Planting the Seeds to Examine Food Security Challenges in the Alaska Food-Energy-Water Nexus

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The Food-Energy Water Nexus

What is the Food-Energy-Water Nexus?
- It takes energy to clean and treat water and to grow food.
- It takes water to grow food and produce electrical power.
- It takes food to power us all to keep these systems running.

These three parts are optimized when considered as parts of a whole, holistic system.
MicroFEWS: The Food-Energy Water Nexus in Rural Alaska

- How Renewable Energy Contributes to Food Security
- Renewables Directly to Heat
- Excess Renewable Generation to Heat
- {Anyone else want to add anything here?}
70 of ~200 Alaska RIMs use renewable energy sources.

Alaska has ~12% of the world's microgrids that incorporate grid scale renewable resources. (data from Navigant Research)
Some renewables already are heat; why not use it as is?

- Solar
- Biomass
- Geothermal

For variable electrical generation, heat is a convenient “dump load” to shed excess generation without wasting it:

- Wind
- Solar
- Conventional hydro
- Hydrokinetic (maybe)

What is a “dump load?”
What is a “dump load” or “dispatchable load”?
- Not time-sensitive
- Not frequency-sensitive

Why is a “dump load” useful?
- Utilize more renewable energy that would otherwise be wasted.
- Stabilize electrical frequency on AC systems.

Easiest usage?
- Heat! Such as for greenhouses!
MicroFEWS Energy Distribution and Dispatch in Rural Alaska

**VARIABLE RENEWABLES**
- Solar PV
- Wind
- Hydrokinetic (In-River)

**FIRM ENERGY SOURCES**
- Diesel Electric
- Hydroelectric (Dam)

**ENERGY DISTRIBUTION & DISPATCH**

**FOOD PRODUCTION AND WATER TREATMENT**

**MODULAR SYSTEM LOADS**
- Lifewater Wastewater Treatment Module (350 W Max)
- UAA In-home Water Reuse System (1.0 kW Max)
- CropBox Hydroponic Module (14 kW Max)

**ENERGY STORAGE SYSTEMS**
- Inverter
- Battery
- Flywheel
- Electric Thermal Heaters

Photo Credit: Steffes Corporation
Example 1: Wind + Diesel → Dispatchable Loads (Water Reuse + CropBox)
Example 2: Passive Solar + Diesel → Water Treatment + Greenhouse
Example 2: Passive Solar, Solar PV, Diesel → Water Treatment + Greenhouse
Example 3: Kongiginak Wind → Heat System

Diesel off with wind + energy storage + distributed heating

20+ thermal electric stoves installed in elder and low income homes

5 - 95 kW Windmatic direct drive turbines
(30-40% wind penetration annually)

VIDEO: https://www.youtube.com/watch?v=90n9ga3SOQQ
Our communities
Kongiganak

http://www.iesconnect.net/projects/kongiganak-wind-heat-system/
Tanana
Cordova

Food

Water

Energy

$14

$10/dozen

Fresh Oysters

Natural Resources Company

![Fishing Harbor](image)

![Hydroelectric Dam](image)
Food Production Components

Market
Subsistence
Locally Grown
Local Food Production in Rural Alaska

- Challenges
  - Funding
  - Lack of piped water
  - Short growing season
  - Takes energy
  - Poor soil
  - Upkeep for projects (labor/education)
  - Consistency (animal/fish populations go up and down)
  - Storage?
What advice would you give to communities in rural Alaska?

- Funding
- Lack of piped water
- Up keep
- Energy
- Poor soil
- ARE YOU STUCK?
What is food security?

Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. - 1996 World Food Summit

FAO 2008. An introduction to the basic concepts of food security. Food and Agriculture Organization of the United Nations
What is food security?

- Subsistence availability
- Market availability
- Food production
- Level of sharing

- Economic cost
- Allocation
- Income
- Infrastructure

- Social value
- Knowledge
- Food safety
- Food quality

- Consistency of affordability
- Consistency of supply
## Examples of food security extremes

<table>
<thead>
<tr>
<th></th>
<th><strong>High</strong></th>
<th><strong>Low</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Availability</strong></td>
<td>Animal/fish populations abundant</td>
<td>Animal/fish populations scarce</td>
</tr>
<tr>
<td></td>
<td>Large local store</td>
<td>No local store</td>
</tr>
<tr>
<td><strong>Access</strong></td>
<td>Food is too expensive</td>
<td>Low cost food</td>
</tr>
<tr>
<td></td>
<td>Working coolers in store</td>
<td>Broken coolers in store</td>
</tr>
<tr>
<td><strong>Utilization</strong></td>
<td>Nutritious food is available</td>
<td>Only foods poor in nutrition are available</td>
</tr>
<tr>
<td></td>
<td>Culturally relevant food is available</td>
<td>Lack of subsistence or locally harvested foods</td>
</tr>
<tr>
<td><strong>Stability</strong></td>
<td>Little change in availability of goods at the store</td>
<td>Never know what the store will have</td>
</tr>
<tr>
<td></td>
<td>Prices do not fluctuate and are predictable</td>
<td>Prices vary based on season, transportation, etc.</td>
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Thank you!
Any Questions?

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Questions We Have for You!

- What are your top three concerns about Food Security?
- Do you have any ideas for helping a community with no agriculture history to kick off an ag culture?
- We have set one of our project goals to maximize renewable energy usage to minimize cost. Do you have any thoughts on this?
- What are your food storage challenges?
- What do people want to grow in your community? Cabbages, per Tim Meyer? Or fresh herbs?
- To produce more local food vs. to make food tastier vs. to sell for profit?
- How do you define food security?