

Final technical report for DOE

Executive summary

In view of the Native Village of Venetie Tribal Government Council this project was a success. If it appears not to have focus on future remedies to the economic burden reliance on diesel as a fuel source, that is because, I think we found almost immediately the prospect of turning generators off would be a significant economic burden in and of itself.

In order to turn off diesel generators, we would need to install a significantly oversized RE (ie..PV / Hybrid / Storage) system which would allow for sags, spikes, and peak load demands without achieving maximum power output of the PV system between variations of climatic changes. For example:

The village demand is 100kw on a cloudy day, with pv array output of around 25%, this would require a 400kw max PV output just to meet the demand, or the diesel generators would have to comeback online to make up. Then the sun comes back out, now we are over producing at 400kw. So we have to find a power dump.

The economic burden would arise from incurred costs of system purchase(, installation, M&O, , land lease,

160 PV Arrays @ 2.5 kw each

Approx Installed cost of current 2.5kw tracking system \$20,000

$\$20,000 \times 160 \text{ arrays} = \$3,200,000$

Provided that we could find a sponsor, or agency willing to loan these capital costs, (which is highly unlikely) the payback rate would have to be so high that it would be more of a burden, than the current diesel fuel cost.

Our recommendation to the communities involved in this feasibility study is most cost effective scenario for them would be as follows:

1. Develop a Community Utility Board to oversee all aspects of utility management, operations, and planning.
2. Address current management deficiencies....fuel tracking must be a top priority. Though difficult when weather, aircraft availability, and scheduling all have an impact on fuel delivery. Example: the village water treatment plant runs out of fuel, the village fuel sales dept has no fuel, so they sell 300 gallons of fuel from the powerplant. Well now the power plant operator has lost track of 300 gallons of fuel. And did payment occur, if so who received payment? The fuel sales dept., or the electric utility, or was the cost simply absorbed by the village council, who owns all 3 departments? Well regardless of payment the operator

still thinks he has 1000 gallons, when in fact he now has 700. now the fuel metering device on the main fuel storage tank is not accurate either because it reflects the 300 gallon discharge and the meter inside the generator plant does not reflect the 300 gallon discharge, so now at months end he reports that he now has 700 gallons, and records his kwh generated and reports this to the PCE office, well those figures are not correct, so they report back to us that something is wrong either in our calculations or our generator efficiency is lacking , customer services and collection practices, we feel that these 2 topics are connected in the most basic of principals...if people feel a sense of trust and confidence in the utility management and operations, service and responsiveness to customer requests, that people would be more inclined to keep current on payments. And would also support a disconnect program for delinquent accounts, which would give customers with up-to-date account balances, a sense that they are not just carrying the entire customer base with their payments. Perhaps a pay-as- go option for repeatedly delinquent accounts.. but that has costs incurred also. It would seem that the more we move to better management, the more it costs for payroll . begin to compile and submit required information to re-instate the Power Cost Equalization program in each community, this would increase revenues , but would also increase work load and hours of management. . cost breakdown : currently 1 hour per day = 5 hours week = 20 hours per month x 16.00 per hour = \$320 per month with pce we figure 3 hours per day = 15 hours week = 60 hours month x 16 per hour = \$960.....the pce only provides reimbursement for amount deducted from residential sales, so no increased revenue there....no federal (USPS), or commercial facility pce credit, so therefore as allowed by pce unbilled facilities can claim up to 70kwh pce credits for resident , the population counted by the 2000 census was 202 people...= 14140kwh x .10 credit \$1414 – payroll increase \$960 = \$454 in additional revenues to be applied for fuel shipment, that does not include indirect costs, such as office space required for utility manager, equipment, increased operator hours, for proper record keeping, logs, and other M&O, fuel tracking...etc. so the pce program, fuel tracking have costs associated with them as well.

3. Energy conservation strategies need to be researched, implemented, and continually adapted to work in our unique climate, and social , economic and cultural ways to that will be sustainable for the future generations. be reinforced at the customer level, through public awareness and outreach activities...ie , energy fairs, incentives for use reductions, customer rate schedules, ie ...<300 kwh = standard rate, >300 = increased user rate. Addition of fuel surcharge for customers over the threshold limit
4. gradual phase in of alternative energy systems...hybrid units of solar, wind, and hydro technologies as funding, technologies, and load demands warrant. Especially through installation of RE technologies to supplement power supply to unbilled community and public facilities, streetlights, health and service organizations, contracted projects, and schools. Although the schools are major revenue account, in reducing their load we would feasibly be able run a smaller generator during peak times, and during times of school closure. Alternative fuels research and demonstration projects...such as biofuels, solar collectors, wood

- boilers, ...etc these alternative technologies need to be researched and where ever possible implemented into practical applications. By utilizing local fuels, whether bio-mass, or just local sources, such as wood bi products..(pellets, chips, sawdust, slash debri, wildfire deadfalls...etc these can all be used for fuels to help offset the high price of heating fuel.
5. general upgrade of entire power distribution system...from the generator to the end use outlets in the homes, facilities, and public works. This would include more frequent operator trainings to increase maintenance capabilities locally rather than contracting out these jobs at a significantly higher cost, and depend on funding, availability, and weather conditions..(example..If our load demand is 35 kw, and the only genset we have running is a 190kw, then we are just wasting fuel by running the very over sized genset. If we could have an operator capability of repairing the 50kw genset then we could reduce fuel consumption by 50%. But we have to wait for an experienced mechanic to come from anchorage,,70 0miles away. We have to first pay for his travel, then his time, then order any needed parts, maybe keep the mechanic here till parts come in?? or send him back home, wait for parts, then fly him back out here....\$\$\$\$\$\$\$\$
 6. . Part of this would be...increase power leg equality through expansion of multi phase distribution to outlying areas, so equalization can be performed trough transformer re sequencing..(ie ..connecting to line 2, from line 3 in order to equalize. This also increases efficiency of generators, as well as minimizes drastic spikes, and sags as various entities usage fluctuates during peak times.

In conclusion, It is our finding through this feasibility study that Energy planning in our communities is something that should be encouraged and implemented into our strategic community master plans.

Short term goals:

Raise public awareness through community energy tracking and conservation initiatives.

Create a community utility board to evaluate and adjust customer rates, service agreements..etc.

Build capacity at the utility level in order to maintain continuity in the Power Cost Equalization Program.

Continue energy tracking and self audits on the utility level to ensure efficient operation of power production and distribution.

Continue to seek Alternative energy projects to gradually phase in more RE systems, and increase local capacity to plan for the design, installation and maintenance of various RE technologies

Long term goals:

Phase in of RE systems to maximize production of re while maintaining efficient operation of diesel generators.

Develop a community energy plan which would serve as a guide to future community expansion and projected energy needs.

Inter agency cooperation agreements to ensure energy efficiency goals are being implemented into other programs...ie Village housing program should build energy efficient cold climate homes, efficient lighting, heating , and appliances. Possibly integrate small scale RE into ALL new structures, residential, community facilities as well as commercial.

Implement alternative energy solutions like used oil recycling, waste heat recovery, natural cooling systems, bio mass, wood slash, and possibly solid waste to energy technologies. These types of energy technologies will become higher in priority as fuel prices continue to rise.

Research the feasibility, social impacts, and cost savings to benefits analysis of regional energy co-op's.

And finally, in summation:

Coming to the point of realization, that Energy costs are not going to decrease anytime soon. We must face this challenge together as individuals, as a community, and as a people. We must each make some hard decisions as to what our own personal energy needs are (ie..lights, heat, shelter), what are some of the energy Luxuries(ie..Video games, microwaves, electric blankets) that we can minimize or eliminate.

And finally coming full circle, we realize that we must begin this sustainable energy challenge by returning to the ways of our ancestors ..in philosophy, and using only what we need of these resources, but always having a contingency plan for life with out resources. But all the while provide these energy services to our customers who want and pay for their luxuries, and commercial entities. But we all must understand that circumstances are most definitely going to happen, where we will have no fuel, no electricity, and times could get hard. If we all face this and do some community planning and public awareness activities, we will be fine. We take it as an opportunity to teach our children how we grew up with out these luxuries. But, how long till the novelty wares off??

We would like to thank the USDOE for this opportunity to conduct this feasibility study: Powering remote northern villages with the midnite sun. It has given us the chance to look at, not only energy costs and alternatives. But has given us a new perspective on our own sustainability, sovereignty and self determination. Thereby empowering us to begin

plan for our energy future in a way that will enhance our social, economic, and cultural traditions for years to come.

In closing, I will add that, in lieu of a \$3,000,000 donation from one of the casino tribes... our Energy Philosophy has changed from pulling our head out of the sand, to :

TURN THE LIGHTS OFF WHEN YOU LEAVE!

Sincerely grateful, (Mahsi' Cho')

Lance Whitwell
Project Director

OBJECTIVES as outlined in our(NVVTG) proposal are as follows:

1. Assess our current energy usage and fuels tracking.

Methods

To assess energy usage we researched village electric utility billings, fuel purchases, and fuel sales from both villages, for the previous two years.

Results

Electric

Village electric utilities were fairly proficient at records management, and were able to provide us with enough information to begin compiling data into spreadsheets, to model customer usage trends and or other patterns interest. Finding no significant fluctuations in either individual or combined month to month/year to year data comparisons.

Although not insignificant we found that a parameter window does exist in the energy demand in the months of may june july where electrical demand is at its minimum. This was very much needed information we would come to appreciate through out the project.

Fuel Purchases

After gaining permissions from the respected village councils, we asked the fuel supplier to provide us with fuel histories for both villages to include delivery schedules, current and historical prices, and account histories. They predictably denied the account information, but provided two year delivery histories for each village. It included purchaser, so we could sort of determine whether it was purchased for electrical generation, or sales.

2. Examine energy uses and improve efficiency

Methods

Electrical

Using data compiled from utilities, we could determine high energy consumers within the community. We used this data to address these consumers on a one on one basis to determine if there were any ways to increase efficiency on an individual basis. We developed a partnership with the Rural Alaska Community Action Program (RuralCap) Energy Savings Initiative Program. We submitted applications for both communities, both were accepted as model community sites. RuralCap sent a project Leader and purchased electrical savings supplies.(ie ..Electronic ballasts, 7-8 bulbs, kill a watt meters...etc), we hired several youth workers, and provided project coordination staff time (logistics, receiving/storage of supplies, conducting initial client interviews, and scheduling individual client home energy conservation appointments). Upon arrival of RuralCap Project Leader, we had a community energy savings workshop to introduce the visiting person, and let the clients know what we were doing. For one week the ESI teams went to each individual home, and did energy conservation awareness/education, lighting upgrades, and energy consumption tests on freezers. This project was limited in scope due to Ruralcap restrictions of servicing only homes of individuals receiving low Income home Energy Assistance Program (LIHEAP) assistance.

Results

The resulting energy saving were very encouraging on an individual home basis. Many clients saw a 10 – 15 % reduction in electrical usage. While a few actually increased, due to the fact that the project repaired some previously inoperable lighting fixtures.

Freezer usage tests concluded, as we predicted, that food storage and refrigeration is the predominant energy demand, as well as the most important, for residential consumers, as we are a mostly subsistence community. So we recognized the increase or rather a leveling out point where the demand for home lighting decreases and the demand for refrigeration increases. For the months of June and July an opportunity exists to supplement or at least reduce diesel generation during this window.

Assisted individual homeowners in applying for weatherization services, and held home energy workshops to assist and educate homeowners on heat savings techniques to lower heating costs.

Assisted with development of power generation efficiency strategies (load analysis, line equalizations, maintenance schedules of generators, operator logs...etc) by providing plant operators with summary data and graphs to allow them to run the appropriate sized generators during non-peak hours

Coordinated with the tribal housing directors to increase energy efficiency standards of new housing units built in the future.

Evaluate Performance of existing PV Systems.

Methods

We continued to record and compile system PV performance throughout the project as available. We were challenged by a series of data acquisition challenges, as telecommunication services were interrupted, and software compatibility issues were experienced. However we believe we were able to compile enough reliable data to make determinations of viability of the solar resource in each of our communities..

Although we were attempting to track fuel savings directly attributable to our PV systems, this proved to be very unreliable as neither of the utilities actually metered fuel consumption of generators.

In addition to the previously known equipment incompatibilities (ie..xantrex vs. Sunnyboy inverters)..we discovered many power grid anomalies and distribution problems. So we took it under our project to investigate these since we were already recording 3 phase information at the power house. We discovered that the Venetie school sub system had a serious although occasional shorting which was causing spikes to the entire system. Investigation into this revealed, during periods of moderate to high northeast winds, a sagging primary wire would blow into a support bolt on one of the power poles. After correcting this most of the spikes and sudden outages were eliminated. Thus allowing the plant operator to run a smaller genset, since he no longer had to overcome sudden huge line spikes which would normally make the generator safety-out. Other than these few system integration obstacles, the integrity of our PV systems and distribution systems was found to be virtually flawless.

Arctic Village was at mid point of fuel upgrade, and power plant replacement project, so we were not able to record phase data for that community. Thus we used the Venetie community data as source of information and presumed that the Arctic Village data would be a similar comparison since both are approximately the same size, as far as generator size, and population.

Results

The overall viability of Solar Power was a proven factor , but will need some infrastructure development on the utility management..(ie...M&O) aspect in each community. This perspective was submitted to both village councils to address.

Optimize combination of PV, Conservation, And fuel cost savings

Methods

PV

Discussed with each community the need to identify critical village infrastructure (ie...clinics, water treatment, communications systems) that would benefit most from integrated PV/RE systems. We looked at the feasibility of redistributing the components of our current PV test sites to these critical services. It was agreed upon by all parties that first the utilities would need to increase their capacity to take over the M&O of systems in each community. At a future time which was not determined, this could be a viable option to increase sustainability and provide backup power to these services during outages of the diesel fired systems.

Conservation

We developed a partnership with the Rural Alaska Community Action Program (RuralCap) Energy Savings Initiative Program. We submitted applications for both communities, both were accepted as model community sites.

Wood energy

We assisted the State of Alaska in performing a feasibility study to determine whether wood energy options were viable for our communities. Due to the vast distances between facilities, it was determined not to be a viable option for us. Although we did pitch the concept to the local school districts, to provide for some heating efficiency cost reductions. Since they state funded, they agreed to pursue this on their own.

Waste Heat Recovery

However, we discovered several ways to reduce some of our heating costs by incorporating Waste Heat Recovery systems on facilities which were close enough to the powerplants. This was invaluable for fuel savings. As we reduced heating fuel consumption by approximately 70% in the Venetie Community washeteria/water treatment plant. This technique is also integrated into a fuel free heating system to the Arctic Village Snow Removal equipment garage in that community, since it is located next to the power house. Cost analysis was not possible due to no historical fuel use data(Both new Buildings). We were consulted on several new infrastructure projects being performed in both communities (clinics, housing, utility upgrades, sewerline installations) and the feasibility of integrating these heat recovery systems into new facilities is being evaluated by engineering departments of these funding agencies. Not only for our own communities, but for remote community development projects across the state of Alaska.

Waste oil to EnergyConverters WOTEC

Another untapped resource we discovered was ***USED OIL***. Both village electric utilities have a significant amount of used that has been collected and stored through years of oil changes and community environmental protection activities.

Arctic Village has integrated a Waste Oil to energy Converter system into their new generator facility so now they no longer have to stockpile this notoriously environmentally hazardous waste product. They simply blend it right back into their fuel system.

Venetie purchased and we installed for them a Used Oil Furnace in their airport equipment garage to utilize their current stockpile, and prevent the stockpiling in the future. So this resource is now being used to offset fuel costs in both communities. Unfortunately both of these systems are new and under control of different entities with in the communities, so no data is available at this time for cost savings analysis.

Results

This project has given us the opportunity to gain significant knowledge into renewable and alternative energy resources and technics. Resulting in the councils taking a very

proactive view into further infrastructure development (ie..zoning, facility planning, inter-agency resource sharing, and dare I even say it???...intra village energy co-ops).

Although both villages are still adamantly opposed to the idea of battery storage systems, they are now aware of new battery technologies which are forthcoming. And also looking into the past for some traditional techniques of food preservation to alleviate some of the cost associated with refrigeration (ie...Community freezers, ice houses, and food cellars are becoming the new trend locally.)

As of late, the village utilities are searching for more immediate solutions to keeping the generators running, rather than seeking ways to turn them off.

Local capacity building

Methods

Community workshops

A total of 4 community workshops were conducted in each community to build local buy in into the project. In addition we orchestrated the first tri-council meetings in over 50 years between the NVVTG council, Arctic Village Council, Venetie Village Council, As well we used 99% local hire for all of our projects. The public awareness and need for increased management capacity in our utilities was taken as constructive. Although not overwhelmingly, definitely as a component of the broader picture that would be only practicable with any expansion to our current PV systems. Which are already providing basically free electricity to community facilities anyway.

The resulting community awareness of these and other RE technologies and strategies are making a real difference in the way we envision our energy future, and also the way in which we evaluate our energy resource inventory.

A pictorial review of our project:



Figure 1 Arctic Village Fixed Array



Figure 2 Arctic Village Tracking Array



Figure 3 Venetie Fixed Array



Figure 4 Venetie Tracking Array



Figure 5 Renewable Energy Education presentations



Figure 6 Education through practacle applications



Figure 7 Presentations at various large gatherings to promote RE



Figure 8 Presentations in local schools



Figure 9 Tribal Energy Summit - 3 Councils



Figure 10 Local Installation/Maintenance skills



Figure 11 Energy Conservation Project team



Figure 12 Community Energy Fair



Figure 13 Reporting for duty, Sir Youth Energy Patrol



Figure 14 Energy Tracking 1



Figure 15 Line monitoring Setup



Figure 16 Commercial fuel efficiency testing



Figure 17 Energy Curriculum in Schools



Figure 18 Used Oil Heaters



Figure 19 Home Energy Audits



Figure 20 RE for Emergency Communications....Forest Fire 1 mile away



Figure 21 Wood resources inventory



Figure 22 Post fire recovery of fuels



Figure 23 Distribution upgrades/Line equalizations



Figure 24 Fuel Tracking 1



Figure 25 Fuel Tracking 2



Figure 26 Line Equalization monitoring



Figure 27 Waste Heat Recovery



Figure 28 Attending RE events Solar Fair Portland, Ore



Figure 29 Traditional Food Preservation techniques 1



Figure 30 Traditional Transportation Techniques



Figure 31 Lower Home Thermostats



Figure 32 Traditional Heating sources

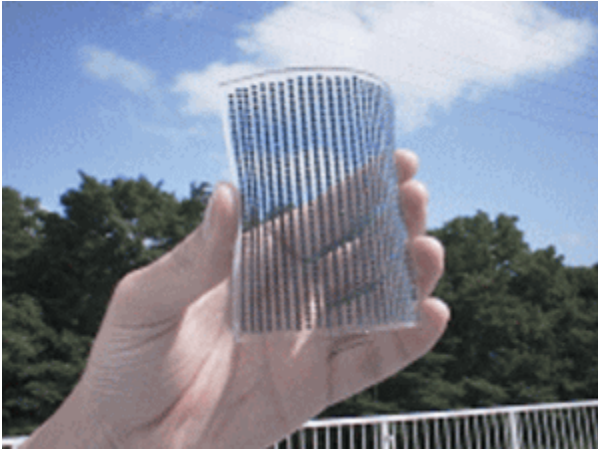


Figure 33 New Technologies....Shape Adaptive 360 degree cells



Figure 34 New Tech Run of River Hydro



Figure 35 Water Wheel Generators

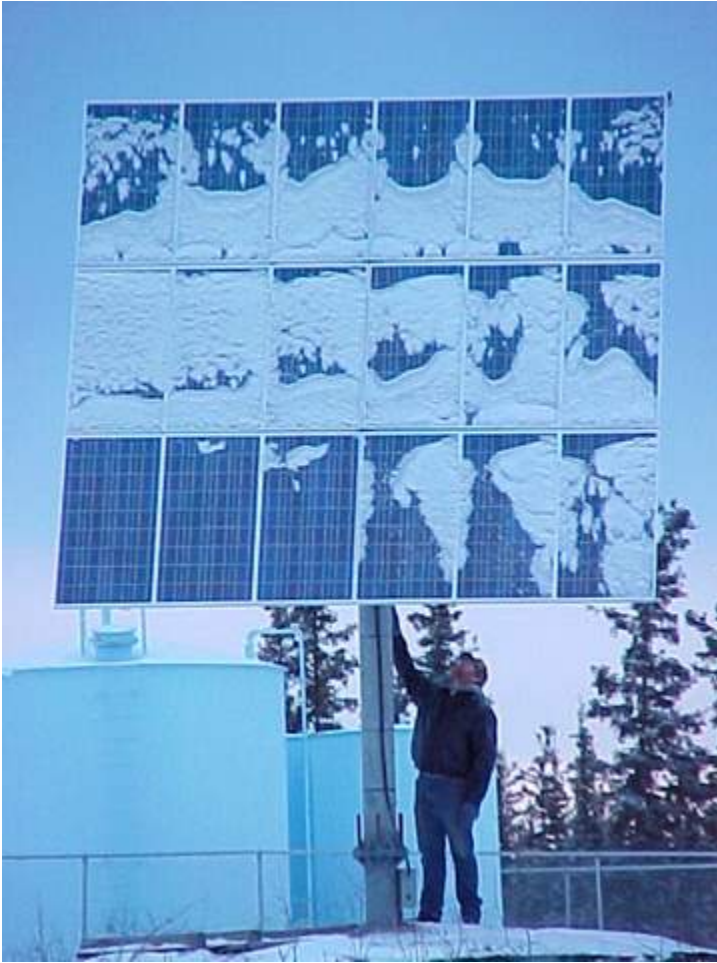


Figure 36 Maintenance



Figure 37 Pay as you go metering



Figure 38 Thank You USDOE