2011 NAB Synergy project

- Borough population: 7,810
- Electricity for village water / sewer plants
- Launched in Ambler, replicating across borough
- 10,000 kWh/year from 10 kW array
- Peak production April-June
- Long sunlight hours in summer + 30% reflection from snow-covered ground in spring
- 12.8 year payback

Powering water treatment facilities with renewable energy
Solar PV
Households versus Community

• **Premise**

“To help the Households bring down the cost of Energy”

• How do we do it?

• Let’s take a look at some issues & calculations
# NAB Fuel Prices February 22, 2015

<table>
<thead>
<tr>
<th>Location</th>
<th>Gasoline/G</th>
<th>Stove Oil/G</th>
<th>Propane/23G</th>
<th>Kwh (1-500)</th>
<th>KwH (500-700)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kotzebue</td>
<td>$7.95</td>
<td>$6.32</td>
<td>$186.79</td>
<td>$0.18</td>
<td>$0.45</td>
</tr>
<tr>
<td>Ambler</td>
<td>$10.75</td>
<td>$11.00</td>
<td>$285.00</td>
<td>$0.20</td>
<td>$0.67</td>
</tr>
<tr>
<td>Kobuk</td>
<td>$10.46</td>
<td>$9.65</td>
<td>$270.00</td>
<td>$0.21</td>
<td>$0.73</td>
</tr>
<tr>
<td>Shungnak</td>
<td>$9.00</td>
<td>$9.00</td>
<td>$330.00</td>
<td>$0.21</td>
<td>$0.73</td>
</tr>
<tr>
<td>Kiana</td>
<td>$6.50</td>
<td>$6.00</td>
<td>$270.00</td>
<td>$0.20</td>
<td>$0.56</td>
</tr>
<tr>
<td>Noorvik</td>
<td>$7.50</td>
<td>$7.00</td>
<td>$278.00</td>
<td>$0.20</td>
<td>$0.55</td>
</tr>
<tr>
<td>Selawik</td>
<td>$7.75</td>
<td>$7.50</td>
<td>$264.55</td>
<td>$0.20</td>
<td>$0.51</td>
</tr>
<tr>
<td>Buckland</td>
<td>$7.00</td>
<td>$7.00</td>
<td>$271.00</td>
<td>$0.20</td>
<td>$0.47</td>
</tr>
<tr>
<td>Deering</td>
<td>$6.75</td>
<td>$6.75</td>
<td>$285.00</td>
<td>$0.20</td>
<td>$0.71</td>
</tr>
<tr>
<td>Kivalina</td>
<td>$6.25</td>
<td>$6.75</td>
<td>$285.00</td>
<td>$0.20</td>
<td>$0.55</td>
</tr>
<tr>
<td>Noatak</td>
<td>$9.99</td>
<td>$9.99</td>
<td>$311.00</td>
<td>$0.21</td>
<td>$0.78</td>
</tr>
</tbody>
</table>

**Retail cost**
Average Regional Stove oil prices over time, close to 100% increase over 8 years.
Cost of Water/sewer/month 2014

- Kotzebue $ 150.00
- Ambler $ 175.00
- Kobuk $ 200.00
- Shungnak $ 140.00
- Kiana $ 140.00
- Selawik $ 250.00
- Noorvik $ 150.00
- Buckland $ 175.00 Partial system
- Deering $ 80.00 Washeteria
- Noatak $ 138.00
- Kivalina $ 0.30/g Washeteria
Goals.

The Synergy projects goals are:

• To offset as much electricity as possible without reversing the electric meter. (No Net metering is available)

• Create as broad as possible power curve, to make smaller impact on generators and also match Community usage.
Arctic circle sun at Kotzebue
summer solstice

The Households are using the
Water/Sewer System primarily
during the day
Ambler 45 Deg Solar PV array 8.4 kw

2 DC strings.
- Sharp 240w modules
- 2pc 8 panels
- 2pc 9 panels
- 10 Kw inverter

Production
4.52 Kwh/Kw
Ambler 45 Deg Solar PV array 8.4 kw

<table>
<thead>
<tr>
<th>Status</th>
<th>Power Right Now</th>
<th>Energy Generation</th>
<th>Yahoo! Weather near Ambler, AK United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORM</td>
<td>--</td>
<td>TODAY 0.0 kWh</td>
<td>23°F Fair</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LIFETIME 13.7 MWh</td>
<td>Wind Speed: 3.00 MPH</td>
</tr>
</tbody>
</table>

### Energy

<table>
<thead>
<tr>
<th>1D</th>
<th>7D</th>
<th>30D</th>
<th>12M</th>
<th>WTD</th>
<th>MTD</th>
<th>YTD</th>
<th>Start Date: Mar 01, 2013 - End Date: Mar 01, 2014</th>
</tr>
</thead>
</table>

- **Mar**: 500 kWh
- **May**: 1,500 kWh
- **Jul**: 1,000 kWh
- **Sep**: 500 kWh
- **Nov**: 100 kWh
- **2014**: 50 kWh
Selawik 90 Deg. Solar Array 9.72 Kw

Individual ABB Micro inverters
Solar world 270w
36 Modules

Production 6.9 Kwh/Kw
Selawik, Cloudy day

Individual ABB Micro inverters
Solar world 270w
36 Modules
Noorvik Array

- [https://easyview.auroravision.net/easyview/index.html?entityId=1896042](https://easyview.auroravision.net/easyview/index.html?entityId=1896042)
Kobuk 180 Degree array 7.38 Kw

Individual ABB
Micro inverters
LG 250 & 285 W
27 Modules

Production
5.87
Kwh/Kw
180 Degree Solar PV array Deering 11.55 Kw

Individual ABB Micro inverters
LG 250 & 285 W
42 Modules

Production
6.78
Kwh/Kw
2014 PCE Calculations

• Formula Used to determine PCE level/kWh for a utility:
• Formula: 95% of the eligible costs per kWh between 14.06 cents/kWh, “the floor” and $1.00/kWh, “the ceiling”.
• Costs below 14.06 cents/kWh and above $1.00/kWh are not eligible for PCE.

• If the eligible costs are $1.00/kWh or more, the maximum PCE level is 81.64 cents/kWh
• ($1.00 – 14.06 cents = 85.94 cents x 95% = 81.64 cents).
Residential customers are eligible for PCE credit up to 500 kilowatt-hours (kWh) per month.

This means the effective electric rate for most Households is approximately $0.20/Kwh.

As long as they don’t use more than 500 Kwh.
• **Community facilities,**

• as a group, can receive PCE credit for up to 70 kilowatt-hours per month multiplied by the number of residents in a community.

• For Ambler @ 271 residents that means
That up to 18,970 Kwh of PCE is available / month

<table>
<thead>
<tr>
<th>Ambler 2012 effective rate</th>
<th>Fuel</th>
<th>1-500kwh</th>
<th>over 700kwh</th>
</tr>
</thead>
<tbody>
<tr>
<td>base el. Rate.</td>
<td>0.3761</td>
<td>0.6761</td>
<td>0.58</td>
</tr>
<tr>
<td>PCE</td>
<td>0.4543</td>
<td>0.45</td>
<td></td>
</tr>
</tbody>
</table>
### Solar Savings 2008 calculations

#### 10 Kw array

<table>
<thead>
<tr>
<th>Kwh produced</th>
<th>Net Power 1 kwh</th>
<th>PCE 1 Cost 1 kwh</th>
<th>PCE 2 Cost 2 kwh</th>
<th>Fuel cost per kwh</th>
<th>PCE</th>
<th>Costsavings</th>
<th>Change savings</th>
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</thead>
<tbody>
<tr>
<td>1426</td>
<td>0</td>
<td>1426</td>
<td>224</td>
<td>0.32</td>
<td>444.29</td>
<td>159.72</td>
<td>0.22 313.19</td>
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<tr>
<td>1426</td>
<td>1167</td>
<td>259</td>
<td>82.88</td>
<td>0.32</td>
<td>164.39</td>
<td>0</td>
<td>0.22 0</td>
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</tbody>
</table>

PCE level $0.6347/Kwh

year 3788.98 year 7117.19
# PCE allocations (AVEC)

<table>
<thead>
<tr>
<th>CF Acct</th>
<th>kWh Used</th>
<th>Total kWh (A)</th>
<th>% of Total Elig (B)</th>
<th>Total Eligible (C)</th>
<th>Total Available (D)</th>
<th>Rpt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-700</td>
<td>700</td>
<td>4499</td>
<td>28.35%</td>
<td>1145.254</td>
<td>4053.75</td>
<td>4057.43</td>
</tr>
<tr>
<td>701+</td>
<td>272</td>
<td>272</td>
<td>1.48%</td>
<td>59.91712</td>
<td>212.08</td>
<td>212.27</td>
</tr>
<tr>
<td>3</td>
<td>640</td>
<td>640</td>
<td>3.49%</td>
<td>140.9815</td>
<td>499.02</td>
<td>499.47</td>
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<tr>
<td>4</td>
<td>42</td>
<td>42</td>
<td>0.23%</td>
<td>9.251908</td>
<td>32.75</td>
<td>32.77</td>
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<tr>
<td>5</td>
<td>700</td>
<td>4046</td>
<td>25.88%</td>
<td>1045.466</td>
<td>3700.53</td>
<td>3703.89</td>
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<tr>
<td>6</td>
<td>700</td>
<td>917</td>
<td>8.82%</td>
<td>356.1985</td>
<td>1260.80</td>
<td>1261.94</td>
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<tr>
<td>7</td>
<td>700</td>
<td>78</td>
<td>4.24%</td>
<td>171.3806</td>
<td>606.62</td>
<td>607.17</td>
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<tr>
<td>8</td>
<td>87</td>
<td>87</td>
<td>0.47%</td>
<td>19.16467</td>
<td>67.84</td>
<td>67.89</td>
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<tr>
<td>9</td>
<td>700</td>
<td>235</td>
<td>5.10%</td>
<td>205.9651</td>
<td>729.03</td>
<td>729.69</td>
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<tr>
<td>10</td>
<td>700</td>
<td>1423</td>
<td>11.58%</td>
<td>467.6619</td>
<td>1655.34</td>
<td>1656.84</td>
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<tr>
<td>11</td>
<td>405</td>
<td>405</td>
<td>2.21%</td>
<td>89.21483</td>
<td>315.79</td>
<td>316.07</td>
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<tr>
<td>12</td>
<td>700</td>
<td>1211</td>
<td>10.42%</td>
<td>420.9618</td>
<td>1490.04</td>
<td>1491.39</td>
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<tr>
<td>13</td>
<td>700</td>
<td>1529</td>
<td>12.15%</td>
<td>491.0122</td>
<td>1737.99</td>
<td>1739.56</td>
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<tr>
<td>14</td>
<td>395</td>
<td>395</td>
<td>2.15%</td>
<td>87.0122</td>
<td>307.99</td>
<td>308.26</td>
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<tr>
<td>15</td>
<td>98</td>
<td>98</td>
<td>0.53%</td>
<td>21.58779</td>
<td>76.41</td>
<td>76.48</td>
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<tr>
<td>16</td>
<td>700</td>
<td>203</td>
<td>4.92%</td>
<td>198.916</td>
<td>704.08</td>
<td>704.72</td>
</tr>
<tr>
<td>17 SL</td>
<td>1120</td>
<td>1120</td>
<td>6.11%</td>
<td>246.7176</td>
<td>873.28</td>
<td>873.88</td>
</tr>
<tr>
<td><strong>Total USED</strong></td>
<td>22380 (G)</td>
<td></td>
<td></td>
<td>18323.34</td>
<td>18339.72</td>
<td>18323.34</td>
</tr>
<tr>
<td><strong>Over Limit?</strong></td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Over by:</strong></td>
<td>4040 (F)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
## Current solar data 4/25/15

<table>
<thead>
<tr>
<th>Community</th>
<th>Installed size Kw</th>
<th>MWh</th>
<th>$/Kwh</th>
<th>$</th>
<th>lb</th>
<th>Gallon</th>
<th>$</th>
<th>Cost installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Since comm retail 4/18/2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambler</td>
<td>10/30/2012</td>
<td>8.4</td>
<td>13.4</td>
<td>0.67</td>
<td>$8,978.00</td>
<td>39,412</td>
<td>992.59</td>
<td>75,000 (8.928571)</td>
</tr>
<tr>
<td>Ambler IRA</td>
<td>10/30/2012</td>
<td>2.2</td>
<td>2.5</td>
<td>0.67</td>
<td>$1,675.00</td>
<td>7,353</td>
<td>185.19</td>
<td>25,000 (11.36364)</td>
</tr>
<tr>
<td>Kobuk</td>
<td>3/1/2013</td>
<td>7.38</td>
<td>5.9</td>
<td>0.73</td>
<td>$4,307.00</td>
<td>17,353</td>
<td>437.04</td>
<td>75,000 (10.1626)</td>
</tr>
<tr>
<td>Shungnak</td>
<td>10/1/2013</td>
<td>7.5</td>
<td>4.5</td>
<td>0.73</td>
<td>$3,285.00</td>
<td>13,235</td>
<td>333.33</td>
<td>75,000 (10)</td>
</tr>
<tr>
<td>Noorvik</td>
<td>10/1/2013</td>
<td>12</td>
<td>13.5</td>
<td>0.55</td>
<td>$7,425.00</td>
<td>39,706</td>
<td>1000.00</td>
<td>75,000 (6.25)</td>
</tr>
<tr>
<td>Noatak</td>
<td>11/1/2013</td>
<td>10.77</td>
<td>10.4</td>
<td>0.78</td>
<td>$8,112.00</td>
<td>30,588</td>
<td>770.37</td>
<td>75,000 (6.963788)</td>
</tr>
<tr>
<td>Deering</td>
<td>11/1/2013</td>
<td>11.55</td>
<td>10.5</td>
<td>0.71</td>
<td>$7,455.00</td>
<td>30,882</td>
<td>777.78</td>
<td>75,000 (6.493506)</td>
</tr>
<tr>
<td>Kotzebue-1</td>
<td>10/15/2014</td>
<td>10.53</td>
<td>1.834</td>
<td>0.45</td>
<td>$825.30</td>
<td>5,394</td>
<td>135.85</td>
<td>83,000 (7.882241)</td>
</tr>
<tr>
<td>Kotzebue-2</td>
<td>11/10/2014</td>
<td>10.53</td>
<td>0.635</td>
<td>0.45</td>
<td>$285.75</td>
<td>1,868</td>
<td>47.04</td>
<td>83,000 (7.882241)</td>
</tr>
<tr>
<td>Selawik</td>
<td>12/10/2014</td>
<td>9.72</td>
<td>2.4</td>
<td>0.51</td>
<td>$1,224.00</td>
<td>7,059</td>
<td>177.78</td>
<td>83,000 (8.539095)</td>
</tr>
<tr>
<td>Kiana</td>
<td>10.53</td>
<td>0.56</td>
<td>$0.00</td>
<td></td>
<td>0</td>
<td>0.00</td>
<td>83,000 (7.882241)</td>
<td></td>
</tr>
<tr>
<td>Buckland</td>
<td>10.53</td>
<td>0.47</td>
<td>$0.00</td>
<td></td>
<td>0</td>
<td>0.00</td>
<td>83,000 (7.882241)</td>
<td></td>
</tr>
<tr>
<td>Kivalina</td>
<td>10.53</td>
<td>0.55</td>
<td>$0.00</td>
<td></td>
<td>0</td>
<td>0.00</td>
<td>83,000 (7.882241)</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>122.17</td>
<td>65.569</td>
<td></td>
<td><strong>$43,572.05</strong></td>
<td><strong>192,850</strong></td>
<td><strong>4856.96</strong></td>
<td><strong>973,000</strong></td>
<td><strong>8.316339</strong></td>
</tr>
</tbody>
</table>
AVEC Cogeneration agreement

Attach copies of the following:

• 1) Evidence of Manufacturer's Product Liability Insurance

• 2) Homeowner's Insurance or other Liability Insurance showing evidence of indemnification of AVEC indemnification of AVEC for personal injury or property damage in an amount not less than $500,000.

• 3) Electrical Drawings page
Questions ?
Selawik 90 Deg. March 28

Status: 2, MEDIUM

Power Right Now:
- TODAY: 26.7 kWh
- LIFETIME: 1.5 MWh

Energy Generation:
- TODAY: 26.7 kWh
- LIFETIME: 1.5 MWh

Yahoo! Weather near Selawik Airport, AK United States
- Temperature: 7°F
- Humidity: 82%
- Pressure: 2.51
- Wind Speed: 15.00 MPH
- Wind Direction: 270
- Cloudy
- Visibility: 10.00 mi

Power Chart:
- Time: 03:00 to 21:00
- Energy Output: 0 to 10,000 kWh
- Graph shows energy output over the day with a peak around 12:00.
Kobuk 180 Deg. March 21

Status: 1 MEDIUM

Power Right Now:

- 30.6 kWh

Energy Generation:

- TODAY: 30.6 kWh
- LIFETIME: 5.4 MWh

Yahoo! Weather:

- Temperature: 9°F
- Weather: Cloudy
- Wind:
  - Speed: 9.00 MPH
  - Direction: 310
- Humidity: 80%
- Pressure: 2.51"
Selawik on a cloudy day

Yahoo! Weather near Selawik Airport, AK United States

Status: MEDIUM
Power Right Now: 2.0 kW
Energy Generation: TODAY 35.0 kWh, LIFETIME 2.2 MWh

Atmosphere:
- Temperature: 7 °F
- Humidity: 82%
- Pressure: 2.48 "
- Visibility: 10.00 mi

Wind:
- Speed: 18.00 MPH
- Direction: 260°

Power

- 1D
- 7D
- 30D
- 12M
- WTD
- MTD
- YTD

Chart showing energy generation from 03:00 to 18:00 on April 15, 2015.