Guidelines For Estimating
Solar Thermal Energy Production Costs
Based on 4 (7500 BTU) Tube Type Solar Collectors

This guide is designed to provide you with planning information and a format for calculating costs of production for on-farm solar thermal energy production for water or space heating. Sale of excess heat energy beyond consumption are not included. Adjustments will be necessary when applying these figures to your own enterprise.

The budget estimates are based on a number of assumptions which are clearly defined in the supporting pages. Input costs are based on industry information. Proper equipment management in the production process and compliance to all applicable environmental requirements is assumed.

**Disclaimer**: This budget is only a guide and is not intended as an in depth study of the cost of production of the Manitoba solar thermal energy industry. Interpretation and utilization of this information is the responsibility of the user. If you require assistance with developing your individual budget, please contact your local MAFRI Business Development Specialist.
### On-Farm Wind Energy Production Costs

#### November, 2012

Based on a $121,000 total capital cost & $0.0694 kwhr Manitoba Hydro rate

<table>
<thead>
<tr>
<th>A. Energy Produced - estimated range</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.01 Total Annual Energy Produced</td>
<td>43,471,500 BTU</td>
<td>65,371,500 BTU</td>
</tr>
<tr>
<td></td>
<td>12,737 kWhr</td>
<td>19,154 kWhr</td>
</tr>
<tr>
<td>1.02 Cost / installed kW - net energy output</td>
<td>$8,322</td>
<td>$5,534</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Operating Costs</th>
<th>Cost/kWhr</th>
<th>Cost/kWhr</th>
<th>Cost</th>
<th>Your Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.01 Maintenance</td>
<td>$0.0024</td>
<td>$0.0016</td>
<td>$30</td>
<td></td>
</tr>
<tr>
<td>2.02 Insurance</td>
<td>$0.0048</td>
<td>$0.0032</td>
<td>$61</td>
<td></td>
</tr>
<tr>
<td>2.03 Property Taxes</td>
<td>$0.0000</td>
<td>$0.0000</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal Operating Costs</strong></td>
<td>$0.0071</td>
<td>$0.0048</td>
<td>$91</td>
<td></td>
</tr>
<tr>
<td>2.04 Operating Interest</td>
<td>$0.0002</td>
<td>$0.0002</td>
<td>$3</td>
<td></td>
</tr>
<tr>
<td><strong>Total Operating Costs</strong></td>
<td>$0.0074</td>
<td>$0.0049</td>
<td>$94</td>
<td></td>
</tr>
</tbody>
</table>

| C. Fixed Costs                      |           |           |      |           |
| 3.01 Buildings                      | $0.0013   | $0.0009   | $17  |           |
| 3.02 Machinery & Equipment          | $0.0407   | $0.0270   | $518 |           |

| 4. Investment                       |           |           |      |           |
| 4.01 Buildings                      | $0.0008   | $0.0005   | $10  |           |
| 4.02 Machinery & Equipment          | $0.0124   | $0.0082   | $158 |           |
| 4.03 Land                           | $0.0000   | $0.0000   | $0   |           |
| **Total Fixed Costs**               | $0.0552   | $0.0367   | $703 |           |
| **Total Operating and Fixed Costs** | $0.0626   | $0.0416   | $797 |           |

| D. Labour                           |           |           |      |           |
| **Total Cost of Production**        | $0.0626   | $0.0416   | $797 |           |

<table>
<thead>
<tr>
<th>E. Value</th>
<th>Per kWhr</th>
<th>Total</th>
<th>Per kWhr</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.01 Estimated Annual On-Farm Energy Valu</td>
<td>$0.0738</td>
<td>$941</td>
<td>$0.0738</td>
<td>$1,414</td>
</tr>
</tbody>
</table>

| Total Value - Cost of Production    | $0.0113   | $144    | $0.0322   | $617    |

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Based on: 127,37 kWhr per year 191,54 kWhr per year

<table>
<thead>
<tr>
<th>Breakeven price</th>
<th>$/kWhr</th>
<th>$/kWhr</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Operating Costs</td>
<td>$0.0074</td>
<td>$0.0049</td>
</tr>
<tr>
<td>B. Operating &amp; labour Costs</td>
<td>$0.0074</td>
<td>$0.0049</td>
</tr>
<tr>
<td>C. Operating &amp; Fixed Costs</td>
<td>$0.0626</td>
<td>$0.0416</td>
</tr>
<tr>
<td>D. Operating, Fixed &amp; Labour Costs</td>
<td>$0.0626</td>
<td>$0.0416</td>
</tr>
</tbody>
</table>

Breakeven Price $/kWhr = Cost ÷ kWhrs

**Estimated Return on Assets (ROA)**

without MB Hydro rate inflation: 7.8% **1** 11.7%
with 2.9% annual MB Hydro rate inflation: 10.8% **2** 16.2%

**Simple Payback Calculation**

A. Without MB Hydro rate inflation: 12.9 Years**1** 8.6 Years
B. With 2.9% annual MB Hydro rate inflation: 9.3 Years**2** 6.2 Years

**Desired Simple Payback = 5 Years**

C. Max.Capital Cost w/o Hydro rate inflation: $4,703 **1** $7,072
D. Max. Capital Cost w/ 2.9% Hydro inflation: $6,516 **2** $9,799

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1. Based on Hydro rate @ $0.0694 per kWh plus PST & GST.
2. Based on 20 year average Hydro rate @ $0.096 per kWh plus PST & GST.

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Guidelines: On-Farm Wind Energy Production Costs

Solar Thermal Energy Production Costs - Input

Assumptions

1. This budget outlines the cost of production for a on-farm solar thermal hot water production operation.
2. Buildings and equipment are valued at new cost.
3. Solar Insolation is based on Natural Resources Canada solar resource maps.
4. Annual BTU production could vary from significantly from minimum or maximum estimates.
5. All heat energy produced is for farm use only.

Solar Thermal Energy Production

- Solar collector output per hour - BTU: 7,500
- Number of solar collectors installed in heat system: 4
- Max. Solar Insolation (hrs/day or kWh/m²/day): 5.97
- Min. Solar Insolation (hrs/day or kWh/m²/day): 3.97
- Capital incentive or grant: $0
- MB Hydro residential rate: $0.069 / kWh
- Manitoba Sales Tax on Hydro: 1.4%
- Federal GST Tax: 5.0%
- Estimated Hydro rate annual inflation: 2.9%

Other Operating Costs

- Maintenance: 0.25%
- Labour Rate: $17.50 / hour
- Hours inspection per week: 0.00
- Insurance: 0.5%
- Property taxes: 0.0%
- Investment Rate: 2.50%
- Operating Interest Rate: 5.50%

Expected Solar Thermal Equipment Lifespan: 20 years
Desired Simple Payback: 5.0 years

Capital Costs

<table>
<thead>
<tr>
<th>Buildings</th>
<th>Original Value</th>
<th>Salvage Value</th>
<th>Useful Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector Mounts / Racks</td>
<td>$400</td>
<td>30 %</td>
<td>25 years</td>
</tr>
<tr>
<td>Collector Mounts installation</td>
<td>$200</td>
<td>30 %</td>
<td>25 years</td>
</tr>
<tr>
<td>Total</td>
<td>$600</td>
<td>30.0 %</td>
<td>25.0 years</td>
</tr>
</tbody>
</table>

Machinery & Equipment

- Solar Collector and Controllers: $10,700
- Heat System (installation): $800
- Capital grant or incentive: $0
- Total: $11,500

Total Bldg., Mach. & Equip: $12,100

Total Land Value: $0

Total Capital Investment: $12,100
## Assumptions

1. This budget outlines the cost of production for a on-farm solar thermal hot water production operation.
2. Buildings and equipment are valued at new cost.
3. Solar Insolation is based on Natural Resources Canada solar resource maps.
4. Annual BTU production could vary from significantly from minimum or maximum estimates.
5. All heat energy produced is for farm use only.

### Solar Thermal Energy Production Worksheet

#### A. Energy Produced

<table>
<thead>
<tr>
<th></th>
<th>Minimum Annual Production</th>
<th>Maximum Annual Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector output (BTU/hr)</td>
<td>7,500</td>
<td>7,500</td>
</tr>
<tr>
<td>Collectors (installed/system)</td>
<td>x 4</td>
<td>x 4</td>
</tr>
<tr>
<td>Solar Insolation (hrs/day)</td>
<td>x 3.97</td>
<td>x 5.97</td>
</tr>
<tr>
<td>Days per year</td>
<td>x 365</td>
<td>x 365</td>
</tr>
<tr>
<td>Total</td>
<td>= 43,471,500 BTU per Year</td>
<td>= 65,371,500 BTU per Year</td>
</tr>
<tr>
<td>Total kWh per Year</td>
<td>= 12,737</td>
<td>= 19,154</td>
</tr>
</tbody>
</table>

#### 1.02 Cost per installed kW - net energy output (minimum estimated annual production)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total kWh per Year</td>
<td></td>
</tr>
<tr>
<td>Maintenance rate</td>
<td>0.25%</td>
</tr>
<tr>
<td>Total</td>
<td>= $8,321.87 Cost per installed kW</td>
</tr>
</tbody>
</table>

#### 1.02 Cost per installed kW - net energy output (maximum estimated annual production)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total kWh per Year</td>
<td></td>
</tr>
<tr>
<td>Maintenance rate</td>
<td>0.25%</td>
</tr>
<tr>
<td>Total</td>
<td>= $5,533.98 Cost per installed kW</td>
</tr>
</tbody>
</table>

#### B. Operating Costs

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>= $600 capital cost - buildings</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>= $11,500 capital cost - equipment</td>
</tr>
<tr>
<td></td>
<td>= $12,100 Total bldg. &amp; equipment</td>
</tr>
<tr>
<td></td>
<td>= 0.25% Maintenance rate</td>
</tr>
<tr>
<td></td>
<td>= $30 Total Maintenance</td>
</tr>
</tbody>
</table>
2.02 Insurance

\[
\begin{align*}
\text{Capital cost - buildings} &: \$600 \\
\text{Capital cost - equipment} &: \$11,500 \\
\text{Total bldg. & equipment} &: \$12,100 \\
\text{Insurance rate} &: 0.5\% \\
\text{Total Insurance} &: \$61
\end{align*}
\]

2.03 Property Taxes

\[
\begin{align*}
\text{Capital cost - buildings} &: \$600 \\
\text{Capital cost - land} &: \$0 \\
\text{Total bldg. & land} &: \$600 \\
\text{Property tax rate} &: 0.0\% \\
\text{Total Property tax} &: \$0
\end{align*}
\]

2.04 Operating Interest

(Operating interest is charged on one half of the subtotal operating costs)

\[
\begin{align*}
\text{Subtotal operating costs} &: \$91 \\
\text{Average} &: 2.00 \\
\text{% operating interest rate} &: 5.50 \\
\text{Operating Interest} &: \$3
\end{align*}
\]

### Capital Costs

**Buildings**
- Collector Mounts / Racks: $400
- Collector Mounts installation: $200
- **Total Building Cost**: $600

**Machinery & Equipment**
- Solar Collector and Controllers: $10,700
- Heat System (installation): $800
- Capital grant or incentive: $0
- **Total Machinery & Equipment Cost**: $11,500

**Total Bldg., Mach. & Equip.**: $12,100

**Total Land Value**: $0

**Total Capital Investment**: $12,100

C. Fixed Costs

3. Depreciation

**Original Cost - Salvage Value**

\[
\begin{align*}
\text{Useful Life} &: \\
\text{Buildings} &: \\
\text{Original cost} &: \$600 \\
\text{Salvage value} &: \$180 \\
\text{Years useful life} &: 25.00 \\
\text{Depreciation} &: \$17
\end{align*}
\]

**Machinery & Equipment**

\[
\begin{align*}
\text{Original cost} &: \$11,500 \\
\text{Salvage value} &: \$1,150 \\
\text{Years useful life} &: 20.00 \\
\text{Depreciation} &: \$518
\end{align*}
\]

4. Investment **Original Cost + Salvage Value** x Investment Rate
4.01 Buildings

$600 original cost
+$180 salvage value
+$0.00 average
= $10

4.02 Machinery & Equipment

$11,500 original cost
+$1,150 salvage value
+$2.00 average
= $158

4.03 Land

$0 land
= $0

D. Labour

$0 Labour

5. Value

5.01 Minimum Estimated Annual On-Farm Energy value

$0.0694 MB Hydro rate per kWhr
+ 1.4% Manitoba Sales Tax - Hydro
+ 5.0% Federal GST
= 12,737.0 kWhr energy produced/year
Total = $940.52 Energy Value

Maximum Estimated Annual On-Farm Energy value

$0.0694 MB Hydro rate per kWhr
+ 1.4% Manitoba Sales Tax - Hydro
+ 5.0% Federal GST
= 19,153.7 kWhr energy produced/year
Total = $1,414.34 Energy Value

Summary Calculations

Future Estimated Average MB Hydro rate

$0.0962 MB Hydro rate per kWhr
(Based on 20 year average rates and 2.9% annual rate increase)

Future Estimated MB Hydro rate

$0.1229 MB Hydro rate per kWhr
(Rate in 20 years with 2.9% annual rate increase)

Future Minimum Estimated Average Annual On-Farm Energy value

$0.0962 MB Hydro rate per kWhr
+ 1.4% Manitoba Sales Tax - Hydro
+ 5.0% Federal GST
= 12,737.0 kWhr energy produced/year
Total = $1,303.27 Energy Value
Future Maximum Estimated Average Annual On-Farm Energy Value

<table>
<thead>
<tr>
<th>$0.0962 MB Hydro rate per kWHr</th>
<th>x</th>
<th>1.4% Manitoba Sales Tax - Hydro</th>
<th>x</th>
<th>5.0% Federal GST</th>
<th>x</th>
<th>19,153.7 kWHr energy produced/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>=</td>
<td>$1,959.82 Energy Value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Estimated Return on Asset (ROA) - without MB Hydro rate inflation

\[
\frac{\$940.52 \text{ Energy Value - minimum range}}{\$12,100 \text{ Total Capital Investment}} = 7.8\% \text{ ROA}
\]

Estimated Return on Asset (ROA) - without MB Hydro rate inflation

\[
\frac{\$1,414.34 \text{ Energy Value - maximum range}}{\$12,100 \text{ Total Capital Investment}} = 11.7\% \text{ ROA}
\]

Estimated Return on Asset (ROA) - with 2.9% annual MB Hydro rate inflation

\[
\frac{\$1,303.27 \text{ Energy Value - minimum range}}{\$12,100 \text{ Total Capital Investment}} = 10.8\% \text{ ROA}
\]

Estimated Return on Asset (ROA) - with 2.9% annual MB Hydro rate inflation

\[
\frac{\$1,959.82 \text{ Energy Value - maximum range}}{\$12,100 \text{ Total Capital Investment}} = 16.2\% \text{ ROA}
\]

Simple Payback Calculation - without MB Hydro rate inflation

\[
\frac{\$12,100 \text{ Total Capital Investment}}{\$941 \text{ Energy Value - minimum range}} = 12.9 \text{ Years Payback}
\]

Simple Payback Calculation - without MB Hydro rate inflation

\[
\frac{\$12,100 \text{ Total Capital Investment}}{\$1,414 \text{ Energy Value - maximum range}} = 8.6 \text{ Years Payback}
\]

Simple Payback Calculation- with 2.9% annual MB Hydro rate inflation

\[
\frac{\$12,100 \text{ Total Capital Investment}}{\$1,303 \text{ Energy Value - minimum range}} = 9.3 \text{ Years Payback}
\]

Simple Payback Calculation- with 2.9% annual MB Hydro rate inflation

\[
\frac{\$12,100 \text{ Total Capital Investment}}{\$1,960 \text{ Energy Value - maximum range}} = 6.2 \text{ Years Payback}
\]

For further information contact your local MAFRI office.

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Killarney GO Centre 204-523-6424
For more information

- Contact your local Manitoba Agriculture, Food and Rural Initiatives (MAFRI) Growing Opportunities (GO) Office.
- Visit us at manitoba.ca/agriculture.