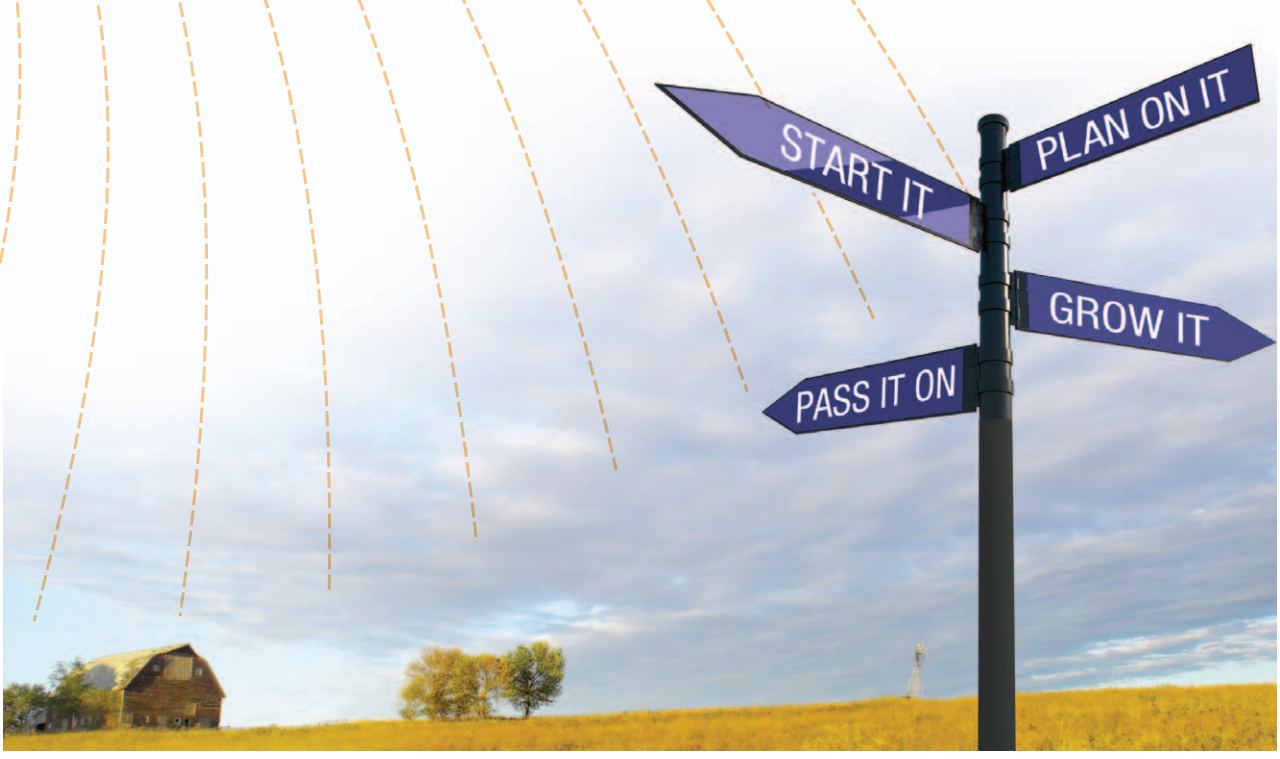
Guidelines for Estimating

Solar PV Energy Production Costs 2016

in Manitoba



Manitoba

Guidelines For Estimating

Solar Photovoltaic Energy Production Costs

Based on 15 (310 watt) Solar Panel Collectors

Date: October, 2016

This guide is designed to provide you with planning information and a format for calculating costs of production for on-farm solar photovoltaic electrical energy production. Sale of excess 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.

This tool is available as an Excel worksheet at: www.manitoba.ca/agriculture or at your local Manitoba Agriculture GO Office.

Note: 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 use of this information is the responsibility of the user. If you need help with a budget, contact your local Manitoba Agriculture GO Office.

On-Farm 15 x 310 watt Solar Photovoltaic Energy Production Costs October, 2016

Based on a $5600 total capital cost & $0.0793 kwHr Manitoba Hydro rate

A. Energy Produced - estimated range	**Minimum**		**Maximum**	
1.01 Total Annual Energy Produced	**6,789**	**kWHr**	**8,486**	**kWHr**
1.02 Cost / installed kW - net energy output	**$7,226**		**$5,781**	

B. Operating Costs	**Cost/kWHr**	**Cost/kWHr**	**Total Cost**	**Your Cost**
2.01 Maintenance	$0.0021	$0.0016	$14	
2.02 Insurance	$0.0041	$0.0033	$28	
2.03 Property Taxes	$0.0000	$0.0000	$0	
Subtotal Operating Costs	**$0.0062**	**$0.0049**	**$42**	
2.04 Operating Interest	$0.0001	$0.0001	$1	
Total Operating Costs	**$0.0063**	**$0.0051**	**$43**	
C. Fixed Costs				
3. Depreciation				
3.01 Buildings	$0.0053	$0.0042	$36	
3.02 Machinery & Equipment	$0.0327	$0.0262	$222	
4. Investment				
4.01 Buildings	$0.0016	$0.0013	$11	
4.02 Machinery & Equipment	$0.0084	$0.0067	$57	
4.03 Land	$0.0000	$0.0000	$0	
Total Fixed Costs	**$0.0480**	**$0.0384**	**$326**	
Total Operating and Fixed Costs	**$0.0544**	**$0.0435**	**$369**	
D. Labour	$0.0000	$0.0000	$0	
Total Cost of Production $ per kWHr	**$0.0544**	**$0.0435**	**$369**	
or				
Total Cost of Production $ per million BTU	**$15.9252**	**$12.7401**	**$369**	

E. Value **Based on:**	**6,789 kWHr per year**		**8,486 kWHr per year**		
Total Value	**Per kWHr**	**Total**	**Per kWHr**	**Total**	
5.01 Estimated Annual On-Farm Energy Valu	**$0.0896**	**$608**	**$0.0896**	**$760**	
Total Value - Cost of Production	**$0.0353**	**$239**	**$0.0461**	**$391**	

Based on:	**6,789 kWHr per year**	**8,486 kWHr per year**	
Breakeven price	**$kWHr**	**$kWHr**	
A. Operating Costs	$0.0063	$0.0051	
B. Operating & labour Costs	$0.0063	$0.0051	
C. Operating & Fixed Costs	$0.0544	$0.0435	
D. Operating, Fixed & Labour Costs	$0.0544	$0.0435	

Breakeven Price $/kWHr = Cost ÷ kWHrs

Estimated Return on Assets (ROA)		
without MB Hydro rate inflation	10.9% * [1]	13.6%
with 3.5% annual MB Hydro rate inflation	16.2% * [2]	20.3%
Simple Payback Calculation		
A. Without MB Hydro rate inflation	9.2 Years[1]	7.4 Years
B. With 3.5% annual MB Hydro rate inflation	6.2 Years[2]	4.9 Years
Desired Simple Payback = 10 Years		
C. Max.Capital Cost w/o Hydro rate inflation	$6,084 * [1]	$7,604
D. Max. Capital Cost w/ 3.5% Hydro inflation	$9,094 * [2]	$11,368

1. Based on Hydro rate @ $0.0793 per kWh plus PST & GST.

2. Based on 20 year average Hydro rate @ $0.119 per kWh plus PST & GST.

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Solar Photovoltaic (PV) Energy Production Costs - Input

Assumptions

1. This budget outlines the cost of production for a on-farm solar PV production operation.
2. Buildings and equipment are valued at new cost.
3. Solar Insolation is based on solar resource maps (link below)
   Natural Resources Canada solar resource maps and **NREL's PVWatts Calculator**
4. Annual kWh production could vary from significantly from minimum or maximum estimates.
5. All electical energy produced is for farm use only.

Solar PV Energy Production

Solar collector output per hour - watts	**310**	
Number of solar collectors installed in heat system	**15**	
Max. Solar Insolation (hrs/day or kWh/m^2/day)	**5.00**	
Min. Solar Insolation (hrs/day or kWh/m^2/day)	**4.00**	
MB Hydro Solar PV Incentive	**$4,650**	
MB Hydro residential rate	**$0.07930**	/ kWhr
Manitoba Sales Tax on Hydro	**8.0**	%
Federal GST Tax	**5.0**	%
Estimated Hydro rate annual inflation	**3.5**	%

Other Operating Costs

Maintenance	**0.25**	%
Labour Rate	**$20.00**	/ hour
Hours inspection per week	**0.00**	
Insurance	**0.5**	%
Property taxes	**0.0**	%
Investment Rate	**2.25**	%
Operating Interest Rate	**4.50**	%
Expected Solar PV Equipment Lifespan	**20**	years
Desired Simple Payback	**10.0**	years

Capital Costs

Buildings	**Original Value**	**Salvage Value**	**Useful Life**
Collector Mounts / Racks	**$600**	**30** %	**20** years
Collector Mounts installation	**$250**	**0** %	**20** years
Total	**$850**	**15.0** %	**20.0** years
Machinery & Equipment			
Solar Panel Collector & Controllers	**$8,500**	**10** %	**20** years
Bidirectional Hydro meter	**$300**	**10** %	**20** years
Electrical System (installation)	**$600**	**0** %	**20** years
Capital grant or incentive	**-$4,650**		
Total	**$4,750**	**6.7** %	**20.0** years
Total Bldg., Mach. & Equip	**$5,600**		
Total Land Value	**$0**		
Total Capital Investment	**$5,600**		

Assumptions

Assumptions

1. This budget outlines the cost of production for a on-farm solar PV 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 kWh production could vary from significantly from minimum or maximum estimates.
5. All electrical energy produced is for farm use only.

Solar Photovoltaic (PV) Energy Production Worksheet

A. Energy Produced

1.01 Minimum Annual Production

		310	Collector output (watts/hr)	
	x	15	Collectors (intalled/system)	
	x	4.00	Solar Insolation (hrs/day)	
	x	365	Days per year	
Total	**=**	**6,789**	**kWh per Year**	

Maximum Annual Production

		310	Collector output (watts/hr)	
	x	15	Collectors (intalled/system)	
	x	5.00	Solar Insolation (hrs/day)	
	x	365	Days per year	
Total	**=**	**8,486**	**kWh per Year**	

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

		6,789	kWh per Year	
	÷	365	Days per year	
	÷	24	Hours per day	
		0.7750	Net energy output (kW)	
		$5,600	Total solar pv installed cost	
	÷	0.7750	Net energy output (kW)	
Total	**=**	**$7,225.81**	**Cost per installed kW**	

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

		8,486	kWh per Year	
	÷	365	Days per year	
	÷	24	Hours per day	
		0.9688	Net energy output (kW)	
		$5,600	Total solar pv installed cost	
	÷	0.9688	Net energy output (kW)	
Total	**=**	**$5,780.65**	**Cost per installed kW**	

B. Operating Costs

2.01 Maintenance

		$850	capital cost - buildings	
	+	$4,750	capital cost - equipment	
	=	$5,600	Total bldg. & equipment	
	x	0.25%	Maintenance rate	
	=	**$14**	**Total Maintenance**	

2.02 Insurance

		$850	capital cost - buildings	

+	$4,750	capital cost - equipment	
=	$5,600	Total bldg. & equipment	
x	0.5%	Insurance rate	
=	**$28**	**Total Insurance**	

2.03 Property Taxes

	$850	capital cost - buildings	
+	$0	capital cost - land	
=	$850	Total bldg. & land	
x	0.0%	Property tax rate	
=	**$0**	**Total Property tax**	

2.04 Operating Interest

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

	$42	subtotal operating costs	
÷	2.00	average	
x	4.50	% operating interest rate	
=	**$1**	**Operating Interest**	

Capital Costs

Buildings		
Collector Mounts / Racks	$600	
Collector Mounts installation	$250	
Total Building Cost	**$850**	
Machinery & Equipment		
Solar Collector and Controllers	$8,500	
Bidirectional Hydro meter	$300	
Electrical System (installation)	$600	
Capital grant or incentive	-$4,650	
Total Machinery & Equipment Cost	**$4,750**	
Total Bldg., Mach. & Equip.	**$5,600**	
Total Land Value	**$0**	
Total Capital Investment	**$5,600**	

C. Fixed Costs

3. Depreciation $\frac{\textbf{Original Cost - Salvage Value}}{\textbf{Useful Life}}$

3.01 Buildings

	$850	original cost	
-	$128	salvage value	
÷	20.00	years useful life	
=	**$36**		

3.02 Machinery & Equipment

	$4,750	original cost	
-	$317	salvage value	
÷	20.00	years useful life	
=	**$222**		

4. Investment **Original Cost + Salvage Value x Investment Rate**
2

4.01 Buildings

	$850	original cost	
+	$128	salvage value	
÷	2.00	average	
x	2.25	% investment rate	
=	**$11**		

4.02 Machinery & Equipment

	$4,750	original cost	
+	$317	salvage value	
÷	2.00	average	
x	2.25	% investment rate	
=	**$57**		

4.03 Land

	$0	land	
x	2.25	% investment rate	
=	**$0**		

D. Labour

x	0	Hours inspection per week	
x	$20.00	Labour Rate per hour	
Total =	**$0**	**Labour**	

5. Value

5.01 Minimum Estimated Annual On-Farm Energy value

	$0.0793	MB Hydro rate per kWHr	
x	8.0%	Manitoba Sales Tax - Hydro	
x	5.0%	Federal GST	
x	6,789.0	kWHr energy produced/year	
Total =	**$608.36**	**Energy Value**	

Maximum Estimated Annual On-Farm Energy value

	$0.0793	MB Hydro rate per kWHr	
x	8.0%	Manitoba Sales Tax - Hydro	
x	5.0%	Federal GST	
x	8,486.3	kWHr energy produced/year	
Total =	**$760.44**	**Energy Value**	

Summary Calculations

Future Estimated Average MB Hydro rate

$0.1185 MB Hydro rate per kWHr

(Based on 20 year average rates and 3.5% annual rate increase)

Future Estimated MB Hydro rate

$0.1578 MB Hydro rate per kWHr

(Rate in 20 years with 3.5% annual rate increase)

Future Minimum Estimated Average Annual On-Farm Energy value

	$0.1185	MB Hydro rate per kWHr	
x	8.0%	Manitoba Sales Tax - Hydro	
x	5.0%	Federal GST	

	x	6,789.0	kWHr energy produced/year
Total	**=**	**$909.43**	**Energy Value**

Future Maximum Estimated Average Annual On-Farm Energy value

		$0.1185	MB Hydro rate per kWHr
	x	8.0%	Manitoba Sales Tax - Hydro
	x	5.0%	Federal GST
	x	8,486.3	kWHr energy produced/year
Total	**=**	**$1,136.78**	**Energy Value**

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

$608.36		Energy Value - minimum range
÷	$5,600	Total Capital Investment
=	**10.9%**	**ROA**

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

$760.44		Energy Value - maximum range
÷	$5,600	Total Capital Investment
=	**13.6%**	**ROA**

Estimated Return on Asset (ROA) - with 3.5% annual MB Hydro rate inflation

$909.43		Energy Value - minimum range
÷	$5,600	Total Capital Investment
=	**16.2%**	**ROA**

Estimated Return on Asset (ROA) - with 3.5% annual MB Hydro rate inflation

$1,136.78		Energy Value - maximum range
÷	$5,600	Total Capital Investment
=	**20.3%**	**ROA**

Simple Payback Calculation - without MB Hydro rate inflation

$5,600		Total Capital Investment
÷	$608	Energy Value - minimum range
=	**9.2**	**Years Payback**

Simple Payback Calculation - without MB Hydro rate inflation

$5,600		Total Capital Investment
÷	$760	Energy Value - maximum range
=	**7.4**	**Years Payback**

Simple Payback Calculation- with 3.5% annual MB Hydro rate inflation

$5,600		Total Capital Investment
÷	$909	Energy Value - minimum range
=	**6.2**	**Years Payback**

Simple Payback Calculation- with 3.5% annual MB Hydro rate inflation

$5,600		Total Capital Investment
÷	$1,137	Energy Value - maximum range
=	**4.9**	**Years Payback**

Created and maintained by Manitoba Agriculture Farm Management **October, 2016**

For more information, contact your local Manitoba Agriculture GO Office or:

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For more information

- Contact your local Manitoba Agriculture, Growing Opportunities (GO) Office.
- Visit us at **manitoba.ca/agriculture**.

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