

Polaris Capital Power

"ONE STOP" energy consortium and investment

PC Fuel Optimizer

A Cleaner Environment Greater Fuel Efficiency

Sept 2018

Background

The Company

Polaris Capital Power Inc. (the “Company” or “PCPI”) is a Canadian energy development and management company. Currently, it focuses on renewable energy projects as well as energy efficiency, savings, storage, conversion technologies and projects in the USA and to a lesser extent in Canada and abroad, including emerging markets. Its US business is conducted by its wholly owned subsidiary, Polaris Capital Power Corporation (“PCPC”). Its international business is conducted by its wholly owned subsidiary, Polaris Capital Power International (“PCPInt”). Its Canadian renewable business is conducted through its affiliate, Constant Solar Energy Inc.

The Fuel Optimizer

Hydrogen and carbon molecules have a tendency to cluster and attract to each other. The PC Fuel Optimizer unit forces these molecules prior to combustion to separate from each other and stay separate until combusted. This separation of clustered molecules then allows the oxygen molecules that are introduced just before combustion to more readily and completely attach themselves to the hydrogen and carbon molecules. This in turn allows for a more complete and efficient combustion of the fuel and therefore cause less pollution, as pollution mainly consists of unburned or inadequately burned hydrogen and carbon.

Results Summary

After several years of testing PC Fuel Optimizer has now implemented hundreds of units around the world in sites delivering the following broad results.

- **80% to 90% reduction in Hydrocarbon Emissions**
- **60% to 80% reduction in Carbon Monoxide Emissions**
- **20% reduction in Nitrogen Oxides**
- **5% to 27% reduction in fuel usage**

Fuel Applicability and Test Types

Units have been successfully tested on Natural Gas, Propane, Gasoline and Diesel burning equipment. Additional tests have been done in relation to the increase in burn temperature achieved. The following pages will provide high level results, all from independent third parties, on various types of installations.

Degree Days

In order to provide accurate saving calculations in relation to ‘space heating’ or other activities that are outside temperature affected we have used ‘Degree Days’ to calculate the true savings. ‘Degree Days’ are defined by the UK Government Carbon Trust as: “A measure of the severity and duration of cold weather. The colder the weather in a given month, the larger the degree-day value for that month. Degree Days are, in essence, a summation over time, of the difference between a reference or ‘base’ temperature and the outside temperature.” The colder the outside temperature the greater the space heating required to achieve the desired temperature.

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Gas (LPG/Natural) Fuel Efficiency

Site 1: Holiday Inn

– Efficiency Improvement 23.3%

“The Holiday Inn has been using the Fuel Optimizers from 1999 to the present. We have continued to save an average of 20% per year in natural gas savings.”

Gordon R. Langford,
General Manager

“We are very pleased to report there are no mechanical problems due to the addition of the Fuel Optimizers.”

Carl Fenwick
Stannair’s Enbridge



The following is an analysis of the gas usage since installation of the PC Fuel Optimizer in the Holiday Inn hotel, Ontario, Canada.

Month	No Product Attached Year 2006/2007			Product Attached Year 2007/2008		
	Days	Consumption	Degree Days	Days	Consumption	Degree Days
Dec/Jan	29	20,295 (A)	426	29	20,827 (A)	539.4
Jan/Feb	30	32,937 (A)	748.7	33	33,567 (E)	698.9
Feb/Mar	31	30,105 (A)	709.1	28	15,613 (A)	672.3
Sub-Total	90	83,337	1,883.80	90	70,007	1,910.60

Calculation Notes:

We have deducted 7,40 cm³ of gas each month which represents the approximate amount of gas that is used for domestic hot water and has nothing to do with degree days.

A = actual, E = Estimate

Savings Calculation Equals Last Year minus This Year, divided by Last Year

$$31.913 - 24.489 = 7.424 \text{ Divided by } 31.913 = 0.233$$

Savings 23.3%

Deductions estimated, assuming 50% of the cm³ of gas used in the summer was attributed to the domestic hot water and 50% of the cm³ of the gas used in the kitchen and swimming pool.

Site 2 Brookfield Properties
 – Efficiency Improvement 9%



Brookfield Properties is a commercial real estate corporation that owns, develops, and operates premier assets in the downtown cores of high-growth North American cities. Our signature properties define the skylines of many major metropolises including New York, Boston, Washington, D.C., Los Angeles, Houston, Toronto, and Calgary. Brookfield Properties is a publicly traded company, and is listed under the ticker symbol BPO on both the New York and Toronto Stock Exchanges.

Month	No Product Attached 2003/2004			Product Attached 2004/2005		
	Days	Consumption	Degree Days	Days	Consumption	Degree Days
May/Jun	30	6,048 (E)	121.4	33	4,691 (E)	158.9
Jun/Jul	31	21,584 (A)		29	10,604 (A)	
Jul/Aug	31	3,637 (E)		31	4,406 (E)	
Aug/Sept	29	4,895 (A)		31	5,568 (A)	
Sept/Oct	33	9,049 (E)		31	9,861 (A)	
Oct/Nov	29	28,757 (A)	341.4	29	22,395 (A)	297.1
Nov/Dec	29	26,561 (E)	467.5	27	27,471 (A)	377.8
Dec/Jan	34	51,960 (A)	639.3	36	50,216 (A)	654.2
Jan/Feb	29	44,049 (E)	763.1	27	47,387 (A)	716.3
Feb/Mar	28	48,192 (A)	523.1	33	49,651 (A)	788.6
Total	303	244,732	2,855.80	307	232,250	2,992.90

Cubic Meters
 Divided by Degree
 Days 85.69

Cubic Meters
 Divided by Degree
 Days 77.6

Savings Calculation Equals Last Year minimum This Year, divided by Last Year

$85.69 - 77.60 = 8.09$ Divided by $85.69 = 0.09$

Savings 9%

Calculation Notes: A = Actual, E = Estimate

Site 3: Beaux Properties
Property 1

– Efficiency Improvement 10%

Beaux Properties has evolved over 3 generations into a sophisticated real estate investment company with diverse experience across North America. Owned and managed privately by the Birnboim family, the company draws on its core strength in the multi-residential sector to expand beyond into other areas of property investment.



Month	No Product Attached 2004/2005			Product Attached 2005/2006		
	Days	Consumption	Degree Days	Days	Consumption	Degree Days
Nov/Dec	31	149,534	444	31	143,469	472.6
Dec/Jan	32	225,830	673.8	33	213,157	690.2
Jan/Feb	29	228,720	742.9	29	169,833	503.8
Feb/Mar	28	217,724	628.7	29	196,644	651.7
Mar/Apr	32	204,797	519.5	32	159,210	474.6
Sub Total		1,020,605			882,313	

Calculation Notes: 36,996 c/m has been deducted each month which represents the approximate domestic hot water used and does not relate to degree days

Total	835,625	3,008.90		697,333	2,792.90
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Cubic Meters
Divided by Degree
Days 277.72

Cubic Meters
Divided by Degree
Days 249.72

Savings Calculation Equals Last Year minus This Year divided by Last Year
 $277.72 - 249.72 = 28.00$ Divided by 277.72 = 0.10
Savings 10%

Site 4: Beaux Properties

Property 2

– Efficiency Improvement 11%

Month	No Product Attached 2004/2005			Product Attached 2005/2006		
	Days	Consumption	Degree Days	Days	Consumption	Degree Days
Nov/Dec	28	78,027	444	28	71,500	609.2
Dec/Jan	32	98,267	673.8	34	82,284	613
Jan/Feb	28	83,666	742.9	24	65,727	519
Feb/Mar	32	89,315	628.7	32	75,406	618.5
Mar/Apr	32	56,208	519.5	28	45,058	300.4
Sub Total		405,483			339,975	

Calculation Notes: 13,304 c/m has been deducted each month which represents the approximate domestic hot water used and does not relate to degree days.

Total	152	338,963	2,947.50	146	273,455	2,660.20
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Cubic Meters
Divided by Degree
Days 115.00

Cubic Meters
Divided by Degree
Days 102.80

Savings Calculation Equals Last Year minus This Year, divided by Last Year

$115.0 - 102.8 = 12.2$ Divided by $115.0 = 0.11$

Savings 11%

Site 5/6: Fisher Price, New York
 – Efficiency Improvement 6%

The following is an analysis of the gas usage since installation of the PC Fuel Optimizer on two boilers at Sunset Cleaner and Draperies, New York in their 242,000 foot warehouse. Each boiler was reviewed only 1 hour after installation of the unit



Boiler Number 1	
Model - Patterson Kelley - N1200	
Serial # BH*****2	
11:00 P.M. Thursday April 10th	
1	10" gas supply
2	2.5" manifold
3	2.3" cabinet
4	O2 - 7.5%
5	CO 69 ppm
6	CO2 - 7.4%
7	Net Stack - 271f
8	Efficiency - 81.6%
9	x air - 59.5
10	Pilot Flame - 2.1vdc
11	Main Burn - 5.0vdc
11:59 P.M. Thursday April 10th	
1	10" gas supply
2	2.5" manifold
3	2.3" cabinet
4	O2 - 7.8%
5	CO 93 ppm
6	CO2 - 9.7%
7	Net Stack - 255f
8	Efficiency - 86.1%
9	x air - 59.5
10	Pilot Flame - 2.1vdc
11	Main Burn - 5.0vdc

Boiler Number 2	
Model - Patterson Kelley - N1200	
Serial # BH*****0	
11:15 P.M. Thursday April 10th	
1	10" Gas Supply
2	3.1" Manifold
3	3.1" cabinet
4	O2 - 7.4%
5	CO - 94ppm
6	CO2 - 7.6%
7	Net Stack - 283f
8	Efficiency - 81.5
9	X air - 53.6
10	Pilot Flame - 2.1vdc
11	Main Burn - 5.0vdc
12:15 A.M. Friday April 11th	
1	10" Gas Supply
2	3.1" Manifold
3	3.1" cabinet
4	O2 - 7.5%
5	CO - 118ppm
6	CO2 - 9.9%
7	Net Stack - 269f
8	Efficiency - 85.9
9	X air - 55.5
10	Pilot Flame - 2.1vdc
11	Main Burn - 5.0vdc

Site 7: Toronto Metropolitan District School Board, Single High School
– **Efficiency Improvement 15% (high fire) and 11% (low fire)**
– **Carbon Monoxide reduced to 0 ppm (both hi-fire and low fire)**



The following is an analysis of the gas usage and gas output as independently tested by Black and McDonald, the technician as T Wiggins at the Toronto Metropolitan Separate School Board. The test results were:

December 19th, 1996

Boiler was fine-tuned prior to installation. Carbon monoxide of 16 - 21 ppm was still exhausted into the atmosphere. The baseline BTU rating recorded 6,000 ft³ for hi-fire and 3,600 ft³ for low-fire.

Two hours after the Fuel Optimizers were installed on the 4 feed line, carbon monoxide was reduced to 0 ppm, indicating a complete burn of the fuel.

January 16th, 1997

Readings were taken before any fine tuning adjustments (pre) and again after adjusting for optimum performance (post). In all cases, carbon monoxide remained at 0 ppm. Fuel consumption was then Decreased manually by 285 ft³ (hi-fire) and 173 ft³ (low-fire)

January 30th, 1997

Natural Gas Consumption is reduced to 5100 ft³ (hi-fire) and 3100 ft³ (low-fire)

February 13th, 1997

Natural gas consumption has stabilized at 5100 ft³ for hi-fire and 3200 ft³ for low-fire, indicating a savings of 15% and 11% respectively.

Site 8: High School Boiler
 – Efficiency Improvement up to 5%

“As you can see the stack temperature and the CO are lower with the Fuel Optimizers installed compared to the first test without the Fuel Optimizers. Before we installed the Fuel Optimizers the efficiency of (one of sic.) the boiler was 73% and the final test the efficiency was 78%, or an increase of 5%.

T Wiggins
 Mechanic



The following is an analysis of the gas usage since installation of PC Fuel Optimizer on a single boiler at one High School with two further sets of adjustments to try optimize the set up. The boiler was a Black & McDonald Combustion set up and the engineer in was T. Wiggins. The boiler test was on a Power Master boiler, model 3LG Serial Number 695***3, 500 HP, 60 PSI, Natural Gas, 20,900 cu. Ft/hr.

High School Test 1; Test Date: December 19th, 1996				
Burner Readings	No Product Attached		Product Attached	
	LO	HIGH	LO	HIGH
Input ft ³ /hour	3600	6000	3600	6000
Main Flo Fuel Pressure	0.75	2.5	0.75	2.5
CO ² Output	8.3	9.9	8.3	9.7
O ² Output	6.2	3.4	6.2	3.7
CO Output (ppm)	21	16	0	0
Stack Temp (F ⁰)	243	292	225	280
Efficiency	84.1	84.2	85.3	84.4
Room Temp	51	51	51	51
Main Burner Flame Signal	19.75	20.75	20.5	20.8

High School Test 2; Test Date: January 16th, 1997				
Burner Readings	No Product Attached		Product Attached	
	LO	HIGH	LO	HIGH
Input ft ³ /hour	3400	6000	3427	5715
Main Flo Fuel Pressure	0.75	2.75	0.65	2.5
CO ² Output	8.5	10.1	8.3	9.9
O ² Output	5.9	3	6.2	3.3
CO Output (ppm)	0	0	0	0
Stack Temp (F ⁰)	261	293	236	281
Efficiency	84.5	84.5	85.2	84.7
Room Temp	59	59	59	59
Main Burner Flame Signal	20.5	20.9	20.5	20.9

High School Test 3; Test Date: February 13th, 1997				
Burner Readings	Pre Adjustment		Post Adjustment	
	LO	HIGH	LO	HIGH
Input ft ³ /hour	3100	5100	3200	5100
Main Flo Fuel Pressure	0.8	2.75	1	2.75
CO ² Output	8.3	10	8.7	10.2
O ² Output	6.2	3.1	5.5	2.8
CO Output (ppm)	12	13	0	0
Stack Temp (F ⁰)	196	257	237	289
Efficiency	86.6	85.6	85.6	84.8
Room Temp	66	66	66	66
Main Burner Flame Signal	20.5	20.6	20.8	21

Temperature Probe Tests

Site 9: Apartment Building Heating System – Temperature improvement 29%

Test Date: December 12th, 2006
Location: Toronto, Ontario Canada

Report from investigator:

A temperature probe test was conducted on December 12, 2006 on an apartment building in Toronto, Ontario Canada. The test was conducted on a Teledyne Therma-King natural gas boiler.

The probe was inserted in the flame and an area of approximately one inch was searched to find the maximum temperature we could. This temperature was 1054 degrees F.

The Fuel Optimizer was installed on the gas line and the probe was re-inserted into the flame in the same area. Within 3-4 minutes the temperature rose to 1475 degrees F. The temperature increased by 421 degrees or 29% proving that the Fuel Optimizers give a more efficient combustion and will save the customers valuable fuel dollars.

We have not changed the volume of gas flowing to the burner but we have met the thermostat temperature setting and the furnace will shut down faster. It is a combination of the higher heat produced and the running time of the furnace that gives the total savings.

Site 10: Domestic Home Furnace – Temperature improvement 31%

Test Date: February 12th 2007
Location: Mississauga, Ontario Canada

Report from investigator:

A temperature probe test was conducted February 12, 2007 on a domestic home furnace in Mississauga Ontario, Canada. The equipment used was a Type K Thermo-couple and a digital read out monitor. The furnace was shut off for a period of 30 minutes prior to the test beginning by turning back the thermostat.

The Fuel Optimizers were installed and the furnace was turned on at 10:30 AM. The probe was inserted into the flame and an area of approximately 1 inch was searched to find the maximum temperature we could. This temperature was 1,572 degrees F. The temperature of the return air was measured at 72 degrees F. The temperature of the supply air measured at 177 degrees F.

At 11:20 AM the Fuel Optimizers were removed and the probe was re-inserted into the flame in the same area. Within 3-4 minutes the maximum temperature dropped to 1,204 degrees F. The temperature of the return air was measured at 72 degrees F. The temperature of the supply air measured at 163 degrees F

The Fuel Optimizers were then re-installed. The probe was inserted into the flame and the same area approximately one inch was searched to find the maximum temperature we could. This temperature was again 1,572 degrees F. The flame temperature increased by 368 degrees F or 31% proving that the Fuel Optimizers gives a more efficient combustion and will save the customer valuable fuel dollars Air supply rose 14 degrees F or 15% differential.

We have not changed the volume of gas flowing to the burner but we have reached the thermostat temperature setting quicker shutting off the furnace in less time. It is the combination of the higher temperature and the running time that gives the customer the savings.

Site 11: Woolwich Farms – Chicken Barn
– **Temperature improvement 36%**
– **Efficiency Improvement 20%**

“These conditioners are installed on tube heaters using natural gas. Comparing the previous period before installation, to current, I have realized a saving of 20% “

Ken Drost
President
Woolwich Farms Ltd



Test Date: November 30th, 2006
Location: Elmira Ontario Canada

This temperature probe test ran November 30th, 2006 at a chicken barn with an atmospheric burner - radiant propane tube heater in Elmira, Ontario Canada.

The probe was inserted in the flame and an area of approximately 1 inch was searched to find the maximum temperature we could. This temperature was 1075 degrees F.

The Fuel Optimizer was installed on the propane line and the probe was re-inserted into the flame in the same area. Within 3-4 minutes the temperature rose to 1470 degrees F.

The temperature increase by 395 degrees or 36% proving that the Fuel Optimizer gives a more complete burn and will save the customer valuable fuel dollars.

We have not changed the volume of the gas flowing to the burner but we have reached the thermostat temperature setting and the furnace will shut off faster. It is a combination of the higher heat produced and the running time of the furnace that gives the total savings.

Site 12: Radiant Tube Heater Exhaust Air Temperature Test in a Chicken Barn
– **Temperature improvement 9%**

Test Date: October 31st, 2007
Location: Palmerston, Ontario Canada

On October 31st, 2007 we conducted an air temperature probe test on a 50 foot radiant tube heater in a chicken barn operated near Palmerston, Ontario Canada

The heater was on and we inserted the probe into the exhaust end of the tube and the highest temperature we could record was 295 degrees F.

The Fuel Optimizer was then installed and the probe was inserted into the tube at the same spot and the temperature rose to 321 degrees F. in a matter of 5-6 minutes.

We have not changed the volume of gas and nor should you. What we are doing is increasing the flame temperature which will heat up the barn quicker meeting the thermostat setting quicker shutting off the burner.

It is the combination of the higher temperature and the running time that gives the customer the savings.

Transportation Tests

Site 13: 1990 Lincoln Town Car 5.0L V8

– **Efficiency Improvement 17%+**

HC ppm	43
CO%	0.00
NO ppm	177

NOTE** this vehicle experienced a 17% savings on identical drive testing



Site 14: 1997 Ford Expedition

– **Efficiency Improvement 20%+**

““We immediately noticed a significant increase of 20% in gas mileage on our highway driving and seem to have better performance on our vehicles”

Marty Demchuk



Site 15: Tractor Trailer/Lorry

– **Efficiency Improvement 18%+**

“Almost immediately upon installation, the idling of our engines smoothed out and they ran significantly quieter. Following a 12 month review of the fuel consumption we have noticed that there is an increase in fuel -

Mileage of approximately 1 mile per gallon in our city operation and as much as 1.5 miles per gallon in our highway operation. It is also beneficial pertaining to oil changes by extending the mileage between changes with cleaner oil. One of our tractors was in for a new head gasket and the mechanics could not believe how clean the engine was.”

Larry Higgins
Manager Independent Contractors
U CAN Universal



Site 16: D-9 Caterpillar Doser

– **Efficiency Improvement 18%+**

	No Product Attached	Product Attached
Hours Worked	479.1	396.4
Fuel Used	19,791.30	13,436.90
Liters per hour	41.309	33.89
Saving	7.41 liters less per hour	



Further Quotes from installations:

“The best I could get of a tank of fuel was 14 hours. Now I can expect 16 hrs and sometimes I can get 17 hours. These fuel savings are substantial.

I also noticed a difference in my oil. I examine it on a very regular basis and usually had to change it every 2 weeks. Now I have found this can be extended to 4 weeks.”

Jason Glenn
Central N.B. Logging

“Since installing your Fuel Optimizers my average kilometers per liter has increased from 12.2 to 13.4, an increase of 10%

I have increased the oil changes to 12,000 kilometers and have noticed that the oil is substantially cleaner than previous changes at approximately 7,000 kilometers.”

Mike Gallagher
Director Quality Control
Navtech Systems

“We did not know what to anticipate but to our pleasant surprise the Gas Line Conditioners surpassed expectations. The savings at both locations averaged 24%. The product works and claimed and the company has been reliable.”

John Persico

Additional Recent Results – School Busses

A large school bus company tested the Fuel Optimizers internally on 23 buses.

Those busses that were running in the urban areas with several stops along the route were experiencing an average of 9% fuel savings.

Those buses on rural routes, who would go much longer between stops were experiencing an average of 18% fuel savings.

Site 17: 20ft Sea Ray, 350 Chevy
 – **Significant Emissions drop**

Third Party testing: Snap On

	No Product Attached	Product Attached
HC (ppm)	501	0
CO%	5.7	1.6
CO ²	16.5	12.7
NOX	97	6



Site 18: 99 Yachts Cruiser 3870 with twin 454 Merc Horizons
 – **Significant Emissions drop**

Third Party testing: Snap On

	No Product Attached	Product Attached
HC (ppm)	143	0
CO%	4.94	0.08
CO ²	7.24	0.00
NOX	33	32



Site 19: 30ft Carver with twin 305 Chevy Small Block
 – **Significant Emissions drop**

Third Party testing: Snap On

	No Product Attached	Product Attached
HC (ppm)	1201	88
CO%	4.5	0.04
CO ²	18.4	0.31
NOX	102	5



Site 20: 200hp Johnson Venom
– **Significant Emissions drop**

Third Party testing: Snap On



	No Product Attached	Product Attached
HC (ppm)	4725	2020
CO%	5.71	0.8
CO ²	8.56	0.71
NOX	168	26

CONTACT

Allow us to create a compelling business case for you and your organization to become environmentally responsible. We have tremendous confidence in our ability to make being a good environmental citizen pay directly to your bottom line.

Please contact directly at:
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