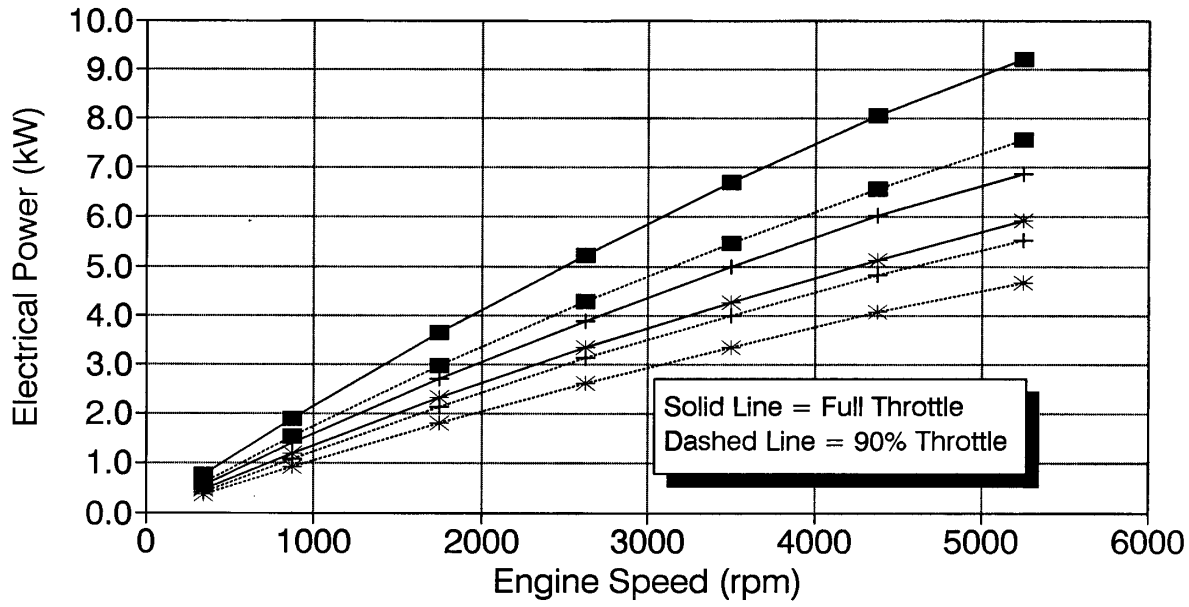
Figure 1

Afterburning Ericsson Engine - CHP

Electrical Power at Sea Level



-18C Ambient Temp 21C Ambient Temp 42C Ambient Temp

Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

For Additional Information Contact
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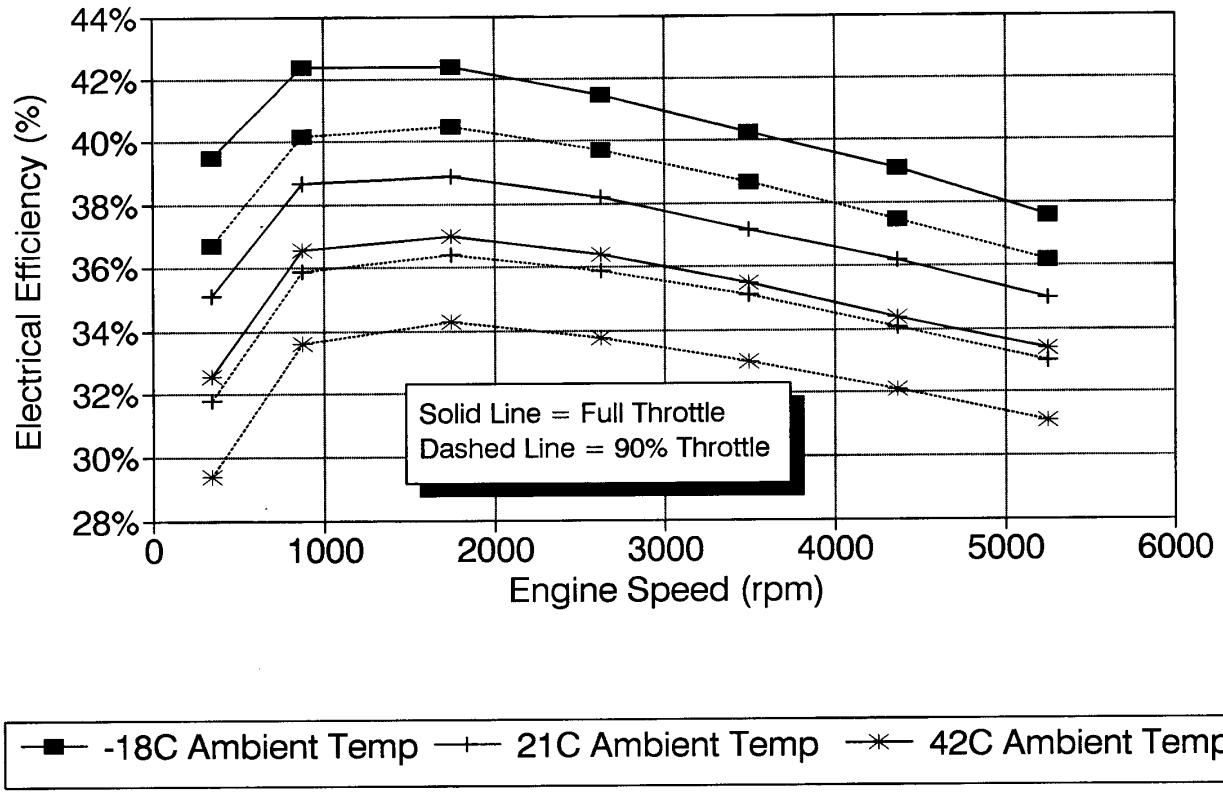
Figure 2

Afterburning Ericsson Engine - CHP

Electrical Efficiency Sea Level



-18C Ambient Temp 21C Ambient Temp 42C Ambient Temp

Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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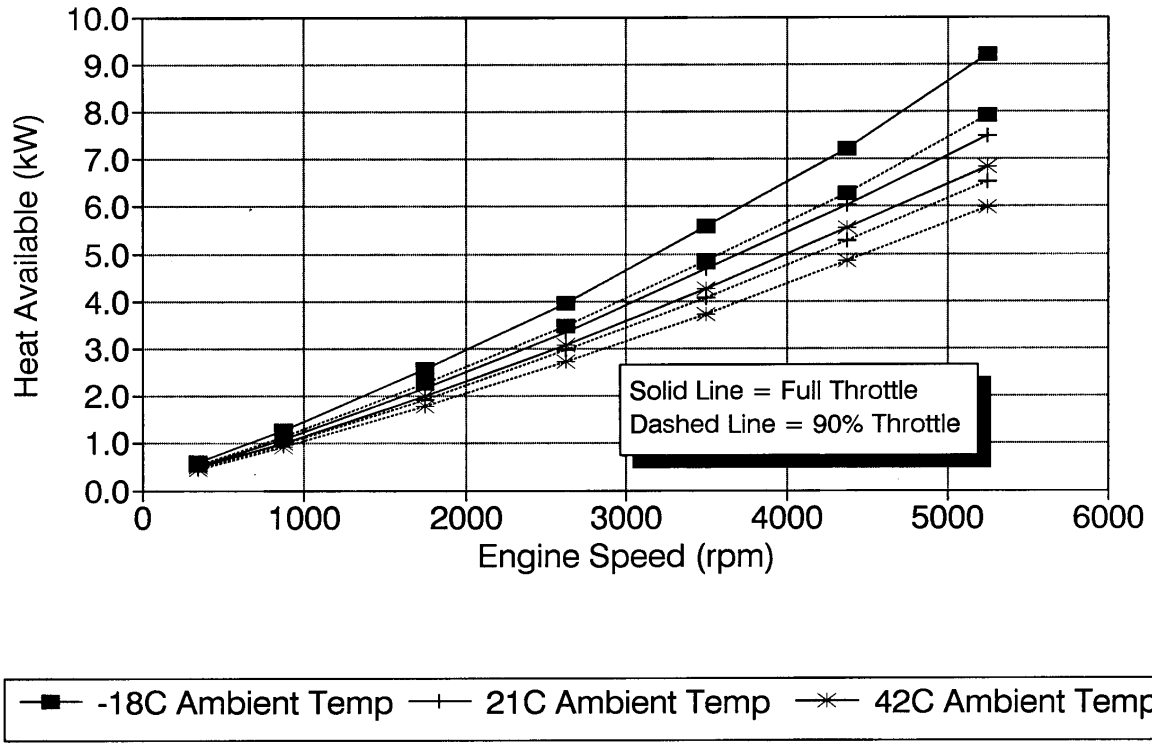
Figure 3

Afterburning Ericsson Engine - CHP

Heat Available at Sea Level



-18C Ambient Temp 21C Ambient Temp 42C Ambient Temp

Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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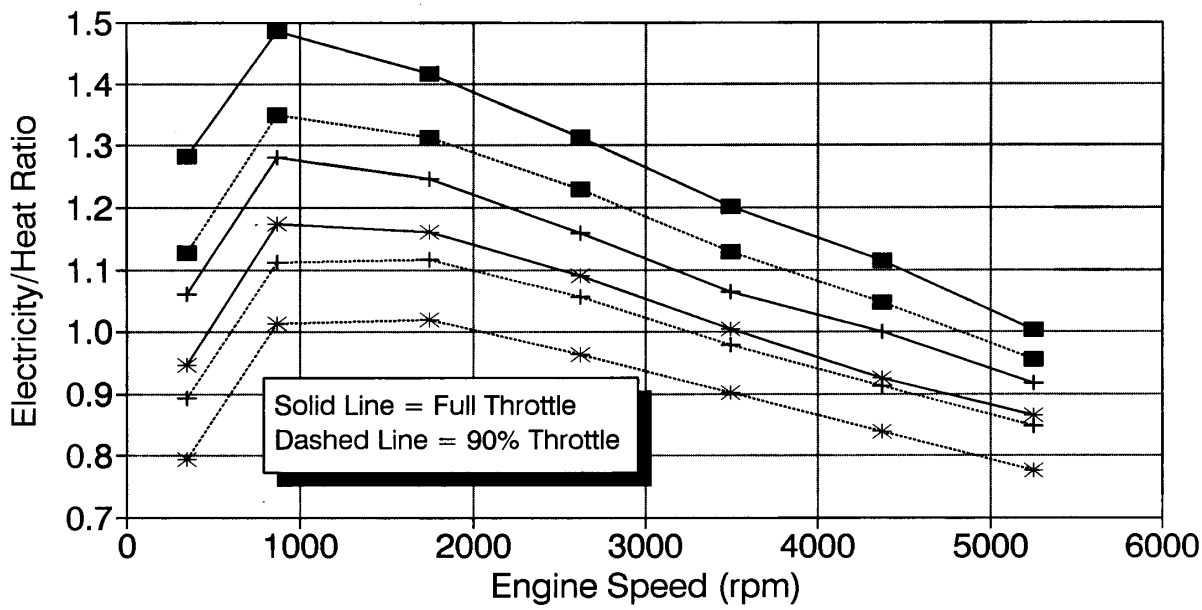
Figure 4

Afterburning Ericsson Engine - CHP

Electricity/Heat Ratio at Sea Level



-18C Ambient Temp 21C Ambient Temp 42C Ambient Temp

Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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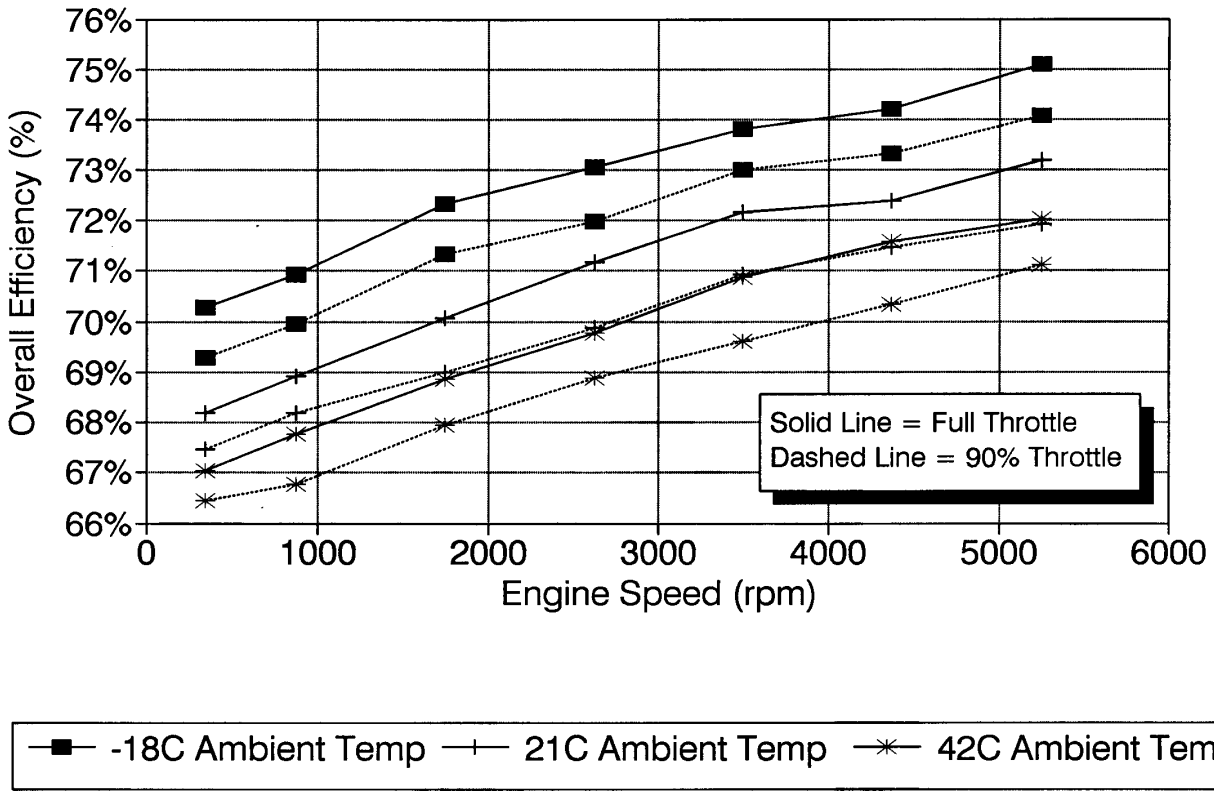
Figure 5

Afterburning Ericsson Engine - CHP

Overall Efficiency at Sea Level



Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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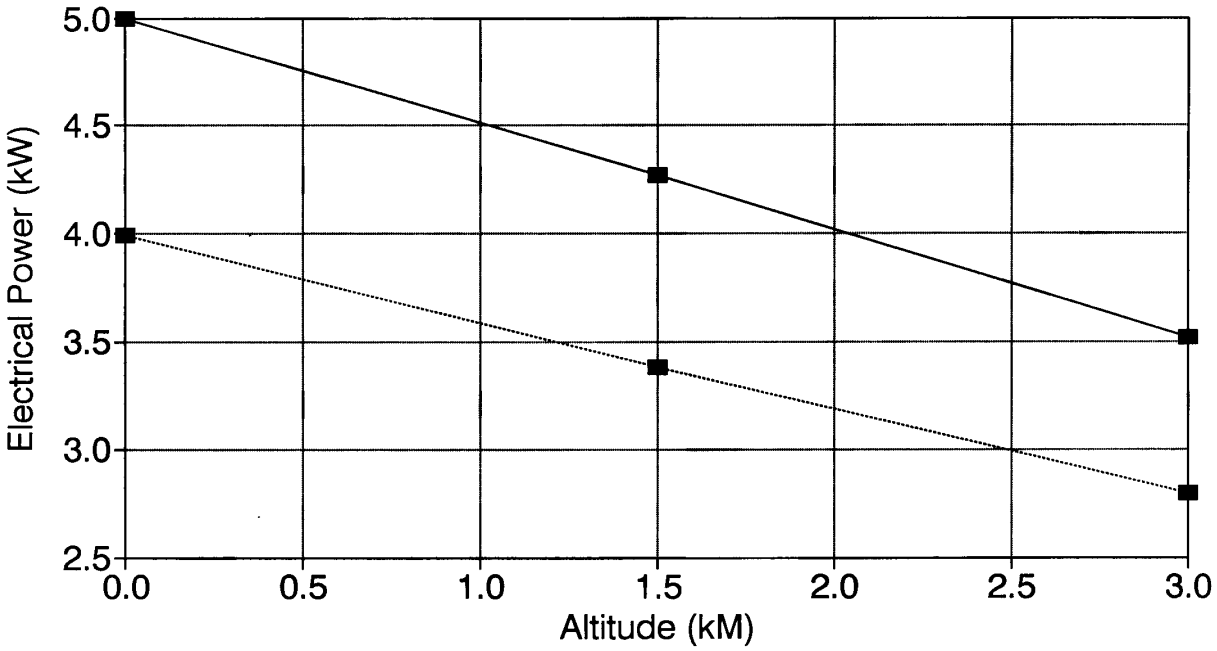
Figure 6

Afterburning Ericsson Engine - CHP

Electrical Power at 3500 rpm and 21C



Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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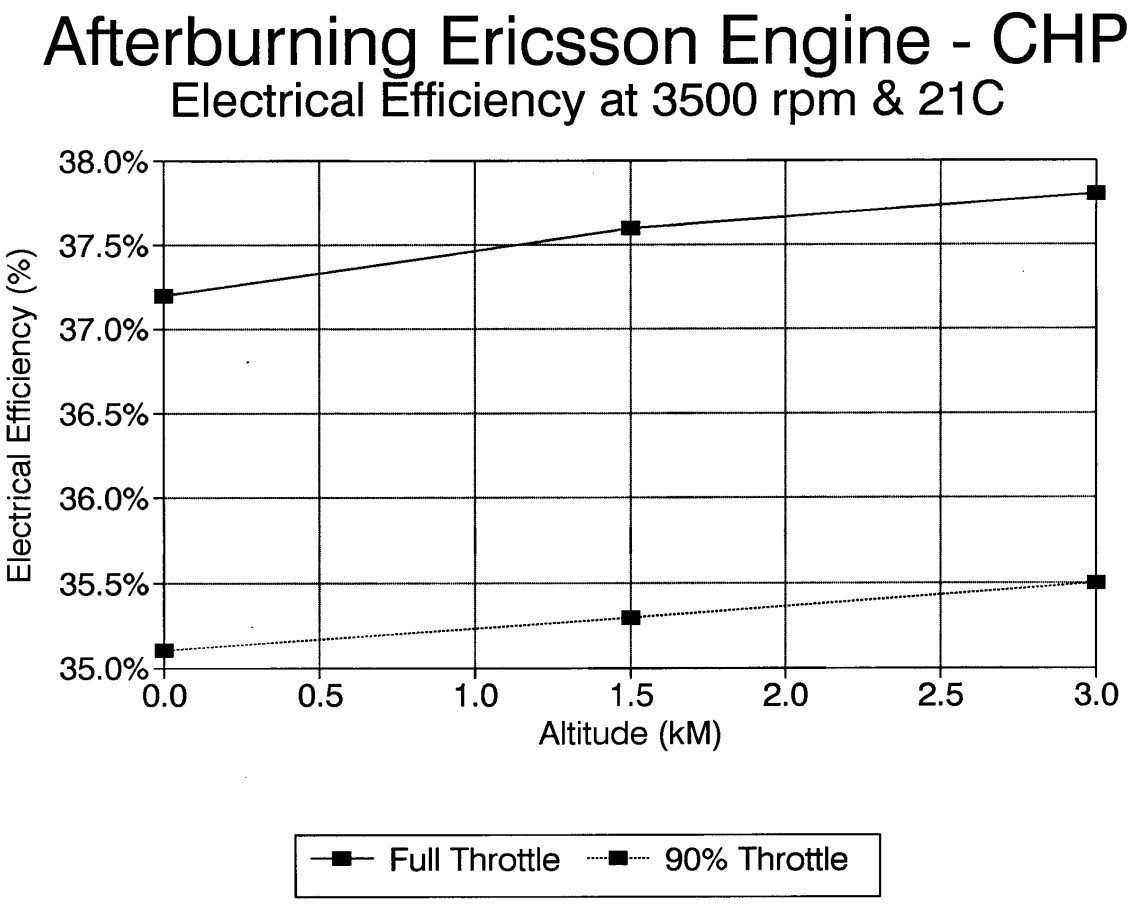
Figure 7



Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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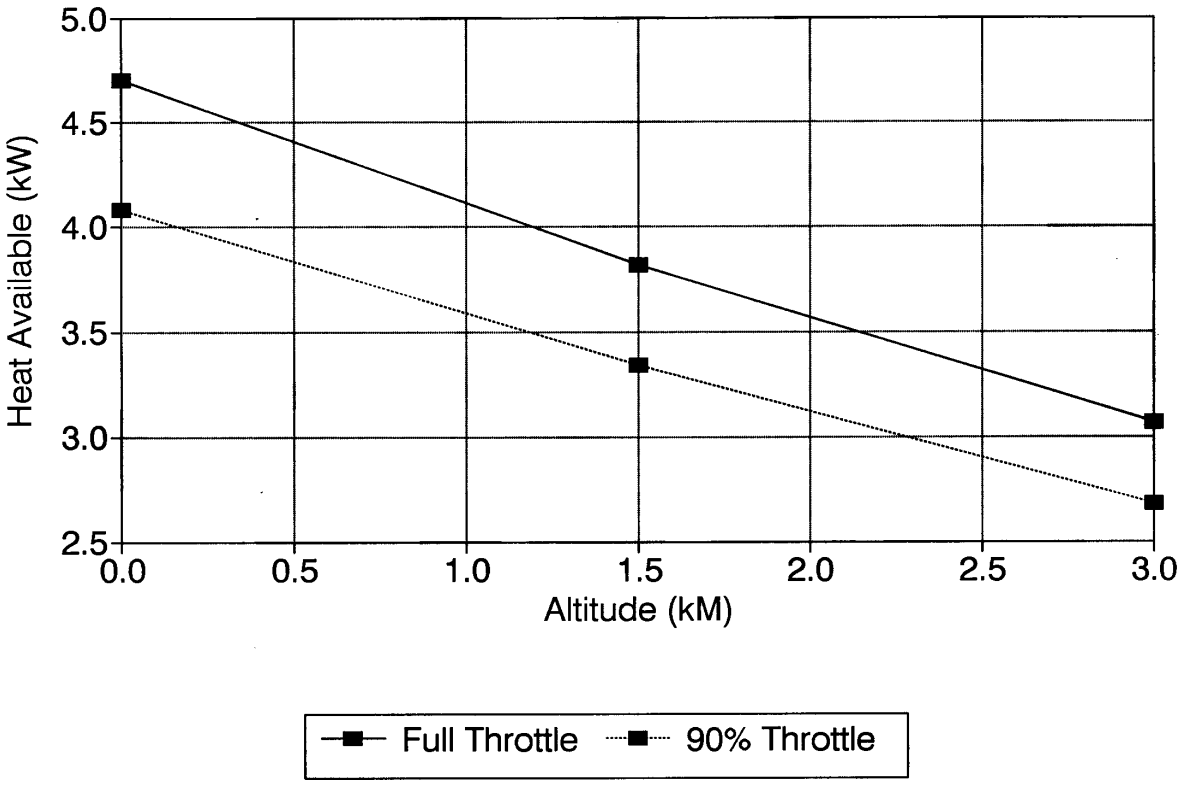
Figure 8

Afterburning Ericsson Engine - CHP

Heat Available at 3500 rpm and 21C



Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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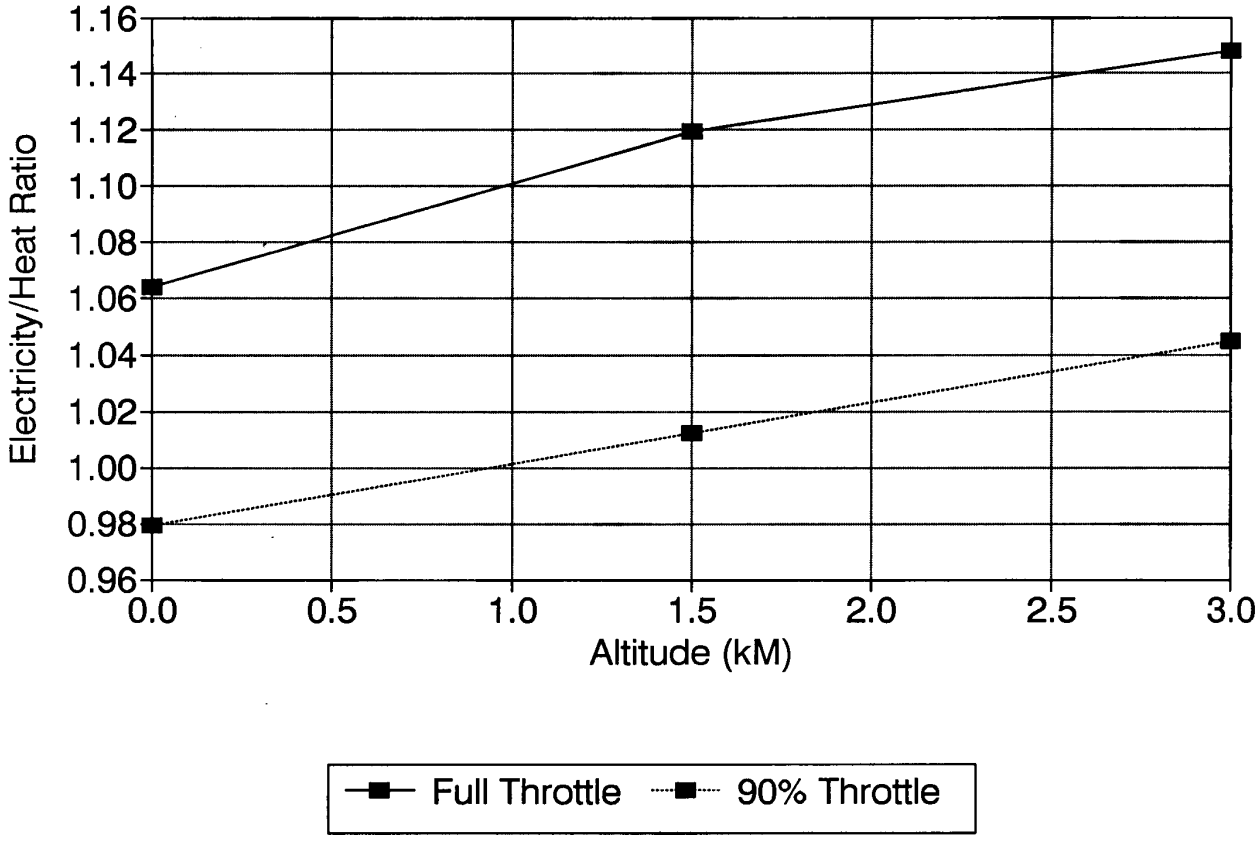
Figure 9

Afterburning Ericsson Engine - CHP

Electricity/Heat at 3500 rpm & 21C



Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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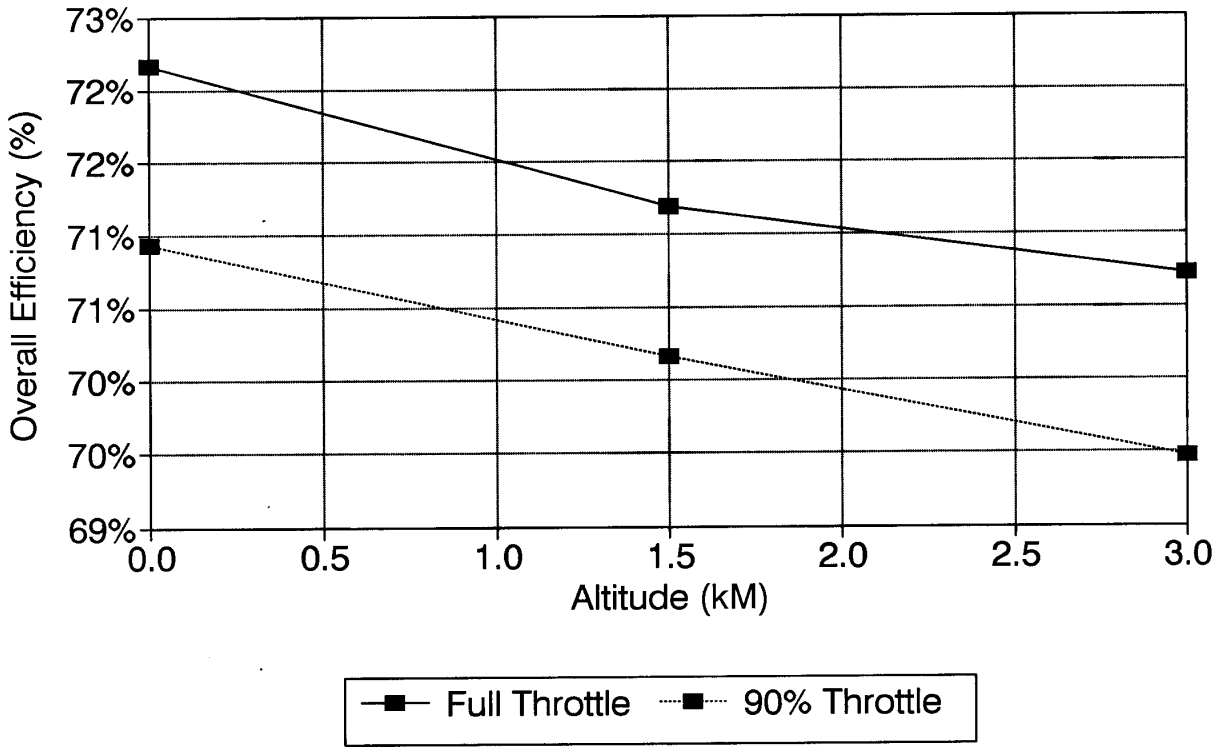
Figure 10

Afterburning Ericsson Engine - CHP

Overall Efficiency at 3500 rpm and 21C



Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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Table 1

5kW Afterburning Ericsson Engine Performance in CHP Mode

27.2% Cutoff
Assumed Generator Efficiency = 90%
Assumed Heater Efficiency = 90%

100% Throttle

Ambient Temp = 0 f -18 c Sea Level

rpm	Heat kW	Power kW	Elec/Heat	Efficiency elect %	Efficiency Tot %
350	0.59	0.76	1.28	39.5%	70.3%
875	1.27	1.89	1.49	42.4%	70.9%
1750	2.57	3.64	1.42	42.4%	72.3%
2625	3.97	5.22	1.31	41.5%	73.1%
3500	5.57	6.71	1.20	40.3%	73.8%
4375	7.23	8.05	1.11	39.1%	74.2%
5250	9.19	9.22	1.00	37.6%	75.1%

Ambient Temp = 70 f 21 c Sea Level

rpm	Heat kW	Power kW	Elec/Heat	Efficiency elect %	Efficiency Tot %
350	0.52	0.56	1.06	35.1%	68.2%
875	1.10	1.40	1.28	38.7%	68.9%
1750	2.16	2.70	1.25	38.9%	70.1%
2625	3.35	3.88	1.16	38.2%	71.2%
3500	4.76	5.00	1.05	37.2%	72.6%
4375	6.03	6.03	1.00	36.2%	72.4%
5250	7.50	6.87	0.92	35.0%	73.2%

Assumptions:
- Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM
- Methane Fuel
- Generator Efficiency = 90%
- Heat Recovery Heat Exchanger Effectiveness = 90%

Ambient Temp = 108 f 42 c Sea Level

rpm	Heat kW	Power kW	Elec/Heat Ratio	Efficiency elect %	Efficiency Tot %
350	0.49	0.46	0.95	32.6%	67.0%
875	1.02	1.20	1.17	36.6%	67.8%
1750	1.99	2.32	1.16	37.0%	68.9%
2625	3.07	3.35	1.09	36.4%	69.8%
3500	4.26	4.27	1.00	35.5%	70.9%
4375	5.54	5.13	0.93	34.4%	71.6%
5250	6.85	5.92	0.86	33.4%	72.0%

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Table 2

5kW Afterburning Ericsson Engine Performance in CHP Mode

27.2% Cutoff
Assumed Generator Efficiency = 90%
Assumed Heater Efficiency = 90%

90% Throttle

Ambient Temp = 0 f Sea Level
-18 c

rpm	Heat kW	Power kW	Elec/Heat	Efficiency elect %	Efficiency Tot %
350	0.54	0.61	1.13	36.7%	69.3%
875	1.14	1.54	1.35	40.2%	70.0%
1750	2.26	2.97	1.31	40.5%	71.3%
2625	3.48	4.28	1.23	39.7%	72.0%
3500	4.85	5.47	1.13	38.7%	73.0%
4375	6.29	6.58	1.05	37.5%	73.3%
5250	7.91	7.56	0.96	36.2%	74.1%

Ambient Temp = 70 f Sea Level
21 c

rpm	Heat kW	Power kW	Elec/Heat	Efficiency elect %	Efficiency Tot %
350	0.48	0.43	0.89	31.8%	67.5%
875	0.99	1.10	1.11	35.9%	68.2%
1750	1.92	2.15	1.12	36.4%	69.0%
2625	2.96	3.13	1.06	35.9%	69.9%
3500	4.08	4.00	0.98	35.1%	70.9%
4375	5.28	4.82	0.91	34.1%	71.5%
5250	6.52	5.53	0.85	33.0%	71.9%

Ambient Temp = 108 f Sea Level
42 c

rpm	Heat kW	Power kW	Elec/Heat Ratio	Efficiency elect %	Efficiency Tot %
350	0.46	0.36	0.79	29.4%	66.4%
875	0.92	0.93	1.01	33.6%	66.8%
1750	1.78	1.81	1.02	34.3%	68.0%
2625	2.72	2.62	0.96	33.8%	68.9%
3500	3.73	3.36	0.90	33.0%	69.6%
4375	4.84	4.06	0.84	32.1%	70.3%
5250	5.99	4.66	0.78	31.1%	71.1%

Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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Table 3

5kW Afterburning Ericsson Engine Performance in CHP Mode

27.2% Cutoff
Assumed Generator Efficiency = 90%
Assumed Heater Efficiency = 90%

100% Throttle

Ambient Temp = 70 f rpm=3500
21 c

Altitude kM	Heat kW	Power kW	Elec/Heat Ratio	Efficiency elect %	Efficiency Tot %
0	4.76	5.00	1.05	37.2%	72.6%
1.5	3.816	4.272	1.12	37.6%	71.2%
3	3.06	3.52	1.15	37.8%	70.7%

90% Throttle

Ambient Temp = 70 f rpm=3500
21 c

Altitude kM	Heat kW	Power kW	Elec/Heat Ratio	Efficiency elect %	Efficiency Tot %
0	4.08	4.00	0.98	35.1%	70.9%
1.5	3.34	3.382	1.01	35.3%	70.2%
3	2.68	2.80	1.04	35.5%	69.5%

Assumptions:

Engine Sized for 5 kW Electrical Output at 21C ambient temperature, Sea Level, and 3500 RPM

Methane Fuel

Generator Efficiency = 90%

Heat Recovery Heat Exchanger Effectiveness = 90%

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