Etron – 1401 Peruville Road, Freeville, NY 13068;
  Ph: 607-898-3553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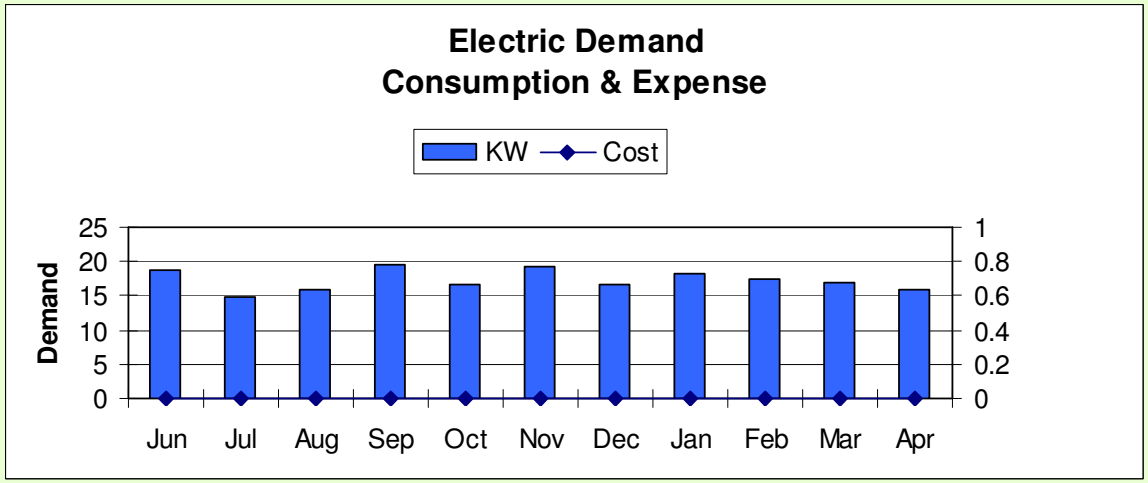
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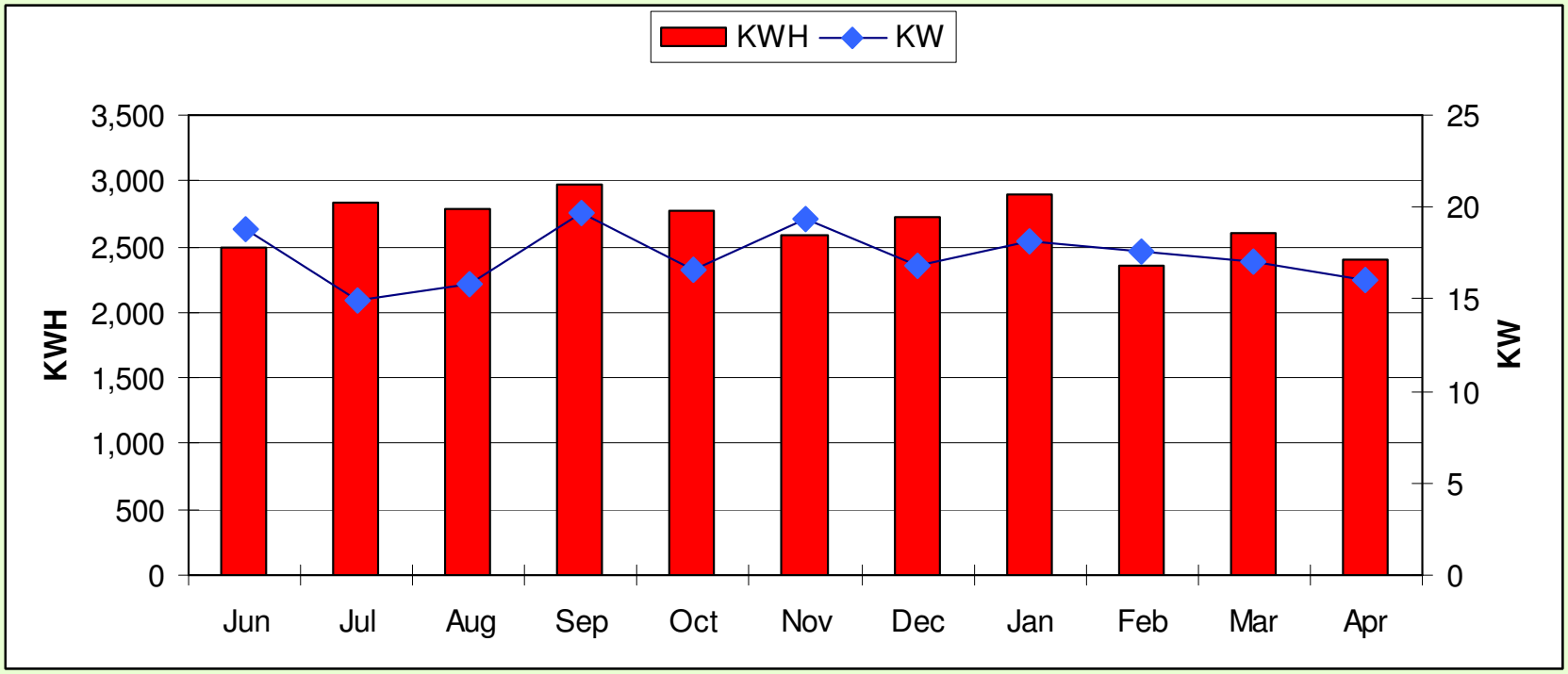
What is the Demand Charge?

- The demand meter constantly measures energy consumption. The demand charge is based on the highest amount of energy used in any given 15 minute period during the typical 30 day billing cycle.
- High demand equipment energized simultaneously will result in higher demand charges
- Strategy: stager high demand energy devices
- Be cognizant of energy consumption of new electrical devices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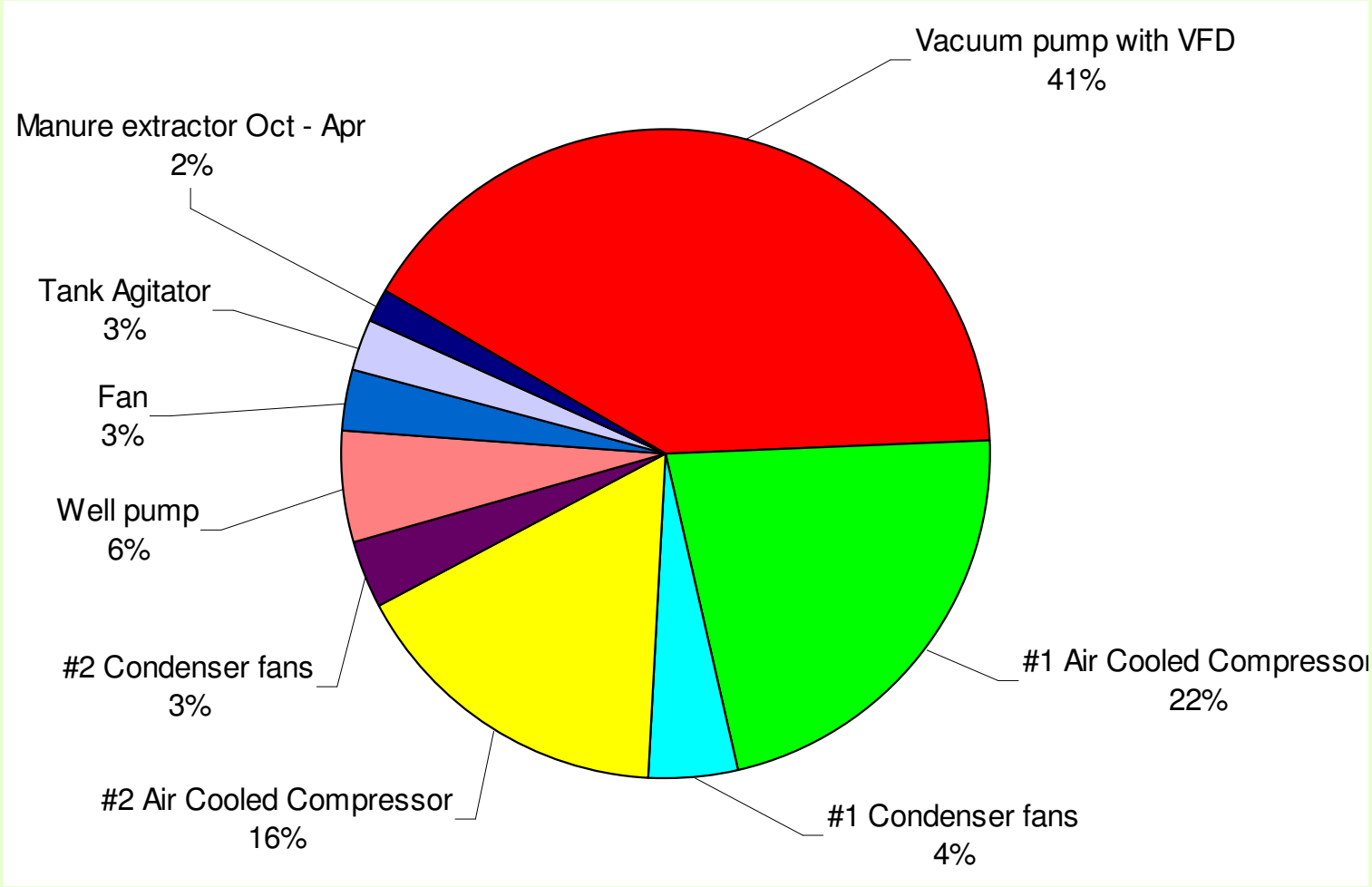
Grassland Farm
Electric Equipment Usage

Motors & Equipment

Item	Location	Existing Equipment	Qty	Horse Power	Watts	KW	Hours/ Day	# of Days	Annual Operating Hours	kWh	Annual kWh Cost @
											$0.15
1		Vacuum pump with VFD	1	7.50	5,439	5.44	6	365	2,190	11,911	$1,830
2		#1 Air Cooled Compressor	1	5.00	3,476	3.48	5	365	1,825	6,344	$975
3		#1 Condenser fans	2	0.40	351	0.70	5	365	1,825	1,281	$197
4		#2 Air Cooled Compressor	1	5.00	3,476	3.48	5	275	1,375	4,780	$734
5		#2 Condenser fans	2	0.40	351	0.70	5	275	1,375	965	$148
6		Well pump	1	2.00	1,492	1.49	3	365	1,095	1,634	$251
7		Fan	1	0.25	187	0.19	12	365	4,380	819	$126
8		Tank Agitator	1	0.50	423	0.42	5	365	1,825	771	$119
9		Manure extractor Oct - Apr	2	3.00	2,238	4.48	0.5	210	105	470	$72
10		Manure extractor May - Sep	2	3.00	2,238	4.48	0.5	40	20	90	$14
11		Electric fence (estimated)	1	1	10	0.01	24.00	365	8,760.00	88	$13
12									Farm:	17,241	$2,649
13	House on same meter as barn operations	Estimated House Usage = Total energy usage from Energy History minus Farm and Equipment.							House:	12,155	$1,867
14									Farm and House Combined:	29,396	$4,516

Energy Equipment use on Grassland Farm



High Demand Equipment

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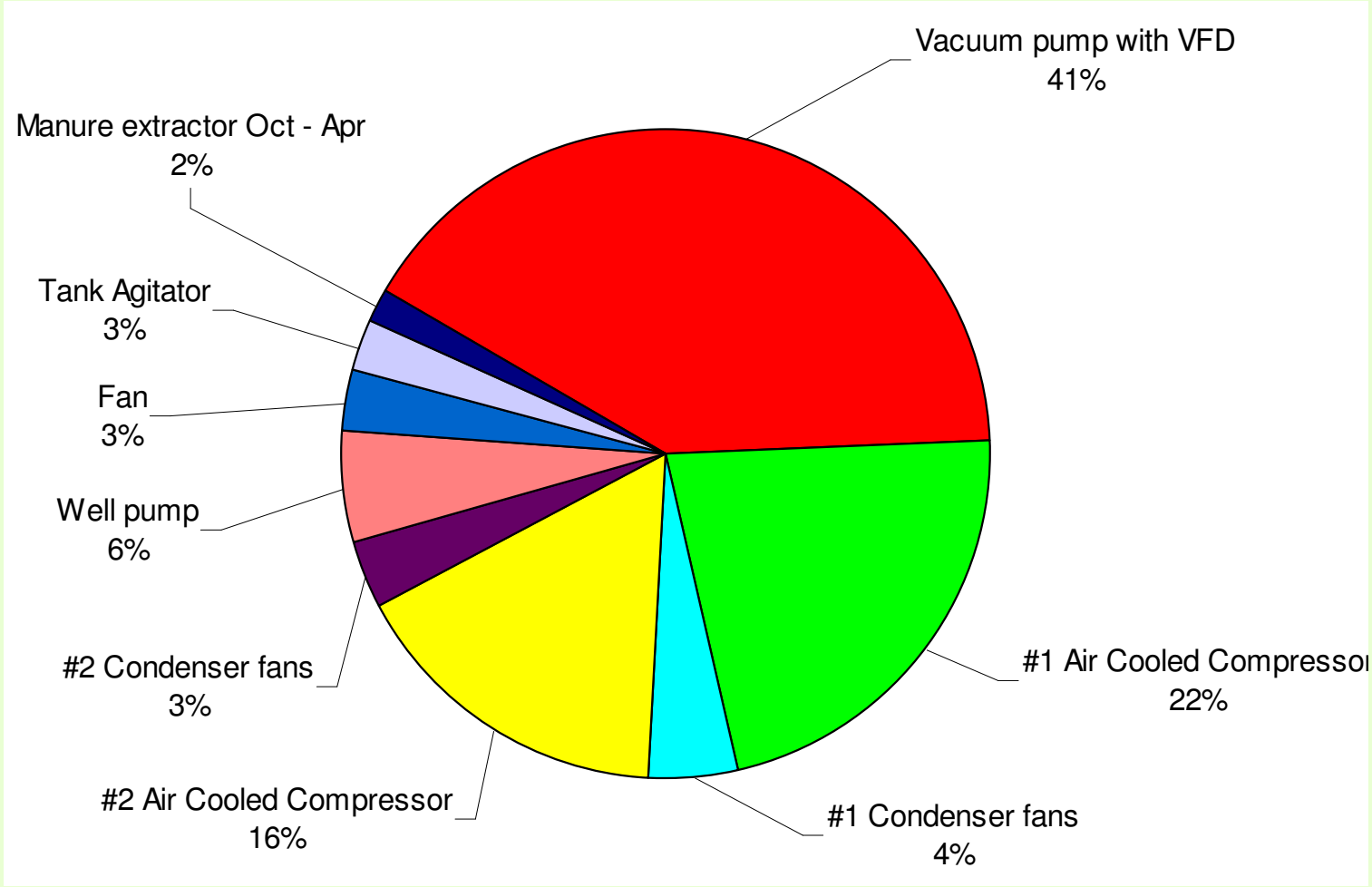
7.5 HP Vacuum Pump uses over 40% of the farm energy

The farm currently uses four milkers. The vacuum pump has a capacity of up to 12 milkers.

Energy Equipment use on Grassland Farm



Variable Frequency Drive

Conventionally, vacuum pumps had operated at constant speed removing air from the milking system at a rate of 7 to 10 cubic feet per minute (cfm) per milking unit primarily to insure good washing. Research in 1982 showed that the actual airflow was below 3.6 cfm/unit 99 percent of the time. The difference between the air removed by the vacuum pump and what actually "leaked" into the system was admitted through a regulator. There was a common misperception that a larger vacuum pump capacity with greater horsepower was necessary to provide stabile vacuum levels and to insure proper cleaning.

Today there is a technology that can reduce the energy used by up to 60 percent. This technology is called a variable frequency drive (VFD). The VFD is electrically installed between the motor on the vacuum pump and the switch that currently controls the motor. A second device that monitors the vacuum level is installed in the vacuum line. This device sends an electrical signal to the VFD that varies with vacuum level. The VFD compares this signal with the set point. As the actual vacuum level differs from the set point, the speed of the motor/vacuum pump is changed to compensate for the change in vacuum level. If the vacuum is too low the motor will go faster and if the vacuum is too high the motor will be slowed. With a VFD, the air removed by the vacuum pump equals the air entering the milking system and there is not need for a conventional regulator.

Cash Incentives

Milk House Equipment	
Plate Heat Exchanger	$ 500.00
7.5 HP Vacuum Pump with Adjustable Speed Drive Package	$2,000.00
10 HP Vacuum Pump with Adjustable Speed Drive Package	$2,500.00
15 HP Vacuum Pump with Adjustable Speed Drive Package	$3,000.00
Scroll Compressor – 5 HP	$ 550.00
Scroll Compressor – 6 HP	$ 660.00

Domestic Hot Water

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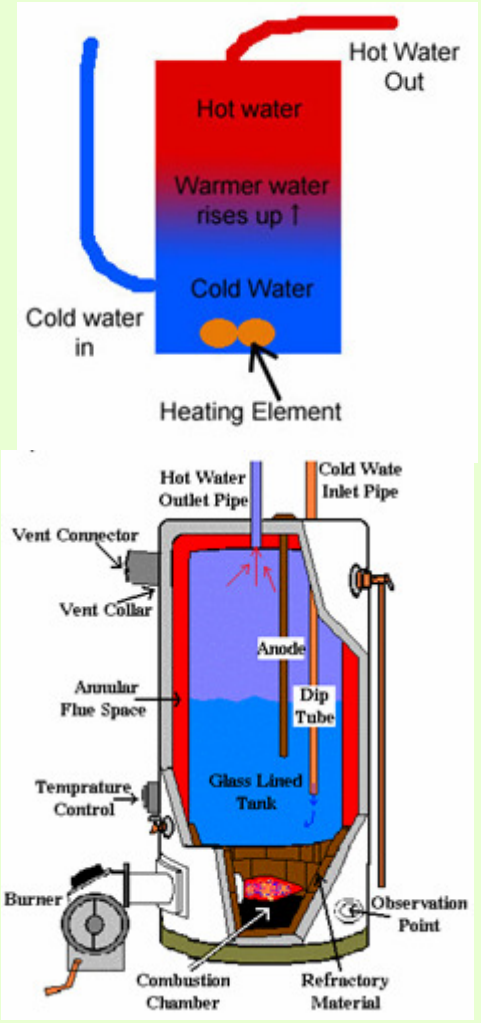
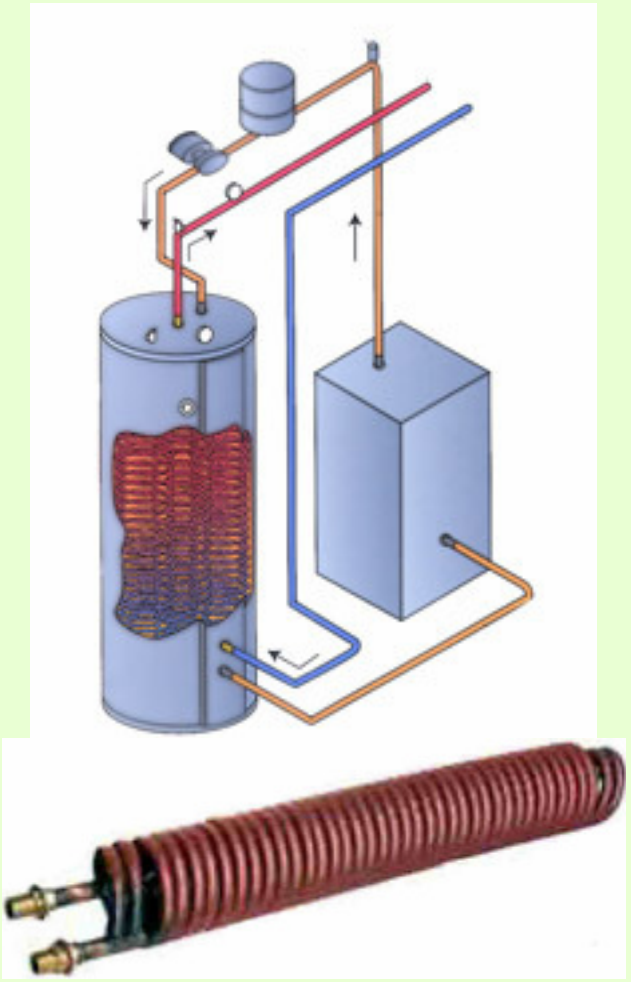
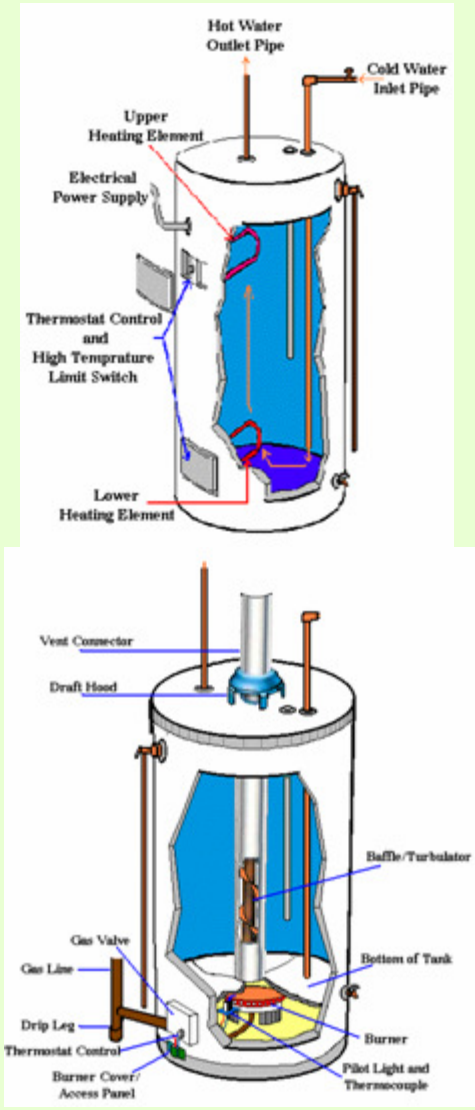
Typical Domestic Hot Water Production







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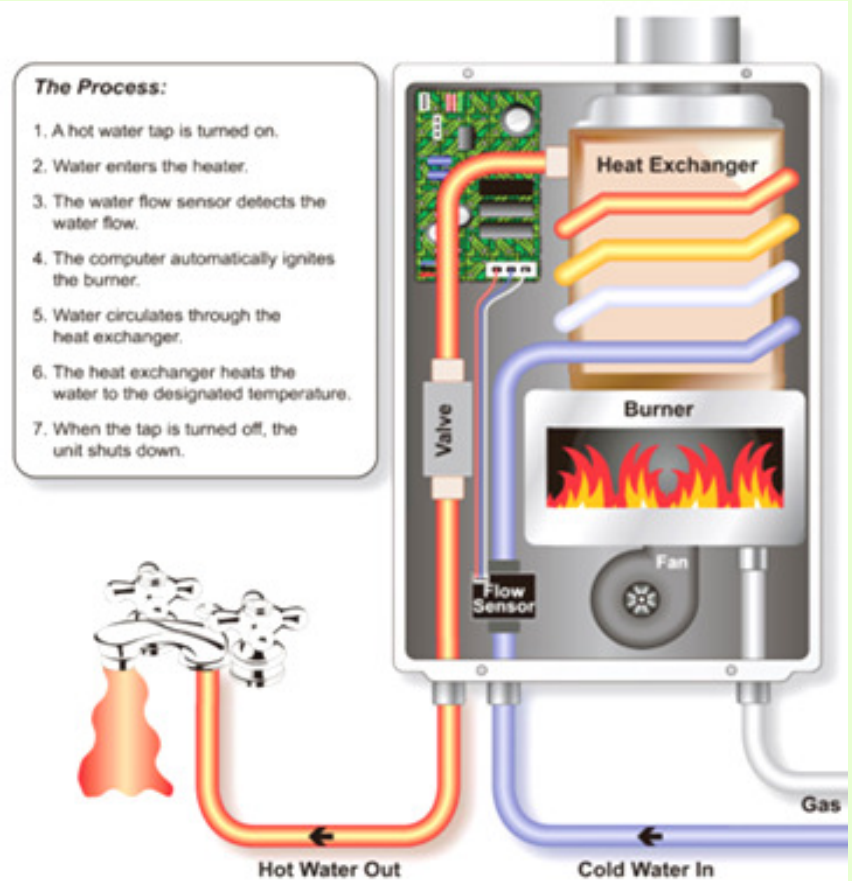
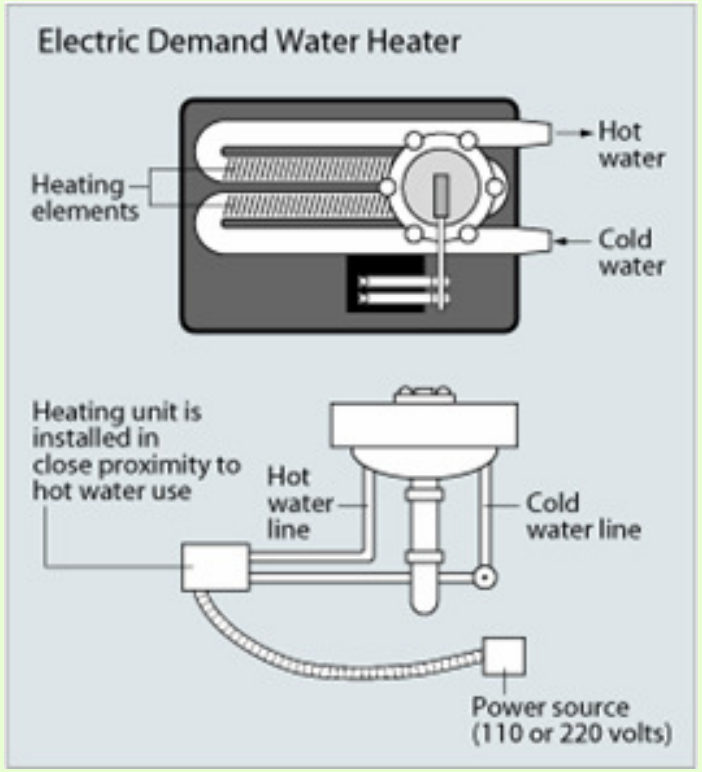
On Demand Tankless Hot Water Heaters

When a hot water tap is turned on, cold water travels through a pipe into the unit and an electric element or gas fired coil heats the water.





On Demand Tankless Water Heaters

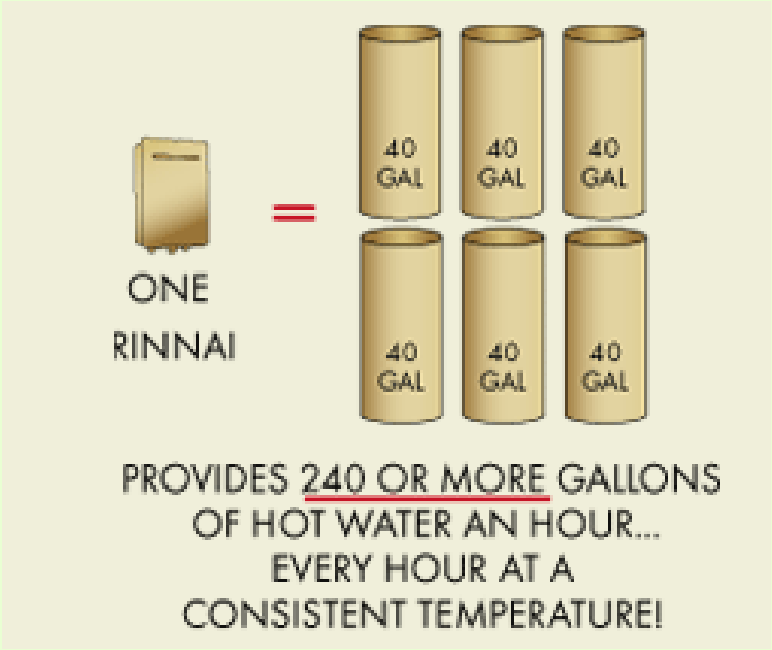
- Demand water heaters heat water directly without the use of a storage tank
- When a hot water tap is turned on, cold water travels through a pipe into the unit and an electric element or gas fired coil heats the water
- No standby heat losses
- Deliver a constant supply of hot water
- You only consume energy when you open the faucet.
- Demand water heaters provide hot water at a rate of 2–8 gallons per minute

- **Electric:** provide approximately 2 gallons per minute

- **Gas-fired:** produce higher flow rates between 5 - 8 gallons per minute

Commercial On Demand Installations

Tank vs. Tankless



Tankless Manufactures

Tankless Water heaters	
Brand	**Website**
Bosch (Aquastar)	www.boschhotwater.com
Bradford White	www.bradfordwhite.com
Eccotemp	www.eccotemp.com
Infinion	www.tanklesswaterheaters.com
Monitor Products	www.monitorproducts.com
Noritz	www.noritzamerica.com
Paloma	www.palomawaterheaters.com
Rheem / Ruud	www.rheemtankless.com
Rinnai	www.foreverhotwater.com
Takagi	www.takagi.com
Toyotomi	www.toyotomiusa.com

Ventilation

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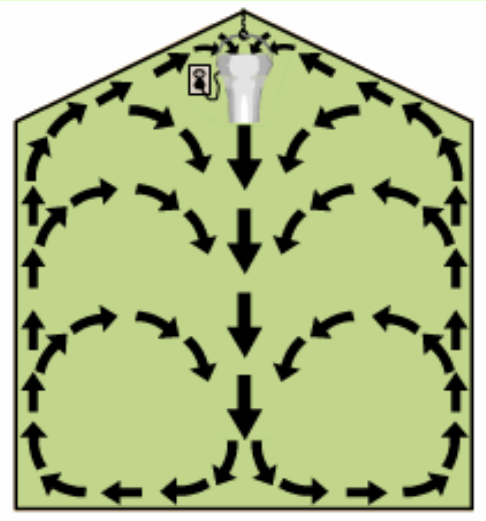
Airius Thermal Equalizers

- Installation of the units will help to stabilize the temperature in the room during the winter and summer months
- This is achieved by stabilizing the temperature in the entire air column and reducing the heat/cool on/off cycle that is typical in high bay spaces.
- Thermostats are typically installed at five feet above the floor. Rooms with high ceilings heat the entire air column to satisfy the thermostat setting.
- Peak ceiling temperature are 5 to 10 degrees warmer than the floor.
- Thermal equalization enhances comfort and reduces energy consumption.



High Bay Applications Gyms and Shops

Airius Thermal Equalizers							
Model	Height	Diameter	Weight	Watts @ 60 Hz	Volts	Coverage*	Ceiling Height*
10	22 in.	13 in.	12 lbs.	15	120/230	1200 sq. ft.	Up to 12 feet
15	22 in.	13 in.	12 lbs.	17	120/230	1200 sq. ft.	Up to 18 feet
25	22 in.	13 in.	12 lbs	35	120/230/277	1200 sq. ft	Up to 30 feet
35	22 in.	13 in.	12 lbs.	76	120/230/277	1200 sq. ft.	Up to 40 feet

Refrigeration

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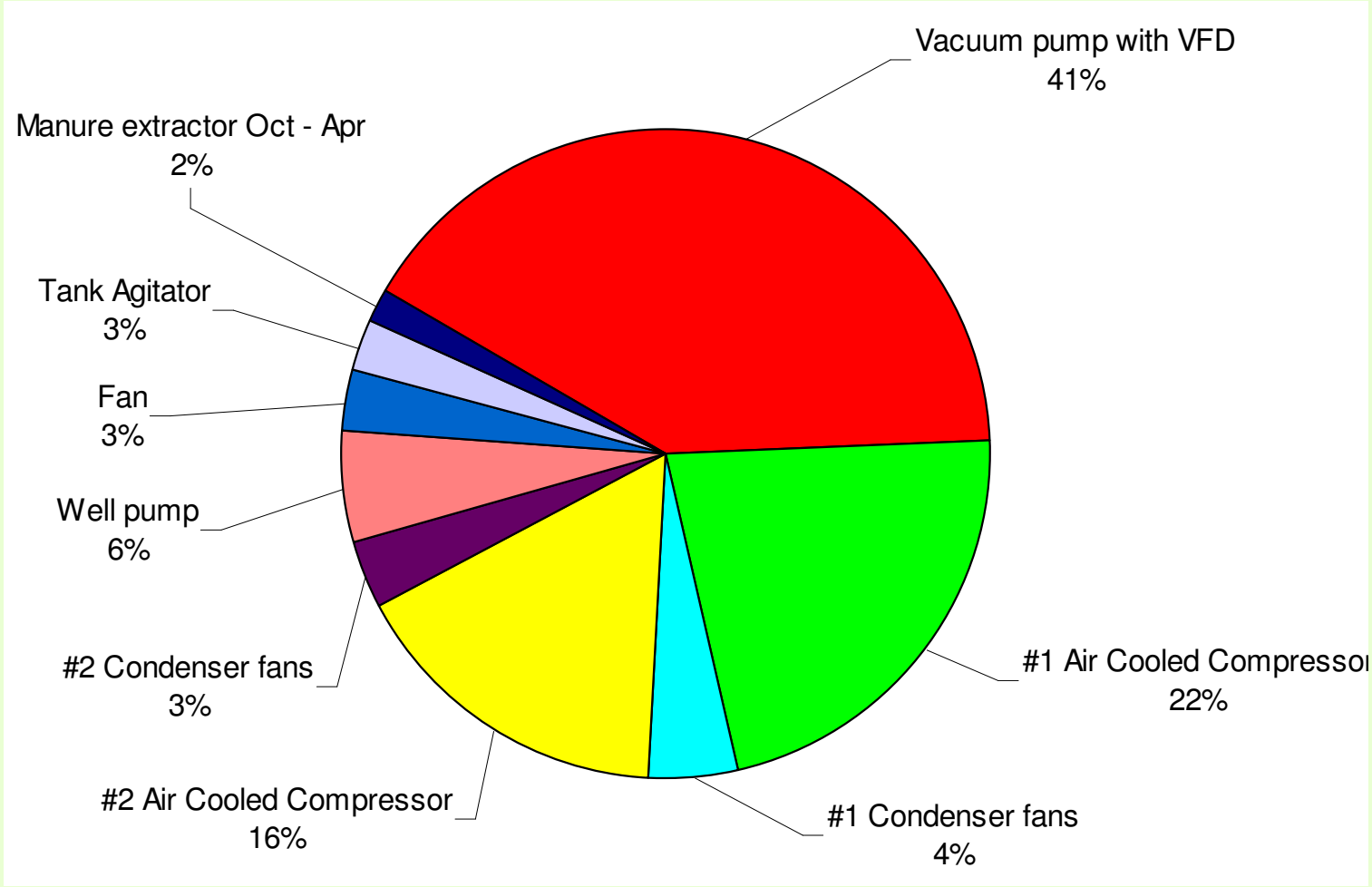
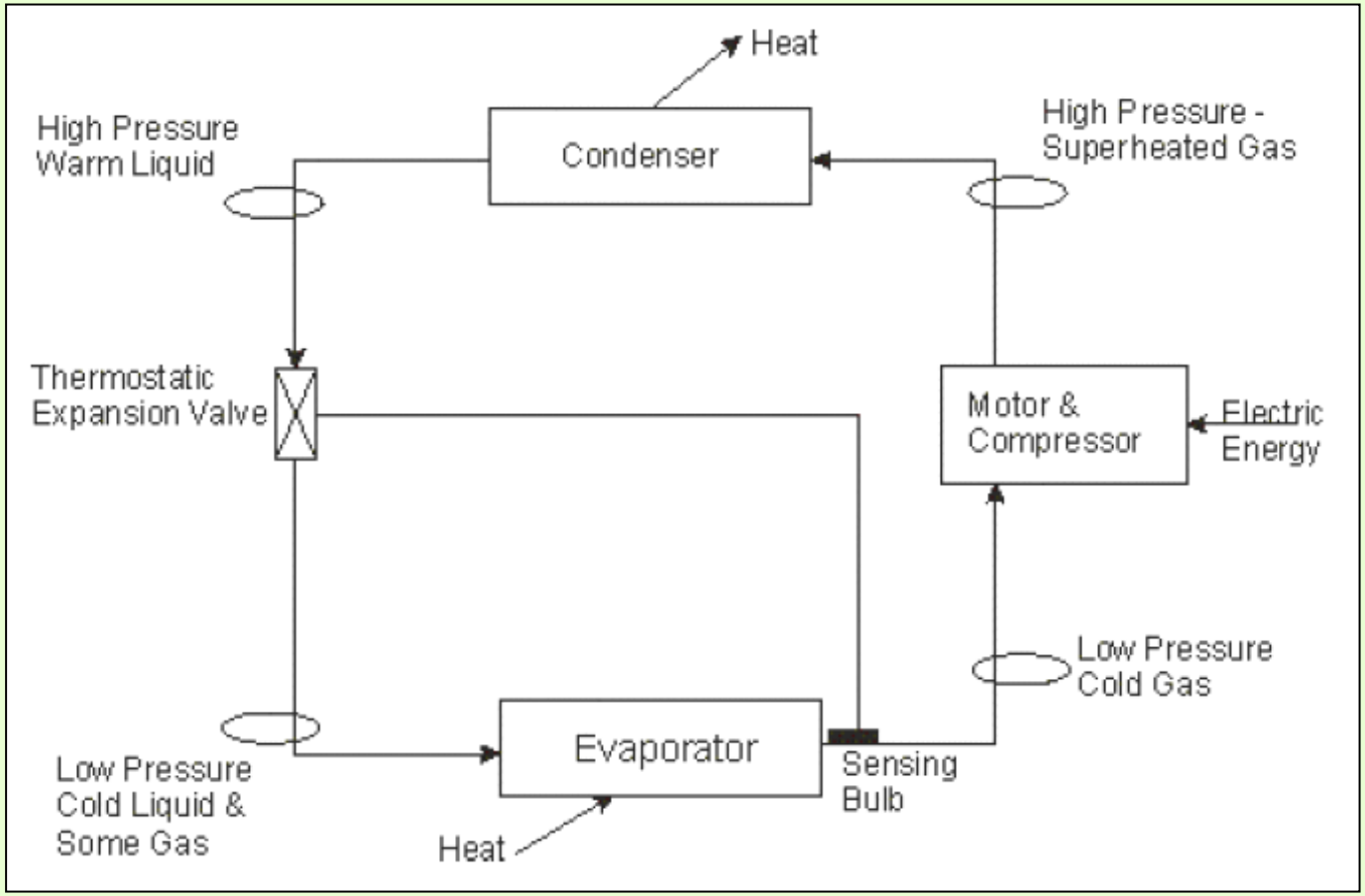
1000 gallon refrigerated
milk holding tank

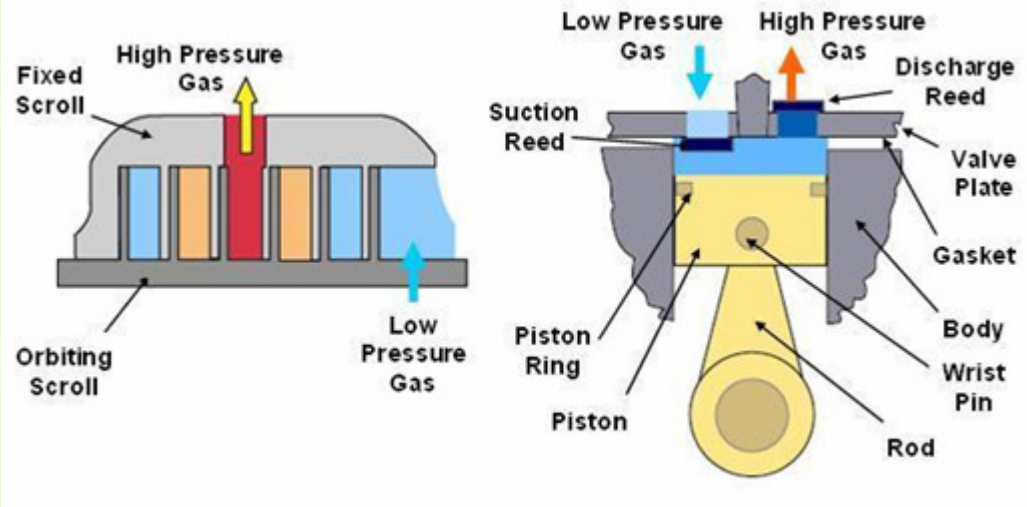
Energy Equipment use on Grassland Farm

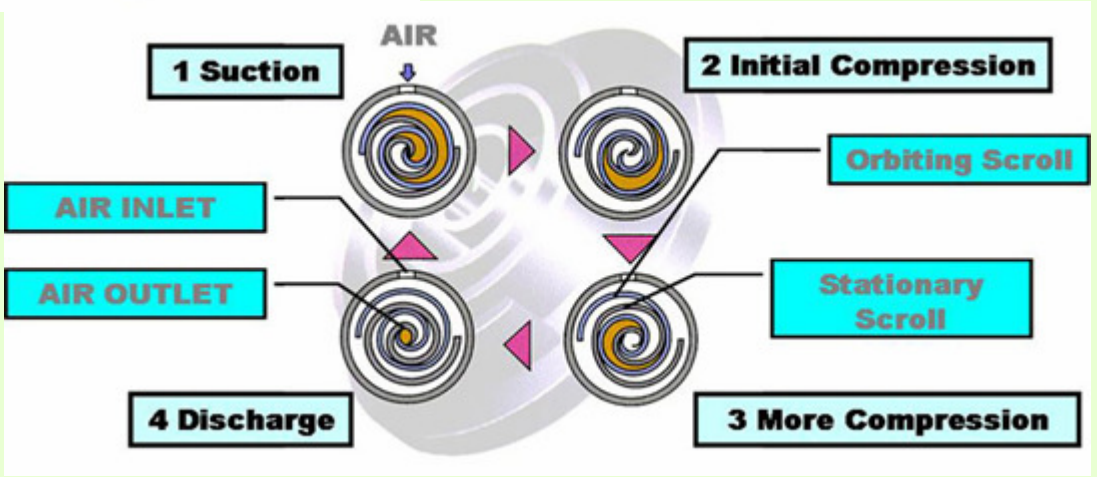


Basic Refrigeration Cycle



How Scrolls Compressors Work www.youtube.com





Cash Incentives

Milk House Equipment	
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15 HP Vacuum Pump with Adjustable Speed Drive Package	$3,000.00
Scroll Compressor – 5 HP	$ 550.00
Scroll Compressor – 6 HP	$ 660.00

Refrigeration NEW!

R10	Evaporator Fan Motor Control for Cooler or Freezer	$550.00 Per Control
R20	Door Heater Controls for Cooler or Freezer	$150.00 Per Circuit
R30	Zero Energy Doors for Coolers	$125.00 Per Door
R31	Zero Energy Doors for Freezers	$300.00 Per Door
R40	High-Efficiency Evaporator Fan Motors for Walk-in Coolers or Freezers	$ 50.00 Per PSC Motor
R41	High-Efficiency Evaporator Fan Motors for Refrigerated Warehouses	$100.00 Per ECM Motor
R42	High-Efficiency Evaporator Fan Motors for Merchandise Cases	$ 20.00 Per ECM Motor
R50	Floating-Head Pressure Controls (1 Coil)	$250.00
R51	Floating-Head Pressure Controls (2 Coils)	$375.00
R52	Floating-Head Pressure Controls (3 Coils)	$500.00
R60	New Discus Compressors – 3 HP	$375.00
R61	New Discus Compressors – 4 HP	$500.00
R62	New Discus Compressors – 5 HP	$625.00
R63	New Discus Compressors – 6 HP	$750.00
R70	New Scroll Compressors – 2 HP	$220.00
R71	New Scroll Compressors – 3 HP	$330.00
R72	New Scroll Compressors – 4 HP	$440.00
R73	New Scroll Compressors – 5 HP	$550.00
R74	New Scroll Compressors – 6 HP	$660.00
R80	Commercial ENERGY STAR® Reach-in Coolers & Freezers	$100.00
R90	Commercial Ice Makers	$100.00

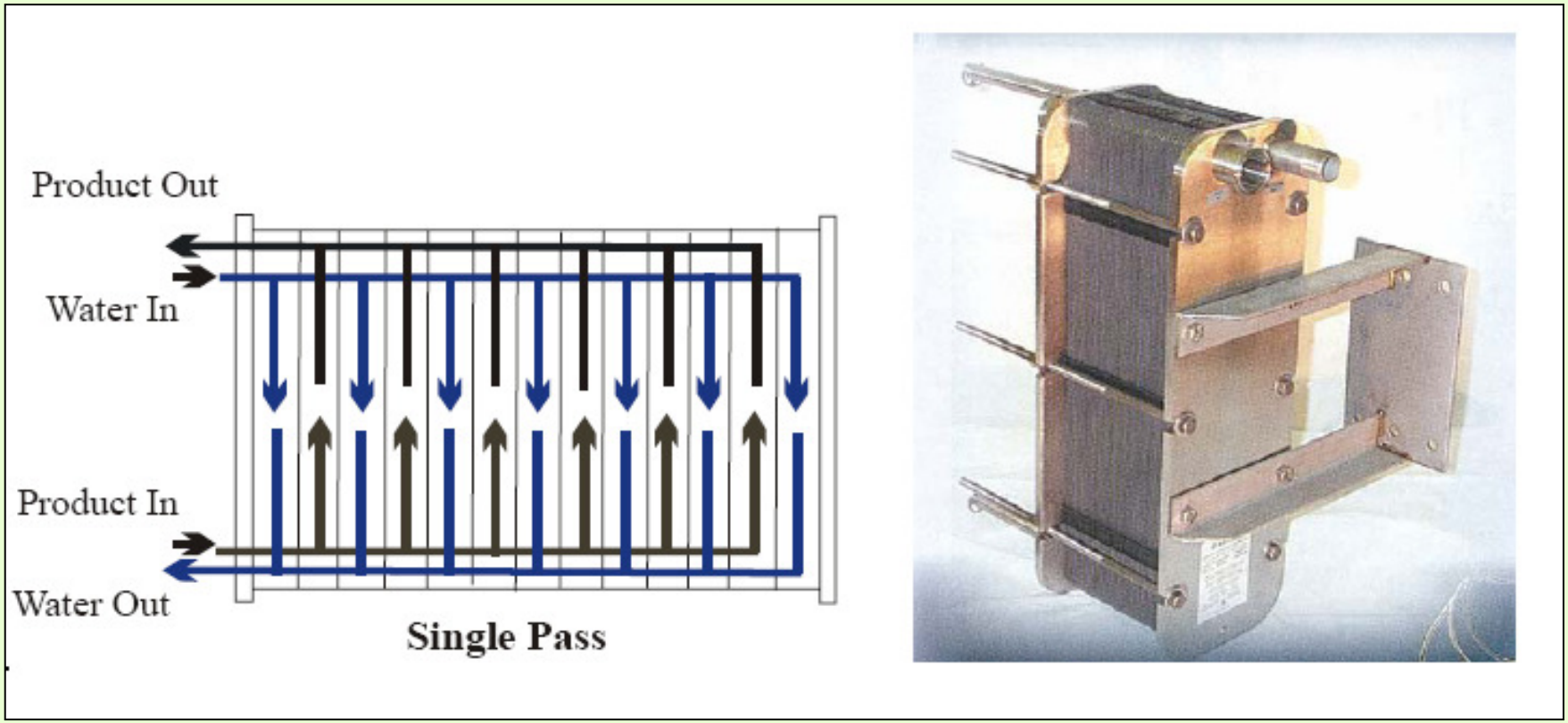
Refrigeration Heat Recovery Unit

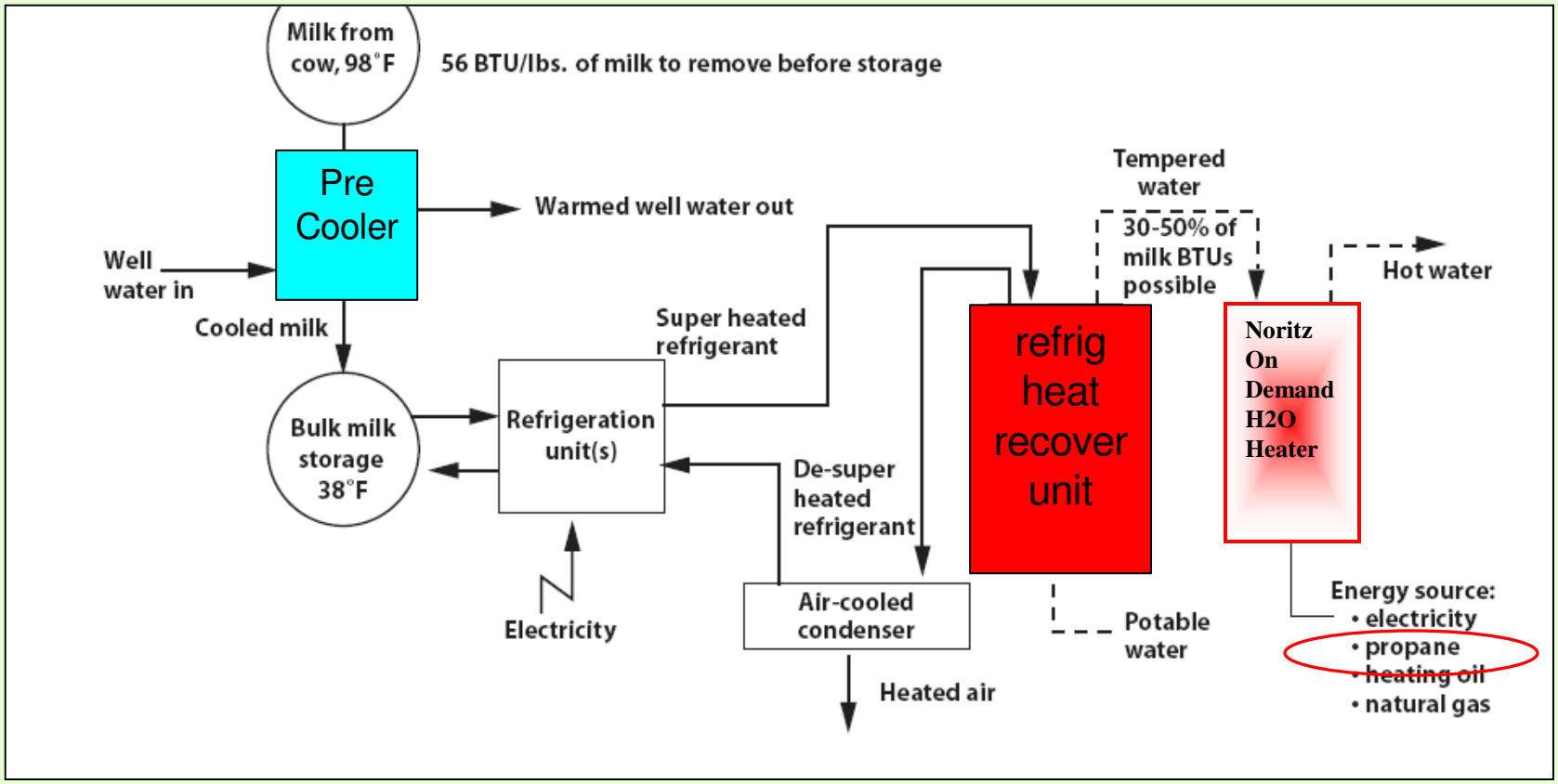
- The refrigeration heat recovery (RHR) unit captures heat from the refrigeration system refrigerant, which would otherwise be discharged to the air through the condenser fans, and transfers it to the water.
- The farm uses on average 12 gallons of propane per month to heat water. This equates to about one half gallon per day.
- Depending on ambient conditions, the in-coming refrigerant gas to the RHR heat exchanger can reach more than 200° F. and then before exiting the tank drops to 115 to 125°F transferring the heat to the water.
- The temperature required for sanitation of milk equipment is 170ºF. The difference in temperature is made up by the on-demand tankless water heater.

Plate Cooler Heat Exchanger

- The concept behind an inline pre-cooler is basic: warm milk is cooled down by well water.
- The pre-cooler is installed in the milk discharge line between the receiver and the bulk tank.
- The milk in the pre-cooler (heat exchanger) flows one way while the water flows another – either through a series of tubes inside a shell or through a series of plates – with neither liquid coming in direct contact with each other.

Well Water Pre-Cooler





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Pre-cooler Savings and Pay Back

Well Water Plate Cooler Savings Estimates		
1. Milk Production		
Daily milk production (Gals)	450	Gals
Gallon production frequency	1	
Annual Cwt of milk produced	14,126	
2. Savings & Cost, Plate Cooler only		
Annual Plate Cooler kWh savings	4,238	KWH's
Annual $ savings	$651	$0.15
Plate Cooler cost	$3,500	
Eff Maine incentive (State)	$500	
KCSWCD CIG incentive (Federal)	$900	
Total Incentive	$1,400	
Final cost	$2,100	
Simple Pay Back (years)	3.2	Years

Milking Equipment Manufactures

- Dairy Equipment Company
  Bou-Matic – www.Bou-Matic.com
- Alfa Laval Agri
  Delaval – www.delaval.com
  Germania Dairy Automation – www.germaniadairy.com
  Universal Dairy Equipment –www.universaldairy.com
  Nu-Pulse Inc.
- Westfalia-Surge – www.westfaliasurge.com
- The Coburn Company, Inc. – www.coburnco.com
- BECO Dairy Automation Inc. - www.becoknows.com
- The Schlueter Company - www.schlueterco.com
- Paul Mueller Company – www.muel.com
- Ross-Holm, Inc – www.ross-holm.com
- Etron – 1401 Peruville Road, Freeville, NY 13068;
  Ph: 607-898-3553

Motors

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Motors

- Motors are designed to run at a constant speed.
- However, motor drive systems are often operated at part or variable load.
- Fans and pumps can have highly irregular load profiles.
- Motors on these systems typically run at constant speed.
- Premium efficient motors can save up 15% of energy cost and up to 50% by controlling or adjusting the speed of the motor using
  - Adjustable Speed Drives (ASDs):
  - Variable Frequency Drives (VFDs)

Air Compressors

- Air leaks in compressed air systems waste a lot of energy:
- 1/8 inch leak = over $1500 annually
- Shut off compressors daily and close supply valve to prevent bleed off over night
- New combined compressor units with VFD motors may lead to reduce HP and efficiency

Cash Incentives

NEMA Premium® Efficiency Motors

Open Drip-Proof Motor

1 & 1.5HP	$ 45.00
2, 3 & 5HP	$ 54.00
7.5HP	$ 81.00
10HP	$ 90.00
15HP	$104.00
20HP	$113.00
25HP	$117.00
30HP	$135.00
40HP	$162.00
50HP	$198.00
60HP	$234.00
75HP	$270.00
100HP	$360.00
125HP	$540.00
150HP & 200HP	$630.00

NEMA Premium® Efficiency Motors

Enclosed Fan-Cooled Motor

1 & 1.5HP	$ 50.00
2, 3 & 5HP	$ 60.00
7.5HP	$ 90.00
10HP	$100.00
15HP	$115.00
20HP	$125.00
25HP	$130.00
30HP	$150.00
40HP	$180.00
50HP	$220.00
60HP	$260.00
75HP	$300.00
100HP	$400.00
125HP	$600.00
150HP & 200HP	$700.00

Solar Programs

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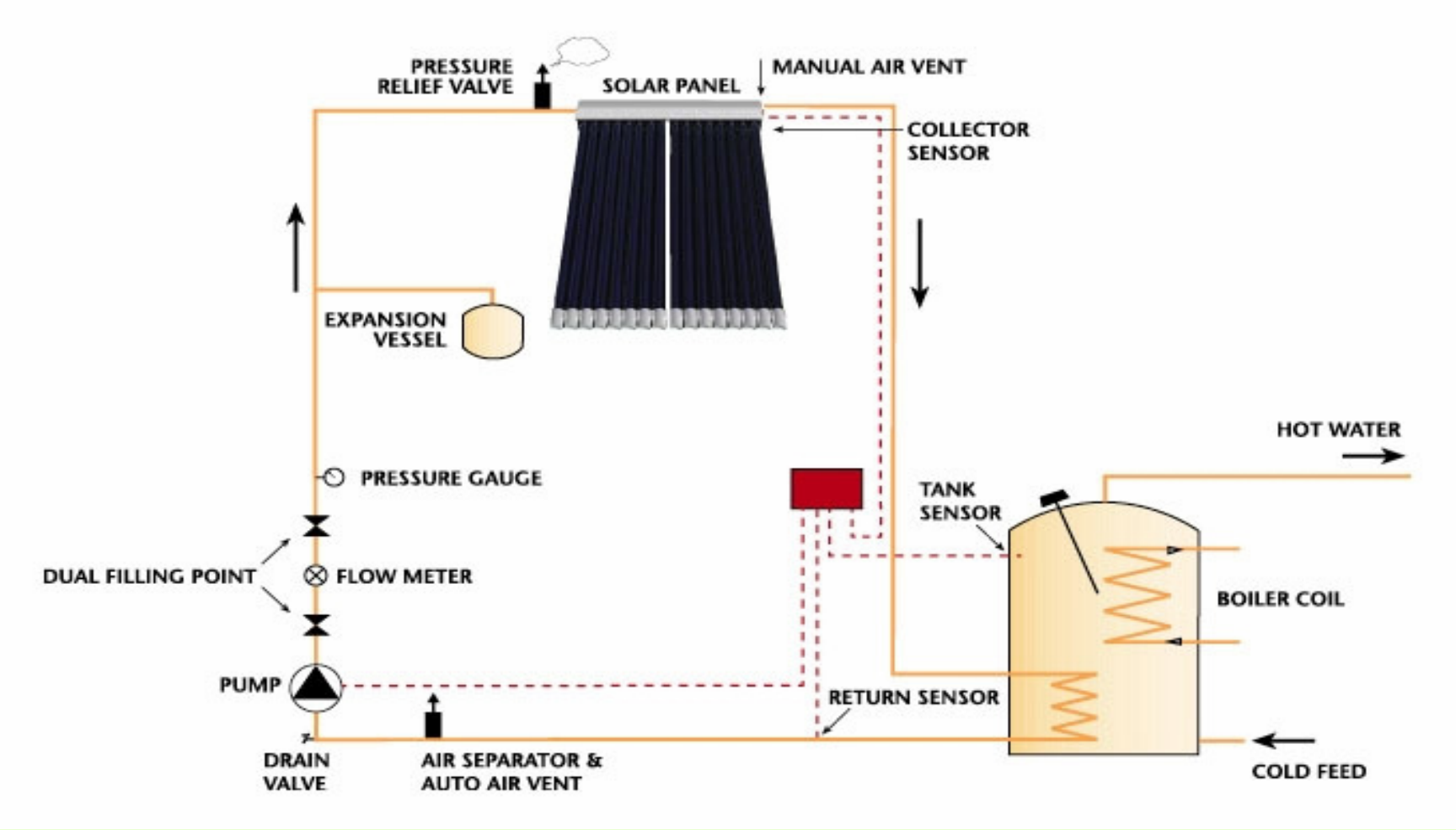
Maine's Commercial Solar Incentive Program

- State Tax Credit:
  - 35% of the system costs or $10,500, whichever is less;
- Federal Tax Credit :
  - 30% (capped at $2000 for residential, but uncapped for commercial)
- Solar hot water systems must be installed by licensed plumbers who have been qualified to install such systems by the Maine Public Utilities Commission
- Certified Solar Thermal Installers can be found at http://www.efficiencymaine.com/pdf/SolarInstallersInternet.pdf
- Richard Fortier, Solar Program Manager Efficiency Maine at the Maine Public Utilities Commission, at (207) 287-3319 or by e-mail at richard.fortier@maine.gov.

Solar Thermal 101



Evacuated Tube Collectors

Success for Energy Savings

- Conduct a focused energy audit
- "If you can measure it you can manage it"
- Document energy consumption for:
  - HVAC equipment
  - Kitchen equipment
  - Lights and electronic equipment
- Identify cash incentives
- Evaluate energy conservation measures and prioritize based on payback between 5-7 years
- Combine energy conservation measures to reduce payback
- Earmark/fence current energy budget to finance prioritized energy conservation measures for the length of payback

Small Business Low Interest Loan Program

- **Small Business Low Interest Loan Program** is to assist small commercial, non-profit, and manufacturing facilities (less than 50 FT employees or less than $5,000,000 in annual sales) with funding Efficiency Maine-approved energy conservation measures by providing loans up to $35,000 at 3% interest (current fixed rate). The Maine Public Utilities Commission's Efficiency Maine Program, administers this program. Additional information can be found by calling **Shirley I. Bartlett at 287-3318, Shirley.bartlett@maine.gov, http://www.efficiency.com**

Any questions please do not hesitate to call me

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