Guidelines for Estimating On-Farm Wind Energy Production Costs 2012 in Manitoba
This guide is designed to provide you with planning information and a format for calculating costs of production for on-farm wind power production. Sale of electricity excess power 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 wind power 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 3.5 kW Wind Turbine Production Costs

November, 2012

Based on a $30000 total capital cost & $0.0694 kWhr Manitoba Hydro rate

### A. Energy Produced - estimated range

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Annual Electricity Produced</td>
<td>4,273 kWhr</td>
</tr>
<tr>
<td>Capacity Factor</td>
<td>13.94%</td>
</tr>
<tr>
<td>Cost / installed kW - net power output</td>
<td>$61,506</td>
</tr>
</tbody>
</table>

### B. Operating Costs

<table>
<thead>
<tr>
<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>$0.0176</td>
<td>$0.0070</td>
<td>$75</td>
</tr>
<tr>
<td>2.02 Misc. Administration</td>
<td>$0.0000</td>
<td>$0.0000</td>
<td>$0</td>
</tr>
<tr>
<td>2.03 Insurance</td>
<td>$0.0351</td>
<td>$0.0140</td>
<td>$150</td>
</tr>
<tr>
<td>2.04 Property Taxes</td>
<td>$0.0000</td>
<td>$0.0000</td>
<td>$0</td>
</tr>
<tr>
<td><strong>Subtotal Operating Costs</strong></td>
<td><strong>$0.0527</strong></td>
<td><strong>$0.0211</strong></td>
<td><strong>$225</strong></td>
</tr>
<tr>
<td>2.05 Operating Interest</td>
<td>$0.0014</td>
<td>$0.0006</td>
<td>$6</td>
</tr>
<tr>
<td><strong>Total Operating Costs</strong></td>
<td><strong>$0.0541</strong></td>
<td><strong>$0.0216</strong></td>
<td><strong>$231</strong></td>
</tr>
</tbody>
</table>

### C. Fixed Costs

<table>
<thead>
<tr>
<th>Cost</th>
<th>Cost</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.01 Buildings</td>
<td>$0.0463</td>
<td>$0.0185</td>
</tr>
<tr>
<td>3.02 Machinery &amp; Equipment</td>
<td>$0.2266</td>
<td>$0.0906</td>
</tr>
<tr>
<td>4.01 Buildings</td>
<td>$0.0323</td>
<td>$0.0129</td>
</tr>
<tr>
<td>4.02 Machinery &amp; Equipment</td>
<td>$0.0693</td>
<td>$0.0277</td>
</tr>
<tr>
<td>4.03 Land</td>
<td>$0.0000</td>
<td>$0.0000</td>
</tr>
<tr>
<td><strong>Total Fixed Costs</strong></td>
<td><strong>$0.3745</strong></td>
<td><strong>$0.1498</strong></td>
</tr>
<tr>
<td><strong>Total Operating and Fixed Costs</strong></td>
<td><strong>$0.4285</strong></td>
<td><strong>$0.1714</strong></td>
</tr>
</tbody>
</table>

### D. Labour

<table>
<thead>
<tr>
<th>Cost</th>
<th>Cost</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.01 Estimated Annual On-Farm Energy Value</td>
<td>$0.0738</td>
<td>$0.0738</td>
</tr>
<tr>
<td><strong>Total Value - Cost of Production</strong></td>
<td>($0.3547)</td>
<td>($0.0976)</td>
</tr>
</tbody>
</table>

### E. Value

Based on: 4273 kWhr per year 10682 kWhr per year

<table>
<thead>
<tr>
<th>Based on:</th>
<th>4273 kWhr per year</th>
<th>10682 kWhr per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Return on Assets (ROA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>without MB Hydro rate inflation</td>
<td>1.1% ²</td>
<td>2.6%</td>
</tr>
<tr>
<td>with 2.9% annual MB Hydro rate inflation</td>
<td>1.5% ⁵</td>
<td>3.6%</td>
</tr>
<tr>
<td>Simple Payback Calculation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Without MB Hydro rate inflation</td>
<td>95.1 Years¹</td>
<td>38.0 Years</td>
</tr>
<tr>
<td>B. With 2.9% annual MB Hydro rate inflation</td>
<td>68.6 Years²</td>
<td>27.4 Years</td>
</tr>
<tr>
<td>Desired Simple Payback = 10 Years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Max. Capital Cost w/o Hydro rate inflation</td>
<td>$3,155 ²</td>
<td>$7,888</td>
</tr>
<tr>
<td>D. Max. Capital Cost w/ 2.9% Hydro inflation</td>
<td>$4,372 ²</td>
<td>$10,930</td>
</tr>
</tbody>
</table>

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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.

Disclaimer: This budget is only a guide and is not intended as an in-depth study of the cost of production of this industry. Interpretation and utilization of this information is the responsibility of the user. No liability for decisions based on this publication is assumed.
Wind Energy Production Costs - Input

Assumptions

1. This budget outlines the cost of production for on-farm wind electricity generation operation.
2. Buildings and equipment are valued at new cost.
3. Capacity factor is based on Canadian Wind Atlas 90 foot turbine formula.
4. Minimum production based on actual vs. predicted kWHr production case studies.
5. Annual kWHr production could vary from significantly from minimum or maximum estimates due to decreased turbine height, local site factors, or relative turbine efficiency.
6. All electricity produced is for farm use only.

Wind Power Production

Wind turbine size - kilowatts (kW) 
3.5
34.84 %
Min. 'Realized' Capacity Factor (% of maximum) 
40 %
Days per year 
365
Hours operation per day 
24
Capital incentive or grant 
$0
MB Hydro residential rate 
$0.0694 / kWhr
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 
24
Misc. Administration or fees 
$0 / year
Insurance 
0.5 %
Property taxes 
0.0 %

Investment Rate 
2.50 %
Operating Interest Rate 
5.50 %

Expected Turbine Lifespan 
20 years
Desired Simple Payback 
10 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>Tower</td>
<td>$6,000</td>
<td>30 %</td>
<td>30 years</td>
</tr>
<tr>
<td>Tower installation</td>
<td>$2,500</td>
<td>30 %</td>
<td>30 years</td>
</tr>
<tr>
<td>Total</td>
<td>$8,500</td>
<td>30.0 %</td>
<td>30.0 years</td>
</tr>
</tbody>
</table>

Machinery & Equipment

<table>
<thead>
<tr>
<th></th>
<th>Original Value</th>
<th>Salvage Value</th>
<th>Useful Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind turbine</td>
<td>$20,000</td>
<td>10 %</td>
<td>20 years</td>
</tr>
<tr>
<td>Bidirectional Hydro meter</td>
<td>$200</td>
<td>10 %</td>
<td>20 years</td>
</tr>
<tr>
<td>Grid tie electrical panel (installatior</td>
<td>$1,300</td>
<td>10 %</td>
<td>20 years</td>
</tr>
<tr>
<td>Capital grant or incentive</td>
<td>$0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$21,500</td>
<td>10.0 %</td>
<td>20.0 years</td>
</tr>
</tbody>
</table>

Total Bldg., Mach. & Equip $30,000

Total Land Value $0

Total Capital Investment $30,000
Assumptions

1. This budget outlines the cost of production for on-farm wind electricity generation operation.
2. Buildings and equipment are valued at new cost.
3. Capacity factor is based on Canadian Wind Atlas 90 foot turbine formula.
4. Minimum production based on actual vs. predicted kWHr production case studies.
5. Annual kWHr production could vary from significantly from minimum or maximum estimates due to decreased turbine height, local site factors, or relative turbine efficiency.
6. All electricity produced is for farm use only.

Wind Energy Production Worksheet

A. Energy Produced

1.01 Minimum Annual Production

\[
\begin{align*}
\times & \quad 34.84\% \quad \text{Max. Capacity factor - Cdn Wind Atlas 90 ft formula} \\
\times & \quad 40.00\% \quad \text{Min. 'Realized' Capacity Factor (% of Max.)} \\
\quad & \quad 13.94\% \quad \text{Capacity factor - annual} \\
\times & \quad 3.5 \quad \text{Wind turbine size - kilowatts (kW)} \\
\times & \quad 365 \quad \text{Days per year} \\
\times & \quad 24 \quad \text{Hours operation per day} \\
\text{Total} & \quad = \quad 4,272.8 \quad \text{kWHr electricity produced}
\end{align*}
\]

Maximum Annual Production

\[
\begin{align*}
\times & \quad 3.5 \quad \text{Wind turbine size - kilowatts (kW)} \\
\times & \quad 34.84\% \quad \text{Capacity factor - annual} \\
\times & \quad 365 \quad \text{Days per year} \\
\times & \quad 24 \quad \text{Hours operation per day} \\
\text{Total} & \quad = \quad 10,681.9 \quad \text{kWHr electricity produced}
\end{align*}
\]

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

\[
\begin{align*}
\times & \quad 13.9\% \quad \text{Capacity factor - annual} \\
\times & \quad 3.5 \quad \text{Wind turbine size - kilowatts (kW)} \\
\quad & \quad 0.4878 \quad \text{Net power output (kW)} \\
\frac{\text{Total turbine installed cost}}{=} & \quad 30,000 \quad \text{Total turbine installed cost} \\
\times & \quad 0.4878 \quad \text{Net power output (kW)} \\
\text{Total} & \quad = \quad 61,506 \quad \text{Cost per installed kW - net power output}
\end{align*}
\]

Cost per installed kW - net power output (maximum estimated annual production)

\[
\begin{align*}
\times & \quad 34.8\% \quad \text{Capacity factor - annual} \\
\times & \quad 3.5 \quad \text{Wind turbine size - kilowatts (kW)} \\
\quad & \quad 1.2194 \quad \text{Net power output (kW)} \\
\frac{\text{Total turbine installed cost}}{=} & \quad 30,000 \quad \text{Total turbine installed cost} \\
\times & \quad 1.2194 \quad \text{Net power output (kW)} \\
\text{Total} & \quad = \quad 24,602 \quad \text{Cost per installed kW - net power output}
\end{align*}
\]

B. Operating Costs

2.01 Maintenance

\[
\begin{align*}
\times & \quad 8,500 \quad \text{capital cost - buildings} \\
\times & \quad 21,500 \quad \text{capital cost - equipment} \\
\times & \quad 30,000 \quad \text{Total bldg. & equipment} \\
\times & \quad 0.3\% \quad \text{Maintenance rate} \\
\times & \quad 75 \quad \text{Total Maintenance}
\end{align*}
\]

2.02 Misc. Administration or fees

\[
\begin{align*}
& \quad 0 \quad \text{misc. administration}
\end{align*}
\]

MAFRI, GO Team Branch
2.03 Insurance

\[
\begin{align*}
\text{Total Insurance} &= \text{Total bldg. & equipmen} \times \text{Insurance rate} \\
&= (\text{capital cost - buildings} + \text{capital cost - equipment}) \times 0.5\% \\
&= ($8,500 + $21,500) \times 0.5\% \\
&= $30,000 \times 0.5\% \\
&= $150
\end{align*}
\]

2.04 Property Taxes

\[
\begin{align*}
\text{Total Property tax} &= \text{Total bldg. & land} \times \text{Property tax rate} \\
&= (\text{capital cost - buildings} + \text{capital cost - land}) \times 0.0\% \\
&= ($8,500 + $0) \times 0.0\% \\
&= $8,500 \times 0.0\% \\
&= $0
\end{align*}
\]

2.05 Operating Interest

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

\[
\begin{align*}
\text{Operating Interest} &= \frac{\text{subtotal operating costs}}{2} \times \text{operating interest rate} \\
&= \frac{$225}{2} \times 5.5\% \\
&= $6
\end{align*}
\]

### Capital Costs

**Buildings**

- Tower: $6,000
- Tower installation: $2,500
- **Total Building Cost**: $8,500

**Machinery & Equipment**

- Wind turbine: $20,000
- Bidirectional Hydro meter: $200
- Grid tie electrical panel (installation): $1,300
- Capital grant or incentive: $0
- **Total Machinery & Equipment Cost**: $21,500

**Total Bldg., Mach. & Equip.**: $30,000

**Total Land Value**: $0

**Total Capital Investment**: $30,000

### C. Fixed Costs

**3. Depreciation**

**Useful Life**

**3.01 Buildings**

\[
\begin{align*}
\text{Useful Life} &= \frac{\text{Original cost} - \text{Salvage Value}}{\text{Salvage value}} \\
&= \frac{$8,500 - $2,550}{30.00} \\
&= 30.00 \text{ years}
\end{align*}
\]

**3.02 Machinery & Equipment**

\[
\begin{align*}
\text{Useful Life} &= \frac{\text{Original cost} - \text{Salvage Value}}{\text{Salvage value}} \\
&= \frac{$21,500 - $2,150}{20.00} \\
&= 20.00 \text{ years}
\end{align*}
\]
4. Investment

| Original Cost + Salvage Value x Investment Rate |  
| --- | --- |
| **4.01 Buildings** |  
| $8,500 original cost + $2,550 salvage value ÷ 2.00 average x 2.50% investment rate = $138 |  
| **4.02 Machinery & Equipment** |  
| $21,500 original cost + $2,150 salvage value ÷ 2.00 average x 2.50% investment rate = $296 |  
| **4.03 Land** |  
| $0 land x 2.50% investment rate = $0 |  
| **D. Labour** |  
| x 0 Hours inspection per week x $17.50 Labour Rate per hour = $0 |  
| **Total** |  
| = $0 Labour |  

5. Value

| Minimum Estimated Annual On-Farm Energy value |  
| --- | --- |
| $0.0694 MB Hydro rate per kWHr x 1.4% Manitoba Sales Tax - Hydro x 5.0% Federal GST x 4,272.8 kWHr electricity produced = $315.51 Electricity Value |  
| Maximum Estimated Annual On-Farm Energy value |  
| $0.0694 MB Hydro rate per kWHr x 1.4% Manitoba Sales Tax - Hydro x 5.0% Federal GST x 10,681.9 kWHr electricity produced = $788.77 Electricity Value |  

Summary Calculations

Future Estimated Average MB Hydro rate

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

Future Estimated MB Hydro rate

$0.1229 MB Hydro rate per kWh (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 kWh x 1.4% Manitoba Sales Tax - Hydro x 5.0% Federal GST x 4,272.8 kWHr electricity produced
Total = $437.19 Electricity Value

Future Maximum Estimated Average Annual On-Farm Energy Value
$0.0962 MB Hydro rate per kWhr
x 1.4% Manitoba Sales Tax - Hydro
x 5.0% Federal GST
x 10,681.9 kWhr electricity produced
Total = $1,092.99 Electricity Value

Estimated Return on Asset (ROA) - without MB Hydro rate inflation
$315.51 Electricity Value - minimum range
÷ $30,000 Total Capital Investment
= 1.1% ROA

Estimated Return on Asset (ROA) - without MB Hydro rate inflation
$788.77 Electricity Value - maximum range
÷ $30,000 Total Capital Investment
= 2.6% ROA

Estimated Return on Asset (ROA) - with 2.9% annual MB Hydro rate inflation
$437.19 Electricity Value - minimum range
÷ $30,000 Total Capital Investment
= 1.5% ROA

Estimated Return on Asset (ROA) - with 2.9% annual MB Hydro rate inflation
$1,092.99 Electricity Value - maximum range
÷ $30,000 Total Capital Investment
= 3.6% ROA

Simple Payback Calculation - without MB Hydro rate inflation
$30,000 Total Capital Investment
÷ $316 Electricity Value - minimum range
= 95.1 Years Payback

Simple Payback Calculation - without MB Hydro rate inflation
$30,000 Total Capital Investment
÷ $789 Electricity Value - maximum range
= 38.0 Years Payback

Simple Payback Calculation - with 2.9% annual MB Hydro rate inflation
$30,000 Total Capital Investment
÷ $437 Electricity Value - minimum range
= 68.6 Years Payback

Simple Payback Calculation - with 2.9% annual MB Hydro rate inflation
$30,000 Total Capital Investment
÷ $1,093 Electricity Value - maximum range
= 27.4 Years Payback

For further information contact your local MAFRI office.

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For more information

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