

Department of Energy  
Office of Energy Efficiency and Renewable Energy  
TRIBAL ENERGY PROGRAM  
FY2004 Year End Project Review Meeting  
Golden, Colorado

# POWERING REMOTE NORTHERN VILLAGES WITH THE MIDNIGHT SUN

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# Project Location

- Alaska Native Gwich'in Indian communities of Arctic Village and Venetie are in northeast Alaska.
- There are no roads to our communities.
- All fuel must be flown in on planes



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# Project Overview

- Known as:
- Americas serengeti
- Largest herd of free range animals outside of Africa
- 170,000 Caribou
- Our culture, tradition, and subsistence depend upon the Porcupine Caribou Herd.



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# Project Team

- **NVVTG**

Native Village of Venetie Tribal Government

- **Arctic Village Electric Utility**

- **Venetie Electric Utility**

- **EES**

Earth Energy Systems

- **IPEC**

Independence Power & Energy Consulting

- **NREL**

National Renewable Energy Laboratory

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# Project Partners

- **Native Village of Venetie Tribal Government**
- **Arctic Village Council**
- **Venetie Village Council**
- **Native Village of Ft. Yukon**
- **Council of Athabascan Tribal Governments**
- **Alaska Native Tribal Health Consortium**
- **University of Alaska, Fairbanks**
- **Denali Commission**
- **Alaska Energy Authority**
- **National Renewable Energy Laboratory**

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# Project Background (cont.)

- Landed cost for Diesel \$2.90 per gallon
- Our energy costs are very high:
  - **\$0.51 per kWh electricity**
  - \$4.75 per gallon gasoline
  - \$3.75 per gallon heating fuel
  - \$120 per 100 lb propane

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# Project Goals

- **Determine the feasibility of powering an entire remote village with renewable and sustainable energy sources.**
- **Compile energy data from the RE systems now in place**
- **Offset the high cost of energy in economically distressed communities**

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# Project Overview (cont.)

- **We believe Renewable Energy, together with better energy efficiency, can:**
  - **teach our young people the importance of energy conservation and new skills**
  - **maintain our subsistence way of life**
  - **save fuel and money in our villages**
  - **lessen environmental risks of fuel use**

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# Current RE systems in use

- 2 of the Worlds farthest North Tribally owned Solar Tracking Array

Venetie, AK

Arctic Village, AK



# Current RE systems in use



- **Waste Heat Recovery**

Constant loop of 180 f glycol from the generator cooling system provides free heat to the community washeteria/laundry/shower facility.

We are looking at ways to use this in other applications.

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# Current RE systems in use

- **Energy Conservation Programs**



We partnered with a regional non-profit to bring energy saving CFL's, electronic ballasts, refrigerator coil brushes, Pressure cookers, comforters, and home weather stripping supplies to low income homes. 2002 12 21

# Project Overview (cont.)

- Our remote communities are dependent on diesel fuel for most of our energy needs.



- We want to reduce our dependency, and increase our self-sufficiency.

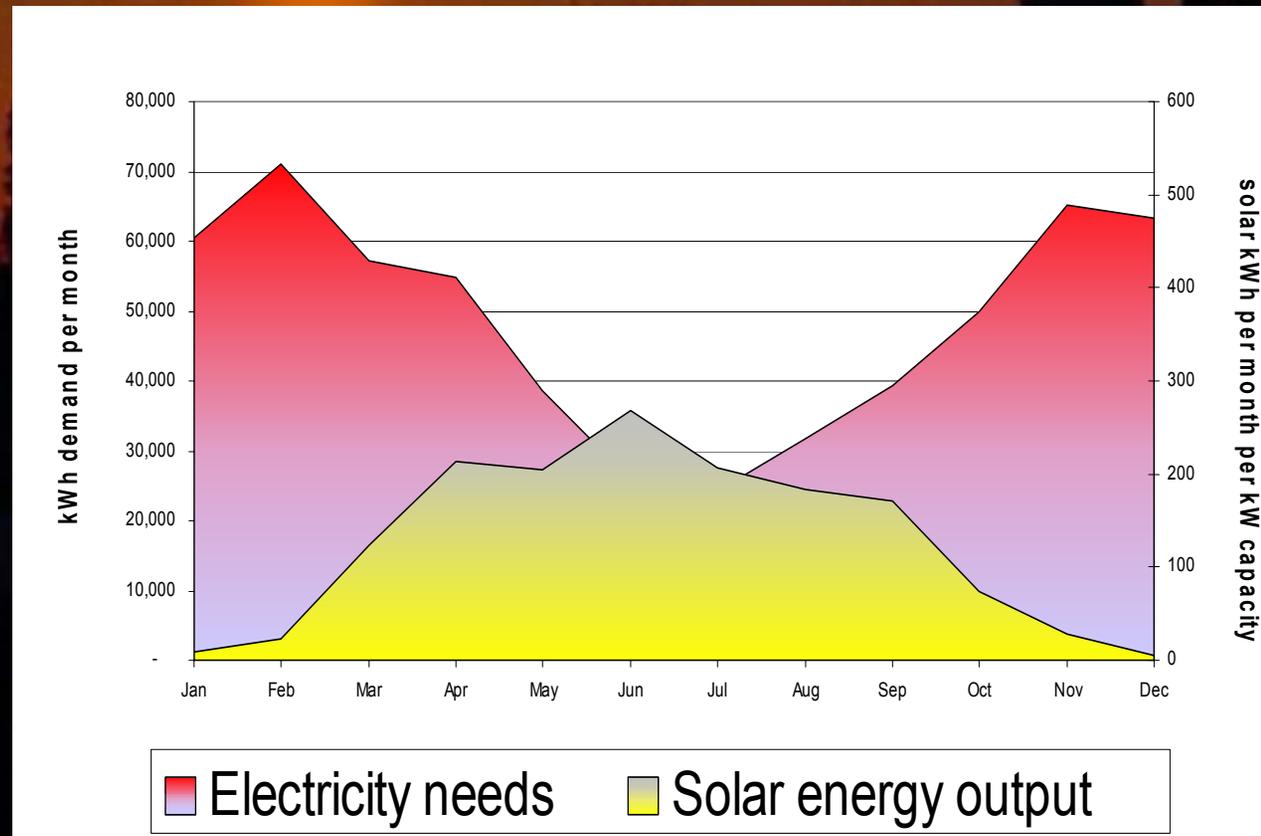
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# Project Overview (cont.)

- During the summer...

we use  
much less  
electricity

and we have  
sunlight  
24/7.



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# Project Objectives

- **Develop new skills among our young people to help maintain and ensure sustainability of our Renewable energy systems and subsistence way of life.**



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# Project Objectives (cont.)

- **Assess our current energy use and growth to better know how and where we use our fuel.**
- **Evaluate our existing PV systems' fuel savings and integration with our village electricity grids.**

# Project Objectives (cont.)



- **Determine costs & benefits of renewable energy resources and energy storage systems that could greatly displace our diesel power during summer.**

# Project Objectives (cont.)

- Identify best sustainable systems for our villages.



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# Project Objectives (cont.)

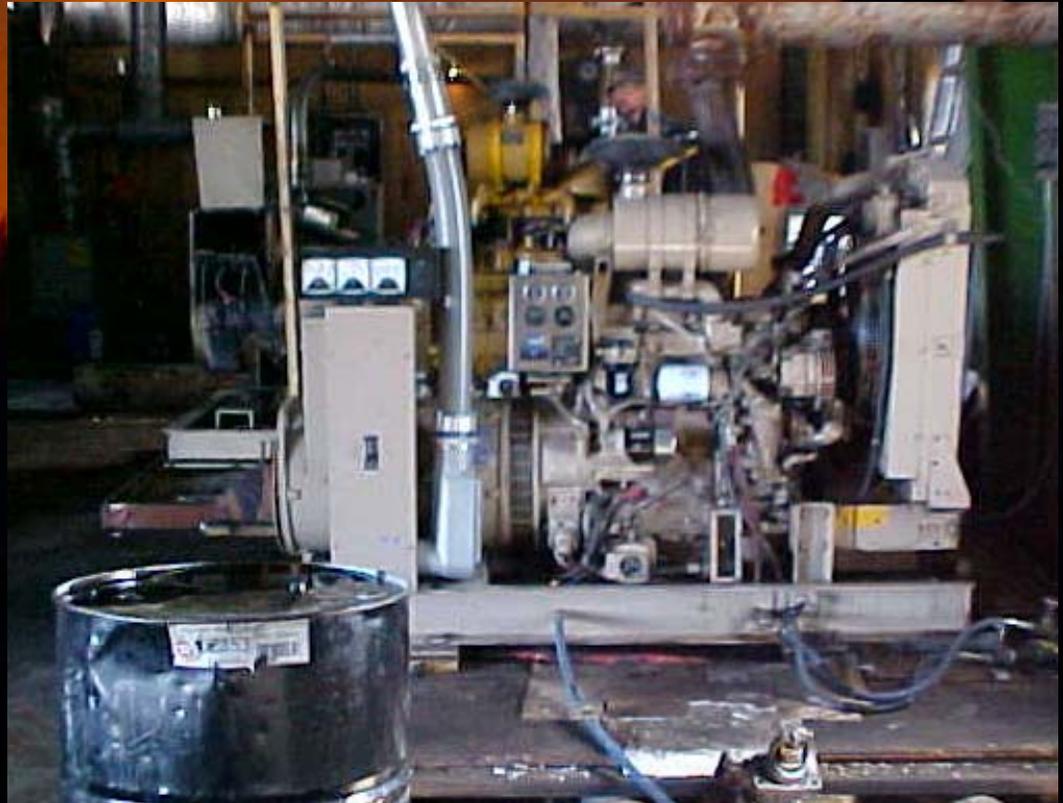
- Develop a business plan to implement the projects.
- Pass our knowledge on to our young people and to other villages.



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# Project Background

- Our village electric power systems are separate.
- Each village has its own diesel-fired generators.



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# Project Background (cont.)

- All our diesel fuel is delivered by air tankers.
- There are great risks and costs involved.



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# Project Background (cont.)

- In year 2000 we began an examination of our renewable energy resources.
- Airport weather histories indicated our wind resources were low quality.
- Better wind resources may exist, but not near to our village power systems.

# Project Background (cont.)

- **Initially we had limited ability to monitor our PV performance.**
- **We did find our small electric grids had unstable power, making integration of PV power output difficult.**
- **Nevertheless our energy programs have reduced our diesel fuel consumption.**

# Project Background (cont.)

- We also installed a PV performance monitoring system.
- We learned how to avoid most of our earlier power system integration problems.

The screenshot displays the Sunny Data Control software interface for a Venetie 2.1 kW Tracker system. The main window shows a 'Current Plant Tree' with two devices: SBC+4CIZ SN:115405092 and WR25004E SN:1353704745. A 'Single Device Information' window is open for the SBC+4CIZ device, showing details such as Device name, Serial Number, Device Type, Field Position, and Transmission Quality. A 'General Overview' window displays real-time power output of 16.0 W and cumulative energy production of 392.1 kWh. A 'Data Channels' window shows a sun icon with 'Vpv 233 V' and 'Iac 79 mA'. A 'Parameters' window shows various energy and operating time statistics. The background of the software interface features a photograph of a person standing next to a large array of solar panels.

Channel Name	Value	Unit
Pac	0.016	kW
E-Total	392	kWh
E-today	0	kWh
Operating Time	806	h
Power On	7	
Serial Number	115405092	
Mode	operating	
Error	---	
Energy Values	35	days
Measuring Data	3401	cycles
Detected	1	devices
Registered	1	devices
Modem-Status	operating	
+Diag Ext+24V	Error	
+Diag D Out	OK	
+Diag MonStart	Cfg-Error	
Error-Cnt	1	

Parameter	Value
Pac	0.016 kW
E-Total	392 kWh
E-today	0 kWh
Operating Time	806 h
Power On	7
Serial Number	115405092
Mode	operating
Error	---
Energy Values	35 days
Measuring Data	3401 cycles
Detected	1 devices
Registered	1 devices
Modem-Status	operating

Parameter	Value
E-Total	392 kWh
h-Total	529 h
Error	---
Pac	16 W

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# Project Background (cont.)

- In fall 2002, we upgraded our fixed-array PV system components after a manufacturer's recall.
- We integrated the upgraded components with our performance monitoring system.
- Upgrades helped to solve earlier power system integration problems.

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# Project Background (cont.)

- In summer 2003, we enabled internet viewing of our PV system performance in near-realtime.

<http://www.rusg.com/educational/nrthrsol/stations/stations.shtml>

- We hope to develop a local school curriculum around it.

## Venetie Washeteria Solar Arrays

### Venetie, AK

[RUSG Home](#) | [Project Home](#) | [Villages](#) | [Contacts](#) | [Educational Resources](#) | [Links](#)

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Station Name: Venetie Washeteria  
 Location: Venetie, AK  
 Coordinates: 67°0.7N 146°23.9 W  
 Elevation: 600 ft above sea level

Notes:  
 Elevation measured from mean sea level  
 Datum Used: WGS 84



[Current Conditions](#) | [Historical Data](#) | [Photo Gallery](#) | [Station History](#)

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Conditions at the Washeteria as of  
September 20, 3: 10 pm

Provisional Data

System Summary Data		
Solar Insolation	Output Power	Heat Sink Temperature
[14] W/m <sup>2</sup>	[1] kW	[15] Deg F
2 DAY PLOT 7 DAY PLOT	PLOT	PLOT

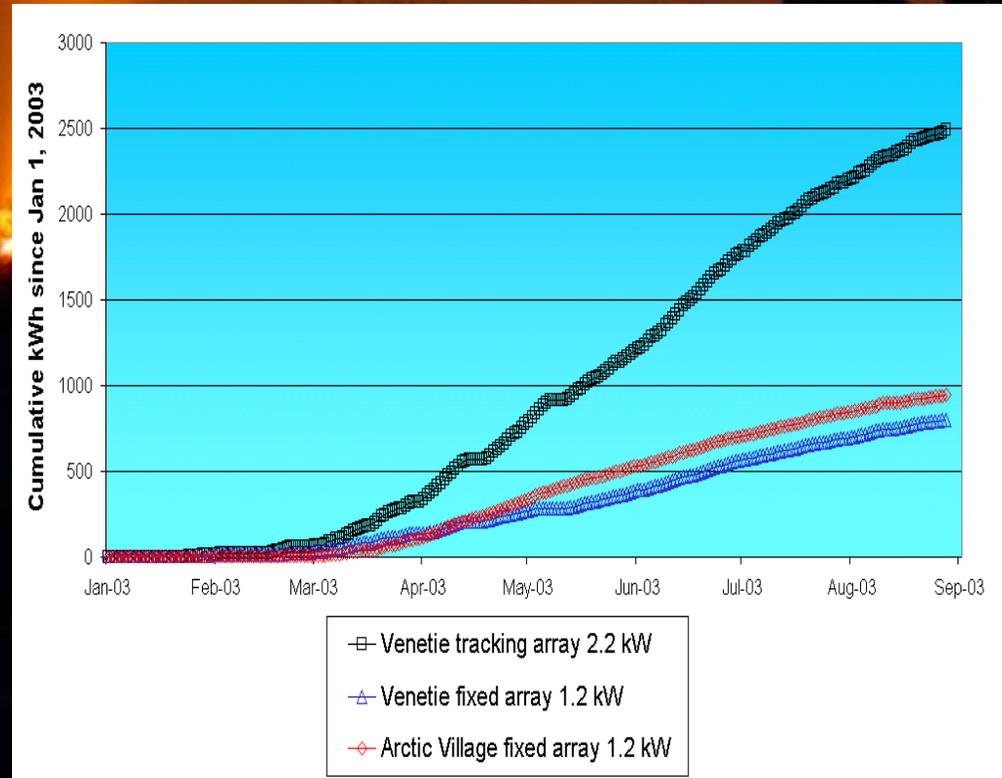
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Rooftop Solar Array Data					
Array Output Voltage	Array Output Current	Array Output Power	Inverter Output Voltage	Inverter Output Current	Inverter Output Power
255 Vdc	4000 mA	1005 W	228 Vac	4350 mA	992 W
PLOT	PLOT	PLOT	PLOT	PLOT	PLOT

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# Project Background (cont.)

- Our fixed-array PV systems have been working well since our upgrades, but our tracker really delivers.
- In summer 2024, we will install an identical 2.2 kW tracking-array in Arctic Village.



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# Requested Technical Support

- **Input into developing models of**
  - **our power consumption, especially during summer**
  - **hybrid power generation with PV, energy storage, & diesel to meet our needs all year long**
- **Input into designs and costs of hybrid power systems**

# Requested Technical Support (cont.)

- **Help finding ways to reduce our summertime power consumption for refrigeration**
- **Ideas for non-hazmat energy storage technologies we might use**

# Accomplishments

- Arctic Village Solar tracker installation
- Three Council Meeting to discuss project.
- Fuel data collected for both villages
- Electric Utility data for 3 years, for both villages
- Energy conservation programs in both villages.
- More efficient generators for both villages
- Power quality analysis

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# Accomplishments

- Farthest North Solar tracking array, in Arctic Village



# Accomplishments

- Energy Conservation Program



# Accomplishments

- **Community Energy Education**



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# Accomplishments

- Fuel Use Data accumulation



We have compiled  
3 years of  
historical fuel  
usage data from  
both villages

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# Accomplishments

- **Electrical use data accumulation**

We have compiled 3 years worth of historical Electrical data for both Villages. And have begun to track local trends, usage and load profiles for individual homes, and businesses.



# Accomplishments

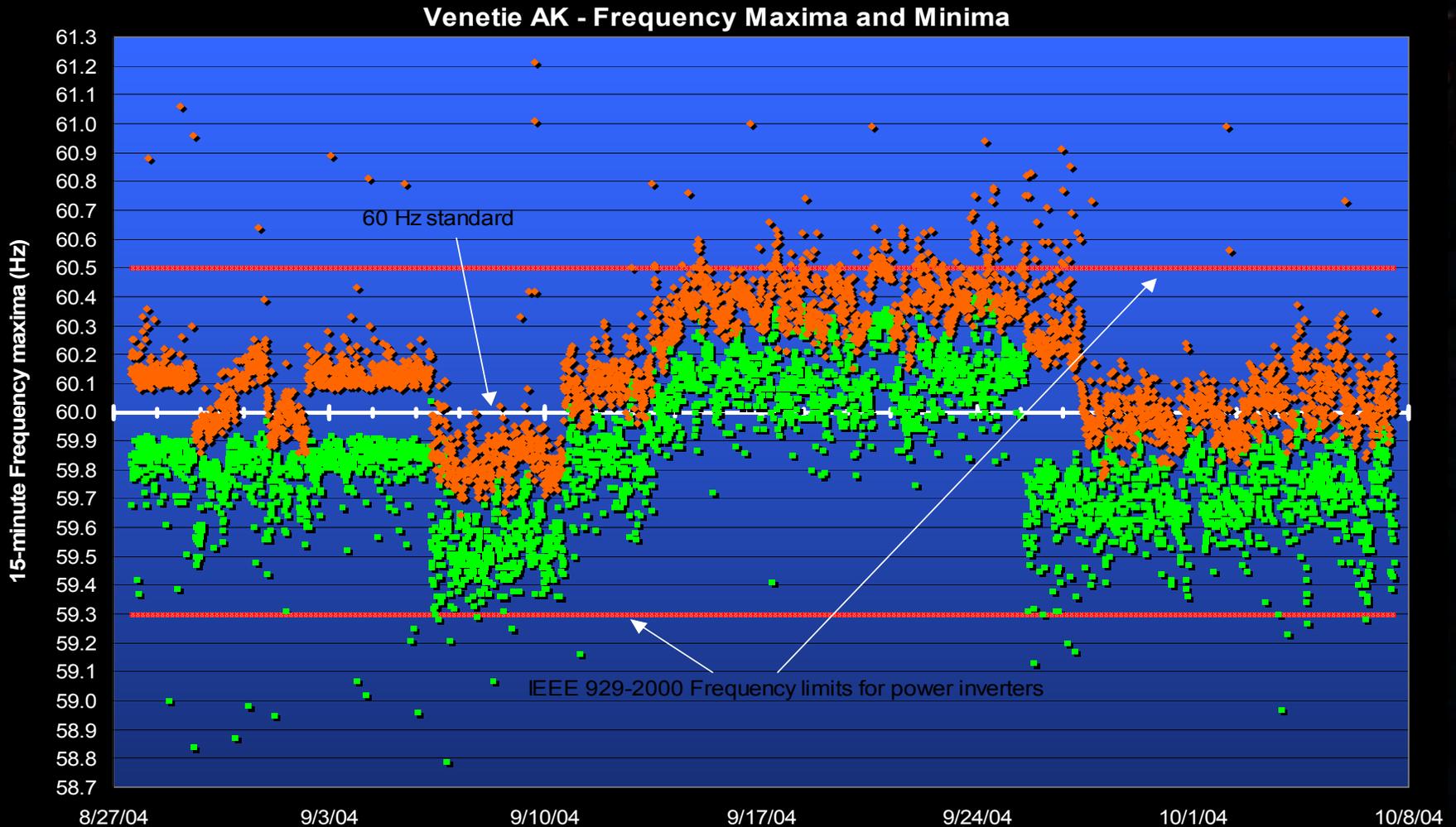
- **New Generators**



Both Arctic Village and Venetie are being upgraded with new, more efficient generators this winter. We have been working with the Alaska Energy Authority in relaying information about our findings of power quality issues. After this upgrade we are hoping to alleviate most of our current power quality problems. 2002.12. 21

# Accomplishments

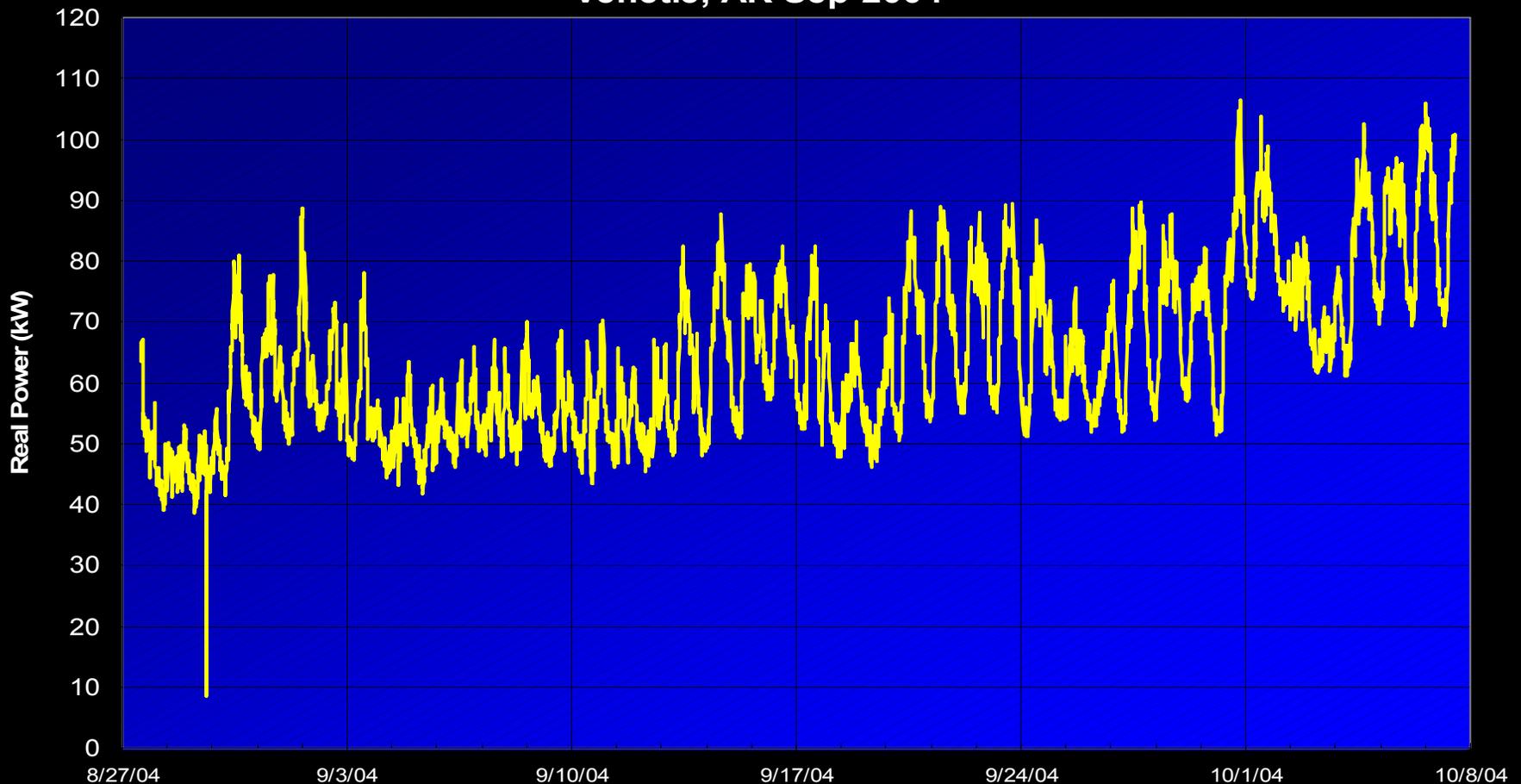
## ● Power grid quality analysis



# Accomplishments

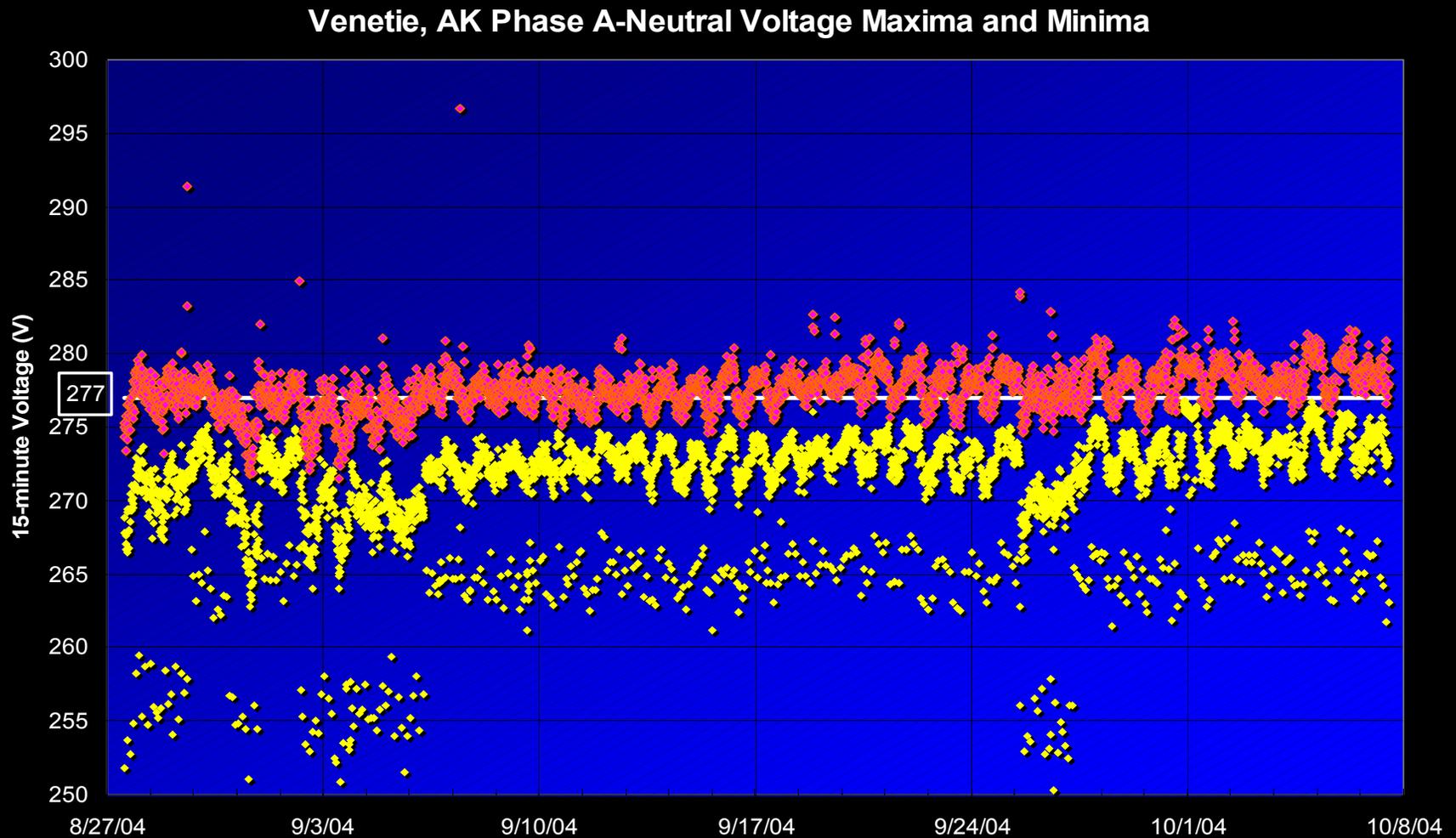
- Power grid quality analysis

Community Electric Demand  
Venetie, AK Sep-2004



# Accomplishments

- Power grid quality analysis



# Accomplishments

- Tri-council meetings



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# Renewable Energy Demonstrations

## Solar Powered Camp

- Water Pumping
- Lighting
- Refrigeration
- Communications
- GPS
- Entertainment



# Current Status

• We are currently on track, and approx 50% complete on our project, with all historical data gathered and being compiled to show fuel and energy usage loads, trends, projections. Partnerships formed, information sharing, and community buy-in have been established. Inter agency/partner cooperative agreements have been proposed and accepted by agencies/ organizations. Despite employee turnovers, Data management lapses, and data communication challenges, we are beginning to see a clearer picture of our energy needs, our energy usage, and expected our community growth patterns.

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# Future Plans

- Solar Thermal
- Wind Study
- More PV
- Hybrid Systems
- Micro Hydro
- Water pumping
- Energy Storage
- Refrigeration

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