

NRCS Energy Efficiency Tools: Dairy and Beef Operations

**Present by:
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**Introductory Page to the Self-Assessment Tool
www.uwex.edu/energy/esa**



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Beef and Other Livestock Operations

- **This tool is not fully completed, however it will be a combination of a Ventilation tool and the lighting and livestock waterer tools.**
- **Jenny Hermans will be presenting on these tools later.**



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Dairy Self Assessment Tool

- **Why assess a Dairy?**
 - -They have many energy consuming operations and utilize multiple energy sources
 - -They have daily operations, 365 days a year resulting in significant energy use
 - -Most dairies are in the process of upgrading or expanding
 - -Most farms will have feasible energy efficiency improvement potential with a 5 year payback or less



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Dairy Self Assessment Tool

- What should be assessed?

Based on a New York survey of 32 dairy farms (14 tie-stalls and 18 free-stalls operations), vacuum pumps used 17%, milk cooling required 25%, lighting consumed 24% and ventilation was 22% of the electricity used. Water heating was split almost equally between electric, heating oil and gas (propane and natural gas) and represented 13% of the energy used.

- Hot water systems
- Milk cooling and refrigeration
- Vacuum systems
- Lighting
- Ventilation and exhaust systems



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The Average Wisconsin Dairy

Number of Milking Cows	80
Milkings per day	2
Hours per milking	1.5
Milk shipped per day	5600 lbs (70 lbs/cow-day)
Number of Milking Units	5 (on a pipeline)
Size of Vacuum Pump	10 hp
Size of Refrigeration	2 - 5 hp compressors
Size of Bulk Tank	800 gal.
Hot Water Usage	115 gal./day

Assessing the Average Dairy



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Step 1: Enter the farms zip code



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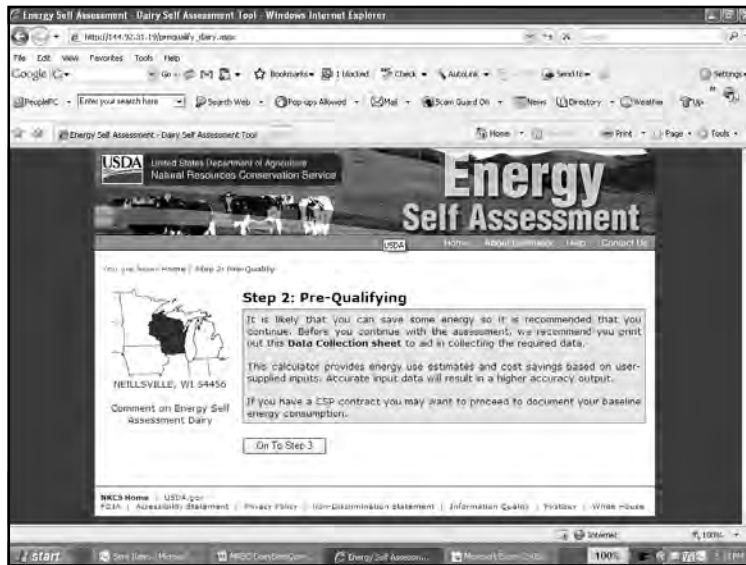
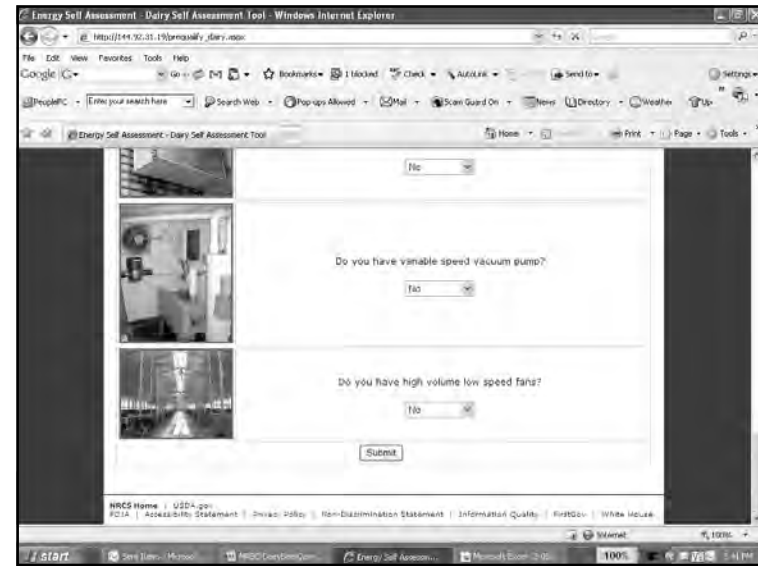
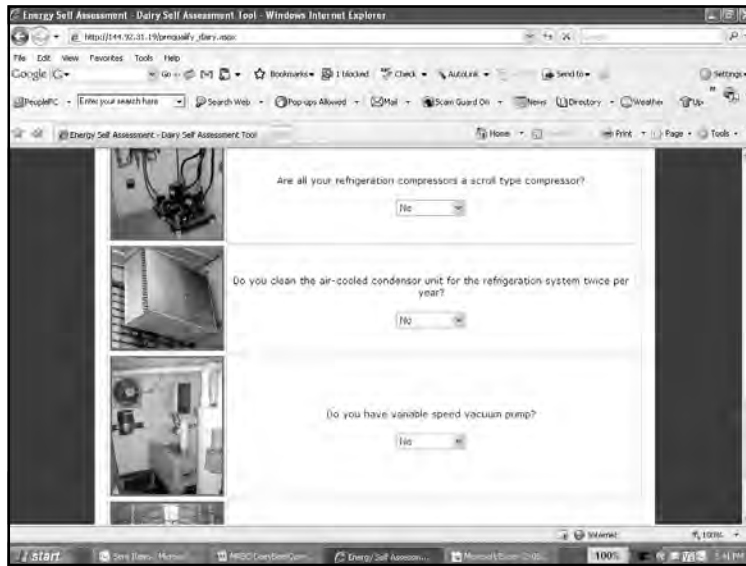
Step 2: Pre-Qualifying

The screenshot shows the 'Energy Self Assessment' tool interface. At the top, it says 'Step 2: Pre-Qualifying'. Below this, there is a map of the United States with a red dot indicating the user's location in Millsville, NJ 08456. The text explains that the tool is designed to estimate current energy costs and identify potential savings from high-efficiency equipment. It lists various technologies such as scroll refrigeration compressors, refrigeration heat recovery, and well-water cooled precoolers. A note indicates that users should click on pictures to get a brief description of the technology and its operating parameters. The page also mentions that a report will be generated with potential savings from different technologies.

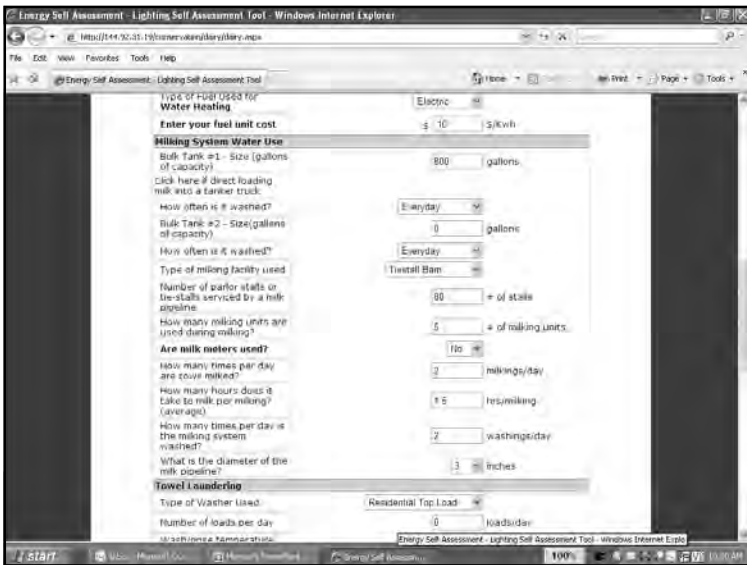
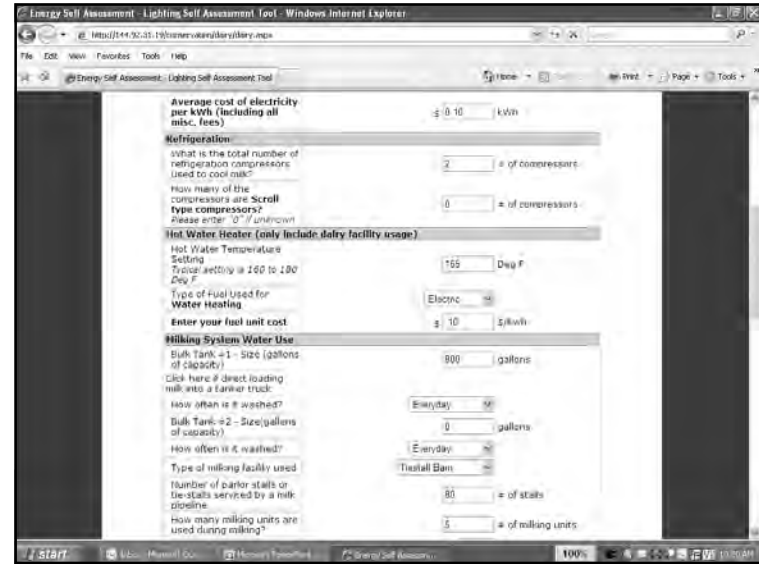
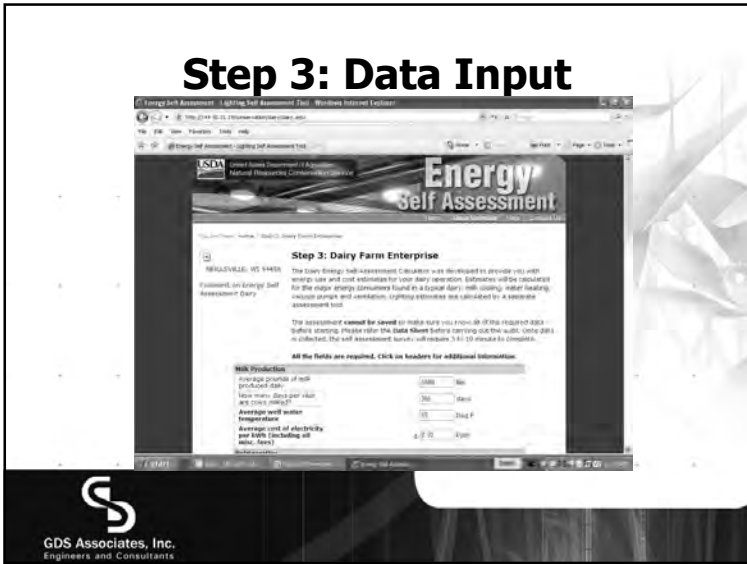
This screenshot shows the questionnaire part of the tool. It features a grid of images for users to click on for definitions. The first question asks, 'On average, how many cows are you milking?' with a dropdown menu set to 'Less Than 100'. The second question asks, 'Do you have a refrigeration heat recovery unit?' with a dropdown menu set to 'No'. The browser's address bar shows the URL 'http://144.92.31.19/energyself_assess.aspx'.

This screenshot shows the questionnaire part of the tool. It features a grid of images for users to click on for definitions. The first question asks, 'Do you have a high efficiency water heater with a thermal efficiency greater than 90%?' with a dropdown menu set to 'No'. The second question asks, 'Do you have a well-water cooled precooler?' with a dropdown menu set to 'No'. The third question asks, 'Do you have a variable speed milk pump? (V2MP)' with a dropdown menu set to 'No'. The fourth question asks, 'Are all your refrigeration compressors a scroll type compressor?' with a dropdown menu set to 'No'. The browser's address bar shows the URL 'http://144.92.31.19/energyself_assess.aspx'.

This screenshot shows the 'Water Heater' section of the tool. It provides detailed information about water heaters, including a study of New York State dairy farms that found propane was converted to the equivalent kWh of energy for water heating. It also discusses thermal efficiency, standby losses, and Energy Factor (EF) ratings. The text explains that gas or oil water heaters have thermal efficiencies of 80% but typically have standby losses of 2-3% per hour, while electric water heaters have a thermal efficiency of 90% but an overall efficiency of 60% due to standby losses. The section concludes with advice on selecting a water heater based on storage tank size and speed of heating.



Step 3: Data Input



Energy Self Assessment - Lighting Self Assessment Tool - Windows Internet Explorer

What type of electrical power is used? - Single Phase

What is the horse power of vacuum pump #1? - 10 HP

Ventilation
What type of housing is being used? - Trestle Barn

Expanded Fan Info (Do not use for circulating fans)

Fan size (in inches)	Number of fans	Hours of operation per fan per year (hrs/yr)	Are fans thermostatically controlled?
48	2	3500	Yes
48	2	1200	No
24	0	0	No
24	0	0	No

Guide for Estimating Hours of Fan Operation (How to use)
Select nearest location with similar weather: Eau Claire, WI

Hours ambient temperature is greater than XX°F

Hours	45 Deg F	50 Deg F	55 Deg F	60 Deg F	65 Deg F	70 Deg F
Hours	2741	3858	3243	2725	1992	1074

Go Back Next >>

Step 4: Analysis

Energy Self Assessment - Dairy Self Assessment Tool - Windows Internet Explorer

United States Department of Agriculture, National Transportation Conservation Board

Energy Self Assessment

PLEASE TAKE SOME MORE TIME TO ANSWER 4 SURVEY AND COMMENTS YOU MIGHT WANT TO SEE CAN IMPROVE OUR TOOLS FOR YOU.

[Click Here To Visit the Survey](#)

Use type:

Analysis of Dairy Farm System

Refrigeration Heat Recovery, Precooler & Water Heating

Baseline Annual Energy Costs

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Water Heating, Plate Cooler and RHR Analysis

Energy Self Assessment - Dairy Self Assessment Tool - Windows Internet Explorer

Refrigeration Heat Recovery, Precooler & Water Heating

	Baseline Annual Energy Costs	Energy Cost	Energy Usage	
Milk Cooling Energy Use	\$1313		13125	kWh
Water Heating Energy Use	\$1365		13649	kWh electricity
Estimated Dairy Hot Water		129		gallons/day
Total Energy Cost	\$2677	\$2677	98207792	\$/year
CO2 Emissions		47531		lbs. CO2 / year

Potential Annual Savings

Description	Refrigeration heat recovery only		Precooler with varying degrees of cooling with well water			
	10	20	30	40	FF	
Estimated Degrees of Milk Cooling (°F)						
Well Water Precooler Energy Savings	2263	4526	6789	9052		kWh
Cost Savings	\$226	\$453	\$679	\$905		\$/year
Refrigeration Heat Recovery	9247	9247	9247	9247	9247	kWh electricity
Cost Savings	\$925	\$925	\$925	\$925	\$925	\$/year
High Efficiency Water Heater w/RHR	442	442	442	442	442	kWh electricity
Cost Savings	\$44	\$44	\$44	\$44	\$44	\$/year
Total Cost Savings	\$969	\$1195	\$1422	\$1640	\$1509	
Total Energy Savings	33067816	40791435	48515034	56238673	54242669	lbs / year
Percent Energy Savings	34%	42%	49%	57%	55%	
Emissions Reduction - CO2	15980	19720	23494	27188	26223	lbs/year

Summary Output Table

Energy Self Assessment - Dairy Self Assessment Tool - Windows Internet Explorer

CO2 Emissions: 47531 lbs. CO2 / year

Description	Refrigeration heat recovery only		Precooler with varying degrees of cooling with well water			
	10	20	30	40	FF	
Estimated Degrees of Milk Cooling (°F)						
Well Water Precooler Energy Savings	2263	4526	6789	9052		kWh
Cost Savings	\$226	\$453	\$679	\$905		\$/year
Refrigeration Heat Recovery	9247	9247	9247	9247	9247	kWh electricity
Cost Savings	\$925	\$925	\$925	\$925	\$925	\$/year
High Efficiency Water Heater w/RHR	442	442	442	442	442	kWh electricity
Cost Savings	\$44	\$44	\$44	\$44	\$44	\$/year
Total Cost Savings	\$969	\$1195	\$1422	\$1640	\$1509	
Total Energy Savings	33067816	40791435	48515034	56238673	54242669	lbs / year
Percent Energy Savings	34%	42%	49%	57%	55%	
Emissions Reduction - CO2	15980	19720	23494	27188	26223	lbs/year

Compressor Analysis

We Would Appreciate Your Feedback
Please take some more time to answer a survey and send comments you might have so we can improve our tools for you.
[Click Here To Visit the Survey](#)

Analysis of Dairy Farm System

Annual Analysis for Scroll Compressors

	Annual Energy Use (kWh)	Annual Energy Use (BTU)	Annual Cost/Savings	Emissions Reduction (lbs. CO ₂)
Baseline Energy Use	13578	45341714	\$1358	4481
Projected Savings	2716	9266343	\$272	
Estimated Simple Payback*	3.7 yrs			

*Based on incremental cost of \$500 per compressor.

Variable Speed Vacuum Pump Analysis

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[Click Here To Visit the Survey](#)

Analysis of Dairy Farm System

Annual Analysis for Variable Speed Vacuum Pumps

	Annual Energy Use (kWh)	Annual Energy Use (BTU)	Annual Cost/Savings	Emissions Reduction (lbs. CO ₂)
Baseline Energy Use	462	1541726	\$96	343
Projected Savings	274	902843	\$27	
Estimated Simple Payback*	3.8 yrs			

*Based on incremental cost of \$250 per vacuum pump.

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Ventilation and Exhaust Fan Analysis

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Analysis of Dairy Farm System

Annual Analysis for Ventilation and Exhaust Fans

	Annual Energy Use (kWh)	Annual Energy Use (BTU)	Annual Cost/Savings	Emissions Reduction (lbs. CO ₂)
Baseline Energy Use	19708	6702359	\$1973	7719
Projected Savings with High Efficiency Fans	3675	15937340	\$466	
Projected Savings with Thermostatically Controlled High Efficiency Fans	5131	17510814	\$513	

High Volume Low Speed Fan Analysis

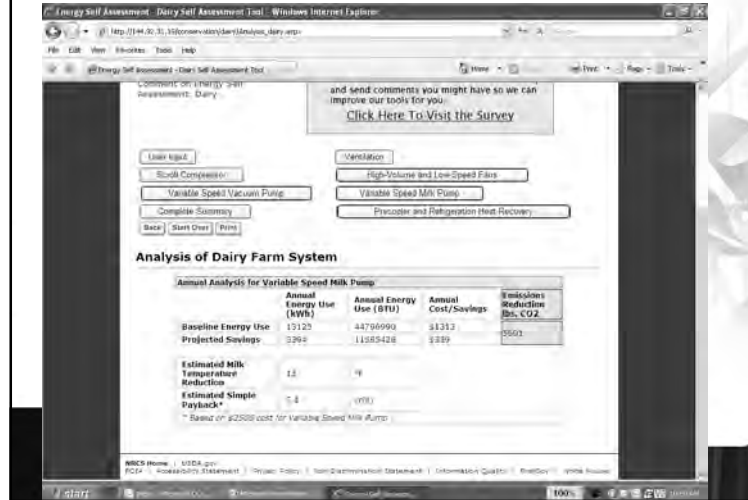
We Would Appreciate Your Feedback
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[Click Here To Visit the Survey](#)

Analysis of Dairy Farm System

Annual Analysis for High Volume Low Speed Fans (HVLS)

	Annual Energy Use (kWh)	Annual Energy Use (BTU)	Annual Cost/Savings	Emissions Reduction (lbs. CO ₂)
Baseline Energy Use with High Speed Fans	0	0	\$0	0
Projected Savings with HVLS	0	0	\$0	0
Incremental Capital Cost	\$0			
Estimated Simple Payback	0 yrs			

Variable Speed Milk Pump Analysis



Limitations of the On-line Assessment Tool

- **Limited inputs = limited and variable outputs**
- **Interactions between a plate cooler, refrigeration heat recovery, and water heater are difficult to represent in a table/quantatively**
 - Without better consultation, producers may be confused
- **Site specific constraints and limitations are difficult to enter**
 - Example: The farm uses a larger or smaller than normal pipeline wash sink (greatest influence on hot water consumption)



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Limitations of the On-line Assessment Tool

- **Does not hierarchically arrange energy efficiency recommendations or display interaction constraints**
 - Example: Based on output, the farm may consider putting in a VSD milk pump, however if a RHR and a PC are installed, a VSD milk pump will reduce net energy savings.
- **Does not save data**
 - Once the producer disconnects, they must start over



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Number of Milking Cows	150
Milkings per day	3
Hours per milking	2.6
Milk shipped per day	13500 lbs (90 lbs/cow-day)
Number of Milking Units	16 (Double 8 parlor)
Size of Vacuum Pump	10 hp
Size of Refrigeration	3 - 5 hp compressors
Size of Bulk Tank	2000 gal.
Hot Water Usage	383 gal./day



An Expanding Dairy

Expansion Model - Prequalifying

On average, how many cows are you milking?	150
Do you have a refrigeration heat recovery unit?	No
Do you have a Well-Water cooled Precooler?	Yes (small, single pass)
What is the temperature of the milk entering the bulk tank?	75 F
Do you have a variable speed milk pump? (VSMP)	No
Are all your refrigeration compressors a scroll type compressor?	No
Do you clean the air-cooled condenser unit for the refrigeration system twice per year?	Yes
Do you have variable speed vacuum pump?	No
Do you have high volume low speed fans?	No



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Comparison of 80 and 150 Cow Dairies Analysis Summary – RHR, PC, and Hot Water Heating

	80 Cows	150 Cows
Milk Cooling Use	13125 kwh	31,642 kwh
Daily Hot Water	129 gal.	383
Annual Million Btu	98.2 MBtu	266.2 MBtu
Total Energy Cost	\$2877	\$7798

Analysis of Dairy Farm System	
Refrigeration Heat Recovery, Precooler & Water Heating	
Estimated Annual Energy Costs	
Energy Cost	Energy Stream
Milk Cooling Energy Cost	13125
Refrigeration Heat Recovery	0
Precooler Energy Cost	0
Water Heating Energy Cost	6798
Total Energy Cost	26613
80 Cows	13125
150 Cows	26613



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Comparison of 80 and 150 Cow Dairies RHR, PC, and Water Heating Cont.

	80 Cows	150 Cows
PC Savings (Current)	0 kwh	10,900 kwh
PC-30 F cooling	6790 kwh	16,400 kwh
RHR Savings	9247 kwh	22,400 kwh
High Efficiency Water Heater	440 kwh	1650 kwh
Total Cost Savings	\$1650	\$3000

Total Energy Cost	
80 Cows	150 Cows
Total Energy Cost	\$2877
80 Cows	2877
150 Cows	7798



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Note the net energy savings loss

- Total cost savings actually decrease with 40 F plate cooler, cooling!

Refrigeration Heat Recovery only	
Description	Precooler with varying degrees of cooling with well water
Estimated Savings of Milk Cooling (kWh)	10
Total Cost Savings	\$2000
80 Cows	\$2000
150 Cows	\$2000



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Comparison of 80 and 150 Cow Dairies

Annual Analysis for Scroll Compressors				
	Annual Energy Use (kWh)	Annual Energy Use (BTU)	Annual Cost/Savings	Emissions Reduction lbs. CO2
Baseline Energy Use				
80 Cows	13578	46341314	\$1358	
150 Cows	20185	68891923	\$2019	
Projected Savings				
80 Cows	2716	9268343	\$272	4481
150 Cows	4037	13778385	\$404	6661
Estimated Simple Payback*	3.7	Yr(s)		
	3.7	Yr(s)		

*Based on incremental cost of \$500 per compressor



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Comparison of 80 and 150 Cow Dairies

Annual Analysis for Variable Speed Vacuum Pump

	Annual Energy Use (kWh)	Annual Energy Use (BTU)	Annual Cost/Savings	Emissions Reduction lbs. CO2
Baseline Energy Use				
80 Cows	9882	33455728	\$980	
150 Cows	22791	77784567	\$2279	
Projected Savings				
80 Cows	3748	19618491	\$578	9484
150 Cows	13874	47350805	\$1387	22892
Estimated Capital Cost	\$5650			
Estimated Simple Payback	9.5	yr(s)		
	4.1	yr(s)		
Return on Investment	10%			
	25%			

Note: Multiple pumps will require one variable speed controller per pump

A single vacuum pump may be large enough to operate the milking system. Check with your dairy equipment dealer.



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Comparison of 80 and 150 Cow Dairies

Annual Analysis for Ventilation and Exhaust Fans

	Annual Energy Use (kWh)	Annual Energy Use (BTU)	Annual Cost/Savings	Emissions Reduction lbs. CO2
Baseline Energy Use				
80 Cows	19706	67262399	\$1971	
150 Cows	61975	211521931	\$6198	
Projected Savings				
80 Cows	4675	13957140	\$486	7714
150 Cows	9720	33174360	\$972	16038
Projected Savings Thermostatically Controlled				
	5131	17510814	\$513	
	9720	33174360	\$972	



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Comparison of 80 and 150 Cow Dairies

Annual Analysis for High Volume Low Speed Fans (HVLS)

	Annual Energy Use (kWh)	Annual Energy Use (BTU)	Annual Cost/Savings	Emissions Reduction lbs. CO2
Baseline Energy Use with High Speed Fans	49950	170479350	\$4995	62741
Projected Savings with HVLS	38025	129779325	\$3802	
Incremental Capital Cost	\$8000			
Estimated Simple Payback	2.1	yr(s)		



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In Closing

- The self assessment tool is an excellent starting point for Dairy Producers to find EE opportunities
- It will only take a farmer 20 to 30 minutes to conduct a full assessment
- The combination of tools available now provide a producer the opportunity to analyze all operations
- Please go to our website and evaluate the too www.uwex.edu/energy/esa



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**Does anyone want to join me at
the pool?**



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