



Guelph Solar Mechanical Inc.



# Solar Hot Water For Dairy Barns

Presented by:

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President of

Guelph Solar Mechanical Inc.



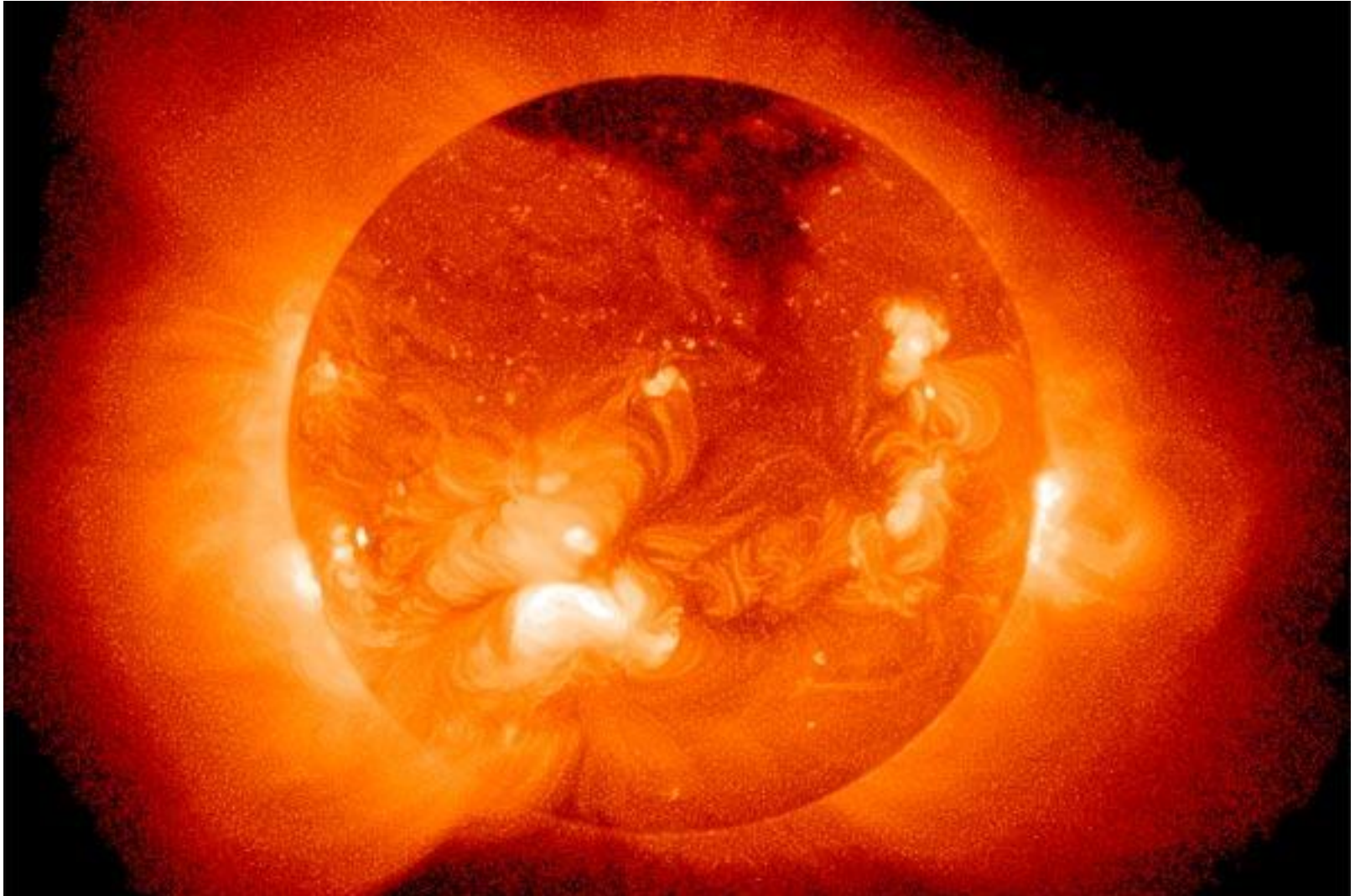
# Agenda

- Introduction, Overview of Solar Power
- Solar Thermal vs. Electric
- Current projects
- System Components
- Dairy Barn Equipment
  - Pre-Cooler
  - Heat Recovery Systems
  - How A Solar Water Heater Fits into the mix
- Financials
- < Questions >



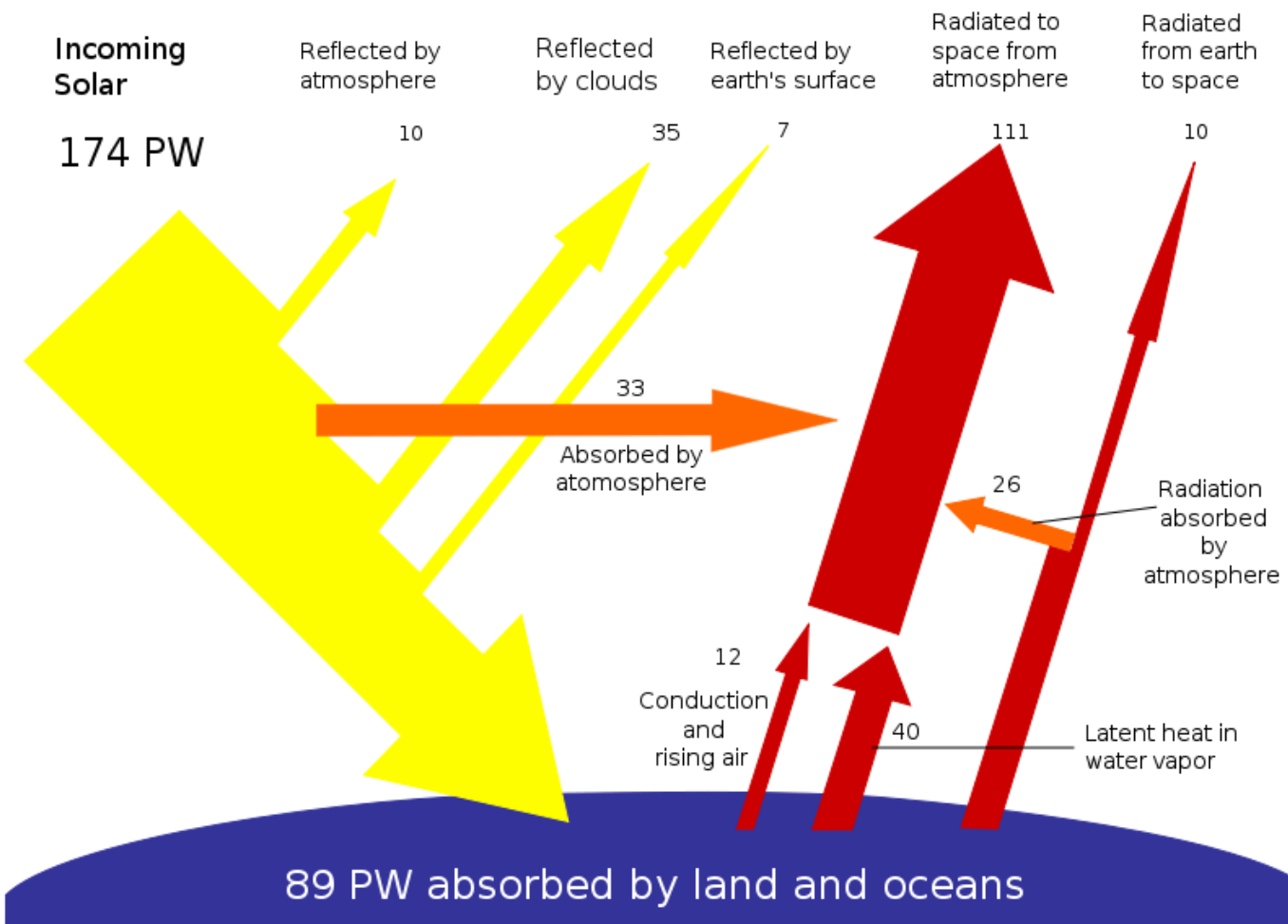
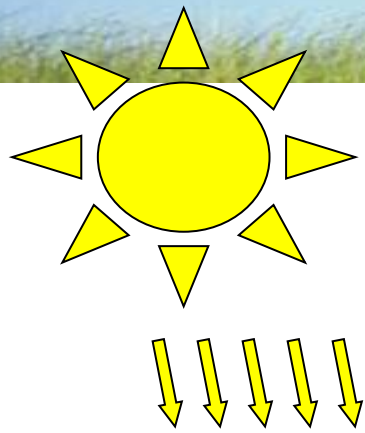
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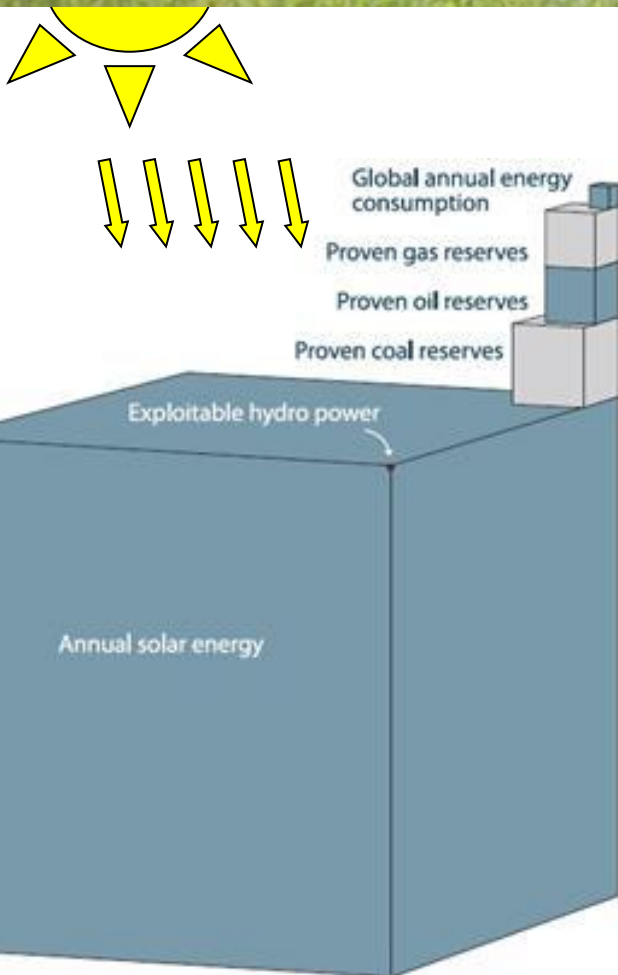
# The Sun- Our Very Own Natural Fusion Reactor





# ENERGY FROM the SUN





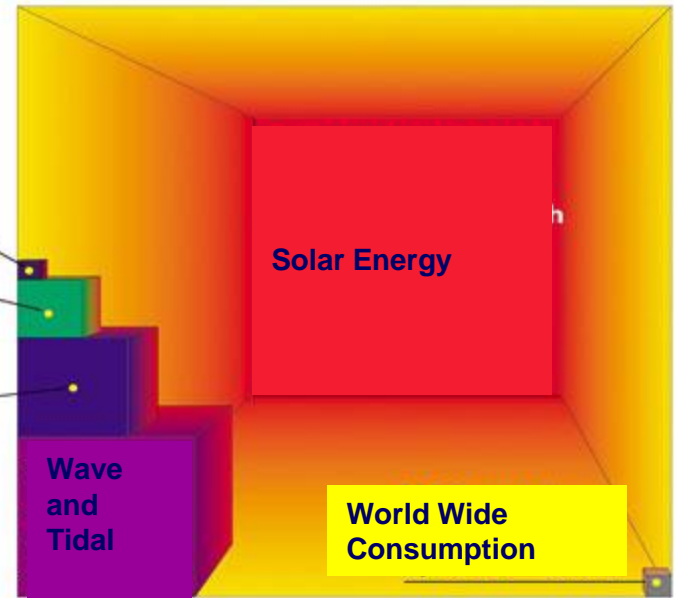
•World energy consumption 1995

Hydro Power

Bio - Mass

Wave and Tidal

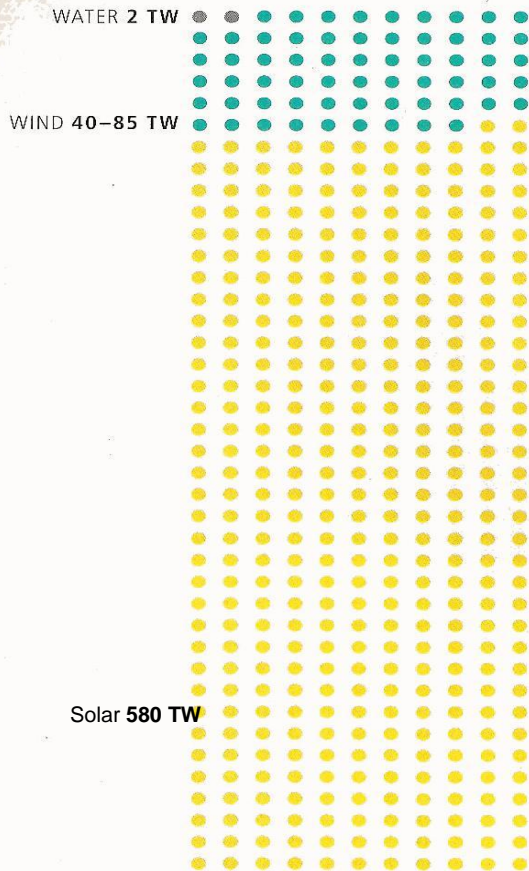
Quelle:  
Eurec. Agency/Eurosolar, WIP:  
Power for the World – A Common Concept





## Scientific American: World could be using 100% sustainable energy by 2030 (Nov 2009)

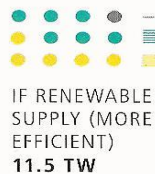
### RENEWABLE POWER AVAILABLE IN READILY ACCESSIBLE LOCATIONS



### POWER NEEDED WORLDWIDE IN 2030



OR



### RENEWABLE INSTALLATIONS REQUIRED WORLDWIDE

WATER 1.1 TW (9% OF SUPPLY)

# 490,000

TIDAL TURBINES – 1 MW\* – <1% IN PLACE  
\*size of unit

# 5,350

GEOTHERMAL PLANTS – 100 MW – 2% IN PLACE

# 900

HYDROELECTRIC PLANTS – 1,300 MW – 70% IN PLACE

# 3,800,000

WIND TURBINES – 5 MW – 1% IN PLACE

# 720,000

WAVE CONVERTERS\* – 0.75 MW – <1% IN PLACE  
\*wind drives waves

WIND 5.8 TW (51% OF SUPPLY)

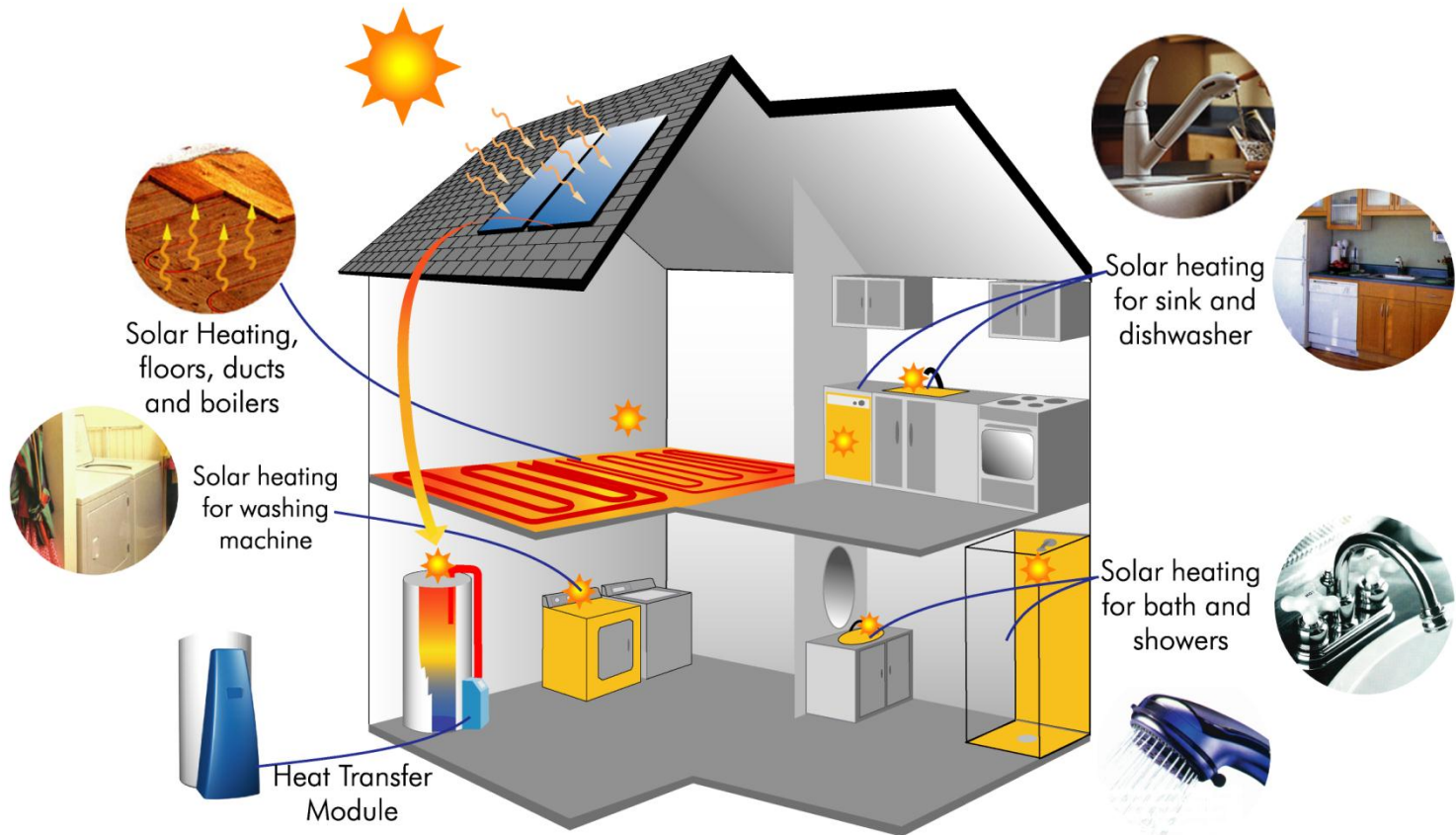
# 1,700,000,000

ROOFTOP PHOTOVOLTAIC SYSTEMS\* – 0.003 MW – <1% IN PLACE  
\*sized for a modest house; a commercial roof might have dozens of systems

# 49,000



# Solar Thermal- hot water





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## Solar PV – Grid Load



A typical 10 kW  
micro-FIT  
ground mount  
system







## Mapleton Dairy Barn - Moorefeild



75 head – Tie Stall  
6 flat plate and 120 gallon solar Storage



## Ben and Jen Polley's Home – Restored 1830's



Evacuate Tube  
System – 60 Tubes

Used for Domestic  
Hot Water and in  
floor space heating





## Ignatius Community House



Two Flat Plate  
Collectors

Used for Domestic  
Hot Water for 5  
people





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## Pool Heating





## Guelph Wellington Hospice



Four Flat Plate Collectors

Used for Domestic Hot Water in a 10 bed facility





## Kozak 50 year Plan



Five Flat Plate  
Collectors

Used for Domestic  
Hot Water and  
Space Heating





## Eden Mills – Historic Mill



Two Flat Plate  
Collectors – Integrated  
into building

Used for Domestic Hot  
Water for home and  
apartment





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Six Flat Plate Collectors on each building

Used for Domestic Hot Water



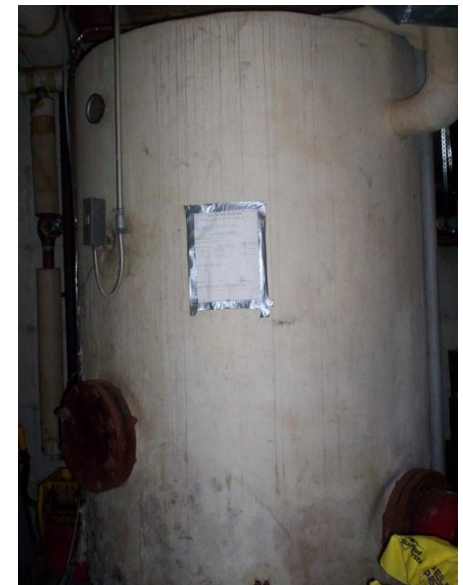




## 40 bed Facility - Loyola Retreat Centre

10 panel system for  
Preheating Domestic  
Hot Water

Using existing tank





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# Solar Thermal Space Heating Okatoks Alberta



The Drakes Landing Solar community in Okatoks Alberta maybe the largest solar community array in the world.

800 solar thermal panels are installed to provide space heating and domestic hot water.

Solar thermal energy is stored in a geothermal well during the summer and is extracted during the winter.





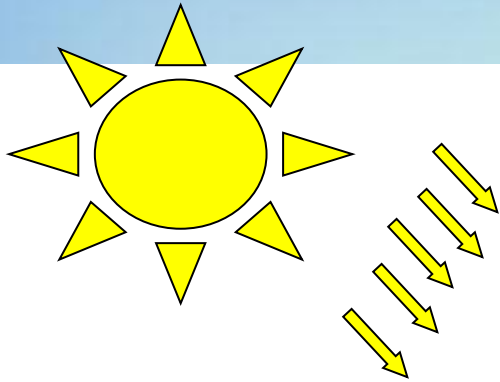
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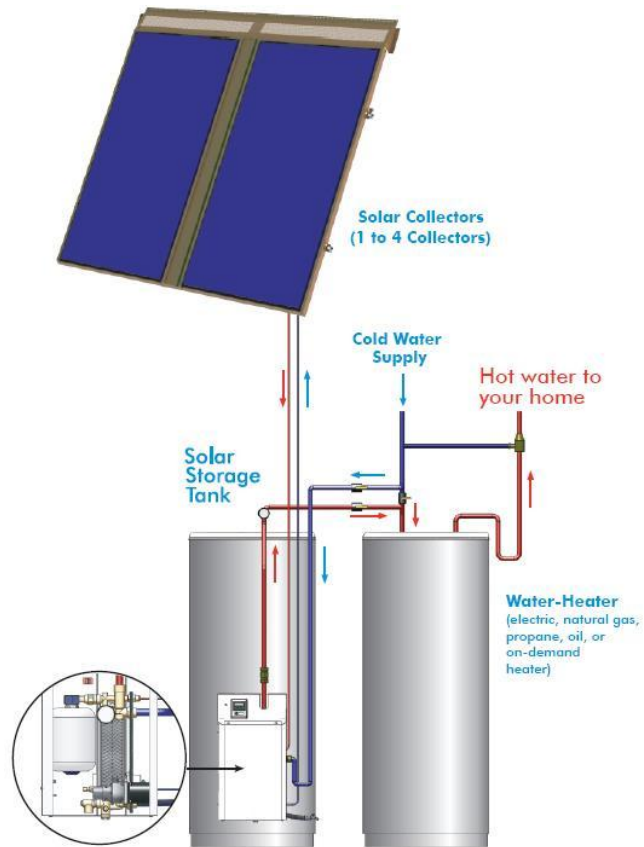
200 Flat Plate  
Collectors

Used for Pre-  
Heating Boiler  
Feed Water

## Bombardier Aerospace – Downsview Manufacturing Plant



# Solar Thermal- hot water



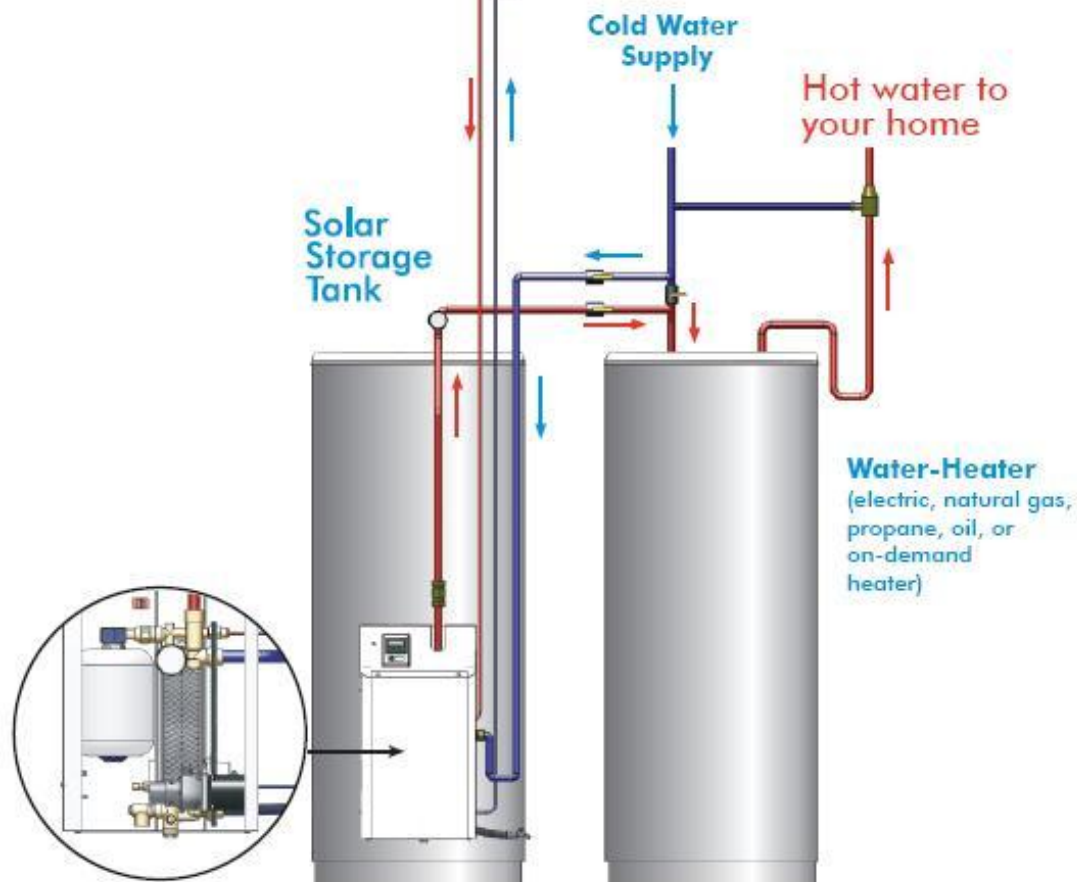


## Solar Thermal



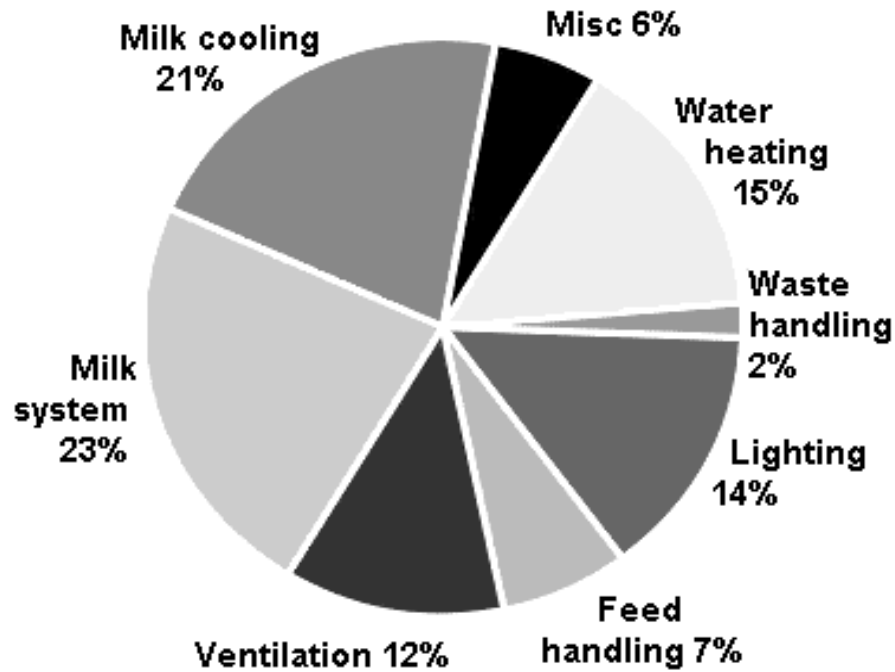
### Basic Components

- Solar Panels
  - Convert solar radiation into heat
- Heat Transfer Fluid
  - Delivers absorbed heat collected at panel to solar storage tank
- Solar Storage Tank
  - The sun is an intermittent source of energy
  - Heat energy is transferred into the storage tank so it is available as required
- Backup Water Heater
  - Solar water heaters can provide about 50% of hot water needs





## OMAFRA – Using Less Energy in Dairy Barns



<http://www.omafra.gov.on.ca/english/engineer/facts/10-067.htm>



### Flat Plate Pre-Coolers vs. Heat Recovery

Heat removed with a pre-cooler cannot be used for water heating.

### Flat Plate Pre-Coolers vs. Heat Recovery

“Are Competing technologies for farms with less than 100 cows.” OMAFRA





### Flat Plate Pre-Coolers

Can save 50% of the milk cooling costs  
Or 11% of the dairy barn electric costs

Milk is chilled quicker

Compressors runs for a shorter time using less electricity

Drinking water for cows is warmed up a few degrees and cows drink more

Average energy usage in a dairy barn is about 1,000 kWhr/ cow-yr

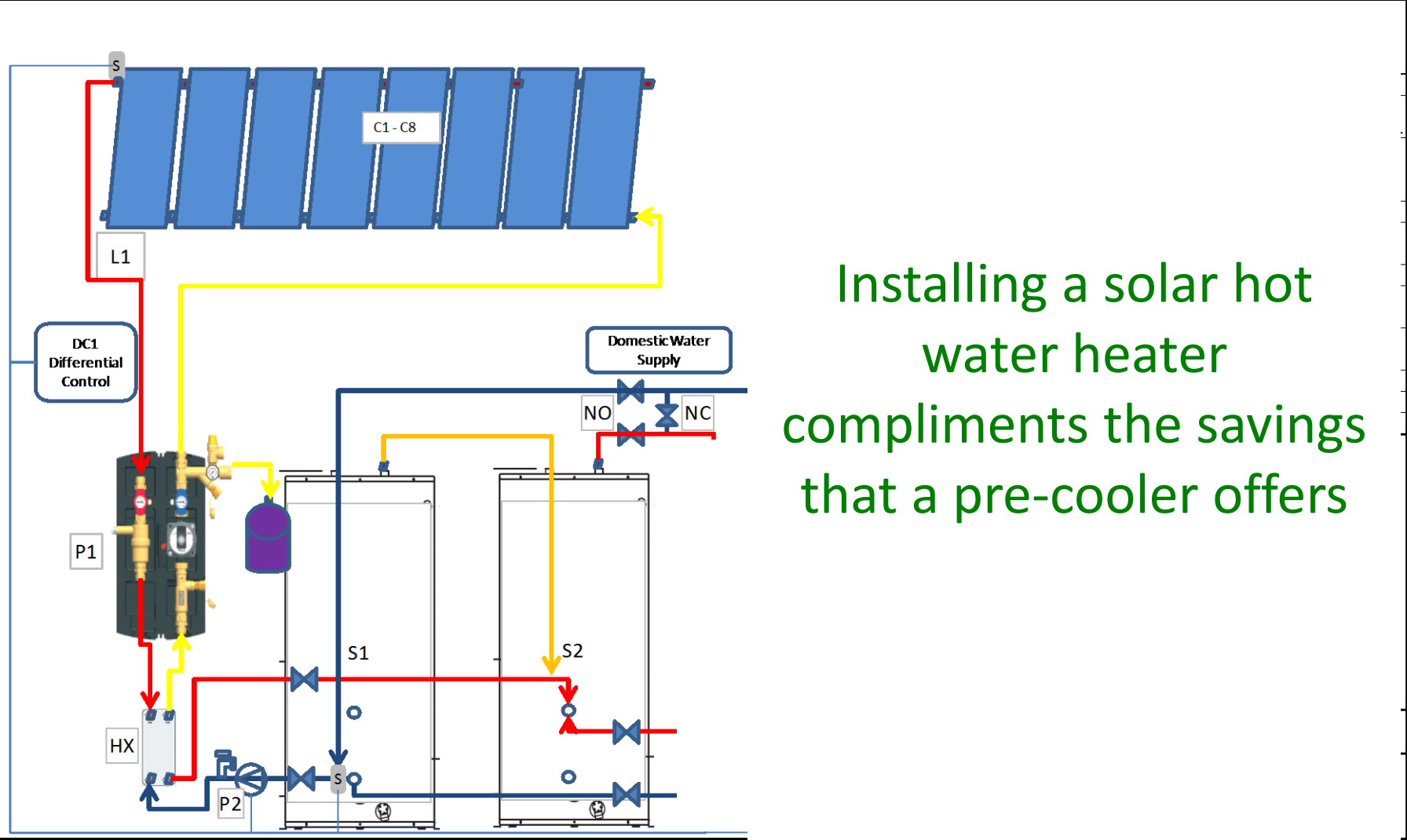
At \$0.15 kWhr (assumes an average of peak and mid peak rates)

Electricity for a 75 head dairy barn will cost about \$12,000 a year

Maybe a 3 year payback?



# Solar water heating in a dairy barn



Installing a solar hot water heater compliments the savings that a pre-cooler offers



## Solar with a Pre-Cooler has 6.5 year payback

**Name:** Your Dairy Barn  
**Panels:** 8 Solcan 2101

**Date:** 9/14/2011  
**Tanks:** 2 120 gallon

Yr.	Annual Electricity Saving	Tax Saving	Loan Payment	Annual Cash Flow	Cumulative Cash Flow	Maintenance Costs	Interest Cost	Principal	Remaining Loan	Remaining CC	Remaining CCA
1	\$1,767.00	\$798.80	-\$2,754.39	-\$188.59	-\$188.59	\$0.00	\$699.02	\$2,055.37	\$11,925.07	\$13,878.90	\$4,626.30
2	\$1,855.35	\$1,130.36	-\$2,754.39	\$231.31	\$42.72	\$0.00	\$596.25	\$2,158.14	\$9,766.94	\$6,939.45	\$6,939.45
3	\$1,948.12	\$593.71	-\$2,754.39	-\$212.56	-\$169.84	\$0.00	\$488.35	\$2,266.04	\$7,500.89	\$3,469.73	\$3,469.73
4	\$2,045.52	\$316.49	-\$2,754.39	-\$392.38	-\$562.23	\$0.00	\$375.04	\$2,379.35	\$5,121.54	\$1,734.86	\$1,734.86
5	\$2,147.80	\$168.53	-\$2,754.39	-\$438.07	-\$1,000.29	\$0.00	\$256.08	\$2,498.31	\$2,623.23	\$867.43	\$867.43
6	\$2,255.19	\$84.73	-\$2,754.39	-\$714.47	-\$1,714.76	-\$300.00	\$131.16	\$2,623.23	\$0.00	\$433.72	\$433.72
7	\$2,367.95	\$32.53	\$0.00	\$2,400.48	\$685.72	\$0.00	\$0.00	\$0.00	\$0.00	\$216.86	\$216.86
8	\$2,486.35	\$16.26	\$0.00	\$2,502.61	\$3,188.33	\$0.00	\$0.00	\$0.00	\$0.00	\$108.43	\$108.43
9	\$2,610.66	\$8.13	\$0.00	\$2,618.80	\$5,807.12	\$0.00	\$0.00	\$0.00	\$0.00	\$54.21	\$54.21
10	\$2,741.20	\$4.07	\$0.00	\$2,445.26	\$8,252.39	-\$300.00	\$0.00	\$0.00	\$0.00	\$27.11	\$27.11

### System Cost

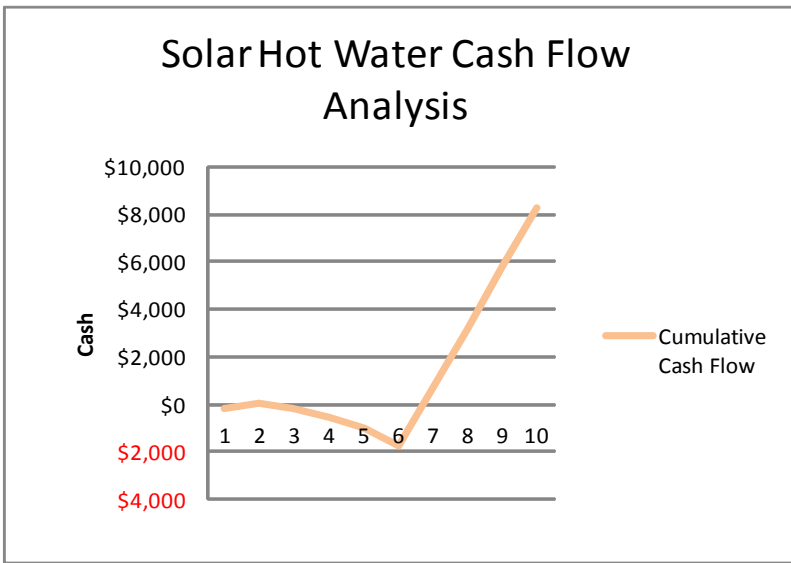
Cost w/o HST, Before Rebates: \$18,505.20  
 Total Rebates: \$6,930.43  
**Cost After Rebates w GST: \$13,980.44**

### Annual Electricity Savings

Water Heating Cost W/O Solar: \$4,302.00  
 Water Heating Cost With Solar: \$2,535.00  
**Annual Savings: \$1,767.00**

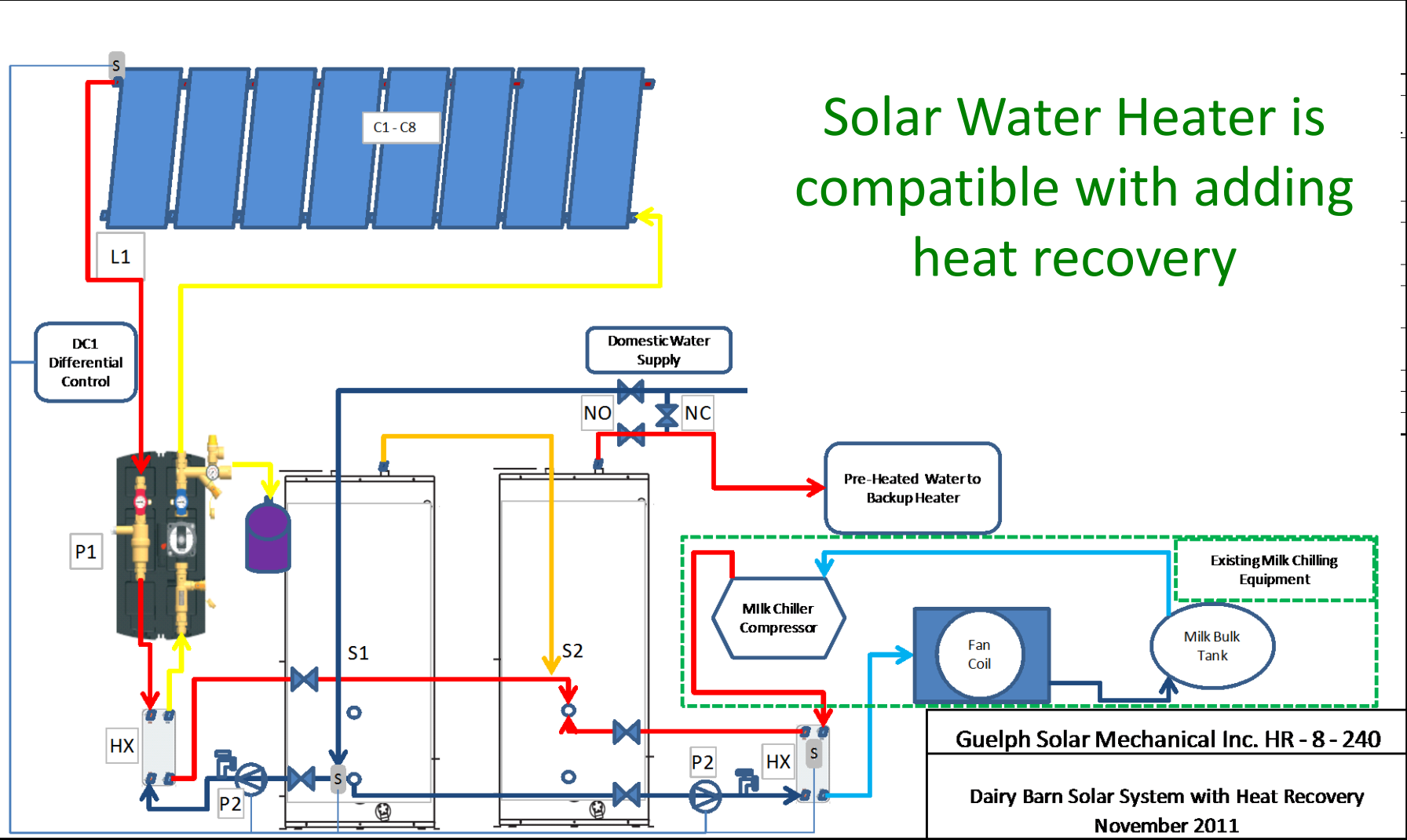
### Table based on the following assumptions:

Energy Inflation Rate 5.00%  
 Inflation Rate 2.00%  
 Interest Rate 5.00%  
 Debt Term (years) 6  
 Effective Tax Rate 15.00%  
 Capital Cost Allowance Rate 50%



# Solar water heating in a dairy barn

Solar Water Heater is compatible with adding heat recovery





## Solar with Heat Recovery is Cash Flow Positive!

**Name:** Your Dairy Barn  
**Panels:** 8 Solcan 2101

**Date:** 9/14/2011  
**Tanks:** 2 120 gallon

Yr.	Annual Electricity Saving	Tax Saving	Loan Payment	Annual Cash Flow	Cumulative Cash Flow	Maintenance Costs	Interest Cost	Principal	Remaining Loan	Remaining CC	CCA
1	\$2,787.00	\$1,005.69	-\$3,756.23	\$36.46	\$36.46	\$0.00	\$953.27	\$2,802.95	\$16,262.49	\$17,253.90	\$5,751.30
2	\$2,926.35	\$1,416.01	-\$3,756.23	\$586.14	\$622.60	\$0.00	\$813.12	\$2,943.10	\$13,319.39	\$8,626.95	\$8,626.95
3	\$3,072.67	\$746.92	-\$3,756.23	\$63.36	\$685.95	\$0.00	\$665.97	\$3,090.26	\$10,229.13	\$4,313.48	\$4,313.48
4	\$3,226.30	\$400.23	-\$3,756.23	-\$129.70	\$556.26	\$0.00	\$511.46	\$3,244.77	\$6,984.36	\$2,156.74	\$2,156.74
5	\$3,387.62	\$214.14	-\$3,756.23	-\$154.47	\$401.79	\$0.00	\$349.22	\$3,407.01	\$3,577.36	\$1,078.37	\$1,078.37
6	\$3,557.00	\$107.71	-\$3,756.23	-\$391.52	\$10.27	-\$300.00	\$178.87	\$3,577.36	\$0.00	\$539.18	\$539.18
7	\$3,734.85	\$40.44	\$0.00	\$3,775.29	\$3,785.55	\$0.00	\$0.00	\$0.00	\$0.00	\$269.59	\$269.59
8	\$3,921.59	\$20.22	\$0.00	\$3,941.81	\$7,727.36	\$0.00	\$0.00	\$0.00	\$0.00	\$134.80	\$134.80
9	\$4,117.67	\$10.11	\$0.00	\$4,127.78	\$11,855.14	\$0.00	\$0.00	\$0.00	\$0.00	\$67.40	\$67.40
10	\$4,323.55	\$5.05	\$0.00	\$4,028.61	\$15,883.74	-\$300.00	\$0.00	\$0.00	\$0.00	\$33.70	\$33.70

### System Cost

Cost w/o HST, Before Rebates: \$23,005.20  
 Total Rebates: \$6,930.43  
**Cost After Rebates w GST: \$19,065.44**

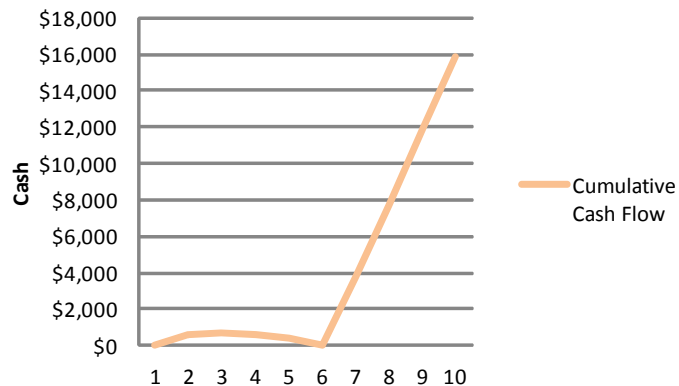
### Annual Electricity Savings

Water Heating Cost W/O Solar: \$4,302.00  
 Water Heating Cost With Solar: \$1,515.00  
**Annual Savings: \$2,787.00**

### Table based on the following assumptions:

Energy Inflation Rate 5.00%  
 Inflation Rate 2.00%  
 Interest Rate 5.00%  
 Debt Term (years) 6  
 Effective Tax Rate 15.00%  
 Capital Cost Allowance Rate 50%

### Solar Hot Water Cash Flow Analysis





## Advantages

- There is a capital grant available to reduce electrical consumption
- Grant approval does not require grid allocation (microFIT PV systems do)
- Solar complements Pre-Cooler and is compatible with Heat Recovery
- Reduces electrical consumption during peak demand
- Provides a solution for dairy barns with less than 100 head
- Can be easily isolated from the milk chilling equipment
  - A leaking water tank does not require the compressor to be worked on
- Eligible for accelerated Capital Cost Allowance (50% for renewable energy)



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Questions?



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# Thank you!

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