

# Puvurnaq Power Company Wind, Diesel, Thermal, and Battery System



**Alaska Energy Storage Workshop  
January 12-13, 2021**

# Wind Heat and Battery System Components



## Systems in Kongiganak, Kwigillingok and Tuntutuliak

- 95 kW Windmatic wind turbines
- 50 Steffes Electric Thermal Storage(ETS) devices
- Community-wide Smart Metering and Smart Grid control
- 270 kwh Lithium-Ion Battery Capacity
- 300 kwh ABB inverter



# 2015 Energy and Fuel Savings

## KONGIGANAK POWER PLANT

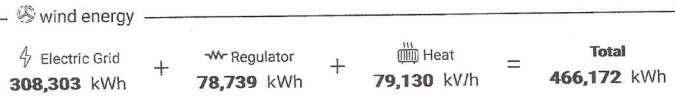
### 2015 Energy Summary (kWh)

Generation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Diesel 1	77,260	57,520	80,480	75,330	20,490	-	-	-	-	130	4,780	2,050	318,040
Diesel 2	630	240	210	120	42,470	24,190	89,600	75,840	63,780	5,540	-	-	302,620
Diesel 3	-	-	-	-	-	-	-	-	15,200	73,340	75,120	80,520	244,180
Diesel 4	100	140	310	510	16,360	11,700	40,470	12,660	4,250	270	100	-	86,870
<b>Total Diesel Generation</b>	<b>77,990</b>	<b>57,900</b>	<b>81,000</b>	<b>75,960</b>	<b>79,320</b>	<b>35,890</b>	<b>130,070</b>	<b>88,500</b>	<b>83,230</b>	<b>79,280</b>	<b>80,000</b>	<b>82,570</b>	<b>951,710</b>
Wind Turbine 1	15,071	18,785	10,260	15,632	13,585	5,327	1,892	8,619	10,914	13,493	16,540	20,201	150,320
Wind Turbine 2	15,520	16,788	10,985	14,160	10,435	5,694	1,793	6,733	8,351	11,398	15,688	20,622	138,166
Wind Turbine 3	20,419	26,665	13,177	7,998	-63	-33	-92	4,547	10,643	11,966	7,393	-63	102,547
Wind Turbine 4	-64	-57	-63	-62	-63	-32	-91	-63	-61	-63	-61	-63	-742
Wind Turbine 5	14,707	18,528	10,517	13,232	12,286	5,742	241	-63	-61	-63	-61	875	75,880
<b>Total Wind Generation</b>	<b>65,653</b>	<b>80,699</b>	<b>44,876</b>	<b>50,959</b>	<b>36,180</b>	<b>16,699</b>	<b>3,744</b>	<b>19,773</b>	<b>29,787</b>	<b>36,731</b>	<b>39,500</b>	<b>41,572</b>	<b>466,172</b>
<b>Total Generation</b>	<b>143,643</b>	<b>138,599</b>	<b>125,876</b>	<b>126,919</b>	<b>115,500</b>	<b>52,589</b>	<b>133,814</b>	<b>108,273</b>	<b>113,017</b>	<b>116,011</b>	<b>119,500</b>	<b>124,142</b>	<b>1,417,882</b>

Consumption	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Station Service	2,292	2,059	2,253	2,159	2,368	1,175	3,455	2,426	2,486	2,830	2,599	2,666	28,758
Wind to Village	40,680	48,443	29,614	30,334	22,777	10,787	2,517	17,107	23,306	25,249	26,578	30,912	308,303
Wind to Load Regulator	10,384	14,345	7,568	10,379	7,725	4,383	1,157	2,340	3,545	5,509	6,395	5,009	78,739
Wind to ETS	14,589	17,911	7,694	10,246	5,678	1,529	70	326	2,936	5,973	6,527	5,651	79,130
Total Village	118,670	106,343	110,614	106,294	102,097	46,677	132,587	105,607	106,536	104,529	106,578	113,482	1,260,013
<b>Total Consumption</b>	<b>143,643</b>	<b>138,599</b>	<b>125,876</b>	<b>126,919</b>	<b>115,500</b>	<b>52,589</b>	<b>133,814</b>	<b>108,273</b>	<b>113,017</b>	<b>119,500</b>	<b>124,142</b>	<b>1,417,882</b>	

% Diesel kWh Displaced by Wind	34.3%	45.6%	26.8%	28.5%	22.3%	23.1%	1.9%	16.2%	21.9%	24.2%	24.9%	27.2%	24.5%
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## ies Kongiganak Wind Battery System Whole Year 2015



diesel displacement

**Wind to Grid** - Reduces the dependence on diesel engines.  
**Surplus Wind to Heat** - Makes use of excess to heat homes.



### footnotes

Assumes \$3 per gallon of diesel for the utility, and \$5 per gallon for residential heating. These numbers are up-to-date but rounded to the nearest dollar.  
(commerce.alaska.gov/dcra/DCRAExternal/community/Details/41bf65a8-2e69-4eba-t06a-t06a-c25d4f9f9)

Assumes 22.4 lbs of CO2 released per gallon of diesel burned, which is the EPA's estimate.  
(epa.gov/tools/faqs/faq.php?id=307)

Assumes 85% efficiency of heaters, which is likely to be accurate due to the prevalence of high efficiency heaters, such as the Toyostove Laser (87%).  
(toyotomiusa.com/factoryOutletStore/L-73-Toyotomi-Laser-Vented-Heater)

Icons from FlatIcon's free-to-use icon library.

The 2019 version of this form uses data from 2018 for the last months of the year, see ed according to production numbers from January 2019 to September 2019.



# 2016

## KONGIGANAK POWER PLANT

### 2016 Energy Summary (kWh)

Generation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Diesel 1	4,930	4,700	9,700	2,230	21,480	39,200	410	1,260	1,120	1,240	1,320	4,650	92,240
Diesel 2	-	-	-	-	-	20	20	-	-	-	-	-	40
Diesel 3	61,580	66,040	52,580	72,140	52,700	33,300	68,980	83,140	70,810	61,460	72,120	67,390	762,240
Diesel 4	-	-	-	-	-	70	-	-	-	-	140	30	240
<b>Total Diesel Generation</b>	<b>66,510</b>	<b>70,740</b>	<b>62,280</b>	<b>74,370</b>	<b>74,180</b>	<b>72,590</b>	<b>69,410</b>	<b>84,400</b>	<b>71,930</b>	<b>62,700</b>	<b>73,580</b>	<b>72,070</b>	<b>854,760</b>
Wind Turbine 1	24,126	13,123	18,804	7,613	12,304	7,248	6,110	5,358	7,706	13,758	-10,852	14,708	141,710
Wind Turbine 2	14,442	3,336	12,733	7,478	-63	-59	3,201	2,815	7,446	14,156	12,097	14,077	91,662
Wind Turbine 3	-64	13,731	22,342	9,350	16,464	9,238	7,615	4,470	6,966	18,117	17,345	17,679	143,253
Wind Turbine 4	-63	-59	-63	5	1,084	-58	608	1,173	7,863	15,564	13,870	14,017	53,942
Wind Turbine 5	26,112	18,193	22,688	8,938	10,642	5,495	4,191	5,288	7,734	13,810	11,007	8,971	143,069
<b>Total Wind Generation</b>	<b>64,553</b>	<b>48,324</b>	<b>76,503</b>	<b>33,384</b>	<b>40,431</b>	<b>21,865</b>	<b>21,727</b>	<b>19,105</b>	<b>37,715</b>	<b>75,404</b>	<b>65,171</b>	<b>69,453</b>	<b>573,636</b>
<b>Total Generation</b>	<b>131,063</b>	<b>119,064</b>	<b>138,783</b>	<b>107,754</b>	<b>114,611</b>	<b>94,455</b>	<b>91,137</b>	<b>103,505</b>	<b>109,645</b>	<b>138,104</b>	<b>138,751</b>	<b>141,523</b>	<b>1,428,396</b>

Consumption	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Station Service	2,648	2,551	2,503	2,903	2,830	2,578	3,252	3,418	3,123	2,901	2,773	2,742	34,222
Wind to Village	44,798	33,831	46,621	22,145	27,389	17,155	17,420	13,260	24,682	45,840	37,721	45,733	376,594
Wind to Load Regulator	8,705	6,465	12,263	5,664	8,236	4,710	4,307	5,068	7,944	18,820	12,923	11,968	107,073
Wind to ETS	11,050	8,028	17,619	5,576	4,806	0	0	777	5,089	10,744	14,527	11,752	89,969
Total Village	111,308	104,571	108,901	96,515	101,569	89,745	86,830	97,660	96,612	108,540	111,301	117,803	1,231,354
<b>Total Consumption</b>	<b>131,063</b>	<b>119,064</b>	<b>138,783</b>	<b>107,754</b>	<b>114,611</b>	<b>94,455</b>	<b>91,137</b>	<b>103,505</b>	<b>109,645</b>	<b>138,104</b>	<b>138,751</b>	<b>141,523</b>	<b>1,428,396</b>

% Diesel kWh Displaced by Wind	40.2%	32.4%	42.8%	22.9%	27.0%	19.1%	20.1%	13.6%	25.5%	42.2%	33.9%	38.8%	30.6%
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## ies Kongiganak Wind Battery System

### Whole Year 2016

wind energy

$$\begin{array}{r}
 \text{Electric Grid} \\
 \text{376,594 kWh}
 \end{array}
 +
 \begin{array}{r}
 \text{Wr Regulator} \\
 \text{107,073 kWh}
 \end{array}
 +
 \begin{array}{r}
 \text{Heat} \\
 \text{89,969 kWh}
 \end{array}
 =
 \begin{array}{r}
 \text{Total} \\
 \text{573,636 kWh}
 \end{array}$$

diesel displacement

**Wind to Grid** - Reduces the dependence on diesel engines.  
**Surplus Wind to Heat** - Makes use of excess to heat homes.

$$\begin{array}{r}
 \text{Electricity} \\
 \text{31,383 gallons}
 \end{array}
 +
 \begin{array}{r}
 \text{Heat} \\
 \text{2,794 gallons}
 \end{array}
 =
 \begin{array}{r}
 \text{Total Displacement} \\
 \text{34,177 gallons} \\
 \text{\$ 108,119 dollars} \\
 \text{383 tons CO2}
 \end{array}$$

Jan - Apr

35%  
diesel displacement

May - Aug

20%  
diesel displacement

Sept - Dec

35%  
diesel displacement

Yearly Average

31%  
average diesel displacement  
(electricity only)

footnotes

Assumes \$3 per gallon of diesel for the utility, and \$5 per gallon for residential heating. These numbers are up-to-date but rounded to the nearest dollar.  
 (commerce.alaska.gov/dora/DCRAExternal/community/Details/41bf65a8-2e59-4eba-b5a-509c25d4f9f9)

Assumes 22.4 lbs of CO2 released per gallon of diesel burned, which is the EIA's estimate.  
 (eia.gov/tools/faqs/faq.php?id=307)

Assumes 85% efficiency of heaters, which is likely to be accurate due to the prevalence of high efficiency heaters, such as the Toyotome Laser (87%).  
 (toyotomiusa.com/factoryOutletStore/L-73-Toyotomi-Laser-Vented-Heater)

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# 2017

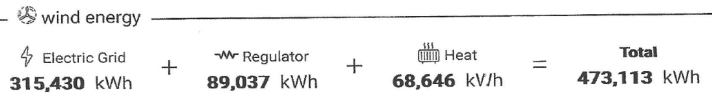
## KONGIGANAK 2017 Energy Summary (kWh)

Generation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Diesel 1	18,520	69,290	64,980	85,510	60,810	3,020	1,070	68,840	79,150	83,820	14,790	66,540	616,340
Diesel 2	-	1,090	720	220	200	80	-	190	310	500	770	2,120	6,200
Diesel 3	67,210	-	-	-	22,180	65,810	63,970	13,360	20	-	66,520	12,940	312,010
Diesel 4	-	480	-	-	50	-	-	-	-	-	670	810	2,010
<b>Total Diesel Generation</b>	<b>85,730</b>	<b>70,860</b>	<b>65,700</b>	<b>85,730</b>	<b>83,240</b>	<b>68,910</b>	<b>65,040</b>	<b>82,390</b>	<b>79,480</b>	<b>84,320</b>	<b>82,750</b>	<b>82,410</b>	<b>936,560</b>
Wind Turbine 1	6,092	11,543	16,256	3,076	5,948	4,196	4,403	-61	3,334	11,119	8,390	10,889	85,184
Wind Turbine 2	11,575	14,058	16,262	7,818	5,745	2,739	5,074	13,823	12,465	10,621	8,079	2,723	110,981
Wind Turbine 3	13,319	20,895	23,461	8,534	7,777	7,606	10,278	9,379	8,338	12,591	6,845	14,311	143,336
Wind Turbine 4	9,475	14,296	13,203	4,954	6	-60	-62	-62	-61	-63	-51	-64	41,510
Wind Turbine 5	11,910	12,720	16,276	6,608	6,222	3,500	5,320	2,304	3,228	5,972	7,612	10,428	92,102
<b>Total Wind Generation</b>	<b>52,371</b>	<b>73,512</b>	<b>85,459</b>	<b>30,990</b>	<b>25,698</b>	<b>17,980</b>	<b>25,013</b>	<b>25,382</b>	<b>27,305</b>	<b>40,240</b>	<b>30,874</b>	<b>38,288</b>	<b>473,113</b>
<b>Total Generation</b>	<b>138,101</b>	<b>144,372</b>	<b>151,159</b>	<b>116,720</b>	<b>108,938</b>	<b>86,890</b>	<b>90,053</b>	<b>107,772</b>	<b>106,785</b>	<b>124,560</b>	<b>113,624</b>	<b>120,698</b>	<b>1,409,673</b>

Consumption	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Station Service	2,676	2,100	2,048	2,564	2,637	3,076	3,260	2,436	2,286	2,360	4,412	2,855	32,710
Wind to Village	35,605	46,346	52,203	19,222	17,660	12,876	17,820	19,786	22,275	26,783	17,138	27,717	315,430
Wind to Load Regulator	8,346	12,832	15,211	5,873	5,144	5,104	7,192	5,586	4,712	6,826	4,212	7,998	89,037
Wind to ETS	8,420	14,335	18,044	5,895	2,894	0	1	11	318	6,632	9,524	2,572	68,646
<b>Total Village</b>	<b>121,335</b>	<b>117,206</b>	<b>117,903</b>	<b>104,952</b>	<b>100,900</b>	<b>81,786</b>	<b>82,860</b>	<b>102,176</b>	<b>101,755</b>	<b>111,103</b>	<b>99,888</b>	<b>110,127</b>	<b>1,251,990</b>
<b>Total Consumption</b>	<b>138,101</b>	<b>144,372</b>	<b>151,159</b>	<b>116,720</b>	<b>108,938</b>	<b>86,890</b>	<b>90,053</b>	<b>107,772</b>	<b>106,785</b>	<b>124,560</b>	<b>113,624</b>	<b>120,698</b>	<b>1,409,673</b>

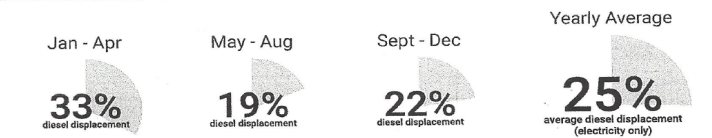
% Diesel kWh Displaced by Wind	29.3%	39.5%	44.3%	18.3%	17.5%	15.7%	21.5%	19.4%	21.9%	24.1%	17.2%	25.2%	
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## ies Kongiganak Wind Battery System Whole Year 2017



diesel displacement

**Wind to Grid** - Reduces the dependence on diesel engines.  
**Surplus Wind to Heat** - Makes use of excess to heat homes.



footnotes

Assumes \$3 per gallon of diesel for the utility, and \$5 per gallon for residential heating. These numbers are up-to-date but rounded to the nearest dollar.  
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Assumes 22.4 lbs of CO2 released per gallon of diesel burned, which is the EIA's estimate.  
(eia.gov/tools/faqs/faq.php?id=307)

Assumes 85% efficiency of heaters, which is likely to be accurate due to the prevalence of high efficiency heaters, such as the Toyotomi Laser (87%).  
(toyotomiusa.com/factoryOutletStore/L-73-Toyotomi-Laser-Vented-Heater)

Icons from FlatIcon's free-to-use icon library.

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# 2018

## KONGIGANAK 2018 Energy Summary (kWh)

Generation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Diesel 1	63,600	6,680	220	1,070	2,860	2,460	12,300	22,070	19,880	9,320	31,030	24,460	195,950
Diesel 2	3,410	30,770	48,870	33,150	41,150	46,120	31,040	24,940	46,300	36,830	32,770	39,430	414,780
Diesel 3	-	-	-	-	-	-	-	-	-	-	-	-	-
Diesel 4	690	4,800	10,290	9,480	9,250	8,710	11,440	6,610	1,320	180	6,480	1,320	70,570
<b>Total Diesel Generation</b>	<b>67,700</b>	<b>42,250</b>	<b>59,380</b>	<b>43,700</b>	<b>53,260</b>	<b>57,290</b>	<b>54,780</b>	<b>53,620</b>	<b>67,500</b>	<b>46,330</b>	<b>70,280</b>	<b>65,210</b>	<b>681,300</b>
Wind Turbine 1	10,114	21,329	15,104	15,684	10,581	-	-	5,461	8,295	14,245	10,584	13,561	124,958
Wind Turbine 2	2,140	4,021	14,156	15,018	12,055	7,433	9,590	11,855	1,932	14,994	7,871	13,940	115,008
Wind Turbine 3	25,362	22,721	16,018	19,818	15,819	8,779	12,113	13,194	8,792	19,386	11,197	14,018	187,217
Wind Turbine 4	8,593	20,412	13,272	15,667	12,160	7,177	7,634	10,998	3,738	15,281	9,696	11,700	136,329
Wind Turbine 5	19,914	20,961	14,774	16,931	13,355	7,103	9,393	11,649	7,982	15,693	11,603	13,286	162,643
<b>Total Wind Generation</b>	<b>66,124</b>	<b>89,445</b>	<b>73,325</b>	<b>83,118</b>	<b>63,970</b>	<b>30,492</b>	<b>38,730</b>	<b>53,157</b>	<b>30,739</b>	<b>79,600</b>	<b>50,951</b>	<b>66,505</b>	<b>726,154</b>
<b>Total Generation</b>	<b>133,824</b>	<b>131,695</b>	<b>132,705</b>	<b>126,818</b>	<b>117,230</b>	<b>87,782</b>	<b>93,510</b>	<b>106,777</b>	<b>98,239</b>	<b>125,930</b>	<b>121,231</b>	<b>131,715</b>	<b>1,407,454</b>

Consumption	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Station Service	4,355	3,076	3,209	3,004	3,220	3,323	3,439	3,435	3,411	3,265	3,090	3,658	40,485
Wind to Village	48,947	67,609	50,600	57,909	30,250	24,674	31,076	44,762	25,821	68,666	41,298	49,858	541,469
Wind to Load Regulator	8,105	8,071	8,382	10,371	9,307	5,622	7,654	8,395	4,918	10,933	5,885	7,522	95,165
Wind to ETS	9,072	13,765	14,343	14,838	24,413	196	-	-	-	3,768	9,125	-	89,521
<b>Total Village</b>	<b>116,647</b>	<b>109,869</b>	<b>109,980</b>	<b>101,609</b>	<b>83,510</b>	<b>81,964</b>	<b>85,856</b>	<b>98,382</b>	<b>93,321</b>	<b>114,996</b>	<b>111,578</b>	<b>115,068</b>	<b>1,222,769</b>
<b>Total Consumption</b>	<b>133,824</b>	<b>131,695</b>	<b>132,705</b>	<b>126,818</b>	<b>117,230</b>	<b>87,782</b>	<b>93,510</b>	<b>106,777</b>	<b>98,239</b>	<b>125,930</b>	<b>121,231</b>	<b>131,715</b>	<b>1,407,454</b>

% Diesel kWh Displaced by Wind	42.0%	61.5%	46.0%	57.0%	36.2%	30.1%	36.2%	45.5%	27.7%	59.7%	37.0%	43.3%	44.3%
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## ies Kongiganak Wind Battery System Whole Year 2018

wind energy

Electric Grid + Regulator + Heat = Total

541,469 kWh + 95,165 kWh + 89,521 kWh = 726,154 kWh

diesel displacement

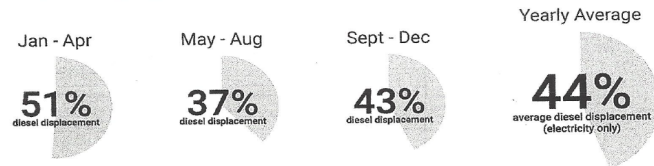
Wind to Grid - Reduces the dependence on diesel engines.  
Surplus Wind to Heat - Makes use of excess to heat homes.

Electricity + Heat = Total Displacement

45,122 gallons + 2,780 gallons = 47,902 gallons

\$ 149,266 dollars

537 tons CO2



### footnotes

Assumes \$3 per gallon of diesel for the utility, and \$5 per gallon for residential heating. These numbers are up-to-date but rounded to the nearest dollar.  
(commerce.alaska.gov/dcra/DCRAExternal/community/Details/41bf65e8-2e69-4aba-b26a-509c25d4f9f9)

Assumes 22.4 lbs of CO2 released per gallon of diesel burned, which is the EIA's estimate.  
(eia.gov/tools/faqs/faq.php?id=307)

Assumes 85% efficiency of heaters, which is likely to be accurate due to the prevalence of high efficiency heaters, such as the Toyotomi Laser (87%).  
(toyotomiusa.com/factoryOutletStore/L-73-Toyotomi-Laser-Vented-Heater)

Icons from FlatIcon's free-to-use icon library.

The 2019 version of this form uses data from 2018 for the last months of the year, scaled according to production numbers from January 2019 to September 2019.

# 2019

## KONGIGANAK 2019 Energy Summary (kWh)

Generation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Diesel 1	15,320	27,990	12,620	51,980	11,420	1,030	58,880	52,630	35,760	30,740	16,990	29,450	344,810
Diesel 2	24,490	31,110	36,000	24,740	38,900	25,660	6,220	3,810	-	18,540	34,170	27,320	270,960
Diesel 3	-	-	-	-	-	-	-	-	-	-	-	-	-
Diesel 4	-	-	-	-	10	16,690	1,360	1,370	1,820	3,240	20	-	24,510
<b>Total Diesel Generation</b>	<b>39,810</b>	<b>59,100</b>	<b>48,620</b>	<b>76,720</b>	<b>50,330</b>	<b>43,380</b>	<b>66,460</b>	<b>57,810</b>	<b>37,580</b>	<b>52,520</b>	<b>51,180</b>	<b>56,770</b>	<b>640,280</b>
Wind Turbine 1	22,041	11,412	17,359	5,785	8,586	6,544	4,590	9,421	13,770	13,890	19,817	15,766	148,982
Wind Turbine 2	21,708	9,989	9,794	6,730	8,142	5,238	4,870	8,595	13,063	6,664	-	-	94,790
Wind Turbine 3	25,077	14,217	19,162	7,014	7,690	8,033	6,589	9,963	18,717	15,518	19,668	14,747	166,295
Wind Turbine 4	22,433	11,900	16,518	5,994	8,591	5,201	4,562	8,037	13,257	13,687	18,245	14,069	142,493
Wind Turbine 5	23,292	12,112	14,953	7,653	3,018	6,557	4,797	6,596	12,722	14,634	19,998	16,926	143,258
<b>Total Wind Generation</b>	<b>114,550</b>	<b>59,630</b>	<b>77,786</b>	<b>33,177</b>	<b>36,027</b>	<b>31,573</b>	<b>25,408</b>	<b>42,612</b>	<b>71,528</b>	<b>64,393</b>	<b>77,628</b>	<b>61,507</b>	<b>695,818</b>
<b>Total Generation</b>	<b>154,360</b>	<b>118,730</b>	<b>126,406</b>	<b>109,897</b>	<b>86,357</b>	<b>74,953</b>	<b>91,868</b>	<b>100,422</b>	<b>109,108</b>	<b>116,913</b>	<b>128,808</b>	<b>118,277</b>	<b>1,336,098</b>

Consumption	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Station Service	3,357	2,845	3,111	3,115	2,828	3,013	3,402	3,516	2,963	3,534	4,004	4,215	39,903
Wind to Village	75,004	38,411	52,214	22,849	25,175	22,960	19,429	32,934	52,426	47,074	54,394	45,505	488,315
Wind to Load Regulator	13,238	7,912	10,368	3,987	5,666	6,704	4,801	7,483	12,039	8,865	11,605	8,229	100,897
Wind to ETS	26,308	13,307	15,204	6,341	5,186	1,909	1,178	2,195	7,063	8,454	11,629	7,773	106,547
<b>Total Village</b>	<b>114,814</b>	<b>97,511</b>	<b>100,834</b>	<b>99,569</b>	<b>75,505</b>	<b>66,340</b>	<b>85,889</b>	<b>90,744</b>	<b>90,006</b>	<b>99,594</b>	<b>105,574</b>	<b>102,225</b>	<b>1,128,655</b>
<b>Total Consumption</b>	<b>154,360</b>	<b>118,730</b>	<b>126,406</b>	<b>109,897</b>	<b>86,357</b>	<b>74,953</b>	<b>91,868</b>	<b>100,422</b>	<b>109,108</b>	<b>116,913</b>	<b>128,808</b>	<b>118,277</b>	<b>1,336,098</b>

% Diesel kWh Displaced by Wind	65.3%	39.4%	51.8%	22.9%	33.3%	34.6%	22.6%	36.3%	58.2%	47.3%	51.5%	44%	43%
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## Kongiganak Wind Battery System Whole Year 2019 (25% Projected Data)

wind energy

Electric Grid + Regulator + Heat = Total

524,378 kWh + 104,077 kWh + 97,975 kWh = 726,430 kWh

diesel displacement

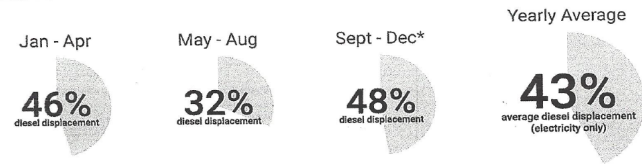
Wind to Grid - Reduces the dependence on diesel engines.  
Surplus Wind to Heat - Makes use of excess to heat homes.

Electricity + Heat = Total Displacement

43,698 gallons + 2,969 gallons = 46,667 gallons

\$ 145,939 dollars

523 tons CO2



### footnotes

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(commerce.alaska.gov/dcra/DCRAExternal/community/Details/41bf65a8-2e69-4eba-b35a-509c25d4f9f9)

Assumes 22.4 lbs of CO2 released per gallon of diesel burned, which is the EIA's estimate.  
(eia.gov/tools/faqs/faq.php?id=307)

Assumes 85% efficiency of heaters, which is likely to be accurate due to the prevalence of high efficiency heaters, such as the Toyotome Laser (87%).  
(toyotomiusa.com/factoryOutletStore/L-73-Toyotomi-Laser-Vented-Heater)

Icons from FlatIcon's free-to-use icon library.

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**KONGIGANAK**  
2020 Energy Summary (kWh)

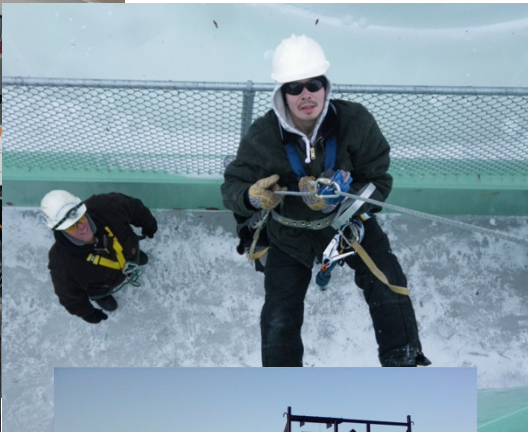
Generation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Diesel 1	40,400	20,520	560	-	-	-	-	-	-	-	-	-	61,480
Diesel 2	39,170	56,890	43,040	33,140	55,040	40,480	40,180	26,220	32,260	42,940	30,370	42,440	482,170
Diesel 3	-	-	-	-	-	8,850	14,030	33,750	3,430	10,440	13,410	14,180	98,090
Diesel 4	40	10,590	17,640	17,710	13,380	18,030	22,890	22,450	16,830	13,350	2,980	16,830	172,720
<b>Total Diesel Generation</b>	<b>79,610</b>	<b>88,000</b>	<b>61,240</b>	<b>50,850</b>	<b>68,420</b>	<b>67,360</b>	<b>77,100</b>	<b>82,420</b>	<b>52,520</b>	<b>66,730</b>	<b>46,760</b>	<b>73,450</b>	<b>814,460</b>
Wind Turbine 1	12,449	6,587	16,806	15,121	7,577	4,594	2,214	-27	-32	-	-0	-	65,287
Wind Turbine 2	-	-	-	-	-	-	-	6,388	9,975	18,289	19,675	19,675	54,326
Wind Turbine 3	14,774	11,732	16,852	15,119	7,514	5,936	4,634	5,154	16,320	12,224	22,283	13,877	146,420
Wind Turbine 4	13,754	5,851	16,108	13,452	6,741	5,651	2,819	3,247	13,602	9,271	16,563	7,452	114,512
Wind Turbine 5	12,587	9,258	16,373	13,954	6,825	6,098	4,607	5,431	15,146	10,927	19,289	13,611	134,105
<b>Total Wind Generation</b>	<b>53,564</b>	<b>33,428</b>	<b>66,138</b>	<b>57,646</b>	<b>28,656</b>	<b>22,281</b>	<b>14,273</b>	<b>13,805</b>	<b>51,424</b>	<b>42,397</b>	<b>76,424</b>	<b>54,615</b>	<b>514,650</b>
<b>Total Generation</b>	<b>133,174</b>	<b>121,428</b>	<b>127,378</b>	<b>108,496</b>	<b>97,076</b>	<b>89,641</b>	<b>91,373</b>	<b>96,225</b>	<b>103,944</b>	<b>109,127</b>	<b>123,184</b>	<b>128,065</b>	<b>1,329,110</b>

Consumption	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Station Service	5,202	4,506	4,617	3,987	3,983	4,047	5,700	4,830	5,289	5,377	5,566	7,199	60,303
Wind to Village	45,827	27,340	47,589	37,536	21,411	17,127	10,631	11,569	40,034	38,520	69,508	20,497	387,589
Wind to Load Regulator	4,039	4,931	8,142	6,896	4,593	3,921	2,482	1,985	4,360	3,987	5,242	2,916	53,494
Wind to ETS	3,698	1,156	10,408	13,214	2,652	1,232	1,160	251	7,030	-110	1,675	31,202	73,567
<b>Total Village</b>	<b>125,437</b>	<b>115,340</b>	<b>108,829</b>	<b>88,386</b>	<b>89,831</b>	<b>84,487</b>	<b>87,731</b>	<b>93,989</b>	<b>92,554</b>	<b>105,250</b>	<b>116,268</b>	<b>93,947</b>	<b>1,202,049</b>
<b>Total Consumption</b>	<b>133,174</b>	<b>121,428</b>	<b>127,378</b>	<b>108,496</b>	<b>97,076</b>	<b>89,641</b>	<b>91,373</b>	<b>96,225</b>	<b>103,944</b>	<b>109,127</b>	<b>123,184</b>	<b>128,065</b>	<b>1,329,110</b>

<b>% Diesel kWh Displaced by Wind</b>	<b>36.5%</b>	<b>23.7%</b>	<b>43.7%</b>	<b>42.5%</b>	<b>23.8%</b>	<b>20.3%</b>	<b>12.1%</b>	<b>12.3%</b>	<b>43.3%</b>	<b>36.6%</b>	<b>59.8%</b>	<b>21.8%</b>	<b>32.2%</b>
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- Since 2013 to 2020 PPC has displaced 275,000 gallons of diesel at both the power plant and ETS homes. With the average price of diesel of \$5.00/gal. the savings is equivalent to \$1,375,000.

# RESULTS!



Kangirarmiut Caurallrit -... Timeline Now

Turn down the oil stove and on with the thermal stove



Like - Comment - Share 1

Qqcuun Campbell, Zena Mute, Evelyn Andrew and 37 others like this.

View all 5 comments

Crystal Lewis Does all thermal stoves work or just some?  
December 2 at 10:49pm

Kangirarmiut Caurallrit - The Going's-On in Kong  
Excess energy gets dispersed to electric stoves equivalent to laser stove heat output  
December 2 at 11:19pm

Just turned their oil stove off :)



Like - Comment - Share

Yuki Daniel, Wayne K Phillip, Maklaar Sim and 30 others like this.

View all 10 comments

Elvina Mute morning Nan Uussa so you won't be cold..winter long  
December 3 at 11:12am

Margaret Active Wow  
Tuesday at 11:41pm





# Lessons Learned

- Components are not meant to last but with the local wind techs we are able to deal with maintenance and repairs on the system components. This cuts the cost on repairs and downtime.
- Remote accessibility is critical for software upgrades and troubleshooting.





# Next Steps

- Expand our renewable energy system with a large-scale solar project- approximately 150 kw
- Keep expanding our renewable system to reach 100% renewables by 2030.

Quyana!  
Roderick Phillip  
Puvurna Power Company  
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## Special Thanks To

Intelligent Energy Systems(IES),  
AEA Renewable Energy Fund, U.S.  
DOE Tribal Energy Program, Calista  
Corporation, Denali Commission,  
Denali Training Fund, NREL,  
the Alaska Legislature, Senator  
Lyman Hoffman and  
Representative Bob Herron, and  
the CWG Community Members  
and Electric Utilities.  
This work is possible because of  
your support.

