Why a Food-Energy-Water Nexus Approach is Useful in Rural Alaska Communities

Erin Whitney

April 12, 2018

UNIVERSITY OF ALASKA FAIRBANKS

ACEP
Alaska Center for Energy and Power

The Food-Energy-Water Nexus

FOOD

On grid:
-greenhouses
-cold storage

Off grid:
-subsistence
-market food/prices
-community agriculture

External:
-game migration patterns
-global markets

The Food-Energy-Water Nexus

FOOD	ENERGY
On grid:	
-greenhouses	-power plant
-cold storage	-turbines
	-battery storage
	-electric heat
Off grid:	
-subsistence	
-market food/prices	-fuel oil cost
-community agriculture	-motor oil cost
External:	
-game migration patterns	-global energy market
-global markets	-energy resource availability

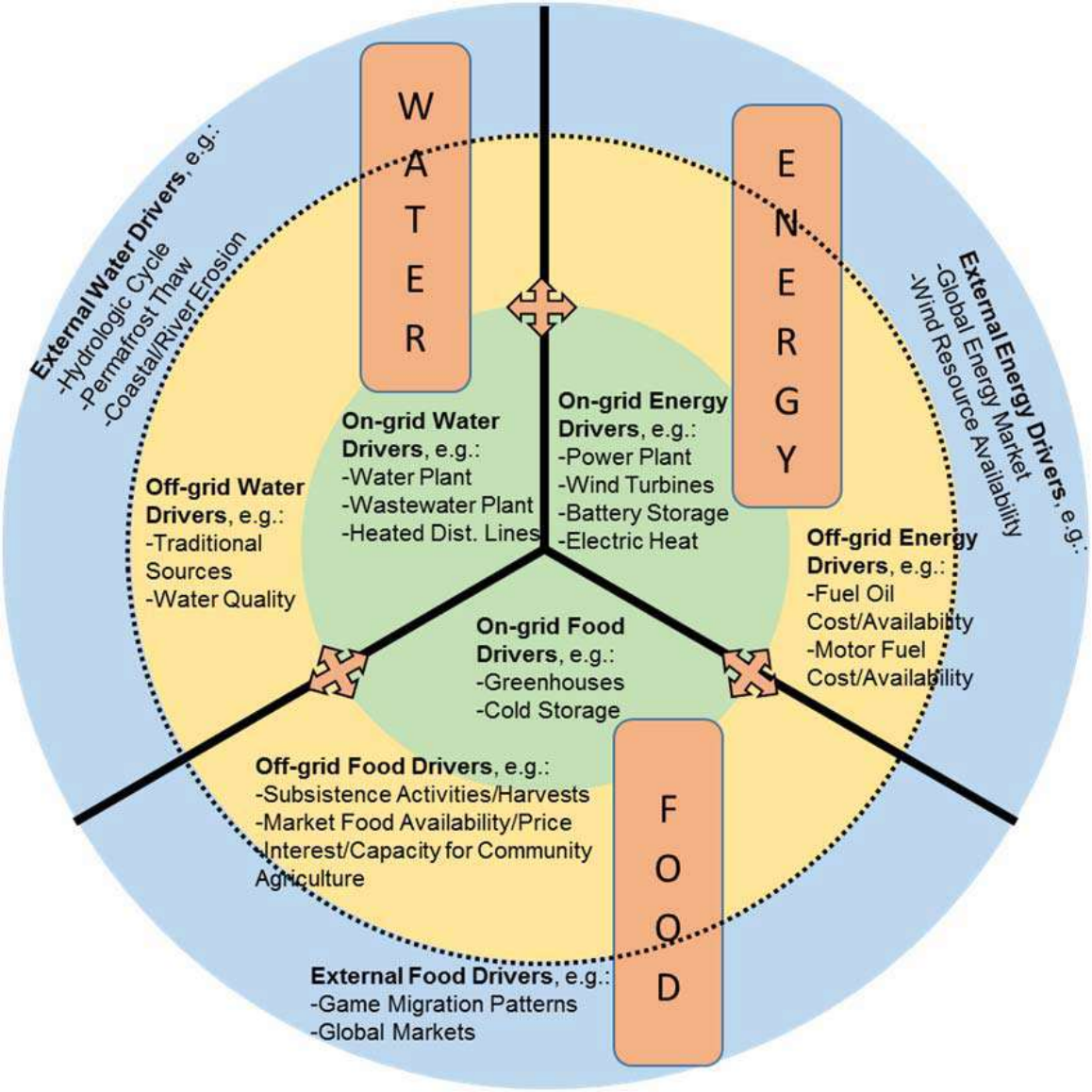
The Food-Energy-Water Nexus

FOOD	ENERGY	WATER
On grid:		
-greenhouses	-power plant	-water plant
-cold storage	-turbines	-waster water plant
	-battery storage	-heated distribution lines
	-electric heat	
Off grid:		
-subsistence		
-market food/prices	-fuel oil cost	-traditional sources
-community agriculture	-motor oil cost	-water quality
External:		
-game migration patterns	-global energy market	-hydrologic cycle
-global markets	-energy resource availability	-permafrost thaw
		-coastal river erosion

The Food-Energy-Water Nexus

FOOD	ENERGY	WATER
On grid: -greenhouses -cold storage	-power plant -turbines -battery storage -electric heat	-water plant -waster water plant -heated distribution lines
Off grid: -subsistence -market food/prices -community agriculture	-fuel oil cost -motor oil cost	-traditional sources -water quality
External: -game migration patterns -global markets	-global energy market -energy resource availability	-hydrologic cycle -permafrost thaw -coastal river erosion

The Food-Energy-Water Nexus



Tanana

Cordova

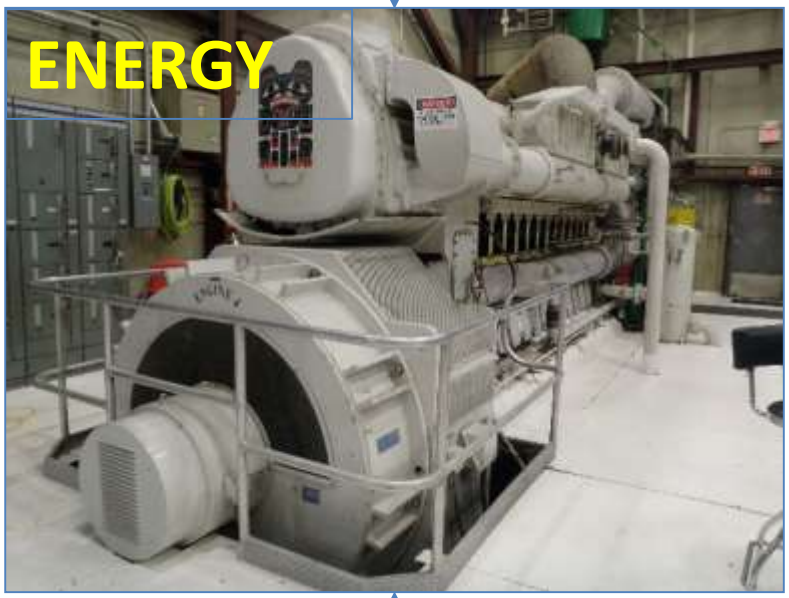


image source: http://www.crks.org/wp/?page_id=1600

image source: https://www.abeautifulplate.com/story-of-copper-river-salmon/

National Science Foundation Funding Announcement (November 2016)

"The NSF INFEWS initiative is designed specifically to attain the following goals:

1. Significantly advance our understanding of the food-energy-water system through quantitative, predictive and computational modeling, including support for relevant cyberinfrastructure;

2. Develop real-time, cyber-enabled interfaces that improve understanding of the behavior of FEW systems and increase decision support capability;

3. Enable research that will lead to innovative solutions to critical FEW systems problems; and

4. Grow the scientific workforce capable of studying and managing the FEW system, through education and other professional development opportunities."

Our Proposal

Goal:

To develop a modeling process (MicroFEWs) for characterizing the impacts of potential renewable energy infrastructure upon the Food-Energy-Water (FEW) nexus in isolated Arctic and Subarctic communities.

Key Research Questions:

A. What are the linkages between renewable energy generation and the local food, energy, and water (FEW) security in Arctic and Subarctic communities?

B. *To what extent can combinations of renewable energy generation and FEW-related energy loads be optimized to enhance FEW security in these communities?*

Project Phases (Duration: 3.5 years)

1. Stakeholder development of the FEW framework

What are the FEW connections in communities, and how do we measure them?

What infrastructure components influence FEW security?

Project Phases (Duration: 3.5 years)

1. Stakeholder development of the FEW framework

What are the FEW connections in communities, and how do we measure them?

What infrastructure components influence FEW security?

2. Baseline data collection

What are the key data streams necessary to understand and characterize existing FEW linkages?

Project Phases (Duration: 3.5 years)

1. Stakeholder development of the FEW framework

What are the FEW connections in communities, and how do we measure them?

What infrastructure components influence FEW security?

2. Baseline data collection

What are the key data streams necessary to understand and characterize existing FEW linkages?

3. **Modular systems case studies**

How can new technologies not currently deployed in renewable hybrid grids be evaluated for their potential to influence FEW security?

Lifewater Wastewater Treatment

UAA In-home Water Reuse System

Containerized Farms

Project Phases (Duration: 3.5 years)

1. Stakeholder development of the FEW framework

What are the FEW connections in communities, and how do we measure them?

What infrastructure components influence FEW security?

2. Baseline data collection

What are the key data streams necessary to understand and characterize existing FEW linkages?

3. **Modular systems case studies**

How can new technologies not currently deployed in renewable hybrid grids be evaluated for their potential to influence FEW security?

4. **Novel Energy Distribution Models (EDMs)**

How can renewable energy and FEW-related infrastructure loads be modeled to optimally manage the variable energy demands associated with production of place-based food, energy, and water requirements, but also to enhance grid stability?

Project Phases (Duration: 3.5 years)

1. Stakeholder development of the FEW framework

What are the FEW connections in communities, and how do we measure them?

What infrastructure components influence FEW security?

2. Baseline data collection

What are the key data streams necessary to understand and characterize existing FEW linkages in remote communities?

3. **Modular systems case studies**

How can new technologies not currently deployed in renewable hybrid grids be evaluated for their potential to influence FEW security?

4. **Novel Energy Distribution Models (EDMs)**

How can renewable energy and FEW-related infrastructure loads be modeled to optimally manage the variable energy demands associated with production of place-based food, energy, and water requirements, but also to enhance grid stability?

5. **MicroFEWs synthesis**

What are the feedbacks between the on-grid infrastructure components described in Objective 4, and the off-grid drivers of the local FEW nexus?

Project Phases (Duration: 3.5 years)

1. Stakeholder development of the FEW framework

What are the FEW connections in communities, and how do we measure them?

What infrastructure components influence FEW security?

2. Baseline data collection

What are the key data streams necessary to understand and characterize existing FEW linkages in remote communities?

3. **Modular systems case studies**

How can new technologies not currently deployed in renewable hybrid grids be evaluated for their potential to influence FEW security?

4. **Novel Energy Distribution Models (EDMs)**

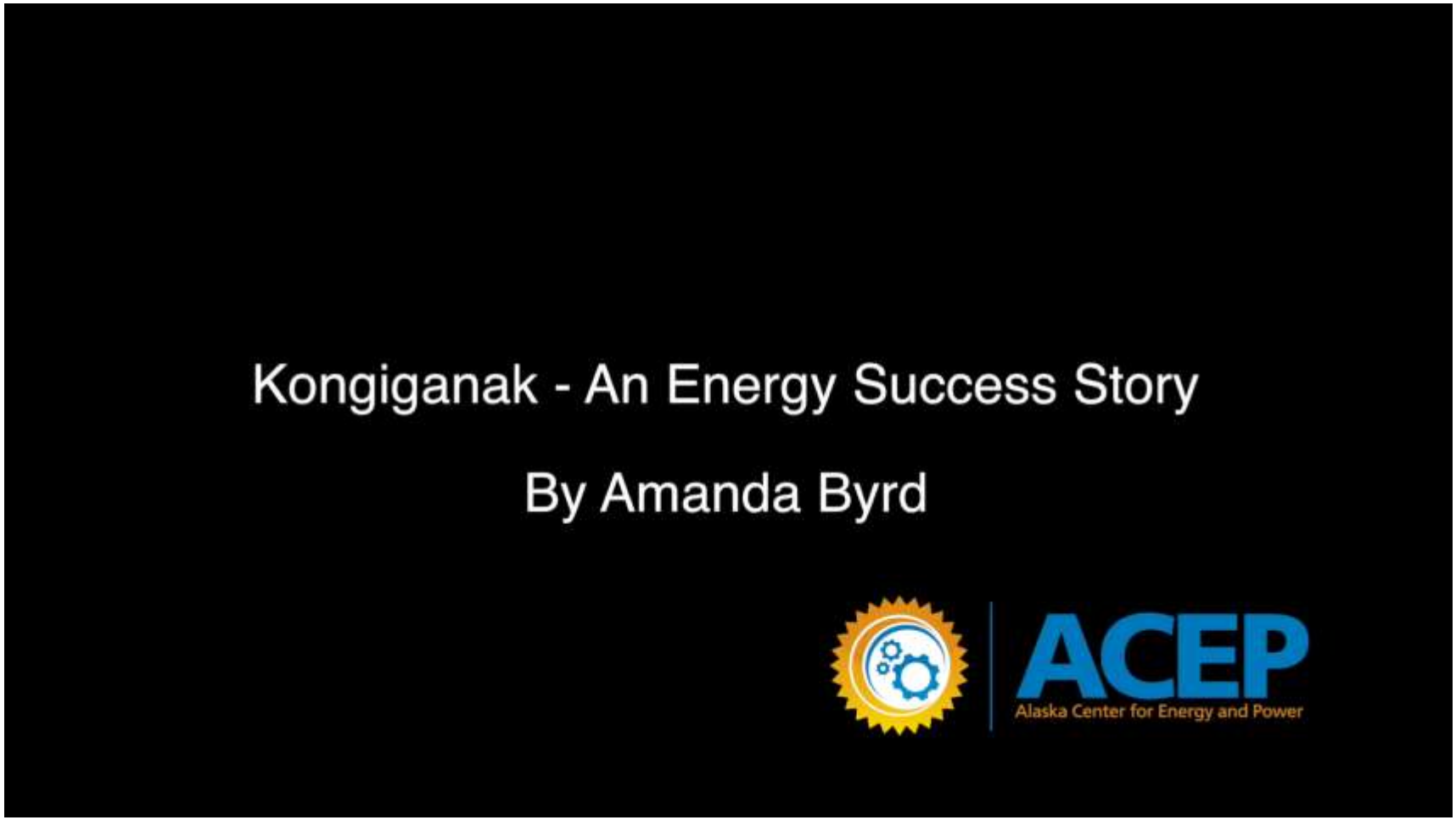
How can renewable energy and FEW-related infrastructure loads be modeled to optimally manage the variable energy demands associated with production of place-based food, energy, and water requirements, but also to enhance grid stability?

5. **MicroFEWs synthesis**

What are the feedbacks between the on-grid infrastructure components described in Objective 4, and the off-grid drivers of the local FEW nexus?

6. **Outreach and capacity development**

How can the knowledge gained from the MicroFEWs process build capacity for community-level planning and continued FEWs research?


Kongiganak - An Energy Success Story
By Amanda Byrd
ACEP
Alaska Center for Energy and Power