



Biogas Solutions

design, construction & service

PROPOSED RESOP RATES FOR ON-FARM BIOGAS SYSTEMS IN ONTARIO

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1.0 BACKGROUND

The Ontario Ministry of Energy is now reviewing the Renewable Energy Standard Offer Program (RESOP) two (2) years after its introduction, in accordance with the RESOP Program Rules. One of the items for consideration is the price paid under the RESOP Contract for electricity generated by biogas from Anaerobic Digestion. The current price paid is 11¢/kW.h. This rate is attractive for power generation using landfill gas and also for (wastewater treatment plant) digester projects, where the fuel generation system is already in place. By way of comparison, producers of solar energy in Ontario are paid 42¢/kW.h. Other forms of renewable energy, including wind/water power, receive 11¢/kW.h, which is also high enough to make many of these projects economically viable.

Although there are European examples of feed-in tariffs for renewable/green power produced from Anaerobic Digestion, it would be desirable, we believe, to have a “made in Ontario” solution.

2.0 DISCUSSION

In addition to diversifying renewable/green energy production, support for biogas by the Province of Ontario also supports the agricultural sector. The Province of Ontario has signaled that it wishes to develop a flourishing biogas industry by providing grants to design and construct Anaerobic Digesters (AD) under the “Biogas Systems Financial Assistance Program”. This program is certainly helpful. However, few on-farm Digesters will be constructed since the returns are not sufficient to permit a farmer to finance construction. Unlike solar and wind/water power, biogas projects have significant annual input and operating costs which must be covered. Therefore, while OMAFRA’s capital grant program goes part way to address the requirements of the biogas industry, the annual operating and financing costs also need to be addressed.

3.0 BASIS OF OUR ANALYSIS

In an effort to lay the ground work for a “made in Ontario” solution, we estimated the construction cost of nine (9) biogas plants between 100 kW and 1.6 MW. This size range was chosen since we have experience in designing, cost estimating, constructing, commissioning, or operating biogas plants in this range.

3.1 Capital Costs

The capital costs are based on a biogas plant system which includes:

1. A primary digester
2. A secondary digester
3. A digestate storage vessel sufficient to store 240 days of production
4. A dry input feeder
5. A biogas engine generator set of the appropriate size
6. An electrical interconnection with the Local Distribution Company (LDC). Since these vary widely in cost, we have included \$50,000 in all nine (9) cases.

We have not included in our analysis:

1. Any grants or subsidies (in the first/base case).
2. Bunkers or other input storage facilities.
3. Biogas Flare.
4. Provision for the utilization of recoverable heat beyond the AD Island.
5. Digestate separation.
6. Utilization of surplus biogas in a packaged boiler.
7. Benefits to the farmer of the Federal Class 43.2 accelerated CCA (50% declining balance).

3.2 Annual Operating Costs

The following assumptions have been made with respect to annual O&M costs:

1. Repayment of the capital cost is based on an interest rate of 8% and a loan term of 25 years covering 100% of the project.
2. All calculations exclude tax considerations.
3. Input costs assume that one half of the input biomass material (say, manure) is available for free; the other half has a delivered cost of \$25/tonne.
4. Parasitic power is 3% of the annual power generated and costs of 6¢/kW.h.
5. Annual maintenance cost is 1.5% of capital.
6. Engine maintenance reserve is 1.5¢/kW.h produced.
7. Engine runs at full power for 8,000 hours per year.
8. Incremental labour cost at \$10,000 for the smaller plants increasing to \$50,000/year for the largest plant.

It should be noted that changes to these assumptions will affect the results. However, we are satisfied that these assumptions are reasonable and realistic at this time. Capital costs can (and have been) reduced in some installations but with a corresponding increase in annual operating costs. It should also be noted that the price assumptions are for current conditions in 2008.

4.0 CONCLUSIONS

The **attached** charts calculate the annual income for nine (9) biogas plant sizes at electricity rates ranging from 11¢/kW.h to 23¢/kW.h. It also calculates the corresponding annual costs and the resulting annual profit at each RESOP price level. Note that there are two (2) tables, one **without** the OMAFRA \$400,000 grant and one table **with** the OMAFRA \$400,000 grant preserved.

The data **attached** indicates that, even with the current OMAFRA grant program in place, the 11¢/kW.h payment is insufficient for all engine sizes considered. The first price level where all engine sizes are viable is 18¢/kW.h. At 500 kW and 750 kW, a price of 17¢/kW.h is possible and 13¢/kW.h is sufficient for the 1.6 MW size.

5.0 RECOMMENDATIONS

1. That the current OMAFRA Biogas Systems Financial Assistance Program be continued for the long term.
2. Based on the continuation of the OMAFRA Biogas Systems Financial Assistance Program, the RESOP rate for biogas projects be at least:

kW_e	¢/kW.h
<500	19
500-1000	17
>1000	13

3. That 20% of RESOP rates continue to be indexed to inflation (Ontario CPI).
4. That the very few existing RESOP contracts for electricity made from biogas be amended to be consistent with these recommendations, to maintain a level playing field going forward.
5. That all farmers have equal access to the RESOP Program, even those who have only enough manure and land to produce 100 kW_e (for example). Our proposal recognizes economics of scale and therefore does not limit RESOP participation to only very large projects.

Analysis of RESOP Rates for On-Farm Biogas Projects in Ontario Without \$400,000 OMAFRA Grant

Annual Income Based on 8,000 hours per year

RESOP Price (¢)	Nominal Size of Biogas Engine Genset (kW)								
	100	190	250	335	346	375	500	750	1600
0.11	88,000	167,200	220,000	294,800	304,480	330,000	440,000	660,000	1,408,000
0.12	96,000	182,400	240,000	321,600	332,160	360,000	480,000	720,000	1,536,000
0.13	104,000	197,600	260,000	348,400	359,840	390,000	520,000	780,000	1,664,000
0.14	112,000	212,800	280,000	375,200	387,520	420,000	560,000	840,000	1,792,000
0.15	120,000	228,000	300,000	402,000	415,200	450,000	600,000	900,000	1,920,000
0.16	128,000	243,200	320,000	428,800	442,880	480,000	640,000	960,000	2,048,000
0.17	136,000	258,400	340,000	455,600	470,560	510,000	680,000	1,020,000	2,176,000
0.18	144,000	273,600	360,000	482,400	498,240	540,000	720,000	1,080,000	2,304,000
0.19	152,000	288,800	380,000	509,200	525,920	570,000	760,000	1,140,000	2,432,000
0.20	160,000	304,000	400,000	536,000	553,600	600,000	800,000	1,200,000	2,560,000
0.21	168,000	319,200	420,000	562,800	581,280	630,000	840,000	1,260,000	2,688,000
0.22	176,000	334,400	440,000	589,600	608,960	660,000	880,000	1,320,000	2,816,000
0.23	184,000	349,600	460,000	616,400	636,640	690,000	920,000	1,380,000	2,944,000

Annual Fuel, Non-Fuel, and Capital Costs

Unit Capital (\$/kW)	10,000	8,947	8,800	8,657	8,671	8,533	7,400	7,200	4,125
Capital (No Grant)	1,000,000	1,700,000	2,200,000	2,900,000	3,000,000	3,200,000	3,700,000	5,400,000	6,600,000
Annual O&M Cost									
8% 25 years ⁽²⁾	99,360	168,912	218,592	288,144	298,080	317,952	367,632	536,544	655,776
Input Costs ⁽²⁾	35,000	66,500	87,500	117,250	121,100	131,250	175,000	262,500	560,000
Parasitic Power ⁽³⁾	1,440	2,736	3,600	4,824	4,982	5,400	7,200	10,800	23,040
Maintenance ⁽⁴⁾	15,000	25,500	33,000	43,500	45,000	48,000	55,500	81,000	99,000
Engine Reserve ⁽⁵⁾	12,000	22,800	30,000	40,200	41,520	45,000	60,000	90,000	192,000
Incr. Labour	10,000	10,000	10,000	10,000	10,000	10,000	15,000	20,000	50,000
Total	172,800	296,448	382,692	503,918	520,682	557,602	680,332	1,000,844	1,579,816

(1) Scope includes Primary AD, Secondary AD, Storage, grid connection, dry feeder

(2) 1/2 Menu based on dairy manure or equivalent manure at no cost, 1/2 energy crop @\$25 /tonne

(3) 3% of power produced at 6¢

(4) 1.5% of Capital

(5) 1.5¢ per kW.h

Break-Even Analysis

Electricity Price (¢)	Nominal Size of Biogas Engine Genset (kW)								
	100	190	250	335	346	375	500	750	1600
0.11	-84,800	-129,248	-162,692	-209,118	-216,202	-227,602	-240,332	-340,844	-171,816
0.12	-76,800	-114,048	-142,692	-182,318	-188,522	-197,602	-200,332	-280,844	-43,816
0.13	-68,800	-98,848	-122,692	-155,518	-160,842	-167,602	-160,332	-220,844	84,184
0.14	-60,800	-83,648	-102,692	-128,718	-133,162	-137,602	-120,332	-160,844	212,184
0.15	-52,800	-68,448	-82,692	-101,918	-105,482	-107,602	-80,332	-100,844	340,184
0.16	-44,800	-53,248	-62,692	-75,118	-77,802	-77,602	-40,332	-40,844	468,184
0.17	-36,800	-38,048	-42,692	-48,318	-50,122	-47,602	-332	19,156	596,184
0.18	-28,800	-22,848	-22,692	-21,518	-22,442	-17,602	39,668	79,156	724,184
0.19	-20,800	-7,648	-2,692	5,282	5,238	12,398	79,668	139,156	852,184
0.20	-12,800	7,552	17,308	32,082	32,918	42,398	119,668	199,156	980,184
0.21	-4,800	22,752	37,308	58,882	60,598	72,398	159,668	259,156	1,108,184
0.22	3,200	37,952	57,308	85,682	88,278	102,398	199,668	319,156	1,236,184
0.23	11,200	53,152	77,308	112,482	115,958	132,398	239,668	379,156	1,364,184

Analysis of RESOP Rates for On-Farm Biogas Projects in Ontario With \$400,000 OMAFRA Grant

Annual Income Based on 8,000 hours per year

RESOP Price (¢)	Nominal Size of Biogas Engine Genset (kW)								
	100	190	250	335	346	375	500	750	1600
0.11	88,000	167,200	220,000	294,800	304,480	330,000	440,000	660,000	1,408,000
0.12	96,000	182,400	240,000	321,600	332,160	360,000	480,000	720,000	1,536,000
0.13	104,000	197,600	260,000	348,400	359,840	390,000	520,000	780,000	1,664,000
0.14	112,000	212,800	280,000	375,200	387,520	420,000	560,000	840,000	1,792,000
0.15	120,000	228,000	300,000	402,000	415,200	450,000	600,000	900,000	1,920,000
0.16	128,000	243,200	320,000	428,800	442,880	480,000	640,000	960,000	2,048,000
0.17	136,000	258,400	340,000	455,600	470,560	510,000	680,000	1,020,000	2,176,000
0.18	144,000	273,600	360,000	482,400	498,240	540,000	720,000	1,080,000	2,304,000
0.19	152,000	288,800	380,000	509,200	525,920	570,000	760,000	1,140,000	2,432,000
0.20	160,000	304,000	400,000	536,000	553,600	600,000	800,000	1,200,000	2,560,000
0.21	168,000	319,200	420,000	562,800	581,280	630,000	840,000	1,260,000	2,688,000
0.22	176,000	334,400	440,000	589,600	608,960	660,000	880,000	1,320,000	2,816,000
0.23	184,000	349,600	460,000	616,400	636,640	690,000	920,000	1,380,000	2,944,000

Annual Fuel, Non-Fuel, and Capital Costs

Unit Capital (\$/kW)	6,000	6,842	7,200	7,463	7,514	7,467	6,600	6,667	3,875
Capital (With Grant)	600,000	1,300,000	1,800,000	2,500,000	2,600,000	2,800,000	3,300,000	5,000,000	6,200,000
Annual O&M Cost									
8% 25 years ⁽²⁾	59,616	129,168	178,848	248,400	258,336	278,208	327,888	496,800	616,032
Input Costs ⁽²⁾	35,000	66,500	87,500	117,250	121,100	131,250	175,000	262,500	560,000
Parasitic Power ⁽³⁾	1,440	2,736	3,600	4,824	4,982	5,400	7,200	10,800	23,040
Maintenance ⁽⁴⁾	9,000	19,500	27,000	37,500	39,000	42,000	49,500	75,000	93,000
Engine Reserve ⁽⁵⁾	12,000	22,800	30,000	40,200	41,520	45,000	60,000	90,000	192,000
Incr. Labour	10,000	10,000	10,000	10,000	10,000	10,000	15,000	20,000	50,000
Total	127,056	250,704	336,948	458,174	474,938	511,858	634,588	955,100	1,534,072

(1) Scope includes Primary AD, Secondary AD, Storage, grid connection, dry feeder

(2) 1/2 Menu based on dairy manure or equivalent manure at no cost, 1/2 energy crop @\$25 /tonne

(3) 3% of power produced at 6¢

(4) 1.5% of Capital

(5) 1.5¢ per kW.h

Break-Even Analysis

Electricity Price (¢)	Nominal Size of Biogas Engine Genset (kW)								
	100	190	250	335	346	375	500	750	1600
0.11	-39,056	-83,504	-116,948	-163,374	-170,458	-181,858	-194,588	-295,100	-126,072
0.12	-31,056	-68,304	-96,948	-136,574	-142,778	-151,858	-154,588	-235,100	1,928
0.13	-23,056	-53,104	-76,948	-109,774	-115,098	-121,858	-114,588	-175,100	129,928
0.14	-15,056	-37,904	-56,948	-82,974	-87,418	-91,858	-74,588	-115,100	257,928
0.15	-7,056	-22,704	-36,948	-56,174	-59,738	-61,858	-34,588	-55,100	385,928
0.16	944	-7,504	-16,948	-29,374	-32,058	-31,858	5,412	4,900	513,928
0.17	8,944	7,696	3,052	-2,574	-4,378	-1,858	45,412	64,900	641,928
0.18	16,944	22,896	23,052	24,226	23,302	28,142	85,412	124,900	769,928
0.19	24,944	38,096	43,052	51,026	50,982	58,142	125,412	184,900	897,928
0.20	32,944	53,296	63,052	77,826	78,662	88,142	165,412	244,900	1,025,928
0.21	40,944	68,496	83,052	104,626	106,342	118,142	205,412	304,900	1,153,928
0.22	48,944	83,696	103,052	131,426	134,022	148,142	245,412	364,900	1,281,928
0.23	56,944	98,896	123,052	158,226	161,702	178,142	285,412	424,900	1,409,928